



VMC Operations Guide

Publications: (available on the VMC web site – <http://vmc.snr.uvm.edu>)

- Project Description Report
- Annual Report
- Directory of Cooperators
- Publication List

Public Relations: (not available in this document)

- Brochure
- Newsletter
- Press Releases

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Introduction

The Vermont Monitoring Cooperative's Operations Guide is intended to document the purpose, process and plans that the program uses to implement monitoring and research, coordination and facilitation, and information services functions as part of its goals and mission. The Operations Guide is updated every few years to reflect changes in the program. A supplemental document, the "VMC Program Description Document" provides a more comprehensive description of the VMC program history, organizational structure, program activity areas and finances. A summary of the VMC mission, goals and brief program description are included below.

VMC Mission Statement

The VMC (the University of Vermont, the Vermont Agency of Natural Resources, the Green Mountain National Forest and other Cooperators) 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.

VMC Goals

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

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.

VMC Program Description

The Vermont Monitoring Cooperative (VMC) was initiated in 1990 as a state, university, and federal partnership. It was designed to enhance access to information on monitoring and research of forested ecosystems in Vermont. The VMC facilitates this process by providing networking opportunities and data management services.

The nature and scope of the services provided by the VMC is divided into three interrelated functions. They are to:

- Conduct monitoring and research of forested ecosystems at the two VMC study sites.
- Coordinate and facilitate data collection, and synthesis of data and information.
- Provide centralized information management and information services.

VMC activities include:

- Initiation of monitoring and research studies,
- Support and tracking of on-going research projects,
- Storage and retrieval of data from projects,
- Resolution of logistical and security concerns at research sites,



- Granting money for monitoring and research projects,
- Providing opportunities for user group interaction, and
- Synthesizing data and information to provide useful support materials to groups concerned with the status and trends in Vermont's forested ecosystems.

Two intensive study sites, one at Mount Mansfield and the other at the Lye Brook Wilderness Area, have been the focus of VMC ecological research activities. Researchers from many different fields (hydrology, geology, biology, chemistry, and others) direct their efforts towards understanding complex forested ecosystems with a focus on the effects of human impacts within these intensive long-term study sites. The VMC data management structure has flexibility allowing data from other sites statewide to be archived and disseminated. Many of our intensive study projects are components of statewide, national and international research endeavors.

An important strength of the VMC is found in its wide array of Cooperators. Ecosystem study requires that experts from many disciplines pool data, interpret results from different perspectives, collectively study new aspects of the environment, and work towards a common goal. Maintaining this network of Cooperators has been an important facet of the VMC's work.

The centerpiece of the VMC is the data library and card catalog system that allows data to be shared, archived, and accessed by scientists and other interested parties. It contains the data and ancillary textual material from over 100 projects, and is linked in time and space. Static web pages exist for most projects and will soon be replaced by a dynamic system that is linked directly to the data library. This system will be updated continuously and will take advantage of new technology and web tools. Information management increases the types and numbers of products available to interested users and the VMC has worked hard to greatly increase access to audience appropriate data and information.

Publications



VMC Annual Publications

Annual Publications:

Annual Report

Directory of Cooperators

Project Description Report

Publication List



Annual Report

Objective: 1. To provide annual documentation of results from studies conducted at the two VMC sites. 2. To stimulate further exchange of information and ideas that expand our understanding of forest ecosystems, and 3. That these scientific conclusions aid in more ecologically based natural resource management.

Development Process: Cooperating scientists working at the two study sites are invited to submit their findings (preliminary or otherwise) for the year in a form that is easily understood by non-experts with an interest in forested ecosystems. Text and graphs are submitted in hard-copy and electronic format. Articles are grouped by topic area, paginated, and compiled into the annual document.

Review Process: Content of articles is reviewed in the process of compiling. A draft document is forwarded to the Department of Forests, Parks & Recreation for review using their policy on publication review. Likewise, a draft copy is reviewed by the VMC Research Director. Comments are reviewed and where appropriate, edits are made.

Directory of Cooperators

Objective: 1. To identify program participants who are actively collecting monitoring or research data, or who are involved in part of the VMC Organizational Structure, and 2. To facilitate networking among scientists, and between scientists and other user groups.

Development Process: The VMC Card Catalog content includes Cooperator information, which is updated annually. The Directory is generated directly from the database, and published annually for the VMC Annual Cooperators meeting.

Review Process: Cooperator content information is provided by participants. The Monitoring Director reviews for errors.

Project Description Report

Objective: 1. To provide information on VMC activities for use by program participants and interested parties, and 2. To provide documentation for long-term studies.

Development Process: Information for this report is provided by each cooperating scientist, and is initiated through the Study Site Application process. Information is stored electronically in the VMC Card Catalog and Data Library. Plot location data is first entered on a hard-copy base map, then entered into the VMC Research Plot Location GIS layer.

Review Process: A draft of each project is reviewed by Cooperators for accuracy. A draft document is generated from the VMC Card Catalog and from the VMC Data Analysis databases. The Research Director reviews and edits. Then the document is forwarded to the Department of Forests, Parks & Recreation for review using their policy on publication review. Comments are reviewed and appropriate edits are incorporated into the document.



Publication List

Objective: To document publications from studies conducted at the two VMC study sites, including VMC publications, journal articles and other sources.

Development Process: Cooperators provide references. References are entered into VMC Card Catalog associated with the study. Publication List is updated annually for VMC Annual Meeting, or for other purposes.

Review Process: Reviewed by staff for accuracy of citations. No other review.



VMC Public Relations

Public Relations Documents:

VMC Brochure

Newsletter

Press Releases

Public Relations



VMC Brochure

Objective: To provide information on the VMC program: topics of study, study sites, cooperating organizations, and data and publications, for distribution to all audiences.

Development Process: Several evolutions of the VMC brochure have been published to reflect changes in studies, cooperators, web address, etc. The development process has varied, and included development and layout assistance from the Information Chief of the Department of Forests, Parks & Recreation, photographic assistance from the UVM Photographer, and updates by the Monitoring Director. The VMC Monitoring Director is responsible for updates, receiving input from the Advisory Committee on suggested revisions. The document is published by the Department of Forests, Parks & Recreation.

Review Process: A draft brochure is distributed to the Advisory Committee for review. The final draft is reviewed by the Department of Forests, Parks & Recreation using their policy on publication review.

Newsletter

Objective: 1. To provide a forum for news on the VMC program or other related environmental programs; 2. To provide current data updates; and 3. To stimulate networking through articles on study observations and preliminary results.

Development Process: The Newsletter is printed quarterly. The VMC Staff and/or Advisory Committee develops ideas on current topics appropriate for the upcoming issue. Development of articles has varied over time, and has included articles written by the VMC Monitoring and Research Directors, VMC Staff and VMC Cooperators. The VMC Data Manager updates the Data Library content page. The VMC Data Management Assistant updates the Mount Mansfield Meteorology data table. The Monitoring Director is responsible for layout and publication. The document is published by the Department of Forests, Parks & Recreation.

Review Process: Content of the articles is reviewed by the Monitoring Director in the process of Newsletter layout. A draft copy is sent to the Research Director and the Department of Forests, Parks & Recreation for review, 1-2 weeks before publication. Revisions are made where appropriate. In addition to a hard-copy publication, the Newsletter is converted to PDF format and posted on the VMC web site.

Press Releases

Objective: 1. To announce VMC events, and 2. To inform the public on new findings from VMC studies.

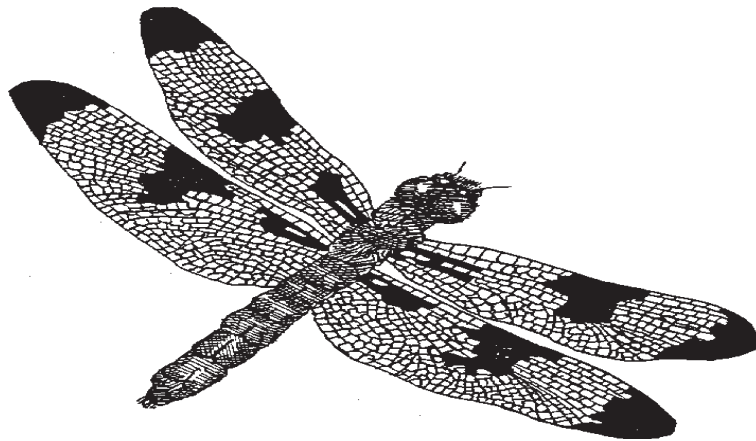
Developmental Process: Advertising upcoming events, like the VMC Annual Cooperators meeting, begins with updating press distribution lists, both through ANR and UVM. The development of content for the Press Release has varied over time, and has included assistance from the FPR Information Chief, development by the Monitoring Director and currently, development by the Data Manager. Once developed, the Press Release is distributed by both ANR and UVM through their distribution channels. Results oriented Press Releases are generally developed by the individual Cooperators and distributed through their distribution channels.

Review Process: Review of Press Releases distributed by the ANR follow their policy procedures and



include review by the Agency Press Officer. Review of Press Releases distribute by the UVM follow their policy procedures and include review by the University Communications Office.

VMC Data Management & Internet Information Delivery Plan





**VMC Data Management &
Internet Information Delivery Plan**

Data Management and Internet Information Plan:

Card Catalog

Data Library

Internet Information Delivery Services

System Administration

Goals: 1) To provide readily accessible, high quality environmental data and information from across



Vermont to policy makers, educators, researchers and the public, emphasizing the Mount Mansfield and Lye Brook study areas; and 2) To encourage and facilitate other research groups to participate.

Card Catalog

Objective: To develop and maintain an electronic, searchable metadata archiving system that allows use and understanding by a broad audience, with sufficient documentation to use and interpret the associated data.

Development Process:

- Preliminary metadata is provided by Cooperators as part of their research application
- Upon completion of first field season the cooperators fill out a detailed Project Information Form. Cooperators control access to their data on this form. There are three classes of data access from which to choose: 1) Class I (Internet Accessible); 2) Class II (Internet access with prior written permission from the Principal Investigator); and 3) Class III (No access at this time (preliminary data, unpublished data, etc.))
- While the project is active, Cooperators review project metadata prior to publishing the VMC's Annual Project Description Report.
- Geographic Information metadata conforms to the Federal Geographic Data Committee's metadata standards.

Data Library

Objective: 1) To continue to build upon the existing multi-disciplinary data archive founded on an integrated relational and distributed database model; 2) To make available existing data to test models and theories; 3) To facilitate combining of multiple datasets to illustrate unexpected patterns; 4) To make available raw or reanalyzed data to help set policy goals and contribute to natural resource management decision-making process; and 5) To add extrinsic value to data and increasing intrinsic value of individual datasets when collectively analyzed.

Developmental Process:

- Incorporates relational and distributed database models
- Temporal and spatial data provided annually by VMC Cooperators
- Data in any format are normalized and added to the data library
- Data requests and summaries are maintained in the data library

Internet Information Delivery Services

Objectives: 1) To provide access to VMC data, summaries and relevant documents in useable formats and in a timely manner, without undue expense or effort; 2) To utilize VMC internet information infrastructure to support data access for similar organizations.

Development Process and Plans:

- Home page: introduction to VMC's mission, goals, organizational structure, data library, study sites, current research, current issues and bulletin board topics.
- Fast Track pages: allow users to navigate to VMC information and results that are presented in formats appropriate to educators (5-12), natural resource managers, natural resource policy makers, the general public, or researchers.
- Search page: allow users to search the VMC card catalog for a list of projects that satisfy the search criteria.



- Project Information page: provide access to project metadata, annual reports, related internal pages, external websites, publications and data access (Class I data is facilitated through these pages).
- Internet Mapping Service: provide dynamic mapping service and geographic information access to data specific to the Mount Mansfield and Lye Brook study sites.
- FTP service: space for exchanging data and other electronic files
- VMC-list: electronic mailing service to facilitate communication.
- Data Access Support: work closely with other webmasters to utilize VMC internet information infrastructure to support data access for similar organizations.

System Administration

Objective: To provide hardware and software support for VMC Information Services.

- Hardware: Seven workstations, Printers (Color & Inkjet), Plotter (*Color*), Data server, Internet Information server, Internet Information Development server, Data Backup server, Meteorological Data server, Document Scanner, Digitizing Table and *Videoconferencing hardware*.
- Software: Adobe Pagemaker, Adobe Acrobat, ChartFx server software, Corel Office Suite, ESRI ArcView, ESRI ArcView Spatial Analyst, *ESRI Arc/Info*, *ESRI ArcView 3D Analyst*, *ESRI ArcView Network Analyst*, *ESRI MapObjects LT*, Microsoft Office Professional, Microsoft Visual Studio (Visual basic, FoxPro, C++, J++), Microsoft SQL Server, Paintshop Pro, Total Access Statistics, Voyager data exploration software, and Winzip.

Information Services

Data Integration



Information Services

Information Services:

Data Integration Plan

Data Integration Project Plan

Information and Education Plan

Information needs of user groups





Objective: To facilitate researchers and resource managers use of environmental data to address specific ecological questions by coordinating the preparation of comprehensive summaries, integrated reports and detailed models.

Development Plans:

- Identify specific ecological questions (see Data Integration Project Plan).
- Utilize internet videoconferencing, in particular data conferencing with whiteboards and application sharing to facilitate close collaboration.
- VMC staff provides infrastructure and data analysis support.

VMC Data Integration Project Plan

Objective: To demonstrate how the Vermont Monitoring Cooperative's monitoring and research data can be used to answer ecological questions pertinent to ecosystem management.

- Develop new tools that organize, use and present data sets that vary in spatial and temporal scales, types of variables, data quality and other factors. Yet these tools must practical and accessible methods.
- Identify ecological questions to address.
- Use existing data, either singly or synthesized with other data.
- Information gaps will arise, modifications in data collection methods will be suggested, or new questions will surface. All these can be used to create a cyclic process - to collect new data, conduct new analyses of existing data or address different ecological questions.

Ecological Questions:

- There are four types of ecological questions that will form the framework of the data integration report. Most questions are relevant to ecosystem management in that they help determine what is "normal" for a specific scale, and eventually will aid in determining ecological impacts from resource management.
- **Natural variability** of ecosystem components
 - Components to include:
 - Weather
 - Air quality
 - Tree crowns
 - Insects (lepidopterans)
 - Tree phenology
 - Insect pests
- **Biodiversity** of forested ecosystems
 - Components to include:
 - Vegetation
 - Amphibians
 - Birds
 - Insects
 - Aquatic biota
- **Condition of forested ecosystems**



Components to include:

- Mercury status (inputs and outputs, pools and cycles)
- Nitrogen export status
- Tree health status
- Stream biota conditions

- **Environmental conditions**

Components to include:

- Physical features of VMC sites
- Pollutant deposition maps
- Weather conditions maps
- Pollutant maps plus acid sensitive lakes & ozone bioindicator plant damage

Ecosystem Management Definition for the VMC Data Integration Report Using ecological knowledge to help determine how to produce desired resource conditions, values, products and services in ways that also sustain diversity and productivity of ecosystems.

For this report the idea of “scale” will be flexible to accommodate both the question being asked and the data set used. The VMC is striving to build a database that can address questions on a temporal scale that stretches from minutes to generations. On a spatial scale the VMC can inform the debate on the global scale, but more realistically it can answer questions on a regional to local scale. Some of the spatial scales that the VMC data users may include are:

- Stand(s) or ecosystem(s) within one VMC site
- Waterbody within VMC site
- Watershed(s)
- Townships surrounding VMC sites
- Vermont
- Lake Champlain Basin
- Connecticut River Basin
- Northern Forest Lands
- Northeastern region
- Ecological Land Type

The Vermont Monitoring Cooperative is focused on the state and function of forest ecosystems at Mount Mansfield and Lye Brook Area study sites, but also compiles data from air, water and land studies statewide. The tools and process used in this forest ecosystem-based integration project can be applied to other ecosystems.

Format for Report Chapters

Ecological question(s).

Project participants.

Process of data integration.

- Data sets used in project.

- Description of data sets (file type, size, where acquired,...)

- Data sets not available.



Project's working definition of data integration.
Approach used in integration process.
Was the project successful in answering the question, and why.
Abbreviated results (if possible).
Applications for ecosystem management.
Products (if appropriate).
Further investigation planned.

Information and Education Outreach Plan 2001

Objective: 1) To develop information outreach materials for various audiences: educators and students, the general public, natural resource professionals, policy makers and scientists; and 2) To involve teachers and students in environmental data collection, data analysis, or data synthesis and product development.

Development Process:

- Develop summaries of VMC projects that include an overview of the general topic, simplified methodologies, and graphs to be posted on the VMC web site.
- Develop fact sheets on current issues of interest to teachers and students including a general overview of the issue, description and integration of VMC projects that are gathering information on that issue and results from VMC studies. This material will be posted on the web site and produced as hardcopy material.
- Make contact with Vermont groups to determine VMC niche in further development of educational services, such as professional development opportunities, curriculum development, or other educational material.
- Develop a plan for future educational resources based on needs assessment from interactions with Vermont educators.
- Solicit research proposals from cooperating scientists in the area of education outreach. Projects should focus on outreach to school-aged children grades 5-12. Activities may be developed to support existing school curricula; promote the involvement of students and/or teachers in ecological monitoring, whether through data collection or use of existing data; or in the development of new curricula that work within the Vermont Framework and Standards.
 - Develop press releases or other newsworthy articles for the general public.
 - Prepare materials from VMC research for policy makers.
 - Work with VMC Cooperators to develop outreach materials on the topic of mercury and forest management based on VMC research findings.
 - Publish quarterly VMC newsletters including articles about current VMC research projects contributed by VMC staff and cooperating scientists.
 - Publish annual report and project description report.
 - Conduct an Annual Meeting for cooperating scientists, the media and general public.
 - Conduct public presentations for the purpose of educating groups about VMC and VMC research and findings.
 - Develop posters and displays for workshops and meetings conducted by or attended by VMC staff.
 - Respond to requests for information related to VMC research and environmental issues in Ver-



mont.

- Support the Burlington Eco-info web site with VMC data and data management services.

Identified Research and Program Activities Needs

Objective: 1) To document needs for research identified by resource managers, policy makers, or scientists that can be addressed by VMC Cooperators; and 2) To identify and facilitate specific data synthesis or products that would advance the goals of the VMC and partners.

The following lists research and program activities needs and the source for these identified needs. Some of these identified needs are currently being addressed.

Identified Research needs from 1997 Mount Mansfield State Forest Management Plan include the following areas:

- Baseline conditions
 - environmental conditions (air quality, weather, etc.)*
 - biological condition*
- Bicknell's thrush
 - ecology*
 - impacts of ski area development*
- Biotic integrity
 - interrelations between ecosystem components*
 - definition of ecosystem health
- Biodiversity
 - baseline for habitat types*
 - identify species of special concern within each habitat type
 - develop compatible management activities
- Development impacts
 - relationship between vegetation removal at high elevations and watershed hydrology*
 - ecological effects of vegetation removal
 - snowmaking effects on watershed hydrology and water chemistry*
 - mapping of old growth red spruce
 - mapping of rare plant communities*
- Ecological Land Classifications
 - map habitat types*
 - applications for conservation of species and communities
- Ecosystem Management Demonstration Project
 - ecosystem effects from forest management



-aesthetic impacts and social responsibility of forest management
-stream impacts using Acceptable Management Protection Practices (MAPS)

- Environmental effects-
 - relationship between air quality and forest ecosystem*
 - high elevation forest health*
- Glade impacts
 - aesthetics near hiking trails
 - forest health effects
 - management options for minimal ecological disturbance
- Trail impact monitoring
 - current status of trails (erosion, vegetation disturbance, use)
 - long-term trends in trail condition, baseline information on trails*
 - trail impacts on sensitive ecological communities*
 - carrying capacity of trails (ecological, visitor experience)
 - extent of impact based on type of use (hiking, bikes, skiers, snowboarders, etc.), time of year of other factors
- Recreation impacts on the environment
 - trails: erosion, plant trampling
 - alpine areas vs. recreation: linking off trail, snowboarding impacts
 - ski areas: snowmaking and hydrology, generators and pollution, high elevation clearing of forests to meadows

Needs that can be supported by the VMC as outlined in the Vermont Forest Resources Plan:

- Support revision of Vermont's soil survey to include soils by biophysical regions, to better link soil mapping to forest and plant communities.*
- Monitor forest health and conditions, and rates of growth and harvest levels in order to detect stresses on the forests.*
- Participate in the National Forest Health Monitoring Program, North American Maple Project, and Vermont Hardwood Health Survey. *
- Develop demonstration sites on land, by biophysical region, that show appropriate vegetation management strategies for timber and wildlife management, and hold workshops to educate private landowners.
- Conduct scientifically based assessments of the impacts of existing forest practices, environmental policies, programs, and regulations, and evaluate their adequacy in achieving the principles of sustainability as defined in 1996 by the Forest Resources Advisory Council.
- Adopt a land classification system for management of state-owned lands that supports Vermont's natural communities, timber management, and recreation goals.
- Revise existing inventory systems for state land to provide the best overall data on forest health conditions, water quality, wildlife habitat, natural heritage sites, unique ecological communities and areas, and forest stand conditions for planning and timber management activities.

VMC role in filling research and information needs of groups according to various regions,



as identified by the VMC Advisory Committee:

- Mount Mansfield-
 - Monitoring and research. *
 - Coordination and facilitation. *
 - Information management. *
 - Provide access to environmental data and information from Mount Mansfield as part of the Smuggler's Notch Education Center. *
 - Assist the Agency of Natural Resources in its goal to produce a management plan for Mount Mansfield that focuses on managing the resource in a sustainable manner, considering all aspects of the ecosystem and all uses of natural resources. *
 - Assist ANR in its goal of determining the magnitude and nature of fine particle air pollution in Vermont by facilitating data collection. *
 - Provide hydrologic data pertinent to storm water run-off in developed and undeveloped watersheds to assist ANR in defining current and future flooding potential given different land uses. *

- Lye Brook Wilderness Area-
 - Monitoring and Research. *
 - Coordination and facilitation. *
 - Information management. *
 - Assist Green Mountain National Forest in revising its Forest Plan, including Lye Brook Wilderness Area. *

- Major River Basins-
 - Provide data, information and access to experts knowledgeable on watershed issues, in particular for watershed groups within VMC study areas. *

- Biophysical Regions-
 - Include long-term monitoring and research data from other Biophysical Regions in VMC Data Library. *
 - Conduct research into developing silvicultural guidelines for the Northern and Southern Green Mountain Biophysical Regions *

- Landscape-
 - Assess the accuracy of the digital elevation model in delineating small watersheds, especially at high elevations. *
 - Evaluate the use of remote sensing techniques in the mountains of Vermont. *

- Vermont-
 - Assist ANR and others in goal of understanding, protecting and managing the health of Vermont's ecosystems by continuing to monitor ecosystems, and assessing and reporting

on the health of ecosystems. *

- Northern Forest Lands-
 - Gather information on the status of biological resources and determine compatible land management techniques. *
 - Develop a common natural community classification system. *
 - Develop educational materials for land managers and landowners on techniques for biological resources conservation. *

- Lake Champlain Basin-
 - Provide access to atmospheric monitoring data, and maintain key monitoring activities to support Lake Champlain Research Consortium. *
 - Produce report characterizing atmospheric conditions to LRC. *
 - Provide data management expertise to Lake Champlain Basin Program in developing a data management system. *
 - Cooperate with LCBP and LCSC in developing education outreach materials.

- Regional-
 - Assist in implementation of the Forest Sensitivity Mapping Project, providing regional coordination and some data management services. *
 - Participate in proposed Northeast Research Cooperative, providing coordination of VMC sites involvement and some assistance in developing a regional database structure. *
 - Participate in US Forest Service Intensive State-Ecosystem Monitoring program. Providing access to local experts, data and data management expertise. *
 - Provide data from VMC sites as part of regional, national and international monitoring networks. *

Suggestions on topics or current issues (responses from March 2000 critique) that would be valuable to include in an effort to expand the distribution of scientific information through environmental education materials:

- The Vermont Herpetology Atlas
- Sources of Vermont's air pollution
- Air quality trends on VMC study sites*
- Acid rain and mercury reports
- Change in forest cover and forest type over time using FS FIA data
- Role of NE forest in CO₂ absorption and atmospheric regulation, carbon exchange in forests*
- Convene a meeting specific to mercury in Vermont
- Role and response of forests to climate change and associated changes in forest phenology
- Provide special focus workshops
- Provide more consistent funding opportunities and identify earlier for planning purposes
- Expand research sites to include the entire state of Vermont

Needs expressed by legislators:



- Information regarding air quality in Vermont
 - Diagrams of air trajectories
 - Maps of air pollution sources
 - Fact sheet on mercury: sources, amounts, effects, unknowns
- Educational displays at the State House and County Fairs
- Information session in conjunction with the Forest Industry at Proctor Maple Research Center

Needs expressed by the Secretary and Deputy Secretary of the Agency of Natural Resources:

- Data on short-term stream water quality changes
- Information on biodiversity

Research needs identified for Class I Wilderness Areas

- Consider air pollution effects on forest productivity and effects on water chemistry and aquatic communities. How do acidifying substances (acid deposition) and oxidants affect ecosystems? Are insect and disease infestations affected by acidifying substances, ozone, or other pollutants?
- How do genomes respond to air pollution and other forms of stress?
- What air pollutants and associated concentrations adversely affect ecosystem fauna? (e.g. Salamanders)?
- What are the effects of emissions from prescribed fire on NAAQS, visibility, and human health? What are the reference conditions for emissions from prescribed fire? What is the balance between public health and ecosystem health effects from prescribed fire?
- What are the soil types that are sensitive to air pollution- what are sensitive processes, nutrient depletion, and nitrogen saturation? What is the relative distribution of soils showing sensitivity to air pollution?
- Should whole tree harvesting be an ecosystem management tool?
- What level of confidence is needed to incorporate air pollution effects information into ecosystem management decisions?
- How do increases in recreation uses affect air quality? How might special use activities affect air quality? What may be associated with human health effects from increases in recreation opportunities on National forests?
- What is the potential for forest management activities to change (probably increase) biogenic emissions of VOCs?
- What are the costs/benefits of ecosystem management?
- How does land use history affect ecosystem management strategies? E.g. land uses that may promote nitrification.
- What are the opportunities to utilize species composition to control or decrease air pollution effects?
- How do we objectively measure and analyze impacts associated with odor?
- What is the spatial variation of ozone sensitive species? Can we introduce genotypes in Eastern Region national forests?
- What soil microbial processes need close examination?
- How might air pollution and environmental change affect trophic relationships between insects



and plants?

- What are the relative effects of different air pollutants? Can we trade off decreases in sulfur emissions for increases in nitrogen emissions?
- What are air pollution effects on heritage resources?
- How do emissions translate into effects on national forests?

Annual Cooperators Meeting

Objective: 1) To provide a means for disseminating research results, and enhancing dialogue and facilitated collaboration between researchers, resource managers and policy makers.

The VMC functions as a cooperative in which researchers from many different fields (ecology, hydrology, biology, environmental chemistry, etc.) direct their efforts towards understanding



Monitoring and Research

Monitoring and Research:

Annual Cooperators Meeting

Grants Program

Monitoring and Research Implementation Plan

Research Implementation Process

Study Site Application

Study Site Maps



conditions and processes in forested ecosystems. Communicating the results of this research to



other interested parties, engaging in constructive dialogue to create better research, and informing public/private land management are pivotal goals of VMC.

Development Process:

Planning for the Annual Meeting begins in November, when the Advisory Committee and the Research and Monitoring Directors establish the theme and format of the meeting, and choose a moderator. The format for meetings varies, but always includes part of the day-long meeting for presentation of results by cooperating scientists. The Directors contact cooperators and keynote speakers (when appropriate), develop the agenda and announce the meeting. Press releases and press information packets are compiled and distributed. Posters are created by VMC staff and Cooperators. Logistical details such as parking permits, catering and audio/visual materials are coordinated by VMC staff and UVM personnel. The meeting is generally held at the UVM School of Natural Resources, but on occasion is held at a Burlington conference center. Attendance varies between 45 and 70.

Review:

Feedback from meeting attendees was formally solicited at the 1999 VMC Annual Meeting and was constructive and positive (see Appendix A). Meeting critiques are conducted by VMC staff and the Advisory Committee following the Annual Meeting and include unsolicited verbal feedback from Annual Meeting participants.

VMC Grants Program

Objective: 1) To promote monitoring and research on areas of importance to the VMC, especially long-term monitoring of forested ecosystems; and 2) To provide seed funds for new research, encouraging scientists to pursue more substantial funding through other sources.

Criteria for funding:

- Objectives of study match VMC goals and current year's focus.
- Ongoing monitoring receives priority over new studies.
- Reasonable budget request according to availability of funds.
- Expectation for success.
- Investigation has scientific merit.
- Investigator agrees to VMC deliverables: submit results in VMC Annual Report, provide data for the VMC Data Library, present results at Annual Cooperators meeting, and provide some form of cost-sharing for the project.
- Methodologies meet VMC site integrity guidelines.
- Past history with VMC favorable (good cooperator).

The philosophy of the VMC Grants Program is to stimulate participation, promote a spirit of cooperation, and encourage graduate and undergraduate student participation.

Granting Process:

- Monitoring and Research Directors draft proposed focus area priorities and budget for Grants Program with assistance from the Advisory, and using the Research and Monitoring Implementation Plan..



- Steering Committee decides on priorities and budget.
- Monitoring and Research Directors distribute Request for Proposals with response time of one month.
- Monitoring Director receives proposals, sets meeting date for review, distributes proposals to Advisory Committee for review.
- Advisory Committee meets to review, discuss and make recommendations for funding.
- Monitoring Director notifies applicants, attends to details of Grant Agreements, and is responsible for Cooperator's satisfying terms of agreement.
- In some cases, funding comes through other organizations (UVM, GMNF). Administration of these grants is conducted by the Research Director (for UVM funds) and Lye Brook Committee Chair (for GMNF funds).

Monitoring and Research Implementation Plan

This plan was developed in 1994-95 and represents cost estimates for that time period. While many of the activity areas will remain pertinent over time, funding amounts will fluctuate.

This plan provides a framework that will allow prioritizing of VMC funding on an annual basis. It presents details on those activities necessary to complete the mission of the VMC: to better understand our forests and the effects of environmental change on them through coordinated long-term monitoring and research.

Many worthwhile studies have been omitted from this list. What follows are those activities that are fundamental in nature, have information of value to many potential users and are considered essential to accomplishing the VMC goals.

VMC PROGRAM ADMINISTRATION

COORDINATION:

Variables: Monitoring and Research Directors
Operating costs: \$ 43,750
Frequency: N/A
Number per site: N/A
Priority ranking for VMC: Required

DATA MANAGEMENT AND INTEGRATION

Variables: Data Manager; GIS; Voyager
Operating costs: \$51,250 start up
Frequency: N/A
Number per site: N/A
Priority ranking for VMC: Required

REPORTING

Variables: Project Description Report, Annual Report, Others
Operating costs: \$6,250
Frequency: Annual

Number per site: N/A

Priority ranking for VMC: Required

SITE CHARACTERIZATION

Variables: Site history (including disturbance history), physical features, ecological land types, forest types, soil types, geology, stand features.

Operating costs: \$ 5,737/site/year

Frequency: Annual

Number per site: Annually determined

Priority ranking for VMC: High

ATMOSPHERIC

1. Meteorology: Provide daily meteorological measurements representative of an area at each site to use in conjunction with other biological, chemical or physical variables.

Variables: Ambient temperature, precipitation, wind speed and direction, relative humidity, solar radiation; optional: UV sensor. Includes data processing and analysis.

Operating costs: \$5,500/site/year; \$7,500 start up/station.

Frequency: Hourly summary

Number per site: 1 per every 1000 ft elevation change and aspect extremes. Goal is for 3 on west slope Mansfield, 2 on east slope Mansfield and 2 at LBA.

Priority ranking for VMC: 1 per site required; others, High priority.

2. Ozone: Provide hourly ambient ozone data from April through September to use in conjunction with other biological, physical and chemical variables at the sites.

Variables: Ambient ozone

Operating costs: \$ 2,000/site/year; \$12,000 start up.

Frequency: Hourly, April through September

Number per site: 1

Priority ranking for VMC: Required

3. Wet Deposition: Provide year-round weekly-based wet deposition chemistry data to use in conjunction with other activities at the site.

Variables: Precipitation amount, pH, conductivity, major ions, optional: heavy metals

Operating costs: \$9,000-15,000/site/year (access dependent cost); \$4,500 start up.

Frequency: Weekly

Number per site: 1

Priority ranking for VMC: Required

4. Dry Deposition: Provide year-round weekly dry deposition chemistry data to use in conjunction with biological, physical and chemical information at the sites.

Variables: NDDN/SO₂, HNO₃, SO₄, NO₃

Operating costs: \$15,000/site/year; \$10,000 start up.

Frequency: Weekly

Number per site: 1

Priority ranking for VMC: Required



5. Aerosols: Determine concentrations and composition of fine aerosols of relevance to light scattering, light absorption, human health and biological effects; to use in conjunction with other biological, chemical and physical variables in trend and relationship assessments.

Variables: IMPROVE Module A Sampling: mass, light absorption, H, Na, Cl, S, Al, Si, Ca, Fe, Mg, P, K, Ti, Cu, Ni, An, As, Se, Pb, Br, Mn, V.

Operating costs: \$15,000/site/year; \$10,000 start up.

Frequency: Twice weekly

Number per site: 1

Priority ranking for VMC: High

6. Atmospheric Mercury: Provide year-round atmospheric mercury deposition measurements in wet deposition, aerosol and vapor phases to use for integrated research and monitoring studies.

Variables: Air volume, precipitation amount, Hg concentration by type

Operating costs:

Frequency: Daily wet deposition; every 6th day dry deposition

Number per site: 1

Priority ranking for VMC: Required

TERRESTRIAL FLORA: Provide baseline information on vegetation community types and locations; locate and monitor rare and endangered species; monitor the condition and nutrient status of, and stresses to forest vegetation; use vegetation information in conjunction with other biological, physical and chemical variables in trend and relationship assessments.

1. Vegetation community inventory and monitoring

Variables: Mapping and monitoring of plant communities, and rare and endangered species.

Operating costs: \$12,500/site/year

Frequency: Baseline over a 5 year period; re-inventory every 5-10 years.

Number per site: TBD

Priority ranking for VMC: High

2a. Forest health monitoring

Variables: NFHM detection plot variables/crowns, growth, damage, ozone bioindicator plant damage; periodic: vegetative diversity, leaf area, lichen communities, foliar chemistry.

Operating costs: \$500/plot/year; additional \$600/plot for periodic measurements.

Frequency: Annual; remeasure some variables every 5 years.

Number per site: 2 per 800 ft elevation change and forest type group.

Priority ranking for VMC: Required

2b. Forest health monitoring

Variables: timing of bud development, leaf expansion, fall color and leaf drop.

Operating costs: \$1,500/plot/year.

Frequency: Twice weekly-spring, weekly-fall.

Number per site: 3 species plots at two elevations.

Priority ranking for VMC: High

3. Annual forest disturbance monitoring



Variables: Aerial mapping and evaluation of insect, disease, weather and air pollution damage to the forest. Optional: ground plot evaluations.

Operating costs: \$500/flight/year; \$300-500/ground plot/year

Frequency: Annual

Number per site: 1-3 aerial surveys per year; ground plots as needed

Priority ranking for VMC: Required

TERRESTRIAL FAUNA: Provide baseline information on the fauna at the site; monitor key animal groups to detect changes over time; use with other variables in trend and relationship assessments.

1. Faunal inventory and monitoring

Variables: Insects, birds, amphibians, small mammals, large mammals.

Operating costs: \$31,250/site/year

Frequency: Baseline over 2-3 years; re-inventory 5-10 years.

Number per site: TBD

Priority ranking for VMC: High

SOILS: Develop a design and procedures for sampling, analyzing and interpreting soil information to use in a long-term soils monitoring program.

1. Long-term monitoring methods development

Variables: macro and micronutrients, heavy metals

Operating costs: \$6,250/year (both sites)

Frequency: TBD

Number per site: TBD

Priority ranking for VMC: High

AQUATIC: Provide information on surface water condition and biological organisms to use in conjunction with other biological, chemical and physical variables in trend and relationship assessments and in understanding movement of nutrients through the forest system.

1. Chemistry

Variables: Stream and water body pH, major ions, and nutrient flux

Operating costs: \$6,250/year

Frequency: Annual

Number per site: 1 stream and 1 water body/site

Priority ranking for VMC: High

2. Biota

Variables: Macroinvertebrates, fish

Operating costs: \$2,500/year

Frequency: Annual

Number per site: 1 stream and 1 water body/site

Priority ranking for VMC: High

3. Hydrology

Variables: Stream flow



Operating costs: \$ 6,250/site/year; \$6,250 startup

Frequency: Daily

Number per site: 1 stream

Priority ranking for VMC: High

NUTRIENT CYCLING: Synthesize information on nutrient input/output through the forest system by establishing baseline information on nutrient factors in long-term studies.

Variables: Analysis of existing data on: site, meteorology, ozone, wet deposition, dry deposition, aerosols, flora, fauna, aquatic chemistry, hydrology, and biota.

Operating costs: \$6,250 per site

Frequency: NA

Number per site: NA

Priority ranking for VMC: High

FOREST MANAGEMENT APPLICATIONS: Conduct normal silvicultural practices in conjunction with monitoring of forest ecosystem parameters to determine the effects and ramifications to the overall forest system; provide basic site and meteorology data to allow cooperators to build concurrent investigative projects.

SITE CHARACTERIZATION

Variables: Site history (including disturbance history), physical features, ecological land types, forest types, soil types, geology, stand features.

Operating costs: \$5,738

Frequency: Annual

Number per site: Annually determined

Priority ranking for VMC: High

METEOROLOGY

Variables: Ambient temperature, precipitation, wind speed and direction, relative humidity, solar radiation, stream flow. Includes data processing and analysis.

Operating costs: \$5,500/site/year; \$7,500 start up/station.

Frequency: Hourly summary

Number per site: 1 per every 1000 ft elevation change.

Priority ranking for VMC: 1 per site high priority.

OTHER INTEGRATIVE RESEARCH STUDIES: Support basic data collection for collaborative, integrative studies conducted at the two study sites, such as Paired Watershed Study, or Long-term Soil Monitoring Study; provide basic site data collection to allow cooperators to build concurrent investigative projects.

Research Implementation Process

The VMC has limited and variable funding to support research. This limits the program's ability to plan and initiate large, multi-disciplinary studies funded solely by the VMC. However, the VMC infrastructure allows coordination among scientists who work independently to maximize collaborations in the field, and integrate data and information by tapping into the VMC centralized databases for data and metadata from studies. There are several types of research that is implemented at the VMC study sites:

Cooperator Driven Research

The most common type of research is “Cooperator driven”. This means that an individual researcher arrives at the VMC with a ecologically oriented research topic that he/she wants to implement at one or both of the VMC study sites. For these studies, funding is external to VMC, and the research objectives and methods have been developed without VMC input. The VMC assists in the implementation of these studies, if they are congruent with the VMC goals, and also makes recommendations on modifications to the research that would help unify it with other studies (through data collection or integration).

Integrated Research by Cooperators

In some cases, VMC Cooperators initiate studies that involve additional scientists from other disciplines to meet their research objectives. An example of this type of research is the Bicknell’s Thrush studies initiated by the Vermont Institute of Natural Science. While this study began with a survey of Bicknell’s Thrush populations, it has evolved into an ecology and demographic study involving ornithologists, ecologists, plant taxonomists, entomologists and toxicologists. The VMC assists in the implementation of these studies, provides small grants for population monitoring and startup funds for research (i.e. insect prey, mercury concentration in bird blood and feathers), cooperates in outreach efforts, and provides data management services.

VMC Initiated Integrated Research

In several cases, the VMC has identified research gaps or the need for research on topics identified by natural resource managers or policy makers, and has developed collaborative, interdisciplinary research and monitoring studies to accomplish a VMC-developed objective. These initiatives can only be accomplished in year’s when VMC funding is sufficient to offer a Grants Program for new research projects. An example of this type of research initiative is the Long-term Soil Monitoring Study. Beginning in 1995, the VMC identified a gap in data collection of soils at both study sites. In 1998 a workshop of local and regional scientists and resource managers was held to solicit ideas on objectives, methods, participation, and funding. In 1999, when the VMC funding was sufficient to allow small grants, a soils mapping effort and data collection to determine an optimum design for the study, were supported by VMC. Additional soil characterization and preliminary data collection were supported by VMC in 2000 in cooperation with the Natural Resources Conservation Service, the USDA Forest Service, the University of Vermont, and the Agency of Natural Resources. The baseline data collection for the long-term study is planned for 2002. The assistance for this type of research has been in organization and coordinating efforts between participants, seeking additional researchers for short-term research studies, and financially supporting basic development work.

The attached study plans are the result of integrated research efforts by the VMC that have developed into conceptual plans or study plans to identify areas of cooperative research. Included are: Climate Change Research Approach; Forest Ecosystem Management Demonstration Project Plan; Long-term Soil Monitoring Plan; and Paired Watershed Plan.

Climate Change Research Approach

The following outlines discussions and conceptual plans for the VMC to pursue to address questions relating to climate change identified at a “VMC Workshop on Integrated Climate Change Research” held in March, 1999.

What is the research niche that VMC should strive towards in providing information to Vermonters on ecological effects of climate change?



Data are needed to address the following questions concerning climate change in Vermont:

- What ecological changes are predicted for Vermont (e.g. species composition, ecosystem structure)?
- How soon will ecological changes occur (rate of change, trends)?
- What spatial pattern will ecological changes follow?
- How will climate change affect ecosystem processes?
- What are the socioeconomic implications for Vermont?
- Do we have sufficient data to characterize current conditions as a baseline?

What are the information needs that VMC should contribute:

Monitoring of watersheds where long-term nutrient budgets can detect change.

- Currently we have Nettle Brook and Sleepers River.
- Need larger watershed (40-50 ha minimum) where input/outputs, climate (incl. meteorology, soil temperature, snow depth) are monitored.
- Lower elevation, non-montane area would be one approach.
- Regional Long-term Ecological Research sites (LTER) are not totally representative of Vermont. Vermont needs complementary watersheds.
- Suggested site: Ranch Valley, which is fairly homogenous, east slope, low and high elevations, and would be complementary to existing regional sites.

Vermont has rich woods with adequate sugar maple regeneration that can be used as a control for comparison against poor regeneration sites that are prevalent in the region.

- Lye Brook has both Ca rich and poor areas.

Tree line as an indicator of climate change.

- Use historical photos, tree ring reconstruction, etc. to document changes in elevational limits of vegetation over the last century.
- Use lake paleolithology to document sediment history. Some have been done: Sterling Pond, Branch Pond, Stratton Mountain(short core), Hapgood. Others could be valuable: Lake of Clouds, ridgetop bogs.
- Regeneration growth limitations at increasing elevations as an indicator of climate change. Some data from Mansfield. Abundant data from Camels Hump.

Soil environment.

- Soil climate (snowless winters where soil freezes) and effects on root environment. Need soil moisture monitoring. Hubbard Brook has research on micro-organisms affected by soil freezing.
- Soil carbon quantification and change over time, including carbon sequestering, shift in where carbon is in the soil profile.
- Characterize decomposers (wood, soil, forest floor), insects, microbes, etc.

Phenological changes in biota.

- Climate change effects on the timing of spring phenology among trees, insect pollinators, etc.
- Disruption of phenological relationships between organisms, especially those overwintering in duff layer.

Socioeconomic implications.

- Paired watershed monitoring on east slope of Mansfield in Ranch Valley vs ski area watershed would gather data on climate change effects on ski industry, implications for increased flood potential in developed (non-vegetated) vs not developed (fully vegetated) hillsides.

Carbon sink/pools.



- Is there something we can contribute that would complement Harvard Forest Study?
- Is there addition work to be done using plant communities as indicators of carbon flux ?

Study to predict changes in nuisance species.

- Monitoring data needed to establish baseline and study trends.
- Could include insects, plants, aquatics, animals.

Other points:

- VMC strength is in providing site-specific data that can be applied to state, regional or national climate change models. We should not dilute this high quality data by trying to broaden our scope.
- Long-term data is very valuable for answering questions now and in the future.
- Archiving samples now for some unknown future need will be very valuable, but long-term security of samples will be an issue.

Local resources and assets:

- Local scientists involved in working with climate change models: Alan Betts, Gerry Livingston.
- Existing data statewide: VMC sites, Camels Hump, Sleepers River, other high elevation sites.
- Data integration infrastructure.

Process to pursue climate change grant proposals:

Draft questions to be addressed in integrated climate change research proposal.

Produce “white paper” on VMC Climate Change Research Questions and Approach.

Produce “white paper” on VMC contributions to climate change questions.

Seek funding sources and develop timeline according to proposal deadlines.

VMC Forest Ecosystem Management Demonstration Project
Project Overview

GOALS Phase I: Ecosystem responses to forest management. Determine the economic, social and ecological effects of silvicultural treatments on the forest ecosystem, and how these effects relate to the landscape as a whole. **Phase II: The process of ecosystem management.** Design a process and model for the implementation of sustainable forestry on a landscape area using available information.

INTRODUCTION

People from diverse fields are requesting similar information on the sustainability of forests in



the region. Resource managers need knowledge on how existing management practices are affecting forest ecosystems, or how new techniques may be more desirable. Policy makers must view the forests in three dimensions. Using ecological knowledge. Overlaying economic information. And weaving into these present social values. Yet the lack of information on all these factors combined has made it difficult to operate for all concerned. The intent of this demonstration project is to provide a foundation for acquiring the information needed to make informed decisions by all those connected to forest ecosystems.

This demonstration project will develop a process and model that could be used to plan for and assess impacts of forest ecosystem management. It will include public and private lands and existing management activities and plans on those lands. Detailed information on how silvicultural practices affect social, economic and ecological factors of forests will be addressed to help land managers, policy makers and others in their job of sustaining forests through best management practices.

SITE INFORMATION

The location for **Phase I** of this demonstration project is Mount Mansfield. It is the site for intensive forest ecosystem monitoring and research being conducted by the Vermont Monitoring Cooperative program. Existing monitoring activities through the VMC includes the collection of baseline information on such components as air quality, weather, forest health, wildlife diversity, stream hydrology, chemistry and biology, and others.

Ownership at the site includes the University of Vermont Natural Area at the summit, State Lands at high and low elevations, the UVM Proctor Maple Research Center and many private landowners at low elevations. The towns of Cambridge, Underhill, Jericho and Stowe surround the mountain and are part of the watersheds on the east and west slopes of the mountain. Mount Mansfield is part of the Northern Forest Lands recently under study. It also forms part of the headwaters for the Lake Champlain Basin.

An integral part of this study will be to compare information needs depending on the landscape scale considered. Information will be collected for at least 6 different scales: an individual stand, the VMC Mansfield study area, the watershed, the 4 town area surrounding the mountain, the state of Vermont, the Northern Forest Lands, and the Lake Champlain Basin.

The small study area is part of the Stevensville Brook watershed on State Land. Treatments will be conducted on part of the 210 acres of northern hardwood forest on the west facing slope of the mountain from 1400-2500 feet in elevation. Two hiking trails and two cross-country ski trails intersect the area.

Phase II of this demonstration area will begin at a later date, and may include the Ranch Valley, the east slope of Mount Mansfield, and/or parts of the Green Mountain National Forest adjacent to the Lye Brook Wilderness area in southern Vermont.

STUDY TOPICS

The following research topics have been proposed as part of this study. Many of these will be addressed at the small study area. Others will be part of the landscape evaluation. Studies are contingent upon external funds awarded to principal investigators.

- Forest health.
- Biodiversity.
- Sustainability.
- Social values.

Economics.
Past land use.
Nutrient cycling.
Site characteristics: meteorology, slope, aspect, soils.
Balance of multiple uses.
Cost/benefit analysis of tangible and non-tangible values.

2/96 version

VMC Forest Ecosystem Management Demonstration Project ***Phase I - Specific Silvicultural Objectives***

Project name: **Forest Ecosystem Management Demonstration Project**

Objectives

- Evaluate and monitor the effects of a range of silvicultural treatments having the potential to minimize ecological impacts and, in some cases, enhance ecological and biodiversity values, thereby sustaining both timber yield and ecosystem functioning
- Provide information that will help forest managers, policy makers, and the general public evaluate the benefits, tradeoffs, and feasibility of alternate silvicultural systems intended to contribute to sustainable forest ecosystem management at larger-spatial scales

Project Start Date : July 2001

Site Characteristics

- Stevensville Brook Research Area, Mount Mansfield State Forest
- Mid elevation northern hardwood forest

Sampling Frame

- 7 experimental units (six treatment units and one control unit), 2 hectares in size
- 40 meter minimum buffering between units
- Five permanent 0.1 hectare plots established randomly within a core area of each unit
- Each 0.1 plot includes a system of smaller, nested plots used for sampling multiple parameters at a spatial scale commensurate with occurrence frequency or density.
- One year of pre-treatment sampling and annual post-treatment re-sampling

Measurements

- Overstory structure (tree diameter, height, crown depth, and condition) and species composition
- Tree regeneration (e.g. tree saplings and seedlings) abundance, composition, and growing substrate
- Herbaceous plant community composition, percent cover, and growing substrate
- Organic soil profile
- Distribution, abundance, and decay stage of standing and downed coarse woody debris
- Gap and tip-up mound abundance and size
- Canopy closure
- Stand age and site productivity (site index)
- Collectively, the measurements allow estimation of tree growth, yield, mortality, and reproduc-



tion; the development of key structural attributes, such as coarse woody debris, gaps, and pit and mound topography; the dynamics of plant and wildlife habitat characteristics; understory plant community dynamics; total above-ground carbon sequestration, and other variables.

Spatial Context

The study is currently limited to the Stevensville Brook research area, although additional study sites may be added in the future.

Contact person:

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VMC Long-term Soil Monitoring Study Work Plan - July 1999

Following years of discussion on implementing a long-term soil monitoring program, this work plan describes the goals, process, timetable and groups collaborating in the implementation of a long-term soil monitoring study. **Our overall goal for long-term soil monitoring is to detect changes in soils due to human caused impacts (i.e. climate change, air pollution, forest management) at two forested sites in Vermont.** In addition to the 200 year monitoring objectives, short-term study objectives are to be accomplished. This plan addresses environmentally induced soil changes. A separate study will be developed to study forest management induced soil changes.

The study approach used here is to measure soil changes in forest locations representative of forests at each study site. At Mount Mansfield this would include forest type and elevation, and at Lye Brook forest type would be the major influence. In addition to addressing the long-term goal of soil changes over a 200 year period, a complementary objective was added that would provide basic soil fertility, physical characteristics, and mineralogy information at each study site to support on-going ecological monitoring and research.

Study Objectives:

1. Determine soil changes due to human caused environmental change at two forested sites in Vermont (Mount Mansfield and Lye Brook Wilderness Area).
2. Provide basic soil characterization to support VMC monitoring and research.

During initial discussions of this study there were several other desirable objectives for this



study: detect soil changes that result in biological changes; monitor soils representative of the Green Mountain biophysical region; determine forest management effects on soil properties. All these objectives were not feasible in one study. It was suggested that complementary studies could be added in the future and/or soil samples could be archived to meet future needs.

A three-step process was identified to complete the objectives outlined above. The first step is to complete mapping at the two sites at a 1:20,000 scale. At Mansfield, some mapping on the west slope (Chittenden County) was completed in the early 1980's, but on the east slope (Lamoille County), further work will be needed, especially in characterizing super-spodosols (a priority for NRCS). Work at Lye Brook site (Bennington and Windham Counties) will be coordinated with Green Mountain National Forest, which has conducted some soils work in the past. Results of this mapping will be valuable for basic soil characterization, generating a base soils map that can be digitized into a GIS and used for determining long-term soil monitoring study locations, and be applied to address current issues of forest sustainability.

A second step is to develop the GIS data layers that would be needed to select appropriate long-term study site locations. GIS layers needed include: bedrock geology, stand age or structure, forest type, topography and soils. VMC will be responsible for coordinating completion of digitizing and compiling of data layers, working with NRCS, GMNF and UVM to ensure appropriate data quality.

The third step is to establish permanent study sites, collect soil characterization samples, and conduct laboratory analyses (by the NRCS Soil Quality Lab). Once the characterization is complete, the VMC Soil Team (representatives from UVM, NRCS, US Forest Service, and Dept. of Forests, Parks and Recreation) will finalize the study design including procedures for lab analysis and sample storage, then seek funding to begin Year 0 of the study implementation. Concurrent with plans for long-term soil monitoring, cooperating researchers will develop funding proposals to address short-term research questions.

Paired watershed study on Mt. Mansfield

P.I. Jamie Shanley, USGS. Collaborators: Tim Scherbatskoy, Beverley Wemple, UVM; Jim Kellogg, VT Div. Water Quality

We propose a paired watershed study on the east slope of Mt. Mansfield. The adjacent watersheds are Ranch Brook, a 10.5-km² nearly pristine forested basin, and West Branch Little River (West Branch), a 12.0-km² basin containing the entire Mt. Mansfield Ski Resort and bisected by Vermont State Highway



108. The two basins have similar geology, size, elevation, slope, aspect, soils, geology, and forest cover; the principle difference between them is the sharp contrast in land use. If the development within West Branch has altered the natural hydrology, the nature and extent of these alterations may be revealed by comparison to the minimally disturbed Ranch Brook.

Problem: High-elevation areas in Vermont are our environments that are most vulnerable to air pollution and other human impacts. Granitic and quartzite bedrock makes these areas sensitive to acid deposition, while thin soils and steep slopes leaves them susceptible to erosion when forests are cleared. Ski area and associated residential development may augment peak flows from impervious surfaces, decrease baseflows through snowmaking withdrawals, and impair water quality not only from erosion, but also from septage leakages and pesticide leaching. There are scant data in Vermont on high-elevation streamflow and water quality, and there have been no scientific studies in the northeastern U.S. on the effect of ski area development on water quantity and quality.

Objectives: (1) Establish permanent streamgaging stations on Ranch Brook and West Branch; (2) Provide a watershed framework for other VMC research on nutrient cycling, forest health, aquatic macroinvertebrates, streamwater quality, and sediment transport; (3) Generate graduate student thesis research and student internship opportunities; (4) Provide real-time flow data on the publicly accessible USGS website for scientific and educational purposes; (5) Foster environmental education efforts in the Mount Mansfield State Forest.

Approach: We will establish the gaging stations in September 2000 and begin monitoring flow by the start of the 2001 water year (October 1, 2000). The stations will be established at mutually agreeable locations, striving for approximately equal watershed sizes. The stations will be unobtrusive, using either pre-existing works of the Mount Mansfield Corporation or natural river controls, and will have only small instrument shelters and short satellite transmission antennae. Besides flow, continuous measurements of air temperature and water temperature will be made. Meteorologic data, most importantly precipitation amount, will be obtained from the weather station on the Nose summit (3900') and the VMC station near the toll road (2900'). Non-recording rain gages will be installed at each gage (~1400'). Snowpack water equivalent will be measured if possible.

Products: Real-time streamflow data (within 4 hours) will be publicly available on the USGS web site by 1 January 2001. A combined data-interpretive report which compares the hydrology of the 2 watersheds will be prepared.

Study Site Applications

INFORMATION ON THE VERMONT MONITORING COOPERATIVE APPLICATION FOR MT. MANSFIELD

THIS IS AN APPLICATION TO BE INVOLVED IN THE VERMONT MONITORING (VMC) MONITORING AND RESEARCH NETWORK AT MOUNT MANSFIELD. IN ADDITION, IT IS THE APPROVAL PROCESS NEEDED TO CONDUCT MONITORING OR RESEARCH ON STATE LANDS AT THIS SITE.

GOALS OF THE VERMONT MONITORING COOPERATIVE

Improve our understanding of the conditions, trends and relationships in the physical, chemical and biological components of the forested ecosystems in Vermont.



Facilitate the efficient coordination of multi-disciplinary environmental monitoring and research activities among program participants.

APPROVAL PROCESS

In providing a well coordinated and integrated monitoring and research program at the Mansfield site, we are requiring all participants to apply to the VMC annually, for project approval and location permission. Project approval is to insure that the proposed project's goals and objectives are in keeping with those of the VMC, to prevent duplication of efforts, and to maintain good communications on all new and changing activities from year to year. Location approval allows each cooperator to function without the threat of interference from others, allows the VMC to insure that land use is in keeping with VMC guidelines, and provides needed information on specific locations of projects to update our GIS information.

The requirements for VMC application approval are:

1. that the project is in keeping with the goals and objectives stated above,
2. that adequate project information is provided to understand the proposed project,
3. that the cooperator agrees to provide data or results to other cooperators at some point in time, and
4. that the applicant agrees to provide an annual progress report or information for an annual VMC report.

In addition, we encourage VMC cooperators to facilitate the flow of information on forested ecosystems through cooperation with other members, and participation in any VMC information exchange meetings.

The application process is meant to be simple, quick, yet informative, and is as follows.

Complete the application, sign and date it, and return to the VMC Monitoring Director, Sandy Wilmot (see below).

Your application will be reviewed and commented on by the VMC Advisory Committee. If the project is approved, the Monitoring Director will sign it and return it to you. This process can be completed at any time, preferably well ahead of the field season.

Location approval can be postponed until the field season to allow for on-site verification of a suitable location. If the applicant needs more information on potential sites for project implementation, list criteria needed on the application (number 4), and the Monitoring Director will assist you in locating an appropriate site.

In addition, the Monitoring Director will set up a site visit for new cooperators, to assist in locating appropriate study sites, and to familiarize the cooperator with other VMC activities. Allow 2-3 weeks for your application approval.

OTHER PERMITS

This approval covers activities conducted on State owned lands at the site. Other landowners that you may need to contact are:

- * Rick Paradis, director of the University of Vermont Natural Area (660 feet on either side of the summit)



(802-656-4055),

* Tim Perkins, Director of the Proctor Maple Research Center (802-899-9926),

* Manager of the Mt. Mansfield Company in charge of the east slope Toll Road access, and

* Private landowners at lower elevations on both sides of the mountain.

Collection or disruption of federally listed threatened or endangered plant or animal species requires a permit from the U.S. Fish and Wildlife Service. Contact Laurie Eaton at 802-951-6313.

Collection or disruption of state listed threatened or endangered plant or animal species requires a permit from the Vermont Agency of Natural Resources Heritage Program. Contact Steve Parren at 802-241-3717.

Collection of any vertebrate species requires a Scientific Collecting Permit from the Vermont Department of Fish and Wildlife.

Any University of Vermont researcher conducting studies involving vertebrate animals must receive approval by the University of Vermont Institutional Animal Care and Use Committee. Contact Penny Cross at 802-656-4067.

Any environmental manipulations (constructions, major cutting of the forest, additions of fertilizer, etc.) especially above a 2300 foot elevation may require more extensive review and approvals, such as approval by local town authorities or Act 250 reviewers.

VMC Monitoring Director: Sandy Wilmot
 Forests, Parks and Recreation
 111 West St.
 Essex Jct., VT 05452
 (802)-879-5687
 sandy.Wilmot@anrmail.anr.state.vt.us

GUIDE TO PLOT LOCATION AND MARKING

State Land on Mount Mansfield is managed for multiple uses. Establishment of plots or study areas must be sensitive to the fact that recreation and aesthetics are two major uses of this mountain.

Guidelines:

1. When establishing permanent plots or study areas off recreational trails, please locate your plots at least 100 feet from the trail. Periodically trails are relocated to avoid erosion, and this distance should prevent conflict between trails and plots. Plus, any markers you use on your plots will not be as visible to recreation users from this distance.
2. Avoid the overuse of flagging. While it is important to mark your study area for relocating and to avoid others using the same spot, too much flagging in the woods can become a problem. Try to be sensitive to this.
3. Permanent markers can consist of a PVC pipe at plot center, aluminum tags on tree butts, or other non-corrosive items. Please clearly label all markers, and where abbreviations are used, send a list of these to the VMC Monitoring Director for permanent documentation.



4. If you frequently visit your study area and are creating “research trails” that hikers may see and wander onto, please place brush or other natural obstructions at the start of your trail to avoid any unwanted entry. This is for your protection and to prevent hikers from being confused about which trail they should be on.

5. On the west slope of the mountain, the Brown’s River watershed (which includes the land above the Underhill State Park) has been designated as an undisturbed area (no cutting will occur other than hazardous trees). The Stevensville Brook watershed (surrounds the Butler Lodge Trail) will undergo silvicultural treatments periodically. On the east slope of the mountain, in the Ranch Brook watershed, the south portion of the watershed is designated as an undisturbed area, and the north portion will periodically undergo silvicultural treatments for research purposes (request a map if you would like to know the boundaries). Keep this in mind when choosing which watershed to locate in.

VERMONT MONITORING COOPERATIVE APPLICATION FOR 2001

FOR MONITORING AND/OR RESEARCH ON MT. MANSFIELD

Applicant’s Name _____ Telephone No.: _____

Applicant’s Address _____



Organization/Affiliation _____

Project Title _____

1. Describe your project, including: purpose, details on study area size, number of samples and parameters to be taken, any changes made to the site, study area markings, structures or equipment to be installed. (This application may be accompanied by a more detailed project description of up to 2 pages in length.) We would like to include information on your activity in our annual VMC Project Description document. See the attached example for format and content required.

For previously approved VMC activities, describe any changes in your project from last year, both in the space below and directly on xeroxed page(s) of the last work plan or project description document. You do not need to complete questions 2-6, but sign and date the application.

2. What types of activities by other VMC cooperators would be incompatible on the area you are using (for example, observational data collection, management manipulations, stream alterations, etc)?

3. What is the anticipated duration of this project?

4. Has a specific study area location been identified, and if so, please indicate location on attached map (this applies to existing projects, too). If location is not known at this time, what criteria are you looking for in locating a plot?

5. List ways in which this project fits the goals and objectives of the VMC.

6. Is your project data going to be available to other VMC cooperators, and if so, when and in what form?

Applicant's signature

Date

Terms of approval (if any):

Project approval:

Location approval:

VMC Official signature

VMC Official signature

Date

Date

2001 VMC Project Description Example

FOREST BIRD MONITORING

OBJECTIVE: Monitor 2 sites established in 1991 to create a site-specific database of forest birds and de-



termine trends over time.

Two permanent study sites were established in 1991; one in upper elevation subalpine spruce-fir, the other in lower elevation northern hardwoods. Five 10-minute point counts are made at 200 meter distances. Birds seen or heard are recorded. This is repeated twice during the height of breeding activities.

Project starting date

6/1991

Site Characteristics

Locations: 2 sites, one northern hardwood and one high elevation spruce fir

Elevations: 2200 and 3800 foot elevations

Aspect: west slope and summit

Sampling Frame

1-km transect

5 10-minute point counts

Measurements

Bird Species

Frequency

Sighting locations

Spatial Context

Results are comparable to 16 Vermont sites.

QA/QC

Trained or experienced field crews.

Contact: Chris Rimmer or Steve Faccio
Vermont Institute of Natural Science
RR 2 Box 532
Woodstock, VT 05091
(802)-457-2779
VTINST@SOVER.NET

2001 VMC Project Description Form

Project name: _____

Objectives



Project Start Date

Site Characteristics

Sampling Frame

Measurements

Spatial Context

QA/QC

Contact person:

**INFORMATION ON THE VERMONT MONITORING COOPERATIVE APPLICATION
FOR LYE BROOK AREA**

THIS IS AN APPLICATION TO BE INVOLVED IN THE VERMONT MONITORING COOPERATIVE'S MONITORING AND RESEARCH NETWORK AT THE **LYE BROOK AREA SITE**. IN ADDITION, IT IS THE APPROVAL PROCESS NEEDED TO CONDUCT MONITORING OR RESEARCH ON THE GREEN MOUNTAIN NATIONAL FOREST (GMNF) AT THIS SITE.



GOALS OF THE VERMONT MONITORING COOPERATIVE AT THE LBA SITE

Improve our understanding of the conditions, trends and relationships in the physical, chemical and biological components of the forested ecosystems in Vermont.

Facilitate the efficient coordination of multi-disciplinary environmental monitoring and research activities among program participants.

Assess the effects of air quality on terrestrial and aquatic ecosystems.

APPROVAL PROCESS

In providing a well coordinated and integrated monitoring and research program at the Lye Brook Area site, we are requiring all participants to apply to the VMC annually, for project approval and location permission. Project approval is to insure that the proposed project's goals and objectives are in keeping with those of the VMC, to prevent duplication of efforts, and to maintain good communications on all new and changing activities from year to year. Location approval allows each cooperator to function without the threat of interference from others, allows the VMC and GMNF to insure that research design is in keeping with GMNF guidelines and is sensitive to wilderness values, and provides needed information on specific locations of projects to update our GIS information.

The requirements for VMC application approval are:

1. that the project is in keeping with the goals and objectives stated above,
2. that adequate project information is provided to understand the proposed project,
3. that the cooperator agrees to provide data or results to other cooperators at some point in time, and
4. that the applicant agrees to provide an annual progress report or information for an annual VMC report.

In addition, we encourage VMC cooperators to facilitate the flow of information on forested ecosystems through cooperation with other members, and participation in any VMC information exchange meetings.

The application process is meant to be simple, quick, yet informative, and is as follows.

Complete the application, sign and date it, and return to the VMC Monitoring Director, Sandy Wilmot (see below).

Your application will be reviewed and commented on by a VMC designated committee. If the project is approved, the Monitoring Director will sign it and return it to you. This process can be completed at any time, preferably well ahead of the field season.

Location approval can be postponed until the field season to allow for on-site verification of a suitable location. If the applicant needs more information on potential sites for project implementation, list criteria needed on the application (number 4), and the Lye Brook Research Director will assist you in locating an appropriate site.

In addition, the Lye Brook Research Coordinator will set up a site visit for new cooperators, to assist in locating appropriate study sites, and to familiarize the cooperator with other VMC activities. Allow 2-3 weeks for your application approval.

OTHER PERMITS



This approval covers activities conducted on the GMNF at the site. If studies extend onto private ownership, you will also need their permission.

Any studies conducted at/or within proximity to Branch Pond require approval by the Forest Service Research Natural Area (RNA) Program using a separate application form. Contact Diane Burbank for further information (802-388-4362).

Collection or disruption of federally listed threatened or endangered plant or animal species requires a permit from the U.S. Fish and Wildlife Service. Contact Laurie Easton at 802-951-6313.

Collection or disruption of state listed threatened or endangered plant or animal species requires a permit from the Vermont Agency of Natural Resources Heritage Program. Contact Steve Parren (802)241-3717.

Collection of any vertebrate species requires a Scientific Collecting Permit from the Vermont Department of Fish and Wildlife.

Any University of Vermont researcher conducting studies involving vertebrate animals must receive approval by the University of Vermont Institutional Animal Care and Use Committee. Contact Penny Cross at 802-656-4067.

Any environmental manipulations (constructions, major cutting of the forest, additions of fertilizer, etc.) especially above a 2300 foot elevation may require more extensive review and approvals.

VMC Monitoring Director:

Sandy Wilmot
Forests, Parks and Recreation
111 West St.
Essex Jct., VT 05452
(802)-879-5687

Lye Brook Wilderness Area Research Coordinator:

Nancy Burt
Green Mountain National Forest
231 North Main St.
Rutland, VT 05701
(802) 747-6742

RESEARCH IN LYE BROOK WILDERNESS

Research is an important use and benefit of the wilderness system. Wilderness areas provide a unique long term opportunity to monitor natural processes in a relatively undisturbed setting. While research is one of the stated uses of wilderness in the Wilderness Act of 1964, wilderness managers must also provide for a primitive, unconfined recreation experience for those desiring solitude and challenge. Wilderness represents a place to “get away from it all”. To fully enhance the wilderness experience, evidence of humans should be minimized. Colored flagging, paint and other obvious plot markings detract from this sense of solitude and remoteness. Much of the Wilderness may be dedicated to trail-less “bushwhacking”, and in some cases the entire Wilderness may be managed as such. Therefore, additional trails created by accessing research locations may also detract from the area’s primitive nature.

While research is an important use of wilderness, only “wilderness dependent” research is appropriate here. “Wilderness dependent” research refers to studies that require an extensive undisturbed setting, such as



monitoring interior songbirds in a continuous mature forest with no canopy openings. Other examples include long term succession of particular habitats in the absence of management activities such as logging, and the monitoring of a reintroduced species such as the pine marten. Research on unique habitats found only within the wilderness would be permissible. Monitoring of recreational impacts may also be necessary for effective wilderness management, such as campsite inventories to detect trends and redirect use as needed.

Lye Brook Wilderness is the only Wilderness in Vermont with a Class I Air Quality status. In short, this means that National Ambient Air Quality Standards must be met, and that proposals for pollutant-emitting industries in the proximity of southern Vermont may be rejected or refined to protect the air shed. Because of this, Lye Brook Wilderness has become a focal point for gathering baseline data and monitoring the effects of air pollution on the ecosystem.

Techniques and materials used for research must be designed to minimize adverse impacts on wilderness values. Motorized equipment, temporary shelters and enclosures will only be allowed in cases where no other alternative exists, and must be approved by the Regional Forester. These will be considered on a case by case basis. Radio telemetry to track animals will generally be permitted.

Because of the restrictions on research in Lye Brook Wilderness, there are opportunities for research outside of the Wilderness. These provide additional options for research which is not compatible with the Wilderness. It also offers easier access, and provides an opportunity for comparative research to monitor the effects of active management on the ecosystem.

GUIDE TO PLOT LOCATION AND MARKING

Within Lye Brook Wilderness:

1. When establishing permanent plots or study areas off trails, please locate plots at least 300 feet off trails. This will minimize the chance of encounters with hikers.
2. Plots should be marked as unobtrusively as possible. Small wooden stakes and inconspicuous tree scribes may be used. Other stakes may be acceptable for permanent plot marking, as long as they are small and relatively inconspicuous. Flagging and paint are not allowed. Other options are available. The Lye Brook Research Coordinator will assist in marking design.
3. Special attention should be paid to avoid establishing "research trails". If your area is frequently visited, please vary the route leaving the trail to avoid creating additional trails. New unplanned trails are not desirable within the wilderness, and this will also help protect your study area.
4. Global Positioning System (GPS) is encouraged for mapping study area locations, and for finding those areas in the future. Assistance from the Lye Brook Research Coordinator or Wilderness Ranger may be available to pinpoint GPS coordinates for future use.

Outside of Lye Brook Wilderness:

1. Plots should be located at least 150 feet from the trail. Periodically trails are relocated to avoid erosion, and this distance should prevent conflicts between trails and plots in most cases.



2. Avoid the overuse of flagging. While it is important to mark your study area, too much flagging in the woods can create problems. It can also prompt disgruntled hikers to remove the flagging. Please be sensitive to this. Flagging colors should be coordinated through the Lye Brook Research Coordinator to avoid confusion between different projects.
3. Permanent markers may consist of a PVC or metal pipe at plot center, aluminum tags on tree butts, or other non-corrosive items. Please clearly mark all items, and where abbreviations are used, send a list of these to the VMC Monitoring Director for permanent documentation.
4. If you frequently visit your study area and are creating “research trails” that hikers may see and wander onto, please place brush or other natural obstructions at the start of your trail to avoid any unwanted entry. Using varied paths from the main trail will help minimize this problem. This is for your protection, and to prevent hiker confusion.
5. Please keep in mind that this area may have silvicultural treatments in the future. Measures will be taken to protect existing study areas, but currently there are no guarantees for long term security. In all likelihood, no logging will occur in at least the next five years, with the exception of an area east of Branch Pond Road (Forest Road 70).

VERMONT MONITORING COOPERATIVE PROGRAM APPLICATION FOR 2001

FOR MONITORING AND/OR RESEARCH AT LYE BROOK AREA SITE

Applicant's Name _____ Telephone No.: _____

Applicant's Address _____



Organization/Affiliation _____

Project Title _____

1. Describe your project, including: purpose, details on study area size and location, number of samples and parameters to be taken, any changes made to the site, study area markings, structures or equipment to be installed. (This application may be accompanied by a more detailed project description of up to 2 pages in length.) We would like to include information on your activity in our annual VMC Project Description document. See the attached example for format and content required.

For previously approved VMC activities, describe any changes in your project from last year, both in the space below and on xeroxed page(s) from previous work plan or project description documents. You do not need to complete questions 2-6, but sign and date the application.

2. What types of activities by other VMC cooperators would be incompatible on the area/water body you are using (for example, observational data collection, management manipulations, shoreline erosion, stream alteration, etc)?

3. What is the anticipated duration of this project?

4. Has a specific study area location been identified, and if so, please indicate location on attached map (this applies to existing projects, too). If location is not known at this time, what criteria are you looking for in locating a plot?

5. List ways in which this project fits the goals and objectives of the VMC and the Lye Brook Area site.

6. Is your project data going to be available to other VMC cooperators, and if so, when and in what form?

Applicant's signature

Date

Terms of approval (if any):

Project approval:

Location approval:

VMC Official signature

Date

VMC Official signature

Date

GMNF Official signature

Date

GMNF Official signature

Date

2001 VMC Project Description Example

FOREST BIRD MONITORING

OBJECTIVE: Continue monitoring 2 sites established in 1991 to create a site-specific database of forest birds and determine trends over time.



Two permanent study sites were established in 1991; one in upper elevation subalpine spruce-fir, the other in lower elevation northern hardwoods. Five 10-minute point counts are made at 200 meter distances. Birds seen or heard are recorded. This is repeated twice during the height of breeding activities.

Project starting date

6/1991

Site Characteristics

Locations: 2 sites, one northern hardwood and one high elevation spruce fir

Elevations: 2200 and 3800 foot elevations

Aspect: west slope and summit

Sampling Frame

1-km transect

5 10-minute point counts

Measurements

Bird Species

Frequency

Sighting locations

Spatial Context

Results are comparable to 16 Vermont sites. See Appendix A.

QA/QC

Trained or experienced field crews.

Contact:Chris Rimmer

Vermont Institute of Natural Science

PO Box 86

Woodstock, VT 05091

(802)-457-2779

2001 VMC Project Description Form

_____project name

Objectives



Project Start Date

Site Characteristics

Sampling Frame

Measurements

Spatial Context

QA/QC

Contact person:



Study Site Map: Lye Brook Wilderness Area

