



Vermont Monitoring Cooperative Strategic Plan 2015-2020

Revised November 4, 2014

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ACKNOWLEDGMENTS

This work was produced in part through funding provided by the U.S. Department of Agriculture, Forest Service, Northeastern Area - State & Private Forestry, with additional in-kind contributions of time from partners at the Vermont Agency of Natural Resources, the Rubenstein School of Environment and Natural Resources, and the US Forest Service Northern Research Station.

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Letter from the VMC Steering Committee

For over 20 years, the Vermont Monitoring Cooperative has brought together practitioners from a range of disciplines and institutions to work together on monitoring and assessing the forested ecosystems of Vermont and the surrounding states. In light of the many evolving activities that VMC cooperators maintain year after year and the changing nature of threats to forest health across the region, the Steering Committee formed a Strategic Planning Committee in 2014 to reevaluate the role of the VMC within the larger network of natural resource professionals. This strategic planning exercise charts the course for VMC over the coming years, both in terms of broad goals and objectives, and specific activities and deliverables. After much work and repeated engagement with the VMC collaborative network, we are pleased to present the Vermont Monitoring Cooperative Strategic Plan for the 2015 – 2020 fiscal years.

This Strategic Plan affirms and renews VMC's long-standing mission, outlines critical gaps that VMC can fill in the capacity of our larger collaborative network, and identifies the research and monitoring activities needed to sustain the health of the region's forested ecosystems. While many new ideas and directions were discussed during this process, the consensus among stakeholders was that the core VMC activities – maintaining long-term ecosystem and environmental monitoring, securing and providing broad access to this data, and facilitating collaboration among organizations, disciplines and arenas – remain essential to our collective success.

In addition to building on the historical strengths of VMC, this Strategic Plan identifies new or previously unrecognized synergies with our partner organizations. Specifically, this includes overlapping objectives and activities defined by the US Forest Service Northeastern Area, Vermont Department of Forests, Parks and Recreation, Green Mountain National Forest, US Forest Service Northern Research Station, Vermont Department of Environmental Conservation, the Vermont Fish and Wildlife Department, and the Rubenstein School of Environment and Natural Resources (see page 22). Many challenges are ahead, ranging from the threat of continued climate change to institutional pressures of shrinking budgets. In light of these, working together to find shared goals and greater efficiency is a crucial step in maximizing the impact of our collective activities.

Many thanks go to all the partners who had a hand in shaping this plan. Not only did they help sharpen the focus of the VMC mission and objectives, they brought to light a wealth of

opportunities to further engage our current collaborators, broaden stakeholder involvement, and connect leadership from across the many organizations represented in our network. In particular, we are deeply indebted to the members of the VMC Strategic Planning Committee who volunteered their time, expertise and enthusiasm. The VMC is in the end, the sum of its parts, and we are both encouraged by and thankful for the many dedicated colleagues who have already contributed so generously to the Vermont Monitoring Cooperative, and their continued efforts to strengthen the Cooperative into the future.

Sincerely,

The Vermont Monitoring Cooperative Steering Committee



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An Introduction to the Vermont Monitoring Cooperative

Established in 1990 as a partnership among the USDA Forest Service, the State of Vermont Agency of Natural Resources and The University of Vermont (UVM), the mission of the Vermont Monitoring Cooperative (VMC) mirrors and builds upon the priorities of these partners. The VMC serves as a hub to facilitate collaboration among federal, state, non-profit, professional and academic institutions towards ongoing monitoring of forested ecosystems across the region and an improved understanding of forested ecosystems in light of the many threats they face.

The VMC is unique in its relatively small staff who function to support and facilitate the activities of a much larger network of actively engaged collaborators. While VMC funding primarily supports ongoing research, monitoring, outreach and data management, the bulk of VMC activities are accomplished by “in kind” contributions provided by the larger collaborative network. Over 60 professionals actively contribute to current and ongoing monitoring and research projects, and more than a hundred other contributors have bolstered the monitoring record through their work in years past. Beyond these direct contributions, the Cooperative encompasses many more individual environmental researchers, land managers, decision makers, environmental advocates, educators, industry professionals and faculty from over 20 organizations across Vermont, New Hampshire, Massachusetts and New York. This committed group of active collaborators synthesize and utilize this information based on a shared interest in the health and management of forested ecosystems across the region.

VMC Collaborative Web

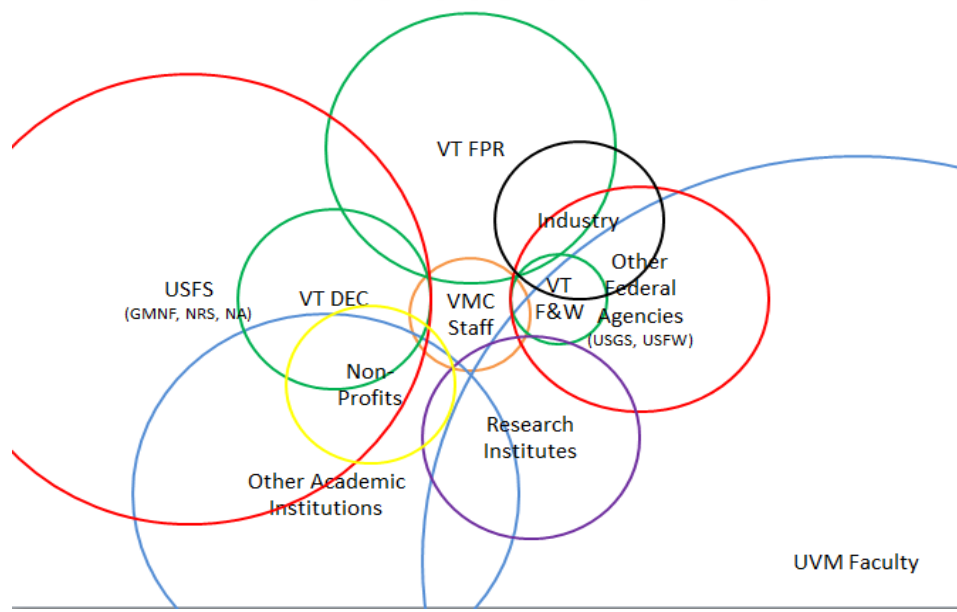


Figure 1. The collaborative interrelationships among VMC's many cooperators and stakeholders.



Figure 2. VMC Soil Climate Analysis Network site at Lye Brook Wilderness Area in Manchester, VT.



Figure 3. VMC forest canopy tower at the Proctor Maple Research Center in Underhill, VT.

Over the 25 year history of the VMC, its core priorities have remained closely aligned with its founding partners: to provide the information necessary to conserve and manage forested landscapes, identify and monitor threats to forest health and function, and to facilitate collaboration among a diverse group of stakeholders. To this end, the VMC has collected and maintained one of the longest and most expansive records of forest health, wildlife, soil, air and water quality data in the region. Made discoverable and downloadable via VMC's online database, this information has been critical to resource managers, researchers and policy makers across the region.

Originally these VMC monitoring and research efforts were focused at two intensive sites: Lye Brook Wilderness Area on the Green Mountain National Forest in southern Vermont (Figure 4), and State-owned lands located on the slopes of Mt. Mansfield within the Browns River, Stevensville Brook and Ranch Brook watersheds (Figure 5). Focusing efforts on these intensive sites provided the capability to co-locate studies to better understand ecosystem processes and impacts across biotic and abiotic strata. Considering the lack of Vermont's representation in other long-term ecological networks (e.g. Long Term Ecological Research Network, National Ecological Observatory Network, experimental forests), and the demonstrated sensitivity of these ecosystems (Vogelmann, 1982; DeHayes et al., 1991; DeHayes et al., 1999, Schaberg et al., 2000) these intensive sites filled a critical gap in environmental monitoring efforts.

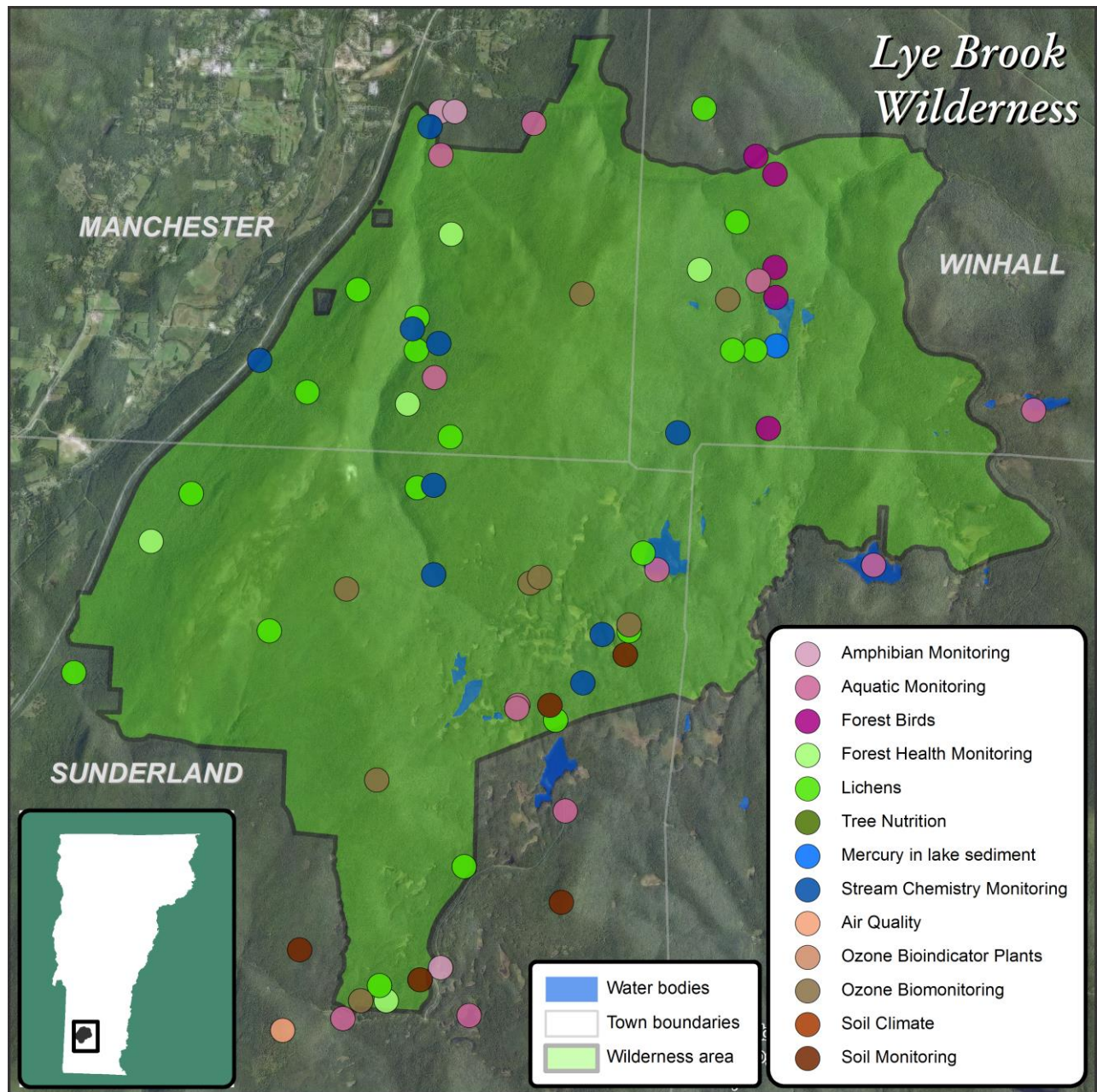


Figure 4. Relative location, boundary, and monitoring and research plot locations at the VMC Lye Brook Wilderness Area intensive site in southern Vermont.

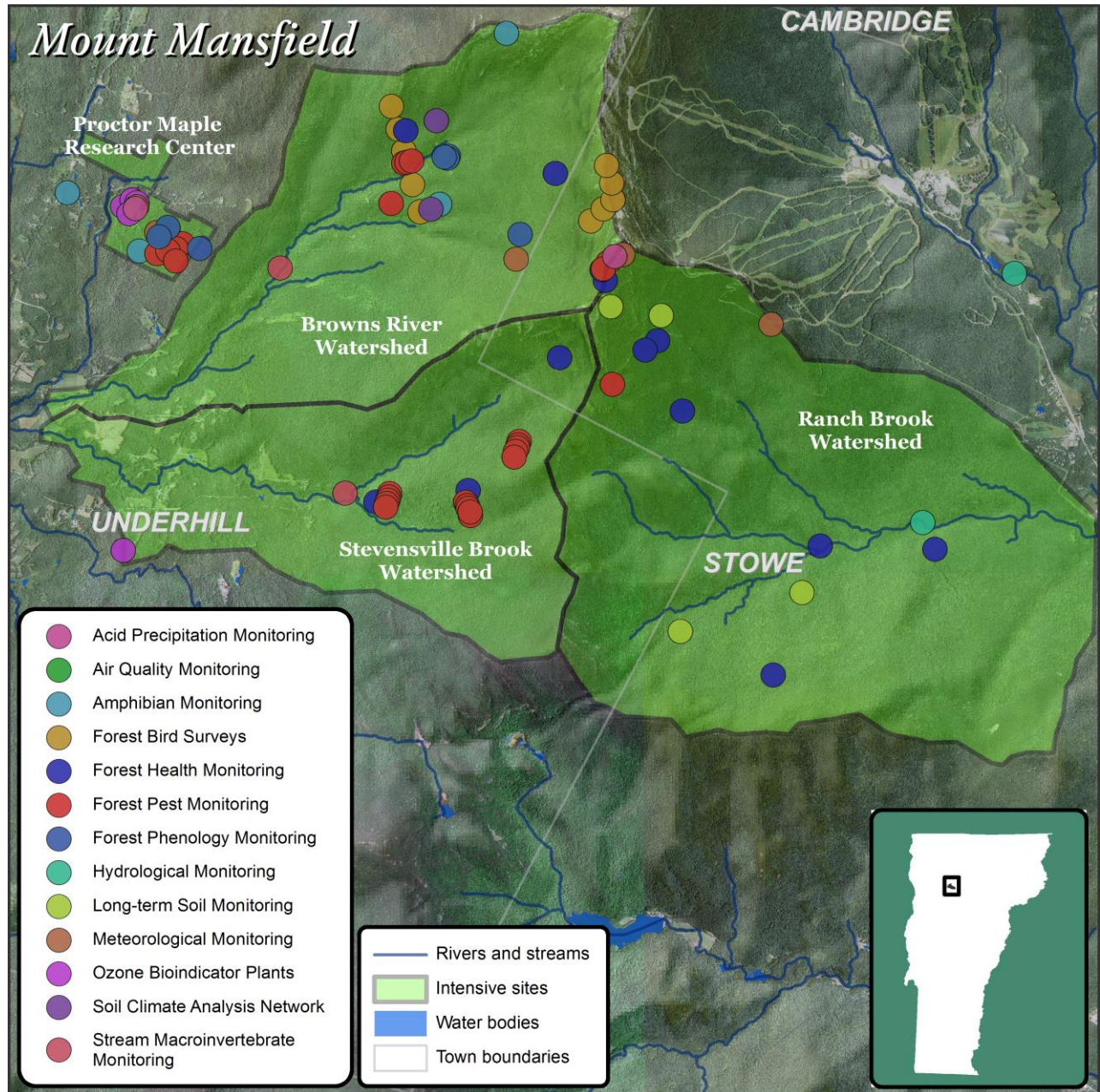


Figure 5. Relative location, watershed boundaries, and monitoring and research plot locations at the VMC Mt. Mansfield intensive site in northern Vermont.

Over the past decade, VMC efforts have expanded beyond these intensive research sites, in part by design to improve our understanding of a diversity of habitat types, but also because of the widening network of collaborators working across the region. The VMC database now contains data from across the state, as well as state and region-wide geospatial data layers relative to forest ecosystem health (i.e. statewide aerial sketch mapping of defoliation, mortality, or other symptoms¹). The wide range of high priority, long-term monitoring efforts, sustained or supported by the VMC collaborative is shown in Table 1. While many of these datasets are maintained directly with VMC financial and technical support, additional datasets (denoted by *) are collected by VMC collaborators, with the VMC fulfilling the role of data archiving, synthesis and distribution.

Table 1. Ongoing monitoring activities maintained or supported by the Vermont Monitoring Cooperative.

Forest Health	i-Tree Eco Urban Forest Monitoring (Burlington) Statewide Expanded Forest Health Monitoring Network Forest Productivity Trends and Patterns (Mt. Mansfield Dendrochronology) Forest Phenology Monitoring: Bud development, Fall Color and Leaf Drop *Forest Inventory and Analysis: species demographic trends *Forest Health Monitoring: North American Maple Project *Forest Health Monitoring: Hardwood Health Survey
Spatial Forest Products	*Aerial Disturbance Sketch Maps *MODIS derived integrated yearly forest canopy condition metrics *MODIS derived yearly forest phenology (start and end of season) *LandFire Derived Species Demographics *Landsat Derived yearly canopy condition
Climate	Meteorological Monitoring at 7 stations across the state Forest Canopy Tower Environmental Monitoring UV-B Monitoring (USDA National Monitoring Network)
Pollution	CAMNET Hazecam *IMPROVE: Fine Aerosol Monitoring: Interagency Monitoring of Protected Visual Environments NADP/AMoN Ammonia gas concentrations NADP/MDN and NADP/AMNet: Atmospheric Mercury Deposition NADP/NTN: precipitation pH, SO ₄ , NO ₃ , NH ₄ wet deposition VAPMP Vermont acid precipitation monitoring program
Soil	Long-term Soil Chemistry and Structure Monitoring Soil Climate Analysis Network (SCAN)
Water	Mount Mansfield Paired Watershed Study (Forest Fragmentation Impacts on Stream Chemistry) Mt. Mansfield Paired Watershed Study (Forest Fragmentation Hydrologic Monitoring) Stream Macroinvertebrate Monitoring Biological and Chemical Survey of Surface Waters in Lye Brook Wilderness Area
Wildlife	Avian Population Monitoring Bicknell's Thrush Population Demographics and Ecology Amphibian Monitoring

¹ Available online at <http://www.uvm.edu/vmc/research/summary.php?id=66>.

While the core group of VMC collaborators are scientists and researchers actively involved in VMC related projects, the network is primarily composed of land managers and decision makers from a range of public agencies. Through their efforts, the findings of the VMC collaborative are regularly communicated to policy makers, practitioners and the general public. VMC information assists partners at the local, state and regional levels in managing the ecological aspects of the forested landscapes while considering the social dimensions represented by the people who live, work and play in those same forests. With the growing interest in quantifying, preserving and enhancing the ecosystem services provided by the region's forested landscapes, there is a need to understand how human activity relies upon and impacts those services. Long-term ecosystem monitoring provided by the VMC generates the data that will be needed to quantify those services, as well as to detect changes or signs of potential degradation from both social and environmental stressors.

As a collective group, the VMC provides the connection between data, researchers, managers and practitioners to compile a more comprehensive assessment of the region's forests. While individuals come and go through positions, and funding is often unstable, the VMC has provided a continuous source of environmental monitoring, from trees to water, air, soils and wildlife, leading to a more complete assessment of environmental conditions, long-term analyses of trends and integration across datasets. This tremendous accumulation of environmental monitoring records places VMC at a crossroad, where synthesis and integration of long-term datasets provide unique opportunities to understand how changing social and environmental factors have affected, and will continue to affect the structure and function of the region's forests. In this way the VMC has provided integral information to sustain forest health and the many benefits healthy forested ecosystems provide.

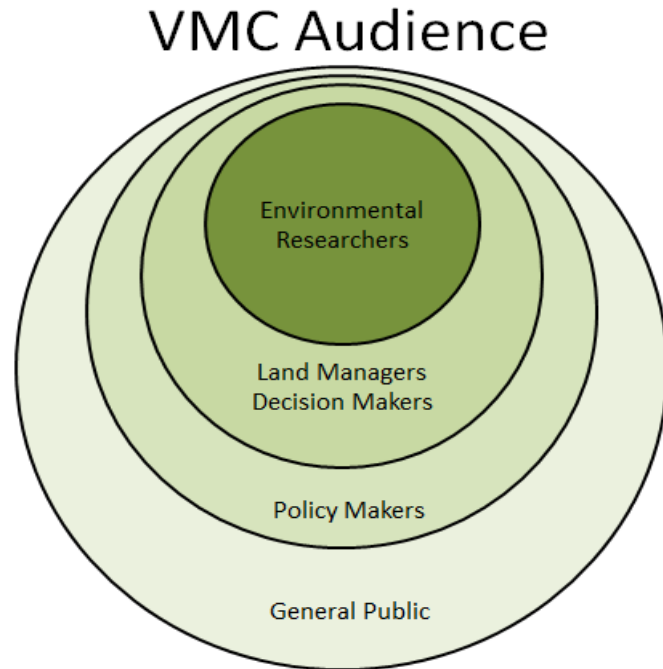


Figure 6. VMC's core of cooperators and scientists who provide data and information to land managers and decision makers, policy makers and the public.



Overview of the Strategic Planning Process

Over the past decade the VMC has undertaken several visioning and review activities. In 2001 the VMC Operations Guide² was updated by VMC staff with input from the Steering and Advisory Committees. In 2002, an external review team with members from the Missouri Department of Conservation, US Geological Survey and US Forest Service convened to review the VMC program and activities³. This was followed in 2004 by an internal review of VMC staff positions and duties, and overall VMC activities. In March 2014, the VMC Steering Committee decided to initiate a strategic planning process to revisit the VMC mission statement, examine how it aligns with the missions and goals of our partners and identify a set of priority activities for VMC focus moving forward.

VMC's mission and goals most directly align with the goals and objectives laid out in the 2010 Forest Resources Plan published by the Vermont Department of Forests, Parks and Recreation (FPR). That Plan delineates five major areas of concentration and concern including: biological diversity, forest health and productivity, forest products and ecosystem services, land ethic and legal, institutional and economic framework; all of which some VMC goals and activities address. The Forest Resources Plan's format is used to write the federal narrative to request VMC funding from US Forest Service Northeastern Area State and Private Forestry and to prepare status reports to FPR from UVM.

Unifying themes across most, if not all, of our partnering organizations included conservation of forested landscapes, maintaining biodiversity (plant and animal), protecting rare and endangered species, promoting recreational opportunities in forested landscapes, promoting sustainable forest management practices to mitigate threats and protect and maintain water quality, maintaining resiliency and promoting adaptation of plant and animal species in the face of climate change. For a full list of priorities and objectives for each of VMC's partnering organizations and how VMC contributes to the success of these objectives, see Appendix C.

² Available online at http://www.uvm.edu/vmc/documents/2001_VMCOperationsGuide.pdf.

³ Available online at http://www.uvm.edu/vmc/documents/2002_VMCReviewFinalReport.pdf.

Informed by these previous planning activities as well as the strategic planning undertaken by each of the primary partnering organizations^{4, 5, 6, 7, 8} that comprise the VMC, we outlined an iterative evaluation of the VMC mission, objectives and activities in 2014 to sharpen our focus, strengthen relationships across organizations, and ensure continued relevance and impact of the collaborative. This process is summarized on the next page.

For a more complete discussion of the process, including intermediate steps and a full analysis and summary of the Strategic Planning Electronic Survey, see Appendix A.

⁴ VT Department of Forests, Parks and Recreation 2010 VT Forest Resources Plan – available online at http://www.vtfpr.org/htm/for_resourcesplan.cfm.

⁵ USFS Northeastern Area State and Private Forestry Strategic Plan FY 2013 - 2018 – available online at http://na.fs.fed.us/pubs/strat_plan/na-strategic-plan-2013-2018-lr.pdf.

⁶ VT Department of Environmental Conservation Strategic Plan 2013-2015 – available online at <http://www.anr.state.vt.us/dec/CO/documents/DECStrategicPlan2013-2015.pdf>.

⁷ VT Fish and Wildlife Department 2005 Wildlife Action Plan – available online at http://www.vtfishandwildlife.com/swg_cwcs_report.cfm.

⁸ USFS Green Mountain National Forest 2006 Forest Plan 2006-2021 – available online at <http://www.fs.usda.gov/detail/greenmountain/landmanagement/planning/?cid=stelprdb5333807>.

Table 2. Overview of the Vermont Monitoring Cooperative Strategic Planning Process

<p>Advisory Committee Working Session <i>April 18, 2014</i></p>	<p>The VMC Advisory Committee reviewed and edited an initial list of strengths, weaknesses, opportunities, threats (SWOTs) generated by the VMC staff, reviewed the current VMC mission statement and proposed changes, and drafted an initial set of goals for later consideration by the Strategic Planning Committee.</p>
<p>Strategic Planning Committee Retreat <i>June 5, 2014</i></p>	<p>VMC held a retreat for the Strategic Planning Committee, comprised of cooperators and leaders from state and federal partnering organizations. This group defined a set of high-level objectives and related activities that they felt VMC should pursue over the next ten years in order to meet the larger mission and goals.</p>
<p>Cooperative-Wide Survey <i>Jul-Aug, 2014</i></p>	<p>To solicit feedback on these draft objectives and related activities, a quantitative survey was delivered to cooperators in August 2014. The survey asked VMC collaborators to identify priority focus areas by asking them to prioritize the draft objectives, rank specific activities where VMC should focus its efforts, and identify collaborator needs.</p>
<p>Steering Committee Review, Public Release <i>Oct – Dec, 2014</i></p>	<p>The VMC 2015–2020 Strategic plan was reviewed and approved by the VMC Steering Committee and released to the public in December leading up to the VMC Annual Conference.</p>
<p>Review and Recalibration <i>2015 – 2020</i></p>	<p>Looking forward, VMC staff will conduct a detailed preliminary review in 2017 to determine if steady, significant and measurable progress is being made toward meeting its goals. If progress is deemed unsatisfactory at that point, new steps will be implemented to help get VMC on track to achieve all goals by 2020. In 2020, the VMC will reconvene a new Strategic Planning Committee to revisit the goals, objectives and activities of the organization in light of the changing environment.</p>



Revised Vermont Monitoring Cooperative Mission

Based on the strategic planning and review processes, the Vermont Monitoring Cooperative's mission was revised.

The mission of the Vermont Monitoring Cooperative is to serve as a hub of forest ecosystem research and monitoring efforts in Vermont and across the region through improved understanding of long-term trends, annual conditions and interdisciplinary relationships of the physical, chemical and biological components of forested ecosystems.

We accomplish this mission by facilitating the collection and synthesis of environmental data and disseminating to researchers, land managers and decision makers the information needed to understand, protect and manage the health of forested ecosystems within a changing global environment.



Goals of the Vermont Monitoring Cooperative



Figure 7. FPR Commissioner, Michael Snyder, speaking at the 2013 VMC Annual Conference.



Figure 8. Audience listening to keynote speaker, Jon Erickson's, presentation at the 2013 VMC Annual Conference.

For 25 years the VMC has filled an essential niche by providing long-term, reliable and professional coordination of monitoring and research activities in Vermont across federal, state and private-sector agencies, organizations and institutions. No other entity in Vermont has shown the commitment and desire or has maintained the necessary funding to perform this service over so many years. In today's funding environment it is more important than ever to minimize duplication and try to leverage available funding to provide the data and information necessary to inform policy and management decisions affecting Vermont's forested landscape. Through its annual meeting, website, workshops, newsletters and other information outlets, VMC consistently provides important information about Vermont's forested landscape to land/resource managers, decision-makers, cooperators/researchers and the public.

Goal 1

To promote the efficient **COORDINATION** of multidisciplinary environmental monitoring and research activities among Federal, State and private sector agencies and institutions with common interests in the long-term understanding, management or protection of forested ecosystems

Objective 1.1

Provide regular opportunities for networking across disciplines and organizations

- ACTIVITY 1.1.1** **Regularly convene environmental professionals at an annual meeting**
Deliverable: Expanded/shared VMC annual conferences with a target of 200 attendees, 50 presenters and 3 structured networking sessions
-
- ACTIVITY 1.1.2** **Provide VMC database training workshops to expand the use and contribution of data**
Deliverable: Mobile training workshops offered at least twice a year at partnering institutions
-
- ACTIVITY 1.1.3** **Expand circulation of newsletters via collaboration with partnering organizations**
Deliverable: Development, deployment and continued support of ecoNEWS VT with collaborators
-
- ACTIVITY 1.1.4** **Improve appeal and functionality of VMC website and database**
Deliverable: New website and database deployment in 2014

Objective 1.2

Coordinate efforts around high priority issues to produce integrated products

- ACTIVITY 1.2.1** **Conduct mini-grant competitions to support high priority research, monitoring, integration and synthesis efforts***
*Deliverable: Development of a Request for Proposals guided by the VMC Scientific Advisory Committee**
-
- ACTIVITY 1.2.2** **Identify and engage partners for integrated analyses around high priority issues**
Deliverable: Collaborator-led integration projects

*Activities may be dependent on securing additional sources of funding.

To promote the efficient COORDINATION of multidisciplinary environmental monitoring and research activities among Federal, State and private sector agencies and institutions with common interests in the long-term understanding, management or protection of forested ecosystems

Objective 1.3

Provide a forum to inform future activities among partners

ACTIVITY 1.3.1 Convene collaborators to reevaluate the VMC strategic plan, identify gaps, strengths and weaknesses in collective VMC efforts on a regular basis

Deliverables: Yearly internal strategic plan review and action plan, summarized in yearly reports to Northeastern Area State and Private Forestry; Preliminary Strategic Plan internal review in 2017; Reconvene the Strategic Planning Committee for renewal and update of the Strategic Plan in 2020

ACTIVITY 1.3.2 Provide a forum for multidisciplinary groups to identify emerging needs and work on proposals for external funding.

Deliverable: Facilitated working groups at VMC Annual Conferences

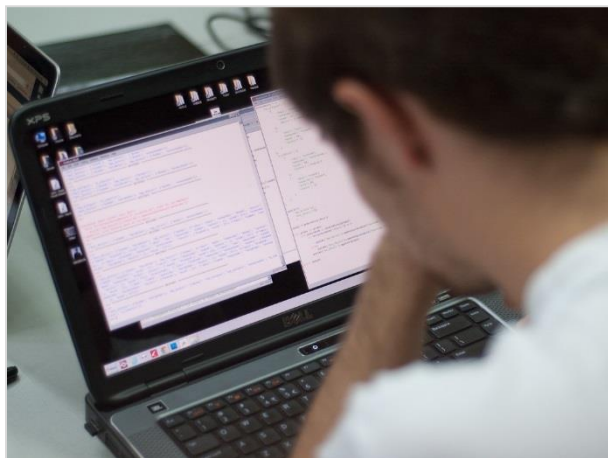


Figure 9. VMC data are available for reference, reuse or incorporation into new research and monitoring activities.

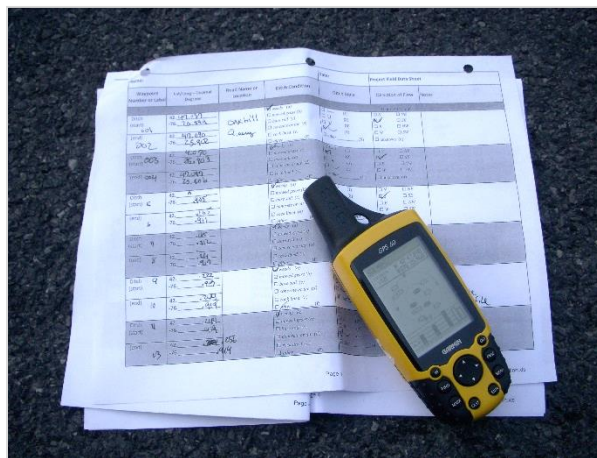


Figure 10. Working with partners, key data are archived beyond the life of individual projects.

Our cooperators and stakeholders alike have universally said that post-collection data analyses, synthesis and reporting are value-added services that the VMC might provide that would allow them to do their jobs better. Local NA State and Private Forestry partners have echoed these sentiments as a way to demonstrate the need and value of continuing federal funding for the VMC. It was also suggested that comparing VMC data to other sites in the region (i.e. Hubbard Brook, Harvard Forest, etc.) would give a broader context and application to VMC data and at the same time possibly help raise regional and national visibility for the organization.

The VMC has periodically produced integrated data summaries or synthesis reports, including a Data Integration Pilot Project (Martin et al., 1994), an Ecological Data Integration (Martin, 1998) project, a study of atmospheric mercury in Vermont and New England (Burkins et al., 2009), and a synthesis of the first 20 years of VMC monitoring data (VMC, 2009). However, VMC has not been consistent in allocating staff time and resources for these ventures.

The 2009 Vermont's Changing Forests (VMC, 2009) report may present an effective model for producing some future reports. During this endeavor the VMC acted as the coordinating organization that brought together like-minded cooperators interested in working on the report, and paid for some of their time to do data analyses and integration, and actual writing of chapters for the report.

Objective 2.1

Facilitate the development and distribution of VMC data syntheses

ACTIVITY 2.1.1 Convene collaborators to participate in a VMC data synthesis and analysis of long-term trends in environmental conditions every 5 years*

Deliverable: VMC synthesis report funded in the 2016 VMC budget for 2017 distribution

*Activities may be dependent on securing additional sources of funding.



Figure 11. Meteorological monitoring equipment installed on Diamond Island in Lake Champlain.

The Vermont Monitoring Cooperative was founded on the premise that a commitment to long-term environmental monitoring and research is essential to collecting baseline data needed to detect changes in conditions and trends and help identify new threats to our forested ecosystems. Long-term environmental monitoring has been a hallmark of the VMC for the past 25 years. No other environmental entity or organization in Vermont has made the commitment to or had the history and continued funding to support monitoring and research projects over this duration.

These long-term data records have allowed our cooperators to detect changes in trends for bird, amphibian and reptile populations, changes in forest tree species distributions and growth rates and to track changes in water chemistry of our lakes and streams. From these data researchers were able to show that much of Vermont’s air pollution (sulfate, nitrate and mercury) was transported to Vermont on air masses originating in the mid-west and south, and these pollutants could even be traced back to specific sources at mid-western coal-fired electrical generating plants.

It is imperative that these long-term records continue, and without an LTER or major Experimental Forest in VT, the VMC and its infrastructure are the logical choice to provide support for and coordination of these important data collections and also provide secure archiving and widespread distribution of the data.



Figure 12. Measuring the diameter of trees on permanent forest health monitoring plots.

Objective 3.1

Maintain long-term monitoring activities

- ACTIVITY 3.1.1** **Continue to supply granting money for monitoring and research projects**
Deliverable: Consistent funding of long-term monitoring efforts in yearly VMC budgets, including the application for external funding from appropriate granting agencies (see the list in the introduction)

- ACTIVITY 3.1.2** **Support and tracking of on-going research projects**
Deliverable: VMC Database and web portal

- ACTIVITY 3.1.3** **Maintain integrity of long-term research sites**
Deliverables: Ongoing monitoring and permitting for use of intensive locations

- ACTIVITY 3.1.4** **Document impact (outcomes) of VMC related activities for funding justification**
Deliverable: Yearly summary of products and outcomes in the VMC annual report

Objective 3.2

Monitor and report on current environmental conditions and potential threats

- ACTIVITY 3.2.1** **Summarize current conditions for all VMC long-term datasets into a yearly annual report**
Deliverable: VMC annual reports

CONNECTIONS TO PARTNERING ORGANIZATIONS

The Vermont Monitoring Cooperative is designed to service the needs of a wide array of partners, and the table below summarizes how each activity meets the various goals and objectives of major partners and contributors to the VMC. The partnering organization’s strategies, goals and activities are identified by numbers or letters, and are defined in Appendix D.

Goal 1. To promote the efficient COORDINATION of multidisciplinary environmental monitoring and research activities among Federal, State and private sector agencies and institutions with common interests in the long-term understanding, management or protection of forested ecosystems			
Objective	Activity	Deliverable	Alignment with Partners⁹
1.1 Provide regular opportunities for networking across disciplines and organizations	1.1.1 Regularly convene environmental professionals at an annual meeting	Expanded/shared VMC annual conferences with a target of 200 attendees, 50 presenters and 3 structured networking sessions	FPR: 2.1.7, 4.1, 4.1.30, 4.2, 4.2.33 NA: I, J DEC: 3, 6 F+W: 8 GMNF: 18, 19, 20
	1.1.2 Provide VMC database training workshops to expand the use and contribution of data	Mobile training workshops offered at least twice a year at partnering institutions	FPR: 1.2.3, 2.1, 2.1.6, 2.1.7, 2.3.13, 3.4.24, 3.5.26, 3.5.28, 4.1, 4.1.30, 4.2, 4.2.33 NA: C, D, H, I, J DEC: 1, 3, 6 F+W: 1, 2, 5 GMNF: 5, 15, 18, 19
	1.1.3 Expand circulation of newsletters via collaboration with partnering organizations	Development, deployment and continued support of ecoNEWS VT with collaborators	FPR: 2.1.7, 4.1, 4.1.30, 4.2, 4.2.33 NA: C, D, H, I DEC: 1, 3, 6 F+W: 1, 4, 5 GMNF: 18, 19

⁹ See Appendix D for the definitions of each partnering agency goal or objective.

Goals of the Vermont Monitoring Cooperative

	1.1.4 Improve appeal and functionality of VMC website and database	New website and database deployment in 2014	FPR: 1.2.3, 2.1, 2.1.6, 2.1.7, 2.3.13, 3.4.24, 3.5.26, 3.5.28, 4.1, 4.1.30, 4.2, 4.2.33 NA: C, D, H, I, J DEC: 1, 3, 6 F+W: 1, 2, 5 GMNF: 5, 15, 18, 19
1.2 Coordinate efforts around high priority issues to produce integrated products	1.2.1 Conduct mini-grant competitions to support high priority research, monitoring, integration and synthesis efforts	Development of a Request for Proposals guided by the VMC Scientific Advisory Committee (May be dependent on additional funds)	FPR: 2.1.7, 2.3.13, 3.4.24, 3.5.26, 3.5.28, 4.5.47 NA: C, D, F, H, I, J DEC: 1, 3, 5, 6 F+W: 2, 5, GMNF: 9, 18, 19, 20
	1.2.2 Identify and engage partners for integrated analyses around high priority issues	Collaborator-led integration projects	FPR: 2.1, 2.1.6, 2.1.7, 3.2.21, 3.4, 3.4.24, 3.5.26, 3.5.28, 4.1, 4.1.30, 4.2, 4.2.33 NA: C, D, F, H, I, J DEC: 1, 3, 4, 6 F+W: 1, 2, 5 GMNF: 9, 18, 19
1.3 Provide a forum to inform future activities among partners	1.3.1 Convene collaborators to reevaluate the VMC strategic plan, identify gaps, strengths and weaknesses in collective VMC efforts on a regular basis	Yearly internal strategic plan review and action plan, summarized in yearly reports to Northeastern Area State and Private Forestry Preliminary Strategic Plan internal review in 2017 Reconvene the Strategic Planning Committee for renewal and update of the Strategic Plan in 2020	FPR: 1.2.3, 2.1.6, 2.1.7, 2.3.13, 3.4.24, 3.5.26, 3.5.28 NA: C, D, F, H, I, J DEC: 1, 3, 6 F+W: 5, 7 GMNF: 18
	1.3.2 Provide a forum for multidisciplinary groups to identify emerging needs and work on proposals for external funding	Facilitated working groups at VMC Annual Conferences	FPR: 1.2.3, 2.1.6, 2.1.7, 2.3.13, 3.1.15, 3.4.24, 3.5.26, 3.5.28, 4.1, 4.2, 4.5 NA: C, D, H, I, J DEC: 1, 3, 5, 6 F+W: 3, 4, 5, 8 GMNF: 18, 19

Goals of the Vermont Monitoring Cooperative

Goal 2. To promote an improved understanding of trends and relationship in the physical, chemical and biological components of the forested ecosystems through DATA ANALYSIS AND SYNTHESIS

Objective	Activity	Deliverable	Alignment with Partners
2.1 Facilitate the development and distribution of VMC data syntheses	2.1.1 Convene collaborators to participate in a VMC data synthesis and analysis of long-term trends in environmental conditions every 5 years	VMC synthesis report funded in the 2016 VMC budget for 2017 distribution	FPR: 1.2, 2.1.6, 2.1.7, 2.3.13, 3.4.24, 3.5.26, 3.5.28, 4.1, 4.1.30, 4.2 NA: A, B, C, D, F, H, I, J DEC: 1, 3, 6 F+W: 1, 2, 5 GMNF: 18, 19

Goal 3. To conduct LONG-TERM MONITORING in order to report on current forest ecosystem health and emerging threats

Objective	Activity	Deliverable	Alignment with Partners
3.1 Maintain long-term monitoring activities	3.1.1 Continue to supply granting money for monitoring and research projects	Consistent funding of long-term monitoring efforts in yearly VMC budgets, including the application for external funding from appropriate granting agencies	FPR: 1.2.3, 2.1.6, 2.1.7, 2.3.13, 3.4.24, 3.5.26, 3.5.28 NA: A, C, D, F, H, J DEC: 1, 3, 6 F+W: 1, 2, 5 GMNF: 5, 15, 18, 19
	3.1.2 Support and tracking of on-going research projects	VMC Database and web portal	FPR: 1.2.3, 2.1.6, 2.1.7, 2.3.13, 3.4.24, 3.5.26, 3.5.28, 4.1, 4.1.30, 4.2.33 NA: A, B, C, D, G, H, I, J DEC: 1, 3, 6 F+W: 1, 2, 5 GMNF: 18, 19
	3.1.3 Maintain integrity of long-term research sites	Deliverables: Ongoing monitoring and permitting for use of intensive locations	FPR: 2.1.6, 2.1.7, 2.3.13, 3.1.15, 3.4.24, 3.5.26, 3.5.28, 4.1.30, 4.5.47 NA: B, C, D, F, G, I DEC: 1, 3, 6 F+W: 1, 2, 5 GMNF: 5, 15, 18, 19

Goals of the Vermont Monitoring Cooperative

	3.1.4 Document impact (outcomes) of VMC related activities for funding justification	Yearly summary of products and outcomes in the VMC annual report	FPR: 1.2.3, 2.1.6, 2.1.7, 2.3.13, 3.2.21, 3.4.24, 3.5.26, 3.5.28, 4.1.30, 4.2.33 NA: A, B, C, D, F, H, I DEC: 1, 3, 6 F+W: 1, 2, 5 GMNF: 5, 9, 15, 18, 19
3.2 Monitor and report on current environmental conditions and potential threats	3.2.1 Summarize current conditions for all VMC long-term datasets into a yearly annual report	VMC annual reports	FPR: 1.2.3, 2.1.6, 2.1.7, 2.3.13, 3.2.21, 3.4.24, 3.5.26, 3.5.28, 4.1.30, 4.2.33 NA: A, B, C, D, F, H, I DEC: 1, 3, 6 F+W: 1, 2, 5 GMNF: 5, 9, 15, 18, 19



Citations and Credits

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PHOTO CREDITS

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Cover photo. Hemlock cones. Photo available at https://www.flickr.com/photos/fauxto_dkp/3246038060 and reproduced under CC BY-ND 2.0 license.

An Introduction to the Vermont Monitoring Cooperative Section

Cover photo. Eastern hemlock (*Tsuga canadensis*) branch. Photo available at <https://www.flickr.com/photos/dendroica/8396096003/> and reproduced under CC BY 2.0 license.

Figure 2. VMC Soil Climate Analysis Network site at Lye Brook Wilderness Area in Manchester, VT. VMC archive.

Figure 3. VMC forest canopy tower at the Proctor Maple Research Center in Underhill, VT. VMC archive.

Overview of the Strategic Planning Process Section

Section cover photo. Spring Peeper (*Pseudacris crucifer*) male perched on hemlock branch. Photo by Dave Huth, available online at <https://www.flickr.com/photos/davemedia/14007130769/in/set-72157594516044649> and reproduced under CC BY-NC 2.0 license

Revised Vermont Monitoring Cooperative Mission Section

Section cover photo. An Aerochem wet/dry precipitation sampler (foreground), instrument shelter with atmospheric mercury sampling equipment on the roof and meteorological tower at the VMC Air Quality site in Underhill, VT. Photo by Jim Duncan.

Goals of the Vermont Monitoring Cooperative Section

Section cover photo. Permanent plot marker for the VMC 200-year soil monitoring study located at Mt. Mansfield and the Lye Brook Wilderness Area. VMC archive.

Figure 7. FPR Commissioner, Michael Snyder, speaking at the 2013 VMC Annual Conference. Photo by Jim Duncan, VMC archive.

Figure 8. Audience listening to keynote speaker, Jon Erickson's, presentation at the 2013 VMC Annual Conference. Photo by Jim Duncan, VMC archive.

Figure 9. VMC data are available for reference, reuse or incorporation into new research and monitoring activities. Photo by Sebastian Sikora, available online at <https://www.flickr.com/photos/hello-sebastian/8207477274> and reproduced under CC BY 2.0 license.

Figure 10. Working with partners, key data are archived beyond the life of individual projects. Photo by UConn Libraries MAGIC, available online at

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Figure 11. Meteorological monitoring equipment installed on Diamond Island in Lake Champlain. VMC archive.

Figure 12. Measuring the diameter of trees on permanent forest health monitoring plots. VMC archive.

Citations and Credits Section

Section cover photo. US Geological stream gage station at Gwynns Falls, Glyndon, Maryland. Available online at <http://md.water.usgs.gov/BES/01589180/>.

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Appendix A: Details of the Strategic Planning Process

Over the past decade the VMC has undertaken several visioning and review activities. In 2001 the VMC Operations Guide was updated by VMC staff with input from the Steering and Advisory Committees. This document clearly summarized the VMC mission and goals and outlined critical VMC activities and services¹⁸. The following year, 2002, an external review team with members from the Missouri Department of Conservation, US Geological Survey and US Forest Service convened to review the VMC program and activities¹⁹. This was followed in 2004 by an internal review of VMC staff positions and duties, and overall VMC activities. In March 2014, the VMC Steering Committee decided to initiate a strategic planning initiative to revisit the VMC mission statement, examine how it aligns with the missions and goals of our partners and identify a set of priority activities for VMC focus moving forward.

Informed by these previous activities, as well as the strategic planning undertaken by each of the primary partnering organizations that comprise the VMC collaborative, we outlined an iterative evaluation of the VMC mission, objectives and activities in 2014 to sharpen our focus, strengthen relationships across organizations, and ensure continued relevance and impact of the collaborative. This planning process allowed for full input from the Advisory Committee, refinement by the Strategic Planning Committee and then feedback from the larger group of VMC collaborators.

APRIL 18, 2014 ADVISORY COMMITTEE MEETING

The VMC Advisory Committee reviewed and edited a list of SWOTs (strengths, weaknesses, opportunities, threats) generated by the VMC staff. Among VMC's **strengths** the committee listed its continuous, long-term data records and data archive, co-location of cross-cutting research/monitoring projects, the new website and data portal, cross-cutting Annual Meeting format, VMC's dedicated network of cooperators and philosophy of collaboration, multidisciplinary perspective, and education and outreach. For the full list of SWOTs see (Appendix B).

¹⁸ Available online at http://www.uvm.edu/vmc/documents/2001_VMCOperationsGuide.pdf.

¹⁹ Available online at http://www.uvm.edu/vmc/documents/2002_VMCReviewFinalReport.pdf.

Also at the meeting, committee members reviewed the current VMC mission statement which reads: “Its mission is to serve Vermont through improved understanding of long-term trends, annual conditions and interdisciplinary relationships of the physical, chemical and biological components of forested ecosystems in Vermont. The VMC facilitates the collection of environmental data, and provides to Vermonters and others the information needed to understand, protect and manage forested ecosystems within a changing global environment.”

The following goals were identified by the Advisory Committee as being crucial to VMC’s future mission:

Goal 1: Monitoring and Analyzing conditions and trends (DOING)

To promote an improved understanding of the conditions, trends and relationship in the physical, chemical and biological components of the forested ecosystems in Vermont.

Goal 2: Efficient Coordination (COORDINATING)

To promote the efficient coordination of multidisciplinary environmental monitoring and research activities among Federal, State and Private Sector Agencies and Institutions with common interests in the long-term understanding, management or protection of forested systems.

Goal 3: Outreach (USING)

Disseminate information to inform natural resource professionals, resource managers, policy makers, and the public about important environmental issues. This should include documenting and describing impacts of VMC monitoring and research done by our cooperators.

Goal 4: Planning....looking forward

Keep an eye on the horizon to identify the next threat or threats to Vermont’s forested ecosystems and develop plans to collect data needed to fill knowledge gaps and make scientifically sound policy and management decisions to mitigate detrimental consequences. This includes periodic review and update to the Strategic Plan to keep VMC nimble and able to respond to relevant Vermont and regional environmental issues.

JUNE 5, 2014 VMC STRATEGIC PLANNING COMMITTEE RETREAT

In June, a specially-formed Strategic Planning Committee comprised of cooperators and leaders from state and federal partnering organizations considered the VMC mission and goals put forth by the Advisory Committee as a part of a larger strategic planning effort. This group defined a set of high-level objectives and related activities that they felt VMC should pursue over the next ten years in order to meet the larger mission and goals.

The proposed VMC mission statement from Strategic Planning Retreat appears on pages 12 of the Strategic Plan. The full list of priorities and activities to achieve those priorities developed at the Strategic Planning Retreat appears on page 6 of Appendix A.

JULY 2014 ELECTRONIC SURVEY:

To solicit feedback on these draft objectives and related activities, a quantitative survey was designed to better understand where VMC collaborators feel efforts should focus. Such feedback is particularly crucial to ensure that the VMC continues to provide valuable services to the environmental community, filling current gaps in our collective efforts and minimizing overlap with activities that may be more efficiently completed by others. In a time when budgets are stretched thinner, yet the need for monitoring, research and coordination around environment grows, this information will allow the VMC to focus its efforts for maximum impact.

Specific questions were targeted to:

- Prioritize stated objectives
- Rank specific activities where VMC should focus efforts
- Prioritize a set of high level objectives and activities to help refine VMC goals
- Identify collaborator needs - Solicit other objectives and activities to achieve those objectives

Overall, this survey provided a unique opportunity to evaluate how collaborators would like to see VMC finances and efforts directed. The results indicate that the continuation of long-term monitoring activities, analysis and reporting of the resulting information and facilitation of networking among collaborators are priorities. However, it is important to consider that the results of this effort allocation activity represent an idealized world, where activities that may be of highest priority are represented by relatively low “effort” cost compared to the true costs of successfully accomplishing them. For example, while maintaining funding for long-term monitoring was the highest valued activity, with the largest effort point allocation (14% of total available), in reality maintaining ongoing monitoring of forest health, wildlife populations, air and water quality currently require over 50% of the VMC budget and staff time. Adding on costs associated with data management, web functionality and access consumes an additional 25% of the current VMC budget and staff time. So while these results are useful to prioritize activities, the full list that can successfully be accomplished may differ from the idealized list presented here. While this may pose a challenge during yearly VMC budget discussions, this information

should prove useful to direct resources for the greatest benefit or identify other activities to cut if necessary in the future.

VMC Strategic Planning Survey Summary

This group defined a set of objectives and related activities that the VMC should pursue over the next ten years in order to meet the larger mission and goals. To solicit feedback on these draft objectives and related activities a quantitative survey was designed to better understand where VMC collaborators feel efforts should focus. Such feedback is particularly crucial to ensure that the VMC continues to provide valuable services to the environmental community, filling current gaps in our collective efforts and minimizing overlap with activities that may be more efficiently completed by others. In a time when budgets are stretched thinner, yet the need for coordination around environmental monitoring and research grows, this information will allow the VMC to focus its efforts for maximum impact.

Survey Structure and Response

In August of 2014, VMC collaborators, steering and advisory committee members were asked to complete an online survey to evaluate and rank the suite of objectives and activities outlined in the VMC draft strategic plan.

While the overarching goals were set by the strategic planning committee, respondents were asked to prioritize each of the individual objectives included under each goal based on a 1 (lowest) to 5 (highest) scale.

Goal 1 - To promote the efficient coordination of multidisciplinary environmental monitoring and research activities among Federal, State and Private Sector Agencies and Institutions with common interests in the long-term understanding, management or protection of forested systems						
Objective 1 - Provide regular opportunities for networking across disciplines and organizations						
Priority	<input type="radio"/> 1 (low)	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5 (high)	<input checked="" type="radio"/> No response
Objective 2 - Coordinate efforts around high priority issues to produce integrated products						
Priority	<input type="radio"/> 1 (low)	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5 (high)	<input checked="" type="radio"/> No response
Objective 3 - Provide a forum to inform future activities among partners						
Priority	<input type="radio"/> 1 (low)	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5 (high)	<input checked="" type="radio"/> No response

Similarly, potential activities to accomplish each goal were ranked, but with respondents asked to assume a limited amount of financial resources available to conduct their selected activities.

From a pool of 100 total “points” respondents were able to allocate points as they deemed appropriate, with the ability to more heavily weight activities they felt were more

important, or equally weight a larger number of activities. The concept follows both financial and effort allocation, such that assigning 10 effort points would correspond with approximately 10% of the available VMC budget and staff effort.

You have 100 points to "spend" on the set of activities you think are most important. You can give all your points to one thing, or spread them out, use them all or leave some unspent

Points remaining: 70 out of 100

Proposed activity	Points
Host annual meetings to convene a wide audience of environmental professionals	0
Provide VMC database training workshops to expand data integration	10
Inform collaborators of upcoming meetings, trainings and workshops	20
Expand the VMC collaborative base through outreach and presentations	0
Disseminate regular newsletters with the latest environmental findings	0

There were also opportunities to provide feedback, additional ideas and information. This information is summarized below, and reflected in this final strategic plan to ensure that the VMC is able to best meet the needs of researchers, ecosystem professionals and policy makers across the region.

The full proposed list of objectives and associated activities available for consideration is summarized here with activities bulleted under each related objective and goal. Because this feedback from the ranking and prioritization of this full list was used to subset and finalize the final set of guiding objectives and activities included in this final strategic plan, you may note that there are activities listed here that are not included in the final strategic plan. Narrowing down activities allows the VMC to focus its efforts where they are needed, while allowing other, lower impact activities to be removed from our responsibilities. In the next several pages we summarize the results of this ranking process, and how decisions were made to retain, remove or add activities in response to this survey.

Original Full List of VMC Objectives and Associated Activities Included in the Survey

Goal 1: coordination

To promote the efficient coordination of multidisciplinary environmental monitoring and research activities among Federal, State and Private Sector Agencies and Institutions with common interests in the long-term understanding,

Objective 1: Facilitate the development and distribution of VMC data syntheses.

- Data syntheses and trends

Objective 2: Initiate analyses of and integration across new datasets.

Goal 3: long-term monitoring

To conduct long-term monitoring in order to report on current forest ecosystem health and emerging threats.

Objective 1: Maintain long-term monitoring activities.

- Maintain funding for monitoring
- Data management and archive
- Maintain intensive sites
- Document impact

management or protection of forested systems.

Objective 1: Provide regular opportunities for networking

- Host annual meetings
- Provide database training workshops
- Provide event information
- Develop an outreach plan
- Expand circulation of newsletters
- Coordinate volunteer and student interns
- Enhance web access and functionality

Objective 2: Coordinate efforts around high priority issues to produce integrated products.

- Mini-grant competitions
- Coordinate grant writing for external funding

Objective 3: Provide a forum to inform future activities among partners.

- Reevaluate the VMC strategic plan
- Identify emerging needs

Goal 2: data analysis and synthesis

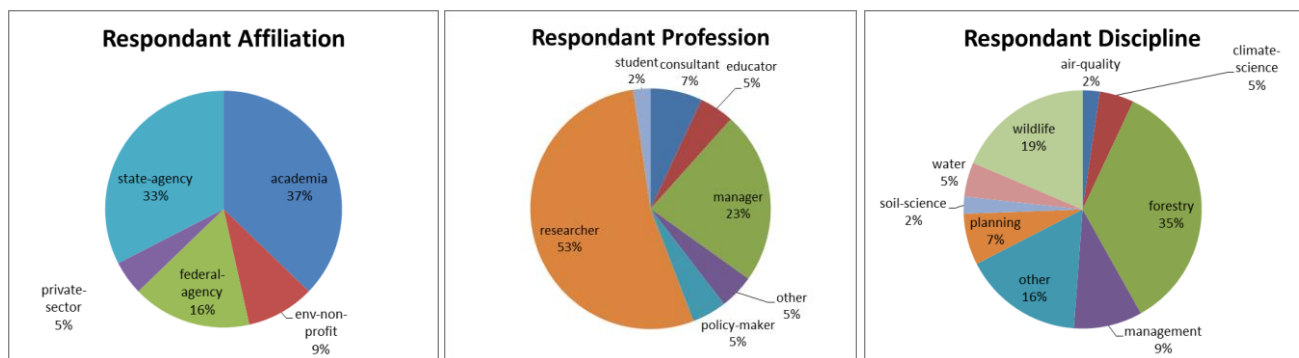
To promote an improved understanding of trends and relationship in the physical, chemical and biological components of the forested ecosystems through data analysis and synthesis

- Novel integrated analyses
- Comparison to other long-term research sites
- Identify new data users

Survey Results

Survey Demographics

Of the 45 participants, response was highest from academic institutions and the Vermont Agency of Natural Resources, but also included responses from Federal Agencies such as the US Forest Service and US Geological Survey, non-profit organizations and the private sector. The majority of respondents were researchers and land managers. Responses from those involved in policy, education and consulting were lower, indicating that a secondary effort to elicit their opinions may be warranted to ensure the VMC captures the diversity of perspectives expected in our regional natural resource community. By discipline, most respondents worked in forestry and wildlife. Because ongoing VMC efforts also include monitoring of water, soil and air resources, it may be warranted to increase representation from collaborators working on water, soil and climate/air quality issues.



Objectives

The mean ranking of all seven proposed objectives was over 4, indicating that most respondents consider each of these to be important objectives for VMC to pursue. However, there was a distinction among the objectives, with **Objective 3.1** (Maintain long-term monitoring activities, mean rank = 4.76, median rank = 5) significantly higher than most almost all other objectives. Other high ranking objectives included **Objective 3.2** (Monitor and report on current environmental conditions and potential threats, mean rank = 4.53, median rank = 5), **Objective 2.1** (Facilitate the development and distribution of VMC data syntheses, mean rank = 4.46, median rank = 5) and **Objective 1.1** (Provide regular opportunities for networking, mean rank = 4.37, median rank = 5). While still considered relatively high priority on the 1-5 scale, objectives pertaining to expanded data syntheses (new analyses around high priority issues, (**Objective 1.2**, mean rank = 4.04, median rank = 4) or data integration and analysis efforts (**Objective 2.2**, mean rank = 4.06, median rank = 4)) were significantly lower than those associated with monitoring, reporting and networking efforts. The lowest ranked objective involved providing a forum to inform future activities among partners (**Objective 1.3**, mean rank = 4.02, median rank = 4).

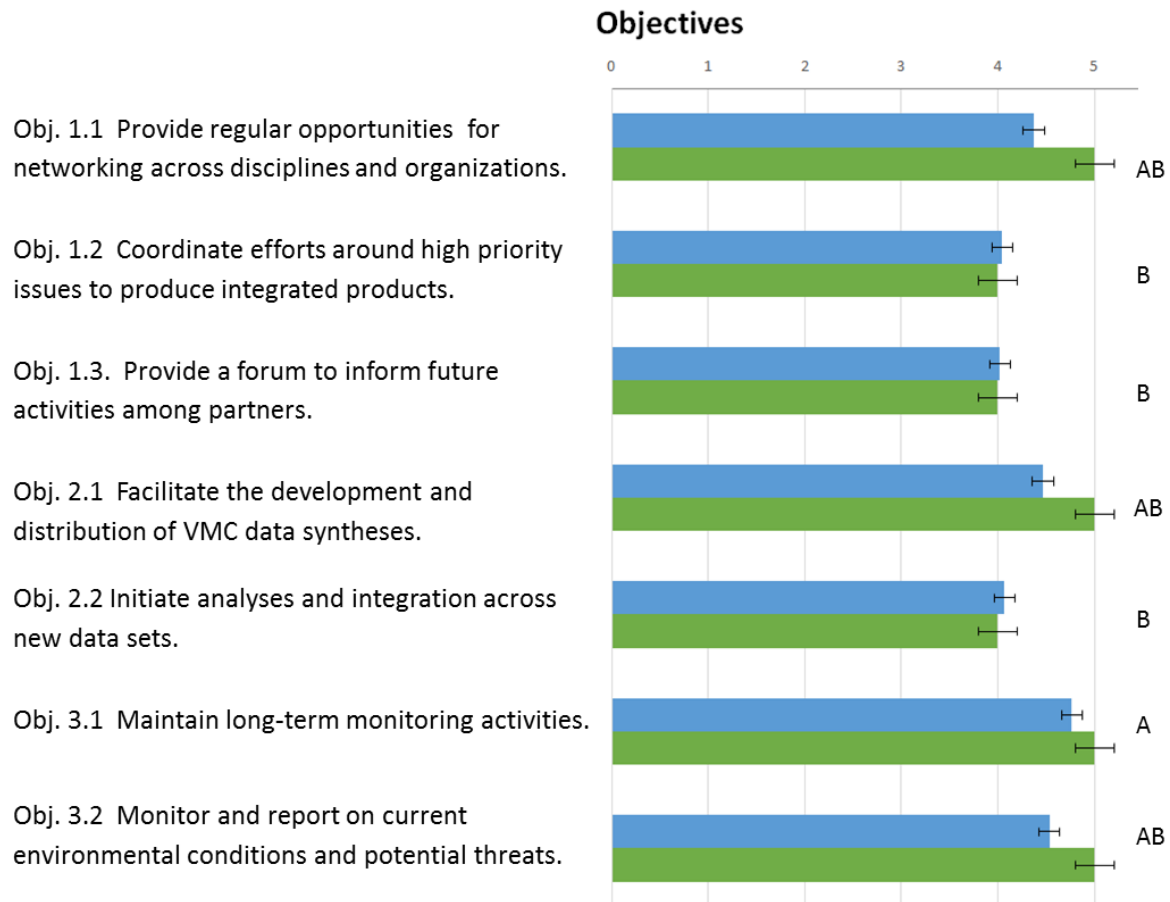


Figure 13. Mean (blue) and median (green) ranks of the seven proposed objectives with standard error. Objectives that share a letter designation are not significantly different.

Activities

Although the potential activities were ranked independently of the objectives, survey results followed a similar pattern, with the highest prioritization going to activities under Objective 3.1 (Maintain long-term monitoring activities) and Objective 1.1 (Provide regular opportunities for networking). However, within objectives, certain activities were allocated significantly more resources than others, providing an opportunity to target a smaller subset of activities to accomplish each objective. To summarize this, each of the activities evaluated in the survey are presented here within their associated objectives. Statistical analyses of points allocated were then used to identify if more effort targeted on a subset of activities should be the focus of VMC efforts moving forward. To reiterate the value ranking of objectives discussed above, objectives are presented in order, from highest to lowest rank.

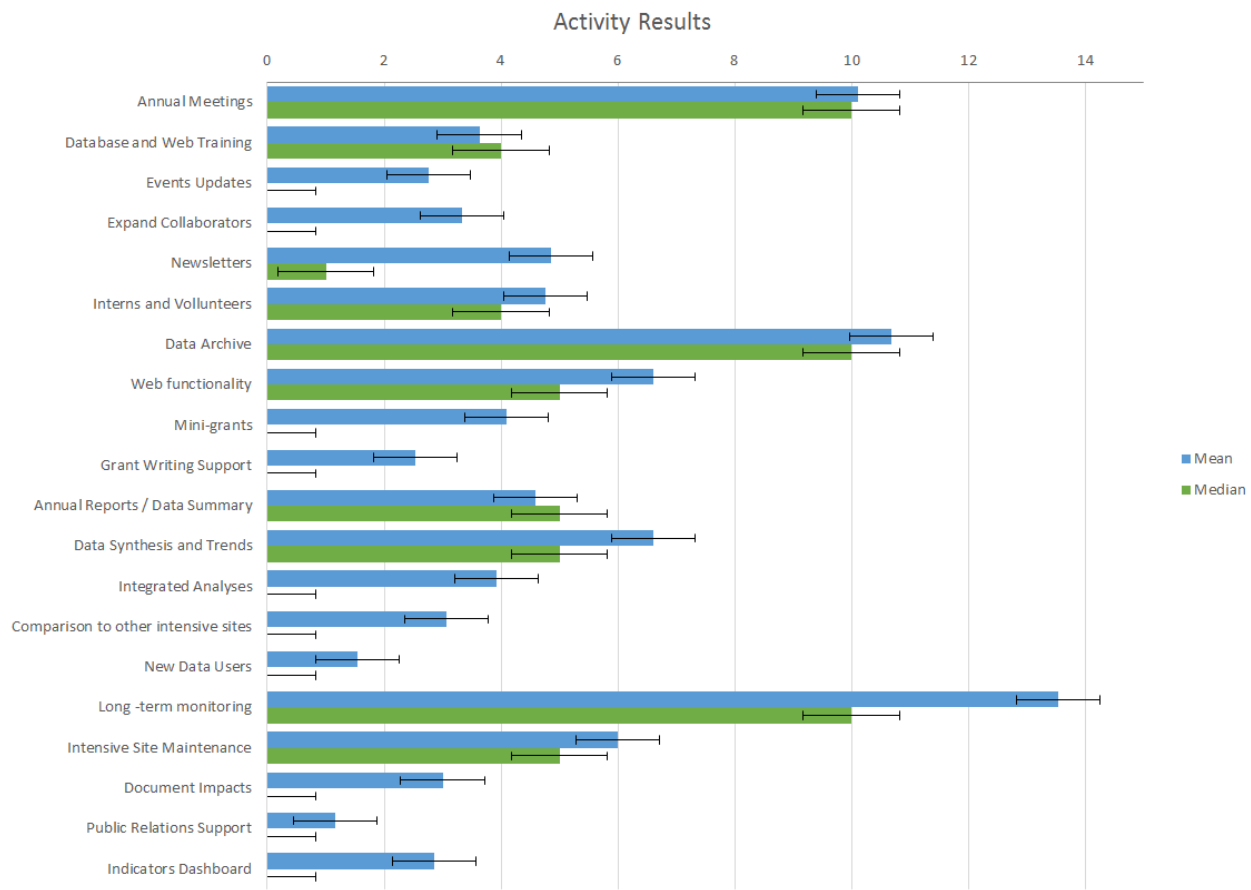


Figure 14. Mean (blue) and median (green) ranks of the twenty proposed activities with standard error.

Objective 3.1 Maintain long-term monitoring activities.

Following Objective 3.1’s top ranking among objectives, two associated monitoring activities were also allocated the greatest number of effort points. These activities involved maintaining funding for long-term monitoring (mean = 13.5, median = 10) and data management and maintenance of the VMC database archive (mean = 10.7, median = 10). These were assigned significantly higher points than the other long-term monitoring related activities (Intensive site maintenance mean = 6.0, median = 5) and documenting impacts of monitoring activities (mean = 3.0, median = 0). While this might justify dropping infrastructure maintenance and documentation of how data is utilized from VMC’s priority list, it is clear that without these activities, the others would not be possible. Without maintaining infrastructure, air quality, water quality and climate data would be jeopardized. Similarly, without directing efforts to documenting impacts, justification of VMC funding and collaborator participation is at risk. The strategic planning committee therefore determined that all four activities under objective 3.1 should be retained.

Final Objective 3.1 activities to maintain long-term monitoring activities.

- Maintain funding for long-term monitoring (rounded mean 14, *actual requirement 51)
- Data storage, access and archive support (rounded mean 11)
- Maintain intensive site infrastructure and permitting (rounded mean 6)
- Document impact of VMC related activities (rounded mean 3)

Final Objective 3.1 Effort: 71 effort units

**Note that the mean survey allocation to maintain funding for long-term monitoring does not reflect the actual costs required to do so (currently 51% of the VMC budget). Therefore, effort allocation has been adjusted to reflect what is required to accomplish this (the highest ranked) activity.*

Objective 3.2 Monitor and report on current environmental conditions and potential threats

While monitoring and reporting on environmental conditions was the second highest ranked objective, when faced with assigning a limited number of points to specific activities, reporting-related activities were not ranked as high as collaboration and networking activities. Among reporting activities, the publication of an annual report to summarize current conditions of long-term VMC monitoring datasets (mean = 4.6, median = 5) received almost double the points allocated to the creation of an indicators dashboard to summarize current conditions relative to historical baselines (mean = 2.9, median = 0). Also included in this objective, activities designed to disseminate these findings to the public and facilitate public relations was the lowest ranked of all activities (mean = 1.2, median = 0). This indicates that collaborators recognize the importance of analyzing and reporting VMC collected data on a regular basis, rather than focusing efforts only on the data collection and storage itself. These results further suggest that the publication of a high quality annual report should be sufficient to meet this objective. Therefore, we chose to allocate the sum of effort units for this objective to the production of formal VMC annual reports.

Final Objective 3.2: Monitor and report on current environmental conditions and potential threats

- Annual report of current conditions and threats (objective sum 9)
- ~~Public Relations support~~
- ~~Online indicators dashboard~~

Final Objective 3.1 Effort: 9 effort units

Total Cumulative Effort by Ranked Objective Order: 80 out of 100 available effort units

Objective 2.1 Facilitate the development and distribution of VMC data syntheses

VMC data analysis and synthesis activities were highly ranked among both the objectives and activities. Respondents prioritized coordinating syntheses of VMC for examination of long-term trends (mean = 6.6, median = 5) and threat identification as high as data management activities. This indicates that while the collection and safe storage of data is important, respondents recognize that allocating the time and expertise to interpreting this information is essential. While syntheses have been conducted sporadically in the past,

planning for regular coordination of cooperators to both summarize and synthesize long-term data sets will be given a higher priority for VMC efforts over the coming years.

Final Objective 2.1: Facilitate the development and distribution of VMC data syntheses.

- Data syntheses and long-term trends (rounded mean 7)

Objective 2.1 Effort: 7 effort units

Total Cumulative Effort by Rank Order: 87 out of 100 available effort units

Objective 1.1 Provide regular opportunities for networking

The next two highest ranking activities also reflect the high ranking of Objective 1.1. Specifically respondents prioritized hosting annual meetings (mean = 10.2, median = 10) and expanding the VMC website for enhanced data search, download, visualization and analysis across datasets (mean = 6.6, median = 5). This was significantly higher than providing regular newsletters (mean = 4.9, median = 1), coordinating interns and volunteers (mean = 4.8, median = 4), providing data management training (mean = 3.6, median = 4), expanding the collaborative base (mean = 3.3, median = 0) or maintaining a calendar with updated event information across organizations (mean = 2.8, median = 0). Similar to some activities required for long-term monitoring, some of the lower-ranked activities here are necessary to ensure the success of the higher-ranked activities. For example, data management and web training is necessary to ensure that collaborators are able to fully utilize the structures that result from the (highly ranked) web and database enhancement. Other lower-rated activities can be considered “low cost” in that much of the work or organization required to complete them is already completed. For example, a recent collaboration with organization comprising the ecoNEWS effort has ensured that regular newsletters with the most recent environmental findings and information can continue with minimal VMC resources moving forward. Considering this, the final list of recommended high priority activities to accomplish Objective 1.1 in the strategic plan include the following:

Final Objective 1.1 activities to provide regular opportunities for networking

- Host Annual meetings (rounded mean 11)
- Provide database training workshops (rounded mean 4)
- ~~○ Provide Event Information~~
- ~~○ Develop an Outreach Plan~~
- Expand circulation of newsletters (rounded mean 5)
- ~~○ Coordinate volunteer and student interns~~
- Enhance web access and functionality (rounded mean 7)

Cumulative Objective 1.1 Effort: 27 effort units

Total Cumulative Effort by Rank Order: 114 out of 100 available effort units

Objective 1.2 Coordinate efforts around high priority issues to produce integrated products

While overall this objective receive a mean rank of 4.04 on the 1-5 scale, most respondents ranked both associated activities (providing mini-grants to support directed work (mean =

4.1, median = 0) and facilitating external grant writing (mean = 2.5, median = 0) as non-priorities (median of 0). This suggests that while the overall goal of coordinating efforts around high priority issues is worthwhile, when resources are limited other activities are favored. Therefore, this strategic plan maintains support for mini-grants, but other new initiatives such as grant writing support will remain limited in scope.

Final Objective 1.2: Coordinate efforts around high priority issues to produce integrated products.

- Mini-grant competition (rounded mean 4)
- *Focus on novel integrated analyses (lumped from objective 2.2 below)*
- ~~Coordinate grant writing for external funding~~

Cumulative Objective 1.2 Effort: 4 effort units

Total Cumulative Effort by Rank Order: 118 out of 100 available effort units

Objective 2.2 Initiate analyses of and integration across new datasets

Similar to the results for coordinating efforts around high priority issues, the objective of initiating integrated analyses across new datasets received relatively low rankings for all proposed activities, with the majority of respondents listing them as non-priorities for VMC. Of the integrated analysis activities, the initiation of novel integrated analyses was the highest ranked activity (mean = 3.9, median = 0). If in the future the VMC advisory and steering committees wish to initiate such activities, it would be possible to design a mini-grant to support such an activity. The strategic plan has therefore been modified to include the initiation of integrated analyses across datasets into Objective 1.2 for more streamlined efforts moving forward. While the comparison of VMC data to other long-term intensive sites is a valuable opportunity to provide regional context to VMC efforts, the realities of budget, staff and time constraints indicates that such activities may not be possible at this point.

~~Objective 2: Initiate analyses of and integration across new datasets.~~

- *Novel integrated analyses (moved to objective 1.2 above)*
- ~~Comparison to other long-term research sites~~
- ~~Identify new data users~~

Cumulative Objective 2.2 Effort: 0 effort units

Total Cumulative Effort by Rank Order: 118 out of 100 available effort units

Objective 1.3 Provide a forum to inform future activities among partners.

Specific activities related to Objective 1.3 were not included in the prioritization exercise in this survey. These activities were considered necessary to the relevance and function of the organization as a whole, and thus not up for debate. Without regular discussions of the current state and future direction of the organization, the VMC would fail to meet its charge. The forested landscape is constantly changing and responding to changing environmental conditions. The ability to redirect energy and resources is key to staying on top of a complex reality. Therefore, this strategic plan includes by default a charge to regularly discuss and revise the goals, objectives and activities of the group. These

activities will naturally manifest in other activities described here (e.g. the focus of mini-grant competitions, synthesis reports or annual meeting themes). But in addition, the charge is to revisit this strategic plan every 5 years. As such, this objective should occupy a small (and highly variable depending on the 5 year strategic planning cycle) effort. For accounting purposes here, 2 effort points should be reserved in each year to represent these discussions.

Objective 1.3 Provide a forum to inform future activities among partners.

- Reevaluate the VMC strategic plan
- Identify emerging needs

Cumulative Objective 1.3 Effort: 2 effort units

Total Cumulative Effort by Rank Order: 120 out of 100 available effort units

Survey Summary

Overall, this survey provides a unique opportunity to evaluate how collaborators would like to see VMC finances and efforts directed. The results indicate that the continuation of long-term monitoring activities, analysis and reporting of the resulting information and facilitation of networking among collaborators are priorities. However, it is important to consider that the results of this effort allocation activity represent an idealized world, where activities that may be of highest priority are represented by relatively low “effort” cost compared to the true costs of successfully accomplishing them. For example, while maintaining funding for long-term monitoring was the highest valued activity, with the largest effort point allocation (14% of total available), in reality maintaining ongoing monitoring of forest health, wildlife populations, air and water quality currently require over 50% of the VMC budget and staff time. Adding on costs associated with data management, web functionality and access consumes an additional 25% of the current VMC budget and staff time. So while these results are useful to prioritize activities, the full list that can successfully be accomplished may differ from the idealized list presented here. While this may pose a challenge during yearly VMC budget discussions, this information should prove useful to direct resources for the greatest benefit or identify other activities to cut if necessary in the future.

Revised List of VMC Objectives and Associated Activities Based on Survey Feedback

Goal 1: coordination

To promote the efficient coordination of multidisciplinary environmental monitoring and research activities among Federal, State and Private Sector Agencies and Institutions with common interests in the long-term understanding, management or protection of forested systems.

Objective 1.1: Provide regular opportunities for networking

- Host annual meetings
- Provide database training workshops
- Expand circulation of newsletters
- Enhance web access and functionality

Objective 1.2: Coordinate efforts around high priority issues to produce integrated products.

- Mini-grant competition
- Focus on novel integrated analyses

Objective 1.3: Provide a forum to inform future activities among partners.

- Reevaluate the VMC strategic plan
- Identify emerging needs

Goal 2: data analysis and synthesis

To promote an improved understanding of trends and relationship in the physical, chemical and biological components of the forested ecosystems through data analysis and synthesis

Objective 2.1: Facilitate the development and distribution of VMC data syntheses.

- Data syntheses and trends

Goal 3: long-term monitoring

To conduct long-term monitoring in order to report on current forest ecosystem health and emerging threats.

Objective 3.1: Maintain long-term monitoring activities.

- Maintain funding for monitoring
- Data management and archive
- Maintain intensive sites
- Document impact

- Annual report of current conditions and threats

Objective 3.2: Monitor and report on current environmental conditions and potential threats.

OCTOBER 14, 2014 STEERING COMMITTEE MEETING:

The Strategic Planning document, having been informed and revised with results from the Electronic Survey, will be presented to the VMC Steering Committee for discussion, and approval. This will include a newly-worded mission statement and VMC priorities for the next 5 years. Input and discussion from this meeting will be incorporated into a final draft of the Strategic Planning document to be publically unveiled at the 2014 VMC Annual Conference.

DECEMBER 11, 2014 VMC ANNUAL CONFERENCE:

The newly-adopted VMC Strategic Plan will be made public.

The strategic plan is intended to not only guide our activities going forward, but also to serve as an action plan. In developing these objectives and specific activities, we have provided specific milestones and timelines to demonstrate our commitment to achieving these goals.

CONTINUING REVIEW OF STRATEGIC PLAN IMPLEMENTATION

In 2017 we will conduct a detailed preliminary review to determine if steady, significant and measurable progress is being made toward meeting our goals. If progress is deemed unsatisfactory at that point, new steps will be implemented to help get us back on track to achieve all goals by 2020.

Appendix B: Vermont Monitoring Cooperative Strengths, Weaknesses, Threats and Opportunities

(Summarized from the April, 2014 VMC Advisory Committee Meeting)

STRENGTHS (What does VMC do well?)

Facilitating collaborations

- Dedicated collaborators
- Long history of collaborations across organizations and disciplines
- Cross cutting Annual Meeting
- Opportunities for regular connections among collaborators
- Funding for small scale / pilot projects

Monitoring

- Cross ecosystem monitoring.....trees, air, water, soils, wildlife
- LONG TERM – historical archive
- Continuity of a large number of environmental datasets
- Co-location of research projects (intensive research sites for data integration)
- Synthesis of disparate datasets (e.g. 2009 Synthesis Report)

Data Management

- Safe and accessible data archiving
- New database structure for improved search capabilities and links to other databases
- New web portal for easier data discovery, visualization, access and download
- Providing access to spatial datasets relevant to forest health beyond what is available at state level geospatial clearinghouses

Outreach and Impact

- Communicating scientific findings via regular newsletters
- Informing land management decisions
- Education –outreach to the community of environmental professionals
- Stimulating new research ideas among collaborators

WEAKNESSES (What VMC should be doing, doing better, specific gaps in our activities or misplaced resources?)

- Lack of national visibility and relevance
- Poorly articulated connection to national forest health program
- Lack of diversification of funding structure
- Structure and leadership....lack of stability in administration, successional plans, clarity in how roles are assigned.
- Focus on Lye Brook and Mt. Mansfield intensive may not represent other biophysical regions.
- Perception of interest only in intensive sites limits inclusion of datasets from other locations.
- Plethora of data not included (or linked) to the database for integration / synthesis.

In addition, VMC could be:

- Linking collaborators to work on competitive proposals
- Documenting the importance of our forested ecosystem / ecosystem services provided
- Compiling more regular synthesis reports
- Publishing yearly updates and trends in environmental datasets
- Documenting how funds are leveraged
- Documenting outcomes
- Offering opportunities for new blood / energy in collaborative network and governance structure

OPPORTUNITIES (What could strengthen VMC's impact?)

- New strategic plan to more directly align VMC with partner priorities and identify focus of ongoing activities
- Opportunity now to expand beyond collecting data to integrating data.
- Regularly bring together collaborators to summarize and update findings from long-term monitoring efforts.
- Connect with outside researchers to use our existing datasets for analysis to produce "actionable science"
- Leveraging joint efforts (efficiencies) across organizations.
- Tie into the work of other consortium organizations (e.g. the rivers program, the water quality monitoring program, climate assessment groups).
- Connecting across the region (comparisons of conditions and trends)
 - o Connect to other long term ecosystem monitoring programs (FIA, LTER, NEON, NERC)

- Comparisons to other sites (Harvard Forest, Hubbard Brook, Bartlett, Huntington Forest (NY))
- New website development...great way to engage collaborators and public to showcase environmental efforts for all collaborators
- Web portal / database workshops to increase use and utility of VMC data system

THREATS (What obstacles does VMC need to overcome?)

- Instability (and lack of diversity) in funding sources
- Upcoming retirements (attrition) and resulting weaker connections to organizations
- Lack of clarity/awareness of VMC beyond current collaborators.

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

VERMONT STATE DEPARTMENT OF FORESTS, PARKS AND RECREATION

2010 Vermont Forest Resources Plan¹²

The Vermont Department of Forests, Parks and Recreation manages the state's forest land base for a range of uses, including production, recreation and conservation. The Vermont Division of Forests developed the 2010 Vermont Forest Resources Plan to provide strategic direction in managing the state forests. The Plan provides an assessment of conditions and trends of the forest resources in the state, discusses threats to them, identifies priority areas to focus resources, and identifies long-term strategies.

UVM's contribution to the Vermont Monitoring Cooperative is funded by a grant agreement between the Vermont Department of Forests, Parks and Recreation (FPR) and the Rubenstein School of Environment and Natural Resources (RSENR). Funding for this Agreement originates from a Forest Service grant to the State, which in turn transfers a portion of those funds to UVM. Because the 2010 Vermont Forest Resources Plan was used as the blueprint to prepare the federal narrative submitted to secure Forest Service funding for the VMC, we list the objectives and corresponding VMC efforts based on that document.

¹² Available online at http://www.vtfr.org/htm/for_resourcesplan.cfm

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

FPR Objectives	VMC Efforts that Fulfill FPR Objectives
<p>Biological Diversity: Conserve biological diversity across all landscapes</p> <ul style="list-style-type: none"> - Goal 2. Protect and conserve natural communities, genetic diversity, rare and endangered species, unique habitats, corridors and buffers <ul style="list-style-type: none"> - Strategy 3. Work with partners to identify landscapes and support species of greatest conservation need. 	
Support long-term monitoring that addresses diversity and population trends of amphibians, reptiles and forest songbirds to inform management and conservation efforts	<ul style="list-style-type: none"> - Provide subgrants to support long-term monitoring of amphibians and reptiles and toward updating the VT Reptile and Amphibian Atlas - Provide subgrants to support long-term monitoring of forest songbirds - Mechanism to inform management – provide information through annual meetings, annual reports and facilitate direct meetings between researchers and managers
Conduct monitoring of species in rare natural communities such as high elevation montane forests that support stewardship of conserved natural areas	<ul style="list-style-type: none"> - Provide subgrants to support monitoring of rare amphibian and bird species (i.e. Bicknell’s Thrush) - Support toward the Mt. Mansfield Science and Stewardship Center (MMSSC)
Maintain long-term access to biodiversity data for access by organizations affiliated with conservation efforts	<ul style="list-style-type: none"> - Collection, archiving and public distribution of biodiversity data as part of its overall core database activities and support.
<p>Forest Health and Productivity: Maintain and enhance forest ecosystem health and productivity</p> <ul style="list-style-type: none"> - Goal 1. Identify trends in forest ecosystem health and productivity <ul style="list-style-type: none"> - Strategy 6. Work with partners to understand Vermont’s Forested ecosystem - Strategy 7. Monitor and report current forest health and evaluate potential threats. - Goal 3. Retain native flora and fauna across the landscape. <ul style="list-style-type: none"> - Strategy 13. Support monitoring and programs that maintain Vermont’s common flora and fauna. 	

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

FPR Objectives	VMC Efforts that Fulfill FPR Objectives
<p>Provide financial support for long-term monitoring of forest ecosystem health indicators such as wildlife species, stream hydrology, weather, atmospheric chemistry, forest health monitoring, tree phenology and forest threats and damages;</p>	<ul style="list-style-type: none"> - Funded Mt. Mansfield forest growth and productivity project - FPR aerial survey and detection sketch maps accessible on the VMC website - FPR forest health monitoring - Funded new VMC long-term forest health monitoring network - Provide subgrant to support long-term high elevation stream flow monitoring in Mt. Mansfield developed vs. undeveloped paired watersheds. - Long-term monitoring of amphibians and reptiles and toward updating the VT Reptile and Amphibian Atlas (subgrant). - Long-term monitoring of forest songbirds (subgrant). - Provide technical and financial support for local, national and international atmospheric monitoring programs operating at the Underhill, VT Air Quality Site (VT99). - Provide technical and financial support for sample collections and mercury analyses for the NADP/MDN & AMNet programs at Underhill (VT99). - Provide technical support for NADP/NTN precipitation sample collections and operation of the USDA UV-B monitoring and research site at Underhill. - Operate 4 Mt. Mansfield & 3 Lake Champlain meteorological stations

FPR Objectives	VMC Efforts that Fulfill FPR Objectives
<p>Maintain and improve web access to forest ecosystem data and reports, including interactive real-time weather data, interactive data visualization datasets and establishment of electronic spatial data online.</p>	<ul style="list-style-type: none"> - Development and public release of new VMC website to utilize new database structure, including project display, search capabilities, user management and visualization - Maintain and implement all QA/QC protocols and automated scripts for near real-time meteorological stations. - Automated uploading of atmospheric mercury speciation and meteorological data into database. - Creation/enhancement of detailed metadata documents defining individual fields for 229 published datasets. - Developed custom extracts of U.S. Forest Service’s Vermont Forest Inventory and Analysis (FIA) data for the VMC website - Consolidated, standardized, documented, archived and made available 28 years of aerial forest disturbance survey data
<p><i>Forest Products and Ecosystem Services: Maintain and enhance forest contributions to ecosystem services</i></p> <ul style="list-style-type: none"> - Goal 1. Maintain and enhance the production of forest products. <ul style="list-style-type: none"> - Strategy 15. Work with partners to assess Vermont’s capacity to produce raw materials for forest products. - Goal 2. Maintain and enhance water resources. <ul style="list-style-type: none"> - Strategy 21. Identify, conserve, restore and protect priority forested watersheds valued for water resources. - Goal 4. Maintain and enhance forest carbon. <ul style="list-style-type: none"> - Strategy 24. Support research that improves the understanding of measuring, monitoring and trends in forest carbon, including application for forest carbon marketing. - Goal 5. Maintain and enhance air resources <ul style="list-style-type: none"> - Strategy 26. Support research and monitoring that improves the understanding of trends in air quality, weather, climate and how they affect forests. - Strategy 28. Monitor changes in forests in relation to air resources. 	

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

FPR Objectives	VMC Efforts that Fulfill FPR Objectives
Provide financial support to the Long-term Soil Monitoring Program	<ul style="list-style-type: none"> - Provide direct funding for sample collections and exchangeable cation analyses of soil samples collected under the 200-year long-term soil monitoring study.
Support long-term high elevation stream monitoring to support resource management decisions	<ul style="list-style-type: none"> - Provide subgrant to support long-term high elevation stream flow monitoring in an undisturbed forested watershed and an adjacent, highly disturbed forested ski resort.
Support measurements of forest carbon through the long-term soil study, and through forest health monitoring plots to improve our understanding of measuring, monitoring and trends in carbon storage and flux.	<ul style="list-style-type: none"> - Provide direct funding for sample collections and exchangeable cation analyses of soil samples collected under the 200-year long-term soil monitoring study. - Provide financial support for expanded long-term Forest health monitoring plot network - Publish data from FPR phenology monitoring plots - Funded Mt. Mansfield forest growth and productivity project

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

FPR Objectives	VMC Efforts that Fulfill FPR Objectives
<p>Support long-term collections of basic meteorological and atmospheric chemistry data, with subsequent archival and online retrieval of data to facilitate integration with other forest ecosystem health data.</p>	<ul style="list-style-type: none"> - Provide technical and financial support for local, national and international atmospheric monitoring programs operating at the Underhill, VT Air Quality Site (VT99). <ul style="list-style-type: none"> o (NADP)/National Trends Network (NTN) o NADP/Mercury Deposition Network (MDN) o Atmospheric Mercury Network (AMNet) o Vermont Acid Precipitation Monitoring Program (VAPMP) o (USDA) UV-B Monitoring and Research Program o Aquatic Acidification Index (AAI) Pilot Project (comprised of CASTNET and Ammonia Monitoring Network (AMoN) sampling); began at Underhill in Dec. 2012 - Operate 4 Mt. Mansfield & 3 Lake Champlain meteorological stations - Provide technical and financial support for the Burlington Hazecam (CAMNET) site
<p><i>Land Ethic: Maintain and enhance an ethic of respect for the land, sustainable use and exemplary management</i></p> <ul style="list-style-type: none"> - Goal 1. Encourage public understanding of ecosystems <ul style="list-style-type: none"> - Strategy 30. Enhance public education and outreach on forest health and productivity issues. - Goal 2. Increase public awareness of the critical role trees and forests play in sustaining Vermont communities and residents. <ul style="list-style-type: none"> - Strategy 33. Support forestry education activities and programs - Goal 5. Demonstrate exemplary forest management on state lands and encourage sustainable use across all landscapes. <ul style="list-style-type: none"> - Strategy 47. Utilize public lands as demonstration forests. 	

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

FPR Objectives	VMC Efforts that Fulfill FPR Objectives
Maintain and enhance website content that improves understanding of forest systems, such as through interactive data visualization tools;	<ul style="list-style-type: none"> - Automated uploading of meteorological and atmospheric mercury speciation data into VMC database. - Creation/enhancement of detailed metadata documents for 229 datasets. - Developed custom extracts of U.S. Forest Service’s Vermont Forest Inventory and Analysis (FIA) data for the VMC website - Consolidated, standardized, documented, archived and made available 28 years of aerial forest disturbance survey data - Development and public release of new website to utilize new database structure, including project display, search capabilities, user management and visualization
Continue newsletters and public meetings, including the VMC Annual Meeting, to explain patterns and relationships in forests	<ul style="list-style-type: none"> - Contribute articles to ecoNEWS VT about current monitoring and research of interest to our cooperators and others, and relevant to Vermont and the region - Host an Annual Conference, produce conference proceedings and make these available on our website - Maintain an on-line listserv with nearly 400 names as an efficient way to distribute important information and news about events
Partner with organizations interested in establishing a high elevation research and stewardship center	<ul style="list-style-type: none"> - Support the planning process toward the Mt. Mansfield Science and Stewardship Center (MMSSC)

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

FPR Objectives	VMC Efforts that Fulfill FPR Objectives
<p>Provide opportunities for students to participate in data collection, field trips and presentations.</p>	<ul style="list-style-type: none"> - Coordinate with the RSENR’s NR-1 instructor to orchestrate the collection of Burlington i-Tree data - Employ student interns to work on Burlington i-Tree data and help coordinate NR-1 labs, establish and measure forest health monitoring plots, and work on other projects as needed - Engage student interns in the production of posters and content for the VMC Annual Conference - Host local Elementary, High School and College student groups and classes - Host Annual Conference on the UVM campus - graduate students are specifically invited and integrated as moderators or presenters - Provide VMC datasets to NR 140 students as a means to generate analyses to discover important trends and results
<p>Initiate a program to establish an urban research/monitoring site, in Burlington, while using these data to help educate students and the public.</p>	<ul style="list-style-type: none"> - Conducted quality control visits to i-Tree monitoring plots - Develop and deliver service-learning labs using i-Tree Eco protocols - Verify Burlington i-Tree data records collected by NR-1 students - Communicate with and provide user feedback to i-Tree authors and programmers; coordinated a visit to Burlington by David Nowak to improve the Burlington i-Tree project

FPR Objectives	VMC Efforts that Fulfill FPR Objectives
<p>Offer educational opportunities for natural resource professionals through VMC’s various outreach activities (newsletter, annual meeting, and website).</p>	<ul style="list-style-type: none"> - Contribute articles to ecoNEWS VT about current monitoring and research of interest to our cooperators and others, and relevant to Vermont and the region - Host Annual Conference, produce conference proceedings and make available on the VMC website - Maintain an on-line listserv with nearly 400 names as an efficient way to distribute important information and news about events - Development and public release of new website to utilize new database structure, including project display, search capabilities, user management and visualization
<p><i>Specific to Management of VMC</i></p>	
<p>Provide all programmatic and administrative oversight of VMC, and employ full- and part-time staff directly supporting VMC.</p>	<ul style="list-style-type: none"> - Provide a Principal Investigator (PI) to ensure programmatic and administrative oversight for VMC; a Program Coordinator, a full-time Monitoring Technician; full-time Data and Web Coordinator and other part-time staff as needed to help with field work and other assigned duties.

US FOREST SERVICE NORTHEASTERN AREA STATE AND PRIVATE FORESTRY

2013 Northeastern Area State and Private Forestry – Strategic Plan¹³

The Northeastern Area State and Private Forestry (NA S&PF) works to protect, conserve, and manage forest resources by collaborating with a range of stakeholder to. Through collaborations, leadership, technical support, sound science, and financial assistance NA S&PF helps to ensure the continued provision of clean water, forest products, wildlife habitat, recreation, and other benefits from the nation’s forest base.

NA S&PF Objectives	VMC Efforts that Fulfill NA S&PF Objectives
A. Contribute to conservation of important forest landscapes across the urban to rural continuum	<ul style="list-style-type: none"> - Continue Burlington i-Tree work & develop protocols to sample the urban-to-rural gradient, extending from urban Burlington to rural Jericho and on to the top of Mt. Mansfield - Continue to assist with development of the Mt. Mansfield Science and Stewardship Center as a way to advance conservation and stewardship at this fragile alpine site
B. Support sustainable forest management for biodiversity and multiple benefits for people	<ul style="list-style-type: none"> - Provide data and information to support sustainable management of habitats
C. Support the management of trees and forests for resilience to natural and human-caused disasters and threats	<ul style="list-style-type: none"> - Continue to gather, archive and distribute data on invasive pests, acid deposition and other forest threats and perturbations - Could involve intervention if specific perturbations/remedies are determined and found to be practical & effective

¹³ Available online at http://na.fs.fed.us/pubs/strat_plan/na-strategic-plan-2013-2018-lr.pdf

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NA S&PF Objectives	VMC Efforts that Fulfill NA S&PF Objectives
D. Promote forest management approaches that facilitate resilience and adaptation to, and mitigation of, climate change	<ul style="list-style-type: none"> - Continue to support monitoring/research on carbon sequestration such as long-term forest health monitoring plot assessments and long-term soil monitoring - Continue to support collection, archiving and public distribution of long-term meteorological/climate data and data on environmental pollutants - Be vigilant and work with our partners to support activities to detect and document forest threats (invasive insects, pathogens and plants)
F. Advance conservation and sustainable management of trees and forests for water quality across all landscapes	<ul style="list-style-type: none"> - Continue to support collection of water chemistry data at Lye Brook and Mt Mansfield high altitude ponds - Continue to fund watershed flow and support water chemistry and sedimentation measurements at the Mt. Mansfield Paired Watershed Study - Support lake/pond sedimentation work
G. Support a competitive forest industry with diversified markets, forest-related jobs, and sustainable use of woody biomass for energy	<ul style="list-style-type: none"> - Continue to support air quality monitoring to inform the impact of biomass use for generation of electricity and heating
H. Support engagement and inclusion of urban residents and communities to maintain the benefits provided by trees and forests	<ul style="list-style-type: none"> - Continue support for Burlington i-Tree work – service learning aspect involves students and instructors, not only to collect data, but also interact with and provide information to land owners and city residents - Continue to provide survey results to city officials for public distribution
I. Expand and deliver technical expertise, improve communications and productivity, capitalize on new technology, and ensure employee safety	<ul style="list-style-type: none"> - Provide improved communication with new database and web interface - Continue to work with partners toward improved effectiveness and efficiency - VMC testing of i-Tree as a long term monitoring tool

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

NA S&PF Objectives	VMC Efforts that Fulfill NA S&PF Objectives
J. Leverage resources and technical expertise in a transparent and collaborative way with other Federal agencies, State agencies, academia, American Indian tribes, non-profits, and other partners in support of common goals	- Continued networking, coordinating and information-sharing conducted of the VMC

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION

2013 Vermont Department of Environmental Conservation Strategic Plan¹⁴

The Vermont Department of Environmental Conservation’s (DEC) mission is to preserve, enhance, restore and conserve Vermont’s natural resources and protect human health for the benefit of this and future generations.

DEC Objectives	VMC Efforts that Fulfill DEC Objectives
1) We manage air, soil and water resources for environmental and public health. We measure environmental conditions for status and trends	<ul style="list-style-type: none"> - Continue to support collection, archiving and public distribution of long-term monitoring across many variables - New VMC website and database supports searches and integration of data variables across projects - Incorporation of spatially-referenced data in the VMC database
2) We issue licenses and permits, and enforce environmental regulations to ensure compliance with state and, in many cases, federal law	<ul style="list-style-type: none"> - Provide scientific data to inform testimony on critical issues – this need will increase in the future (e.g. road management - erosion, stream silting, permitting upper elevation development) - Informing stakeholders and partners through VMC website, meeting venues and newsletters (i.e. ecoNEWS VT) that pertinent data are available
3) We collect, interpret and communicate environmental scientific information to Vermonters, and provide a forum for public comment on our work	<ul style="list-style-type: none"> - Contribute articles to ecoNEWS VT about current monitoring and research of interest to our cooperators and others, and relevant to Vermont and the region - Development and public release of new website to utilize new database structure, including project display, search capabilities, user management and visualization

¹⁴ Available online at <http://www.anr.state.vt.us/dec/co/documents/DECStrategicPlan2013-2015.pdf>

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

DEC Objectives	VMC Efforts that Fulfill DEC Objectives
4) We provide technical assistance to landowners, businesses, municipalities and individuals regarding environmental issues and resource management	<ul style="list-style-type: none"> - Provide data and information through the VMC website and annual meetings - Provide pertinent data and information through articles contributed to ecoNEWS VT - Facilitate regular meetings with partners and stakeholders to determine data and information that are needed and let them know what data are available
5) We manage funding and support for environmental projects including site clean-up, recreational access, and infrastructure including water supply, stormwater and wastewater systems	<ul style="list-style-type: none"> - Provide grants for mini-projects to answer environmental questions raised by other organizations, as funding is available
6) Our scientists, managers, and field staff provide expert testimony and assistance to other organizations, partners, and sister agencies at the state, federal, local and regional levels to advance our mission and people’s understanding of our natural environment, its importance and relevance	<ul style="list-style-type: none"> - VMC collaborators provide expert testimony when needed

VERMONT FISH AND WILDLIFE DEPARTMENT

2005 Vermont Wildlife Action Plan¹⁵

The Vermont Fish and Wildlife Department's (FWD) mission is “the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont.” The Department’s dedicated professionals enforce laws, manage Wildlife Management Areas, conduct species-specific research, restoration and management actions, issue licenses, grow fish, and provide educational and outreach services. Three of the Department’s planning goals are: Conserve, enhance, and restore Vermont’s natural communities, habitats, and species and the ecological processes that sustain them. Through the Wildlife Action Plan, Vermont has developed a comprehensive “all-species conservation strategy” to meet these goals.

FWD Objectives	VMC Efforts that Fulfill FWD Objectives
1) Identify wildlife distribution and abundance: Provide information on the distribution and abundance of species of wildlife, including low and declining populations as the State Fish and Wildlife Dept. deems appropriate, that are indicative of the diversity and health of the State's wildlife.	<ul style="list-style-type: none"> - Provide subgrants to support long-term monitoring of amphibians and reptiles and toward updating the VT Reptile and Amphibian Atlas - Provide subgrants to support long-term monitoring of forest songbirds - Provide subgrants to support monitoring of rare amphibian and bird species (i.e. Bicknell’s Thrush)
2) Describe location and condition of key habitats: Describe the locations and relative condition of key habitats and community types essential to conservation of species identified in (1).	<ul style="list-style-type: none"> - Provide 28 years of aerial forest disturbance survey data

¹⁵ Available online at http://www.vtfishandwildlife.com/SWG_CWCS.cfm

FWD Objectives	VMC Efforts that Fulfill FWD Objectives
<p>3) Describe key problems and research needs: Describe problems that may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats.</p>	<ul style="list-style-type: none"> - Provide structured time during the VMC Annual Conference Working Group Sessions to convene biologists, managers and others to discuss key problems and look for possible solutions and/or define avenues of research to help find solutions.
<p>4) Describe and prioritize conservation actions: Describe conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions.</p>	<ul style="list-style-type: none"> - Help facilitate discussions among collaborators and stakeholders around prioritization of conservation actions to conserve identified species and habitats
<p>5) Monitor species, habitats and conservation actions: Describe plans to monitor species identified in (1) and their habitats; monitor the effectiveness of the conservation actions proposed in and, adapt these conservation actions to respond appropriately to new information or changing conditions.</p>	<ul style="list-style-type: none"> - Support Vermont forest health monitoring plot assessments – archived data provide intensive measurements of stand variables which are important indicators of certain wildlife species habitats

FWD Objectives	VMC Efforts that Fulfill FWD Objectives
<p>7) Coordinate with other plans: Coordinate the development, implementation, review, and vision of the Action Plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.</p>	<ul style="list-style-type: none"> - The VMC Strategic Plan has already compiled information on the plans of its partners and may be a useful resource
<p>8) Include public participation: Describe public participation in the development, revision, and implementation of the Action Plan and projects and programs. Plant conservation and education and law enforcement projects are not eligible for State Wildlife Grants funding. We expect that species, community and landscape level conservation will provide secondary benefits including addressing the needs of many plant Species of Greatest Conservation Need (SGCN).</p>	<ul style="list-style-type: none"> - Provide venues such as the at VMC Annual Conference for planning meetings or workshops to gather outside public input

US FOREST SERVICE GREEN MOUNTAIN NATIONAL FOREST

2006 Green Mountain National Forest Management Plan¹⁶

National forests were established to provide watershed protection and continual forest resources for the nation. The Green Mountain National Forest (GMNF), covering 400,000 acres in central and southern Vermont, manages for both the present and future generations by balancing a range of activities and uses. Management of the forest is guided by the 2006 GMNF Land and Resource Management Plan, with an emphasis on long-term ecological, social and economic sustainability.

GMNF Objectives	VMC Efforts that Fulfill GMNF Objectives
Goal 1: Provide for a wide range of uses and activities in an ecologically, socially, and economically sustainable way	<ul style="list-style-type: none"> - Incorporation of VMC and cooperator projects in the Monitoring and Evaluation framework adopted by GMNF
Goal 2: Maintain and restore quality, amount, and distribution of habitats to produce viable and sustainable populations of native and desirable non-native plants and animals	<ul style="list-style-type: none"> - Continued gathering of terrestrial flora and fauna monitoring data to inform GMNF efforts to sustainably manage viable populations - Continued long-term monitoring of forest bird populations and demographics and associated habitat - Continued long-term monitoring of amphibian and reptile populations and associated habitat

¹⁶ Available online at <http://www.fs.usda.gov/detail/greenmountain/landmanagement/planning/?cid=stelprdb5333807>

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

GMNF Objectives	VMC Efforts that Fulfill GMNF Objectives
Goal 3: Maintain or restore the natural, ecological functions of the soil	<ul style="list-style-type: none"> - Long Term Soil Monitoring Project tracks changes in soil health over time, including regular assessments of soil mercury levels. - Cooperators studied the spatial variability in nitrogen export from forested watersheds related to differences in soil nitrogen - Cooperators established and maintain Soil Climate Analysis Network site
Goal 4: Maintain or restore aquatic, fisheries, riparian, and wetland habitats	<ul style="list-style-type: none"> - Through monitoring, VMC informs GMNF efforts to sustainably manage viable populations of aquatic wildlife. - Lake chemistry monitoring by cooperators on Lye Brook through the Long-Term Monitoring of Acid Sensitive Lakes program - VMC partnered with GMNF and DEC to conduct intensive biological and chemical surveys of acid-sensitive lakes in the Lye Brook Wilderness
Goal 5: Maintain or improve air quality on the GMNF	<ul style="list-style-type: none"> - VMC cooperators maintain particulate monitoring and precipitation chemistry monitoring (NADP/NTN) and particulate levels (IMPROVE) near Lye Brook
Goal 6: Maintain or restore ecological processes and systems on the GMNF within desired ranges of variability, including a variety of native vegetation and stream channel types, and their patterns and structural components	<ul style="list-style-type: none"> - Establishment of the Long Term Ecosystem Monitoring Program to assess change in forest, soil, air and wildlife conditions at permanent monitoring plots, and future integration with expanded VMC forest health monitoring network

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

GMNF Objectives	VMC Efforts that Fulfill GMNF Objectives
Goal 8: Provide for a sustainable supply of forest products	<ul style="list-style-type: none"> - Help establish and expand the Long Term Ecosystem Monitoring Program to assess change in forest, soil, air and wildlife conditions, providing information on forest condition is needed for planning forests supplies into the future - Aggregate and provide data on aerial detection surveys of pest and disease impacts on forest health
Goal 9: Demonstrate innovative, scientifically, and ecologically sound management practices that can be applied to other lands	<ul style="list-style-type: none"> - Forest Ecosystem Management Demonstration Project on Mt. Mansfield provides new silvicultural approaches account for soil, wildlife and water-related impacts
Goal 12: Provide a diverse range of high-quality, sustainable recreation opportunities that complement those provided off National Forest System lands	<ul style="list-style-type: none"> - Incorporation of recreation and tourism values of forested landscapes into spatial decision making tools through the McIntire-Stennis grant at UVM - Comparison of streamflow and chemistry at disturbed and undisturbed watersheds to inform ski area management and planning
Goal 13. Manage designated wilderness to preserve an enduring resource that represents ecosystems and natural processes unique to northeastern forests while providing opportunities for solitude and unconfined recreation consistent with the Wilderness Act of 1964 and subsequent legislation	<ul style="list-style-type: none"> - Informing resource management planning and expectations through long-term monitoring activities in Wilderness - Lye Brook Subcommittee coordinated research and monitoring activity planning across institutions - Participating in the 50th Anniversary of Wilderness Act to showcase monitoring work taking place on the GMNF
Goal 15: Maintain or enhance visual resources such as viewsheds, vistas, overlooks, and special features	<ul style="list-style-type: none"> - Incorporation of recreation and tourism values of forested landscapes into spatial decision making tools through the McIntire-Stennis grant at UVM

Appendix C: Vermont Monitoring Cooperative Partner Connections Review

GMNF Objectives	VMC Efforts that Fulfill GMNF Objectives
Goal 17: Support regional and local economies through resource use, production, and protection	<ul style="list-style-type: none"> - Evaluation of economic impacts of different management practices and harvest regimes, including for biomass, through Forest Ecosystem Management Demonstration Project
Goal 18: Maintain and enhance partnerships with communities and organizations	<ul style="list-style-type: none"> - Serve as a partner to the GMNF in providing monitoring data and coordinating the research and monitoring activities of partners
Goal 19: Provide a diverse range of information and education opportunities that will enhance the understanding of the GMNF	<ul style="list-style-type: none"> - Disseminate information about forest condition and monitoring through newsletters and ecoNEWS VT - Networking and information exchange opportunities provided through the annual VMC Conference - Dissemination of data collected by and on the GMNF to a wider audience through the VMC website - Participation in the 50th Anniversary of Wilderness Act to showcase monitoring work taking place on the GMNF
Goal 20: Coordinate Forest planning and implementation with federal, State, and local agencies	<ul style="list-style-type: none"> - Participate in the Lye Brook Subcommittee, which coordinates research and monitoring activity planning across institutions - Inform the planning process with data and information gathered by VMC and its cooperators

Appendix D: List of Vermont Monitoring Cooperative Partner Objectives

Below are the various goals, objectives, strategies and/or activities of the various organizations that partner with or contribute to the Vermont Monitoring Cooperative. These codes are used to identify matches with VMC's strategic goals, objectives and activities presented in the main text of the Strategic Plan.

VT DEPARTMENT OF FORESTS, PARKS AND RECREATION (FPR)

1. Biological Diversity
 - 1.2 Protect and conserve natural communities, genetic diversity, rare and endangered species, unique habitats, corridors and buffers
 - 1.2.3 Work with partners to identify landscapes and support species of greatest conservation need.
2. Forest Health and Productivity
 - 2.1 Identify trends in forest ecosystem health and productivity
 - 2.1.6 Work with partners to understand Vermont's Forested ecosystem
 - 2.1.7 Monitor and report current forest health and evaluate potential threats.
 - 2.3 Retain native flora and fauna across the landscape.
 - 2.3.13 Support monitoring and programs that maintain Vermont's common flora and fauna.
3. Forest Products and Ecosystem Services: Maintain and enhance forest contributions to ecosystem services
 - 3.1 Maintain and enhance the production of forest products.
 - 3.1.15 Work with partners to assess Vermont's capacity to produce raw materials for forest products.
 - 3.2 Maintain and enhance water resources.
 - 3.2.21 Identify, conserve, restore and protect priority forested watersheds valued for water resources.
 - 3.4 Maintain and enhance forest carbon.
 - 3.4.24 Support research that improves the understanding of measuring, monitoring and trends in forest carbon, including application for forest carbon marketing.
 - 3.5 Maintain and enhance air resources
 - 3.5.26 Support research and monitoring that improves the understanding of trends in air quality, weather, climate and how they affect forests.
 - 3.5.28 Monitor changes in forests in relation to air resources.
4. Land Ethic: Maintain and enhance an ethic of respect for the land, sustainable use and exemplary management
 - 4.1. Encourage public understanding of ecosystems
 - 4.1.30 Enhance public education and outreach on forest health and productivity issues.
 - 4.2 Increase public awareness of the critical role trees and forests play in sustaining Vermont communities and residents.
 - 4.2.33 Support forestry education activities and programs
 - 4.5 Demonstrate exemplary forest management on state lands and encourage sustainable use across all landscapes.
 - 4.5.47 Utilize public lands as demonstration forests.

US FOREST SERVICE NORTHEASTERN AREA, STATE AND PRIVATE FORESTRY (NA)

- A. Contribute to conservation of important forest landscapes across the urban to rural continuum
- B. Support sustainable forest management for biodiversity and multiple benefits for people
- C. Support the management of trees and forests for resilience to natural and human-caused disasters and threats
- D. Promote forest management approaches that facilitate resilience and adaptation to, and mitigation of, climate change
- E. Support efforts to reduce wildfire threats to people, communities, and natural resources
- F. Advance conservation and sustainable management of trees and forests for water quality across all landscapes
- G. Support a competitive forest industry with diversified markets, forest-related jobs, and sustainable use of woody biomass for energy
- H. Support engagement and inclusion of urban residents and communities to maintain the benefits provided by trees and forests
- I. Expand and deliver technical expertise, improve communications and productivity, capitalize on new technology, and ensure employee safety
- J. Leverage resources and technical expertise in a transparent and collaborative way with other Federal agencies, State agencies, academia, American Indian tribes, non-profits, and other partners in support of common goals

VT DEPARTMENT OF ENVIRONMENTAL CONSERVATION (DEC)

- 1. We manage air, soil and water resources for environmental and public health. We measure environmental conditions for status and trends
- 2. We issue licenses and permits, and enforce environmental regulations to ensure compliance with state and, in many cases, federal law
- 3. We collect, interpret and communicate environmental scientific information to Vermonters, and provide a forum for public comment on our work
- 4. We provide technical assistance to landowners, businesses, municipalities and individuals regarding environmental issues and resource management
- 5. We manage funding and support for environmental projects including site clean-up, recreational access, and infrastructure including water supply, stormwater and wastewater systems
- 6. Our scientists, managers, and field staff provide expert testimony and assistance to other organizations, partners, and sister agencies at the state, federal, local and regional levels to advance our mission and people's understanding of our natural environment, its importance and relevance

VT FISH AND WILDLIFE DEPARTMENT (F+W)

- 1. Identify wildlife distribution and abundance: Provide information on the distribution and abundance of species of wildlife, including low and declining populations as the State Fish and Wildlife Dept. deems appropriate, that are indicative of the diversity and health of the State's wildlife.
- 2. Describe location and condition of key habitats: Describe the locations and relative condition of key habitats and community types essential to conservation of species identified in (1).
- 3. Describe key problems and research needs: Describe problems that may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats.
- 4. Describe and prioritize conservation actions: Describe conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions.

5. Monitor species, habitats and conservation actions: Describe plans to monitor species identified in (1) and their habitats; monitor the effectiveness of the conservation actions proposed in and, adapt these conservation actions to respond appropriately to new information or changing conditions.
6. Develop a plan review process: Describe procedures to review the Wildlife Action Plan at intervals not to exceed ten years.
7. Coordinate with other plans: Coordinate the development, implementation, review, and vision of the Action Plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.
8. Include public participation: Describe public participation in the development, revision, and implementation of the Action Plan and projects and programs. Plant conservation and education and law enforcement projects are not eligible for State Wildlife Grants funding. We expect that species, community and landscape level conservation will provide secondary benefits including addressing the needs of many plant Species of Greatest Conservation Need (SGCN).

US FOREST SERVICE GREEN MOUNTAIN NATIONAL FOREST (GMNF)

1. Provide for a wide range of uses and activities in an ecologically, socially, and economically sustainable way
2. Maintain and restore quality, amount, and distribution of habitats to produce viable and sustainable populations of native and desirable non-native plants and animals
3. Maintain or restore the natural, ecological functions of the soil
4. Maintain or restore aquatic, fisheries, riparian, and wetland habitats
5. Maintain or improve air quality on the GMNF
6. Maintain or restore ecological processes and systems on the GMNF within desired ranges of variability, including a variety of native vegetation and stream channel types, and their patterns and structural components
7. Protect rare or outstanding biological, ecological, or geological areas on the GMNF
8. Provide for a sustainable supply of forest products
9. Demonstrate innovative, scientifically, and ecologically sound management practices that can be applied to other lands
10. Provide other resource benefits through coordinated timber harvesting
11. Provide opportunities for renewable energy use and development
12. Provide a diverse range of high-quality, sustainable recreation opportunities that complement those provided off National Forest System lands
13. Manage designated wilderness to preserve an enduring resource that represents ecosystems and natural processes unique to northeastern forests while providing opportunities for solitude and unconfined recreation consistent with the Wilderness Act of 1964 and subsequent legislation
14. Provide a safe, efficient, and effective Forest transportation system that meets both the needs of the Forest Service and the public
15. Maintain or enhance visual resources such as viewsheds, vistas, overlooks, and special features
16. Provide protection and stewardship for significant heritage resources on the GMNF
17. Support regional and local economies through resource use, production, and protection
18. Maintain and enhance partnerships with communities and organizations
19. Provide a diverse range of information and education opportunities that will enhance the understanding of the GMNF
20. Coordinate Forest planning and implementation with federal, State, and local agencies
21. Protect human life, property, and facilities from wildland fire hazards
22. Meet anticipated future needs and opportunities on public lands and improve management effectiveness of the National Forest through adjustment of land ownership