Vermont's Wildlife Action Plan*

November 22, 2005

Approved by the US Fish & Wildlife Service 11/22/2005

***Formerly the Comprehensive Wildlife Conservation Strategy**

Vermont's Wildlife Action Plan*

November 22, 2005

Main Document

Vermont Fish & Wildlife Department
103 South Main Street, 10 South, 2nd flr
Waterbury, VT 05671-0501

802-241-3700

www.vtfishandwildlife.com

Approved by the US Fish & Wildlife Service 11/22/2005

**Formally the Comprehensive Wildlife Conservation Strategy*

I. Acknowledgments

Just over a year ago we asked local, state and national agencies, non-governmental organizations, sportsmen, conservationists, academics, land managers and other wildlife experts to join together in the development of an all-state, all-species wildlife conservation strategy. The response to this ambitious challenge was an extraordinary and unprecedented outpouring of collaborative effort resulting in Vermont's Wildlife Action Plan (formally the Comprehensive Wildlife Conservation Strategy). We thank the many participating Conservation Partners (Table 1-1) for responding to the call despite already busy schedules. Moreover, our appreciation goes out to the individuals serving on the eight technical teams (Table 3-1) charged with the nitty-gritty details of conducting species and habitat assessments, integrating the varied and complex needs of many wildlife species and crafting a report for all Vermonters interested in wildlife conservation.

We gratefully acknowledge the help of the International Association of Fish and Wildlife Agencies, and in particular Dave Chadwick, who provided tireless and invaluable 24-7 assistance, coordination and encouragement to Vermont and the other states and territories. We are grateful to the US Fish & Wildlife Service, particularly Colleen Sculley and the rest of the staff at the Region 5-Federal Assistance office, for their ongoing guidance and support.

We thank Vermont's congressional delegation who helped create the opportunity for this Wildlife Action Plan (WAP) and for establishing and maintaining the State Wildlife Grants program that funds WAP development and implementation. State Wildlife Grants together with the other federal wildlife conservation funding programs are vital to keeping common species common.

We humbly note that our goal would have been unattainable without a solid foundation—the rich legacy of Vermont's wildlife conservation history—the observations, stories, data, research, planning efforts, conservation, education and wildlife-recreation programs, institutions and traditions established and nurtured by those passionate about wildlife and Vermont's natural heritage over the past two centuries.

Finally, to all those furry, finned, feathered, scaled, slimy and shelled creatures—the charismatic megafauna and the enigmatic microfauna—that so fascinate and enrich our lives and economies, we look forward to a bright and healthy future together in the Green Mountain State.

Funding

Funding for the development of the Vermont Wildlife Action Plan was provided by the State Wildlife Grant Program, Vermont Fish & Wildlife Department, voluntary contributions to Nongame & Natural Heritage Program Wildlife Tax-Check-off and License Plate fund, and the many organizations, agencies, businesses and individuals who volunteered their time and expertise.

Recommended citation

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, B. Popp, editors. 2005. Vermont's Wildlife Action Plan. Vermont Fish & Wildlife Department. Waterbury, Vermont. www.vtfishandwildlife.com

OFFICE OF THE GOVERNOR
STATE OF VERMONT

Dear Fellow Vermonters,

It is my pleasure to present to you this report: *Vermont's Comprehensive Wildlife Conservation Strategy* (CWCS). It was prepared by the Vermont Fish & Wildlife Department in collaboration with representatives of more than 60 local, state and national partner organizations and agencies. The CWCS represents the beginning of a historic conservation effort -- never before has Vermont undertaken such a comprehensive review of its wildlife.

Wildlife is important to Vermont and Vermonters. Wildlife is integral to the functioning of the ecosystems upon which we all depend, and two-thirds of Vermonters take part in wildlife-associated recreation. These Vermonters, along with tourists coming to Vermont to enjoy our wildlife, add close to $400 million to our economy annually.

We have a rich heritage of wildlife conservation going back more than 225 years to the appointment of our first game wardens in 1779. In 1864, George Perkins Marsh of Woodstock changed the way people around the world thought about land and land stewardship with his book *Man & Nature*. In the early 1900's, sportsmen played pivotal roles in the return of Vermont's wildlife icon the white-tailed deer, and later moose, beaver and salmon. And this year, all Vermonters can join me in celebrating the recovery of the common loon, peregrine falcon, and osprey to the point where they have been removed from the state's endangered species list.

The Comprehensive Wildlife Conservation Strategy marks the start of a new era in wildlife conservation, one where we can keep common species common. Furthermore, the CWCS complements my Clean & Clear Action Plan for Lake Champlain and the recently released Northern Forest Land Council 10th Anniversary Forum's Final Report: *Recommendations for the Conservation of the Northern Forest* to conserve the public and private forest lands and improve the economic viability of communities within our northern forests.

Together, these efforts support healthier wildlife populations and Vermont's reputation for a high quality of life and conservation of natural resources.

Sincerely,

The Honorable James Douglas

III. A User's Guide to Vermont's Wildlife Action Plan

Vermont's Wildlife Action Plan identifies conservation strategies designed to prevent wildlife from becoming endangered or threatened. It provides guidance that state and federal agencies, local governments, private landowners, businesses, universities, and non-government organizations all can follow. As a statewide, all-species conservation guide this document contains an enormous amount of information. Although it may seem easy to get lost in the details, readers are encouraged to remain mindful of the following:

- Use the Wildlife Action Plan to identify how your organization's mission and goals relate to and match up with the needs of wildlife and wildlife habitat. Some questions to consider include the following: What strategies, in what part of the state, could our organization implement? Which would provide the most benefits for the greatest number of Species of Greatest Conservation Need?

- Be aware of groups of species with similar needs. Use the Action Plan as starting points in planning and implementing various conservation efforts. For example, projects focused on a particular species, habitat type, landscape or problem might also address the needs of many other Species of Greatest Conservation Need (as well as other species that are not rare or declining).

- Consider the problems or opportunities you wish to address and determine the scale at which you are comfortable working. The Wildlife Action Plan contains strategies that range up the scale from local to statewide and beyond. For example do you prefer to work locally (e.g., maintaining and improving habitat on your own land), within your community (e.g., incorporating wildlife conservation your town plan), within a landscape or watershed (e.g., maintaining or improving the connectivity of a river and its tributaries), or at the statewide level (e.g., reducing the economic pressures that drive land conversion and fragmentation).

- Recognize the complexity of habitat management. By its nature, managing habitats can positively affect some species while negatively affecting others. This is to be expected, and land managers have long wrestled with how best to balance the needs of multiple species and habitats for a variety of conservation and economic uses. For example, managing for older growth forests at a location may benefit some species, but may not benefit (in fact, may displace) others that require forests at earlier successional stages. Similarly, thinning a forest stand will likely displace species requiring "forest interior" conditions.

  Further complicating habitat management issues is the fact that, in some cases, several Species of Greatest Conservation Need may be associated with a particular habitat type, but they may have different management needs or may use the same location at different times of the year or at different life stages. At times, managing for one or several Species of Greatest Conservation Need may conflict with the needs of other Species of Greatest Conservation Need or other more common species.

  There is no single "right" way to manage lands– just different ways that result in different outcomes. It is often beneficial to approach this complexity by looking beyond a specific property and examining how it fits into a broader area. This larger scale assessment should incorporate not only ecological opportunities but also economic issues, social needs, and political factors.

- Implementing these strategies will significantly help Species of Greatest Conservation Need, but they are not requirements. The Wildlife Action Plan is a guidance document, not a regulatory one. They are intended to provide a "menu" of opportunities; some may or may not be appropriate at any given place or point in time.

Finally, as complete and comprehensive as it is, the document is not without limitations. For example, by virtue of the federal guidance that helped create the Wildlife Action Plan, it focuses only on animals. Additional work is required to integrate the findings and recommendations in this document with other environmental conservation and resource management plans, recreation plans, forest management plans, transportation plans and town plans to name just a few.

Examples of Using the Wildlife Action Plan

If you are interested in management of a particular property or area

As an example, if you are developing a management plan for your woodland property in northern Vermont, you might be interested to know which habitat and community types are most likely to occur in that part of the state and the Species of Greatest Conservation Need (SGCN) generally found in them. Thus, you might want to "enter" the document at chapter 4:35 and appendix B. There you'll to find community descriptions, SGCN lists, information on the problems impacting those communities as well as priority conservation strategies, potential partners and potential funding sources. More detailed information about management considerations for these species can then be found in appendix A. Together with forest stand data and other economic factors this set of information can help guide on-the-ground management decisions.

If you are interested in the conservation a particular species or taxonomic group

"Enter" the document at appendix A to find detailed information about each Species of Greatest Conservation Need (SGCN), or at chapter 4 to learn about a taxonomic group (e.g., birds, fish, invertebrates, mammals, reptiles and amphibians). For example, if you are interested in conserving reptiles and amphibians you can go straight to chapter.4.30, if you are particularly interested in wood turtle conservation go to appendix A5 for the wood turtle Species Assessment Report.

The habitat description section of in each Species Assessment Report contains a list of habitat types, communities and landscapes used by that species. From the species-specific information you can then go to chapter 4:35 and appendix B to find conservation information for those habitat types, communities and landscapes and to see which other species occur in these habitats. This broader habitat-based level of analysis can enable more "bang for the buck" from various conservation actions.

If you are interested in a particular habitat type, community or landscape

"Enter" the document at chapter 4:35 and at appendix B. Here you will find information on the Species of Greatest Conservation Need that are associated with the habitat type, community or landscape as well as the Ecological Landscapes where the best management and restoration opportunities occur for the habitat. For example, if you are interested in lake (lacustrine) conservation you can go to appendix B:67 to find the Lacustrine Summary. It contains a list of the SGCN associated with lacustrine areas, ecological descriptions, and summaries of problems impacting lakes as well as priority conservation strategies.

If you want to address the overarching problems impacting wildlife across the state and region

"Enter" the document at chapter 1:9-Statewide Themes for Action. Here you will find strategies designed to address the issues and problems impacting Vermont's wildlife and wildlife habitat that are most effectively addressed at the state, regional/national and international levels. For example, habitat loss along migration routes and the economic pressures that drive habitat fragmentation.

Regardless of how you intend to apply the information (whether for research, education, grant writing, or on-the-ground management) or which way you choose to "enter" the document, you're encouraged to read the introduction and to move from one section to another. This approach should help put the conservation strategies listed within each section into a broader perspective and enhance the value, effectiveness and impact of your conservation work.

Additional Resources available from the VT Fish & Wildlife Department (FWD)

- *Conserving Vermont's Natural Heritage: a Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity*, available from FWD (www.vtfishandwildlife.com/library.cfm) is designed specifically to help communities plan for and conserve wildlife at the municipal level.
- The USDA's voluntary Wildlife Habitat Incentives Program (WHIP) provides technical and financial assistance to landowners to create and enhance wildlife habitat on their lands. For information contact 802-241-3700 or fwinformation@state.vt.us
- In the coming months the Department expects to complete a new landowner's guide to managing wildlife habitat. To check on its status contact fwinformation@state.vt.us.

Acknowledgement: We thank the Wildlife Action Plan developers in Wisconsin and Arizona for sharing their user's guides which we have adapted here.

IV. Table of Contents:
Vermont's Wildlife Action Plan 11/22/2005

I. Acknowledgements ii

II. Foreword iii

III. Users' Guide to Vermont Wildlife Action Plan v

IV. Table of Contents vii

V. NAAT Reviewer's Guide to Vermont's Wildlife Action Plan xi

VI. Executive Summary xxv

Chapter 1: Introduction
- Mandates, Mission and Strategic Focus 1-1
- Problem and Need 1-2
- Vermonters Care About Wildlife 1-3
- Congress Responds 1-3
  - Comprehensive Wildlife Conservation Strategy 1-4
  - Expected Results and Benefits of the Wildlife Action Plan 1-6
- Conservation Partners 1-7
- Statewide Themes for Action 1-9

Chapter 2: Vermont Overview
- Vermont Cares about Wildlife Conservation 2-1
- The Vermont Landscape—an Overview 2-1
  - Climate 2-2
  - Geology 2-2
  - Topography 2-3
  - Hydrology 2-3
  - Land Use History 2-4
  - Biophysical Regions of Vermont 2-4
- Vermont's Landscape—an Historical Perspective 2-6
- Vermont's Contemporary Land Use 2-8
- Contemporary Problems Impacting Wildlife in Vermont 2-8
  - Loss of Habitat 2-9
  - Impacts of Roads and Trails 2-10
  - Pollution & Sedimentation 2-10
  - Invasive Exotic Species 2-11
  - Climate Change 2-11
  - Data Gaps and Information Needs 2-11
  - The Silver Lining 2-12
- Conservation Success! Keeping Common Species Common 2-13
  - The Importance of Education, Law Enforcement and Wildlife-Associated Recreation to Wildlife Conservation 2-17
  - VT Department of Forests, Parks & Recreation: Current Efforts Related Wildlife Conservation 2-21
  - Vermont Department of Environmental Conservation 2-25
  - Why Is The Vermont Agency Of Transportation Concerned About Fisheries & Wildlife Issues? 2-29

Chapter 3: Developing Vermont's Wildlife Action Plan

Process and Organization 3-1
Timeline 3-1
Organizational Structure 3-1
Outreach and Public Involvement 3-5
Coordination with Other Agencies 3-7
Outreach events and products 3-8
Species & Habitat Conservation 3-10
Identifying Species of Greatest Conservation Need 3-10
Conservation of Species of Greatest Conservation Need & Their Habitats 3-14
Fine Filter Species 3-15
Coarse Filter 3-16
Landscape Classification & Ecological Divisions 3-17

Chapter 4: Conserving Vermont's Wildlife Resources

Vermont's Species of Greatest Conservation Need 1
Problems Impacting Species of Greatest Conservation Need 9
SGCN Conservation Strategy Development 11
Conserving Vermont's Birds 12
Conserving Vermont's Fishes 15
Conserving Vermont's Invertebrates 20
Conserving Vermont's Mammals 24
Conserving Vermont's Reptiles & Amphibians 30
SGCN Conservation at Multiple Scales 35
Landscape Forest Summary 41
Northern Hardwood Forest Summary 49
Spruce-Fir-Northern Hardwood Forest Summary 55
Oak-Pine-Northern Hardwood Forest Summary 61
Landscape Level Aquatic and Shoreline Summary 67
Landscape Fluvial (Stream) Summary 73

Chapter 5: Implementation, Monitoring & Review

Monitoring & Adaptive Management 5-1
Wildlife Action Plan: Implementation 5-13
Wildlife Action Plan Review 5-17

Chapter 6: Glossary & Acronym Key

Glossary 6-1
Acronym Key 6-4

Appendices

Users Guide to Vermont's Wildlife Action Plan

A. Species of Greatest Conservation Need Assessment Summaries
- A1-Birds
- A2-Fishes
- A3-Invertebrates
- A4-Mammals
- A5-Reptiles & Amphibians
- A6-Plant Species of Greatest Conservation Need list

B. Habitat & Community Conservation Summaries
- Introduction /SGCN Conservation at Multiple Scales
- Floodplain Forest Summary
- Hardwood Swamp Summary
- Softwood Swamps Summary
- Vernal Pools & Seeps Summary
- Open Peatlands Summary
- Marshes and Sedge Meadows Summary
- Wet Shores Summary
- Shrub Swamps Summary
- Upland Shores Summary
- Outcrops & Upland Meadows Summary
- Cliff & Talus Summary
- Lake Champlain Tributaries Summary
- Lower Connecticut River Summary
- Lake Champlain Summary
- Lacustrine Summary (excluding Lake Champlain)
- Grassland & Hedgerow Summary
- Mines and Quarries Summary
- Subterranean Summary
- Buildings & Other Structures Summary

C. Definitions of General Problem and Strategy Categories

D. Charters for the Teams & Committees of Vermont's CWCS

E. Sample Conservation Partner Correspondence

F. Sample CWCS Media Coverage

G. Sample Fish & Wildlife Conservation Newsletters

H. Secure Species: the initial species assessments during SGCN selection

I. Explanation of Legal Status and Information Ranks-VFWD-NNHP

J. SWG Proposal Evaluation Form

K. Invasive Exotic and Pest Species

L. Plans & Planning Processes Impacting Vermont's Wildlife

V. A Reviewer's Guide to Vermont's Comprehensive Wildlife Conservation Strategy[1] [2]

For use by the USFWS National Advisory-Acceptance Team (NAAT)

Congress requires that each state complete a Comprehensive Wildlife Conservation Strategy (CWCS) by October 1, 2005 if it wishes to remain eligible for State Wildlife Grant funds. There are eight congressionally required elements that each CWCS must address to be approved. Congress designated the Director of the US Fish & Wildlife Service (USFWS) to make approval determinations. The USFWS assembled a team of USFWS personnel and representatives from state fish and wildlife agencies and the International Association of Fish & Wildlife Agencies under the title National Advisory Acceptance Team (NAAT) and charged this group with reviewing each CWCS and making recommendations to the USFWS Director regarding CWCS approval.

According to USFWS guidance documents supplied to states, the NAAT "believes it must make an affirmative finding that all of the eight required elements are satisfactorily fulfilled in order for an "approval" recommendation to be made to the Director of the U. S. Fish and Wildlife Service."

This document is provided to help NAAT reviewers understand how Vermont addressed each of the eight congressionally required elements for a CWCS and where that information can be found in the report. It begins with an overview of how the report is organized and is followed by the eight elements and specifics as to where information satisfying the element can be found in the CWCS.

Report Development & Organization

Vermont took a linear approach to developing its CWCS (fig IV-1). We began by gathering stakeholders, experts and other agencies, organizations and individuals interested in wildlife conservation to finalize the development process and staff CWCS technical teams. Technical teams assessed the state's wildlife populations and then selected Species of Greatest Conservation Need (SGCN). For each SGCN the teams then delineated habitats, identified problems, research and monitoring needs and crafted conservation strategies. The SGCN were then assigned to one or more of 120 habitat categories, aquatic and natural communities and landscapes. These were then organized into 24 major habitat categories. Summaries of the status of each major habitat category were then developed. Statewide strategies and major themes for action were then identified to address those problems that impact many SGCN and habitats. Finally, a plan for the development of a statewide wildlife monitoring and adaptive management program was created.

Though development of this CWCS followed a bottom-up arc from individual species and populations to state and region-wide problems and solutions, its presentation in this report follows a different path. A user-friendly format, that includes five main chapters and 17 appendices, was selected to first provide readers with context, a big-picture view of wildlife conservation in the state, before diving deep in to the specifics of more 300 SGCN. Additionally, because we anticipate that most users of this 1,000-page document will only read sections of it there is some redundancy in the report. Reviewers will find information to help complete their assessment in the locations noted in Table IV-1.

---

[1] **Acknowledgement:** We thank the CWCS developers in Michigan and North Dakota for sharing their CWCS reviewer guides which we have adapted here, and the USFWS Region 5 Federal Assistance staff for their support and assistance.

[2] **CWCS is the Action Plan:** Comprehensive Wildlife Conservation Strategy was the working title of the Wildlife Action Plan during it's development. The CWCS name was changed to Wildlife Action Plan after receiving federal approval on 11/22/2005.

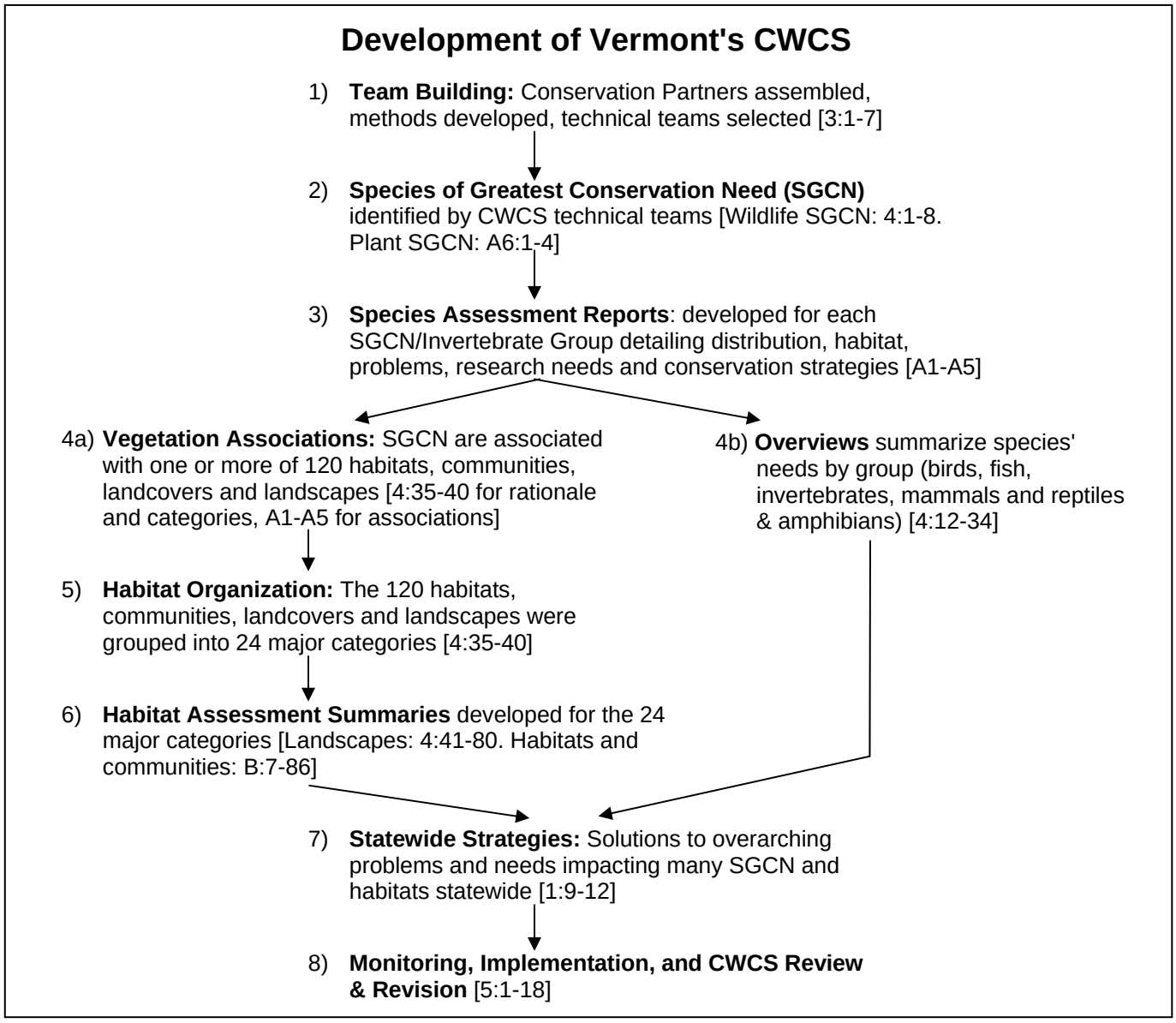

Fig 1: Development of Vermont's CWCS (Locations beginning with a letter (e.g., "B") refer to appendices. Appendix "A" contains subsection A1 through A6, one each of the six wildlife taxa examined in the CWCS (e.g. A3:1-6 refers to pages one through six if of appendix A3)

Table 1: Organization of Vermont's CWCS Report (Locations beginning with a letter (e.g., "B") refer to appendices. Appendix "A" contains subsection A1 through A6, one each of the six wildlife taxa examined in the CWCS (e.g. A3:1-6 refers to pages one through six if of appendix A3)

	Chapter/Page
Report Development/Methods	3
Species of Greatest Conservation Need	
List of SGCN	4:1-8, A6:1-4
SGCN selection procedures	3:10-14
Overview of SGCN by taxon (birds, fishes, invertebrates, mammals, herpitiles)	4:12-34
Detailed SGCN information (e.g. status, distribution, habitat, problems, research & monitoring needs and conservation strategies)	A1-A5
Habitation Delineation & Assessment	
Methods	3:15-17
Rationale for organization	4:35-40
Descriptions: desired conditions, problems, research, conservation strategies for Major landscapes Habitats and communities	 4:41-80 B7-86
Problems Impacting Vermont's Wildlife	
Problem identification and organization (methods)	3:14
Problem definitions	C:1-6
Summary of major problems	2:8-12
Problems impacting each SGCN	A1-A5
Problems impacting SGCN habitat	B:7-86
Conservation Strategies	
Strategy development and organization (methods)	3:14
Definitions of strategy categories	C:7-12
Statewide strategies and themes for action	1:9-12
Conservation strategies by taxon (birds, fishes, invertebrates, mammals, herpitiles)	4:XX-XX
Conservation strategies for individual SGCN & SGCN Invertebrate Groups	A1-A5
Habitat conservation strategies: Major landscapes Habitats and communities	 4:41-80 B7-86
Monitoring & Adaptive Management	5:1-12
Implementation	5:13-16
Review & Revision	5:17-18
Glossary/Acronym Key	6:1-5

Element 1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife.		
NAAT Guidance	**Chapter/Page**	**Detail**
1A. The Strategy indicates sources of information (e.g., literature, data bases, agencies, individuals) on wildlife abundance and distribution consulted during the planning process.	4:3-8 A6:1-4 3:9-13 A1-A5:all	List of VT's wildlife Species of Greatest Conservation Need List of VT's plant Species of Greatest Conservation Need Vermont used the best available science and information on wildlife abundance and distribution including databases and records maintained by NNHP*, Natureserve, universities and research facilities, regional and national monitoring efforts & the knowledge of technical experts. Together this represents the Vermont's current of state of species knowledge. For information sources for each SGCN see Species/Invertebrate Group Assessment Report bibliographies
1B. The Strategy includes information about both abundance and distribution for species in all major groups to the extent that data are available. There are plans for acquiring information about species for which adequate abundance and/or distribution information is unavailable.	A1-A5:all A.3all A1-A5:all 5:1-14	Abundance is noted by State rank & distribution by biophysical region and 8-digit watershed on the first page of each Species/Invertebrate Group Assessment Report. Abundance and distribution data came from NNHP* databases and was augmented by technical team experts. A distribution narrative is also included in the Species/Group Reports. Due to the dearth of data on invertebrate species, invertebrate SGCN are treated by taxonomic and habitat groupings rather than individually. Research needs for each SGCN and SGCN Group are detailed in the Research & Monitoring section of each Species Assessment Report. A plan-wide data gathering monitoring program is outlined in chapter 5.
1C. The Strategy identifies low and declining populations to the extent data are available.	3:9-10 A1-A5:all I:1 (for rank definitions) A1-A5:all A1-A5:all	VT's CWCS focused on low and declining populations. Our SGCN list includes federal and state threatened and endangered species, species ranked S1 and S2, and species identified by our technical team experts, partners and scientific literature. SGCN with low populations are identified with a State Rank of S1 (very rare) or S2 (rare) in the Conservation Assessment section of each Species Assessment Reports. The "Regionally Rare" field provides an indication of rarity in the Northeastern US and adjoining Canadian provinces based on regional and national research, BBS routes, other monitoring and consensus within technical teams. Declining populations are noted in the "State Trend" field of the Species Assessment Reports (see Conservation Assessment section). This field records population trends as "Stable," "Fluctuating," "**Declining**," "Increasing," or "Unknown." In many cases "unknown" was selected because of knowledge gaps. The "Assessment Narrative" field provides details where available. Research and monitoring needs are identified for species whose population trends are unknown or poorly known in the Research & Monitoring section of each Species Assessment Report.

* *NNHP: Nongame & Natural Heritage Program of the Vermont Fish & Wildlife Department*

Element 1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife.		
NAAT Guidance	**Chapter/Page**	**Detail**
1D. All major groups of wildlife have been considered or an explanation is provided as to why they were not (e.g., including reference to implemented marine fisheries management plans). The State may indicate whether these groups are to be included in a future Strategy revision.	3:9-10 A2 4:20-23 A3	VT's CWCS process considered all major groups of wildlife including, birds, fish, herptiles invertebrates, mammals, *and* plants. There are no marine environments with or adjacent to Vermont's borders. Several anadromous and catadromous fishes are on the VT SGCN list. Appropriate references are included in the Species/Invertebrate Group Assessment Reports for these species. Our knowledge of VT invertebrate is the most limited of all taxa. Research designed to augment our knowledge of invertebrates is included in the Invertebrate Overview and Invertebrate Group Reports
1E. The Strategy describes the process used to select the species in greatest need of conservation. The quantity of information in the Strategy is determined by the State with input from its partners, based on what is available to the State.	4:3-8 A6:1-4 3:9-13, 4:1-2 3:11, 4:12-34 3:11, 4:20-23 A3:all	List of VT's wildlife Species of Greatest Conservation Need List of VT's plant Species of Greatest Conservation Need See chapter 3 for selection procedure details. In general, expert input was incorporated through our CWCS technical teams (six Species Teams, Integration Team and Conservation Strategy Review Team). Additional input was solicited from Conservation Partners during Partner meetings and through individual and group correspondence Taxon specific selection procedures: Species Teams (technical experts for each of the six taxa listed above) selected SGCN based on criteria and guidance developed by our interdisciplinary Integration Team. There was some variation between teams in the threshold used for selection as SGCN (e.g. the herpitile team was the most conservative in selecting SGCN and the mammal team selected the most SGCN based on the need to address data gaps). This being Vermont's first CWCS our priority was not to ensure parity in numbers across taxa but rather to ensure that experts within each taxon were in accord regarding the species selected. The shear number of invertebrate species in VT (15,000-36,000) combined with our lack of knowledge of invertebrate biology and life-histories limited invertebrate SGCN selection. Whereas SGCN in other taxa are generally those species about which we know the *least*, invertebrate SGCN are generally those we know *best*. Future CWCS directed research and surveys will help expand our knowledge of this taxon.

NAAT Guidance	Chapter/Page	Detail
2A. The Strategy provides a reasonable explanation for the level of detail provided; if insufficient, the Strategy identifies the types of future actions that will be taken to obtain the information.	3:15	Protocols for describing habitats were developed by our multidisciplinary Integration Team in consultation with Species Teams.
	4:35-39 & repeated at B:1-5	Because no habitat classification system satisfactorily integrated the aquatic and terrestrial communities, successional stages, cultural habitats and landscapes used by VT's SGCN, a hybrid of several classification systems with more 120 types organized into 24 major habitat categories was created
	A1-A5:all	Habitat descriptions for each SGCN and Invertebrate SGCN Group are in the Species/Invertebrate Group Assessment Reports. Each includes a narrative, general habitat preferences, landscape requirements and assignment to one or more habitat type.
	4:41-80, B:7-86, 5:7, 1:11	Strategies to address habitat location and condition data gaps are included with habitat summaries, in the monitoring/ adaptive management plan for CWCS implementation and as statewide strategy (#3).
2B. Key habitats and their relative conditions are described in enough detail such that the State can determine where (i.e., in which regions, watersheds, or landscapes within the State) and what conservation actions need to take place	A1-A5:all	Key habitats for each SGCN are described in the Species Assessment Reports. Descriptions include a narrative and associations with 120 habitat, community and landscape categories.
	4:41-80 & B:7-86	Detailed assessments of the 24 major habitat categories comprising the 120 habitat types were created. Each contains descriptions, location, **current and desired conditions**, priority problems, research and monitoring needs and priority conservation strategies.

Element 3. Descriptions of problems which may adversely affect species identified in the 1st element or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats.		
NAAT Guidance	**Chapter/Page**	**Detail**
3A. The Strategy indicates sources of information (e.g., literature, databases, agencies, or individuals) used to determine the problems or threats	3:10-11 A1-A5:all	Vermont used the best available science and information to identify priority problems for SGCN and their habitats including records maintained by NNHP, Natureserve, universities and research facilities, PIF, PARC & the knowledge of technical experts. Teams identified only those factors posing significant and potentially significant problems for a species or habitat (not exhaustive lists of all possible problems).
	A1-A5:all	See the bibliography in each Species/Invertebrate Group Assessment Report for additional sources used.
	4:41-80, B-7-86	See the bibliography in each Habitat Summary for additional sources used. Technical team and expert knowledge played a significant role in the identification of problems.
	3:10-16	Identifying and addressing problems for SGCN generally began at the Species Teams level. However Integration Team and the Conservation Strategy Review Team also played important roles.

Element 3. Descriptions of problems which may adversely affect species identified in the 1st element or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats.		
NAAT Guidance	**Chapter/Page**	**Detail**
3B. The threats/problems are described in sufficient detail to develop focused conservation actions	C:1-6	Definitions for problem categories are in appendix C: Species Teams assigned each problem to one of 22 habitat related and non-habitat related problem categories. These categories were adapted from the wildlife conservation planning component of the Forest Plan Revision developed by the USFS Green Mountain National Forest in 2004. Categories are not mutually exclusive and depending on the problem and the species it impacts a problem could at times be placed in tow or more categories.
	A1-A5:all	Priority problems impacting a SGCN are listed in the Problem section of each Species/Invertebrate Group Assessment Report. This section contains a habitat-related and a non-habitat related problem list each followed by a narrative description of problems for that SGCN. Better known species generally have fuller problem descriptions. For some poorly understood SGCN descriptions of problems were more difficult. Species Teams have in some cases provided consensus recommendations of problems to provide a starting place to future researchers.
	4:12-34	Taxon-wide problems are described in the taxa overviews
	4:41-80 B:7-86	Problems impacting habitats are addressed in the Problem section of each Habitat Summary. The table includes a category field (for organizing problems), a "detail" field and a rank field (high, medium, low).
	3:14-15 table 3-5	Problems were assessed and ranked using methods adapted from Salafsky et al (2003) as many other states have done in their CWCS development.
	2:8-12	Major problems impacting species and habitats are summarized here.
3C. The Strategy considers threats/ problems, regardless of their origins (local, State, regional, national and international), where relevant to the State's species and habitats.	2:8-12, 4:9-10 C1-6	Problems, regardless of cause or origin, were considered. For example broad scale problems such as global warming and acid deposition as well as local problems such as the impact of recreational trails were all considered.
	3:15-16 C:1	Technical teams were instructed not to develop exhaustive lists of problems but rather to focus on the significant problems impacting a species or habitat.
3D. If available information is insufficient to describe threats/problems, research and survey efforts are identified to obtain needed information.	A1-A5:all	The Research & Monitoring Needs section of the Species/Invertebrate Group Assessment Reports includes a "threats and their significance" data field. In some cases research is also identified in the conservation strategies section of the Species/Invertebrate Group Assessment Reports.
	4:12-34	Taxon overviews note research needs that came up repeatedly.
	4:41-80 and B:7-86	Habitat summaries contain a "Problem and Information Needs" table that includes insufficient information problems.
	2:8-12	Data needs were identified as one of the major problems limiting our ability to conserve wildlife.

Element 3. Descriptions of problems which may adversely affect species identified in the 1st element or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats.		
NAAT Guidance	**Chapter/Page**	**Detail**
3E. The priority research and survey needs, and resulting products, are described sufficiently to allow for the development of research and survey projects after the Strategy is approved.	A1-A5:all	Priority research and survey needs are described for each SGCN in the Research and Monitoring section of the Species/Invertebrate Group Assessment Reports. Five research and monitoring categories were selected to help manage data collection (Habitat Requirements, Threats and Their Significance, Habitat Change, Monitor Threats, and Other Monitoring Needs). Technical Teams provided a narrative description of the research or monitoring need, and a priority rank of low, medium and high. As noted earlier teams were directed to focus on significant problems (medium and high). For most SGCN distribution and abundance data is the primary need.
	4:12-34	Priority research and survey needs applicable taxon-wide are broadly described in the taxa overviews
	4:41-80 B:7-86	Priority research and survey needs are described for each habitat category in the Problem and Information Needs section of each Habitat Summary
	5:1-12	Research and survey needs spanning multiple species and taxa will be addressed in the statewide wildlife monitoring and adaptive management program that will begin with CWCS implementation.
	1:11	The need for a wildlife monitoring and adaptive management program is identified as a fundamental statewide strategy

Element 4 Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions.		
NAAT Guidance	**Chapter/Page**	**Detail**
4A. The Strategy identifies how conservation actions address identified threats to species of greatest conservation need and their habitats.	C:7-10	Vermont's CWCS is a strategic document rather than an operational one and therefore focused on conservation strategies, not actions. We have been as explicit as possible in developing and describing conservation strategies while at the same time strategies are intentionally broad, directional, and nonspecific so as not to constrain our selection of actions for implementing strategies. Actions will be developed in the coming months and years during operational planning by the Fish & Wildlife Department and conservation partners. Generally, the connection between the problems and conservation strategies identified in the CWCS are intuitive and self-evident (e.g. habitat threatened by encroaching development would be targeted through a suite of strategies including technical assistance to developers and municipal planning authorities, conservation easements and efforts to increase funding for land acquisition).
	e.g. A2:81	Strategies are included to address immediate localized problems as well as broader, diffuse stressors and problems that may cause or exacerbate the localized problems (e.g. riparian habitat restoration to improve stream water temperatures and regional efforts to address climate change). Strategies are primarily voluntary and incentive-based.

Element 4 Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions.		
NAAT Guidance	**Chapter/Page**	**Detail**
4B. The Strategy describes conservation actions sufficiently to guide implementation of those actions through the development and execution of specific projects and programs.	3:14-16 C:7-10 4:11 C:7 5:13-15 1:9-12 4:12-34 A1-A5:all 4:41-80, B7-86	Technical teams developed conservation strategies to address priority problems to SGCN and their habitats identified. Strategies are organized using categories adapted from Salafsky et al (2005) Strategies balance the need to guide implementation with the need to maintain relevance and flexibility through the life of the CWCS (~10 years) and therefore are broad and directional. This allows for different approaches to providing that assistance, leaves the door open to a variety of potential implementers and allows for adaptation in response to changing conditions and new information. Where strategy implementation is to be funded by the State Wildlife Grant program the approach will be consistent with the mission and strategic plan of VT Fish & Wildlife Dept, and precise procedures will be detailed in operational plans once the CWCS is finalized. Conservation strategies are found in the following locations of the CWCS: 1) Statewide Strategies (strategies that appeared repeatedly across taxa and habitats, and strategies to address statewide, regional, and national problems). 2) Taxon-wide strategies 3) Species and invertebrate group specific strategies 4) Habitat and landscape strategies
4C. The Strategy links conservation actions to objectives and indicators that will facilitate monitoring and performance measurement of those conservation actions.	A1-A5:all 4:41-80 B:7-86 1:11 5:5-8	Performance measures are included for every conservation strategy in the Species/Invertebrate Group Assessment Reports and in the Habitat Summaries. Because of the inefficiencies (and impossibilities) inherent to monitoring every conservation action generated during CWCS implementation, the need for an effective plan-wide CWCS monitoring and adaptive management program is needed. Such a program could not be designed in time for inclusion in this CWCS but has been identified as statewide strategy (1:11). Guidelines and development recommendations are in chapter 5.
4D. The Strategy describes conservation actions (where relevant to the State's species and habitats) that could be addressed by Federal agencies or regional, national or international partners and shared with other States.	1:7 4:11 6:1 A1-A5 all 4:41-80 B7-86	Vermont's CWCS is predicated on the need to engage all possible organizations, agencies and individuals in wildlife conservation efforts and therefore contains conservation strategies that these entities can address. Moreover, partners may be the more logical and appropriate leaders for implementation of some strategies found in this report. Conservation partner definition Each conservation strategy in Species/Invertebrate Group Assessment Reports and Habitat Summaries includes a list of potential partners that could help implement it. No attempt is made to assign strategies to any partners and neither is implementation limited to this list.

Element 4 Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions.		
NAAT Guidance	**Chapter/Page**	**Detail**
4E. If available information is insufficient to describe needed conservation actions, the Strategy identifies research or survey needs for obtaining information to develop specific conservation actions	A1-A5 all 4:41-80 B7-86 e.g.A4:49	Research and survey needs are identified for each SGCN in its Species/ Invertebrate Group Assessment Report (in the Research & Monitoring Needs section and in some cases in the Conservation Strategies section) Research and survey needs for habitats are described in the Priority Conservation Strategy section of each Habitat Summary There are cases where so little is known about a SGCN that surveys and research are needed before species specific conservation actions can be recommended here. Where this occurs (e.g., red bat, other small mammals and invertebrates), the recommended surveys and research are described in the Research and Monitoring Needs section of each Species/Invertebrate Group Assessment Report and the Conservation Strategies section does not appear.
4F. The Strategy identifies the relative priority of conservation actions.	3:15 A1-A5:all 4:41-80 and B:7-86 5:13-15, J	All strategies selected for inclusion in VT's CWCS are deemed "priority" strategies and are ranked "medium" or "high" priority (low priority strategies were dropped from consideration). No further prioritization is included here. The rationale is that no prioritization that would satisfy all partners and their varied missions and interests. Detailed discussions with the Conservation Strategy Review team focused prioritization efforts on problems impacting SGCN and habitats rather than on strategies. For species-level conservation, strategy ranks are found in the Species Strategies section of each Species/Invertebrate Group Assessment Report. For habitat level conservation, all strategies found in the Priority Conservation Strategies section of habitat summaries are considered "priorities." Allocation of SWG funds will require additional strategy and action prioritization. This will occur in the coming months and years according to the process described in "Allocating State Wildlife Grant Funds."

Element 5. Descriptions of the proposed plans for monitoring species identified in the 1st element and their habitats, for monitoring the effectiveness of the conservation actions proposed in the 4th element, and for adapting these conservation actions to respond appropriately to new information or changing conditions		
NAAT Guidance	**Chapter/Page**	**Detail**
5A. The Strategy describes plans for monitoring species identified in Element #1, and their habitats.	A1-A5:all 4:41-80 B7-86 5:7 1:11 5:2-5 4:12-34	Monitoring needs are described for each SGCN/SGCN Invertebrate Group in the research and monitoring needs section of each Species/Invertebrate Group Assessment Report. Survey and monitoring recommendations are described for habitats in the Priority Conservation Strategies section Habitat Summaries. Due to time constraints in the development of Vermont's CWCS, the report does not contain detailed monitoring plans for SGCN and SGCN habitats. Development of a monitoring plan was identified as a statewide strategy (1:11) and a framework for its development is provided in chapter 5. Existing monitoring programs addressing SGCN are reviewed. Includes monitoring needs that were frequently cited for a taxon

Element 5. Descriptions of the proposed plans for monitoring species identified in the 1st element and their habitats, for monitoring the effectiveness of the conservation actions proposed in the 4th element, and for adapting these conservation actions to respond appropriately to new information or changing conditions		
NAAT Guidance	**Chapter/Page**	**Detail**
5B. The Strategy describes how the outcomes of the conservation actions will be monitored.	A1-A5:all 4:41-80 B:7-86 5:5 5:5	Performance measures are included for conservation strategies in the Species/Invertebrate Group Assessment Reports and in the Habitat Summaries. Development of the monitoring plan noted in 5A will include implementation, effectiveness and validation monitoring procedures. Some implementation and financial monitoring protocols are already in operation for State Wildlife Grant-funded projects.
5C. If monitoring is not identified for a species or species group, the Strategy explains why it is not appropriate, necessary or possible	4:35 5:8	Not every SGCN or SGCN group will be directly monitored. Attempting to do so would quickly grind VT's CWCS program to a halt. The monitoring program that will be developed as part of VT's CWCS implementation will likely include a coarse filter strategy based on key indicators and habitats that will provide an effective means of monitoring most SGCN. The monitoring plan to be developed will also identify those SGCN that cannot be served by indicator or habitat monitoring, and those that are extremely rare or threatened. These will be monitored directly.
5D. Monitoring is to be accomplished at one of several levels including individual species, guilds, or natural communities.	1:11 5:7-8	The monitoring program to be developed as part of VT's CWCS implementation will monitor SGCN, habitats threats and actions at multiple scales from species and site specific to statewide, regional and international.
5E. The monitoring utilizes or builds on existing monitoring and survey systems or explains how information will be obtained to determine the effectiveness of conservation actions.	5:2-5 A1-A5 4:12-34 5:2	Existing monitoring and survey systems are reviewed in monitoring section of chapter 5 and noted in some Species Assessment Reports and Taxa Summaries. Utilizing and where needed, building on effective existing monitoring systems will be stressed in the development of VT's CWCS monitoring program.
5F. The monitoring considers the appropriate geographic scale to evaluate the status of species or species groups and the effectiveness of conservation actions.	1:11 5:8	Monitoring of species, habitats, threats and strategies should be at scales appropriate to provide meaningful data for a broad array of users.
5G. The Strategy is adaptive in that it allows for evaluating conservation actions and implementing new actions accordingly.	5:5 5:6-7 A1-A5:all 4:41-76 B:7-86 J:5	Implementation, effectiveness and validation monitoring will be important components of VT's CWCS monitoring program and will be used to assess our efforts and to focus future conservation actions. VT's CWCS encourages adaptive management by including performance measures for strategies in the Species Assessment Reports and Habitat Summaries. Projects funded through SWG will be required to have explicit goals and objectives that can be monitored so that data can support overall plan monitoring.

Element 6. Descriptions of procedures to review the Strategy at intervals not to exceed ten years.		
NAAT Guidance	**Chapter/Page**	**Detail**
6A The State describes the process that will be used to review the Strategy within the next ten years.	5:6-7 5:17-18	Vermont's CWCS will be reviewed on a 10-year cycle. That cycle begins almost immediately as monitoring and reporting described in the CWCS and new and ongoing collaboration with partners will contribute significantly to the review of the CWCS. In 2015 we expect to show that we've reviewed and adapted VT's CWCS accordingly from the outset.

Element 7. Descriptions of the plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Strategy with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats		
NAAT Guidance	**Chapter/Page**	**Detail**
7A. The State describes the extent of its coordination with and efforts to involve Federal, State and local agencies, and Indian Tribes in the development of its Strategy.	3:7 3:7-9 1:8 3:1-9	There are no Native American tribes within the borders of Vermont that are officially recognized by the state or by the federal Bureau of Indian Affairs. Further, there are no tribal entities that manage significant land and water areas within the state or administer programs that significantly affect the conservation of Species of Greatest Conservation Need or their habitats. However all Vermonters including Native Americans were encouraged to take part in the development of the CWCS as Conservation Partners and the general public input process Federal, State and local agencies were invited to participate in CWCS development early in the process. Many participated in CWCS development as Conservation Partners (Table 1-1) and staff from many agencies served on CWCS technical teams (Table 3-1). Agencies (with other Conservation Partners) also previewed and provided comments on drafts of the CWCS before a draft was made available to the general public.
7B. The State describes its continued coordination with these agencies and tribes in the implementation, review and revision of its Strategy.	5:13 1:7 A1-A5:all 4:12-80 B:7-86 3:7-8 5:16-17	Effective implementation of VT's CWCS requires ongoing collaboration and coordination among partners (including local, state, and federal agencies—as well as with neighboring states and Quebec provinces). This is stressed throughout the document. Implementation of many of the conservation strategies included here will require continued coordination and collaboration with other agencies. The review and revision process will follow the same process used in the development of the CWCS and will include participation by agencies.

Element 8. Descriptions of the necessary public participation in the development, revision, and implementation of the Plan.		
NAAT Guidance	**Chapter/Page**	**Detail**
8A. The State describes the extent of its efforts to involve the public in the development of its Strategy.	3:1-9 1:8 D:all E:all 3:6 F:all G:all 3:8	Public involvement in the CWCS is described in chapter 3. Public involvement occurred particularly through non-governmental organizations and citizen committees such as the VT Fish & Wildlife Board and the VT Agency of Natural Resources' Endangered Species Committee. Public involvement began early in the CWCS development process. Many participated in CWCS development as Conservation Partners (Table 1-1) and staff from many NGOs served on CWCS technical teams (Table 3-1). NGO's also previewed and provided comments on drafts of the CWCS before a draft was made available to the general public. Charters for Conservation Partner and technical team participation are in appendix D. Sample correspondence with partners is in appendix E. General public involvement in CWCS development is described in chapter 3. Sample media coverage is in appendix F Sample outreach documents are in appendix G VT CWCS web address is: www.vtfishandwildlife.com/SWG_home.cfm The General public was invited to review and comment on a draft of the CWCS in July and August of 2005.
8B. The State describes its continued public involvement in the implementation and revision of its Strategy.	1:7 A1-A5:all 4:12-80 B:7-86 3:9 5:13 5:16-17	Implementation of many of the conservation strategies for SGCN and habitats will require public involvement. Ongoing outreach efforts will help inform and involve the public in CWCS implementation and revision. Effective implementation of VT's CWCS requires ongoing collaboration and coordination with the public. This is stressed throughout the document. The review and revision process will follow the same process used in the development of the CWCS and the public will again be encouraged to participate.

References

Salafsky, N., D. Salzer, J. Ervin, T. Boucher, and W. Otlie. 2003. Conventions for defining, naming, measuring, combining, and mapping threats to conservation: an initial proposal for a standard system, December 2003 Draft. Bethesda, MD.

Salafsky N., D. Salzer. 2005. Proposed Taxonomy of Conservation Actions Draft 5. January, 11 2005. Bethesda, MD.

VI. Executive Summary

Development of Vermont's Wildlife Action Plan (WAP) formerly the Comprehensive Wildlife Conservation Strategy) began in January of 2004. Completion of a WAP by October 1, 2005 is a requirement of the federal State Wildlife Grants (SWG) program. The goal of both the State Wildlife Grants program and the WAP is to prevent wildlife from becoming endangered through early, strategic efforts to conserve wildlife and habitat. SWG provides funding and the WAP provides the strategic guidance. Since 2001, Vermont has received or become eligible for more than $3 million in State Wildlife Grant funds.

This is an historic effort. Never before has Vermont undertaken such a comprehensive review of its wildlife. Moreover, every state and territory in the nation is also developing Action Plans. Combined, this is the largest wildlife conservation effort in the US—ever. Wildlife biologists, ecologists, sportsmen and other conservationists, business leaders and state and federal agencies representing more than 60 entities have signed on as Conservation Partners to work with the Vermont Fish & Wildlife Department (VFWD) to create Vermont's Wildlife Action Plan.

This report is the result of extraordinary effort. Employing a rigorous science-based process using the best available existing information WAP technical teams of VFWD staff and Conservation Partners assessed the status all of Vermont's birds (268), fish (94), mammals (61), reptiles and amphibians (42) and many, many groups of invertebrates ranging from mussels, to beetles, to butterflies (estimates of Vermont invertebrate diversity range from 15,000 to 36,000 species).

Following Congressional requirements, the WAP focuses on Species of Greatest Conservation Need (SGCN)—wildlife with declining populations; wildlife that are threatened or potentially threatened; and, wildlife that are so little known in the state that experts cannot yet ascertain their status. Congress further required that each WAP include the following eight elements:

1. Identification of the distribution and abundance of SGCN
2. Descriptions of the location and condition of key habitats
3. Descriptions of key problems and research needs for SGCN and their habitats

4. Prioritized conservation strategies
5. Monitoring plans for species, habitats and conservation actions
6. A process to review and revise the WAP at intervals not to exceed ten years
7. Coordination with other wildlife and land management plans
8. A public involvement process.

Identification of Species of Greatest Conservation Need began in May of 2004. By September 2004 technical teams had selected 143 vertebrates, 191 invertebrate and 577 plants as Species of Greatest Conservation Need. (Note that plants are not eligible for SWG funds, but our hope is that conservation of wildlife SGCN will benefit the plants).

From September 2004 through May 2005 technical teams completed element numbers two through seven above and an interim review of conservation strategies (a.k.a. the reality test) by the Conservation Strategy Review Team occurred in January and February of 2005. Review of the WAP by Agency of Natural Resources commissioners, conservation partners and the general public ran from April through July of 2005.

Problems and Solutions

The problems most frequently identified as impacting SGCN are not new concepts to those concerned about wildlife conservation, they include:

- Information needs and data gaps critical to conservation success
- Loss of habitat (from conversion, degradation, fragmentation and lack of needed successional stages in appropriate juxtaposition)
- Impacts of roads and trails
- Pollution and sedimentation
- Invasive species
- Climate change

As a wildlife conservation guide for the entire state—not just the Vermont Fish & Wildlife Department—the WAP includes some strategies that almost any individual or organization can implement. The most common strategies proposed here to alleviate problems impacting SGCN also aren't new: they include conducting habitat restoration, providing education and technical

assistance to landowner and land managers, providing financial and economic incentives and encouraging wildlife-compatible resource use.

Moreover, the recommendations in this report underscore the need for proactive, cost-effective conservation efforts and increased collaboration, coordination and sharing of data and expertise among all those interested in wildlife conservation. The WAP and its recommended strategies help realize these needs by:

- Providing a common conservation vision to guide state and federal agencies as well as sportsmen's and non-profit conservation organizations.
- Putting existing land and resource management and conservation needs into a broader context, providing recognition for the contributions that landowners and land managers are already making towards a long-term conservation strategy.
- Building a reliable, science-based data set to provide a "big picture" view (biophysical region and statewide) of Vermont's wildlife resources to establish current conditions and to measure changes into the future. These data will allow state agencies to work with the public and private sector more effectively.
- Identifying areas where conservation activities will provide the greatest benefit to cost ratio (thereby increasing the effectiveness of limited conservation resources).
- Allowing use of existing programs to more effectively provide incentives or technical assistance to private landowners for voluntary actions to conserve natural resources on private lands and identify the need for additional landowner incentive or technical assistance programs.

Finally, a monitoring program will collect new data and provide an ongoing assessment of the impact and effectiveness of conservation strategies. This information along with regular communication and coordination with conservation partners will serve as the backbone of a adaptive management program to fine-tune conservation strategies and ensure that Vermont's Wildlife Action Plan will remain a vital road map for wildlife conservation efforts.

The Future of Wildlife Conservation

State Wildlife Grants funding comes at a critical time. The traditional funding source for wildlife conservation at the state level has been sportsmen. Hunting, fishing and trapping licenses and taxes on their gear account for nearly 80% of Vermont's wildlife conservation funds. But the pressures on wildlife have changed and increased in intensity since these funding programs began in the early decades of the 1900's. Today, these funds, most of which are dedicated for game and sportfish species, are stretched thin as the Fish & Wildlife Department addresses new issues and problems such as development and Act 250 reviews, pollution, invasive species and overabundant wildlife. Furthermore there are new and expanding constituencies interested in wildlife and putting pressure on wildlife including hikers, bird watchers, and off-road vehicle users.

The State Wildlife Grants program is not intended to replace sportsmen's dollars. Rather, it will take some of the weight of conservation funding off the shoulders of sportsmen and broaden our capacity to conserve wildlife.

The task of conserving our Species of Greatest Conservation Need is challenging but we know success is possible from our history with wildlife conservation successes such as the wild turkey, white-tailed deer, moose, common loon, fisher and peregrine falcon. Conserving wildlife is in all our best interests. It means reducing the potential imposition of regulatory requirements on Vermont businesses and communities that come with threatened and endangered species listings. It means healthier ecosystems upon which we all depend. And it means a Vermont rich in wildlife which we can all enjoy.

The Wildlife Action Plan and State Wildlife Grants dollars mark the start of a new era in wildlife conservation, one where we can keep common species common.

Vermont's
Wildlife Action Plan

November 22, 2005

Chapter 1
Introduction

Mandate, Mission and Strategic Focus 1

Problem and Need 2

Vermonters Care about Wildlife..... 3

Congress Responds 3

Wildlife Action Plan 4

Expected Results and Benefits of the Wildlife Action Plan 6

Major Conservation Partners..... 7

Statewide Themes for Action..... 9

formally the Comprehensive Wildife Conservation Strategy (CWCS)

1. Introduction

These are exciting times for wildlife conservation. All across the country, state fish and wildlife agencies are completing a Wildlife Action Plan. New funds and new initiatives are advancing a long history of conservation success.

Vermont is noted for its beautiful juxtaposition of woodlands and farms, streams and ponds—not to mention Lake Champlain and the Green Mountain chain. Fish and wildlife resources are an integral part of the Vermont experience and quality of life for Vermonters. Deer, moose, wild turkey, and geese are thriving and offer sustainable hunting and viewing opportunities. In recent years, loon, osprey, peregrine falcon populations have recovered allowing for their removal from the state threatened and endangered species list. And, many of our waters teem with outstanding fishing opportunities. The landscape and the wildlife attest to the state's meaningful conservation ethic. Vermont's Wildlife Action Plan offers an opportunity for measured engagement, by all Vermonters, in addressing new challenges, filling in knowledge gaps, and implementing management programs to keep common species common thus preventing future need to place species on threatened and endangered species lists.

Mandate, Mission and Strategic Focus

The Vermont Fish & Wildlife Department is specifically charged with promulgating rules, through the Fish & Wildlife Board, enforcing those rules and procedures, and conducting programs that implement the following policy statements.

"The inhabitants of this State shall have liberty in seasonable times, to hunt and fowl on the lands they hold, and on other lands not enclosed, and in like manner to fish in all boatable and other waters (not private property) under proper regulations. (Vermont Constitution, Chapter 2, Article 67)."

"It is the policy of the state that the protection, propagation, control, management and conservation of the fish, game, and furbearing animals in this state is in the interest of the public welfare, and that safeguarding of these valuable resources for the people of the state requires a constant and continual vigilance (10 V.S.A. Section 4081).

The Department's mission is "the conservation of all species of fish, wildlife, and plants and their habitats for the people of Vermont." The Department's dedicated professionals enforce laws, manage Wildlife Management Areas, conduct species-specific research, restoration and management actions, issue licenses, grow fish, and provide educational and outreach services. Three of the Department's planning goals are:

Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.

Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

Maintain safe fish and wildlife based activities and limit harmful human encounters with fish and wildlife species and provide general public safety service incidental to primary fish and wildlife enforcement duties.

Throughout its 100-year history, many of the Department's initiatives focused on game species, in part because of constituent interest, as well as the user-pay system of funding fish and wildlife conservation through license sales and excise taxes on hunting and fishing equipment. As our mission statement suggests, the scope of conservation challenges facing the Department extends beyond species which people choose to harvest.

Problem and Need

Historically, there have been dedicated funds available for game and sportfish species as well as Threatened and Endangered species. Unfortunately, there has not been a dedicated revenue stream supporting management for the vast majority of wild animals that do not fall within either category. For example, 269 species of birds are found in Vermont. However, only about 30 of these are hunted and only a handful (e..g., common loon, osprey, peregrine falcon) have had recovery funding.

The full status of many species is unknown in Vermont. There are many species for which very little population or distribution data exist including most reptiles, amphibians, small mammals, stream fish, and invertebrates, including insects and crustaceans. In 1985, the Nongame and Natural Heritage Program was established within the Fish and Wildlife Department. Both an income tax check-off and a conservation license plate have been important revenue mechanisms for addressing wildlife diversity management and species recovery planning generating approximately $250,000 per year, but still not sufficient to adequately meet needs.

Vermonters Care about Wildlife

Wildlife is very important to the people of Vermont. Almost anyone you talk with has a story to tell about deer hunting, hummingbirds in the garden, or geese winging south.

The 2001 National Survey of Fishing, Hunting, and Wildlife Associated Recreation conducted by the U. S. Fish and Wildlife Service documented that 67% of Vermonters went fishing, hunting, or wildlife watching. Vermont ranked second, only behind Alaska in participation (US Dept of Interior). This same survey estimates that $386 million was spent on wildlife recreation in Vermont.

A 2000 public attitude survey of 1005 Vermonters determined that the protection of fish and wildlife resources, including habitats, as well as the opportunity to engage in wildlife-dependent recreation was important to 97 percent of respondents (Responsive Management 2000).

Congress Responds

In the early 1990's state fish and wildlife agencies partnered with a variety of non-government organizations and businesses to advocate for broader federal funding to address the needs of species that were not hunted or fished and to "keep common species common." However this was never implemented. The funding initiative was labeled Teaming with Wildlife. Initially, an excise tax on wildlife–related recreational equipment, such as binoculars and wildlife viewing guides, was identified as the best funding alternative. Over time, and with congressional encouragement, a different model was developed, one utilizing

offshore gas and oil receipts. The concomitant legislation was termed the Conservation and Reinvestment Act (CARA).

Congress responded with a new annual appropriation in Fiscal Year 2001 first called the Wildlife Conservation and Restoration Program and later the State Wildlife Grants Program. Since that time, the Vermont Fish and Wildlife Department has been eligible for more than 3 million dollars of federal funds. These dollars have vastly improved our ability to fund new research, inventory, and management initiatives for species such as bobcats, timber rattlesnakes, lake sturgeon, butterflies, and the Bicknell's thrush.

Wildlife Action Plan

The receipt of federal dollars has been predicated on individual state commitment to develop a plan. These documents must be submitted to the U. S. Fish and Wildlife Service for approval by October 1, 2005. Even though the Wildlife Action Plan is expected to address the full array of wildlife in a state or jurisdiction, the focus is on "species of greatest conservation need." The federal legislation prescribes eight elements for consideration in the ACTION PLAN, as per below:

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

6) Develop a plan review process: Describe procedures to review the Wildlife Action Plan at intervals not to exceed ten years.

7) Coordinate with other plans: Coordinate the development, implementation, review, and revision of the Action Plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.

8) Include public participation: Describe public participation in the development, revision, and implementation of the Action Plan and projects and programs.

Plant conservation and education and law enforcement projects are not eligible for State Wildlife Grants funding. We expect that species, community and landscape level conservation will provide secondary benefits including addressing the needs of many plant Species of Greatest Conservation Need (SGCN). Furthermore, the Vermont Action Plan include some education and law enforcement-based conservation strategies under the assumption that the Action Plan will have planning and funding development beyond the requirements of the State Wildlife Grants program.

Though the secondary benefits to plants and other non-SGCN species noted above are expected to accrue from the implementation of the Action Plan, this Plan should not be viewed as a biological diversity (biodiversity) conservation plan. State Wildlife Grant funds will be targeted to conservation of SGCN. Just as historic and ongoing game management efforts benefit multiple non-target species of plants and wildlife, so to will the Wildlife Action Plan.

Expected Results and Benefits of the Wildlife Action Plan

The Action Plan should provide the following benefits:

- Provide a science-based foundation for understanding the issues involved in addressing wildlife needs.
- Reduce the risk of further Threatened and Endangered Species listings that would impose additional regulatory requirements on Vermont businesses and communities.
- Provide a common conservation vision to guide state and federal agencies as well as sportsmen's and non-profit conservation organizations, in improving prospects for effective coordination and reducing conflicts.
- Put existing land and resource management and conservation needs into a broader context, providing recognition for the contributions that landowners and land managers are already making towards a long-term conservation strategy.
- Increase the effectiveness of limited conservation resources by identifying areas where conservation activities will provide the greatest benefit to cost ratio. Encourage conservation actions to be more proactive and less reactive and improve coordination between agencies and organizations to ensure cost-effective conservation.
- Allow use of existing programs to more effectively provide incentives or technical assistance to private landowners for voluntary actions to conserve natural resources on private lands.
- Identify the need for additional landowner incentive or technical assistance programs more easily.
- Demonstrate Vermont's commitment and capacity to conserve species and habitats. Vermont's reputation for a high quality of life and preservation of natural resources—one of the state's core strengths in attracting businesses—will be maintained.
- Build a reliable, science-based data set to provide a "big picture" view (biophysical region and statewide) of Vermont's wildlife resources to establish current condition and measure changes into the future. These data will allow state agencies to work with the public and private sector to more effectively.
- Conserving Vermont's wildlife will maintain and perhaps increase the numbers of Vermonters and visitors who interact with and recreate in the outdoors.
- Vermont's eligibility for future conservation funds from State Wildlife Grants will be maintained. These funds can be used for conservation activities that benefit the environment, economy and communities of the state.

Major Conservation Partners

At the outset, it is important to acknowledge that the Vermont Wildlife Action Plan is *not* only, or simply, a Department plan. Instead, it is a blueprint for wildlife conservation *in Vermont*. The distinction is important and one that presupposes potential participation in achieving conservation strategies by a wide variety of management, education, and research entities.

Vermont has an outstanding history of citizen participation in the management of its fish and wildlife resources. This should come as no surprise given the high level of interest Vermonters have in wildlife, as noted above.

Even though sportsmen and women were at the forefront of early funding and conservation initiatives, and remain committed unto those ends, the past thirty years or so has seen the emergence of other interests including birders and nature photographers, land and habitat conservation advocates, and hikers and paddlers, to name a few. The Vermont Wildlife Action Plan has benefited from the strong, helpful, and encouraging planning assistance of many individuals and organizations (table 1-1).

Table 1-1: Wildlife Action Plan Conservation Partners

The development of Vermont's Wildlife Action Plan has been a collaboration of dozens of agencies, organizations and businesses representing diverse interests who have joined forces to better conserve wildlife. As of August 1, 2005 the following entities have signed on as Conservation Partners

American Chestnut Foundation
Association of Vermont Conservation Commissions
Audubon Vermont
Burlington Electric Department
Center for Woodlands Education
Connecticut River Watershed Council
The Conservation Fund
Consulting Foresters Association of Vermont
Ducks Unlimited
Echo
Endangered Species Committee
Fairbanks Museum & Planetarium
Forest Watch
Green Mountain National Forest
Hunters, Anglers & Trappers Assoc of Vermont
International Association of Fish & Wildlife Agencies
Keeping Track, Inc
Lake Champlain Basin Program
Lake Champlain Committee
Lake Champlain International, Inc.
Lake Champlain Land Trust
Lake Champlain Walleye Association
Lewis Creek Association
Marsh-Billings-Rockefeller NHP
National Wild Turkey Federation
National Wildlife Federation
Natural Resources Conservation Service
The Nature Conservancy
New Haven River Anglers Association
North Country Environmental & Forestry
Northern Forest Alliance
NorthWoods Stewardship Center
Ruffed Grouse Society
Ryegate Power Station
Sierra Club
Society of American Foresters
Smugglers Notch Resort
Sportsmen Inc
Trout Unlimited
US Fish & Wildlife Service, Lake Champlain Fish & Wildlife Resources Complex
US Fish & Wildlife Service, Missisquoi NWR
US Fish & Wildlife Service, Nulhegan Basin Division
University of Vermont Rubenstein School of Environment and Natural Resources
University of Vermont Botany Department
Vermont Agency of Transportation
Vermont Association of Snow Travelers
Vermont ATV Sportsman's Association, Inc
Vermont Cooperative Fish & Wildlife Research Unit
Vermont Coverts
Vermont Department of Environmental Conservation
Vermont Department of Forests, Parks & Recreation
Vermont Department of Housing & Community Affairs
Vermont Farm Bureau
Vermont Federation of Sportsmen's Clubs
Vermont Fish & Wildlife Board
Vermont Forest Products Association
Vermont Institute of Natural Sciences
Vermont Land Trust
Vermont League of Cities and Towns
Vermont Loggers Association
Vermont Natural Resources Council
Vermont Outdoor Guides Association
Vermont Regional Planning Commissions
Vermont Ski Area Association
Vermont State Grange
Vermont Trappers Association
Vermont Woodlands Association
Wildlands Project
Wings Environmental

Representative Steve Adams
Office of Congressman Sanders
Office of Senator Jeffords
Office of Senator Leahy

Statewide Themes for Action

In the course of reading or evaluating this Action Plan, it becomes apparent that there is a great deal of commonality, or unifying themes, between taxonomic groupings of species of greatest conservation need. For example, habitat conservation, improved knowledge of distribution and abundance, and education are obviously foundational, given their redundancy. Concomitantly, it is possible to make some strategy groupings that would appear to be pivotal in achieving conservation success. Before doing so, it would be helpful to make four observations.

First, in 2002, the International Association of Fish and Wildlife Agencies (IAFWA) adopted a position paper entitled "The Value of the North American Model of Fish and Wildlife Conservation" (Prukop and Regan 2005). The Vermont Fish and Wildlife Department is a member of IAFWA and has incorporated the Model into its strategic planning. Several recommendations for, or to, state agencies are instructive for thinking about wildlife conservation in the context of the Action Plan, including the need to maintain wildlife as a public trust (i.e., not owned by anyone), the need to use science to make management decisions, and the importance of regulating trade and possession of wildlife.

Second, conserving Vermont's Species of Greatest Conservation Need requires that we address problems at the appropriate scale. Recommended strategies address problems at the species level (e.g., the illegal harvest of wood turtles through education and law enforcement), the habitat level (e.g., the lack of early successional habitat through forestry), the landscape level (e.g., maintaining and restoring connectivity of riparian areas) *and* the regional/national and international levels (e.g., habitat loss along migration routes).

Third, collaborative efforts to address habitat concerns related to development, including assessment of direct and indirect impacts, avoidance and minimization of impacts and appropriate mitigation *early* in a project's planning processes can not only protect habitat from alteration, degradation, conversion and fragmentation, but can speed the project more successfully through the permit review process.

Fourth, Vermont wildlife has already benefited from a strong environmental ethic, deeply rooted connections to the land, based on traditional forestry and agricultural economies, and a very high percentage of Vermonters who engage in recreational activities that are dependent on wildlife. In other words, there are compelling and inherent reasons for optimism about the future of wildlife conservation in the Green Mountain State.

All that being said, there are state, regional, national, and international factors that are a cause for concern regarding habitat viability, clean water and air, international trade in wildlife, and a diminution of understanding about wildlife and its management, in part because of complex social factors. Each of the four sets of presuppositions above forms the backdrop for the conservation strategies presented below and throughout this document.

Habitat Themes

1) Through education, legislation, and policy improvements address issues such as sprawl, poorly planned development, and global warming that drive habitat conversion, degradation and fragmentation (The Wildlife Society[1]). Possible tools include:

   - Maintain and expand incentives for private landowners such as the Wildlife Habitat Incentives Program (WHIP), Landowner Incentive Program (LIP), and the Current Use Program (officially the Agricultural and Managed Forests Land Use Value Program) and other appropriate management agreements. Consider amending tax policies and providing tax abatement and/or other tax relief to reduce the pressures on property owners to subdivide and sell property (parcelization). Create incentives for rural landowners to enhance their land as working forests or farms. Strengthen the Current Use program to include management of land for the benefit of wildlife as a conforming use. Increase funding for the Vermont Housing and Conservation Trust fund.
   - Continue to utilize permitting processes such as Act 250 to address critical habitat considerations where appropriate.
   - Promote and enhance programs designed to manage retention of open space including forestland and agricultural land. Assist local and regional land-use planning organizations such as towns and regional planning commissions. Support plans that identify natural resources and wildlife values and take steps to conserve habitat such as the designation of growth centers that focus development in existing centralized communities. Consider restoring existing village or urban facilities and infrastructure. Increase funding for Rural Community Assistance programs.
   - Acquire critical habitats in fee title or easement. Follow Vermont Agency of Natural Resources land acquisition policies and procedures (VANR 1999) for parcels and rights therein that will be owned by the State.

[1] The Wildlife Society, the North America Section of the Society of Conservation Biology and the U.S. Society for Ecological Economics have all taken similar positions on the need to address the negative impacts of economic growth on wildlife. The American Fisheries Society and the Ecological Society of America are currently considering similar positions.

2) Through education, incentives, legislation, and policy efforts address global warming and pollutants such as mercury and acid deposition.

- Support the recommendations of the *Climate Change Action Plan* developed by the Conference of New England Governors and Eastern Canadian Premiers (2001) and local and regional initiatives such as the Alliance for Climate Action to reverse the growth of greenhouse gas emissions in Vermont.
- Work with state and federal agencies and legislators to ensure adequacy of and compliance with interstate emissions standards for greenhouse gases, mercury, and sulfur dioxide and nitrogen oxides that cause acid deposition.

3) Develop a collaborative, statewide and regional wildlife monitoring and adaptive management program to develop SGCN baselines, measure progress toward desired outcomes for SGCN, and to evaluate and improve the effectiveness of the conservation strategies proposed here and throughout this document. Such a program will:

- Identify key protocols and systems for data collection and sharing.
- Identify goals and objectives for SGCN conservation.
- Determine SGCN distribution and abundance, identify indicators and trends, and assess habitats, natural communities and other appropriate land classification categories to provide data at scales relevant to a variety of users in order to more effectively conserve SGCN.
- Identify conservation opportunity areas where the likelihood of successful conservation is strongest and the conservation needs of wildlife and their habitats would be best met.

Population Level Themes

4) Through policy and education support the enforcement of existing laws that protect species of greatest conservation need. For example:

- Prevent the importation or movement of invasive, non-native species.
- Regulate the illegal taking, trade, sale and collection of species of greatest conservation need.

Technical Assistance & Outreach Themes

5) Work to develop and implement landowner incentives, technical assistance and education for sustainable management of species of greatest conservation need, including:

- Develop and enhance partnerships between local, state and federal agencies, non-governmental organizations, industry and private individuals to increase the focus on species of greatest conservation need and conservation of associated habitats.

- Provide outreach materials and technical assistance to encourage sound land management and compatible recreation practices (e.g., VFWD's habitat planning manual *Conserving Vermont's Natural Heritage*). Demonstrate management goals and practices on public lands, especially Wildlife Management Areas.

- Proactively collaborate with transportation planners and engineers regarding the location and design of new and expanded roadways.

- Look for opportunities to implement Action Plan strategies through existing federal cost-share programs (e.g., USDA's Conservation Reserve Enhancement Program, the USFS Forest Legacy Program and the USFWS Landowners Incentive Program).

- Disseminate ecologically sound information through appropriate media, e.g., develop a web site with information on all species of greatest conservation need in Vermont. Include information on identification, natural history, conservation, management suggestions, reporting, and contacts.

- Promote increased cooperation and communication among all agencies and groups concerned with conservation education and resource management.

- Showcase the success of the Action Plan through regular outreach to partners.

- Develop outreach and education programs that promote the conservation of SGCN and the habitats that they depend on, and increase awareness of the importance of maintaining or restoring these species.

Regional Coordination Themes

6) Provide regional coordination for conservation and management of species of greatest conservation need.

- Look for opportunities for collaborative management between jurisdictions (e.g., Lake Champlain, Atlantic Coast Joint Venture, the Connecticut River Joint Commission, the Conte National Wildlife Refuge, and the Northern Forest Lands Council).

References

Austin, J.M. C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson. VT League of Cities and Towns. 2004. Conserving Vermont's Natural Heritage. A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Vermont Fish & Wildlife Department and Agency of Natural Resources. Waterbury, VT. www.vtfishandwildlife.com/library.cfm?libbase_=Reports_and_Documents

Prukop, J. and R. Regan 2005. The Value of the North American Model of Fish and Wildlife Conservation. Wildlife Society Bulletin 33(1): 374-377.

U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

VANR. 1999. Lands Conservation Plan. Vermont Agency of Natural Resources. Waterbury, VT. http://www.vtfpr.org/lands/acquis.cfm

Vermont's Wildlife Action Plan

November 22, 2005

Chapter 2: Vermont Overview

Vermont Cares about Wildlife Conservation 1

The Vermont Landscape—an Overview 1
- Climate 2
- Geology 2
- Topography 3
- Hydrology 4
- Land Use History 4
- Biophysical Regions of Vermont 4

Vermont's Landscape—an Historical Perspective 6

Vermont's Contemporary Land Use 6

Contemporary Problems Impacting Wildlife in Vermont 8
- Loss of Habitat 9
- Impacts of Roads and Trails 10
- Pollution & Sedimentation 10
- Invasive Exotic Species 11
- Climate Change 11
- Data Gaps and Information Needs 11
- The Silver Lining 12

Conservation Success! Keeping Common Species Common 13

The Importance of Education, Law Enforcement and Wildlife-Associated Recreation to Wildlife Conservation 17

Vermont Department of Forests, Parks & Recreation: Current Efforts Related Wildlife Conservation 21

Vermont Department of Environmental Conservation 25

Why is the Vermont Agency of Transportation concerned about fisheries and wildlife issues? 29

formally the Comprehensive Wildlife Conservation Strategy (CWCS)

2. Vermont Overview

Vermont Cares about Wildlife Conservation

It is no mystery why people enjoy living in and visiting Vermont. This state has what so many other once rural places have lost: a wealth of wildlife and scenic beauty, traditional working landscapes that support viable local economies, and desirable social and cultural attributes – low crime rate, helpful neighbors, and close-knit villages and towns.

Wildlife, scenic beauty, and the landscape that supports this way of life are not only vital parts of Vermont's rural character and identity, but are highly valued by Vermont residents. Based on 2001 public opinion survey results from the U.S. Fish and Wildlife Service, Vermont ranked first in the nation in percentage of residents that actively observed wildlife (60%). The results also show that hunting, fishing, and wildlife viewing expenditures in Vermont totaled $386 million, an increase of $6.42 million over the previous survey in 1997. At least 280,000 Vermont residents participate in wildlife-associated activities. This constitutes nearly 50% of the state's resident population – the highest percentage in the nation. In addition, approximately 307,000 non-residents participate in wildlife-associated activities in the state each year. These statistics represent a significant contribution to the state's economy and underscore the strong connection Vermont residents and non-residents have to the land and wildlife.

Vermont's diverse natural resources, which include forests, clean waters, vibrant fisheries, healthy wildlife populations, rare species, significant natural communities, and a working landscape, provide people with the opportunity to, among other things, hunt, fish, trap, watch wildlife, hike and work the land.

The Vermont Landscape—an Overview

Vermont's landscape is a rich tapestry of mountains, valleys, woods and wetlands, with a fascinating geological history. It is Vermont's natural landscape that enriches the lives of those who live here and draws so many visitors to the state. It is this same landscape that

provides us with clean air, clean water, and habitat for thousands of species of plants and animals.

Understanding Vermont's natural heritage requires understanding the physical landscape. The configuration of mountains, valleys, wetlands, lakes, and rivers is crucial in determining the distribution of natural communities, habitats, and native species.

The following broad environmental factors influence the distribution of species, habitats and natural communities: climate, bedrock geology, surficial geology, topography, hydrology, and land use history. These factors that comprise and influence the Vermont landscape and subsequently the flora and fauna of the state are explained below.

Climate

Vermont's lowest land point is the shore of Lake Champlain, only 95 feet above sea level. Vermont's highest point is the Chin on Mount Mansfield, which rises to 4,393 feet. The distance between Lake Champlain and the summit of Mount Mansfield is only 20 miles, but in that short distance, the climate, topography, and vegetation change considerably. On the shores of Lake Champlain, where the growing season is 150 days, shagbark hickories and sweet gum trees grow. Apple orchards are common in this environment as well as dairy farming due to the influence of climate on growing season. On the summit of Mount Mansfield, where the growing season is limited to 90 days, red spruce and balsam fir grows in stunted and contorted mats, bending to the direction of incessant winds.

Climate is major factor in determining the distribution of natural communities, habitats, plants and animals. Elevation provides a means for understanding the influence of climate on wildlife and habitats in Vermont because climate changes in relatively short distances with change in elevation. Thus the affect of climate on biota can easily be observed.

Geology

Vermont's bedrock composition is varied and thus, influences important factors such as soils, hydrology, and subsequently plant

distribution and abundance. These variations influence in part the distribution of wildlife. The rocks that comprise the Southern Green Mountains were formed more than 570 million years ago. The rocks of the Champlain Valley and the Northern Green Mountains date from a time 540 to 443 million years ago when Vermont was the edge of a warm, tropical sea. The remains of marine mammals that inhabited that sea can be found in the Champlain Valley's limestone rock. The youngest rocks in Vermont are the granites, like the stone that makes up the Barre granite quarries. These rocks were formed 200 to 400 million years ago as a result of deep underground magma welling up and hardening.

Whether the bedrock is limestone or granite – or some other kind of rock – is particularly important in the distribution of natural communities and plants because each kind of rock has its own unique physical and chemical composition. For instance, rich fens, a rare type of wetland with plants that require high levels of calcium, occur almost exclusively in areas where limestone or similar calcium-rich rock are found.

Vermont's surficial geology is defined by the sands, gravels, clays, peats, and other deposits found on top of the bedrock as a result of both glacial activity and post-glacial events (like flooding) that continue today. Bedrock and surficial geology together have a profound influence on the soils in which Vermont's plants grow.

Topography

Topography describes the physical landscape and influences the distribution of plants, animals, and natural communities. The soil on the top of a mountain tends to be shallow and dry, whereas the soil at the base of a slope tends to be deep, moist, and rich in organic matter because of the downslope movement of plant litter and soil. Cliffs, for example, offer a unique habitat for specialized groups of plants, and may offer important denning habitat for bobcat and nesting sites for peregrine falcon. Certainly, topography influences the quality and distribution of winter habitat for white-tailed deer in Vermont.

Hydrology

Water and its movement have a profound influence on animals, plants and natural communities, and ecosystem processes. Lakes, ponds, rivers, and streams provide habitat for a diversity of fish, aquatic plants, aquatic invertebrates, and other organisms. Wetlands form in waterlogged soils, either in low-lands where water collects by gravity, in uplands where impermeable soils create perched water tables, or at the highest elevations where fog and abundant rain provide a constant supply of water for wetland plants and animals.

Land Use History

Land use history has influenced the distribution of plants and animals across Vermont. For instance, the degree and type of forest cover have a great influence on the species that occur in an area. Vermont has more forest today (78%) than it had in the mid-1800s (25%), and the effect of this change on wildlife has been dramatic. Additionally, Vermont's agricultural activity also affected the soils and the plants that grow in them.

Biophysical Regions of Vermont

The five factors described previously combine to create eight distinct biophysical regions. It is important to consider Vermont's biophysical regions when assessing and planning for the conservation of wildlife (Fig 2-1). For example, what may be a common species in one biophysical region may be rare in another, thus, increasing the importance of conserving habitat for that species in the region in which it is rare. Vermont's biophysical regions are described below.

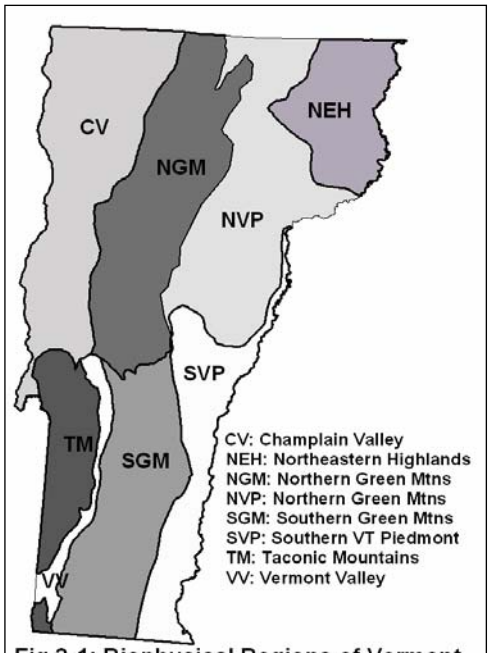

Fig 2-1: Biophysical Regions of Vermont
Data Source: VCGI

Northeast Highlands: Granite bedrock dominates this cool region, which is characterized by large wetlands, remote mountains, and lakes and ponds. Spruce and fir dominate the lowlands as well as the high elevations, whereas northern hardwoods cloak the mid-elevations.

Forty-three percent of this region is conserved, the highest percentage of any of Vermont's biophysical regions.

Northern Vermont Piedmont: Calcium-rich soils combine with a cool climate to support mixed forests and Northern White Cedar Swamps, Fend and other interesting natural communities in this region. The uplands have fine agricultural soils, but a short growing season. Eight percent of the region is conserved.

Southern Vermont Piedmont: Calcium-rich soils and rolling hills make this a good place for agriculture. The climate is average for Vermont, except in the extreme southeast where it is quite warm. Northern hardwoods and red oak dominate the vegetation. Seven percent of the region is conserved.

Southern Green Mountains: A broad plateau is dotted with a few dominant peaks and several ski areas. Climate is cold and rainfall is relatively high. Northern hardwoods, spruce, and fir dominate, and there are a number of small lakes and ponds. Thirty-three percent of this region is conserved.

Northern Green Mountains: This area has a cool climate and high elevations and is mostly forested. Northern hardwoods dominate the side slopes, whereas high elevations have spruce and fir as well as Alpine meadow habitat. Twenty-six percent of the region is conserved.

Champlain Valley: This region of Vermont has a warm climate and abundant fertile farmland. The Champlain Valley contains both northern hardwood forest and also various species of oaks and hickory. It has some of the state's most significant natural diversity and also the state's most densely populated areas. Nine percent of the region is conserved.

Taconic Mountains: The slate belt of Vermont and New York is found in this region. The Taconics are dramatic wooded hills dominated by sugar maple, beech, and yellow birch forests. Dry oak and hickory forests are found on the lower elevation knolls, while

spruce and fir occur at the highest elevations. Ten percent of the region is conserved.

Vermont Valley: The Marble Valley has marble and limestone with glacial deposits on the valley walls, abundant springs, and wetlands. About 10 percent of the region is conserved.

Vermont's Landscape—an Historical Perspective

Vermont's landscape has long been altered by people. Native cultures grew crops, harvested animals for food and clothing and lived in established settlements. During the 17th and 18th centuries, land was cleared for the development of agricultural economies. By the mid-1800s, 75% of Vermont's forests were cleared for agriculture, and in particular, sheep farming. These changes had an effect on the state's waters, forests, and wildlife. Even some species of wildlife such as beaver and deer that had been common, nearly disappeared from the land. As other influences caused people to begin to move towards the western United States, lands were abandoned and forests began to regenerate.

With the return of the forest and the work of the Vermont Fish & Wildlife Department and partners the recolonization and reintroduction of animal species, beaver, deer, wild turkey, fisher, and others that had declined have now returned and are today abundant. These species and more stand as great testament to Vermont's commitment to wildlife conservation and the resiliency of the forests and wildlife. Many species of fauna and flora, however, have not recovered. The passenger pigeon, for instance, is now extinct, and some large predators such as wolves and mountain lions that once roamed the New England forests, are no longer present.

Vermont's Contemporary Land Use

Agriculture and forestry still support Vermont's economy in significant ways. These elements of Vermont's business and economic communities offer great opportunities for wildlife conservation because they allow private landowners to realize a

financial return from their land while keeping the land in an undeveloped or natural condition. Many of these land-based business interests are excellent stewards of the land and wildlife.

Vermont non-industrial forestland owners have a long history of active engagement in the management of forest resources throughout the state. Since the advent of the Vermont Use Value Appraisal Program (a.k.a. Current Use Program) 11,000 landowners have brought almost 1.5 million acres of forestland under forest management. Many of Vermont forestland owners manage their lands for wildlife and forest resources and seek to enhance their management skill through their involvement in non-profit organizations advocating sustainable forest management such as Vermont Coverts: Woodlands for Wildlife, Inc., Vermont Woodlands Association, and the Woodland Owners Association. These stewards provide strong examples of Vermonters taking steps to conserve our wildlife resources.

The landscape of Vermont is also supporting increasing demand for residential and commercial development. The Vermont Forum on Sprawl reports that the rate of development in Vermont is 2.5 times greater than the rate of population growth. Like other New England states, residential development is often dispersed in rural and suburban areas rather than in existing village and urban communities.

Based on data from the U.S. Census Bureau, the population of Vermont in 2004 is 621,394 and has increased by 2.1% since 2000. The human population of Vermont is quite small compared to many other states.

Since 1964, Vermont has lost roughly one-third of its farms and half of its farming acreage (Pers. Comm. Vermont Dept of Agriculture 2005). Today, Vermont loses approximately 100 farms each year.

Parcelization is a term that describes the subdivision of land into smaller and smaller pieces and multiple ownerships. This phenomenon has been shown to have an impact on the ability of local forest product economies to remain sustainable. Parcelization is occurring in parts of Vermont where larger tracts of land are

subdivided into smaller multiple smaller parcels for residential development. This may have some influence on Vermont's forest products interests in the future and at the very least is something that should be considered with respect to maintaining viable forest products economies for all the positive benefits that they provide to the state and its wildlife.

Contemporary Problems Impacting Wildlife in Vermont

An extraordinary amount of work went into developing this report. Our technical teams assessed the status all of Vermont's birds (268), fish (94), mammals (61), reptiles and amphibians (42) and many group of invertebrates ranging from mussels, to beetles, to butterflies and isopods. From there Species of Greatest Conservation Need (SGCN) were selected and the technical teams then described the habitat these species used, problems impacting the species and their habitats, and strategies to conserve both species and habitats. Add to this assessments and recommendation for 25 major landscapes and community types and it's not surprising that this report tops the 1,000-page mark.

The interesting thing is this: if you take two steps back from the details to view the big picture, the view is not a grim one. Yes there are more than 300 SGCN but the picture we see is a hopeful one, a roadmap to healthy wildlife populations for Vermont's future. The reasons are repetition, economies of scale, and cooperation.

The problems most frequently identified as impacting SGCN are, loss of habitat (due to conversion, degradation, fragmentation and lack of needed successional stages), the impacts of roads and trails, pollution and sedimentation, invasive species, climate change, and data gaps and information needs. Though these are big, serious and complicated problems they are much easier to address than hundreds of smaller problems.

Loss of Habitat: Due to Degradation, Conversion, Fragmentation or Lack of Needed Successional Stages

These four categories are not mutually exclusive and problems can often logically be placed into more than one category depending on the particular stress it causes for a species or habitat.

Habitat Conversion: The complete transformation or loss of a habitat by human action (examples include: filling a wetland to create a grassy field, converting a forest stand into a parking lot, or damming a stream to create a reservoir). Though many agencies and organizations work diligently to conserve important wildlife habitats, Vermont continues to lose approximately 525 acres of significant habitat each year to regulated development alone. According to the Vermont Environmental Board, regulated development in Vermont constitutes approximately one-third of the total development that occurs on an annual basis. Significant habitats are those habitats that are addressed by various statutes, largely Act 250, and include deer winter habitat, wetlands with significant wildlife functions, habitat for rare, threatened and endangered species and several types of habitat necessary for the survival of black bears. These habitats represent only a few of the many habitats that are affected by loss due to development.

Habitat Alteration/Degradation: A lessening of the quality of a habitat by human action stopping short of complete conversion (examples include: the reduction of mast (fruit and seed) production in a forest stand, riprapping a streambank, and significant land use changes adjacent to a habitat such as replacing a forest stand on the edge of a wetland with a housing development.

Habitat Fragmentation: The breaking up of habitats into smaller, non-contiguous patches as a result of habitat conversion (e.g., housing, commercial development, roads, utility lines). Fragmentation can: 1) render important habitats inaccessible (such as isolating a den site from a feeding site), 2) isolating

populations (for example grassland butterflies, spotted salamander, and tiger beetles); and, 3) degrade remaining habitat patches through edge effects that favor edge-tolerant species such as raccoons and crows, as well as invasive exotic species that can out-compete native and rare species. The result of habitat fragmentation is often increased predation, increased mortality, reduced mobility and changes in habitat micro-climates.

Inadequate Distribution of Successional Stages: The lack of either late, mid or early successional habitat in appropriate patch size and/or juxtaposition can be a problem for some SGCN especially as fragmentation makes it harder for species to move between forest patches (examples include ruffed grouse and woodcock which prefer early successional forest stands, American marten which prefers late-successional stands and Canada lynx which depends on a mix of forest stages).

Impacts of Roads and Trails

In the last quarter of the 20th century, Vermont expanded its road system by an average of 26 miles per year to a total of about 14,251 miles. The number of vehicle miles traveled by Vermont residents is growing at seven times the rate of population growth, according to information from the Vermont Agency of Transportation (1999). Transportation systems, including some hiking and recreation trails, can cause numerous problems for SGCN including: vehicle-wildlife collisions; reducing animal and fish passage, thus limiting habitat availability and isolating populations; vehicle emissions of pollutants such as ozone and greenhouse gases; and facilitating the spread of an exotic, invasive species into otherwise healthy areas.

Pollution & Sedimentation

The introduction of exotic materials from point and non-point sources can significantly impact SGCN, particularly aquatic species. Pollutants & sediments include sands and silts, chemicals and toxins; excess nutrients from farm and municipal sewage plants; garbage and other solid waste; radioactive materials; road salt; excessive noise; excessive heat; and light pollution that disturbs animals and disrupts migration patterns. Sediments can be a problem for SGCN through their physical

presence alone. For example, soils can wash into a stream from a construction site and smother fish eggs and other aquatic species living in the spaces between rocks and gravel streambed.

Invasive Exotic Species

The introduction and spread of nuisance exotic and native species (plants and animals) may lead to the elimination of native wildlife populations, threaten long-term stability of habitats and even lead to extirpation by out-competing a native species, displacing its food source or altering a key process or function of a habitat. Invasive exotic species in Vermont include Eurasian watermilfoil, purple loosestrife, common buckthorn, Japanese knotweed, Morrow's honeysuckle, goutweed, black swallow-wort and zebra mussels. Additional information can be found in Appendix K.

Climate Change

Long-term changes linked to global warming and other climate issues can lead to major changes in habitat availability (e.g., high elevation habitats, wintering areas and migration stopovers) (Glick 2005), vegetative composition and location (e.g., the movement up in elevation or north in latitude, invasion by exotic pests), climate variability (e.g., change in snow depth, rainfall and/or natural disturbances). Many specific details as to how climate change is affecting Vermont's wildlife today is a major unknown, but the pervasiveness and scale of the problem requires that we begin planning to address it now.

Data Gaps and Information Needs

A lack of information has been identified as a principal impediment to the conservation of many Species of Greatest Conservation Need. In particular we need additional information on the distribution and abundance of SGCN and the status of local and statewide populations, a better understanding of habitat needs, life-history information, and information related to SGCN movement and migration. This information will help to fine-tune strategies and guide management for SGCN.

The Silver Lining

We noted at the beginning of this section that recurring problems actually give us hope that we can conserve Vermont's Species of Greatest Conservation Need because if we address a problem for one species we're likely to do the same for many others. Similarly, several conservation strategies outlined in this report including habitat restoration, encouraging wildlife-compatible resource use, providing education and technical assistance to landowner and managers and providing economic incentives for conservation come up again and again in this report. The good news here is that we can focus our limited conservation resources on the strategies that will provide the biggest bang for the buck.

Therefore to the list of major issues impacting Species of Greatest Conservation Need we'll add one problem that our technical teams did not identify directly in their assessments but that was often discussed during team meetings—the lack of sufficient funding for wildlife conservation. Without sufficient funding we will not be able to implement many of the conservation strategies identified in this report. The State Wildlife Grants program is a critical first step in funding SGCN conservation, but more is needed. And, to make the most of SWG funds, Vermont will have to develop the required matching stateside funds.

Conservation Success!
Keeping Common Species Common

In spite of the changes to the Vermont landscape, the fact is, Vermont remains a relatively rural state with an abundance of conserved land, private landowners who are excellent stewards of the environment, and many wildlife conservation success stories. The public opinion survey results (U.S. Fish & Wildlife Service 2001) speak volumes for the bright future of wildlife conservation in Vermont—that is, the public has a strong interest in and dedication for the conservation of Vermont's natural heritage.

Moreover a review of past and ongoing wildlife conservation efforts provides proof of our collective ability to recover and conserve wildlife and the habitats required for their survival. It also identifies the key building blocks for successful conservation.

In 1724, when the first European settlement was established at Fort Dummer, near Brattleboro, the state was primarily forested and had abundant fish and wildlife populations including passenger pigeons, fisher, wolves, deer, black bear, beaver, and salmon. However, by 1865 many of these species would be present in far fewer numbers or on the cusp of extirpation because of unregulated harvests, habitat loss and habitat degradation.

Hunting and fishing license fees, soon after the turn of the 20th century, coupled with federal wildlife and sportfish restoration act dollars, enacted in the 1930's and 1950's respectively, established a financial framework in support of conservation. These monetary resources enabled Vermont, and the other states, to conduct inventories and research, acquire habitats, and provide conservation education to the public. Today, some of the species of low abundance 150 years ago are now once again common throughout the State. Consider, for example:

White-tailed deer: Numbers were so low in the late 1800's that no open season was offered and deer were transplanted from New York. Through extensive research, harvest management, and habitat

protection, Vermont can now support in excess of 150,000 deer with 48 days of hunting opportunity, annually.

Wild turkey: This bird was extirpated from the state in the 1800's. Birds were reintroduced to the state in 1969. We now have more than 40,000 turkey and both fall and spring hunting opportunities.

Fisher: This mid-sized carnivore was extirpated from the state. Animals were reintroduced to Vermont beginning in 1959, and this predator now thrives on the Vermont landscape.

Anadromous fish on the Connecticut River: Migratory fish in the Connecticut River, including Atlantic salmon, American shad, striped bass and river herring were reduced or eliminated in 1798 by a dam built in Turners Falls, Massachusetts. With the construction of fish passage at dams, and active restoration programs shad, stripers and herring are now abundant in the lower river, and annual runs of Atlantic salmon have been restored to the lower river after a nearly two hundred year absence.

Trout and salmon in Lake Champlain: Landlocked Atlantic salmon disappeared from Lake Champlain in the 1850's, and native lake trout were gone by 1929. A restoration program was begun in the 1970's in cooperation with the State of New York and the US Fish and Wildlife Service, and these fish are plentiful once again in Lake Champlain where they support a popular fishery that brings hundreds of millions of dollars into the regional economy each year.

Lake sturgeon: A combination of dam construction, pollution and over-fishing reduced lake sturgeon populations in Lake Champlain in the early 1900's to the point that the commercial fishery was abandoned and all fishing for sturgeon was prohibited in 1967. Since this fishing closure sturgeon conservation has benefited from water quality improvements, better water flows at the dams, and outreach to anglers to release any sturgeon they catch. Recent studies have documented successful natural reproduction of sturgeon in all four of their historic spawning rivers in Vermont.

Peregrine falcon, osprey, and common loon: These birds were gone or nearly gone from the state by the mid-1900's, Through focused management (e.g., the construction of artificial nesting platforms, water level management, and public education), each of these three species has recovered sufficiently that they've recently been removed from the state's endangered species list—a first for any species in Vermont.

These success stories suggest that new dollars will produce new success stories for the future. In other words, the fish and wildlife profession has demonstrated the will and the competence to restore and manage wildlife. The Wildlife Action Plan, coupled with sustained funding and the dedicated participation of partners, will offer a template for advancing the success stories to a new suite of species.

The Importance of Education, Law Enforcement and Wildlife-Associated Recreation to Wildlife Conservation

Through the State Wildlife Grants program (SWG) Congress provides every state with critically needed funds for wildlife conservation. Congress' intention is to support proactive and strategic efforts to prevent future Endangered Species Act listings—in other words, to keep common species common. To meet Congressional intent, states are compelled to employ all of their best conservation tools including education, wildlife-associated recreation and the creation and enforcement of wildlife protection laws and regulations. These are among the most proactive, strategic and time-tested tools in any conservation tool box.

The details of the SWG program legislation, however, currently preclude states from using SWG funds for law enforcement and recreation projects. A limited amount of SWG funds can be used for conservation education, but only in a supporting role in the implementation of a conservation strategy (e.g., signage explaining the purpose of a restoration project). This poses a dilemma for states trying to implement a truly comprehensive wildlife action plan because it restricts their use of three vital conservation tools. Moreover, it limits the participation of three significant conservation constituencies from participating in Wildlife Action Plan implementation—the law enforcement, education and outdoor recreation communities.

A limited number of education and law enforcement conservation strategies specific to particular species or habitat categories were addressed in the species and habitat conservation summaries of this report (Appendices A and B). We recognize that alternative funding sources are needed for their implementation. In this section of the Wildlife Action Plan report we present additional conservation strategies based on conservation education, wildlife-associated recreation and law enforcement. It is our hope that future renderings of the State Wildlife Grants program, along with other funding mechanisms will provide for the implementation of these strategies and other others in their realms.

Conservation Education

Wildlife and human communities depend on healthy ecosystems and ecological processes. Their functions are essential for our quality of life and for the Vermont economy. Conservation strategies that follow a sound education model can foster healthy public behavior and attitudes toward land and wildlife conservation. Furthermore, strong educational programs that expand Vermonters' ecological literacy will enhance the credibility and effectiveness of other conservation efforts and build support for future efforts. Finally, the public plays a key role in influencing legislators, who in turn affect policy and funding decisions. Recommended strategies include:

- Foster and enhance educational partnerships to maximize efficiency (e.g., develop volunteers, outreach to teachers and youth group leaders to deliver programs)
- Ensure that sound messages, curricula, and best educational practices are followed to maximize our efforts (e.g., provide teacher training, curriculum support materials for teachers and students,

- Define a land stewardship message that promotes the conservation and ethical use of Vermont's fish, wildlife, and plants, and the habitats that sustain them.
- Focus outreach and education efforts to enable the public to make informed decisions on issues affecting ecosystems in Vermont such as: habitat degradation and fragmentation, threats to fish and wildlife species and their habitats, the value of working rural landscapes and other rural lands, the sustainable and ethical utilization of wildlife.

The connection between of education to wildlife conservation is recognized nationwide. The International Association of Fish and Wildlife Agencies (IAFWA) is sponsoring the development of a national strategic plan for conservation education, the resulting plan will make conservation education a top priority for state fish and wildlife agencies (Case 2005).

Wildlife-Associated Recreation

Hunting, fishing, trapping, and wildlife viewing have a long heritage in Vermont and Vermont leads the nation in wildlife viewing (US DOI 2001). By providing the means for more people to connect with wildlife, we can foster more and stronger relationships to the natural world. Applying the concept of stewardship through recreation Vermonters can become knowledgeable about and appreciate wildlife, natural communities, and conservation in ways that promote citizen interest in contributing to conservation. Recommended strategies include:

- Work with the broader community of recreation groups (e.g., outdoor guides, birders, sportsmen and women, hikers, paddlers, climbers, spelunkers, mountain bikers and snowmobile and ATV associations) to foster partnerships that build a stronger wildlife ethic among members.
- Expand educational programs on watchable wildlife, including such topics as birding, wildlife photography, animal track identification, and backyard habitat. Target population centers, with a focus on youths and families.
- Increase information available to the public on how and where to watch wildlife. Provide information to encourage watchable wildlife practices, such as viewing, photographing, and feeding, in a manner that is ethical, safe, and consistent with protecting the welfare wildlife resources.
- Foster a recreational ethic based on the concept of giving back to the natural world.
- Include an educational component in recreation activities making the connection between our actions and the impact on wildlife.
- Involve Vermonters in activities that will increase their understanding of wildlife and land stewardship and the influences of human activities on wildlife, in order to build public support for fish and wildlife conservation (e.g., citizen science projects such as the bird atlas, butterfly survey and other wildlife inventories, teacher training courses, streambank plantings, and field classrooms).
- Encourage responsible outdoor recreation through programs such as "Stop Aquatic Hitchhikers," "Leave No Trace," "Stay on the Trails," and "Be Bear Aware."

Recent projects
A joint VFWD-Vermont Federation of Sportsmen's Club project in 2003 is a good example of a wildlife-based recreation project. Using funds from the short-lived Wildlife Conservation and Restoration Program (WCRP), a predecessor to the State Wildlife Grants program, public access to the Blueberry Hill Wildlife Management Area was enhanced.

The Fish & Wildlife Department recently developed and helped implement a combined physical education/ conservation curriculum for Vermont schools.

Statewide Comprehensive Outdoor Recreation Plan (SCORP): In addition to the Wildlife Action Plan, states are developing comprehensive plans for outdoor recreation as a requirement for receiving support from the Land and Water Conservation Fund (LWCF). The National Parks Service in the U.S. Department of the Interior administers the LWCF. The National Parks Service's term for this planning process is known as the SCORP, which stands for Statewide Comprehensive Outdoor Recreation Plan. The Department of Forests, Parks & Recreation (FPR) is leading the development of Vermont's SCORP. The document will be ready in 2005

Law Enforcement

The creation and enforcement of fish and wildlife laws are among our society's oldest attempts to conserve wildlife. Vermont's first game wardens were appointed in 1779 to protect deer and were called "Deer Reeves." Law enforcement is an effective conservation tool and has been at the core of wildlife conservation ever since.

State game wardens prevent the illegal taking, trade, sale, collection and importation of wildlife by proactive enforcement of fish and wildlife laws. Game wardens also prevent and investigate the unlawful destruction of critical habitat, trespass and disturbance of refuge areas and sensitive breeding grounds and enforce the regulations and permits that govern wildlife research, education and rehabilitation.

Law enforcement professionals strive to be proactive: Game wardens are an integral part of the Fish & Wildlife Department's outreach and education programs. Wardens teach conservation at schools, civic organizations and conservation camps and are often the first, and sometimes, only contact that the general public has with a conservation professional. Recommended strategies include:

- Maintain staffing of game wardens and compliance officials statewide sufficient to ensure the adherence of all laws pertaining to fish, wildlife and habitat conservation. State game wardens conduct routine patrols providing enforcement of boat, ATV and off road recreational vehicles to address the illegal operation and destruction of sensitive habitat and wildlife areas.
- Review, update, and enforce regulations controlling the importation and possession of exotic and potentially harmful fish and wildlife species and their pathogens.

Recent projects

As people interact more and more with wildlife, the number of wildlife-human conflicts increases. In 2002 Vermont game wardens responded to more than 1,000 calls from the public on issues such as rabies and damage to property. If not adequately addressed members of the public might try to resolve the issues themselves in a manner unduly detrimental to wildlife. Many encounters require a physical response by a warden to prevent human injuries or disease exposure. Funds from the short-lived Wildlife Conservation and Restoration Program (WCRP), a predecessor to the State Wildlife Grants program, helped enhance VFWD's wildlife-human conflict management efforts through additional equipment, outreach materials and staff training. These enhancements improved responsiveness and effectiveness in addressing these real and growing needs.

All for one and one for all: Law enforcement, Education & Recreation

It should be clear to a reader by this point that not only is each of these three tools critical to the long-term conservation of wildlife, but that they are all tightly intertwined. For example, our best opportunities to instill the message of conservation in the public are when they are out in nature recreating. And, state game wardens are often the ones to deliver the message. Furthermore, outdoor guides and other recreationalists often provide tips to wardens and compliance officers regarding habitat degradation or the illegal taking of wildlife, and by doing so they send a strong message to the general public that Vermonters care about wildlife.

Vermont Department of Forests, Parks & Recreation: Current Efforts Related Wildlife Conservation

The mission of the Department of Forests, Parks & Recreation is to practice and encourage high quality stewardship of Vermont's environment by:

- *monitoring and maintaining the health, integrity, and diversity of important species, natural communities, and ecological processes;*
- *managing forests for sustainable use;*
- *providing and promoting opportunities for compatible outdoor recreation; and*
- *furnishing related information, education, and service.*

To fulfill our mission, the Department will continue to work, as we have for almost a century, for sound management and sustainable use of Vermont's forests, forest land, other natural resources, and outdoor recreation opportunities.

The Vermont Department of Forests, Parks and Recreation pleased to have had the opportunity to be involved in Vermont's first Wildlife Action Plan. As the proposed conservation strategies are implemented, this plan could have a significant impact on the management of public and private forest lands within the state.

Without healthy, sustainable forests in Vermont, attempts to conserve wildlife would be in vain. The animals and the habitat are inextricably linked… Forests should continue to dominate our state's landscape to ensure healthy wildlife populations.

The vast majority of Vermont's forests are privately owned and unless landowners can expect a reasonable return from their forest resources, maintaining land as part of a working landscape may be difficult. Equitable taxation (through programs like the Use Value Appraisal Program) and strong local markets for forest products are critical to ensure the conservation of forested habitats by this largest portion of landowners. The Department's efforts (in this respect) can be broadly categorized into program management, state lands management, information and education, forest protection and economic development.

With respect to programs which most directly effect wildlife resources, our activities include:

State Land Management: Manage in a sustainable manner state-owned land for the purpose for which it was acquired and the wishes of the public, and in cooperation with the Fish & Wildlife Department and Department of Environmental Conservation. This amounts to 348,000 acres (1999). Primary goals include protecting land and water, maintaining ecosystem integrity, maintaining or enhancing biodiversity, protecting historic and cultural sites, providing compatible recreation opportunities, and producing wood products. In accordance with long-range management plans we additionally, construct and maintain high-quality forest roads for management activities, developed parks and recreational sites, and controlled recreational access for public uses. The Department also manages and/or monitors conservation easements on over 42,000 acres (1999) of private land. Both state-owned land and easements include those purchased with assistance from the Vermont Housing and Conservation Trust Fund, federal Land and Water Conservation Fund, the Forest Legacy Program, and State Trails Fund to ensure they are maintained for the public values for which they were acquired.

The Forest Legacy Program (FLP) is a federal grant program to protect forestlands from conversion to non-forest uses. The Vermont Department of Forests, Parks & Recreation is State Lead Agency for Vermont's Forest Legacy Program. The program is entirely voluntary. landowners who wish to participate may either sell the property as fee simple title (all rights), or only a portion of the property rights and retain ownership of the land. The use of conservation easements allows the land to remain in private ownership and ensures that important public values such as wildlife habitat, natural areas, forest resources, and outdoor recreation opportunities are protected.

Use Value Appraisal (Current Use Program): Administration of the forestry portion of the use value appraisal (current use) tax program on the million + acres (1999) of actively managed, private forest land enrolled. This includes providing public information, approving management plans, and inspecting parcels to insure compliance with standards and the management plan.

Private Land Management -- Technical Assistance: Provide information and technical assistance to private landowners on how to manage their land properly. This includes helping landowners understand and evaluate the timber, wildlife, ecological, historical, and aesthetic values of their woodlands. Advising landowners on the availability of private consulting services to help them carry out their management objectives.

Acceptable Management Practices (AMPs): Provide information and materials, and monitor practices that maintain water quality -- minimizing erosion, sedimentation, and temperature changes -- on logging jobs. Assist loggers and landowners to implement AMPs. Respond to citizen complaints. Assist in fact-finding and prosecution of violations. Provide education directly and through partnerships.

Acquisition of Land/Interests in Land: Continue to provide adequate state land for conservation, outdoor recreation, timber production, and other purposes consistent with a statewide policy and plan (the Agency's Lands Conservation Plan, effective July 1999). This includes exchanges, fee-simple acquisitions, acquisitions of interests in land, and identification/disposal of surplus lands.

Forest Land Conservation: Following up the recommendations of the Vermont Forest Resources Advisory Council (FRAC) and Northern Forest Lands Council (NFLC) continue to explore ways to:

- Enhance local rural-based economies through public policies that encourage, rather than discourage, investment in forest-dependent businesses.
- Conserve tracts of undeveloped forest land.
- Explore continually-evolving issues about Vermont's forest land.

Natural Areas Designation/Protection: Continue to identify, designate, and protect areas of significant biodiversity and/or geologic interest on state land. Presently 33 areas are designated.

Forest Health Monitoring: Assess, monitor, and report on the health of Vermont's forest resources by periodic measurements of tree condition and other ecosystem parameters (e.g., soil chemistry and structure, indicator plants and animals, vegetation structure), following national, regional, and state protocols. This includes Vermont Hardwood Health Survey, North American Maple Project, National Forest Health Monitoring Program, and Forest Inventory and Assessment (FIA).

Forest Insect and Disease Management: Protect Vermont's timber, sugarbush, urban forest, Christmas tree, and non-commercial forest resources from significant loss of ecological, economic, or aesthetic value due to damage by forest insects, disease pests, or other biotic and abiotic stressors. Assess role of natural insect and disease outbreaks in overall ecosystem integrity. The Department provides information, data, and technical assistance to landowners, managers, and state and federal agencies. We also implement procedures for handling insect and disease outbreaks and assist in research conducted by other organizations.

Vermont Forest Ecosystem Monitoring (VForEM): Participate as a major partner in VForEM to: Provide information needed to understand, protect, and manage forested ecosystems within a changing global environment. Promote understanding of the conditions, trends, and relationships in the physical, chemical, and biological components of forested ecosystems in Vermont. Promote efficient coordination of multi-disciplinary environmental monitoring and research among federal, state, and private entities.

Conservation Education: Continue and improve interpretive education programs and materials for individuals, schools, groups, and state park visitors, on natural resources, their management, and other related topics. This includes the summer park naturalist program; fall park naturalist program for Vermont students; Project Learning Tree coordination; production of needed written, audio, photographic, and video materials; providing information via the Internet; networking with other educational institutions, organizations, and programs on special projects; and filling requests for natural resources career information. Continue work on alignment of curriculum materials (PLT) with "Vermont Framework of Standards and Learning Opportunities." Continue work with Vermont Institute for Science, Math, and Technology (VISMIT) and Department of Education on natural resources education. Provide information on state land.

Informal and Formal Education: Continue strong commitment throughout the Department, in all activities, on education in our informal contacts with the public, presentations, workshops and demonstrations in the field, school visits, activities on state lands, and other means. This includes continuing education and training for loggers, foresters, and others resource workers. Produce and provide printed materials and public use maps; fill requests for alternative formats. Work with the Department of Education on natural resources management education as a requirement in school curricula, including such topics as wildlife, forestry, water resources, recreation, etc.

Research and Monitoring: Participate in a variety of research and monitoring projects (often with cooperators, such as the University of Vermont and U.S. Forest Service) on important natural resources issues, such as forest health, recreational use of lakes, economic contributions of forest-based businesses, and forest practices. Make the data and information available and useful to the public and special interests.

Vermont Department of Environmental Conservation

The concept that healthy wildlife populations support healthier natural systems upon which we all depend goes to the heart of our mission at the Department of Environmental Conservation (DEC) As such, DEC as been pleased to participate in the development of the Wildlife Action Plan

The DEC is one of three departments in the Agency of Natural Resources. The Department's activities include: monitoring and ecological assessment, education, grants and regulatory oversight of the quality of air, surface water, drinking water, and groundwater, wetland and surface water ecosystems; and waste management and disposal. Department vision and mission statements describe 1) the future condition that the Department collectively wishes for Vermont and the balance that the Department seeks between Vermonters and the resources that the Department manages and 2) what the Department is working to accomplish respectively.

DEC Vision

"We envision a Vermont where people live in harmony with diverse and healthy natural systems; appreciate and enjoy our natural resources; understand the environment; work together responsibly to reduce waste and risks to human health and the environment; and prosper without significant degradation of natural systems. We envision a Vermont where people breathe clean air, drink clean water; eat safe food; and live in a sustained and healthy environment."

DEC Mission

"To preserve, enhance, restore, and conserve Vermont's natural resources, and protect human health, for the benefit of this and future generations."

The Department's work is organized into six programs: Air, Drinking Water, Surface Water, Waste, Groundwater and Earth Resources, and Management. Each of the Department's programs has identified goals developed strategies for achieving those goals. Goals and strategies that address wildlife conservation include:

Air: Goals of the Air program include *"to maintain a level of air quality in Vermont that supports a healthy, diverse ecosystem."* Strategies to achieve this goal include: maintaining base compliance, permitting, monitoring, and outreach and education programs; install air pollution control devices on regional air pollution generators having a discernable impact on Vermont; develop action plans for reducing chemicals which exceed Hazardous Ambient Air Quality standards.

Surface water: Goals of the Surface Water program include *"to maintain and enhance a level of surface water quality, quantity and stream morphology that supports the integrity of healthy ecosystems."* Strategies to achieve this goal include: maintain basic compliance, permitting, planning, monitoring, outreach, and education activities; reduce phosphorus loading to Lake Champlain through point and non-point source controls and improve municipal policies and bylaws; develop, with extensive education and public participation, watershed management plans for all major and minor watersheds that will outline strategic actions to monitor, restore, maintain and enhance the quality of waters within

each basin; provide education and technical assistance to enable communities, local organizations, and individuals to understand and minimize their impact on the watershed environment; develop assistance programs to enhance the management of dams, including removal when appropriate; develop and maintain a morphologically based stream restoration approach to river management; restore river reaches and lakes that are altered by artificial flow and water level management.

Groundwater and Earth Resources: Goals of the Groundwater and Earth Resources Program include *"to conserve Vermont's earth resources."* Strategies to achieve this goal include: maintain basic compliance, permitting, planning, monitoring, mapping, outreach, and education activities; complete investigation and remediation of contaminated sites; produce maps of all known sources and locations of contaminated groundwater.

Waste: Goals of the Waste program include *"to reduce hazardous and solid waste generation through pollution prevention, source reduction, reuse and recycling, to ensure safe management of solid and hazardous wastes that are generated, and to mitigate health and environmental impacts of improper waste disposal actions and accidental releases."* Strategies to achieve this goal include: maintain basic compliance, permitting, planning, monitoring, outreach, and education activities; provide waste prevention information, assistance and recognition; provide solid and hazardous waste facilities management and oversight; provide emergency spill response and management of contaminated sites.

The above provides a summary of Department of Environmental Conservation goals and strategies related to environmental conservation, many of which directly and indirectly benefit wildlife. Strategies include many long-established ongoing activities, including technical assistance, monitoring, grants, and regulatory services. Each program works in partnerships with citizen groups, municipalities, businesses and other government agencies including the Vermont Fish & Wildlife Dept and the US Fish & Wildlife Service. These coordinated efforts are critical to the success of making progress towards each of the program's goals. A few of those activities are described below.

Biodiversity monitoring is an ongoing activity conducted by DEC biologists. Monitoring activities are conducted to evaluate the status of selected biological species and communities. Specific activities include: 1) distributional surveys of plant and animal species listed by the Vermont Endangered Species Committee as endangered, threatened, rare, or of special concern; and 2) monitoring of biological communities or community types whose diversity is threatened (e.g., Lake Champlain mussel and cobble/shale invertebrate communities threatened by zebra mussels). Data are used to: 1) describe species distributions; 2) identify species/communities at risk; and 3) develop management plans for the protection of identified species/communities (e.g., Lake Bomoseen bladderwort relocation).

DEC biologists, in collaboration with other state and federal agencies, have been involved in a variety of activities related to the ecology of wetlands. These activities include: investigations onto the occurrence and potential causes of malformations among Northern leopard frogs in Vermont; a study of the biological communities of vernal pools; demonstrations of the use of herbivorous insects for the control of invasive exotic plant species in lakes and wetlands

The Department is increasingly using watersheds as the basis for water quality protection and management, and to determine assessment and monitoring priorities. Through the Department's educational efforts, watersheds are now the focus as people learn about their individual role in causing and controlling pollution, protecting water resources, and in preserving the land. The Department, following the "Guidelines for Watershed Planning," is conducting seven Basin Planning Processes that includes working with local land owners and other residents to restore impaired waters and formulate strategies to restore and protect waters throughout the watersheds. As part of this effort, bioassessment and biomonitoring will increasingly guide water quality management.

For more information about DEC programs and projects go to:
http://www.anr.state.vt.us/dec/dec.htm

Why is the Vermont Agency of Transportation Concerned about Fisheries and Wildlife Issues?

The Vermont Agency of Transportation (VTrans) has a productive working relationship with the Vermont Fish and Wildlife Department, and numerous activities related to fisheries and wildlife described in the following pages. There are several important reasons for this work.

1. **Safety:** Wildlife on Vermont's highways represents a significant risk to humans. Numerous lives are lost and there are billions of dollars in property damage every year nationally due to vehicle-animal collisions.

2. **Fiscal Benefits:** There are potential fiscal benefits to the state and the agency by reducing wildlife collisions and better planning for wildlife and fisheries impacts from transportation including:
   - Reduced insurance claims.
   - Increased hunting and fishing license revenues from healthier and more numerous deer and moose herds and a healthy indigenous fishery.
   - Improved planning lessens the potential for regulatory battles and thus reduces transportation project costs.
   - Reduced bridge and culvert maintenance costs. Bridges and culverts that provide fish passage are subject to fewer impacts from sediment and debris transport and erosion.

3. **Stewardship:** Protection of wildlife and improved fisheries are important issues for Vermonters. Transportation has been shown to have negative effects to fisheries and wildlife including: increased animal mortality from vehicle collisions; direct and indirect effects to habitat from the existing transportation system, increased traffic, and proposed improvements including new and expanded roadways; reducing animal and fish passage, thus limiting habitat availability and isolating populations; and the effects of pollutants from vehicles such as ozone and green house gases on the state's ecological health. VTrans needs to be a good environmental steward and respond to the public's concerns about fish and wildlife protection.

   Stewardship means better working relationships with regulatory agencies—improved trust, communication, coordination and collaboration - which all help to avoid confrontation in the regulatory process.

4. **Wise Allocation of Resources:** Hundreds of state bridges and culverts are insufficient regarding fish passage. Federal and state dollars to repair, retrofit, and replace these structures are severely limited. Planning and cooperation with the Vermont Department of Fish and Wildlife is needed to make investments that will have the most benefit to all indigenous aquatic organisms.

5. **Prudence in the Regulatory Process:**
    - Working with Fish and Wildlife biologists to better plan, predict problems, and evaluate resources in advance of project design prevents conflicts regarding specific species and habitats during regulatory processes.

    - Planning for mitigation at the watershed or bioregion level, rather than mitigating transportation impacts on a case by case basis has the potential to reduce mitigation costs and have greater wildlife benefits.

    - Transportation agency knowledge and involvement in wildlife and fisheries planning means that indirect and cumulative impacts (under the National Environmental Policy Act NEPA) are better coordinated and more easily addressed for large projects.

The National Perspective

Road ecology - the notion of accommodating wildlife and fisheries movement around and through the transportation system and minimizing habitat fragmentation - is being considered nationally through the Federal Highway Administration (FHWA) and at increasing numbers of state DOTs.

States are employing a mix of underpasses, bridge extensions, culvert installations and modifications and associated fencing and ecowalls to facilitate and guide wildlife movement. Research is also underway through the auspices of the National Cooperative Highway Research Program to investigate how to identify the best wildlife crossing alternative for a site, design guidance and standards, maintenance costs, and a tool to determine cost effectiveness.

Several states, including Vermont, a leader in the Northeast, have also been conducting research and setting policy regarding practice and design guidance for culvert installation, design and prioritization for fish passage.

Transportation planners and highway engineers, biologists, state and federal environmental regulators, and environmental interest groups have been sharing information and research for several years within the context of the biannual International Conference on Ecology and Transportation (ICOET). This first gathering of experts supported in part by the FHWA occurred in 2003 at Lake Placid, New York. The theme for the 2005 conference, which will be held later this year, is "*On the Road to Stewardship*." The conference website (www.icoet.net/ICOET2005.html) explains that:

> The 2005 "Stewardship" theme is designed to encourage conference presenters and participants to share information about projects and best practices that show how they are moving beyond regulatory requirements in order to respond to broader scientific and community-driven concerns related to the consideration of ecological concerns in transportation planning, project development, construction, operations and maintenance.

History in Vermont and Initiatives Underway

For the past several years, the Vermont Agency of Transportation has had several important initiatives related to road ecology. This work is a collaborative partnership with the Vermont

Fish and Wildlife Department and includes a Wildlife Crossing Steering Committee, chaired by VTrans' Director of Program Development. Initiatives include:

- The effects of new transportation projects on habitat and consideration of animal and fisheries passage are considered early in the project planning process. These effects are also considered in the maintenance and upgrading of the existing transportation infrastructure. One recent and very successful example of the former is agreement reached among the regulatory agencies regarding a major expansion of Route 78 through the Missisquoi National Wildlife refuge.

- The first-ever northeast regional wildlife and transportation conference held in 2004, a follow-up to the 2003 ICOET conference, and designed to forge a regional strategy regarding transportation and wildlife issues.

- VTrans and other partners on the Aquatic Organisms Steering Committee including the Vermont Fish & Wildlife and US Forest Service assessed the condition of over 200 large culverts (greater than 6' in diameter) in the Upper White River Watershed. The survey revealed that about one half of the existing large culverts under the state and interstate systems never pass fish. The remaining culverts only pass fish some of the time, and all of the structures suffered from structural damage and nearby stream degradation. Additional survey work in the Connecticut River Watershed during 2005 will help set future Agency culvert retrofit and replacement policy and priorities.

- A statewide GIS habitat database for use as a predictive model for making transportation decisions related to habitat connectivity. The database utilizes data collected by VTrans Operations and Maintenance road crews as well as data from the Vermont Fish and Wildlife Department.

- An inter-agency agreement that will create habitat for the eastern racer, a snake thought to have been extirpated from the state for at least 25 years that was recently discovered on VTrans property.

- Researchers from the University of Massachusetts Amherst have been retained to conduct a ground-breaking study on the efficacy of wildlife crossing structures being installed on the Bennington Bypass.

- VTrans and VDFW staff continue to monitor existing Interstate structures to identify potential crossing structures that are already part of the transportation system.

- Finally, VTrans staff continue their involvement in a habitat training program (recognized by AASHTO in 2003 with a National Environmental Stewardship Award nomination) that gets diverse personnel in to the field with wildlife experts from Keeping Track, Inc, the Vermont Herp Atlas, VFWD and others to learn how their work as transportation professionals can reduce impacts and reconnect habitat.

The Future

The Vermont Agency of Transportation's environmental policy adopted in 2004 recognizes the need for the agency to be proactive regarding its environmental stewardship responsibilities. The effects of the transportation system on Vermont's fisheries and wildlife are noted above. VTrans' approach in the past has included research, dialogue and partnerships with the Department of Fish and Wildlife and other interests. This work will continue in 2005 including:

- Norwich University students performing both pre-construction and post-construction aquatic studies during the summer of 2005—upstream, downstream, and within large culverts on the Agency's critical list.
- A culvert design workshop planned for July 11-15, 2005 for ANR and VTrans personnel with the goal of developing a set of design criteria that address hydraulics, debris and sediment transport, and the passage of all indigenous aquatic organisms.

References

Case, D. J. 2005. IAFWA Summit on Conservation Education, Final Report to International Association of Fish and Wildlife Agencies. February 3, 2005. D.J. Case & Associates. Mishawaka, IN. www.iafwa.org/conservationeducation/docs/Ed_Summit_Final_Report.pdf

Ecological Society of America's Committee on Land Use. 2000. Ecological Principles for Managing Land Use. Ecological Society of America, Washington, DC

Forman, Richard T. 1995. Land Mosaics, The Ecology of Landscapes and Regions. Cambridge University Press. New York.

Glick, P. The Waterfowlers' Guide to Global Warming. National Wildlife Federation. Washington, DC. www.nwf.org/globalwarming/pdfs/waterfowlbook.pdf

2005).Hammond, F.M. 2002. The Effects of Resort and Residential Development on Black Bears in Vermont. Final Report. Fish & Wildlife Department, Agency of Natural Resources. Waterbury, Vermont.

MacArthur, R.H. and E.O. Wilson. 1967. The Theory of Island Biogeography. Princeton University Press

National Invasive Species Council 2005. National Agricultural Library, U.S. Department of Agriculture. http://www.invasivespecies.gov/

U.S. Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

VFWD. 2001. Conservation 2001: Acting on a Vision for Fish & Wildlife Conservation, A Comprehensive Wildlife Conservation and Restoration Plan. Vermont Fish & Wildlife Department. Unpublished. Waterbury, Vermont.

Vermont's Wildlife Action Plan

November 22, 2005

Chapter 3 Developing Vermont's Wildlife Action Plan

Process and Organization 1
- Timeline 1
- Organizational Structure 1
- Outreach and Public Involvement 5
- Coordination with Other Agencies 7
- Outreach Events and Products 8

Species & Habitat Conservation 10
- Identifying Species of Greatest Conservation Need 10
- Conservation of Species of Greatest Conservation Need 14
  - Fine Filter-Species 14
  - Coarse Filter-Conservation at Multiple Scales 15
  - Landscape Classification & Ecological Divisions 16

**formally the Comprehensive Wildlife Conservation Strategy (CWCS)*

Developing Vermont's Wildlife Action Plan

Process and Organization

Timeline

The creation of Vermont's Wildlife Action Plan began in August 2003 when a Steering Committee of Vermont Fish & Wildlife Department directors and program leaders began regular scoping meetings. A project coordinator was hired in January 2004 and January to May 2004 was devoted to: reviewing federal guidelines, planning literature and past planning efforts; designing the Action Plan organizational structure and development process; and soliciting the support of stakeholder organizations and agencies. The identification of Species of Greatest Conservation Need (SGCN) occurred from May through September 2004. Habitat delineation for SGCN, problem assessment and strategy development occurred from September 2004 through January 2005. Integration and conservation planning ran from October 2004 through April 2005. Review and additional input by the Department, agencies and other stakeholders and the general public, ran from February though July of 2005. Final document preparation and editing occurred from May through August 2005. The anticipated submission date of the Action Plan is September 1, 2005.

The Action Plan Steering Committee identified five primary concepts during the scoping process that should frame the development of the Wildlife Action Plan:

1. Conserve, enhance and restore Vermont's wildlife and wildlife habitat.
2. Represent good science and conservation planning.
3. Identify conservation priorities yet remain flexible and open to new opportunities.
4. Be a strategy for the entire state; one that all agencies, organizations and individuals can find useful.
5. Build and support advocates for wildlife conservation.

The Action Plan Steering Committee recognized that meeting these goals required the resources, participation and ingenuity of many conservation-minded individuals, organizations and agencies. This in turn required a development process that included stakeholders and conservation partners to the greatest extent possible.

Organizational Structure

Six technical teams (Species Teams), two coordination teams (Integration Team and Steering Committee) and two advisory committees (Conservation Strategy Review Team and Conservation Partners) were created to develop the Wildlife Action Plan (Fig 3-1). Team descriptions follow below. Full charters for each team can be found in Appendix D.

Steering Committee: (Fish and Wildlife Department directors and program heads and the Action Plan Coordinator). The Action Plan Steering Committee is the executive body for Action Plan development and implementation with statutory responsibility for completion

of the Action Plan and management of State Wildlife Grant funds. The Steering Committee provides leadership and organizational commitment to ensure success of the Action Plan; encourages meaningful participation and buy-in among partners; and, appoints members to technical teams. See Table 3-1 for a list of Steering Committee members.

Wildlife Action Plan Coordinator: Manages the Action Plan project, supports activities of the technical and coordination teams, directs outreach and communications efforts, and writes website, newsletter and Action Plan content.

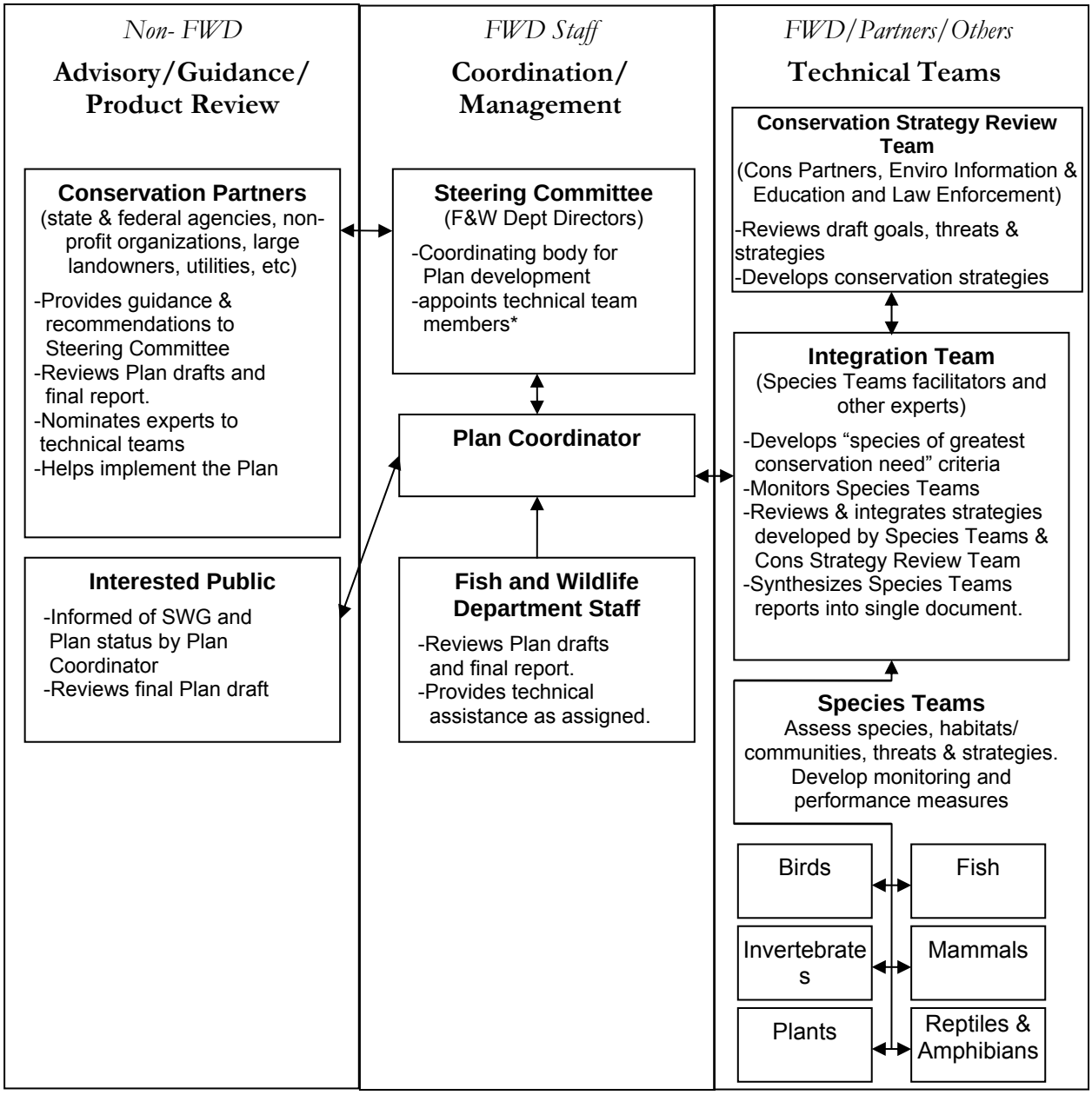

Figure 3-1: VT Wildlife Action Plan Teams and Committees

Conservation Partners: (representatives of state & federal agencies, non-profit organizations, large landowners, utilities, State legislators, academics, and others).

Conservation Partners provide guidance and recommendations to the Action Plan Steering Committee; review SGCN lists and Action Plan drafts; nominate experts for participation on Species, Integration and Conservation Strategy Review teams; and, help implement the Action Plan upon its completion. The Conservation Partners committee is open to any and all organizations that wished to participate. See table 1-1 for a list of conservation partners.

Species Teams: (selected Fish and Wildlife staff, conservation partners, and other wildlife conservation experts). There are six Species Teams: Bird, Fish, Invertebrate, Mammal, Plant, Reptile & Amphibian (Herps). These teams develop and refine lists of species of greatest conservation need; assess species distribution and abundance, identify habitats, communities, problems & strategies; develop monitoring and performance measures; recommend draft strategies for managing species of greatest conservation need; address comments made by Conservation Partners during interim review. See Table 3-1 for a list of Species Team members.

Integration Team: (Species Team leaders plus additional Fish & Wildlife staff and non-staff experts in wildlife conservation). The Integration Team develops criteria for designating species of greatest conservation need; keeps Species Teams on schedule; organizes species into groups based on habitat needs, synthesizes reports of the Species Teams and strategies developed by the Conservation Strategy Review team; identifies gaps in information and addresses special habitat and natural community needs; and prioritizes strategies and solutions to conservation challenges. See Table 3-1 for a list of Integration Team members.

Conservation Strategy Review Team: (State and federal agencies and non-profit organizations). The Conservation Strategy Review team (CSR) includes a main team as well as an Education CSR and a Law Enforcement CSR. The CSR was added to the array of Action Plan teams and committees in direct response to early feedback from Conservation Partners. Partners wanted additional opportunities to participate in Action Plan strategy development. CSR members were selected by the Steering Committee from a pool of nominees submitted by Conservation Partners. See Table 3-1 for a list of CSR members.

The Conservation Strategy Review team reviews problems and draft strategies developed by the Species Teams and the Integration Team. The CSR can also develop additional strategies as needed. These teams will also help present the draft Action Plan to Conservation Partners and the general public during review sessions. Because staffing and budget limitations made it impossible to include conservation education and law enforcement professionals on every Action Plan team and committee the Education and Law Enforcement CSRs were created to insert key perspectives and ideas into the process in a strategic and cost-effective manner. Conservation Strategy Review team members will also help implement the Action Plan upon its completion.

Table 3-1: Members of the Vermont Action Plan Steering Committee, Conservation Strategy Review Team, Integration Team and Species Teams
*Denotes chair, facilitator or co-facilitator of a team or committee

Steering Committee		**Conservation Strategy Review Team (CSR)**	
Ron Regan*	VT Fish & Wildlife Dept, Operations Director	Eric Palmer*	VT Fish & Wildlife Dept.
Tom Decker	VT Fish & Wildlife Dept, Wildlife Director	Colleen Sculley*	US Fish & Wildlife Service
Eric Palmer	VT Fish & Wildlife Dept, Fisheries Director	Rob Borowske	VT Fish & Wildlife Dept Board
Scott Darling	VT Fish & Wildlife Dept District Biologist	Gina Campoli	VT Agency of Transportation
Steve Parren	VT Fish & Wildlife Dept, NNHP Coordinator	Peg Elmer	VT Dept of Housing & Community Affairs
Tom Wiggins	VT Fish & Wildlife, Department Planner	Jamey Fidel	VT Natural Resources Council
Jon Kart	VT Fish & Wildlife Dept, Action Plan Coordinator	Roy Marble	VT Federation of Sportsmen's Clubs
		David Kelley	VT Ski Areas Association
Integration Team		Warren King	Audubon Society
Scott Darling*	VT Fish & Wildlife Dept	Sherb Lang	Hunters Anglers & Trappers of VT
Christa Alexander	VT Fish & Wildlife Dept	Leo Laferriere	Society of American Foresters
John Austin	VT Fish & Wildlife Dept	Art Menut	VT Farm Bureau
Farley Brown	VT Coverts	Julie Moore	VT Agency of Natural ResourcesPlanning Division
Doug Burnham	VT Dept of Environmental Conservation	Virginia Rasch	Assoc of VT Conservation Commissions
Dave Capen	University of Vermont	John Roe	The Nature Conservancy
Kathy Daly	Wildlands Project	Rick Schoonover	Vermont Trappers Association
Therese Donovan	VT Fish & Wildlife Coop Unit	Dave Tilton	US Fish & Wildlife Service
Paul Fredrick	VT Forest, Parks and Recreation Department	Jim Wood	North Country Environmental & Forestry
Clayton Grove	US Forest Service	Steve Wright	National Wildlife Federation
Eric Sorenson	VT Fish & Wildlife Dept	**Education CSR**	
Elizabeth Thompson	University of Vermont	Mark Scott	VT Fish & Wildlife Dept.
Keith Weaver	US Fish & Wildlife Service	Ginger Anderson	VT Forest Parks & Recreation Dept
Cedric Alexander	VT Fish & Wildlife Dept	Sally Laughlin	VT Endangered Species Committee
Ken Cox	VT Fish & Wildlife Dept	Gale Lawrence	Naturalist, writer
Mark Ferguson	VT Fish & Wildlife Dept	**Law Enforcement CSR**	
Steve Parren	VT Fish & Wildlife Dept	Bob Rooks	VT Fish & Wildlife Dept.
Bob Popp	VT Fish & Wildlife Dept	Mark Sweeny	US Fish & Wildlife Service
Kim Royar	VT Fish & Wildlife Dept	Pat Bosco	US Fish & Wildlife Service

Table 3-1 continue

Species Teams			
Bird Team		**Invertebrate Team**	
Cedric Alexander*	VT Fish & Wildlife Dept	Mark Ferguson*	VT Fish & Wildlife Dept.
Eric Derlath	US Fish & Wildlife Service	Steve Fiske	VT Dept of Environmental Conservation
Patrick Doran	Wildlands Project	Trish Hanson	VT Forest Parks & Recreation Dept
Dave Frisque	US Fish & Wildlife Service	Bryan Pfeiffer	Wings Environmental
Margaret Fowle	National Wildlife Federation	Kent McFarland	VT Institute of Natural Science
John Gobeille	VT Fish & Wildlife Dept.		
Paul Karczmarczyk	Ruffed Grouse Society	**Mammal Team**	
Mark Labarr	Audubon Society	Kim Royar*	VT Fish & Wildlife Dept.
Chris Rimmer	VT Institute of Natural Science	Pat Bartlett	Consulting Foresters Assoc VT
Allan Strong	University of Vermont	Tom Decker	VT Fish & Wildlife Dept.
		Bill Kilpatrick	University of Vermont
Fish Team		Sue Morse	Keeping Track, Inc
Ken Cox*	VT Fish & Wildlife Dept.	John Sease	US Forest Service
Doug Facey	St. Michaels College	Peter Smith	Green Mountain College
Anne Hunter	VT Fish & Wildlife Dept.	Charles Wood	University of Vermont, retired
Rich Langdon	VT Dept of Environmental Conservation	**Plant Team**	
John Lepore	VT Agency of Transportation	Bob Popp*	VT Fish & Wildlife Dept.
Craig Martin	US Fish & Wildlife Service	Dorothy Allard	Endangered Species Committee-Flora
Donna Parrish	VT Fish & Wildlife Coop Unit	Errol Briggs	VT Grange
Steve Roy	US Forest Service	Anne Bove	VT Dept of Environmental Conservation
		Mary Beth Deller	US Forest Service
Reptile & Amphibian Team		Brett Engstrom	Endangered Species Committee-Flora
Steve Parren*	VT Fish & Wildlife Dept.	Diana Frederick	VT Forest Parks & Recreation Dept
Jim Andrews	Middlebury College	Marc Lapin	Endangered Species Committee-Flora
Steve Faccio	VT Institute of Natural Science	Annie Reed	Endangered Species Committee-Flora
Chris Slesar	VT Agency of Transportation	Ned Swanberg	VT Institute of Natural Science
		Susan Warren	VT Dept of Environmental Conservation
		Mike Winslow	Lake Champlain Committee

Outreach and Public Involvement

The Vermont Fish & Wildlife Department recognized that to fully meet our goals for the Action Plan we needed the resources, participation and ingenuity of many conservation-minded individuals, organizations. To honor the efforts of the people and organizations participating in this project the following guidelines developed by the International

Association of Public Participation (IAP2 2004) were utilized in planning and implementing the public involvement process for Vermont's Action Plan:

1. Public participation includes the promise that the public's contribution will influence the Wildlife Action Plan.
2. The public participation process involves participants in defining how they participate.
3. The public participation process provides participants with the information they need to participate in a meaningful way.
4. The public participation process communicates to participants how their input affected the development of the Wildlife Action Plan.

In addition to the involvement of Conservation Partner organizations and agencies noted earlier, additional outreach and public involvement efforts focused on the following groups:

General Public: The general public has been kept informed about the State Wildlife Grants and Wildlife Action Plan several ways. These include: ongoing publications of two Department newsletters (*Fish & Wildlife Conservation News* and *Natural Heritage Harmonies*), a website dedicated to Vermont's Action Plan (http://www.vtfishandwildlife.com/SWG_home.cfm); presentations to conservation and wildlife oriented organizations, lectures at the University of Vermont; postings to listserves such as Vermont's science teacher listserve, and the general news and recreation media. Our public outreach goals were to inform the public that: wildlife may be at risk without our help and without adequate funds to conserve them; that with the financial support of State Wildlife Grants program, the Vermont Fish and Wildlife Department and Conservation Partners are developing strategies to conserve Vermont's wildlife; and; the general public can view a draft Action Plan and provide comments in spring 2005.

Endangered Species Committee: The Endangered Species Committee (ESC) is a standing citizens committee of the Agency of Natural Resources. It advises the Agency Secretary on issues concerning the State's listed and potential endangered and threatened species. The committee reviews the endangered and threatened species list and makes recommendations to the Secretary about amendments and ways to protect listed species. The ESC is supported by taxa-specific Scientific Advisory Groups (SAGs). Positions on the ESC and SAGs are filled by experts from local, state and regional organizations, agencies and education/research facilities. The Endangered Species Committee was briefed on the Action Plan early in the process. Several ESC and SAG committee members serve as Species Team members.

Fish and Wildlife Board: The Fish and Wildlife Board is a citizens committee of the Fish & Wildlife Department responsible for reviewing and approving fish and wildlife regulations in the state. The 14 members each represent one Vermont county and serves for six years. The board has been kept informed of the progress of the Action Plan via VFWD newsletters and email. Two Fish and Wildlife Department Board members were invited to the introductory Action Plan meeting and who have received regular Action Plan updates via the Conservation Partner listserve. Robert Borowske, Board Chairman was also made a member of the Conservation Strategy Review team.

Internal Constituencies: Staff of the Wildlife and Fisheries divisions and the Nongame and Natural Heritage Program of the Vermont Fish & Wildlife Dept received periodic updates and briefings on Action Plan status through division meetings, postings to the Action Plan website and through email. Leaders and members of the Integration Team, the Conservation Strategy Review team and six Species Teams included staff in all seven VFWD offices in the state. Staff was encouraged to provide input on all aspects of the process.

Coordination with Other Agencies & Native American Tribes

Congressional guidelines require that each state Action Plan "coordinate the development, implementation, review and revision of the Action Plan with federal, state and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats."

Native American Tribes: There are no Native American tribes within the borders of Vermont that are officially recognized by the state or by the federal Bureau of Indian Affairs. Further, there are no tribal entities that manage significant land and water areas within the state or administer programs that significantly affect the conservation of Species of Greatest Conservation Need or their habitats. Therefore, in developing Vermont's Action Plan no special efforts were made to reach out to the Native American community however all Vermonters including Native Americans were encouraged to take part in the development of the Action Plan as Conservation Partners and the general public input process.

Development: State and federal agencies concerned with wildlife and land conservation and management have been highly involved in the development of Vermont's Action Plan. All are considered Conservation Partners in the development of the Action Plan. Representatives of eight state and federal agencies serve on Action Plan technical and coordinating teams (Table 3-1) of the dozen agencies serving as Conservation Partners. Several agencies provided data used in the development of the Action Plan. These agencies, as well as inter-agency groups such as the Lake Champlain Ecosystem Team, have also been kept informed of the ongoing developments in the Action Plan through email and US mail and partner meetings. Presentations and briefings were made to the commissioners of sister agencies at the State Agency of Natural Resources—the Department of Forests, Parks and Recreation, and the Department of Environmental Conservation, the Agency Secretary, the Vermont Agency of Agriculture, the inter-agency Lake Champlain Ecosystem Team, Windsor County Regional Planning Commission, and representatives of the Vermont Department of Housing & Community Development, and the US Department of Environmental Protection.

The International Association of Fish & Wildlife Agencies (IAFWA) and the Region 5 US Fish & Wildlife Service (USFWS) played significant and indispensable roles as facilitators of interstate, regional and national coordination through 1) Electronic listserves-IAFWA nationally and USFWS regionally; and, 2) Meetings of States, Federal Agencies and Partners—IAFWA nationally (two meetings) and USFWS regionally (three meetings).

Implementation, Review & Revision: All Conservation partners, including federal, state and local agencies will be encouraged to take part in the implementation, review and revision

of the Action Plan. Plans for these steps can be found in chapter 5 Vermont's Action Plan: Implementation and Review.

Outreach Events and Products

Partner Meetings: In March 2004 representatives of approximately 80 organizations and agencies interested in wildlife conservation and management were invited to an introductory Action Plan meeting. At this meeting the proposed Action Plan development process was presented. Through a series of discussions and brainstorming sessions the attendees helped the VFWD fine tune the process and focus on key issues. Participants were invited to take part in the development of Vermont's Action Plan by participating as Conservation Partners, by nominating people to serve on Species Teams and the Integration Team, and by keeping their memberships informed and engaged in the Action Plan.

In June 2005 Conservation Partners met for a second time to discuss the draft Action Plan report and Action Plan implementation. All questions, comments and suggestions were recorded and a responsiveness summary was developed and shared with all partners shortly after the meeting. The Conservation Partner comment period for the Action Plan originally ran from June 20 to July 18, 2005 but was extended to August 12, 2005 for a total of more than seven weeks.

In July 2005 a two-week public comment period and two public meetings on the final draft Action Plan were held. This comment period was three weeks to August 12, 2005 for a total comment period of five weeks. Public meetings were advertised through the Department's website, in the Department newsletter, through the news media and with the help of Conservation Partners who encouraged their memberships to attend the meetings and to provide comments on the report. Comments on the Action Plan were accepted during the meetings, via email, US mail, telephone and the Action Plan website.

The Action Plan was a significant topic of discussion among partner and potential partners during a September 2004 regional conference on Wildlife and Transportation held in Vermont.

Individual Partner Meetings: More than 40 meetings with individual partner organizations and agencies were held during the development of the Action Plan. The purpose of the meetings included keeping interested partners informed and outreach to potential partners.

Partner Correspondence: Between May 2004 and July 2005 Conservation Partners received periodic updates tracking progress in the development of the Action Plan via email and US mail. This includes the distribution of responsiveness summaries to Partner feedback, the announcement of a website dedicated to the VT Action Plan; the release of a draft list of Species of Greatest Conservation Need, the responsiveness summary to the CSR team recommendations and planning for a review meeting on the draft Action Plan report. Partners were invited to comment on any and all aspects of the Action Plan process and report in all communications. See Appendix E for a sample of correspondence and partner updates.

Species Team, Integration Team and Conservation Strategy Review team meetings: The six Species Teams and Integration Team began meeting in May 2004 with most having monthly meetings at least through January 2005. The Conservation Strategy Review team met in Dec 2004 and February and March of 2005. These meeting were open to Conservation Partners and the general public. Meeting schedules were posted to the Action Plan website.

Media: The Action Plan Coordinator managed the project's media campaign. Press advisories were released three times during the life of the project. Stories and editorials ran in two of the state's major newspapers and an unknown number of local and regional papers. The project was also covered at least twice on television and on public and commercial radio stations. Sample coverage is included in Appendix F.

Newsletters/Website: *Fish & Wildlife Conservation News* was created by the Fish & Wildlife Department specifically to inform the public about the State Wildlife Grant program and the projects it supports. Three issues were produced during the course of Action Plan development. *Natural Heritage Harmonies* produced by the Nongame and Natural Heritage program provided the public with information about Department projects, including work on Species of Greatest Conservation Need. See Appendix G for sample newsletters. During implementation of the Action Plan these newsletters will continue to inform and involve the public in SWG and Action Plan conservation efforts.

In July 2004 the Department unveiled a website dedicated to Vermont's Wildlife Action Plan (http://www.vtfishandwildlife.com/SWG_home.cfm). This site contains background on SWG, Action Plan requirements and background materials, links to Conservation Partners, SGCN lists, team and committee meeting schedules, updates and Partner correspondence, copies of press releases as well as copies of media coverage and answers to frequently asked questions. Drafts of the Action Plan were also posted to the site and an online feedback and comment form allowed people to submit comments electronically. During implementation of the Action Plan the website will continue to inform and involve the public in SWG and Action Plan conservation efforts.

Species & Habitat Conservation

Identifying Species of Greatest Conservation Need

Congress created the State Wildlife Grants program (SWG) in 2001 with the goal of preventing wildlife populations from declining to the point of requiring Endangered Species Act protections. To receive SWG funds, State Fish and Wildlife Departments agreed to develop statewide Wildlife Action Plans. Congress directed that the Action Plan identify and be focused on the "species of greatest conservation need."

Congress left it up to each state to identify their Species of Greatest Conservation Need (SGCN). The State Wildlife Grants program defines wildlife as "any species of wild, free-ranging fauna including aquatic species and invertebrates as well as native fauna in captive breeding programs intended for reintroduction within its previously occupied range." Furthermore, it was Congress' intent that SWG assist wildlife that have not previously benefited from other federal wildlife conservation and management programs (e.g., Federal Aid to Wildlife Restoration Act, Federal Aid in Sport Fish Restoration Act, or the Endangered Species Act). In Vermont, SGCN include:

- Species with declining populations;
- Species threatened or potentially threatened; and,
- Species that are so little known in the state that experts cannot yet ascertain status.

Though plants are not eligible for State Wildlife Grants Program funding, Vermont's Action Plan does include plant SGCN. It is expected that habitat conservation efforts for wildlife SGCN will benefit at least some of the plants. Plant specific conservation strategies, if and when they are implemented, will be funded through mechanisms other than SWG. Several game and sportfish species are identified here as SGCN. We expect to target other established funding programs for the conservation of these species before tapping SWG.

Vermont began its process of identifying Species of Greatest Conservation Need (SGCN) with a systematic review of all its known wildlife. The review was designed to assist the teams selecting the SGCN by equalizing the between well-known wildlife species supported by large datasets and poorly understood species.

The Integration Team was tasked with developing review criteria (Table 3-2). Six Species Teams (Bird, Fish, Herpitile (Reptile & Amphibian) Invertebrate, Mammal and Plant) conducted the reviews and selected SGCN with guidance and coordination provided by the Integration Team.

The Species Teams were provided with lists of species found in Vermont within their respective taxa (the Invertebrate team received the most up-to-date invertebrate list available but it is widely accepted that a complete list of the estimated 15,000-36,000 invertebrates in Vermont may never be possible (ANR 1995). The lists and supporting information were developed by the VFWD's Nongame and Natural Heritage Program (NNHP) using their Biotics© database and augmented with other databases, records and information from

Natureserve, universities and research facilities, regional and national monitoring efforts, published literature and the knowledge of technical experts.

Species teams met multiple times between May and September 2004 to conduct review. Data was captured in the Action Plan database.

Once the reviews were complete (Appendix A for SGCN, Appendix H for secure species) the Species Team selected SGCN using selection criteria (Table 3-3) developed by the Integration Team. Species were assigned conservation priorities of high, medium or low. Species ranked medium and high constitute Vermont's Species of Greatest Conservation Need. Low priority species were considered secure. There were a few cases where a specific Species Team approached their tasks differently:

> **Bird Team:** An unusually rich collection of data and prior conservation planning efforts are available to bird conservators—far more than is available for other taxa. The Bird Team took advantage of this information by first focusing on species found on the watch lists of the North American Bird Conservation Initiative and Partners In Flight for Bird Conservation Regions 13 and 14 (Rosenberg 2004) as well as BBS route. Once watch list species were reviewed the team turned its attention to other species.
>
> **Invertebrate Team:** It is estimated that Vermont is home to between 15,000 and 36,000 invertebrate species (VANR 1995). The vast majority are un-cataloged, un-studied and just plain unknown. Application of the review criteria to invertebrates on a species by species basis would be unproductive. Instead the Invertebrate team interviewed additional experts within Vermont, regionally and nationally to help in the identification of species and species groups of greatest conservation need.
>
> **Plant Team:** The Plant Team also had to contend with a huge list of species—more than 2000 vascular plants (Flora 1993) and 600 bryophytes (Allard 2004). The team took advantage of plant conservation assessments previously conducted by the Agency of Natural Resources' Endangered Species Committee to create its list of Species of Greatest Conservation Need. All species ranked S1 (critically imperiled) and S2 (imperiled) became SGCN. Those SGCN also on the New England Plant Conservation Program list of regionally rare plants were then ranked High Priority. All others were ranked medium priority.

Table 3-2: Criteria for Reviewing Vermont's Wildlife

Category	Criterion	Allowed Response	Definition/example
Species that are rare or declining	State and/or Federally listed Threatened or Endangered species	Endangered, Threatened, Special Concern [See Appendix I for definitions of T& E status and ranks]	E: Endangered: in immediate danger of becoming extirpated in the state T: Threatened: with high possibility of becoming endangered in the near future. SC: Special Concern: rare; status should be watched
	Rare and very rare species	S-Ranks S1,S2 [See appendix I for definitions of T& E status and ranks]	S1: Critically imperiled (very rare): At very high risk of extinction or extirpation due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors. S2: Imperiled (rare): At high risk of extinction or extirpation due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors
	State Trend	Stable, Fluctuating, Declining, Increasing, Unknown	Based on research data such as BBS routes, other monitoring and best judgment of experts
	Regionally Rare	Yes/No/ Unknown	Based on regional and national research, BBS routes, other monitoring and consensus within technical teams.
	Extirpated in Vermont	Yes/No/ Unknown	
Vulnerable species at risk due to any of the following	Habitat Loss/Conversion/fragmentation	Yes-development, Yes-succession, Yes-natural causes, No, Unknown	Species negatively affected by habitat conversion, degradation, fragmentation or succession
	Life-history traits making the species vulnerable	Yes/No/ Unknown	Species with low fecundity, that take a long time to reach sexual maturity, that take a long time between reproductive events (e.g., sturgeon, wood turtle)
	Species vulnerable to taking	Yes-Regulated, Yes-Unregulated, No, Unknown	Hunting, trapping or collection, legal or otherwise.
	Species vulnerable to other deadly contact with humans	Yes/No/ Unknown	Road kill (bobcat, turtles), wind turbines (birds, bats) contaminates (fish) etc
	Species w/ limited, localized at-risk populations	Yes/No/ Unknown	Populations that cannot or do not intermix with the meta-population. E.g., non-vagile invertebrates in a sandplain community and perhaps spruce grouse.
	Species significantly impacted by exotics	Yes/No/ Unknown	Impact may lead to elimination of populations, limits to long-term stability, extirpation
Species or species groups w/ unknown status or	Unknown status-more data is needed	Yes/No/ Unknown	
	Species w/ taxonomic uncertainties	Yes/No/ Unknown	

Category	Criterion	Allowed Response	Definition/example
taxonomy			
Category	**Criterion**	**Allowed Responses**	**Definition/example**
Other factors to consider	Keystone species	Yes/No/ Unknown	Species with a disproportionately strong influence on ecosystem functioning and diversity (Power et al.1996).
	Responsibility species	Yes/No/ Unknown	Species for which Vermont has a long-term stewardship responsibility because they are not doing well regionally, even if populations are stable in Vermont (e.g., Bobolink)
	Endemic species	Yes/No/ Unknown	Species found only in Vermont
	Relationship to core population	central peripheral, disjunct, unknown	
	Requires rare or specialized habitats	Yes/No/ Unknown	A species with a very narrow niche, e.g., a species requiring a host plant found only in a handful of serpentine rock outcrops.
	Species with limited dispersal capability	Yes/No/ Unknown	Non-vagile species in dispersed habitats.
	Requires key Vermont migration stopover points	Yes/No/ Unknown	
	Species selected based on expert opinion	Yes/No	Combined opinion of the team.
	Actively managed? (if so list applicable plan(s)	Yes-Mgt plan exists, Yes-regulated, No	Does a management plan exist for the species or species group? (E.g., an osprey plan, waterfowl plan, species recovery plan.)
Secure?	Species Secure	Yes/No/ Unknown	Combined opinion of the team
	Final Assessment	High, Medium, Low Priority	

Table 3-3: Criteria for Selecting Vermont's Species of Greatest Conservation Need
Because the circumstances, issues and problems impacting each species is unique, teams were given some flexibility in assigning ranks to species.

Species (and Species Groups) of Greatest Conservation Need	**High Priority**	Species that are vulnerable (rarity is an aspect of vulnerability).
		Species with immediate limits to its survivability based on known problems and/or known impacts to the population
		Species exhibit negative population trends.
		Species may be extirpated locally (Vermont) but still exist regionally.
	Medium Priority	Species may be well distributed and even locally abundant, but populations are challenged by factors that increase mortality or habitat loss and therefore threaten the species in Vermont.
		Consider what is known about the species regionally.
		Since this may be the most difficult category to assign species to, there should be a consensus among group members.
Common Species	**Low Priority**	Species is secure for the immediate future.
		Species may be vulnerable to some mortality and/or problems (e.g., habitat degradation) but population is abundant enough to tolerate negative forces

There is some variability between Species Teams regarding thresholds used for selection as SGCN (e.g. the herpitile team was the most conservative in selecting SGCN and the mammal team selected the most SGCN based on the need to address data gaps). This being Vermont's first Action Plan our priority was not to ensure parity in numbers across taxa but rather to ensure that experts within each taxon were in accord regarding the species selected.

The list of Species of Greatest Conservation Need includes 144 vertebrate species (out of a total of 468), 192 invertebrate species or groups (out of an estimated 15,000-36,000) and 577 plant species out of approximately 2600 vascular and non-vascular species. See Table 3-4 for summary statistics on Vermont's SGCN.

Table 3-4: Summary Statistics for Vermont's Species of Greatest Conservation Need
High and medium priority ranked species constitute Vernont's SGCN.
*27,250 is the median of the estimated 15,000 to 36,000 Vermont invertebrates (ANR 1995)
** This low percentage reflects the large number of invertebrates whose conservation status is unknown

	Total species in VT	High Priority SGCN	Medium Priority SGCN	Total SGCN	% SGCN of total VT Species
Birds	269	22	35	57	21%
Fish	94	18	15	33	35%
Reptiles & Amphibians	42	12	7	19	45%
Mammals	63	16	17	33	52%
Invertebrates*	27250*	192	0	188	0.69%**
Plants	2000	200	377	577	29%
Total	29718	403	450	853	2.87%

This list was then reviewed by the Integration Team, Steering Committee and the Commissioner of the Fish & Wildlife Department. It was then made available to Vermont Fish & Wildlife staff, Action Plan Conservation Partners, the Action Plan Conservation Strategy Review team and the general pubic for feedback and comments via the Action Plan website.

Conservation of Species of Greatest Conservation Need

Fine Filter-Species

Once Species of Greatest Conservation Need were identified, technical teams set about developing individual species reports for each SGCN. Reports identified species distribution, habitat needs, problems affecting species and their habitats, research and monitoring needs and conservation strategies for each SGCN (Congressionally required elements #1-#5). Invertebrate SGCN were addressed in groups rather than as individual species. Fourteen invertebrate groups were created based on taxonomy (e.g., butterflies, crustaceans, tiger beetles) and habitat use (e.g., freshwater, grasslands, hardwood forests). Reports were not developed for plant SGCN. All data was entered into the Action Plan database.

Distribution for all SGCN was identified by biophysical region (Girton & Capen 1997) using terminology consistent with the Nongame Natural Heritage Program's element occurrence tracking procedures. Distribution of fish SGCN and some additional aquatic SGCN was also

identified by 8-digit watershed unit (NRCS 2003). Historic occurrence was noted in a narrative for some of the rarer and extirpated SGCN.
Protocols for describing habitat were developed by the Integration Team in consultation with Species Teams. Habitat descriptions for SGCN include a narrative, elevation preferences, migrant status, home range and patch size requirements and landscape requirements (e.g., corridor needs, habitat mosaics or wetland complexes, preference for managed or passively managed forest, large grasslands or developed landscapes).

Research needs for each SGCN, where needed to determine species status or to identify problems, were developed by each Species Team. Research needs were assigned "high," "medium" and "low" priorities.

Priority problems and potential risks to Species of Greatest Conservation Need were enumerated for each species. These were not exhaustive lists of all possible problems. Teams identified only those factors posing significant and potentially significant problems for a species. A narrative description was entered into the database. Species teams also assigned each problem to one of 22 habitat related and non-habitat related problem categories (Appendix C). These categories are the same as those used in Species of Concern Status Reports during the U.S. Forest Service's Forest Plan Revision process for the Green Mountain National Forest.

Species specific conservation strategies were also developed by the Species Teams. Strategies were designed to address the problems identified for each SGCN. Strategies were assigned either a "medium" or "high" priority status (low priority strategies are not included in the Action Plan) and each strategy was also assigned to a category (Salafsky 2004) to aid in organizing and review of strategies (Appendix C).

Strategies were not prioritized beyond this step. As a conservation guide for the state, Vermont's Action Plan is meant to provide guidance to organizations, agencies and individuals wishing to conserve wildlife. The varied goals and missions of the partners involved in the Action Plan span a broad spectrum of wildlife interests, skills and reach (some are local, others are state, regional and federal entities). No prioritization was found to satisfy all partners, however, the conservation need is deemed so great that there is room for everyone to select the species and habitats they find most important and implement the strategies they are most capable of working on. Detailed discussions with the Conservation Strategy Review team focused prioritization efforts on problems impacting SGCN and habitats (see below).

Coarse Filter-Conservation at Multiple Scales

To aid in the development of community and landscape level conservation strategies, all SGCN were assigned to at least one of more than 100 communities, cultural habitats and or landscapes. These elements were organized in four major groups: 1) forest and riparian/fluvial landscapes; 2) terrestrial natural communities and successional stage forests; 3) fish assemblages and lacustrine waters (lakes and ponds); and, 4) cultural habitats (see the tables 4-1 and 4-2 in the SGCN Conservation at multiple Scales section of Chapter 4). "Wetland, Woodland, Wildland - A guide to the natural communities of Vermont" (2000) by Thompson and Sorenson was used as the basis for terrestrial natural communities. Forest cover types (Eyre 1980) and U.S Forest Service Forest Inventory & Analysis types (USDA 2003) were used for early successional and managed forests. "A Classification of the Aquatic

Communities of Vermont" by Langdon et. al. (1998) was used as the basis for aquatic habitat designations and Reschke (1990) was adapted for cultural habitats.

These 100 categories were grouped into 24 major categories (see the tables 4-1 and 4-2 in the SGCN Conservation at multiple Scales section of Chapter 4) and the Integration Team developed assessments for each. Assessments included descriptions and general locations; current conditions; desired conditions based on the needs of SGCN associated with each category; a ranked list of significant problems impacting that category; conservation strategies to address each problem along with the identification of potential conservation partners and funding sources for each; and a listing of other relevant plans and planning processes.

The ranking of habitat problems was done according to a process described in Salafsky et. al. (2003) using four criteria: severity, scope, timing and reversibility (Table 3-5). This same process was employed by many other states developing Comprehensive Wildlife Conservation Strategies. Problems described in the habitat and community summaries (and in species summaries) are not comprehensive. Only those problems ranked as medium and high are included in this report. The decision to list only medium and high problems was a strategic one to focus attention on those problems determined or perceived to be most important. If additional problem(s) are later identified as significantly impacting a species or habitat it will be incorporated into the Action Plan database during project review and reporting. Strategies and actions to address additional problem(s) will also be eligible for SWG funding.

Table 3-5: Sample Problem and Information Need Assessment Tool

[1]Severity: The degree to which a problem impacts the viability/integrity of a habitat within the next 10 years.
[2]Scope: The extent of the habitat affected by the problem within 10 years.
[3] Timing: Time until a problem will start having an impact on a habitat
[4] Reversibility: Degree to which effects of a problem can be restored.
* Information needs & data gaps ranked hi/med/low based on the best available knowledge of tech teams.

Problem/ Information Need* Category *	Detailed description of information need or problem	Severity[1] 4=Serious damage/loss 3=Significant damage 2=Moderate damage 1=Little to no damage	Scope[3] 4=Throughout (>50%) 3= widespread (15-50%) 2=Scattered (5-15%) 1=localized(<5%)	Timing[4] 4=current (<1yr) 3=Imminent (1-3yrs) 2=near-term (3-10yrs) 1=Long-term (>10yrs)	Reversibility[4] 4=irreversible 3= reversible| w/difficulty 2=reversible w/ some difficulty 1=easily reversible	Score (Σ=severity + scope + timing + reversibility)	Ranks High=12-16 Med=6-11 Low=5

Once all problems for habitats were ranked it became possible to assess these problems by category across all habitats. A matrix of habitat types and problem categories was developed (Salfasky et. al. 2003). This matrix allowed the Integration Team and Conservation Strategy Review team to identify priority problems at the state level.

This assessment helped identify the scope problems across habitats. Broad scale problems, those impacting multiple habitat categories, were addressed by the Integration Team through state level conservation strategies.

Landscape Classification & Ecological Divisions

Where available distribution of SGCN was recorded by biophysical region (Girton & Capen 1997) and 8-digit watersheds (NRCS 2003). Implementation of the Action Plan will include the development of baseline information the distribution and abundance of SGCN, and on amount,

location, condition and status of habitat within each biophysical region. These landscape units were selected in part because they will integrate well with other conservation efforts within the state and regionally. In its guidance to states, IAFWA recommended the use of Bailey's Sections for landscape classification (Bailey 1995, Bailey 1998). Biophysical regions can be considered a sub-unit of the Bailey's section providing finer grain detail. Data can be integrated into Bailey's sections to aide in regional, national and international conservation efforts.

References

Allard, D. 2004. A Preliminary Recovery Plan for the Bryophytes of Vermont.

Bailey, R.G. 1995. Description of the Ecoregions of the United States, 2d ed., USDA-Forest Service Miscellaneous Publication 1391

Bailey, R.G. 1998. Ecoregions Map of North America: Explanatory Note. Prepared in Cooperation with The Nature Conservancy and the US Geological Survey. USDA Forest Service, Miscellaneous Publication Number 1548. Washington, DC.

Eyre, F. H. ed. 1980. Forest Cover Types of the United States. Society of American Foresters. Washington, DC.Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 7+ vols. New York and Oxford.

Girton, P. and D. Capen. 1997. A report on biophysical regions in Vermont. Unpublished report prepared for the Vermont EcoMapping roundtable.

International Association for Public Participation. 2004. Core Values for the Practice of Public Participation. 11166 Huron St. Suite 27, Denver, CO. www.iap2.org/corevalues/coreofvalues.html

Langdon, R., J. Andrews, K. Cox, S. Fiske, N. Kamman, and S. Warren. 1998. A classification of the aquatic communities of Vermont. The Nature Conservancy and the Vermont Biodiversity Project, Montpelier, Vermont.

Natural Resources Conservation Service, U.S. Department of Agriculture. 2003. WaterHydro_WBD8VT. VT Center for Geographic Information. Vermont.

Reschke, Carol. 1990. Ecological Communities of New York State. Latham, NY: New York Natural Heritage Program, NYSDEC, www.dec.state.ny.us/website/dfwmr/heritage/EcolComm.htm

Rosenberg, R. 2004. Partners In Flight Continental Priorities And Objectives Defined At The State And Bird Conservation Region Levels Vermont. Cornell Lab of Ornithology Ithaca, NY

Salafsky, N., D. Salzer, J. Ervin, T. Boucher, and W. Otlie. 2003. Conventions for defining, naming, measuring, combining, and mapping threats to conservation: an initial proposal for a standard system, December 2003 Draft. Bethesda, MD.

Salafsky N., D. Salzer. 2005. Proposed Taxonomy of Conservation Actions Draft 5. January, 11 2005. Bethesda, MD.

Thompson, E. H., and E. R. Sorenson. 2000. Wetland, woodland, wildland - A guide to the natural communities of Vermont. University Press of New England, Hanover

U.S. Department of Agriculture, Forest Service. 2003. Forest inventory and analysis national core field guide, volume 1: field data collection procedures for phase 2 plots, version 1.7.

U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis, 201 14th St., Washington, D.C., 20250

(VANR) Vermont Agency of Natural Resources. May 22, 1995. Biodiversity Workshop

Vermont's
Wildlife Action Plan

November 22, 2005

Chapter 4
Conserving Vermont's
Wildlife Resources

Vermont's Species of Greatest Conservation Need 1
- Problems Impacting Species of Greatest Conservation Need..... 9
- SGCN Conservation Strategy Development..... 11
- Conserving Vermont's Birds 12
- Conserving Vermont's Fishes 15
- Conserving Vermont's Invertebrates..... 20
- Conserving Vermont’s Mammals 24
- Conserving Vermont's Reptiles & Amphibians..... 30

SGCN Conservation at Multiple Scales..... 35
- Landscape Forest Summary..... 41
- Northern Hardwood Forest Summary 49
- Spruce-Fir-Northern Hardwood Forest Summary 55
- Oak-Pine-Northern Hardwood Forest Summary..... 61
- Landscape Level Aquatic and Shoreline Summary 67
- Landscape Fluvial (Stream) Summary..... 73

**formally the Comprehensive Wildlife Conservation Strategy (CWCS)*

Vermont's Species of Greatest Conservation Need

Vermonters love their wildlife. And wildlife love Vermont. During the past century many wildlife species once rare or missing from the state have returned in larger numbers. The resurgence of Vermont's forests is a significant reason. From a low of 40% forest cover in the 1840s the state is now 78% forested. However, more trees are not the whole story. Restoring wildlife to the state also required the hard work and dedication of scientists, wildlife and habitat managers, sportsmen and other conservationists. Signature species such as deer, moose, beaver, fisher, osprey, peregrine falcon and loon, all missing or in perilously low numbers just decades ago are now faring well.

Keeping wildlife populations healthy offers a host of benefits: healthier ecosystems upon which we all depend, more wildlife to enjoy; and, fewer species on the brink of extirpation means fewer regulatory mandates.

Our work, however, is not complete. A significant number of wildlife species need attention to avoid new threats such as habitat loss, fragmentation and degradation; invasive exotic species; unregulated collecting and harvesting by people; and even natural events that could contribute to the decline of a species.

The State Wildlife Grants program is helping Vermonters meet these new challenges. Created by Congress in 2001 it provides federal funds for conservation to prevent fish and wildlife populations from becoming endangered. Per Congressional requirements, the Wildlife Action Plan is centered on the identification and conservation of "Species of Greatest Conservation Need" (SGCN).

Selecting SGCN

Vermont's list of Species of Greatest Conservation Need includes 144 vertebrate species (of 470 in the state) and includes game and non-game species, 192 invertebrate species (of an estimated 15,000-36,000) and 577 plant species (of an estimated 2000 vascular and non-vascular plant species).

In Vermont, six Action Plan Species Teams, with expertise in birds, fish, invertebrates, mammals, plants and reptiles & amphibians, met frequently between May and September 2004 to assess the status of Vermont's wildlife. They employed assessment criteria developed by the interdisciplinary Action Plan Integration Team to aid and normalize SGCN selection. Criteria included the degree of species rarity, species designated as at-risk, population trends, species whose habitat are vulnerable to loss, habitat fragmentation, habitat conversion or succession changes and species threatened by exotic plants or animals.

Teams used the best information available at the time from local, regional and national sources. However, while a wealth of information is available for some species; others (especially invertebrates, fish, small mammals and some reptiles and amphibians) are poorly known. Species were ranked with a conservation priority of high, medium or low. Those ranked medium and high constitute Vermont's Species of Greatest Conservation Need. Those ranked low priority are considered reasonably secure. It is expected that low priority species will benefit from

conservation efforts directed toward species ranked medium and high as well as from other ongoing wildlife management programs (e.g., federal aid to sportfish and wildlife).

Ongoing wildlife monitoring required by the State Wildlife Grants program will help track species and strategy progress toward greater security. Regularly scheduled Action Plan review and revision will provide opportunities to add additional species to the list as warranted and to remove those species deemed secure.

Details of the Species of Greatest Conservation Need selection process can be found in Chapter 3: Developing the Vermont Action Plan.

Plant SGCN

Vermont's plant SGCN list includes 577 of approximately 2,000 vascular and non-vascular plants found in the state. This list includes all species ranked S1 (critically imperiled) and S2 (imperiled) and a very few others that warrant concern. Those SGCN also on the New England Plant Conservation Program list of regionally rare plants will be ranked High Priority. All others were ranked medium priority. Plants are not eligible for SWG funds. The plant list can be found in appendix A6.

Use of and Changes to this List

The list of Species of Greatest Conservation Need will help prioritize the allocation of State Wildlife Grants funds and other conservation funds. The list will also provide a quick measure of our success conserving Vermont's wildlife. It should be noted that the SGCN list is not the same as the State or Federal Endangered Species List and should not be construed to function as one. Some of the species on the list may be relatively common including some game species. It is our goal to keep them that way.

The Species of Greatest Conservation Need list can be amended if and when important information becomes available about a species' status. For example, there are a number of current and pending inventory and assessment projects funded by State Wildlife Grants that could significantly increase our understanding of a species' status.

Big Game: White-Tailed Deer, Moose & Wild Turkey

Nearly 20 game and sportfish species are listed on the following pages as Species of Greatest Conservation Need (SGCN) due to concerns about population declines and loss of habitat. White-tailed deer, moose and wild turkey, however, were not selected as SGCN. Though absent or nearly extirpated from the state by the 1865, their populations are now sufficiently large and stable. And, relative to SGCN, our knowledge of deer, moose and turkey biology and management is great.

White-tailed deer, moose and wild turkey rank high among Vermont's greatest wildlife restoration successes. Still their management remains of utmost concern because of the great importance they have to Vermonters and because of the significant roles they play in their ecosystems. Fortunately, management plans (developed with significant public involvement), harvest regulations and monitoring protocols have long been in place for these species and dependable implementation funds come through license fees and the Federal Aid to Wildlife Restoration Act.

For more information about deer, moose and wild turkey go to http://www.vtfishandwildlife.com

Vermont's Species of Greatest Conservation Need

Birds 57 out of 268 Vermont bird species.

High Priority

Common Loon[2, 3]
Pied-billed Grebe[1, 2, 3]
American Bittern[1, 2, 3]
Least Bittern[2, 3]
American Black Duck[2, 3]
Bald Eagle[2, 3]
Northern Harrier[1, 2, 3]
Peregrine Falcon[2, 3]
Spruce Grouse[2, 3]
Upland Sandpiper[1, 2, 3]
Common Tern[1, 2]
Black Tern[1, 3]
Common Nighthawk[2, 3]
Whip-poor-will[1, 2, 3]
Purple Martin
Sedge Wren[1, 2, 3]
Bicknell's Thrush[1, 2, 3]
Golden-winged Warbler[1, 2, 3]
Canada Warbler[1, 2, 3]
Rufous-sided Towhee[2]
Vesper Sparrow[2, 3]
Grasshopper Sparrow[2]

Medium Priority

Great Blue Heron[2]
Black-crowned Night-heron[3]
Blue-winged Teal
Osprey[2, 3]
Cooper's Hawk[2, 3]
Northern Goshawk[2, 3]
Red-shouldered Hawk[2, 3]
American Kestrel
Ruffed Grouse[2]
Sora
Lesser yellowlegs
American Woodcock[2, 3]
Black-billed Cuckoo
Barn Owl
Long-eared Owl[1]
Short-eared Owl[1, 2]
Chimney Swift
Black-backed Woodpecker[3]
Olive-sided Flycatcher[3]
Gray Jay
Veery[2]
Wood Thrush[2, 3]
Brown Thrasher
Blue-winged Warbler
Chestnut-sided Warbler
Black-throated Blue Warbler
Prairie Warbler[3]
Bay-breasted Warbler[2]
Blackpoll Warbler
Cerulean Warbler[1, 2]
Field Sparrow
Henslow's Sparrow[1, 2]
Bobolink[3]
Eastern Meadowlark[2]
Rusty Blackbird[2, 3]

[1]Wildlife Species of Regional Conservation Concern in the Northeastern United States: Northeastern Endangered Species and Wildlife Diversity Technical Committee, *Northeast Wildlife*, 1999, 54:93-100
[2]New Hampshire Species of Greatest Conservation Need
[3]New York Species of Greatest Conservation Need
Cross listings with regional, New Hampshire and New York lists are shown for informational purposes only and include species listed as SGCN in NH and NY as of 5/12/05

Vermont's Species of Greatest Conservation Need

Fish 33 of 94 Vermont fish species

High Priority

Atlantic salmon-anadromous
Northern brook lamprey[1, 3 *]
American brook lamprey[1, 2, 3 *]
Lake sturgeon[1, 3]
American eel[3]
Artic Char[2]
Muskellunge
Brassy minnow
Bridle shiner[1, 2, 3]
Blackchin shiner
Blacknose shiner[2]
Quillback[3]
Silver redhorse
Greater redhorse[3]
Stonecat
Eastern sand darter[1]
Channel darter[1]
Sauger[3]

Medium Priority

Blueback herring (CT River only) [3]
Atlantic salmon-landlocked[3]
Silver lamprey[1, 3*]
Sea lamprey (CT River only) [*]
Mottled sculpin
American shad[3]
Mooneye[1, 3]
Cisco
Lake whitefish
Round whitefish[1, 2, 3]
Brook trout (naturally reproducing populations only) [3]
Lake trout (naturally reproducing populations only)
Redfin pickerel[2]
Shorthead redhorse
Redbreast sunfish

*This species of lamprey is not a parasite to freshwater fish

[1]Wildlife Species of Regional Conservation Concern in the Northeastern United States: Northeastern Endangered Species and Wildlife Diversity Technical Committee, *Northeast Wildlife*, 1999, 54:93-100
[2]New Hampshire Species of Greatest Conservation Need
[3]New York Species of Greatest Conservation Need
Cross listings with regional, New Hampshire and New York lists are shown for informational purposes only and include species listed as SGCN in NH and NY as of 5/12/05

Vermont's Species of Greatest Conservation Need

Mammals 33 of 58 Vermont mammal species

High Priority
Northern bog lemming[1, 2]
Water shrew
Long-tailed shrew
Pygmy shrew
Indiana bat[2, 3]
Small-footed bat[1, 2, 3]
Silver-haired bat[1, 2, 3]
Eastern pipistrelle[2]
Red bat[1, 2, 3]
Hoary bat[1, 3]
New England cottontail[1, 2, 3]
Rock vole
Woodland vole
Southern bog lemming
American marten[2]
Lynx[1, 2, 3]

Medium Priority
Masked shrew
Smoky shrew
Hairy-tailed mole
Little brown bat
Northern long-eared bat[2]
Big brown bat
Southern flying squirrel
Northern Flying Squirrel
Muskrat
Wolf[2, 3]
Common gray fox
Black bear[2]
Long-tailed weasel
Mink
Northern river otter
Bobcat[2]
Mountain lion

[1]Wildlife Species of Regional Conservation Concern in the Northeastern United States: Northeastern Endangered Species and Wildlife Diversity Technical Committee, *Northeast Wildlife*, 1999, 54:93-100
[2]New Hampshire Species of Greatest Conservation Need
[3]New York Species of Greatest Conservation Need
Cross listings with regional, New Hampshire and New York lists are shown for informational purposes only and include species listed as SGCN in NH and NY as of 5/12/05

Vermont's Species of Greatest Conservation Need

Reptile and Amphibians 19 of 42 Vermont species

High Priority
Jefferson Salamander[1, 2, 3]
Common Mudpuppy[3]
Fowler's Toad[2, 3]
Western (Striped) Chorus Frog[3]
Spotted Turtle[1, 2, 3]
Wood Turtle[1, 2]
Spiny Softshell (Turtle) [3]
Five-lined Skink[3]
Eastern Racer
Eastern Rat Snake
Eastern Ribbon Snake[1, 2, 3]
Timber Rattlesnake[1, 2, 3]

Medium Priority
Blue-spotted Salamander[1, 3]
Spotted Salamander
Four-toed Salamander
Common Musk Turtle
Northern Water Snake
Brown Snake
Smooth Green Snake[2, 3]

[1]Wildlife Species of Regional Conservation Concern in the Northeastern United States: Northeastern Endangered Species and Wildlife Diversity Technical Committee, *Northeast Wildlife*, 1999, 54:93-100
[2]New Hampshire Species of Greatest Conservation Need
[3]New York Species of Greatest Conservation Need
Cross listings with regional, New Hampshire and New York lists are shown for informational purposes only and include species listed as SGCN in NH and NY as of 5/12/05

Vermont's Species of Greatest Conservation Need

Invertebrates 192 of an estimated 15,000 to 36,000 Vermont invertebrate species.

Odonata (Dragonflies & Damselflies) (41)

Bog/Fen/Swamp/Marshy Pond Odonata Group+ (20)
Southern Spreadwing (Lestes disjunctus australis)
Subarctic Bluet (Coenagrion interrogatum)
Citrine Forktail (Ischnura hastata)
Comet darner (Anax longipes)
Mottled Darner (Aeshna clepsydra)
Zigzag Darner (Aeshna sitchensis)
Subarctic Darner (Aeshna subarctica)
Green-striped Darner (Aeshna verticalis)
Spatterdock Darner (Aeshna mutata)
Swamp Darner (Epiaeschna heros)
Harlequin Darner (Gomphaeschna furcillata)
Cyrano Darner (Nasiaeschna pentacantha)
Petite Emerald (Dorocordulia lepida)
Painted skimmer (Libellula semifasciata)
Ski-tailed Emerald (Somatochlora elongata)
Forcipate Emerald (Somatochlora forcipata)
Delicate Emerald (Somatochlora franklini)
Kennedy's Emerald (Somatochlora kennedyis)
Ebony Boghaunter (Williamsonia fletcheri)
Black Meadowhawk (Sympetrum danae)

Seep/Rivulet Odonata Group+ (1)
Gray petaltail (Tachopteryx thoreyi)

Lakes/Ponds Odonata Group+ (7)
New England bluet (Enallagma laterale)
Vernal Bluet (Enallagma vernale)
Slender Bluet (Enallagma traviatum)
Lilypad Forktail (Ischnura kellicotti)
Ringed Emerald (Somatochlora albicincta)
Lake Emerald (Somatochlora cingulata)
White Corporal (Libellula exusta)

River/Stream Odonata Group+ (14)
American rubspot (Hetaerina americana)
Blue-fronted dancer (Argia apicalis)
Rainbow bluet (Enallagma antennatum)
Spine-crowned clubtail (Gomphus abbreviatus)
Rapids clubtail (Gomphus quadricolor)
Skillet clubtail (Gomphus ventricosus)
Cobra clubtail (Gomphus vastus)
Brook snaketail (Ophiogomphus aspersus)
Riffle snaketail (Ophiogomphus carolus)
Maine snaketail (Ophiogomphus mainensis)
Rusty snaketail (Ophiogomphus rupinsulensis)
Stylurus amnicola (Riverine Clubtail)
Zebra Clubtail (Stylurus scudderi)
Stygian shadowdragon (Neurocordulia yamaskanensis)

+ Note that each Odonata species was assigned to a single community type, even though there is sometimes overlap suggested by the description of habitat

Lepidoptera (Butterflies & Moths) (33)

Wetland Butterflies Group(7)
Bog copper (Lycaena epixanthe)
Jutta arctic (Oeneis jutta)
Dion skipper (Euphyes dion)
Black dash (Euphyes conspicua)
Two-spotted skipper (Euphys bimacula)
Mulberry wing (Poanes massasoit)
Broad-winged skipper (Poanes viator)

Grassland Butterflies Group (4)
Cobweb skipper (Hesperia metea)
Persius duskywing (Erynnis persius)
Regal fritillary (Speyeria idalia)
Dusted Skipper (Atrytonopsis hianna)

Hardwood Forest Butterflies Group (5)
West Virginia white (Pieris virginiensis)
Early hairstreak (Erora laeta)
Hackberry emporer (Asterocampa celtis)
Tawny emporer (Asterocampa clyton)
Edwards' hairstreak (Satyrium edwardsii)

Moths Group(17)
A Ghost Moth (Sthenopis thule)
Currant Spanworm (Itame ribearia)
Imperial Moth (Eacles imperialis pini)
New England Buckmoth (Hemileuca lucina)
Hermit Sphinx (Sphinx eremitus)
Plum Sphinx (Sphinx drupiferarum)
Clemens' Sphinx (Sphinx luscitiosa)
A Noctuid Moth (Xestia (Anomogyna) fabulosa)
A Noctuid Moth (Lasionycta taigata)
A Noctuid Moth (Lemmeria digitalis)
Franclemont's Lithophane (Lithophane franclemonti)
An Autumnal Noctuid Moth (Pachypolia atricornis)
Ostrich Fern Borer Moth (Papaipema sp. 2)
A Noctuid Moth (Properigea sp. 1 (P. costa))
A Noctuid Moth (Xestia homogena)
Pine Barrens Zanclognatha (Zanclognatha martha)
A Noctuid Moth (Zale submediana)

Mayflies/Stoneflies/Caddisflies Group (8)
A Mayfly (Ameletus browni)
A Mayfly (Ameletus tertius)
Tomah Mayfly (Siphlonisca aerodromia)
Roaring Brook Mayfly (Epeorus frisoni)
A Mayfly (Eurylophella bicoloroides)
A Mayfly (Baetisca rubescens)
A Stonefly (Alloperla voinae)
A Caddisfly (Rhyacophila brunnea)

Vermont's Species of Greatest Conservation Need

Invertebrates, continued

Tiger Beetles Group (6)

A Tiger Beetle (Cicindela ancocisconensis)
Cobblestone Tiger Beetle (Cicindela marginipennis)
A Tiger Beetle (Cicindela patruela)
Puritan Tiger Beetle (Cicindela puritana)
Beach-dune tiger beetle (Cicindela hirticollis)
Long-lip Tiger Beetle (Cicindela longilabris)

Ground Beetle Group (Carabidae) (73)

Sphaeroderus nitidicollis brevoorti
Agonum crenistriatum
Agonum darlingtoni
Agonum decorum
Agonum moerens
Agonum picicornoides
Agonum punctiforme
Agonum superioris
Scaphinotus bilobus
Pterostichus brevicornis
Pterostichus castor
Pterostichus lachrymosus
Pterostichus pinguedineus
Pterostichus punctatissimus
Nebria suturalis
Notiophilus nemoralis
Bembidion rufotinctum
Bembidion cordatum
Bembidion grapei
Bembidion muscicola
Bembidion mutatum
Bembidion quadratulum
Bembidion robusticolle
Bembidion rolandi
Bembidion affine
Acupalpus alternans
Acupalpus rectangulus
Diplocheila impressicollis
Diplocheila striatopunctata
Diplocheila assimilis
Pseudamara arenaria
Dyschirius brevispinus
Dyschirius erythrocerus
Dyschirius politus
Elaphropus dolosus
Elaphropus levipes
Elaphrus fuliginosus
Geopinus incrassatus
Harpalus fulvilabris
Harpalus indigens
Harpalus providens
Lophoglossus scrutator
Miscodera arctica
Notiobia sayi
Notiophilus aquaticus
Notiophilus borealis
Notiophilus novemstriatus
Olisthopus micans
Parastachys oblitus
Parastachys rhodeanus
Patrobus foveocollis
Pentagonica picticornis
Pericompsus ephippiatus
Platynus cincticollis
Platynus parmaginatus
Platypatrobus lacustris
Schizogenius ferrugineus
Sericoda obsoleta
Sericoda quadripuncata
Tetragonoderus fasciatus
Trichocellus cognatus
Atranus pubescens
Amara laevipennis
Amara erratica
Anchomenus picticornis
Apristus latens
Blethisa quadricollis
Blethisa julii
Blethisa multipuncata
Carabus goryi
Carabus maeander
Dicaelus dilatus
Dicaelus teter

Mollusca (27)

Freshwater Mussels Group (13)

Eastern pearlshell (Margaritifera margaritifera)
Dwarf wedgemussel (Alasmidonta heterodon)
Elktoe (Alasmidonta marginata)
Brook floater (Alasmidonta varicosa)
Pocketbook (Lampsilis ovata)
Fluted-shell (Lasmigona costata)
Creek heelsplitter (Lasmigona compressa)
Pink heelsplitter (Potamilus alatus)
Fragile papershell (Leptodea fragilis)
Black sandshell (Ligumia recta)
Giant floater (Pyganodon grandis)
Cylindrical papershell (Anodontoides ferussacianus)
Alewife floater (Anodonta implicata)

Snails Group (14)

Fingered valvata (Valvata lewisi)
Mossy valvata (Valvata sincera)
Squat duskysnail (Amnicola (Lyogyrus) grana)
Canadian duskysnail (Amnicola (Lyogyrus) walkeri)
Buffalo pebblesnail (Gillia altilis)
Pupa duskysnail (Lyogyrus (Amnicola) pupoidea)
Boreal marstonia (Marstonia (Pyrgulopsis) decepta)
Liver elimia (Goniobasis livescens)
Sharp hornsnail (Pleurocera acuta)
Spindle lymnaea (Acella haldemani)
Mammoth lymnaea (Bulimnea megastoma)
Country fossaria (Fossaria rustica)
Disco gyro (Gyraulus circumstriatus)
Star gyro (Gyraulus crista)

Crustaceans Group (3)

An Amphipod (Diporeia hoyi)
Taconic Cave Amphipod (Stygobromus borealis)
Appalachian brook crayfish (Camburus bartonii)

Ant Group (1)

A Slave-making Ant Leptothorax sp. 1 (L. pillagens

Problems Impacting Species of Greatest Conservation Need

Element number three of the eight congressionally required elements of a Wildlife Action Plan requires that states: describe the problems that may adversely affect Species of Greatest Conservation Need or their habitats and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats. For the purposes of this report "problem" is defined as follows:

> **Problem:** A force causing a negative impact at the species, population, habitat and landscape levels (e.g., habitat conversion, pollution, illegal pet trade). A problem can also be the lack of information or a data gap vital to the successful management of a species.

For each Species of Greatest Conservation Need in the Action Plan we identified priority problems. Priority research needed to evaluate other potential problems was also identified. Problems are detailed in short narrative descriptions in each species summary (Appendix A) in each habitat/community summary (Appendix B).

Each of the problems identified in the Action Plan was assigned to one of 22 categories roughly grouped into habitat-related factors and non-habitat-related factors. These categories make it possible to search our database for similar factors impacting other species. It also makes it easier to organize and create summaries for broad scale conservation planning. The problem categories were developed by the U.S. Forest Service during the current Forest Plan Revision for the Green Mountain National Forest.

The 22 categories are not mutually exclusive and problems can often logically be placed into more than one category depending on the particular stress it causes for a species or habitat. For example, a road can fragment the habitat of grassland nesting birds, cars traveling the road can squash amphibians crossing the road to mate in an adjacent stream, and salt spread on the road to prevent icing can wash into that stream impacting its population of brown trout. In this example the problems stemming from the road would be recorded in the "Habitat Fragmentation," "Impacts of Roads & Trails," and "Pollution" categories.

Problems are often species and/or habitat specific. What may negatively impact one species may benefit another. For example, if a cold water stream with a healthy brook trout population was dammed it might no longer support brook trout. That impact of the dam would be described as the "conversion of habitat" category. However, the reservoir created by the dam might make it more suitable for a warm water fish species.

Clearly life is too complex to be stuffed into any one box. Therefore it is important to read the full description of a factor affecting a species or habitat in the appropriate species or habitat summary. Definitions for these factors can be found in Appendix C.

Problem Categories

See Appendix C for definitions of each category. See Appendix A-SGCN summaries and Appendix B-habitat/community/landscape summaries for context.

Habitat-Related Problem Categories

- Climate Change
- Habitat Alteration/Degradation
- Habitat Conversion
- Habitat Fragmentation
- Hydrologic Alteration
- Impacts of Roads and Trails
- Inadequate Distribution of Successional Stages
- Inadequate Disturbance Regime
- Invasion by Exotic Species
- Sedimentation

Non-Habitat-Related Problem Categories

- Competition
- Disease
- Genetics
- Harvest or Collection
- Incompatible Recreation
- Loss of Prey Base
- Loss of Relationship with Other Species
- Parasitism
- Pollution
- Predation or Herbivory
- Reproductive Traits,
- Trampling & Direct Impacts

SGCN Conservation Strategy Development

Element number four of the eight congressionally required elements of a Wildlife Action Plan requires that states describe "conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions."

We identified strategies to address the problems impacting each of Species of Greatest Conservation Need (SGCN) and habitats in the Action Plan. Strategies identified in the Action Plan are based on the best science available today as well as our strategic assessment of needs and priorities of all wildlife species. In the coming years, as monitoring data on SGCN and conservation actions becomes available, as priorities change, or new problems or opportunities arise, strategies may need to be revisited. Not every strategy in this report will be eligible for State Wildlife Grant funding. Furthermore, it may not be suitable, or feasible, for the Vermont Fish & Wildlife Department to implement some of the strategies in this report, however, some conservation partners may find them fitting and practical.

Strategies are described in the Action Plan in short narratives in each species summary and in each habitat, community and landscape summary. Strategies are intentionally broad, directional, and nonspecific so as not to constrain our selection of actions for implementing them. For example, a strategy such as "provide technical assistance to landowners to maintain or improve riparian habitat for Species of Greatest Conservation Need" allows for different approaches to providing that assistance and leaves the door open to a variety of providers to implement. Where strategy implementation is to be funded by the State Wildlife Grant program the approach should be consistent with the Department's mission and strategic plan, and precise procedures will be detailed in operational plans once the Action Plan is finalized.

Vermont's Action Plan was designed to be a strategy for the state, not just the Fish & Wildlife Department. While the department may be responsible for implementing many of the strategies in this report, it will be conservation partners, however, that may be the more logical and appropriate leaders for others, due to their skills and expertise, staffing, history, location, available resources and constituencies.

Each of the strategies identified in the Action Plan were assigned to one of 27 categories in six major classes. The categories were developed by the Conservation Measures Partnership (Salafsky 2005) as a means to standardize terminology (not practices) among conservation practitioners worldwide. Many states have used these same categories to organize the strategies and actions in their Action Plan.

It should be noted that the categories are used solely for the purpose of organizing and grouping strategies developed by Action Plan teams and committees. It was not our goal to create strategies for every category. A few categories were not applicable to the species or habitats in Vermont whereas others were deemed not as effective. Definitions for each strategy can be found in Appendix C.

Conserving Vermont's Birds

Birds Team

Cedric Alexander, Vermont Fish & Wildlife Dept. (team leader)
Eric Derlath US Fish & Wildlife Service
Patrick Doran, Wildlands Project
Dave Frisque, US Fish & Wildlife Service
Margaret Fowle, National Wildlife Federation
John Gobeille, Vermont Fish & Wildlife Dept.
Paul Karczmarczyk, Ruffed Grouse Society
Mark Labarr, Audubon Society
Chris Rimmer, Vermont Institute of Natural Science
Dr. Allan Strong, University of Vermont

Team Charge

The Bird was charged with identifying Species of Greatest Conservation Need (SGCN); describing the distribution and habitat usage for each SGCN; evaluating problems impacting SGCN and their habitat; identifying priority research needs to improve our ability to conserve these species; and, developing conservation strategies to address priority problems. Details of Species Team and other Action Plan team and committee charges can be found in Appendix D of this document.

Introduction

The Vermont Fish and Wildlife Department convened the Action Plan Bird Team in May 2004. The 9-member team was composed of biologists from the VFWD, USFWS, UVM Co-op Unit, and 5 non-profit conservation organizations. The team met a total of 8 times over the ensuing 12 months. The Department is very grateful for the many days of work team members contributed to attend meetings, research and prepare spreadsheets and reports, and consult with one another between meetings.

Selecting Bird SGCN

In contrast to lesser-known taxa, the bird team benefited from the relative wealth of available data on bird distribution and abundance. Data from Vermont's original and current Breeding Bird Atlases and the USFWS Breeding Bird Surveys helped immensely in selecting our 57 SGCN. In addition to these actual data sources, ongoing bird conservation programs, including the Vermont Endangered Species Scientific Advisory Group on Birds SAG-B), Partners-In-Flight, North American Bird Conservation Initiative, National Audubon Society's Watch List, and the American Bird Conservancy's Green List all contributed to our understanding of which species belonged on Vermont's SGCN list.

Selection criteria included knowledge about current listing as endangered or threatened, population declines, rarity, vulnerability of habitat, life history traits, impacts from humans, and recent range expansion or contraction. Each species was examined across all criteria and the team developed a high, medium, and low conservation need ranking to attempt to separate species with greater need from those that may be more secure, at least in the short term.

Bird species rare in Vermont did not always make the SGCN listing. Species that have expanded their range in recent decades due to a proliferation of winter bird feeders, such as Tufted titmouse, were excluded, as we did not consider Vermont to be a geographic area of responsibility for that species. Other species for which Vermont is on the extreme periphery of their breeding range, and for which confirmed breeding records are very infrequent, such as the three-toed woodpecker, were also not selected. These 'filtering' methods are consistent with the work of Vermont's SAG-B (see Chapter 3: Developing Vermont's Action Plan, for details on selection criteria and process).

Full reports on each Species of Greatest Conservation Need are in Appendix A of this document. The following is a summary of those reports.

Birds and Their Habitat Needs

Vermont's bird SGCN utilize a variety of habitats from open and shrub-dominated wetlands, mature hardwood or coniferous forests, young regenerating forests, old fields, grasslands, and other cultural habitats such as buildings and structures. As birds are generally more mobile relative to most species from other taxa, they are usually better able to exploit smaller, more widely distributed habitat patches. However, most species benefit from the larger assemblages of similar habitat types, such as a contiguous forest area or large, agricultural (grassland) complex.

The Bird Team organized most birds into one of several habitat guilds, for which a particular conservation strategy would often be appropriate for all species in the guild. These guilds match the major habitat categories used in this report (see the section titled SGCN Conservation at Multiple Scales later in this chapter):

- Northern hardwood forest & Oak-pine-northern hardwood forest
- Spruce-fir northern hardwood forest
- Sub-alpine krummholz & Montane spruce-fir forests (high elevation areas)
- Early successional forest stages
- Riparian
- Lacustrine (lakes and ponds)
- Wetlands-(open, shrub and forested wetlands)
- Cliff & Talus
- Grassland
- Grassland/Edge
- Urban

Discussion of Problems Impacting Bird SGCN

The problems identified most frequently as problems for Vermont's bird populations are all related to changes in habitat: conversion of habitat (49 SGCN), habitat alteration (31), habitat fragmentation (27), and distribution of successional stages (27). Many bird species find optimum habitat in young regenerating forests, which have declined statewide in recent decades. Similarly, grassland-dependent species, which are declining throughout the northeast, are finding less and less suitable habitat in Vermont as farms are managed more intensively, or sold and either developed or reverted to forestland. Increased roads, housing

units, free-roaming pets, and other attendant disturbances further fragments habitat to the detriment of most species. See appendix A for full reports on each SGCN.

Research & Monitoring Needs and Conservation Strategies

The research and monitoring needs and conservation strategies most frequently identified by the Bird Team and those best applied for multiple bird SGCN are as follows:

Research & Monitoring Needs

1. Better determine habitat requirements and habitat availability.
2. Better determine the distribution and relative abundance of populations in Vermont.
3. Better identify and evaluate problems.
4. Obtain better knowledge of basic life history traits.

Conservation Strategies

1) Habitat Restoration via efforts on public lands and conservation payments or other financial incentives, fee simple purchase, easements, management guidelines, and cooperative agreements with user groups and private landowners. Existing technical assistance/cost-share programs (WHIP, LIP, CRP) were frequently identified as potential funding sources to implement conservation on private lands. Important Bird Area designations can aid in the development of needed funds. Common habitat restoration themes include incentives and planning to slow the rate of fragmentation and development and maintain blocks of contiguous forest, grasslands, early and late-successional habitats.

2) Species Restoration projects, which may involve active translocation of individuals or eggs from a source population into suitable Vermont habitats, and/or may involve efforts to provide suitable nesting sites and reduce predation or human disturbances around nesting sites.

3) Raising awareness within the general public to build support and opportunities for conservation techniques. Important Bird Area designations can help focus public attention on opportunity areas.

4) Developing and evaluating forestry practices that can enhance habitat suitability such as maintain or increasing aspen stands or the retention of coarse woody debris and snags. Provide technical assistance to landowners and communities about best management practices.

5) Initiate an international effort to maintain large blocks of undeveloped forests linked together by habitat corridors in order to provide a network of interconnected habitats throughout northeastern New England and southeastern Canada.

6) Identify, prioritize and maintain existing contiguous forest blocks and associated linkages that allow for upward and northward movement in response to climate change.

7) Participate in existing regulatory processes (e.g., Act 250) to protect and restore critical habitats.

See Appendix A for full reports on each bird Species of Greatest Conservation Need.

Conserving Vermont's Fishes

Fish Team

Kenneth Cox, Vermont Fish & Wildlife Department (team leader)
Dr. Douglas Facey, Saint Michael's College
Anne Hunter, Vermont Fish & Wildlife Department
Richard Langdon, Vermont Department of Environmental Conservation
John Lepore, Vermont Agency of Transportation
Craig Martin, U.S. Fish & Wildlife Service
Dr. Donna Parrish, Vermont Fish & Wildlife Cooperative Research Unit
Steven Roy, U.S. Forest Service, Green Mountain National Forest

Team Charge

The Fish Team was charged with identifying Species of Greatest Conservation Need (SGCN); describing the distribution and habitat usage for each SGCN; evaluating problems impacting SGCN and their habitat; identifying priority research needs to improve our ability to conserve these species; and, developing conservation strategies to address priority problems. Details of the Species Teams and other Action Plan team and committee charges can be found in Appendix D of this document.

Introduction

Vermont with its estimated 7,100 miles of rivers and streams and 809 lakes and ponds supports populations of 92 fish species (Langdon et al. in press). Eighty of these are recognized as being native to the state. A native species is one that was present in the state prior to early European colonization. The remaining 12 species are non-indigenous to Vermont. These fishes were either purposely introduced, legally and illegally, to waters of the state, such as for sport fish enhancement (e.g., brown and rainbow trout), or gained access inadvertently to the state via interstate waterways, such as canals (e.g., gizzard shad). Lake Champlain has the most diverse fish community of any Vermont water with about 71 species documented to exist there.

Vermonters are probably aware of the existence of about one third of the fish species occurring in the state. Our familiarity with most of these fishes is rooted in sport fishing; that is, their recognized value as game fish and to a lesser degree their use as bait fish. As for the remaining two-thirds of Vermont species, many exist here largely out-of-sight of the general public and others are viewed more or less with ambivalence. Nonetheless, the diversity of Vermont's ichthyofauna contributes significantly to the functional ecological complexity of our aquatic systems. Many species are excellent indicators of the health of our environment, such as their sensitivity to toxic chemicals (e.g., mercury and PCBs) and habitat change. Additionally, sport fisheries, utilized and valued by the public, are dependent directly and indirectly on healthy communities and ecosystems.

Native fishes face many conservation challenges. The threats of habitat alteration, loss and fragmentation are pervasive in Vermont's rapidly changing landscape. The introduction of non-indigenous fishes, including associated aquatic pathogens and parasites, also pose risks to aquatic ecosystem health and native species conservation. Just within the past 20 years, seven non-native fishes have shown up in state and interstate waters. Whirling disease, caused by the parasite *Myxobolus cerebralis*, first appeared in native brook trout inhabiting Vermont sections of the

Batten Kill as recently as 2002. Two viral diseases have also recently appeared in Vermont waters. Largemouth bass virus was first detected in Lake Champlain in 2002 and a year later in Lake St. Catherine; and esocid lymphosarcoma infecting Lake Champlain northern pike in 2002 (http://www.vtfishandwildlife.com/fisheries_health.cfm). Unregulated or illegal transportation of fishes from out-of-state sources and between in-state waters is likely cause for the increasing incidences of disease-causing organisms appearing in Vermont fish populations.

Fish SGCN Selection

Selection criteria included 27 categories reflecting our knowledge about current listing as endangered and threatened; species rarity; population declines; vulnerability of habitats; life history traits; vulnerability to collection, harvest or other taking; other impacts from humans; and dispersal capability. Only native species were considered. Each species was examined across all criteria by the eight-person team. Based on this evaluation process the team assigned a high, medium and low rank to attempt to separate species with greater conservation needs from those with more secure status, at least in the short term. See chapter 3 of this report, "Developing Vermont's Action Plan," for details on selection criteria and process. This approach resulted in 33 species making either the rank of high conservation need or medium conservation need.

High Conservation Need: Northern brook lamprey, American brook lamprey, lake sturgeon, American eel, brassy minnow, bridle shiner, blackchin shiner, blacknose shiner, quillback, silver redhorse, greater redhorse, stonecat, muskellunge, anadromous Atlantic salmon, arctic char, eastern sand darter, channel darter, and sauger.

Medium Conservation Need: Silver lamprey, sea lamprey (Connecticut River basin population only), mooneye, blueback herring (Connecticut River basin population only), American shad, shorthead redhorse, redfin pickerel, cisco or lake herring, lake whitefish, round whitefish, landlocked Atlantic salmon, brook trout (naturally reproducing populations only), lake trout (naturally reproducing populations only), mottled sculpin, and redbreast sunfish.

Species of Greatest Conservation Need status for two species, sea lamprey and blueback herring, are limited to specific populations within the state, i.e. populations residing in the Connecticut River basin. Similarly, lake trout and brook trout are defined with limitations. One species, the arctic char, is believed to be extirpated. (It should be noted that Connecticut River sea lamprey are not parasitic in freshwater, and that neither northern or American brook lamprey species are parasitic).

Although a disproportionate number of Vermont's SGCN are at the periphery of their range, this should not diminish the importance of these species to the state's biodiversity or in terms of their ecological significance. To illustrate this, of the 80 native Vermont fish species, nearly half of these are here on the eastern edge of each of the species' natural North American range.

Full reports on each Species of Greatest Conservation Need are in Appendix A of this document. The following is a summary of those reports.

Habitat Needs

Vermont's fish species use a variety of habitats: small ponds, large lakes, rivers, streams, and wetlands. Some habitats are used year round and others are occupied seasonally, such as while spawning. Within water bodies, SGCN have specific habitat needs for example, riffles or pools in streams or deep, cold areas of lakes. Loss or degradation of any one critical habitat component can threaten the survival of the species in that particular water.

While most of our fishes are completely freshwater dependent, others spend portions of their lives in both freshwater and marine environments. Four SGCN (American eel, blueback herring, American shad and sea-run Atlantic salmon) are dependent on both. Herring, shad and salmon have anadromous life cycles, that is spawning and at least a portion of the juvenile life occurs in freshwater; to attain maturity the fish must go to sea for a period of years. In contrast, eel are catadromous. Maturity is attained in freshwater and reproduction occurs in the ocean. Consequently, whether anadromous or catadromous, these species are not only are faced with problems at the Vermont landscape level but also those at the regional and international scopes. To conserve our native fishes, and in particular SGCN, it is essential that we protect, enhance and restore habitat degradation and loss not only within Vermont but also, where appropriate, beyond our borders.

Discussion Problems Impacting Fish SGCN

Factors affecting the security of SGCN are classified as either habitat or non-habitat problems. The most frequently identified habitat related problems impacting aquatic systems are habitat alteration, habitat fragmentation, habitat conversion, invasive non-indigenous species, and climate change. Habitat alteration includes activities, which diminish the quality and/or quantity of habitat features critical to the survival and maintenance of fish populations and other biota on which SGCN are dependent, including stream flows and lake water levels, water temperature regimes, and habitat diversity. Sedimentation is a form of habitat alteration by which the composition of the stream or lake bottoms are altered by greater than normal deposition of fine materials (e.g., silt, sand, organic matter) changing the composition and suitability of substrates to the detriment of their spawning, cover and food production values. Habitat conversion results in the total or near complete loss of function as a result of extreme habitat alteration. Examples of habitat conversion are loss of active flood plains, wetland draining and on-stream impoundments. Habitat fragmentation occurs when artificial structures, such as dams, impassable bridge structures, and dewatered stream channels, interfere with the movements of fish preventing their access to critical spawning areas or seasonal refugia. Habitat fragmentation also interferes with the natural dispersal of fish and genetic flow within and between populations. Climate change threatens several SGCN at the regional scale by altering (warming) their required thermal regimes. Invasive species, such as nonnative aquatic plants and zebra mussels, can impact aquatic habitats in a variety of ways. Exotic plants represent a "double edged sword" with respect to the conservation of certain fish species requiring abundant aquatic vegetation. Invasive plant species, such as Eurasian milfoil, may displace native plant communities on which fish are dependent for refugia, food production, and spawning. And, on the other hand, invasive vegetation control programs may eliminate these functions before native plants are restored to desired levels.

While virtually all fishes identified as SGCN are impacted by one or more problems to their habitats, non-habitat related problems are generally more variable from species to species. In

some cases, non-habitat problems are a consequence of impacts on habitat. Those affecting SGCN include competition from other species, predation, loss of prey base, water pollution, disease and parasites, and over-harvest. The sea lamprey problem in Lake Champlain poses a challenging dilemma. Sea lamprey has been identified as a known or potential parasite/predator on several SGCN. On the other hand, other SGCN may be threatened by certain control methods needed to control sea lamprey abundance and parasitism rates in the lake. Further research and monitoring is required to ensure that successful control measures minimize harm to SGCN.

Research & Monitoring Needs and Conservation Strategies

The Fish Team identified priority research and monitoring projects and needs to improve our ability to conserve Vermont's fish SGCN. The Team also developed conservation strategies to address problems impacting each SGCN. Those cited most frequently and those most effectively applied for multiple fish SGCN include:

Research & Monitoring Needs

1. Better determine the distribution and relative abundance of populations in Vermont.
2. Acquire better information on species' life histories, biology and habitat requirements.
3. Monitor and assess populations and habitats for current condition and future changes.
4. Identify and monitor problems for species and their habitats.
5. Establish a centralized fish database within the Agency of Natural Resources to manage fish and other aquatic data, track permits and management projects that impact aquatic species.

Conservation Strategies

1. Protect and restore aquatic and riparian habitats through improved water quality; flow, water level and temperature regimes; sediment reduction; establishment of streamside buffers (see ANR buffer policy); and suitable aquatic habitat structure, diversity and complexity.
2. Maintain and restore aquatic organism passage and habitat connectivity at barriers (e.g., dams, culverts) to provide access to critical habitats and maintain ecological connectivity.
3. Assess, monitor and manage as appropriate potential negative and beneficial effects of the Lake Champlain sea lamprey control program on SGCN and other non-target fishes.
4. Participate in existing regulatory processes (e.g., Act 250, stream alteration permits) to protect and restore critical habitats.
5. Implement measures and programs to prevent the introduction and expansion of non-indigenous species to Vermont waters; develop and execute appropriate invasive species control programs.
6. Support and cooperate with inter-agency programs for the restoration of anadromous and catadromous fishes to the Connecticut River basin.
7. Support efforts to curb global warming and its negative impacts on SGCN.

8. Support state and regional efforts to require reduction in emissions from coal burning power plants and other sources of acid precipitation.

See Appendix A for full reports on each fish Species of Greatest Conservation Need.

References

(ANR) VT Agency of Natural Resources. 1/20/2005. Riparian Buffer Guidance, and Riparian Buffers and Corridors Technical Papers www.anr.state.vt.us/dec/dec.htm

Langdon, R.W., M.T. Ferguson, and K.M. Cox. *In press*. Fishes of Vermont. Vermont Department of Fish and Wildlife, Waterbury, Vermont.

Conserving Vermont's Invertebrates

Invertebrate Team

Mark Ferguson, Vermont Fish & Wildlife Dept. (team leader)
Steve Fiske, Vermont Dept of Environmental Conservation
Trish Hanson, Vermont Forest Parks & Recreation Dept
Kent McFarland, Vermont Institute of Natural Science
Bryan Pfeiffer, Wings Environmental

Team Charge

The Invertebrate Team was charged with identifying Species of Greatest Conservation Need (SGCN); describing the distribution and habitat usage for each SGCN; evaluating problems impacting SGCN and their habitat; identifying priority research needs to improve our ability to conserve these species; and, developing conservation strategies to address priority problems. Details of Species Team and other Action Plan team and committee charges can be found in Appendix D of this document.

Introduction

The role of invertebrates in our world is fairly unrecognized by humans. But once we get beyond the buzz of mosquitoes and our annoyance with blackflies, our reliance upon these tiny animals slowly unfolds. Within cool forest streams, stonefly and mayfly nymphs consume leaves that fall from forest trees and provide a food source for brook trout and other fishes. In the gardener's corner, bees, flies, wasps, and butterflies pollinate the flowers that will later yield the anticipated fruits and vegetables. Spiders wait to ambush flies in our homes. Dragonflies patrol the stream shores for their insect prey. Beetles, flies, and other invertebrates consume the wastes produced by the human world, leaving fertile soil in exchange. Mostly unnoticed and even avoided these smallest of creatures serve an amazing array of functions that we depend upon in our everyday life. The diversity of species we are so fortunate to have is, itself, something to marvel.

Of the thousands of species that occur in Vermont, several are rare or threatened enough to be at risk of disappearing from the state in the future. The causes that lead to their predicament vary among species. One of the greatest obstacles in taking action to help conserve these "at risk" invertebrates is the scarcity of information that exists on their distribution, abundance, habitat requirements, life history characteristics, population trends, and threats. It is necessary to assess the status and needs of each species to adequately conserve populations and track the success of these actions. Obtaining baseline information is, therefore, included as a component of actions to be taken for invertebrate SGCN (Appendix A).

Selecting Invertebrate SGCN

The task of assessing the conservation needs of Vermont's invertebrates is daunting. The number of species that occur within the state is not known; however, estimates for insects alone have ranged 15,000 to 20,000 different species. In addition, many of our invertebrates have not yet been scientifically described. Life history, distribution, and abundance

information is available for a small minority of Vermont's invertebrates that would be considered as conservation targets, such as freshwater mussels and some tiger beetles. Thus the Invertebrate Team had to determine how best to assess conservation needs with limited information to draw upon. State and regional experts, as well as entomological hobbyists, have compiled a valuable knowledge base for selected groups of invertebrates over the last century. Although distributional information is often limited, an understanding of the natural history of many of these species enabled the team to move forward. It was the team's decision that identification of SGCN would focus on species and species groups for which adequate information was available. The following invertebrate groups were reviewed while compiling the SGCN list:

- Dragonflies and Damselflies (Odonata)
- Butterflies and Moths (Lepidoptera)
- Mayflies (Ephemeroptera)
- Stoneflies (Plecoptera)
- Tiger Beetles (Carabidae, in part)
- Caddisflies (Tricoptera, in part)
- Freshwater Mussels and Freshwater Snails (Mollusca, in part)
- Invertebrates currently considered to be rare within Vermont

SGCN selection criteria included knowledge about: current listing as endangered and threatened; population declines; rarity; vulnerability of habitat; life history traits; vulnerability to collection or take; population limitations; regional status; historic occurrence; disjunct populations; habitat specialization; impacts by exotics; and dispersal capability. A review using these criteria resulted in a SGCN list of 192 species. It is the Invertebrate Team's expectation that, as available information on invertebrates increases, future iterations of the Action Plan will include a review of more taxa to be considered in the SGCN list.

Full reports on Invertebrate Species of Greatest Conservation Need are in Appendix A of this document. The following is a summary of those reports.

Habitat Needs

As invertebrates are the most diverse of Vermont's animals, the breadth of habitats they occupy is great. From deep lakes and slow rivers to the alpine peaks of our highest mountains, from the leaf litter of lowland floodplain forests to treetops in upland beech stands, there are invertebrates utilizing an amazing array of niches in every corner of Vermont. Many of these species have fairly general habitat requirements, or live in natural communities that are common and secure within the state. A number of these are so abundant that they are treated as forest and agricultural pests. Such species do not normally require special conservation attention.

In contrast, habitat specialization is also a common strategy among invertebrates. Examples of habitats that host specialized invertebrates include fens, black spruce bogs, river cobble shores, large rivers, or alpine meadow. Herbivorous invertebrates will often feed on only a small number of plant hosts, exhibiting another form of specialization. While such specialization is often advantageous when the required habitat or plant host is plentiful, it

creates a risk to these invertebrates when the habitat or host is rare, widely scattered, or also at risk. In such cases, conservation attention is sometimes needed to ensure that these specialized invertebrates remain a part of Vermont's fauna.

Certain habitats or areas of Vermont support highly diverse wildlife assemblages, including SGCN invertebrates. A good example is Lake Champlain and its lower tributaries, where many of our dragonfly and freshwater mussel SGCN are located. These species rich areas provide us the opportunity to help conserve many SGCN simultaneously.

Discussion of Problems Impacting Invertebrate SGCN

The greatest problems faced by SGCN invertebrates in Vermont relate to the loss, degradation, and fragmentation of their habitats. Poorly planned construction is ever-increasing on the landscape, often whittling away the wetland and upland habitats available to these creatures when these areas are not protected. As small habitat units disappear from the landscape, the remaining ones become more distant from one another; this presents an obstacle to those invertebrates that are limited to short-distance movement. Surface runoff from developed and agricultural lands can carry pollutant and sediment loads that find their way to rivers and streams, particularly during heavy rain events. The buildup of sediments on river bottoms embeds the natural substrate and can smother the invertebrates that reside there. Other pollutants entering streams and rivers can be detrimental to sensitive aquatic species.

Exotic species are having a negative impact on several invertebrate SGCN, and will likely present increased challenges to conservation in the future as new foreign species invade our lands and waters. Freshwater snails and mussels have been eliminated from several large areas of Lake Champlain due to zebra mussel invasion. A small exotic fly originally introduced to control gypsy moths has instead preyed upon many native woodland moth species, including some of our giant silk moths. This may prompt the need for future inclusion as SGCN such species as the lunar moth, polyphemus moth, and cecropia silkmoth.

Some of the challenges faced by SGCN invertebrates stem from their dwindling numbers and their natural life history characteristics. Low natural recruitment of offspring into the adult populations can hinder population recovery when numbers are low, such as with freshwater mussels. Other factors shared by several invertebrate SGCN groups that limit or impact populations include trampling/direct impacts, limited localized populations, and the requirement of specialized habitats.

Research & Monitoring Needs and Conservation Strategies

The Invertebrate Team identified priority research and monitoring projects to improve our ability to conserve Vermont's invertebrate SGCN. The Team also developed conservation strategies to address problems impacting each SGCN. Those used most frequently and those best applied to multiple invertebrate SGCN include:

Research & Monitoring Needs

1. Define particular habitat requirements of SGCN within Vermont, utilizing current knowledge of researchers and field investigations.

2. Determine important life history characteristics when such information is lacking for particular SCGN.
3. Obtain baseline SGCN distributional and abundance data by conducting surveys throughout the state.
4. Conduct inventories to detect and gather information on new SGCN populations.
5. Assess potential and existing impacts of problems on SGCN populations and their habitats.
6. Monitor trends in SGCN population size and structure, and in habitat.
7. Monitor current and potential threats to SCGN species.

Conservation Strategies

1. Conserve high priority SGCN sites through acquisition, easements, technical assistance, and other cooperative means.
2. Protect and restore aquatic habitats on which SGCN are dependent through pollution abatement, riparian buffers (ANR 2005), flow regulation, easements, and other means.
3. Work with foresters to avoid impacts to SGCN populations and habitats during forest management activities.
4. Work with biologists to minimize impacts to SGCN invertebrate populations and habitats during and following management activities for sport fish and game wildlife.
5. Participate in existing regulatory processes (e.g., Act 250, stream alteration permits) to protect and restore critical habitats.

Conclusion

The work to conserve our invertebrate SGCN has already begun. A Butterfly Atlas project was begun in 2002 to assess the distribution and abundance of butterfly species throughout Vermont. Coordinated by the Vermont Institute of Natural Science and funded by SWG, this initiative trains and utilizes volunteers to gather the data. The Vermont Fish & Wildlife Department has been active for many years investigating the distribution and population trends of several rare, threatened, and endangered invertebrates, including the cobblestone tiger beetle, brook floater, elktoe, and dwarf wedgemussel. Cooperation among several state and federal agencies, UVM, and The Nature Conservancy resulted in the Lake Champlain Native Mussel Working Group, which is dedicated to conserving native mussel populations within the Champlain Basin in both Vermont and New York. This group has been active in monitoring populations in Champlain tributaries and addressing threats to populations, such as the zebra mussel. All these efforts provide a good base from which Action Plan can help us launch new initiatives directed at invertebrate conservation.

See Appendix A for full reports on Invertebrate Groups of Greatest Conservation Need.

References

(ANR) VT Agency of Natural Resources. 1/20/2005. Riparian Buffer Guidance, and Riparian Buffers and Corridors Technical Papers www.anr.state.vt.us/dec/dec.htm

Conserving Vermont's Mammals

Mammal Team Members

Kimberly Royar, Vermont Fish & Wildlife Dept. (team leader)
Patrick Bartlett, forester
Thomas Decker, Vermont Fish & Wildlife Dept.
Dr. William Kilpatrick, University of Vermont
Susan Morse, Keeping Track
John Sease, U.S. Forest Service
Dr. Peter Smith, Green Mountain College
Dr. Charles Woods, biologist

Team Charge

The Mammal Team was charged with identifying mammals of greatest conservation need (SGCN), describing the distribution and habitat usage for each SGCN; evaluating problems impacting SGCN and their habitat; identifying priority research needs to improve our ability to conserve these species; and, developing conservation strategies to address priority problems. Details of Species Team and other Action Plan team and committee charges can be found in Appendix D of this document.

Introduction

Sixty-one mammal species presently exist in Vermont or were here just prior to European settlement. Several of these species are now believed to be extirpated (elk, wolverine, wolf, mountain lion, caribou).

Although many of Vermont's mammals are extremely adaptable and resilient (raccoon, red fox, skunk), others are sensitive to habitat loss and fragmentation (Indiana bat, bobcat, rock shrew), global warming (lynx, marten), competition (New England cottontail), and pollution (otter, mink, bats).

Some of the mammals listed as Species of Greatest Conservation Need (SGCN) presently appear to be secure but could be at risk in the next 20-30 years due to loss of critical habitats or population declines due to other environmental threats (black bear, otter, mink, little brown myotis, big brown bat). A number of species are facing immediate threats (New England cottontail, Indiana bat, marten, and lynx) and without attention could exist only as memories on the Vermont landscape. Others are listed primarily because little is known about the status and/or distribution of their populations in Vermont (hoary bat, shrews, gray fox, etc.). The Mammal Team interpreted the criteria for listing fairly broadly in hopes of preventing the decline of species that are presently secure. Funding sources for conservation may vary from federal aid to outside grants to the State Wildlife Grants program (reserved for species at greatest risk).

Selecting Mammal Species of Greatest Conservation Need

Of the sixty-one mammal species native to Vermont, the Mammal Team opted to list 23 as species of greatest conservation need and designate 3 (deer, moose, beaver) as species with ecological and/or social significance/influence.

The designation process included the completion of a matrix that identified distribution, population status, ranking, threats, and habitat/natural community requirements. Based on the results of the matrix, the Team prioritized the 61 species into high, medium, and low categories. Those species that were the most vulnerable (faced with immediate threats to survival or showing a significant population decline) were ranked as high. In addition, species that were extirpated locally but still existed regionally were included on the high list. Sixteen species were designated as having high conservation priority:

Eastern pipestrelle, hoary bat*, Indiana bat, long-tailed shrew, lynx*, marten, New England cottontail*, northern bog lemming*, pygmy shrew, red bat*, rock vole*, silver-haired bat*, small-footed bat*, southern bog lemming, water shrew*, and woodland vole.

**Listed as species of regional conservation need by the Northeast Endangered Species and Wildlife Diversity Technical Committee, 1999.*

Seventeen additional species were ranked as medium. The Team was influenced by the legislative intent of "keeping common species common" so some of the species in the medium category were those that might be well-distributed and even locally abundant at the present time, but that Team members felt were at risk in the next 20-30 years due to the increasing potential for mortality or habitat loss/fragmentation. Mammals may have been included in the medium category either because little was known about their population status, distribution, and/or trends in Vermont or they have been considered extirpated in the region. Medium conservation priority species include:

Big brown bat, black bear, bobcat, gray fox, hairy-tailed mole, little brown bat, long-tailed weasel, masked shrew, mink, muskrat, northern flying squirrel, northern long-eared bat, river otter, smokey shrew, southern flying squirrel, mountain lion, and wolf.

Three species (beaver, moose, and white-tailed deer) were relegated to a special category due to the fact that they have significant ecological and/or social influence. Beaver are a keystone species that provides habitat for many other wildlife species. Loss of beaver and beaver-created wetlands in the 1600s through the 1700s probably resulted in the decline of otter, moose, a variety of invertebrates, brook trout, and associated songbirds. The reintroduction and subsequent trap and transfer program funded by hunters and trappers and implemented by the Fish & Wildlife Department in the 1920s through the 1950s, resulted in the re-establishment of beaver in Vermont. Since then, otter populations have recovered and moose, once extirpated, now exist through the State. Maintaining beaver-created wetlands has become more challenging as human activities expand into and around wetland habitats thus increasing the potential for beaver-human conflicts.

Deer and moose are species valued by many Vermonters. They can also have a significant ecological effect on the landscape. Populations of deer and moose that exceed carrying capacity

have a huge impact on regenerating forests and the herbaceous understory and can pose serious public safety threats. Presently, all three species are carefully managed and regulated by the Vermont Fish & Wildlife Department. By listing these species in a special category, the Team did not necessarily intend for State Wildlife Grant funds be directed towards them, but to simply highlight the importance of these species to the people and systems of Vermont.

Full reports on each Species of Greatest Conservation Need are in Appendix A of this document. The following is a summary of those reports.

Habitat Needs

The habitat needs of the mammals listed as SGCN, varies widely by species. In general, however, maintaining healthy populations of Vermont's native mammals requires the conservation of critical habitats and the connective corridors that provide linkages between food, cover, and refugia habitats. In some cases, it also means conserving large blocks of contiguous forestland with corridors (including riparian buffers) to provide a network of large interconnected habitat blocks suitable for wide-ranging species such as lynx, bobcat, and black bear. Several researchers have recommended the establishment of an international effort to identify and protect biotic corridors for both the protection of biological diversity, as well as, to facilitate the movements of a variety of mammal and bird species across state and federal boundaries (Wydevan, 1998). This would require a cooperative effort between various local, state, and international governments as well as non-governmental organizations.

Discussion of Problems

The problems identified most frequently as threats to SGCN mammals were: Conversion of Habitat (24), Habitat Alteration (19), Pollution (16), and Loss of Prey Base (14). See Appendix A for full reports on each SGCN.

We do not understand all the ramifications, but the pattern seen elsewhere in the US and the world is that increased human population density, higher consumption of land and other resources, and lack of awareness of the impacts to other species can lead to devastating losses of native biota (TWS 2004). Vermont is not immune from these sorts of impacts and our landscape is continuing to be developed (DeVillars 1999). For example, Vermont lost an average of 6,500 acres of wildlife habitat is lost per year to development (Austin, pers.com). Habitat alteration and loss is a near universal challenge to many native mammal SGCN.

Pollution was also identified as a potential threat to species like mink and otter. Because they are at the top of the food chain, industrial pollutants, and heavy metals (PCBs, mercury, DDT) can build up in their bodies (Novak, 1987). Although the ramifications are not clear, it is likely that the biomagnification of these toxins negatively affects reproduction and survival. Bats are also extremely susceptible to pesticides and other environmental poisons because they store some lipophilic pesticides in brown adipose fat tissue. These stores are released as bats use their fat reserves during hibernation. Bats can, therefore, be exposed to both chronic and acute

poisoning, which can result in death. In addition, broad spectrum insecticides can deplete insect diversity and limit the food sources available for bats (loss of prey base).

Other threats that may influence the future of SGCN are global climate change, habitat fragmentation, competition, disease, impacts of roads and trails, invasion by exotic species, and trampling or direct impacts. Perhaps the biggest challenge for some species like bats, wolf, and mountain lion is the public's understanding of the conservation of these species. According to the North American Bat Conservation Partnership Strategic Plan, "Throughout North America, sensational and inaccurate presentation of public health issues involving bats has created an exaggerated fear of these ecologically important species. The resulting unwarranted public perception presents an especially serious threat to bat survival. Although general public awareness of the values of bats has increased over the past two decades, ignorance remains an important impediment to bat conservation. Medical professionals, government agencies, private industry, and educators often lack materials necessary to educate the public about how to safely share their communities with bats" (http://www.batcon.org/nabcp/newsite/index.html).

Work done in other states on wolf recovery and management highlight the same issues. The number one strategy in the Michigan gray wolf recovery and management plan states "Public support is vital for the long-term survival of wolves in Michigan. Information and education efforts designed to exchange information with Michigan residents are essential and need to receive a high priority." (Cool, 1997) It is clear that for some species recovery efforts must begin with a public outreach and education effort. To attempt recovery efforts without the support of the public is likely dooming them to failure.

Research and Monitoring Needs and Conservation Strategies

The Mammal Team developed research, monitoring, and conservation strategies for each individual SGCN species. Below is a compilation of the strategies that arose most frequently:

Research and Monitoring

1. Determine the distribution and relative abundance of populations in Vermont.
2. Determine critical habitat needs and connectivity requirements.
3. Identify and evaluate problems.
4. Determine life history requirements.

Conservation Strategies

1. Develop outreach and education programs that promote the conservation of SGCN and the habitats that they depend on, and increase awareness of the importance of maintaining or restoring these species.
2. Identify the habitat requirements of SGCN and develop strategies for conservation and protection through fee simple purchase, easements, management guidelines, and cooperative agreements with user groups and landowners, etc. (i.e. bat hibernaculums and maternity roost trees, bobcat denning sites, reverting field habitat for New England cottontail, bear-scarred beech stands, connective corridors, etc.).

3. Initiate an international effort to maintain large blocks of undeveloped forests linked together by habitat corridors in order to provide a network of interconnected habitats throughout northeastern New England and southeastern Canada.
4. Maintain riparian buffers along streams (see ANR 2005).
5. Maintain and restore habitat connectivity and minimize fragmentation of forest blocks. Identify and prioritize wildlife road crossing locations. Work with the Agency of Transportation and adjacent landowners to reduce wildlife mortality and increase the potential for movement from one side of the road to the other.
6. Work to eliminate pollution that causes acid rain, the deposition of heavy metals, and global climate change.
7. Continue to work cooperatively with landowners, towns, and communities to protect critical habitats and maintain connectivity. Provide *Conserving Vermont's Natural Heritage* to municipal and regional planners (Austin et.al. 2004)
8. Participate in existing regulatory processes (e.g., Act 250, stream alteration permits) to protect and restore critical habitats.

Vermont is at a crossroad. Due primarily to conscious choices made by her citizens in the last 100 years (restoration of deer, beaver, turkey, fisher populations, enactment of Act 250 legislation and wetland regulations, etc.), as well as, economic forces that essentially allowed the state to bypass the Industrial Revolution (Bryan, pers com), Vermont has remained predominantly rural throughout the 20th century. Many mammal species, therefore, are at population levels that are likely higher than they were prior to European settlement (fisher, red fox, white-tailed deer, raccoon, bobcat). Today, however, with Vermont's population growing, development pressures increasing and increased roads and traffic the potential for significant habitat destruction in the next ten years is high. In addition, global climate change is already influencing the potential residency of some native mammal populations in Vermont (Royar, pers com). The decisions made by Vermonters today will chart the course for the future and influence the long-term viability of our native wildlife populations.

See Appendix A for full reports on each mammal Species of Greatest Conservation Need.

References

(ANR 2005) VT Agency of Natural Resources. 1/20/2005. Riparian Buffer Guidance, and Riparian Buffers and Corridors Technical Papers www.anr.state.vt.us/dec/dec.htm

Austin, J.M. C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson. VT League of Cities and Towns. 2004. Conserving Vermont's Natural Heritage. A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Vermont Fish & Wildlife Department and Agency of Natural Resources. Waterbury, VT. www.vtfishandwildlife.com/library.cfm?libbase_=Reports_and_Documents

Bryan, F. Political Science Department, University of Vermont, Burlington, VT

Cool, K. L. 1997. Michigan Gray Wolf Recovery and Management Plan for the Michigan Department of Natural Resources, Lansing, Michigan. Prepared by the Michigan Gray Wolf Recovery Team.

North American Bat Conservation Partnership Strategic Plan, www.batcon.org/nabcp/newsite/index.html

Novak, M., J.A. Baker, M.E. Obbard, and B. Malloch. Wild Furbearer Management and Conservation in North America. Ontario Trappers Assoc. 1150pp.

Northeast Endangered Species and Wildlife Diversity Committee. 1999. Wildlife Species of Regional Conservation Concern in the Northeastern United States. Northeast Wildlife V.54.

Royar, Kim. Vermont Fish & Wildlife Department.

Sanders, Chris. 2004. Vermont Species Bat Conservation and Recovery Plan. 55 pp.

The Wildlife Society (TWS). 2004. Position on Economic Growth. Adopted by the TWS Council September 2004.

Wildlife Species of Regional Conservation Concern in the Northeastern United States. Northeast Wildlife Vol. 54, 1999.

Wydevan, Adrian P., T.K. Fuller, W. Weber, K. MacDonald. 1998. The potential for wolf recovery in the northeastern United States via dispersal from southeastern Canada. Wildlife Society Bulletin, 26 (4): 776-784.

Conserving Vermont's Reptiles & Amphibians

Reptile & Amphibian Team

Steve Parren, Vermont Fish & Wildlife Dept (team leader)
Jim Andrews, Middlebury College
Steve Faccio, Vermont Institute of Natural Science
Chris Slesar, Vermont Agency of Transportation

Team Charge

The Reptile and Amphibian Team was charged with identifying Species of Greatest Conservation Need (SGCN); describing the distribution and habitat usage for each SGCN; evaluating problems impacting SGCN and their habitat; identifying priority research needs to improve our ability to conserve these species; and, developing conservation strategies to address priority problems. Details of Species Team and other Action Plan team and committee charges can be found in Appendix D of this document.

Introduction

For much of the year Vermont's 40 species of amphibians and reptiles, collectively known as herps or herptiles (from the Greek *Herpeton*), are secretive creatures shunning the fuss made over our more charismatic mega-fauna. But stand beside a Vermont wetland, pond or vernal pool on an early spring evening and the cacophony of calls from wood frogs, spring peepers, chorus frogs, and others and these enigmatic micro-fauna will make themselves noticed.

Vermont's reptiles and amphibians certainly deserve notice. As if their penchant for feasting on black flies, mosquitoes, garden slugs, rodents and other pests isn't reason enough to conserve them (some frogs are reported to eat as many as 3,000 insects a year), many also play critical roles in ecosystems, and serve as excellent indicators of the health of natural systems due to their sensitivity to toxic chemicals and habitat change.

Amphibians and reptiles face many conservation challenges in today's world, be it crossing high-traffic roads or the loss of habitat and connections between habitat patches. It could be argued that all 21 amphibians and 19 reptiles known to be extant in Vermont deserve Species of Greatest Conservation Need (SGCN) designation. The Action Plan Reptile and Amphibian Team took a conservative approach to selecting SGCN in order to highlight those species thought to be most in need of conservation assistance so that scarce resources can be directed toward their conservation.

Selecting Amphibian & Reptile SGCN

Selection criteria included knowledge about current listing as endangered and threatened, population declines, rarity, vulnerability of habitat, life history traits, vulnerability to collection or take, other impacts from humans, and dispersal capability. Each species was examined across all criteria and the four-person team developed a high, medium, and low conservation need ranking to attempt to separate species with greater need from those that may be more secure, at least in the short term (see Chapter 3: "Developing Vermont's Action Plan," for details on selection criteria and process). We created a numerical ranking

that assisted our assignment to high, medium, and low priority categories. This approach resulted in 12 species of high conservation need and seven of medium conservation need:
High Conservation Need: common mudpuppy, Jefferson salamander (and hybrids), Fowler's toad, western chorus frog-E, eastern racer-T, eastern ratsnake-T, eastern ribbonsnake, timber rattlesnake-E, five-lined skink-E, spiny softshell turtle-T, spotted turtle-E and wood turtle (see Appendix I for definitions of the codes used here).

Medium Conservation Need: DeKay's brownsnake, smooth greensnake, northern watersnake, common musk turtle, four-toed salamander, blue-spotted salamander, spotted salamander.

Though some of Vermont's SGCN are at the periphery of their range (e.g., western chorus frog, common mudpuppy, fowlers toad, and mink frog], a finding that challenges conventional wisdom is that species populations have been documented to be more at risk of loss at the core of their range than at the periphery (Channel & Lomolino 2000, Lomolino 1995). This argues for us giving serious consideration to SGCN that may be peripheral in Vermont.

Full reports on each Species of Greatest Conservation Need are in Appendix A of this document. The following is a summary of those reports.

Habitat Needs

Since many reptiles and amphibians use a variety of habitats annually and over the course of their lives, maintaining healthy populations entails maintaining connectivity between habitats. Connectivity also enables individuals to find alternative cover, food sources, breeding, or over-wintering sites when natural disasters occur. Furthermore, connectivity between populations ensures vital genetic exchange and allows for the re-colonization of areas where populations have been eliminated due to drought, winterkill, disease, or anthropogenic forces. This can only occur if the landscape is permeable to these animals–that is, development proceeds in a way that allows amphibians and reptiles to move freely across the landscape. To conserve our native amphibians and reptiles, especially those considered SGCN, it will be essential to maintain a network of interconnected sites where natural processes are allowed to occur.

Discussion of Problems

The problems identified most frequently as problems Vermont's reptile and amphibian populations are all closely related: trampling and direct impacts (all 19 SGCN), the impact of roads and trails (13), habitat fragmentation (17), habitat alteration (17), and habitat conversion (14). See appendix D for full reports on each SGCN.

We do not understand all the ramifications, but the pattern seen elsewhere in the US and the world is that increased human population density, higher consumption of land and other resources, and lack of awareness of the impacts to other species can lead to devastating losses of native biota (TWS 2004). Vermont is not immune from these sorts of impacts and our landscape is continuing to be developed (DeVillars 1999). Habitat alteration and loss is a near universal challenge to native amphibians and reptiles.

Crossing roads is a real problem for both amphibians and reptiles in Vermont. Vernal migrations of salamanders and frogs to breeding pools result in many dead and wounded animals when a busy road must be crossed. At some sites in Vermont, thousands of amphibians are killed during a single night, which may overwhelm the reproductive capacity to sustain the populations and, according to the Vermont Agency of Transportation, constitutes a public safety issue (C. Slesar, VTrans, pers comm). Female turtles seeking nest sites are more at risk of being killed on roads than more sedentary males, resulting in a sex bias in some populations and raises questions about population persistence (Sheen & Gibbs. 2004, Marchand & Litvaitis 2004). The still abundant, but believed to be declining, wood turtle often encounters roads in Vermont during its annual movements along riparian corridors. Snakes emerging from hibernation often bask on warm pavement, increasing their risk of being struck by vehicles.

Other factors that may negatively impact amphibians and reptiles now and in the foreseeable future include pollution, changes in hydrology, sedimentation, and global changes such as temperature and ozone depletion as well as disease and collection. A variety of frog malformations were documented in Vermont in recent years, and parasitic trematodes (flatworms), as well as agricultural chemicals, were implicated as causative agents (DEC 2004). And, while our long winter buffers us from some diseases and exotic invasions, such risks do exist. Botulism killed many mudpuppies in the Great Lakes only a few years ago. Red leg disease, which is caused by the parasite *Aeromonas hydrophilia*, has been documented in Vermont. Finally, some species, particularly turtles, may have too narrow a reproduction margin for exploitation as food or as pets.

Research & Monitoring Needs and Conservation Strategies

The Reptile and Amphibian Team identified priority research and monitoring projects to improve our ability to conserve Vermont's reptile and amphibian Species of Greatest Conservation Need. The Team also developed conservation strategies to address problems impacting each SGCN. Those used most frequently include:

Research & Monitoring Needs

1. Better determine habitat needs, identify significant breeding sites, vernal pools and habitat connections.
2. Better determine the distribution and relative abundance of populations in Vermont.
3. Better identify and evaluate problems.
4. Monitor trends in population size, distribution and habitat.

Conservation Strategies

1. Help people better value reptiles and amphibians and to understand the essential needs of all life stages, especially upland habitat in proximity to breeding pools.
2. Encourage reports of road-killed specimens, road crossings, and road basking areas to VFWD, VTrans, and the Vermont Reptile and Amphibian Atlas Project. Develop safer crossings at significant sites when roads are being upgraded.

3. Maintain habitat through appropriate management, direct habitat disturbance and site roadways away from sensitive sites such as breeding pools.
4. Continue to work cooperatively with landowners, habitat management agencies, towns and communities to protect habitat and maintain connectivity. Develop management guidelines for owners and managers of appropriate habitat.
5. Conserve known critical habitat through fee simple purchase, development rights or easements, management agreements and education of private landowners and managers.
6. If loss of important sites is likely due to development, consider creating or enhancing other pools that might allow some adults to transfer to the new site if they encounter it or develop a new breeding population from dispersal of colonizers.
7. Protect turtle nests and adults by predator trapping.
8. Work with biologists to minimize impacts to SGCN populations and habitats during and following management activities for sport fish and game wildlife.
9. Participate in existing regulatory processes (e.g., Act 250, stream alteration permits) to protect and restore critical habitats.

Vermont's Reptiles and amphibians are fortunate for a number of reasons. We have a much less developed landscape than many states. For example, even the eastern newt, a very abundant species in Vermont, is declining in Rhode Island due to development and roads (C.J. Raithel RI Dept of Environmental Management pers comm). We have an engaged Scientific Advisory Group on Reptiles and Amphibians that provides advice to the Vermont Endangered Species Committee. We also have a well developed Reptile and Amphibian Atlas Project (http://cat.middlebury.edu/herpatlas/) that mostly though volunteer efforts has collected, and continues to collect valuable information on the distribution of reptile and amphibian species in Vermont and raises awareness of conservation need in Vermont. Some groups in Vermont sponsor 'salamander nights' helping small amphibians cross roads safely and raise awareness about the impacts of traffic. The Vermont Fish and Wildlife Department continues to work on conservation projects that benefit reptiles and amphibians, including species listed here as SGCN, and we are working with other agencies including the Vermont Transportation Agency. More needs to be done, but with the foundation we already have in place, and the awareness and strengthening of partnerships promoted by Action Plan, we expect more conservation actions in our shared future.

See Appendix A for full reports on each reptile and amphibian Species of Greatest Conservation Need.

References

Channel, R. and M.V. Lomolino. 2000. Dynamic biogeography and conservation of endangered species. Nature 403:84-86.

(DEC) Vermont Department of Environmental Conservation. 6-2004. Biomonitoring and Aquatic Studies. http://www.anr.state.vt.us/dec/waterq/bass.htm

DeVillars, J.P. 1999. An Open Letter to the People of Vermont. Vermont Keeping In Touch. U.S. Environmental Protection Agency Vermont State Unit. September 1999.

Galbraith, D.A., R.J. Brooks, and G.P Brown. 1997. Can management intervention achieve sustainable exploitation of turtles? Proceedings: Conservation, Restoration, and Management of Toirtoises and Turtles-An International Conference, pp. 186-194).

Garber, S.D. and J. Burger. 1995. A 20-yr study documenting the relationship between turtle decline and human recreation. Ecological Applications. 5(4): 1151-1162.).

Lomolino, M.V. and R. Channel. 1995. Splendid isolation: patterns of geographic range collapse in endangered mammals. Journal of Mammalogy 76(2): 335-347.)

Marchand, M.N. and J.A. Litvaitis. 2004. Effects of habitat features and landscape composition on the population structure of a common aquatic turtle in a region undergoing rapid development. Conservation Biology 18(3): 758-767).

Sheen, D.A. and J.P. Gibbs. 2004. Effects of roads on the structure of freshwater turtle populations. Conservation Biology 18(4):1143-1149.

The Wildlife Society (TWS). 2004. Position on Economic Growth. Adopted by the TWS Council September 2004.

SGCN Conservation at Multiple Scales

Vermont's list of Species of Greatest Conservation Need (SGCN) comprises 144 vertebrate species (including chestnut sided-warbler, lake sturgeon, and spotted salamanders) as well as 192 invertebrate species (including tawny emperor butterflies, cobblestone tiger beetles, and giant floater mussels). Developing individual conservation plans for each SGCN would have been exhausting and impractical. Moreover, attempts to implement the more than 300 plans would be impossible due to insufficient resources and the high overall cost, resulting from the inefficiency of implementing many uncoordinated plans (not to mention problems reminiscent of the Keystone Cops stemming from the hundreds of biologists in the field bumping into each other).

Fortunately an easier, cheaper, and more efficient approach to addressing the needs of our Species of Greatest Conservation Need exists. That method consists of designing and implementing conservation efforts at multiple scales. For example, wildlife managers have been creating edge habitat for decades (Smith 1980) where, for example, an early successional stage of forest borders later successional forest. They do this because research shows that this improves conditions for deer, rabbit, turkey, ruffed grouse and several other species. In this example management actions were targeted at the habitat level.

Similarly, research in the 1960's and 1970's indicated that pesticides such as DDT so weakened the eggs of loon, osprey, peregrine falcons and many other birds of prey that eggs were collapsing under the weight of expectant parents. Not only did this add to nationwide population crashes, it also impeded restoration efforts because the pesticides remained in the birds for years. Action taken at the state and federal level—the regulation of pesticides—eventually helped these species and loon, osprey, peregrine falcon were finally removed from the Vermont's endangered species list in April of 2005.

Following this approach, we began at the species level by assessing SGCN individually. Then SGCN were organized by taxonomic group and by habitat usage with habitats grouped by vegetation type. This resulted in conservation strategies at five levels (table 4-1). Some species will always require specific conservation attention, such as those that are very rare, those that are declining across their range, those that aggregate for breeding, and those that require large home ranges. Their needs are addressed at the Species Level. Other species' needs can be met by the long-term conservation of high quality habitats and communities used by these species (the Community Level). Still other species will require conservation at the scale of wildlife travel corridors and large forest blocks (the Landscape Level).

Table 4-1 Organization of Conservation Information in this Report

Level	Organization	Location in this document
1) Species	144 individual species summaries & 16 invertebrates group summaries	Appendix A
2) Taxon	5 group summaries (bird, fish, invertebrate, mammal and reptile & amphibian)	Chapter 4
3) Community & Cultural Habitat Groups	120 communities & cultural habitats grouped into 18 summaries	Appendix B
4) Landscapes	6 landscape summaries (4 forest, riparian & fluvial)	Chapter 4
5) State & Region	State-level conservation strategies and action themes	Chapter 1

Selection of Classification Systems

Though great strides have been made in developing vegetation classification systems that function at the site, landscape, region and national scales (Barnes 1979, Allen and Starr 1982, Forman and Godron 1986, Cleland et. al 1997, Grossman et. al 1998) they are incomplete. In particular, no system satisfactorily integrates aquatic and terrestrial communities and cultural habitats[1] used by wildlife. The efforts of every

[1] Cultural habitats are communities and sites that are either created and/or maintained by human activities or are modified by human influence to such a degree that the physical condition is substantially different from what existed prior to human influence (adapted from Reschke 1990)

state, however, in development of their Action Plan greatly improve our prospects and plans are underway for coordination and information sharing once states' Action Plan reports are approved (IAFWA 2005).

In lieu of a unified habitat classification system, Vermont's Action Plan technical teams utilized the best features of five peer-reviewed vegetation classification systems that can be crosswalked with those used in other states to support broader scale conservation efforts—regionally, nationally, and internationally. Forest Cover Types (Eyre 1980) and U.S Forest Service Forest Inventory & Analysis Types (USDA 2003) were used for early successional stage forests. Natural Communities (Thompson and Sorenson 2000) were the basis most terrestrial vegetation. "A Classification of the Aquatic Communities of Vermont" by Langdon et. al. (1998) was adapted for aquatic community designations and cultural habitats[1] were adapted from Reschke (1990). Landscape scale communities were adapted from Poiani et.al. (2000).

One hundred 120 aquatic and natural community types, cultural habitats and land cover types, capturing most of the habitat required by SGCN were selected from the five systems (table 4-2). Each was assigned to one of 22 categories. Because Lake Champlain and the Connecticut River harbor most of the fish diversity in Vermont, these two waterbodies were broken out from the taxonomy to provide for a more targeted assessment. Technical teams then developed assessment summaries for each that includes descriptions and general locations; current conditions; desired conditions based on the needs of associated SGCN; priority problems; conservation strategies to address problems (along with the identification of potential conservation partners and funding sources); and a listing of relevant plans and planning processes pertinent to a habitat type. (Appendix B)

In addition, three landscapes were selected (forest, riparian, and fluvial/stream) to address connectivity needs of many SGCN as well as the needs of wide-ranging SGCN. Assessment summaries were also completed for each landscape (see this chapter).

Successional Stages, Species of Greatest Conservation Need & the Action Plan

Plant succession produces cumulative change in the types of plant species occupying a given area through time. It is complicated by factors such as disturbance (large and small), local conditions, seed banks and soil legacies (Oliver 1981). A highly simplified timeline begins when land is cleared. Pioneer species typically return first followed by other species generally better adapted to the new and changing conditions created by the previous suite of species. Given sufficient time and appropriate conditions the area moves roughly through early, middle, and late successional stages—often referred to as mature or old growth. A disturbance, if sufficiently large, can re-set the clock anytime and succession begins again. The best known examples are forest succession but it occurs in virtually all vegetated areas. For example, lichen communities on granite mountaintops experience successional changes (Wessels 2002).

Succession can significantly impact habitat for Species of Greatest Conservation Need and other wildlife as in the edge habitat example noted earlier. Generally as succession moves from early to late stages some wildlife will lose out (e.g., spruce grouse, woodcock, cottontail rabbit) and others will benefit (e.g., marten, northern goshawk). Others still prefer a mix of successional stages in appropriate configurations (e.g., black bear, lynx).

Over the past two centuries the mix of successional stages available to Vermont's wildlife has changed dramatically in both distribution and abundance. Though precise estimates (current and historic) are unavailable, prior to 1800 a significant percentage of Vermont's forests were in late-successional stages (>150-300 years and older). One-hundred years later early-successional stages (1-15 years) dominated the state and today mid-successional forests (60-100 years) are most abundant. Wildlife populations have responded in turn. Vermont's SGCN list contains relatively few species requiring mid-successional forests and more that thrive in early and late-successional representations.

Because the loss of late-successional forests in the eastern US occurred prior to the advent of modern wildlife biology and the current scarcity of later-successional stages (particularly northern hardwood forest types) our understanding how wildlife utilized these stages is not as advanced as our knowledge of wildlife in early successional stages. Historic records and research in late-successional areas elsewhere indicate that the distribution and abundance of some wildlife species was much greater when late-successional forests were in greater abundance—even if these species can survive without them. Given the lack of this condition on the landscape it is advisable to increase its availability to wildlife.

The habitat, community and landscape summaries that follow here and in Appendix B address habitat the needs of Species of Greatest Conservation Need that use that vegetation type in one or more successional stages. Conservation strategies address the particular successional stage needs well those species that prefer a mosaic of successional stages.

Table 4-2: Landscape, Community, Habitat & Cover Type Categories

***** Categories marked with an asterisk "*" are considered major categories for the purposes of organizing this report (24 in all). Conservation summaries were developed addressing characteristics and location, current and desired condition, SGCN using this habitat category, priority problems impacting this category, conservation strategies to address the problems and a list of other plans and planning entities with significant interest in this area.

Landscapes (adapted from Poiani et.al. 2000)

*****Landscape Forests
- Large blocks of contiguous forest
- Statewide and regional wildlife corridors and linkages
- *Spruce-Fir Northern Hardwoods
- *Northern Hardwood Forests
- *Oak-Pine-Northern Hardwoods (These three Northern Hardwood natural communities comprise the bulk of Vermont's landscape forests)

*****Landscape Level Aquatic & Shorelines (includes riparian areas)

*****Fluvial (Riverine) (adapted from Langdon et.al. 1998)
- Brook trout
- Brook trout-slimy sculpin
- Blacknose dace-slimy sculpin
- Blacknose dace-bluntnose minnow
- Blacknose dace creek chub
- Tessellated darter-fallfish
- Blacknose dace-slimy sculpin
- White sucker-tessellated darter

Aquatic Communities (adapted from Langdon et.al. 1998)

*****Lower Connecticut River (Atlantic salmon-American shad community)

*****Lower Lake Champlain Tributaries (Redhorse-lake sturgeon community)

*****Lacustrine (lakes and ponds)
- Dystrophic lakes
- Meso-eutrophic lakes
- Oligotrophic lakes
- High elevation acidic lakes

*****Lake Champlain

Cultural Habitats
(adapted from Reschle 1990)

*****Building & structures

*Mine & gravel pits

*****Grassland & hedgerows
- Grasslands
- Hedgerow
- Old field/shrub
- Orchard

Successional Stages & Forest Cover Types
(Eyre 1980, US Dept of Agriculture 2003)

Stages: Seedling/Sapling Sapling/Pole Timber, Pole Timber

Cover types

Boreal Conifers
- Balsam fir
- Black spruce
- White spruce

Boreal Hardwoods
- Aspen
- Pin cherry
- Paper birch

Spruce-Fir
- Red spruce
- Red spruce-balsam fir
- Paper birch-red spruce-balsam fir

Pine and Hemlock
- Eastern white pine

Habitat descriptions in the Individual Species Summaries (A1-A5) note specific stage & cover type needs for SGCN

Landscape Forest Summaries (next section) incorporate stage and cover type

Table 4-2 continued: Terrestrial Natural Communities (Thompson & Sorenson 2000)

Open or Shrub Wetlands

*Open Peatlands
- Alpine peatland
- Dwarf shrub bog
- Black spruce woodland bog
- Pitch pine woodland bog
- Poor fen
- Rich fen
- Intermediate fen

*Marshes & Sedge Meadows
- Deep bulrush marsh
- Deep broadleaf marsh
- Shallow emergent marsh
- Sedge meadow
- Cattail marsh
- Wild rice marsh

*Wet Shores
- Calcareous riverside seep
- River cobble shore
- Lakeshore grassland
- Riverside sand or gravel shore
- Outwash plain pondshore
- River mud shore
- Rivershore grassland

*Shrub Swamps
- Buttonbush basin swamp
- Alder swamp
- Alluvial shrub swamp
- Sweet gale shoreline swamp
- Buttonbush swamp

Forested Wetlands

*Floodplain Forests
- Silver maple-ostrich fern riverine floodplain forest
- Lakeside floodplain forest
- Silver maple-sensitive fern riverine floodplain forest
- Sugar maple-ostrich fern riverine floodplain forest

*Hardwood Swamps
- Red maple-black ash swamp
- Red maple-northern white cedar swamp
- Calcareous red maple-tamarack swamp
- Red or silver maple-green ash swamp
- Red maple-black gum swamp
- Red maple-white pine-huckleberry swamp

*Softwood Swamps
- Northern white cedar swamp
- Spruce-fir-tamarack swamp
- Black spruce swamp
- Hemlock swamp

*Seeps & Vernal Pools
- Vernal pool
- Seep

Open Upland Communities

*Upland shores
- Riverside outcrop
- Lake sand beach
- Lake shale or cobble beach
- Erosional river bluff
- Sand dune

*Outcrops & Upland Meadows
- Alpine meadow
- Boreal outcrop
- Serpentine outcrop
- Temperate acidic outcrop
- Temperate calcareous outcrop

*Cliffs & Talus
- Boreal acidic cliff
- Boreal calcareous cliff
- Temperate acidic cliff
- Temperate calcareous cliff
- Open talus

Upland Forests & Woodlands

*Spruce-Fir Northern Hardwood Forest (included with landscape forest summary)
- Subalpine krummholz
- Montane spruce-fir forest
- Lowland spruce-fir forest
- Montane yellow birch-red spruce forest
- Boreal talus woodland
- Cold-air talus woodland
- Red spruce-northern hardwood forest

*Northern Hardwood Forest (included with landscape forest summary)
- Northern hardwood forest
- Rich northern hardwood forest
- White pine-northern hardwood forest
- Mesic red oak-northern hardwood forest
- Hemlock forest
- Hemlock-northern hardwood forest
- Northern hardwood talus woodland

*Oak-Pine-Northern Hardwood Forest (included with landscape forest summary)
- Limestone bluff cedar-pine forest
- Mesic maple-ash-hickory-oak forest
- Valley clayplain forest
- White pine-red oak-black oak forest
- Dry oak forest
- Pine-oak-heath sandplain forest
- Dry oak-hickory-hophornbeam forest
- Red cedar woodland
- Red pine forest or woodland
- Pitch pine-oak-heath rocky summit
- Dry oak woodland
- Transition hardwood talus woodland

References

Allen, T., F.H.; Starr, 1982. Hierarchy: perspectives for ecological complexity. Chicago: The University of Chicago Press.

Barnes, R.B. 1979. Wildlife habitat from a forest resource inventory: is it possible? Transactions of the Northeast Section of the Wildlife Society 36:151-159.

Cleland D.T, P.E. Avers, W.H McNab, M.E. Jensen, R.G. Bailey, T. King, and W.E. Russell 1997. National Hierarchical Framework of Ecological Units. Ecosystem Management: Applications for Sustainable Forest and Wildlife Resources, Mark S. Boyce and Alan Haney, editors. Yale University Press, New Haven & London.

Eyre, F. H. ed. 1980. Forest Cover Types of the United States. Society of American Foresters. Washington, DC.

Forman, R.T.T.; Godron, M. 1986. Landscape Ecology. New York: Wiley and Sons

Grossman, D.H., D. Faber-Langendoen, A.W. Weakley, M, Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K.D. Patterson, M. Pyne, M. Reid and L. Sneddon. 1998. International Classification of Ecological Communities: Terrestrial Vegetation of the United States. Volume I: The National Vegetation Classification Standard. The Nature Conservancy.

(IAFWA) International Association of Fish and Wildlife Agencies. May 2005 Comprehensive Wildlife Conservation Strategies: National Support for Coordinated Implementation. Washington, D.C.

Langdon, R., J. Andrews, K. Cox, S. Fiske, N. Kamman, and S. Warren. 1998. A classification of the aquatic communities of Vermont. The Nature Conservancy and the Vermont Biodiversity Project, Montpelier, Vermont.

Oliver, C.D. 1981. Forest Development in North America Following Major Disturbances. Forest Ecology and Management 3:153-168

Poiani, K.P., B.D. Richter, M.G. Anderson, and H.E. Richter. 2000. Conservation at multiple scales: functional sites, landscapes, and networks. BioScience 50:133-146

Smith, R.L. 1980 Ecology and Field Biology, 3th edition. Harper & Row. New York.

Reschke, Carol. 1990. Ecological Communities of New York State. Latham, NY: New York Natural Heritage Program, NYSDEC, www.dec.state.ny.us/website/dfwmr/heritage/EcolComm.htm

Simberloff D. 1998. Flagships, umbrellas, and keystones: Is single-species management passe in the landscape era? Biological Conservation 83:247–257.

Thompson, E. H., and E. R. Sorenson. 2000. Wetland, Woodland, Wildland—A guide to the natural communities of Vermont. University Press of New England, Hanover.

U.S. Department of Agriculture, Forest Service. 2003. Forest inventory and analysis national core field guide, volume 1. U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis, 201 14th St., Washington, D.C., 20250.

Wessels, T. 2002. The Granite Landscape: A Natural History of America's Mountain Domes, From Acadia to Yosemite. The Countryman Press. Woodstock, VT

Landscape Forest Summary

Vermont's three primary landscape scale forests – Northern Hardwood, Spruce-Fir-Northern Hardwood, and Oak-Pine-Northern Hardwood – form the foundation of the state's forested habitat that supports many of Vermont's SGCN. These landscapes function at two different levels. First, in sum, these three forests, if maintained in large, interconnected forest blocks, meet the large scale habitat needs of Vermont's widest ranging wildlife species that move throughout the landscape. Secondly, each of the three large forests hosts numerous SGCN that may require one or more of the natural community types associated with that respective large forest. In general, habitat requirements, problems, and conservation strategies should be assessed and developed at both levels. However, in many cases, the landscape scale forest provides most of the habitat needs for many of the SGCN associated with one of the habitats or natural community types.

Characteristics and Location

Landscape Level Forest provides both the area and habitat needed by Vermont's wide-ranging wildlife species. These species use the full mosaic of diverse habitats associated with Vermont's upland forestland frequently crossing habitat boundaries. The conservation and management of Vermont's landscape level forests for wide-ranging wildlife also provides the essential habitat for all SGCN that depend on the natural communities associated with those habitats.

Habitats associated with the landscape level forest

Northern Hardwood Forest: The Northern Hardwood Forest is best developed at Vermont's middle elevations and is widespread in the state. Beech, sugar maple, and yellow birch are the prominent tree species, but hemlock, red oak, red maple, white ash, basswood, and white pine can be common as well, with some scattered red spruce. These are the dominant communities in nearly all biophysical regions, excepting for the highest elevations of the Green Mountains and the lowest elevations in the Champlain Valley.

Spruce-Fir-Northern Hardwood Forest: The Spruce-Fir-Northern Hardwood Forest is found in the coldest regions of the state. Red spruce and balsam fir are the most abundant trees at higher elevations and in low, cold, moist areas. Other conifers include white spruce, black spruce, northern white cedar, and tamarack. Warmer and better drained sites have significant amounts of hardwood, including yellow birch, sugar maple, and beech with paper birch at mid-elevations. Conifer and mixed forests of this habitat blanket Vermont's highest peaks above 2,500 feet.

Oak-Pine-Northern Hardwood Forest: The Oak-Northern Hardwood Forest is best developed in the warmer regions of Vermont—the Southern Vermont Piedmont, Champlain Valley, and the lower elevations in the Taconic Mountains. These forest communities generally occur as large patches or locally as small patches within Northern Hardwood Forests and on dry, south-facing slopes and ridgetops. In the Oak-Northern Hardwood Forest, hardwoods such as sugar maple, beech and yellow birch are common,

but warmer climate species such as red oak, shagbark hickory, and white oak can be present in significant numbers. White pine is a prominent part of this Forest.

Landscape Forest Condition

Historical Perspective: It has been estimated that 95% of Vermont was forested when Europeans first arrived in the early 1600s. The population of Native Americans in the Champlain Valley and Connecticut River valley in the early 1600s was only 8,000 and only a small amount of forestland was cleared for agriculture, primarily in the river valleys (Klyza and Trombulak 1999). Significant forest clearing began with the arrival of European settlers, however, primarily for lumber, fuelwood, potash, and agriculture. It has been roughly estimated that the percent of forest cover in Vermont was reduced to 82% by 1790, 47% by 1850, and reached a low of 37% by 1880, after which the area of forest began to increase as farms were abandoned (various sources in Klyza and Trombulak 1999). According to Harper (1918), by 1850 more than 60% of the land in New England had been cleared for agriculture.

The effect on Vermont's forests was not limited to clearing. Forests in the region that were not cleared were typically on steep slopes, stony ground, or poorly drained soils. Many of these were heavily harvested for timber and many were used as woodland pastures, with the result that virtually all of our forests have been altered by human activity (Whitney 1994). In general, our forests today are much younger than the presettlement forests. The composition of presettlement forests was also different from our present-day forests, as has been described in several studies of early land survey records that documented witness and boundary line trees (Siccama 1971, Cogbill 1998, Cogbill 2000, Cogbill et al. 2002). These studies indicate that beech was much more abundant in presettlement forests, whereas sugar maple and white pine were less abundant. Red spruce was more abundant in mid-elevation presettlement forests, whereas red maple, white birch, and poplars – species now associated with younger forests and human activity – were much less abundant in the presettlement forests (Cogbill 2000).

Prior to European settlement in the northeastern United States, natural disturbance (including wind, fire, and flooding) were the primary forces affecting the region's forests. In Vermont, wind has been the primary source of natural disturbance in upland forests, ranging from frequent local blowdowns of individual trees to infrequent hurricane events that can affect thousands of acres. A recent study, based on the review of many sources of information, provides figures on the expected percentage of the presettlement regional landscape occupied by different age classes (Lorimer and White 2003). For northern hardwood forest, the expected percentage occupied by uneven aged forest over 150 years ranges from 70 to 89 percent, depending on the assumptions and models used. In these forests, from 1.1 to 3.0 percent was occupied by early successional forests (1-15 year age class). For spruce-northern hardwood forest, the expected percentage occupied by uneven aged forest over 150 years ranges from 35 to 78 percent, depending on the assumptions and models used. In these forests, from 2.4 to 7.1 percent was occupied by early successional forests (1-15 year age class).

Current Condition: Vermont's landscape level forest for wide-ranging wildlife species is influenced by two, diverging trends in the state's forestland. First, Vermont is experiencing

increasing acreage of forest in the state. As of 1997, Vermont was estimated to be 78% forested; however, this varies greatly by biophysical region, ranging from 94% forested in the Southern Green Mountains to 40% in the Champlain Valley (Frieswyk and Widmann 2000). Second, however, Vermont's blocks of contiguous forestland have become broken into smaller and smaller units as forests are converted to other land uses, primarily new housing and commercial development and new and/or upgraded roads. Again, the availability of large blocks of contiguous forestland varies by biophysical region with the Northeast Highlands and Green Mountains having the most contiguous forest and the Champlain Valley and Vermont Valley comprised of the smaller, fragmented forests.

The landscape level forest also varies greatly in the proportion of the forest in various successional stages. In general, early successional forest is available on 10% of the state's forestland, ranging from 2.7% in the Taconic Mountains to over 19% in the Northern Vermont Piedmont (Frieswyk and Widmann 2000). The current availability of late successional stage habitat is nearly non-existent in the state, although trends lean toward an increasing availability of this habitat, particularly in the Southern Green Mountains.

In general, the highest forest elevations are more vulnerable to immediate impacts of both climate change and pollution. These areas also contain the more fragile soils. The lower elevation forests are more vulnerable to permanent conversion and to fragmentation of forest blocks.

Desired Condition (SGCN Needs): The habitat needs of wide ranging wildlife species is best met by maintaining large blocks of contiguous forest connected by linkages. Species such as black bear, marten, river otter, lynx, wolf, and others cross forest boundaries. Successful conservation and management of these wide ranging species therefore requires a landscape level approach, compounding the complexity of development and implementation of successful strategies**.** Management for early successional forest may enhance an area for some wide-ranging wildlife (e.g., black bear, lynx), while others may require that a large portion of their home range be managed for late successional forest stages (e.g., pine marten). Management schemes should therefore be designed at the landscape level in order to maintain blocks of intact, minimally roaded, forest while encouraging early successional harvests in areas that are already fragmented (Dan Harrison, pers. com. 2004). Paved roads, housing development, and other permanent conversions of forest are cumulatively detrimental to most wide-ranging wildlife.

Potential habitat for wide-ranging SGCN can be defined through the overlay of the marten habitat map (Carroll 2004), lynx habitat map (Carroll 2004), black bear habitat (Vermont Fish and Wildlife Department 1989), unfragmented forest block map (Feree 2004), contiguous forest block map (UVM spatial analysis lab 2005), and the maps describing potential wolf habitat (Harrison and Chapin 1998).

Several wide-ranging wildlife species will not persist or become re-established without linkages to other states and Canada. Therefore, regional connectivity (i.e., linkages to New York, New Hampshire, and Canada) must be maintained and statewide connectivity within Vermont be restored through the re-establishment of forest and linkages in the more fragmented biophysical regions. Linkages along riparian habitats will also provide connectivity for both semi-aquatic and upland species.

The total amount of forested area needed by wide-ranging SGCN varies greatly based on the home range requirements of a species, habitat quality, and the number of individuals needed to sustain the population. In general, some area sensitive birds may require a minimum forest block size of 7500 acres (Robbins et. al. 1989), bobcat populations of 250 breeding females require approximately 2000 square miles, and maintaining Vermont's black bear population may require as much as 6000 square miles of habitat (Vermont Fish & Wildlife Black Bear Management Plan 199__). Some species are so wide-ranging that Vermont can meet only a portion of their population's current or potential habitat needs (e.g., lynx, wolf, marten). In addition, maintaining viable populations of migrating songbirds and raptors may require conservation of wintering grounds in other parts of the country and world.

Species of Greatest Conservation Need in Landscape Level Forests

High Priority

American marten (Martes americana)
Lynx (Lynx canadensis)

Medium Priority

Red-shouldered hawk (Buteo lineatus)
Northern goshawk (Accipiter gentiles)
Wolf (Canis ?)
Mountain lion (Felis concolor)
Bobcat (Lynx rufus)
Black bear (Ursus americanus)
Northern river otter (Lutra canadensis)

SGCN Note: For more information about a specific Species of Greatest Conservation Need see that species' assessment summary in Appendix A.

Problems & Information Needs

See Appendix C for definitions of problem and strategy categories used here

Problem/ Information Need Category	Problem/ Information Need Detail	Rank
Habitat Conversion	Permanent conversion of large blocks of forestland to housing development, commercial development, and roads	High
Habitat Fragmentation	Break up of large forest blocks and riparian corridors into smaller block size due to forest conversion and loss of connectivity across political boundaries.	High
Impacts of Roads and Trails	Human and motorized disturbance from new roads and trails in sensitive habitats (e.g., denning sites, feeding areas)	High
Distribution of successional stages	Lack of appropriate landscape level approach to management resulting in habitat degradation (lack of either late or early successional habitat in appropriate size and juxtaposition).	High
Climate Change	Influences tree species composition and snow depths, the latter of which favors competing species	High
Pollution	Acid rain, sulfur and mercury deposition	High

Priority Conservation Strategies

See Appendix C for definitions of problem and strategy categories used here
See Chapter 6 for definitions of acronyms used in the Partners and Funding Source columns.

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
Identify and prioritize, for conservation, existing contiguous forest blocks and associated linkages that allow for upward and northward movement in response to climate change.	Number of suitable habitat patches available, miles of riparian corridors & linkages conserved.	USFWS, USFS, TNC, ANR, UVM	SWG, LIP, VHCB, FPR, TNC
Acquisition and conservation easements on high priority sites	Number of acres conserved	ANR, VLT, TNC, VHCB, and other land trusts	VHCB, VLT, LIP, USFS, USFWS, LWCF, Forest Legacy
Technical assistance to private landowners, user groups and forest managers to reduce problems and fragmentation to habitats for wide ranging species and to restore and enhance degraded habitats.	Number landowners managing for species of greatest conservation need	NRCS, TNC, VFWD, FPR, Coverts, Keeping Track, SAF VWA, NWF	LIP, SWG
Financial incentives for private landowners to reduce problems and fragmentation to habitats for wide ranging species and to restore and enhance degraded habitats	Number of acres affected/restored	VFWD, NRCS	LIP, WHIP
Technical assistance to town and regional planning organizations. Distribute *Conserving Vermont's Natural Heritage* (Austin et.al. 2004)	Number of towns contacted; No. towns incorporating wide-ranging species into planning	VFWD, RPCs, VFS, AVCC, SAF, VWA, Coverts, Keeping Track	VFWD
Technical assistance to state and federal land management agencies	Number of state and federal land management plans in the NEK providing for lynx and marten habitat	ANR, USFWS, USFS	ANR
Develop a landscape level planning effort for public/private lands that addresses the needs of late and early successional species and integrates habitat for prey species (e.g., deer, moose, beaver, snowshoe hare) according to population objectives of species management plans	Development of a coordinated effort for the development of target goals and objectives between private and public land entities.	ANR, TNC, USFS, USFWS, RGS, CT Coverts, VWA, Audubon Vermont, Keeping Track	PR, SWG, NRCS
Increase cooperation/coordination between adjacent states and provinces to support and encourage trans-jurisdictional actions to address issues such as global climate change, acid rain and connectivity.	Implementation of trans-jurisdictional actions.	USFWS, USFS, ANR, other states, VTrans, USDOT, TNC, Quebec, VTA.	USFWS, IAFWA
Work with VTrans to identify and maintain wildlife highway/road crossings	Number of functional linkages across highways/roads	VFWD, VTrans, TNC	SWG, PR, VTrans

Coordination with other plans

See Chapter 6 for definitions of acronyms used in the lead column

Plan or planning entity	Goal/Scope of plan	Lead
Black Bear Plan	Bear population goals	ANR
USFWS Wolf Recovery Plan	Wolf recovery in eastern United States	ANR, USFWS, NWF
VT Biodiversity Project	Conserving biodiversity in Vermont	TNC
Northern Forest Bird Initiative	Landscape planning for Northern Forest birds	Audubon
Partners in Flight	Bird conservation plan	PIF, ANR, VT Audubon, USFWS

References

Austin, J.M. C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson. VT League of Cities and Towns. 2004. Conserving Vermont's Natural Heritage. A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Vermont Fish & Wildlife Department and Agency of Natural Resources. Waterbury, VT. www.vtfishandwildlife.com/library.cfm?libbase_=Reports_and_Documents

Carroll, Carlos. 2003. Impacts of Landscape Change on Wolf Variability in the Northeastern U.S. and Southeastern Canada: Implications for Wolf Recovery, Wildlands Project Special Paper No. 5, Richmond, VT.

Cogbill, Charles V. 1998. Report on the Vermont presettlement forest database. Unpublished report for the Vermont Biodiversity Project.

Cogbill, Charles V. 2000. Vegetation of the presettlement forests of northern New England and New York. Rhodora, Volume 102, No. 911, 250-276.

Cogbill, Charles V., John Burk, and G. Motzkin. 2002. The forests of presettlement New England, USA: spatial and compositional patterns based on town proprietor surveys. Journal of Biogeography, Volume 29, 1279-1304.

Frieswyk, T. and R. Widmann. 2000. Forest Statistics for Vermont: 1983 and 1997. Resource Bulletin NE-00-145. USDA, Forest Service, Northeast Research Station. 130 pp.

Harper, R.M. 1918. Changes in the forest area of New England in three centuries. Journal of Forestry, Volume 16, 442-452.

Harrison, D.J. & T.G. Chapin. 1998. Extent and Connectivity of Habitat for Wolves in Eastern North America. Wildlife Society Bulletin, 26/4, Winter 1998

Klyza, Christopher M. and Steven T. Trombulak. 1999. The Story of Vermont: A Natural and Cultural History. Middlebury College Press and University Press of New England. 240 pp.

Lorimer, Graig G., and Alan S. White. 2003. Scale and frequency of natural disturbances in the northeastern US: implications for early successional forest habitats and regional age distributions. Forest Ecology and Management, Volume 186, 41-64.

Malmsheimer, R.W., W.R. Bentley and D.W. Floyd . 2000. The Implementation of the Northern Forest Lands Council's Recommendations: An Analysis Six Years Later. The

State University of New York College of Environmental Science and Forestry. Syracuse, New York. For The North East State Foresters Association, Concord, New Hampshire.

Northern Forest Lands Council. 1994a. Finding Common Ground: Conserving the Northern Forest. Concord, NH:

Northern Forest Lands Council. 1994b. Finding Common Ground: The draft recommendations of the Northern Forest Lands Council for public policy changes affecting the 26 million acre northern forest of Maine, New Hampshire, New York, and Vermont. Concord, NH: Northern Forest Lands Council.

Ray, J.C., J.F. Organ, and M.S. O'Brien. 2002. Canada lynx (Lynx canadensis) in the Northern Appalachians: Current Knowledge, Research Priorities, and a call for Regional Cooperation and Action, a report of a meeting held in Portland, Maine. 22 pp.

Robbins, C.S., D.K. Dawson, and B.A. Dowell. 1989. Habitat area requirements of breeding forest birds of the Middle Atlantic States. Wildlife Monographs 103. The Wildlife Society, Bethesda, MD.

Saunders, Dennis A., R.J. Hobbs, and C.R. Margules. Biological Consequences of Ecosystem Fragmentation: A Review (1991) Conservation Biology, Volume 5, No. 1. 32 pp.

Siccama, Thomas G. 1971. Presettlement and present forest vegetation in northern Vermont with special reference to Chittenden County. American Midland Naturalist. Volume 85, No. 1, 153-172.

UVM Spatial Analysis Lab 2005.

Vermont Biodiversity Project.

Vermont Fish & Wildlife Department. Black Bear Management Plan.

Vermont Department of Forest & Parks. 1999. Vermont Forest Resources Plan 1998-2008.

Whitney, Gordon G. 1994. Form Coastal Wilderness to Fruited Plain: A History of Environmental Change in Temperate North America from 1500 to Present. Cambridge University Press. 451 pp.

Northern Hardwood Forest Summary

Characteristics and Location

The Northern Hardwood Forest is best developed at Vermont's middle elevations and these are widespread in the state. Beech, sugar maple, and yellow birch are the predominant tree species, but hemlock, red oak, red maple, white ash, basswood, and white pine can be common as well, and red spruce makes an occasional appearance.

These are the dominant communities in nearly all biophysical regions, excepting the higher elevations of the Green Mountains and the warmer regions of the Champlain Valley, Taconic Mountains, and Southern Vermont Piedmont. Where the natural communities serve as landscape level habitat (i.e., matrix), they should be represented in large blocks of contiguous forest (1,000 acre to 20,000 acre blocks) of various successional stages, elevation, and soils.

The natural communities that comprise Northern Hardwood forest formation habitat are found in every biophysical region of the state.

Natural communities of the Northern Hardwood Forest:

Northern Hardwood Forest: A variable community, generally dominated by beech, sugar maple, and yellow birch. This community occurs as a landscape natural community type (i.e., matrix) throughout the state.

Rich Northern Hardwood Forest: High diversity hardwood forests of sugar maple, white ash, and basswood, with excellent productivity and high herb diversity. Maidenhair fern, blue cohosh and wood nettle are characteristic herbs. This community occurs as a landscape natural community type (i.e., matrix) in the Taconic Mountains.

White Pine-Northern Hardwood Forest: Areas where white pine is a significant canopy component of Northern Hardwood Forests, usually where soils are coarser and better drained.

Mesic Red Oak-Northern Hardwood Forest: Northern hardwood species and red oak co-dominate. Mostly on south-facing slopes in the northern parts of Vermont.

Hemlock Forest: Dominated by hemlock, often on shallow soils.

Hemlock-Northern Hardwood Forest: Mixed forest of hemlock and northern hardwoods. This community occurs as a landscape natural community type (i.e., matrix) in the Southern Vermont Piedmont and the Taconic Mountains.

Northern Hardwood Talus Woodland: Characteristic species are mountain, rock polypody, red berried elder, and Northern Hardwood species.

Northern Hardwood Forest Condition

Historical Perspective: Northern Hardwood Forests have dominated the Vermont landscape for at least the last 4,500 years, a period over which there was a gradual cooling of the climate. These past forests are believed to have fairly closely resembled the composition

of forests of today. Notable differences in the presettlement northern hardwood forests were the predominance of beech, making up over 40% of the trees (Siccama 1971) and the lower abundance of sugar maple. Although red spruce has decreased in abundance since presettlement times at mid-elevations, it has increased in abundance in valleys due to regeneration in old fields (Hamburg and Cogbill 1988). Similarly, white pine is now more abundant due to its regrowth in abandoned fields (Cogbill 2000). Presettlement forests also likely had much less red maple, white birch, and poplars than the forests of today, as these species are associated with younger forests (Cogbill 2000).

Current Condition: Vermont's Northern Hardwood Habitat has become more widespread as farmland on the slopes and in the valleys has reverted to forest. However, human population growth and economic development result in forestland conversion and fragmentation that yield smaller blocks of contiguous Northern Hardwood. While much of the Northern Hardwood Forests has been cleared or logged at one time, current land management trends will likely yield less early successional habitat in the future.

Desired Condition (SGCN Needs): Northern Hardwood Forest should be represented in both large blocks of contiguous forestland that contribute to the full complement of landscape level habitat for wide-ranging species, as well as in the natural community types that serve specific SGCN associated with that type. The large, contiguous forest blocks of Northern Hardwood Forest should exist in 1,000 to 20,000 acre blocks of various successional stages, elevations, and soils and well represented within each biophysical region. Prey wildlife species supported by northern hardwoods are an important component to maintaining several of the wide-ranging wildlife. In addition, the value of hard mast as wildlife food (i.e., nuts and acorns) from northern hardwoods is important for many SGCN with stands of bear-scarred American beech being a classic example.

Species of Greatest Conservation Need in Northern Hardwood Forest

High Priority

Canada Warbler (Wilsonia canadensis)
Jefferson Salamander (Ambystoma jeffersonianum)
Fowler's Toad (Bufo fowleri)
Spotted Turtle (Clemmys guttata)
Wood Turtle (Clemmys insculpata)
Hardwood Forest Butterflies Group (Edwards' hairstreak)
Silver-haired Bat (Lasionycteris noctivigans)
Eastern Red Bat (Lasiurus borealis)
Hoary Bat (Lasiurus cinereus)
Woodland Vole (Microtus pinetorum)
Long-tailed or Rock Shrew (Sorex dispar)
Pygmy Shrew (Sorex hoyi)
Water Shrew (Sorex palustris)
Southern Bog Lemming (Synaptomys cooperi)

Medium Priority

Cooper's Hawk (Accipiter cooperii)
Long-eared Owl (Asio otus)
Red-shouldered Hawk (Buteo lineatus)
Veery (Catharus fuscescens)
Chimney Swift (Chaetura pelagica)
Black-billed Cuckoo (Coccyzus erythropthalmus)
Black-throated Blue Warbler (Dendroica caerulescens)
Wood Thrush (Hylocichla mustelina)
American Woodcock (Scolopax minor)
Chestnut-sided Warbler (Dendroica pensylvanica)
Ruffed Grouse (Bonasa umbellus)
Blue-spotted Salamander (Ambystoma laterale)
Spotted Salamander (Ambystoma maculatum)
Four-toed Salamander (Hemidactylium scutatum)
Brown Snake (Storeria dekayi)
Long-tailed Weasel (Mustela frenata)
Hairy-tailed Mole (Parascalops breweri)
Cinereus or Masked Shrew (Sorex cinereus)
Smoky Shrew (Sorex fumeus)
Common Gray Fox (Urocyon cinereoargenteus)
Mink (Mustella vison)
Black bear (Ursus americanus)

SGCN Note: Plant SGCN not listed here: 59 species. The SGCN invertebrate group listed here contains numerous species. For more information about a specific Species of Greatest Conservation Need see that species' assessment summary in Appendix A.

Problems & Information Needs

See Appendix C for definitions of problem and strategy categories used here

Problem/ Information Need Category	Problem/ Information Need Detail	Rank
Habitat Conversion	Permanent conversion of large blocks of forestland to housing development, commercial development, and roads	High
Habitat Fragmentation	Break up of large forest blocks, riparian corridors, and migration paths	High
Impacts of Roads and Trails	Human and motorized disturbance from new roads and trails in sensitive habitats (e.g., denning sites, breeding sites, feeding areas)	High
Distribution of successional stages	Lack of appropriate landscape level approach to management resulting in a lack of either late or early successional habitat in appropriate size and juxtaposition.	High
Climate Change	May affect species composition	Low
Pollution	Acid rain, sulfur and mercury deposition	High
Invasive Exotic Species	Introduction of exotics species such as sudden oak death, hemlock wooly adelgid, beech bark disease, emerald ash borer, and garlic mustard could affect survival of species such as marten, black bear, Edwards hairstreak, West Virginia white, small mammals songbirds, etc.	High

Incompatible Recreation	Inappropriate location of ski, hiking, snowmobile trails, illegal ATV use, rock climbing.	Medium
Habitat Degradation	Loss of key feeding areas (beech stands, riparian areas, snags, cavity trees, etc.). Loss of dead and down material, fragmentation of contiguous forests..	High
Herbivory	Excessive deer and moose browsing alters tree regeneration, composition, and ability to compete with invasive exotics	Medium

Priority Conservation Strategies

See Appendix C for definitions of problem and strategy categories used here
See Chapter 6 for definitions of acronyms used in the Partners and Funding Source columns

Strategy	**Performance Measure**	**Potential Partners**	**Potential Funding Sources**
Identify and prioritize existing contiguous forest blocks and associated linkages	Number suitable habitat patches available and miles of linkages and riparian corridors conserved	USFS, USFWS TNC, ANR, UVM	SWG, LIP, VHCB, FPR, TNC
Develop a landscape level planning effort for public/private lands that address the needs of late and early successional species and integrates habitat for prey species (e.g., deer, moose, beaver, snowshoe hare) according to population objectives of species management plans	Adoption of target goals and objectives for public and private lands by private and public land entities	USFWS, USFS, ANR, NRCS	PR, SWG, NRCS, USFWS
Acquisition and conservation easements on high priority sites	Number of acres conserved	ANR, VLT, TNC, VHCB	VHCB, VLT, LIP, Forest Legacy
Provide technical assistance to private landowners, user groups and forest managers to manage for SGCN including, SGCN associated with early successional and late successional habitat.	Number landowners managing for SGCN.	NRCS, TNC, ANR, SAF, VWA, Covert	LIP, SWG
Financial incentives for private landowners to reduce problems and fragmentation to habitats for SGCN and to restore and enhance degraded habitats	Number of acres affected/restored	VFWD, NRCS	LIP, WHIP
Technical assistance to town and regional planning organizations, distribute *Conserving Vermont's Natural Heritage* (Austin et.al. 2004)	Number of towns contacted; No. towns incorporating wide-ranging species into planning	VFWD, RPCs, AVCC, VFS	VFWD
Technical assistance to state and federal land management agencies	Number of state and federal land management plans that include SGCN conservation.	ANR, USFWS, USFS	ANR, USFWS, NRCS
Work with VTrans to identify and maintain wildlife highway/road crossings and recreational user groups to avoid road and trail placement in sensitive habitat types.	Number functional linkages across highways/roads	VFWD, VTrans, VAST, GMHA	SWG, PR, VTrans
Manage deer and moose populations at levels that provide suitable harvest opportunities, but do not impair forest regeneration	Number of deer and moose/square mile.	VFWD	PR

Coordination with other plans

See Chapter 6 for definitions of acronyms used in the lead column

Plan or planning entity	Goal/Scope of plan	Lead
Bat Conservation Plan	Bat habitat conservation	ANR
Partners in Flight	Bird conservation plan	PIF, VINS, ANR, VT Audubon, USFWS
The Vermont Forest Resources Plan 1999-2008	Conservation and management of Vermont's Forests	FP&R

References

Austin, J.M. C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson. VT League of Cities and Towns. 2004. Conserving Vermont's Natural Heritage. A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Vermont Fish & Wildlife Department and Agency of Natural Resources. Waterbury, VT. www.vtfishandwildlife.com/library.cfm?libbase_=Reports_and_Documents

Cogbill, Charles V. 2000. Vegetation of the presettlement forests of northern New England and New York. Rhodora, Volume 102, No. 911, 250-276.

Hamburg, S.P. and C.V. Cogbill. 1988. Historical decline of red spruce populations and climatic warming. Nature, Volume 331, 428-431.

Siccama, Thomas G. 1971. Presettlement and present forest vegetation in northern Vermont with special reference to Chittenden County. American Midland Naturalist. Volume 85, No. 1, 153-172.

Thompson, E.H. and E.R. Sorenson. 2000. Wetland, Woodland, Wildland, A Guide to the Natural Communities of Vermont. 456 pp.

Spruce-Fir-Northern Hardwood Forest Summary

Characteristics and location

These forests characterize our coldest regions. At higher elevations and in low cold, moist areas, red spruce and balsam fir may dominate the canopy. Warmer or better drained sites have significant amounts of hardwoods (yellow birch, sugar maple, and beech) along with softwoods in the canopy. Human or natural disturbance can also lead to temporary dominance by hardwood species.

These forests occur where growing seasons are short, summers are cool, and winters are harsh. The conifer-dominated forests blanket our highest peaks above 2,500 feet as well as occurring in cold lowland pockets within large areas of Northern Hardwood Forest. The mixed forests of red spruce and hardwoods are more widely distributed.

Subalpine Krummholz: Low, dense thickets of balsam fir and black spruce at high elevations. Generally shallow to bedrock.

Montane Spruce-fir Forest: Dominated by red spruce and balsam fir, with occasional heartleaf birch, paper birch, and yellow birch. Higher elevations generally above 2500 feet.

Lowland Spruce-Fir Forest: Dominated by red spruce and balsam fir, with occasional white spruce, black spruce, paper birch, and yellow birch. Lowlands of Northeastern Highlands and cold valleys elsewhere.

Montane Yellow Birch-Red Spruce Forest: Mixed forest at high elevations (2,200-3,000 feet), dominated by yellow birch, and red spruce.

Red Spruce-Northern Hardwood Forest: Mixed forest of red spruce, yellow birch, sugar maple, beech, balsam fir, white ash, and other species, not associated with mountain slopes, generally below 2,400 feet elevation, sometimes up to 2,700 feet. A variable community**.**

Boreal Talus Woodlands: Rockfall slopes dominated by heart-leaved paper birch with occasional red spruce. Appalachian polypody, skunk currant, and mountain maple are often abundant.

Cold-Air Talus Woodland: Rare. Found where cold air drains at the bases of large talus areas. Characteristic plants are black spruce, abundant mosses and liverworts, foliose lichens, and Labrador tea.

Spruce-Fir-Northern Hardwood Forest Condition

Historical Perspective: In recent geologic time, forests dominated by spruce and fir became established in eastern North America only as recently as 8,000 years ago (Webb 1987). A warming trend, known as the hypsithermal interval, occurred from about 6,000 to 4,000 years ago, at which time spruce and fir dominated forests were greatly reduced in distribution. There has been a general expansion of spruce and fir since this time associated with a general cooling of climate (Klyza and Trombulak 1999).

Balsam fir has increased substantially when compared to presettlement forests, likely the result of its competitive advantage over spruce after heavy cutting (Whitney 1994). Red spruce has decreased in abundance at mid-elevation as a result of natural climate warming after the "little ice age" and forest harvesting, whereas it has increased in abundance in valley settings as a result of regeneration in old fields (Hamburg and Cogbill 1988).

Current Condition: Many of the natural communities within the spruce–fir–northern hardwood formation exist at high elevations and are often on shallow, acidic, infertile soils. They are, therefore, particularly susceptible to global climate change and acid rain. In addition, fragmentation through permanent conversion of forest blocks to roads, houses, ski trails etc. pose the most significant problems to this forest type and the species that depend on it.

Desired Condition (SGCN Needs): Many of the below listed SGCN depend upon large, contiguous, interconnected, forest blocks. Where they exist within a biophysical region, examples of large, intact blocks of appropriate natural communities should be conserved to ensure the long-term viability of the associated SGCN (i.e. Montane Spruce Fir: black poll warbler, olive-sided flycatcher, Bicknell's thrush, bay-breasted warbler; Lowland Spruce Fir: black-backed woodpecker, gray jay, bay-breasted warbler). Contiguous forest blocks will ideally exist in 1,000-20,000 acre blocks at various elevations and of various soil types. Conservation of these blocks should incorporate SCGN distribution and habitat needs.

SGCN in Spruce-Fir Northern Hardwood Forest

High Priority

Bicknell's Thrush (Catharus bicknelli)
Spruce Grouse (Falcipennis canadensis)
Canada Warbler (Wilsonia canadensis)
Jefferson Salamander (Ambystoma jeffersonianum)
Wood Turtle (Clemmys insculpta)
Tiger Beetles Group
Eastern Red Bat (Lasiurus borealis)
Hoary Bat (Lasiurus cinereus)
Lynx (Lynx canadensis)
American Marten (Martes americana)
Rock Vole (Microtus chrotorrhinus)
Woodland Vole (Microtus pinetorum)
Long-tailed or Rock Shrew (Sorex dispar)
Water Shrew (Sorex palustris)
Northern bog lemming (Synaptomys borealis)
Southern Bog Lemming (Synaptomys

Medium Priority

Cooper's Hawk (Accipiter cooperii)
Northern Goshawk (Accipiter gentilis)
Long-eared Owl (Asio otus)
Chimney Swift (Chaetura pelagica)
Black-billed Cuckoo (Coccyzus erythropthalmus)
Olive-sided Flycatcher (Contopus cooperi)
Black-throated Blue Warbler (Dendroica caerulescens)
Bay-breasted Warbler (Dendroica castanea)
Blackpoll Warbler (Dendroica striata)
Gray Jay (Perisoreus canadensis)
Black-backed Woodpecker (Picoides arcticus)
Blue-spotted Salamander (Ambystoma laterale)
Spotted Salamander (Ambystoma maculatum)
Wolf (Canis ?)
Mountain Lion (Felis concolor)
Long-tailed Weasel (Mustela frenata)
Hairy-tailed Mole (Parascalops breweri)
Cinereus or Masked Shrew (Sorex cinereus)
Smoky Shrew (Sorex fumeus)
Black Bear (Ursus americanus)

SGCN Note: Plant SGCN not listed here: 21 species. The SGCN invertebrate group listed here contains numerous species. Wolf and mountain lion utilize this spruce-fir northern hardwood forests but are addressed in the Landscape Forest Summary. For more information about a specific Species of Greatest Conservation Need see that species' assessment summary in Appendix A1-A5.

Problems & Information Needs

See Appendix C for definitions of problem and strategy categories used here

Problem/ Information Need Category	Problem/ Information Need Detail	Rank
Habitat Conversion	Permanent conversion of large blocks of forestland to housing development, and commercial development including: quarries, wind farm, roads, and recreational development	High
Habitat Fragmentation	Break up of large forest blocks, riparian corridors, and migration paths	High
Impacts of Roads and Trails	Human and motorized disturbance from new roads and trails in sensitive habitats (e.g., denning sites, breeding sites, feeding areas) Conversion of habitat to roads and trails may interrupt movement corridors and provide habitat for competing species.	Medium
Distribution of successional stages	Lack of appropriate landscape level approach to management resulting in habitat degradation (lack of either late or early successional habitat in appropriate size and juxtaposition).	Medium
Climate Change	May alter species composition	Medium
Pollution	Acid rain, sulfur and mercury deposition may affect prey base and vernal pool chemistry	High
Habitat Degradation	Loss of concentrated food, cover, breeding habitats (deer wintering areas, vernal pools, conifer wetlands, coarse woody debris etc.).	High
Incompatible recreation	Inappropriate location of ski, hiking, snowmobile trails, illegal ATV use, rock climbing.	Medium
Herbivory	Excessive deer and moose browsing alters native tree regeneration, composition, and resistance to invasive exotics.	Medium

Priority Conservation Strategies

See Appendix C for definitions of problem and strategy categories used here
See Chapter 6 for definitions of acronyms used in the Partners and Funding Source columns

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
Identify and prioritize for conservation, existing contiguous forest blocks and associated linkages that also considers climate change	Number of suitable blocks conserved. The number of miles of riparian corridors & linkages conserved	TNC, ANR, UVM	SWG, LIP, VHCB, FPR, TNC
Acquisition or conservation easements on high priority sites	Number of acres conserved	ANR, VLT, TNC, VHCB	VHCB, VLT, LIP
Technical assistance to private landowners, user groups and forest managers to maintain and enhance SGCN habitat in Spruce-Fir NHF.	Number landowners/user groups/forest managers managing for Spruce-Fir SGCN.	NRCS, TNC, VFWD, FPR, Coverts, SAF, VWA, Keeping Track	LIP, SWG
Financial incentives for private landowners to maintain and enhance SGCN habitat in	Number of acres affected/restored	VFWD, NRCS	LIP, WHIP

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
Spruce-Fir NHF			
Technical assistance to town and regional planning organizations to maintain and enhance SGCN habitat in Spruce-Fir NHF. Distribute *Conserving Vermont's Natural Heritage* (Austin et.al. 2004)	Number of towns contacted; Number of towns incorporating the needs of SGCN in Spruce-Fir NHF into planning	VFWD, RPCs, AVCC, VFS	VFWD
Technical assistance to state and federal land management agencies to maintain and enhance SGCN habitat in Spruce-Fir NHF	Number of state and federal land management plans for Spruce-Fir NHF providing for lynx and marten habitat. Number of state and federal land management plans for Spruce-Fir NHF that include SGCN in their management objectives.	ANR, USFWS, USFS, SAF	ANR
Maintain forested buffers along stream and rivers (See ANR buffer policy)	Number of miles of streams with intact buffers	ANR, VLT, TNC, NWF, Coverts	SWG, LIP, WHIP, Trout Unlimited, NRCS
Work with VTrans to identify and maintain wildlife highway/road crossings	Number functional linkages across highways/roads	VFWD, VTrans	SWG, PR, VTrans
Work with recreational groups to reduce the number of trails in sensitive habitats	Number of sensitive habitats with limited disturbance	GMC, VAST, VT Ski Area Association	
Increase cooperation/coordination between adjacent states and provinces to support and encourage trans-jurisdictional actions to address issues such as global climate change, acid rain and other pollutants.	Implementation of trans-jurisdictional actions.	USFWS, USFS, ANR, other states, TNC, Quebec,	USFWS, IAFWA
Manage moose populations at levels that provide suitable prey, but do not impair forest regeneration	Number of moose/square mile	ANR	PR

Coordination with other plans

See Chapter 6 for definitions of acronyms used in the lead column

Plan or planning entity	Goal/Scope of plan	Lead
Bat Conservation Plan	Bat habitat conservation	ANR
Spruce Grouse Recovery Plan	Spruce grouse reintroduction	ANR
Partners in Flight	Bird conservation plan	PIF, ANR, Audubon, USFWS
Riparian Buffer Guidance, and Riparian Buffers and Corridors Technical Papers (http://www.anr.state.vt.us/site/html/buff/anrbuffer2005.htm)	Helps in the development of recommendations and designs for Act 250-regulated projects that incorporate appropriate buffer zone widths for protecting riparian functions	ANR
VT Forest Resources Plan	Conservation and Management of VT Forests	VT FP&R

References

Austin, J.M. C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson. VT League of Cities and Towns. 2004. Conserving Vermont's Natural Heritage. A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Vermont Fish & Wildlife Department and Agency of Natural Resources. Waterbury, VT. www.vtfishandwildlife.com/library.cfm?libbase_=Reports_and_Documents

Hamburg, S.P. and C.V. Cogbill. 1988. Historical decline of red spruce populations and climatic warming. Nature, Volume 331, 428-431.

Klyza, Christopher M. and Steven T. Trombulak. 1999. The Story of Vermont: A Natural and Cultural History. Middlebury College Press and University Press of New England. 240 pp.

Webb, T., III. 1987. The appearance and disappearance of major vegetational assemblages: Long-term vegetational dynamics in eastern North America. Vegetatio, Volume 69, 177-187.

Whitney, Gordon G. 1994. Form Coastal Wilderness to Fruited Plain: A History of Environmental Change in Temperate North America from 1500 to Present. Cambridge University Press. 451 pp.

Thompson, E.H. and E.R. Sorenson. 2000. Wetland, Woodland, Wildland, A Guide to the Natural Communities of Vermont. 456 pp.

Oak-Pine-Northern Hardwood Forest Summary

Characteristics and Location

The Oak-Pine-Northern Hardwood Forest is best developed in the warmer regions of Vermont—the Southern Vermont Piedmont, Champlain Valley, and the lower elevations in the Taconic Mountains. Forest communities in this formation generally occur as large patches or locally as small patches within Northern Hardwood Forests and on dry, south-facing slopes and ridgetops. In the Oak-Northern Hardwood Forest Formation, hardwoods such as sugar maple, beech and yellow birch are common, but warmer climate species such as red oak, shagbark hickory, and white oak can be present in significant numbers. White pine is a prominent part of this formation.

The natural communities that comprise the Oak-Pine-Northern Hardwood forest type are diverse in their species composition, but all have species that occur in warmer climates, or on dryer sites such as south-facing rocky ridges.

Natural communities of the Oak-Pine-Northern Hardwood Forest:

Red Pine Forest or Woodland: Maintained by fire, these small areas are dominated by red pine, have very shallow soils, and have blueberries and huckleberries in the understory. They are widespread, and often surrounded by Northern Hardwood Forests.

Pitch Pine-Oak-Heath Rocky Summit: These are fire-adapted communities on dry, acidic ridgetops where red oak, white oak, pitch pine, scrub oak, and white pine are characteristic trees. Heath shrubs (blueberries and huckleberries) are abundant.

Limestone Bluff Cedar-Pine Forest: Northern white cedar dominates these areas of shallow soils over calcareous bedrock. Red pine, white pine, hemlock, and hardwoods are also present. Characteristic herbs are ebony sedge and rock polypody. This community has suffered high degree of loss from historic levels due to shoreline development.

Red Cedar Woodland: These are open glade-like communities on ledge crests, where red cedar is native and persistent, and grasses and sedges dominate the ground layer.

Dry Oak Woodland: These are very open areas with trees of low stature on dry, south facing hilltops. Grasses and Pennsylvania sedge are dominant on the forest floor.

Dry Oak Forest: These forests occur on rocky hilltops with very shallow, infertile soils. Red oak, chestnut oak and white oak can all be present; usually other tree species are absent. Heath shrubs dominate the understory.

Dry Oak-Hickory-Hophornbeam Forest: These forests occur on till-derived soils, but they are often found on hilltops and bedrock exposures are common. Soils are well drained, but are more fertile than in Dry Oak Forests. Red oak, sugar maple, hophornbeam, and shagbark hickory are variously dominant. Sometimes sugar maple is the dominant tree, sometimes it is oak and hickory. Pennsylvania sedge forms lawns.

Mesic Maple-Ash-Hickory-Oak Forest: Sugar maple, white ash, hickories and red and white oak are present in varying abundances. This community needs better documentation.

Valley Clayplain Forest: Found on the clay soils of the Champlain Valley, this forest is variously dominated by white oak, swamp white oak, bur oak, hemlock, red maple, and shagbark hickory. Soils are poorly drained. Clay plain forests in Vermont have declined by 87.9% since pre-European settlement (Lapin 2003).

White Pine-Red Oak-Black Oak Forest: These forests are found on coarse-textured soils. Red and black oak co-dominate along with white pine. Beech and hemlock are also common. Heath shrubs are common in the understory.

Pine-Oak-Heath Sandplain Forest: This is a rare community type, found on dry sandy soils in warmer areas. Characteristic species are white pine, pitch pine, black oak, and red oak with an understory dominated by heath shrubs. Due to high development pressure, only 5% of the original 15,000 acres of sandplain forest in Chittenden County remain (Engstrom 1991).

Transition Hardwood Talus Woodland: These talus woodlands are found in warmer areas, often on limestone but occasionally on slate, schist, granite, gneiss, or other rock. Some characteristic species are red oak, basswood, white ash, sweet birch, bitternut hickory, northern white cedar, hackberry, bulblet fern, and American yew.

Oak-Pine-Northern Hardwood Forest Condition

Historical Perspective: The natural communities that we recognize now are not static – they have changed dramatically over time as component species have migrated across the landscape in response to climatic change. The Oak-Pine-Northern Hardwood Forest Formation (and its characteristic species: pine, oak, and hickory) provides a good example of how species migrations are independent of each other. After the retreat of the glaciers to the north, pine became well established in the northeastern United States by about 12,000 years ago, while oak was not well established until about 8,000 years ago, and hickory arrived in New England 2,000 to 3,000 years after the first increase in oak populations (Jacobson et al. 1987; Prentice et al. 1991).

It is often thought that white pine dominated the presettlement landscape of Vermont, but evidence from early land surveys indicates that it had a variable and restricted distribution (Cogbill 2000). Pine was abundant only in scattered areas of the Champlain and Connecticut River valleys, and was generally uncommon elsewhere. White pine has more than doubled in frequency since presettlement times, apparently due to its establishment and growth in abandoned agricultural fields (Cogbill 2000).

Current Condition: Of the three landscape level forests in Vermont, the Oak-Pine-Northern Hardwood Forest has been the most altered by human activities. The primary reason may be that this forest type is most closely associated with the Champlain and Connecticut River Valleys – Vermont's most populated and agricultural regions. The Oak-Pine-Northern Hardwood Formation occurs in the warmest region of the state that are generally the most desirable for settlement and agriculture. Human alteration of the landscape has most significantly altered some of the larger natural community types (i.e., Valley Clayplain Forest, Pine-Oak-Heath Sandplain Forest) of this forest. In fact, in the southern Champlain Valley 87.9% of the Clay Plain Forest has been lost or degraded (Lapin 2003), primarily as a result of conversion to agricultural uses. One of Vermont's rarest and most threatened natural communities is the Pine-Oak-Heath Sandplain Forest of the northern Champlain Valley. As a consequence of its high value for residential development,

it has been estimated that only 5% of the original 15,000 acres of sandplain forest now remain in Chittenden County (Engstrom 1991). Many of the rarest SGCN are directly associated with these communities.

Many of the other natural communities of this forest are small in size and often isolated. Several are found along drier ridgetops that make them less vulnerable to forestland conversion. However, fire suppression over the past 200 years or more has taken away one of the more important natural disturbances vital to regenerating this forest type. Without fire, regenerating oak following timber removal is difficult, particularly when under the influence of herbivory (i.e., deer browsing, hare and rabbit girdling). Invasive plants (e.g., honeysuckle, buckthorn) and exotic insects (e.g., gypsy moth) can have significant effects on the quality of the wildlife habitat.

Desired Condition (SGCN Needs): Oak-Pine-Northern Hardwood Forest should be represented in both large blocks of contiguous forestland that contribute to the full complement of landscape level forest for wide-ranging species, as well as in the natural community types that serve specific SGCN associated with that type. Although contiguous forest blocks are limited in size and availability, where they exist, large, contiguous forest blocks of Oak-Pine-Northern Hardwood Forest will ideally exist in 1,000 acre or more blocks of various elevations and soils. The oak component of this forest serves as important fall foods for numerous mammals, including some key prey species (e.g., deer, small mammals) for wide-ranging wildlife. Because much of the Oak-Pine-Northern Hardwood Forest has been converted to agriculture and development, the remaining fragmented blocks will ideally be maintained, if not enlarged, as well as interconnected through forested or riparian corridors.

SGCN in Oak-Pine Northern Hardwood Forest

High Priority

Jefferson Salamander (Ambystoma jeffersonianum)
Fowler's Toad (Bufo fowleri)
Spotted Turtle (Clemmys guttata)
Wood Turtle (Clemmys insculpata)
Timber Rattlesnake (Crotalus horridus)
Eastern Rat Snake (Elaphe obsolete)
Five-lined Skink (Eumeces fasciatus)
Hardwood Forest Butterflies
Tiger Beetles Group
Indiana Bat (Myotis sodalis)
Silver-haired Bat (Lasionycteris noctivigans)
Eastern Red Bat (Lasiurus borealis)
Hoary Bat (Lasiurus cinereus)
Woodland Vole (Microtus pinetorum)
Southern Bog Lemming (Synaptomys cooperi)

Medium Priority

Northern Goshawk (Accipiter gentilis)
Long-eared Owl (Asio otus)
Red-shouldered Hawk (Buteo lineatus)
Cooper's Hawk (Accipiter cooperii)
Chimney Swift (Chaetura pelagica)
Black-throated Blue Warbler (Dendroica caerulescens)
American Woodcock (Scolopax minor)
Chestnut-sided Warbler (Dendroica pensylvanica)
Ruffed Grouse (Bonasa umbellus)
Blue-spotted Salamander (Ambystoma laterale)
Spotted Salamander (Ambystoma maculatum)
Four-toed Salamander (Hemidactylium scutatum)
Brown Snake (Storeria dekayi)
Long-tailed Weasel (Mustela frenata)
Hairy-tailed Mole (Parascalops breweri)
Cinereus or Masked Shrew (Sorex cinereus)

SGCN Note: Plant SGCN not listed here: 89 species. The SGCN invertebrate groups listed here contain numerous species. For more information about a specific Species of Greatest Conservation Need see that species' assessment summary in Appendix A.

Problems & Information Needs

See Appendix C for definitions of problem and strategy categories used here

Problem/ Information Need Category	Problem/ Information Need Detail	Rank
Habitat Conversion	Permanent conversion of forestland to housing development, commercial development, agriculture, and roads	High
Habitat Fragmentation	Break up of large forest blocks, riparian corridors, and migration paths. Wider ranging reptiles and birds depend upon contiguous habitat mosaics of 1000 ha or more.	High
Impacts of Roads and Trails	Human and motorized disturbance from new roads and trails in sensitive habitats (e.g., denning sites, breeding sites, feeding areas)	High
Inadequate Disturbance Regime	Fire Suppression: many habitats depend upon fire.	Medium
Climate Change	Alters water temperatures and levels for amphibians and reptiles.	Medium
Pollution	Acid rain affects on amphibians.	Medium
Habitat Degradation	Alteration of tree composition and loss of large, dead trees for cavities and roosts	Medium
Herbivory	Excessive deer browsing alters tree regeneration and composition	High
Invasive Exotic Species	Fragmented forest blocks encourage invasive plant species. Gypsy moth infestations affect oak productivity and survival.	High

Priority Conservation Strategies

See Appendix C for definitions of problem and strategy categories used here

See Chapter 6 for definitions of acronyms used in the Partners and Funding Source columns

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
Identify and prioritize existing contiguous forest blocks and associated linkages	Number forest blocks identified and assessed	TNC, ANR, Univ of VT	ANR, LIP, VHCB, TNC
Acquisition and conservation easements on high priority sites	Number of acres conserved	ANR, VLT, TNC, VHCB	VHCB, VLT, LIP
Technical assistance and/or financial incentives for private landowners, user groups and forest managers to maintain/enhance Oak-Pine NHF	Number of landowners managing land for SGCN	NRCS, TNC, ANR, SAF, VWA, VT Coverts	LIP, SWG
Financial incentives for private landowners to maintain and enhance SGCN habitat in Oak-Pine NHF	Number of acres affected/restored	VFWD, NRCS	LIP, WHIP
Technical assistance to town and regional planning organizations. Distribute *Conserving Vermont's Natural Heritage* (Austin et.al. 2004)	Number of towns & RPC's considering SGCN in their planning	VFWD, RPC's, AVCC, SAF, VWA, Coverts, VFS	VFWD
Technical assistance to state and federal land management agencies	No. state & federal land mgmt plans providing for SGCN, including use of prescribed fire	ANR, USFWS, USFS	ANR
Manage deer populations at levels that provide suitable harvest opportunities, but do not impair forest regeneration	Number of deer/square mile. Level of browse. Change in the # of wildlife road mortalities	ANR	PR
Continue working with VTrans & towns to identify and improve wildlife-highway/road crossings	Number of functional linkages across highways/roads	VFWD, VTrans	SWG, PR, VTrans
Increase cooperation/coordination between adjacent states and provinces. Develop trans-jurisdictional actions to address issues such as global climate change, acid rain & connectivity.	Implementation of trans-jurisdictional actions.	USFWS, USFS, ANR, other states, TNC, Quebec, VTA	USFWS, IAFWA

Coordination with other plans

See Chapter 6 for definitions of acronyms used in the lead column

Plan or planning entity	Goal/Scope of plan	Lead
Bat Conservation Plan	Bat habitat conservation	ANR
ANR Long Range Management Plans	Management activities on ANR Lands	ANR
Green Mountain Forest Plan	Management activities on GMNF	USFS
Partners in Flight	Bird conservation plan	PIF, ANR, Audubon, USFWS
The Nature Conservancy Champlain Valley Ecoregional Plan	Land conservation targets for the Champlain Valley Ecoregion	TNC
Champlain Basin Plan	Conservation of Champlain Basin resources	LCBP
Watershed Management Plans	Watershed plans for the Lake Champlain Basin	DEC

References

Austin, J.M. C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson. VT League of Cities and Towns. 2004. Conserving Vermont's Natural Heritage. A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Vermont Fish & Wildlife Department and Agency of Natural Resources. Waterbury, VT. www.vtfishandwildlife.com/library.cfm?libbase_=Reports_and_Documents

Cogbill, Charles V. 2000. Vegetation of the presettlement forests of northern New England and New York. Rhodora, Volume 102, No. 911, 250-276.

Engstrom, Brett. 1991. Sandplain Natural Communities of Chittenden County, Vermont: A report to the Vermont Department of Fish and Wildlife concerning the management and viability of a threatened habitat in Vermont. Unpublished report, 23 pp.

Lapin, Marc F. 2003. Nature Conservation in an Agricultural Landscape: Forest Ecology, Fragmentation Analysis, and Systematic Site Prioritization, Southern Champlain Valley, Vermont, USA. PhD Dissertation, Cornell University. 225 pp.

Jacobson, George L., Thompson Webb III, and Eric C. Grimm. 1987. Patterns and rates of vegetation change during the deglaciation of eastern North America. Pages 277-288 in W.F. Ruddiman and H.E. Wright, Jr., editors. North America and Adjacent Oceans During the Last Deglaciation. The Geology of North America, Volume K-3. Geological Society of America, Boulder, Colorado.

Prentice, Colin., Patrick J. Bartlein, and Thompson Webb III. 1991. Vegetation and climatic change in eastern North America since the last glacial maximum. Ecology, Volume 72, No. 6, 2038-2056.

Thompson, E.H. and E.R. Sorenson. 2000. Wetland, Woodland, Wildland, A Guide to the Natural Communities of Vermont. 456 pp.

Landscape Level Aquatic and Shoreline Summary

Vermont's aquatic and shoreline landscape includes all surface waters and their adjacent streambanks, floodplains and/or lakeshores. This landscape includes lacustrine (lake) formations, fluvial (stream and river) formations, floodplain forests, and shores and marshes. This landscape also includes thousands of miles of streambank areas that are comprised of upland communities adjacent to surface waters. The aquatic and shoreline landscape is described as an interconnected system of the lacustrine, fluvial, floodplain, marsh, shore, and upland communities that comprise it for the purpose of identifying and conserving the common habitat functions these communities provide at the landscape level.

Riparian (riverbank) areas, if maintained in continuous, sufficiently wide, interconnected corridors throughout a watershed, serve as movement corridors for many of Vermont's wildlife species. Maintaining intact terrestrial communities adjacent to surface waters also serves to protect aquatic habitats. Riparian areas help protect water quality, provide organic inputs, regulate water chemistry and physical properties (such as temperature), and provide physical aquatic habitat structure (e.g., undercut banks, large woody debris). Again, because aquatic communities are often inter-connected throughout the landscape, maintaining intact riparian areas is essential to protecting aquatic communities from the headwaters to downstream receiving waters.

> "It is a well known fact that the best fishing is where a forest is near the shore, and best of all where the limbs overhang the water. Not only do the trees afford shelter, furnish food and prevent evaporation, but at the same time they keep the water clear and cool in the summer. In the winter the forests afford protection by lessening the severity of the winter frosts, and in all forest regions the changes of temperature are not so severe as in treeless countries and on the open plain: and the effect upon the water is even greater….But the forests not only regulate the flow of water, as above stated, but they purify the water."
> **- Frank H. Carleton, from the Fifteenth Biennial Report of the Commissioners of Fish and Game of the State of Vermont, 1899-1900.**

Habitat requirements, problems, and conservation strategies have been assessed and developed for both the landscape level, and the individual aquatic and terrestrial species' habitats that are associated with it. Many SGCN meet most of their habitat needs within the aquatic-terrestrial interface that the aquatic and shoreline landscape provides. These species, in particular, are discussed in this section.

Characteristics and location

Aquatic and shoreline landscapes are comprised of streams, rivers, lakes, wetlands, shorelines and floodplains that form a complex and interrelated hydrological system. This hydrological system extends up and down streams and along lakeshores from the bottom of the water table to the top of the vegetation canopy, and includes land that is directly affected by surface water (Verry 2000). Riparian areas are known for their high biological diversity. They are "characterized by frequent disturbances related to inundation, transport of sediments, and the abrasive and erosive forces of water and ice movement that, in turn, create habitat complexity and variability…resulting in ecologically diverse communities" (Verry 2000).

The landscape level includes both the terrestrial-aquatic interface and the aquatic areas found throughout Vermont, from the mountain streams to the large valley rivers and the lakes and ponds scattered throughout the landscape. The following aquatic and terrestrial areas are

associated with the aquatic and shoreline landscape (for details see the following summaries in Appendix B):

Lacustrine ("Inland" Lakes)	Floodplain Forests
Lake Champlain	Upland Shores
Lake Champlain Tributaries	Wet Shores
Connecticut River Tributaries	Swamps and Marshes

Landscape Condition

Current Condition: Nationwide an estimated 70% to 90% of natural riparian vegetation, vital to maintaining the integrity of riparian and aquatic habitats, has already been lost or is degraded due to human activities (Doppelt 1993). In Vermont, some of our rivers, streams, lakes, and wetlands still have intact riparian areas, while many others no longer have functioning riparian areas due to more than 200 years of intensive human use of the land.

In general, riparian areas in Vermont are most affected by habitat conversion, alteration, and fragmentation. Typically, steeper mountainous streams and high elevation lakes and ponds, less suited for human development, have well forested riparian areas with cold, clean water and stable stream channels and shorelines. Recreational activities and their associated development and forestry are the land uses most common in these areas that may affect riparian and aquatic species. Mid and low elevation waterbodies and their adjacent riparian areas are more likely to be impacted by human land uses, including clearing of riparian vegetation, alteration of stream channels and lakeshores, and direct inputs of toxins, excess nutrients, and sediments. These impacts are related primarily to roads, residences, commercial development, and agriculture, with agriculture being especially extensive in the lower valleys of the Champlain and Connecticut tributaries. Lacustrine areas and their associated shorelines are particularly impacted by lakeshore development, such as seasonal and permanent residences, marinas and docks, and public and private beaches. In many instances these developments have altered natural lakeshore and littoral zones resulting in the direct loss of habitats for SGCN through the addition of fill materials (sand, bottom barriers) and the removal of native aquatic vegetation.

The fragmentation of riparian habitat is extensive in Vermont, due primarily to Vermont's roadways paralleling the stream, rivers, and lakeshores, and use of rich floodplain areas for agriculture. Historic settlement and transportation patterns and ease of construction have resulted in roads paralleling the majority of Vermont's major waterbodies and thousands of associated bridges and culverts. This results in removal of riparian vegetation and fragmentation, both longitudinally and laterally between the waterbody and adjacent upland communities.

Desired Condition (SGCN Needs): Aquatic and shoreline areas provide several habitat functions for the species that inhabit them. Some species rely directly on both the aquatic and terrestrial components of the riparian-aquatic interface. For example, mink and otter use aquatic areas within 100 meters of water's edge for feeding and riparian areas for denning and as travel corridors. These species move daily between terrestrial and aquatic areas to fulfill their life needs. Other species move seasonally between the aquatic and terrestrial components of the aquatic and shoreline landscape. For example, the wood turtle uses streams and rivers for overwintering, and uses adjacent riparian areas up to 300 meters from

the water's edge for foraging, breeding, nesting, and dispersal. For those species that are strictly aquatic, the adjacent terrestrial riparian areas function to protect the aquatic areas, providing shade, organic inputs, filtering and storage of overland runoff, and bank stability.

On a landscape level, aquatic and shoreline areas provide habitat for 41 SGCN.

Species of Greatest Conservation Need in Aquatic and Shoreline

High Priority

Peregrine Falcon (Falco peregrinus)
Bald Eagle (Haliaeetus leucocephalus)
Wood turtle (Clemmys insculpata)
Common Mudpuppy (Necturus maculosus)
Silver-haired Bat (Lasionycteris noctivagans)
Eastern Red Bat (Lasiurus borealis)
Hoary Bat (Lasiurus cinereus)
Eastern Pipistrelle (Pipistrellus subflavus)
Water Shrew (Sorex palustris)
Bog/fen/swamp/marshy pond Odonata group
Freshwater Mussels group
Freshwater Snails group
Lakes/ponds Odonata group
Mayflies/Stoneflies group
River/stream Odonata group
Vernal Pool Odonata
Elktoe (Alasmidonta marginata)
American Eel (Anguilla rostrata)
American Brook Lamprey (Lampetra appendix)
Atlantic Salmon (anadromous) (Salmo salar)
Brassy Minnow (Hybognathus hankinsoni)
Bridle Shiner (Notropis bifrenatus)
Blackchin Shiner (Notropis heterodon)
Blacknose Shiner (Notropis heterolepis)
Northern Brook Lamprey (Ichthyomyzon fossor)
Stonecat (Noturus flavus)

Medium Priority

Blue-winged teal (Anas discors)
Osprey (Pandion haliaetus)
Pied-billed Grebe (Podilymbus podiceps)
Lesser Yellowlegs (Tringa flavipes)
Northern River Otter (Lutra canadensis)
Muskrat (Ondatra zibethicus)
Mink (Mustella vison)
Cinereus or Masked Shrew (Sorex cinereus
Mottled Sculpin (Cottus bairdi)
Redfin Pickerel (Esox americanus)
Brook Trout (naturally reproducing populations) (Salvelinus fontinalis)
Silver Lamprey (Ichthyomyzon unicuspis)
Redbreast Sunfish (Lepomis auritus)
Sea Lamprey (Petromyzon marinus) (Connecticut River only)
Atlantic Salmon (landlocked) (Salmo salar)

SGCN Notes: Plant SGCN not listed here include 16 species. For more information about a specific Species of Greatest Conservation Need see that species' assessment summary in Appendix A.

Problems & Information Needs

See Appendix C for definitions of problem and strategy categories used here

Problem/Info Need Category	Problem/Info Need Detail	Rank
Habitat Conversion	Floodplain forests, lakeshores and other riparian communities converted to agriculture, roadways, and residential/commercial development. Habitat conversion is most prevalent in low and mid elevation areas.	High
Habitat Degradation	Removal or alteration of vegetative community, ground disturbance, and manipulation of shorelines and streambanks; can lead to degradation of water quality, and loss of physical habitat structure. Habitat degradation occurs primarily in upper elevation areas, in contrast to complete habitat conversion, which is more common in mid and low elevation areas.	High
Habitat Fragmentation	Interruption of movement corridors to and from breeding, feeding, and seasonal habitats via conversion, degradation, and road mortality (herps).	High
Inadequate Disturbance Regime	Dams, drainage ditching, floodplain filling, and channel incision (floodplain abandonment) that affect flooding, erosion, and deposition processes	High
Invasion by Exotic Species	Habitat alteration from invasive plant species (e.g., Japanese knotweed, Purple loosestrife); plant inter-species competition for habitat.	High
6. Harvest or Collection, Trampling or Direct Impacts	Collection and harvest pressures; increased human activity disturbing breeding, nesting and movement.	High

Priority Conservation Strategies

See Appendix C for definitions of problem and strategy categories used here
See Chapter 6 for definitions of acronyms used in the Partners and Funding Source columns

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
Develop a plan to identify and prioritize existing contiguous riparian corridors and associated wildlife habitat linkages	Increase in number of riparian habitat linkages identified and conserved	ANR, TNC, NWF, NRCS, FSA	EQIP, CRP, CREP
Technical assistance to private landowners to maintain and enhance SGCN habitat in riparian areas.	Increase in number of acres of riparian habitat restored and/or conserved by private landowners	NRCS, ANR, USFWS, FSA	WHIP, LIP EQIP, , CREP
Financial incentives for private landowners to maintain and enhance SGCN habitat in riparian areas.	Increase in number of acres of riparian habitat restored and/or conserved by private landowners	NRCS, ANR, USFWS, FSA	WHIP, EQIP,CRP ,REP,LIP
Technical assistance to town and regional planning organizations to maintain and enhance SGCN habitat in riparian areas. Distribute *Conserving Vermont's Natural Heritage* (Austin et.al. 2004)	Increase in number of towns incorporating riparian conservation into planning and zoning	ANR, ACCD, VLCT, AVCC, NRCS, FSA	ANR, NRCS
Technical assistance to state and federal land management agencies on riparian habitat management goals/strategies	Increase in % or number of state and federal land management plans providing for riparian conservation	ANR, VTrans, USFWS, USFS	
Work with VTrans, towns, and private landowners to identify and maintain (or restore) riparian habitat connectivity and improve aquatic organism passage	Increase in % or number of road crossings that do not impede riparian corridor movement – longitudinally and laterally	VTrans, ANR, NRCS	WHIP, VTrans, SWG
Technical assistance to landowners and conservation groups on invasive exotic management and eradication		TNC, ANR, NRCS, FSA	LIP, CRP, CREP,

Coordination with other plans

See Chapter 6 for definitions of acronyms used in the lead column

Plan or planning entity	Goal/Scope of plan	Lead
ANR State Lands Management Plans	Management practices for ANR-owned lands	FPR, VFWD
Floodplain Forests of Vermont	Natural Community Inventory	ANR
Riparian Buffer Guidance, and Riparian Buffers and Corridors Technical Papers 1/20/2005 http://www.anr.state.vt.us/site/html/buff/anrbuffer2005.htm	Helps in the development of recommendations and designs for Act 250-regulated projects that incorporate appropriate buffer zone widths for protecting riparian functions	ANR
ANR Stream Geomorphic Assessments	Stream and riparian condition inventories	ANR

References

Austin, J.M. C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson. VT League of Cities and Towns. 2004. Conserving Vermont's Natural Heritage. A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Vermont Fish & Wildlife Department and Agency of Natural Resources. Waterbury, VT. www.vtfishandwildlife.com/library.cfm?libbase_=Reports_and_Documents

Carleton, Frank H. 1899-1900. Why forest preservation should interest fisherman. 15th Biennial report of the Commissioners of Fisheries and Game of the State of Vermont. p. 98-110

Doppelt, B., M. Scurlock, C. Frissell, J. Karr. 1993. Entering the Watershed: A New Approach to Save American River Ecosystems. Island Press. Washington, D.C. As farms are abandoned management strategies to maintain grassland habitat are critical.

Verry, E. S., J. W. Hornbeck, and C. A. Dolloff (eds). 2000. Riparian management in forests of the continental Eastern United States. Lewis Publishers, Boca Raton, FL.

Landscape Fluvial (Stream) Summary

Characteristics and location

There are more than 7,000 miles of rivers and streams in Vermont draining 4 major watersheds: Connecticut, Lake Champlain, Hudson, and Memphremagog. The headwater streams of the western Green Mountains drain to the large rivers of the lower Champlain Valley and eventually into Lake Champlain. The eastern slopes of the Green Mountains drain primarily to the Connecticut River. Portions of the Northeastern Highlands and Northern Piedmont drain north into Lake Memphremagog. The Taconic Mountains and southern Green Mountains drain into the Batten Kill, Deerfield, Walloomsac, and Hoosic rivers. These rivers, with the exception of the Deerfield, eventually drain into the Hudson River in New York. The Deerfield drains to the Connecticut River. Despite this diversity of landscape over which Vermont's streams and rivers flow, fluvial ecosystems can be described by three general categories based on physical stream characteristics. There are various biotic communities associated with each of these physical stream types, depending on both the physical stream characteristics and the geographic location of the waterbody. For example, the large rivers of the lower Lake Champlain watershed are similar in physical characteristics to the large tributaries feeding Lake Memphremagog, but some of the species found in these two settings differ due to the repopulation patterns of aquatic species into freshwater ecosystems post-glaciation. This summary does not include discussion of the lower Connecticut River tributaries and the lower Lake Champlain tributaries below the fall-line and/or below 150 feet elevation, as these areas are covered under separate summaries.

General types of fluvial communities:

High-elevation Headwater Streams: These streams are typically located in high elevation mountainous areas. They are small in size, having small drainage areas, and are located in steep valleys (typically > 4% slope). Valleys are confined, meaning the stream channel has little or no floodplain, and upland forest communities are adjacent to the channel, typically with no distinct riparian vegetative community present. Channel bed form is usually cascade over bedrock and boulders or step-pools over boulders and cobbles. Stream flow is fast and turbulent with white water common. Stream temperatures are typically very cold. Forest canopy completely shades the stream, and the food web of the system is based on inputs of organic material from the adjacent vegetation (e.g., leaves, twigs, branches). Large trees falling into the stream channel also provide important habitat features and channel bed stability, acting as cover and causing localized scour and deposition of stream sediments. Species that typically inhabit these streams include brook trout, slimy sculpin, northern spring salamander, northern dusky salamander, two-lined salamander, and numerous aquatic insects, including stoneflies and mayflies. SGCN species uniquely associated with these ecosystems include the water shrew, some specific mayfly and Odonata species and naturally reproducing populations of brook trout.

There are some headwater streams in high elevation areas that do not meet the above description. Small, low gradient streams are often found in ridgeline saddles and bowls. These streams are typically meandering, with alternating riffles and pools and gravel and sand substrates. Adjacent wetlands are often associated with these streams. These are typically still cold water systems, due to abundant groundwater feed and cooler climatic

conditions influenced by high elevation, and therefore often host many of the same species as the high gradient headwater streams. Invertebrate communities, however, are likely to be distinct from the higher gradient systems (Burnham 2005).

Mid-elevation Streams and Rivers: These streams are typically located in mid elevation areas where the steep mountains transition to the low gradient valleys. Stream channels are small to moderate in size, and are located in moderately steep valleys (typically 2-4% slope). Valleys are semi-confined, resulting in narrow floodplains. These floodplains may have narrow bands of distinct riparian vegetation, but quickly transition into upland forest communities. Channel bed form is typically step-pool or plane bed. Step-pool channels have short vertical drops over boulders and cobbles with channel spanning pools in between, which are typically dominated by cobbles and gravels. Plane bed systems lack distinct pools, and are primarily riffles, runs, and rapids over a mix of boulders, cobbles, and gravels. Stream flow is fast and somewhat turbulent with whitewater common. Stream temperatures are typically cold to cool. Forest canopy usually shades the stream but may not form a complete canopy over the channel. The aquatic food web in these channels is based largely on inputs of organic material from the adjacent vegetation (e.g., leaves, twigs, branches), though some mosses and algae are also present, providing primary production in the waterbody. Large trees falling into the stream channel and transported from upstream provide important habitat features and channel bed stability, acting as cover and causing localized scour and aggradation of the channel bed. Species that typically inhabit these streams include brook trout, slimy sculpin, blacknose dace, white sucker, longnose dace, northern dusky salamander, two-lined salamander, and numerous aquatic insects. SGCN species uniquely associated with this habitat potentially include naturally reproducing populations of brook trout, as well as American eel, Atlantic salmon, wood turtle, river otter, water shrew, mink, muskrat and some specific mayfly and Odonata species.

Low-elevation Large Valley Rivers: These rivers are located at low elevations in Vermont's large river valleys, such as the Winooski, Lamoille, Mississquoi, Barton, Otter, and Batten Kill. This description does not include those portions of the large Lake Champlain tributaries located below the fall-line. These river channels are moderate to large in size, and are located in low gradient valleys (typically <2% slope). Valleys are unconfined, and floodplains are broad and flat. Adjacent wetlands are common in the floodplains. These floodplains have extensive distinct riparian vegetation and often include unique natural communities, such as floodplain forest, marsh, and shoreline communities. The channel bed undulates vertically, being composed of alternating riffles and pools or dune-ripple formations. Riffle-pool systems are dominated by gravels and sands, where dune-ripple systems are usually dominated by sands and silts. Stream flow is slow and flat with whitewater rarely present. Stream temperatures are typically cool to warm. Forest canopy shades the nearbank area of the channel but does not form a complete canopy over the channel. The aquatic food web in these channels is based on inputs of organic material from the adjacent vegetation (e.g., leaves, twigs, and branches) and transported from upstream, as well as instream aquatic vegetation. Large trees falling into the stream channel and transported from upstream provide important habitat features, especially since coarser streambed substrates are typically lacking in these systems. Woody debris provides cover and substrate for aquatic biota, as well as helping to maintain channel bed stability and enhancing habitat complexity with localized scour and aggradation of the channel bed. Numerous cool and warmwater fish species inhabit these streams, including bluntnose minnow, fallfish,

blacknose dace, creek chub, tessellated darter, and white sucker, as well as several mussel species. SGCN species uniquely associated with this habitat include American eel, sea lamprey (Connecticut River drainage only), Atlantic salmon (landlocked and anadromous), blackchin shiner, bridle shiner, blacknose shiner, redfin pickerel, stonecat, giant floater, cylindrical floater, elktoe, brook floater, wood turtle, river otter, mink, muskrat, bald eagle, osprey and some specific species of freshwater snails and Odonata.

Low Elevation Small Streams: These streams are small in size, but located in low gradient valleys (<2% slope) at low elevations (but above the Lake Champlain fall-line and 150 feet in elevation), and typically drain directly into a large waterbody (e.g., Lake Memphremagog, large tributaries of Lake Champlain). Valleys are unconfined, and floodplains are broad, relative to stream size, and flat. These floodplains have distinct riparian vegetation on the valley floor, and transition into upland forest communities on the valley side slopes. Adjacent wetlands are common in the floodplain. The channel bed undulates vertically, being composed of alternating riffles and pools or dune-ripple formations. Riffle-pool systems are dominated by gravels and sands, where dune-ripple systems are dominated by sands and silts. Stream flow is slow and flat. Stream temperatures are typically cool to warm. Streamside vegetation shades the channel, usually forming a closed canopy over the channel. The aquatic food web in these channels is based primarily on inputs of organic material from the adjacent vegetation (e.g., leaves, twigs, branches). Large trees falling into the stream channel provide important habitat features, especially since coarser streambed substrates are typically lacking in these systems. Woody debris provides cover and substrate for aquatic biota, as well as helping to maintain channel bed stability and enhancing habitat complexity with localized scour and aggradation of the channel bed. Typically cool and warmwater fish species inhabit these streams, such as blacknose dace and creek chub. SGCN species uniquely associated with this habitat include American eel, Atlantic salmon (landlocked), blackchin shiner, brassy minnow, bridle shiner, redfin pickerel, stonecat and some specific species of Odonata.

Landscape Fluvial Condition

Current Condition: In general, fluvial ecosystems in Vermont are most affected by conversion, alteration, and fragmentation. Typically steeper mountainous streams at high elevations, less suited for human development, have well forested riparian areas with cold, clean water and stable stream channels. Recreational activities and their associated development, such as ski resorts, and forestry are the land uses most common in these areas that may affect stream habitats. Mid and low elevation streams and rivers are more likely to be impacted by human land uses, including clearing of riparian vegetation, alteration of stream channels, and direct inputs of toxins, excess nutrients, and sediments. These impacts are related primarily to roads, residences, commercial development, and agriculture, the latter being especially extensive in the lower valleys of the Lake Champlain and Connecticut River tributaries.

The fragmentation of fluvial ecosystems is extensive in Vermont. A recent inventory of more than 200 culverts in the White River watershed showed more than half of the culverts inventoried were barriers to the upstream movement of all fish species present in the waterbody all of the time, and the other half of the culverts inventoried were barriers to some species and/or barriers some of the time (i.e. under certain stream flows when species

movement is likely to occur) (Vermont Fish and Wildlife 2004). In addition, most of Vermont's major rivers have large flood control and/or hydroelectric dams on them, with numerous smaller dams found throughout Vermont's smaller streams. Such structures influence local habitat conditions, restrict movement of aquatic species, and alter downstream flood and sediment transport processes. The Vermont Agency of Transportation is currently funding research regarding the extent of stream impediments and how to address issues such as culvert sizing and retrofits.

Some aquatic habitat degradation is due to lasting effects of historic land uses. During the last two centuries land use in Vermont has been dominated by extensive land clearing for forestry and agriculture, aggressive stream clearing of boulders and coarse woody debris for stream log driving and flood control, and by dam construction and railroad and road building. Such activities have resulted in the relocation and straightening of stream and river channels throughout Vermont, resulting in an overall decrease in available fluvial habitat. For example, a recent assessment of the upper White River watershed between Granville and Stockbridge shows that 93% (17.8 of 19.1 miles) of the length of the mainstem White River has been channelized in the past, 13 miles of which are still in channelized form (Vermont Department of Environmental Conservation 2004). In addition, the extensive removal of natural substrates, such as boulders and coarse woody debris, has reduced overall stream habitat complexity throughout the Northeast (Verry 2000). The hard armoring of channels combined with the construction of flood control dams means that many of Vermont's river channels have not regained their historic sinuosity. Furthermore, the slow regrowth of the Northeast's forests means that large woody debris contribution to stream and river channels has yet to reach historic levels (Verry 2000). Zadock Thompson, who served as Vermont's Assistant State Geologist and State Naturalist in the mid 1800's, offers first-hand insight on the impacts Vermont's intensive land use history has had on the streams and rivers of the state.

> "Before the country was cleared, the whole surface of the ground was deeply covered with leaves, limbs, and logs, and the channels of all the smaller streams were much obstructed by the same. The consequence was that, when the snows dissolved in the spring, or the rains fell in the summer, the waters were retained among the leaves, or retarded by the other obstructions, so as to pass off slowly, and the streams were kept up, nearly uniform as to the size during the whole year. But since the country has become settled, and the obstructions, which retarded the water, removed by freshets, when the snow melts or the rains fall, the waters run off from the surface of the ground quickly, the streams are raised suddenly, run rapidly, and soon subside. In consequence of the water being thus carried off more rapidly, the streams would be smaller than formerly during a considerable part of the year, even though the quantity of water be the same. It is a well known fact that the freshets in Vermont are more sudden and violent than when the country was new."
> **Zadock Thompson, Natural History of Vermont, 1853**

Desired Condition (SGCN Needs): Most of Vermont's aquatic species rely on streams and rivers that provide clean water, a diversity of in-channel habitat, and unobstructed movement upstream and downstream between habitats.

Characteristics of water quality vary in streams from clear and cold with little buffering capacity in most mountain streams to somewhat turbid and cool or warm with greater buffering capacity in the large valley rivers. Species found in the mountain headwater and mid-elevation streams are typically dependent on cold well-oxygenated waters. Some species

found in the headwater streams, such as brook trout, are fairly acid tolerant. Low-elevation rivers and streams typically support species with warmer water temperature requirements and tolerance to some turbidity and nutrient enrichment.

Whether in the mountain streams or large valley rivers, most aquatic SGCN require instream cover and/or substrates for protection and colonization. Most fish species seek cover for predator avoidance and to reduce metabolic (energy) demands. Mussels need firm substrates for colonization, as do most aquatic insect species. Substrates utilized may vary from rock to sand to instream aquatic vegetation, depending on the species, but all species can suffer from excessive fine sediments in the channel that can bury instream substrates. Loss of complexity and solid substrates for cover and colonization reduces overall habitat availability and quality. In addition, many species use instream substrates for reproduction. For example, brook trout deposit eggs in gravels on the channel bottom, whereas many shiner species utilize aquatic vegetation to spawn. Embedding of substrates, destabilization of substrates due to chronic channel instability, and direct removal of substrates all impact aquatic habitats and species. The mammal and bird species associated with streams and rivers, such as bald eagle, osprey, mink, river otter, muskrat, and water shrew, are also impacted when aquatic species are affected, as these species rely on aquatic species as prey. In addition, muskrat, otter, mink, and particularly water shrew, utilize undercut streambanks and other stable bank areas for denning. Chronic channel instability that results in substantial streambank erosion may reduce potential denning areas for these species.

Some of the SGCN uniquely associated with streams and rivers have extensive movement requirements, such as the Atlantic salmon and American eel, migrating from freshwater streams and rivers to the Atlantic Ocean and back again. Other species move shorter distances, but still require habitat connectivity to be able to access spawning, rearing, and seasonal habitats. There are also species, such as wood turtle and river otter, that move back and forth between the aquatic and nearby terrestrial habitats both daily and seasonally. Thus, it is important to maintain habitat connectivity both longitudinally along the river channel and adjacent riparian lands, as well as laterally between the aquatic habitat and the riparian habitat.

Ideally, Vermont's rivers and streams would provide an interconnected network of habitats in which species can move upstream and downstream as needed to fulfill seasonal and diurnal habitat needs. Instream structure would provide an abundance and diversity of habitat niches and be naturally maintained by physical stream processes over time (e.g., flooding, balanced sediment transport). Streams and rivers would be connected to the adjacent riparian habitats, which in turn function to protect and provide for fluvial habitat components, such as instream coarse woody debris and pollutant removal from surface runoff.

It is difficult to quantify the number of miles of intact fluvial and riparian habitat needed to conserve SGCN as the exact distribution of all SGCN associated with fluvial habitats is not known at this time.

Streams and Rivers provides habitat for 25 species and invertebrate groups of greatest conservation need.

Species of Greatest Conservation Need in Fluvial Habitat

High Priority

Bald eagle (Haliaeetus leucocephalus)
Fowlers toad (Bufo fowleri)
Wood turtle (Clemmys insculpata)
River/stream Odonata Group [dragonflies]
Elktoe (Alasmidonta marginata)
Giant floater
Cylindrical floater
Brook floater
Dwarf wedge mussels Group
Freshwater Snails Group
Mayflies/Stoneflies Group
American eel (Anguilla rostrata)
Atlantic salmon (anadromous) (Salmo salar)
Brassy minnow (Hybognathus hankinsoni)
Bridle shiner (Notropis bifrenatus)
Blackchin shiner (Notropis heterodon)
Blacknose shiner (Notropis heterolepis)
Stonecat (Noturus flavus)

Medium Priority

Osprey (Pandion haliaetus)
Northern river otter (Lutra canadensis)
Muskrat (Ondatra zibethicus)
Mink (Mustella vison)
Water shrew
Redfin pickerel (Esox americanus)
Brook trout (Salvelinus fontinalis)
Atlantic salmon (landlocked) (Salmo salar)

SGCN Notes: Lake sturgeon is addressed in the Lake Champlain tributaries summary. Plant SGCN not listed here: 16 species. The SGCN invertebrate groups listed here contain numerous species. For more information about a specific Species of Greatest Conservation Need see that species' assessment summary in Appendix A.

Problems & Information Needs

See Appendix C for definitions of problem and strategy categories used here

Problem/Info Need Category	Problem/Info Need Detail	Rank
Habitat Conversion	Channel straightening and maintenance of such that reduces overall stream/river miles, loss of floodplain connectivity, impoundment of river channels	High
Habitat Alteration	Floodplain and stream channel manipulation (e.g., riprap); degradation of water quality, loss of physical habitat structure, temperature alteration	High
Habitat Fragmentation	Interruption of movement to and from breeding, feeding, and seasonal habitats via alteration and conversion; roadways, and impassable dams and culverts	High
Sedimentation	Alteration of habitat (e.g., spawning areas); smothering of organisms	High
Pollution	Acid rain threatens higher elevation habitats, nutrient overloading is common in lower elevation areas, other toxins are suspected but data is unavailable to assess impacts	High
Pollution	Catastrophic spills: toxic chemicals (e.g., chlorine) and contaminants limit mid and lower elevation habitats, especially where roadways and development are in close proximity to stream channels	High
Invasion by Exotic Species	inter-species competition for habitat and food; predation on native species, loss of native riparian vegetation community from invasive competition.	High
Hydrologic Alteration	Stream flow regulation at dams, watershed development, and withdrawals alter hydrographs and instream flows	High
Inventory need	Minimal data is available on the distribution in Vermont of many fluvial-associated SGCN	Med

Priority Conservation Strategies

See Appendix C for definitions of problem and strategy categories used here
See Chapter 6 for definitions of acronyms used in the Partners and Funding Source columns

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
Conduct inventories of known and potential SGCN sites		ANR, USFS, USFWS, TU	SWG, TU, EPA, NRCS
Provide technical assistance to anglers and other conservation groups on invasive exotic management and eradication	No new introductions of invasives exotic species that impact fluvial habitats	TNC (plants), angler groups, baitfish dealers	NRCS, LCBP
Provide technical assistance to private landowners and watershed organizations on riparian and fluvial habitat conservation	Increase in number of stream/river miles in "reference" condition, as per VTANR Stream Geomorphic Assessments	ANR, NRCS, FSA,	Clean & Clear, LCBP, LIP, CRP, WRP, EQIP
Provide financial incentives to private landowners for conservation and protection of SGCN and their riparian and fluvial habitat	Increase in number of stream/river miles and associated riparian areas that are conserved and/or restored	ANR, NRCS, USFWS, FSA	LIP, WHIP, USFWS, CRP, CREP, WRP
Provide technical assistance to town and regional planning organizations. Distribute *Conserving Vermont's Natural Heritage* (Austin et.al. 2004)	Increase in number of towns incorporating riparian and aquatic habitat conservation into planning and zoning; and increase in number of stream/river miles under regulated development that are in "reference" condition, as per VTANR Stream Geomorphic Assessments	ANR, ACCD, VLCT, AVCC, TNC, watershed organizations	ACCD planning grants, LCBP, SWG
Monitor, protect and restore water quality from excessive nutrient sediment loading, other pollutants.	Miles of SGCN habitat meeting water quality standards.	ANR, USFWS, NRCS, USFS, Lake & Watershed Associations	ANR. Clean & Clear (in L. Champlain Basin)
Support efforts to reduce the long range transport of acid rain pollutants to Vermont.	Reduction in acidity levels in monitored high elevation waterbodies	ANR, USFS, AG office, Legislature, Congress.	
Identify pollutant sources posing risks of catastrophic spills to SGCN populations and implement programs to minimize those risks		ANR, Agency of Agric., VTrans, wastewater facilities, town road managers	
Technical assistance to state and federal land management agencies to ensure consistency in program implementation and sensitivity to SGCN requirements	Increase in % or number of state and federal land management plans that provide for fluvial and riparian habitat conservation	ANR, USFS, USFWS, ACOE, VTrans	
Support efforts to manage flow regulation projects to minimize impacts on SGCN	Decrease in number of river miles with altered flow regimes	ANR, ACOE, VT Dam Task Force, USFWS, watershed orgs	LBCP, USFWS, ACOE, SWG
Provide technical assistance to VTrans, towns, and private landowners to identify and maintain (or restore) aquatic habitat connectivity	Increase in % or number of road crossings that do not impede aquatic organism movement	ANR, VTrans, Better Back Roads, USFWS, USFS, AVCC	SWG, USFWS, LCBP, VTrans

Coordination with other plans

See Chapter 6 for definitions of acronyms used in the lead column

Plan or planning entity	Goal/Scope of plan	Lead
ANR State Lands Management Plans	Management practices for ANR-owned lands	FPR, VFWD
ANR Stream Geomorphic Assessments	Stream and riparian condition inventories	ANR
Opportunities for Action – LCBP	Aquatic resource conservation for the Lake Champlain Basin	LCBP
Strategic Plan for the Restoration of Atlantic Salmon to the Connecticut River.	"Protect, conserve, restore and enhance the Atlantic salmon population in the Connecticut River for the public benefit, including recreational fishing."	CRASC

References

Austin, J.M. C. Alexander, E. Marshall, F. Hammond, J. Shippee, E. Thompson. VT League of Cities and Towns. 2004. Conserving Vermont's Natural Heritage. A Guide to Community-Based Planning for the Conservation of Vermont's Fish, Wildlife and Biological Diversity. Vermont Fish & Wildlife Department and Agency of Natural Resources. Waterbury, VT. www.vtfishandwildlife.com/library.cfm?libbase_=Reports_and_Documents

Burnham, D. 2005. Vermont Department of Environmental Conservation. Personal communication.

Thompson, Zadock. 1853. Natural History of Vermont with Numerous Engravings and an Appendix. Stacy and Jameson.

Vermont Department of Environmental Conservation. 2004. Stream geomorphic assessment data available from the DEC River Management Program, Water Quality Division, Waterbury, VT.

Vermont Department of Fish and Wildlife. 2004. Evaluation of Bridge and Culverts for Aquatic Organism Passage and Fluvial Function in the White River Watershed. Waterbury, VT.

Verry, E.S., J.W. Hornbeck, and C.A. Dolloff (eds). 2000. Riparian management in forests of the continental Eastern United States. Lewis Publishers, Boca Raton, FL.

Vermont's Wildlife Action Plan

November 22, 2005

Chapter 5
Implementation, Monitoring & Review

Monitoring & Adaptive Management 1
- Adaptive Management 1
- Current Survey and Monitoring of Vermont Wildlife 2
- Current Habitat and Vegetation Monitoring in Vermont 3
- What Kind of Monitoring Is Needed to Successfully Implement the Action Plan and Conserve SGCN? 5
- Primary Challenges to the Implementation of a SGCN Monitoring Program 6
- Adapting Conservation Actions in Response to New Information or Changing Conditions 6
- Plans for Monitoring SGCN, Habitats and Conservation Actions 7
- Resources for Developing Vermont's Action Plan Monitoring Program 9

Action Plan: Implementation 14
- Implementation and Participation 14
- Coordination and Collaboration 15
- Prioritizing Conservation Need 15
- Implementation Funds and Resources 16
- Allocating State Wildlife Grant Funds 16

Action Plan Review 18
- Interstate Coordination and Information Sharing 18
- Ten Year Review 19

**formally the Comprehensive Wildlife Conservation Strategy (CWCS)*

Monitoring & Adaptive Management

This section of the Action Plan outlines plans to track the status of Species of Greatest Conservation Need (SGCN), evaluate and improve the effectiveness of conservation strategies and provide data to keep the Action Plan report up-to-date.

Adaptive Management

Elements five and six of the Eight Required Elements of a Action Plan outline Congressional expectations for monitoring and plan review in the Action Plan report. Specifically element five requires that states provide:

> Proposed plans for monitoring species [of Greatest Conservation Need] and their habitats, for monitoring the effectiveness of the conservation actions proposed in the 4th element [strategies], and for adapting these conservation actions to respond appropriately to new information or changing conditions.
>
> Element six requires that states provide:
> Descriptions of procedures to review the strategy at intervals not to exceed ten years.

Just as a doctor checks a patient's blood pressure at every visit, wildlife monitoring allows biologists to identify changes in the health of wildlife (e.g., population changes, the spread of disease, changes to the landscape). Wildlife biologists can also monitor the impact of strategies to determine effectiveness just as doctors assess the efficacy of treatments and compare competing medical practices. The goal is not simply to cure one patient but improve the understanding and standard of care for all patients.

Taken together elements five and six speak to the need for an adaptive management program to track changes in wildlife populations and hone the effectiveness of conservation strategies. Adaptive management is a formalized method for learning from experience (Fig 1) where design, management, and monitoring are integrated to test assumptions in order to adapt, learn and improve (Salafsky et. al. 2001). Instead of relying on a fixed conservation goal and an inflexible plan for achieving the goal, adaptive management allows for midcourse corrections.

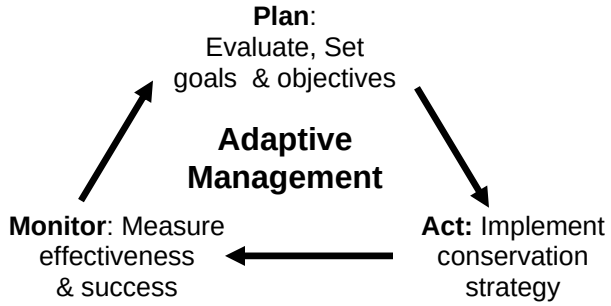

Fig 5-1 Basic steps in an adaptive management process (adapted from Noss & Cooperider 1994)

In the initial **planning** phase our Action Plan Species Teams and the Integration Team spent many hours evaluating data, identifying problems limiting SGCN and habitats. They

then developed hundreds of conservation strategies and research recommendations that the Vermont Fish & Wildlife Department (VFWD), Conservation Partners and others could begin to implement during an **action** phase. Measuring the effectiveness and success of the plans and actions occurs in the **monitoring** phase. The cycle begins anew with the fine-tuning of goals and objectives before action is renewed.

Monitoring is a linchpin in the adaptive management process. Monitoring is also a complex, demanding and never-ending task. With VFWD, sister departments at the Agency of Natural Resources, conservation partners, other local and federal agencies, academic institutions, non-governmental organizations and even individuals engaged in a broad range of wildlife and habitat monitoring projects, before any new monitoring programs are initiated a review of existing efforts and careful planning are required.

Current Survey and Monitoring of Vermont Wildlife

A list of current survey and monitoring projects that may provide relevant data for the conservation and management of SGCN is remarkably long. The Fish & Wildlife Department along with the Department of Environmental Conservation (DEC) and other conservation partners monitor state and federally designated threatened and endangered species, and some rare species and uncommon natural communities. VTrans in coordination with VFWD is recording road mortality data on the state highway system. Additionally data from wildlife surveys are regularly collected by VFWD's Nongame & Natural Heritage Program (NNHP). Many of these surveys, however, are not repeated enough to provide population trends, nor are they sufficient in extent to provide statewide estimates. In general baseline distribution and abundance estimates for SGCN has never been determined. Population trends, habitat availability or impacts of threats are similarly unknown. Nonetheless, any new monitoring efforts should build on these and other existing monitoring programs, as well as the expertise of the VFWD, conservation partners and others within Vermont, regionally and nationally.

The following is a cursory review of survey and monitoring efforts in Vermont that may benefit SGCN conservation and management. It is not meant to be comprehensive.

Birds: Birds are the most studied and best monitored group of wildlife in Vermont—and nationally. Key Vermont monitoring efforts include the Breeding Bird Atlas (Vermont Institute of Natural Science (VINS) & VFWD—sponsored by the State Wildlife Grants program (SWG)), the annual Breeding Bird Surveys (NABCI), and the Common Tern, the Important Bird Area and the Marshbird Monitoring programs (Audubon). The Vermont Institute of Natural Science has maintained bird data since 1974 with the eBird Online database. VINS also manages the Mountain Birdwatch, Forest Bird Monitoring Project, Loon Recovery Project, the Peregrine Falcon recovery program (with VFWD) and monitors of Bicknell's thrush on Hispaniola and of bobolink in Paraguay and Bolivia. A multi-party effort is underway to restore and monitor bald eagles in state. Other species-specific and guild-specific monitoring occurs for, osprey, American woodcock, turkey, waterfowl, and double crested cormorants. Regional and national monitoring efforts include the Breeding Bird Survey and Atlantic Coast Joint Venture.

Fish: Historically referred to as "vermin fishes" (Greeley 1930) and "trash fish," the species not prized by anglers have not been the focus of fisheries biologists either. More recently a variety of entities have been conducting surveys on a broader range of fish including some SGCN. *Fishes of Vermont* (Langdon et. al. in prep) is supported by DEC's 9,000 record fish distribution database. Non-native invasive species, such as alewife and zebra mussel, are also the subject regular surveys.

Invertebrates: Mussels may be best monitored of all Vermont invertebrates with semi-permanent survey stations in place. The SWG sponsored Vermont Butterfly Survey; a citizen science-based monitoring program coordinated by VINS is Vermont's first state-wide systematic inventory of invertebrate species. Some invertebrate monitoring occurs for pest species (FPR and Agency of Agriculture), as indicators of water quality (DEC) for several threatened and endangered invertebrates such as tiger beetles (3 species) and mollusks (10 species). DEC's water quality monitoring employs an index of integrity based on the composition of invertebrates in water bodies. Some taxa-wide surveys include moth surveys at Ethan Allen Firing Range (Griggs and Grehan 2000) and Mount Mansfield (Griggs and Grehan 2001). Nevertheless, most invertebrate taxa remain largely uninvestigated and unknown in Vermont. There remains a serious need for basic background survey work to document the presence and distribution of major orders of insects in Vermont, notably Odonata (dragonflies and damselflies).

Mammals: Deer, moose, black bear and furbearing species are closely monitored by VFWD. Keeping Track, Inc. has citizen monitoring teams in many sections of the state and region collecting long-term data on black bear, bobcat, moose, fisher, river otter, and mink. Threatened and Endangered species include American marten, and Canada lynx. Monitoring of several bats species in certain regions of the state has begun in the past three years funded by SWG. Most other mammals, particularly small mammals, have not been monitored historically and no baseline data is available. Numerous individual localized surveys have occurred in the past but on ongoing, repeatable monitoring have not taken place.

Reptiles & Amphibians: The Vermont Reptile and Amphibian Atlas (Middlebury College) is an ongoing citizen science research and monitoring project begun in 1995 to determine the distribution of reptiles and amphibians in Vermont. Additionally monitoring for some threatened and endangered reptiles and amphibians is conducted by VFWD, and DEC initiated Northern Leopard Frog surveys in 1996 in response to reports of malformed frogs in the Lake Champlain Basin.

Current Habitat and Vegetation Monitoring in Vermont

- Coordinated wildlife surveys (songbirds, reptiles, amphibians, and selected mammals—black bear, fisher, and bobcat) were conducted statewide in 2003-2004 by the Vermont Cooperative Fish and Wildlife Research Unit (VT Coop). These surveys provide a consistent statewide, on-the-ground baseline data for monitoring and results will inform predictive occurrence models for multiple taxa (T. Donovan, VT Coop), personal communication).

- The Ambient Biomonitoring Network program was established by DEC's Water Quality Division 1985 to: monitor long-term trends in water quality as revealed in changes over time to ambient fish and aquatic macroinvertebrate communities; to evaluate site-specific impacts of point and non-point discharges to aquatic biological communities, and to establish baseline data to assist in establishing Vermont-specific biological criteria for water quality classification attainment determinations in lakes, wetlands, rivers, and streams (DEC 2004b)

- The Long-Term Water Quality and Biological Monitoring Project for Lake Champlain began in 1992. A joint effort shared by DEC and the New York State Department of Environmental Conservation the n 1995, the primary purpose of the project is to detect long-term environmental change in the lake.

- The Vermont Wetlands Bioassessment Project is a coordinated effort between DEC and NNHP to document and understand biological and physical characteristics associated with vernal (seasonal) pools and northern white cedar swamps in the state (DEC 2004b).

- A joint Agency of Transportation-VFWD wildlife road crossing project is identifying significant wildlife travel corridors and road crossings to help reduce roadkill and improve future road design and placement.

- The Forest Inventory and Analysis (FIA) is a recurring inventory conducted by the US Forest Service's FIA Unit of the Northeastern Research Station in conjunction with the Vermont Department of Forests, Parks & Recreation. The inventory provides data for measuring changes and trends in the extent and condition of forest land, associated timber volumes, and rates of timber growth, mortality, and removal (Wharton et. al 2003). Though this information is developed primarily for timber management and does not track old-growth forests it does provide important information to wildlife managers.

- The National Resources Inventory program of the National Resource Conservation Service (NRCS) collects and distributes data on a state, regional and national level about the status, condition, and trends of soil, water, and related resources. The focus is primarily on agricultural lands with data includes available land-use types and land-use changes, erosion, and wetlands.

- The Gap Analysis Project (GAP) sponsored by the US Geological Survey (USGS) provides nationwide land cover data that can be used to identify lands important to wildlife and the extent to which habitat for native animal and plant species are being protected. A revised Vermont/New Hampshire GAP report is expected in 2007 (USGS 2005).

- The Vermont Monitoring Cooperative (VMC) coordinates numerous monitoring and survey operations in Vermont focusing primarily on forest health issues.

- The Nongame and Natural Heritage Program conducts ongoing natural community inventory identifies and maps natural community types statewide. A survey and

report on the distribution, ecology, classification of hardwood swamps was completed in 2004. NNHP also updates and maintains data on known and mapped significant natural communities, maps natural communities on state land and works with non-governmental organization partners to map or identify significant natural communities on NGO lands.

- Habitat Loss and fragmentation: the Vermont Forum on Sprawl can provide research, tools and training to track changes to habitat due to development. Also the NRCS State Office is creating a GIS layer urban and built-up lands by County. This GIS-based data may be helpful in efforts to assess habitat fragmentation

What Kind of Monitoring Is Needed to Successfully Implement the Wildlife Action Plan and Conserve SGCN?

In addition to monitoring the status, trends and problems impacting SGCN populations, an adaptive management program requires implementation, effectiveness and validation monitoring (Derr et. al 2005) to ensure that goals and objectives are achieved and SWG funds are spent wisely:

- **Implementation Monitoring:** Assessing the degree to which a conservation strategy was implemented (e.g., were trees planted in a riparian area?).
- **Effectiveness Monitoring:** Measuring the impact or effect of a conservation strategy (e.g., did planting trees in the riparian area stabilize the streambank?—the strategy's objective).
- **Validation Monitoring:** Checking the assumptions upon which the conservation strategy was based (e.g., did stabilizing the streambank actually reduce sedimentation of spawning beds downstream, producing more salmon fry? —the strategy's objective). Validation monitoring can help answer questions such as: Is the conservation strategy worth repeating or might another strategy produce results faster, more economically, or meet with better social acceptance?

The Fish & Wildlife Department already has implementation and financial monitoring protocols operating for State Wildlife Grants-funded projects. SWG project managers have 90 days from completion of a project to submit a draft report to the VFWD Division Director associated with each project. Division Directors review and edit the report and are responsible for final approval of all reports. Upon final approval reports are submitted to the US Fish & Wildlife Service Division of Federal Assistance for review.

SWG project managers review expenditure tracking reports report according to a regular schedule each year. Financial reporting of all in-kind match is required annually. Project managers are responsible for securing this information from third-parties organizations and contractors. The VFWD business office also tracks and documents third party match.

Though critically important, effectiveness and validation monitoring may not be practical or possible for each SWG funded conservation project (e.g., small scale, dispersed, technical support). Effectiveness may take years to determine (e.g., waiting for trees to grow to

sufficient height to shade a stream) and validation of a strategy's success may be difficult to tease out from other problems impacting a species or a site (e.g., the strategy did produce more salmon fry but the results were masked two unseasonably hot summers and an accidental chemical spill). SWG administrators and planners may want to focus conservation efforts on specific species and/or regions of the state (e.g., selected watersheds) for periods of time sufficient to ensure that the cumulative conservation efforts can be measured effectively. The demonstration projects can be rolled out to the elsewhere in the state after evaluation proves their utility.

Primary Challenges to the Implementation of a SGCN Monitoring Program

Pursuant to Congressional requirements Action Plan technical teams identified priority monitoring needs for every SGCN. Performance measures were also developed aid in implementation and effectiveness monitoring of Action Plan conservation strategies. However plans to implement a comprehensive monitoring program will first have to address four overarching issues:

1. Financial and staffing resources are insufficient to manage the current volume of wildlife survey and monitoring data developed by resource professionals.
2. Little data exists for most SGCN (lack of data was one criterion for selection as a Species of Greatest Conservation Need). Developing baseline distribution and abundance estimates is the first step in monitoring populations.
3. Despite SWG funds, financial resources are insufficient to support individual monitoring programs for 143 vertebrate and 188 invertebrate Species of Greatest Conservation Need.
4. Consistent protocols and systems for data collection and data sharing do not exist. Without the ability to collect and share data opportunities are lost and efforts can be duplicated.

To be successful, any Action Plan monitoring program will need to address these four challenges. It is hoped that the Action Plan and SWG funds will help direct future research and development efforts, facilitate the integration of existing monitoring projects across organizations and improve collaboration.

Adapting Conservation Actions in Response to New Information or Changing Conditions

White-tailed deer, the most closely watched animal in the state, underscores the need to adapt management to changing conditions and information. Vermont's deer management plan was crafted by many experts with seemingly limitless oversight and review. The recent finding of chronic wasting disease in the New York deer population, however, significantly changed the landscape for deer management in the region. New legislation, rules and procedures to protect the herd and the public were designed and implemented within weeks of confirmation of the initial findings. Action Plan monitoring and review procedures will be the primary tool to identify new information, changing conditions and the need for

adaptation. It will act at three scales—individual conservation projects, ongoing plan-wide adaptations (year-to-year), and 10-year plan review.

The iterative nature of adaptive management (plan→ implement→ monitor→ evaluate→ plan→…) builds opportunities to adapt directly into Action Plan project management activities. Project reporting, monitoring and the increased communication and coordination among conservation partners fostered by Action Plan implementation will feed into overall Action Plan management from year-to-year. All this information will be used to formally review and revise the Action Plan on a 10-year cycle (see also Action Plan Review later in this chapter).

Plans for Monitoring SGCN, Habitats and Conservation Actions

A statewide wildlife monitoring and adaptive management program is needed to measure progress toward desired outcomes for SGCN, their habitats, to evaluate and improve the effectiveness of conservation strategies, to adapt conservation actions to new information or changing conditions and to sustain the effectiveness of strategies in attaining desired outcomes. There was insufficient time to develop such a complex and important program prior to the October 1, 2005 deadline for Action Plan completion. In the coming months the Vermont Fish & Wildlife Department will initiate a collaborative process to develop and implement a statewide wildlife monitoring and adaptive management program to answer the following questions (adapted from USFS 2004, Schoonmaker and Luscombe 2005):

- What are the status and trends of SGCN, their habitats, and other important communities for which there are not specific anticipated outcomes (e.g., invasive species)?
- What are the areas of land and water within each biophysical region that will provide that provide the best opportunities for conservation actions for SGCN and habitats?
- Were planned conservation actions carried out?
- Are SGCN and habitats responding to the conservation actions as anticipated?
- How does new information compare with previous information or expectations?
- Who is implementing these actions?
- What are the costs of conservation actions?
- Are objectives consistently being achieved with outcomes as anticipated?
- How are stakeholders responding to conservation actions and Action Plan implementation?

Major guidelines for the development of this Action Plan monitoring program include:

Collaboration: Planning to develop and implement a Species of Greatest Conservation Need monitoring program should begin with collaboration. As with the design of conservation strategies in this report, successful monitoring of SGCN will require the help

and cooperation of many partners. Many current survey and monitoring efforts are conducted by interagency and inter-organizational efforts locally, regionally and nationally. These collaborations share expertise, make the best of limited resources, prevent redundancies of effort, increase the level of expertise of volunteers and improve program quality and effectiveness.

How much collaboration is needed? As many entities as possible should be brought together to develop consistent monitoring protocols and systems for data collection and data sharing, identifying indicators for species and habitats and goals and objectives for SGCN conservation.

The need for collaborative fund raising efforts cannot be overstated. Sufficient funds are imperative for monitoring to be effective. The State Wildlife Grants program currently is not sufficiently funded to finance the monitoring needs outlined here. Even if it was, state-side match is insufficient. A collaborative effort of agencies, conservation partners, local, state and federal elected officials, NGOs and private businesses and individuals is needed to develop adequate funding mechanisms at the state and federal levels.

Coordination: The coordination of monitoring programs, summarizing of results and sharing data with resources managers, researchers, local, state and national decision makers, educators, stakeholders and the general public will be essential to the success of a monitoring collaborative, to Action Plan efforts and to wildlife conservation in general. Solid coordination throughout the implementation phase will also make revisions of the Action Plan report straightforward and uncomplicated.

Baseline data: Distribution and abundance information for SGCN and their habitats are needed in order to establish meaningful baseline data. This data will be used to determine measurable goals and objectives that are the foundation of monitoring priorities.

Indicators: Monitoring every SGCN, their habitats, problems and the effects of conservation actions is too costly and time-consuming to ever complete. Relevant indicators that are measurable, precise, consistent, and sensitive are needed as coarse filters to make monitoring useful and manageable. Indicators should also be of appropriate scale, easily obtained and obvious in meaning so that results can be supported by a broad array of users.

Citizen Science: Successful monitoring projects such as VINS' Bird Atlas, Butterfly Survey and LoonWatch, the Vermont Reptile and Amphibian Atlas, Keeping Track Inc.'s big mammal monitoring, Audubon's Christmas Bird Counts, Marshbird Monitoring, and Great Backyard Bird Count and VFWD's Big Game Report Stations provide multiple benefits that should be considered in the development of new monitoring efforts. In addition to the direct benefits—improved wildlife knowledge—citizen-based monitoring also provides wildlife education through active field work on local projects, boosts awareness of and involvement in natural resource protection at the community level, and can be highly cost-effective.

Resources for Developing Vermont's Action Plan Monitoring Program

Baseline Wildlife Data and Predictive Models for Wildlife Distribution and Land-Use Change: A long-term study by the VT Coop will soon help determine the distribution of a diverse array of terrestrial species: predict how land use will change over time; and, predict how occurrence of biodiversity will change in response to land use change (T. Donovan, VT Coop, personal communication). In 2003-2004 coordinated wildlife assessments (songbirds, reptiles, amphibians, and selected mammals—black bear, fisher, and bobcat) were conducted statewide. Results will inform predictive occurrence models for multiple taxa. Importantly, these surveys provide the first statewide, on-the-ground baseline data for monitoring changes in biodiversity over time. Land use change will be modeled under multiple policy scenarios, including no change in current policies. The corresponding impact on biodiversity will be quantified for each policy scenario. Finally, spatial optimization methods will be used to identify land use patterns that are optimal for conserving an array of species, subject to socio-economic constraints. The result will be a decision-making tool that informs stakeholders of how projected land use change scenarios will likely affect different levels of biodiversity. The Unit intends to repeat these surveys on a 5-10 year cycle for long-term monitoring purposes.

Habitat-Based Monitoring for Assessing Conservation Strategies: *Habitat Monitoring: an Approach for Reporting Status and Trends for State Comprehensive Wildlife Conservation Strategies* (Schoonmaker and Luscombe 2005) was commissioned by Defenders of Wildlife expressly to help states develop their Action Plan monitoring programs. This report provides a framework to track and assess the effectiveness of conservation actions and to adapt proposed conservation actions as needed in response to new information and changing conditions. It includes guidance for developing conservation goals, building habitat baseline data, and detecting changes over time to measure outcomes. Species monitoring is not addressed in detail. The paper stresses the importance of building a constituency of involved stakeholders and ensuring that the development of a wildlife conservation strategy and monitoring program is a goal-driven process.

VMC as a Model for Coordination of Statewide SGCN Monitoring: The Vermont Monitoring Cooperative (VMC) (http://vmc.snr.uvm.edu) is a collaborative partnership that collects and pools information and data on Vermont's forested ecosystems. Participating cooperators from government, academic and private sectors, conduct research projects on a variety of topics including forest health, air quality and meteorology, wildlife and aquatic systems. The VMC makes the data and results from these projects available to other scientists, educators, resource managers and the general public through its online data library and card catalogue containing the data and metadata from more that 100 projects.

All-Bird Monitoring as a Model for Statewide SGCN Monitoring Programs: The science and reach of bird monitoring far exceeds monitoring programs for other taxa. The "All-Bird monitoring" programs coordinated by North American Bird Conservation Initiative (NABCII) (http://www.nabci-us.org/) should be the bases for bird monitoring in Vermont. Furthermore the development of monitoring protocols for other taxa can benefit from a review of these bird monitoring programs.

Reptile and Amphibian Monitoring: In addition to Vermont's Reptile and Amphibian Atlas, two other initiatives are developing monitoring protocols for reptiles and amphibians.

Partners in Amphibian and Reptile Conservation (PARC) (http://www.parcplace.org/) and Amphibian Research and Monitoring Initiative (ARMI) (http://armi.usgs.gov/). Both entities should be involved in the development of monitoring plans for Vermont.

Comprehensive Water Monitoring and Assessment Program: To ensure that states are responsible for implementing the Clean Water Act, the U.S. Environmental Protection Agency (EPA) requires that states develop a comprehensive water quality monitoring and assessment program to track environmental conditions and changes over time, to help set levels of protection in water quality standards, and to identify problem areas that are emerging or that need additional regulatory and non-regulatory actions to support water quality management decisions (EPA 2003)

Land Type Association Modeling/Mapping: In 2005 the Vermont Department of Forest, Parks and Recreation, The Nature Conservancy and the US Forest Service have started a project to define Land Type Associations (LTA) throughout the state. Land Type Associations describe landscapes of matrix communities (1,000's of acres) based on factors such as bedrock and surficial geology and soil types. The primary purpose of this project is to correlate LTA's w/ insect and disease outbreaks to aid forest management. Data from this project, particularly the baseline mapping data, can be helpful to wildlife and habitat monitoring.

The Montréal Process is an international working group formed in 1994 to develop and implement internationally agreed upon criteria and indicators for the conservation and sustainable management of temperate and boreal forests http://www.mpci.org/.

Data storage and data sharing: The volume of government (local, state, federal), NGO, and private sectors data available for plants, animals, ecosystems, climate, geology, hydrology, social and economic that could be used to conserve wildlife is simply huge. The management, storage and accessibility of monitoring data will be a significant issue for any coordinated monitoring efforts. Vermont's NNHP manages much of the current wildlife data in collected in Vermont but the program is already understaffed. Additional resources that may be of assistance in data storage and data sharing include:

> **The National Biological Information Infrastructure (NBII)** (www.nbii.gov) is a broad, collaborative program led by the Center for Biological Informatics of the U.S. Geological Survey. The NBII links biological databases, information products, and analytical tools maintained by NBII partners and other contributors in government agencies, academic institutions, non-government organizations, and private industry. NBII facilitates also work on new standards, tools, and technologies that make it easier to find, integrate, and apply biological resources information.
>
> **NatureServe:** (www.natureserve.org) represents an international network of biological inventories—known as natural heritage programs and conservation data centers—operating in all 50 U.S. states, Canada, Latin America and the Caribbean (NNHP is the Vermont affiliate to NatureServe). NatureServe collects and manages data on rare, threatened and endangered plants, animals, and ecosystems, establishes scientific standards for biological inventory and biodiversity data management, and develops data management tools.

References

DEC. 2004a Ambient Water Quality Monitoring Program Strategy-USEPA Review Draft 1-29-2004. Vermont Department of Environmental Conservation.

DEC. 2004b. Biomonitoring and Aquatic Studies 6-2004. Vermont Department of Environmental Conservation. www.anr.state.vt.us/dec/waterq/bass.htm

Derr T., A. Moote, M. Savage, M. Schumann, J. Abrams, L. McCarthy, and K. Lowe. 2005. The Multiparty Monitoring Handbook Series. USDA Forest Service's Collaborative Forest Restoration Program. www.fs.fed.us/r3/spf/cfrp/monitoring.

EPA. March 2003. Elements of a State Water Monitoring and Assessment Program. Assessment and Watershed Protection Division, Office of Wetlands, Oceans and Watershed, U.S. Environmental Protection Agency. www.epa.gov/owow/monitoring/repguid.html

Greeley, J. R. 1930. Fishes of the Champlain watershed, pages 44-87, in: A biological survey of the Champlain watershed. Supplemental to Nineteenth Annual Report, 1929. New York State Conservation Department, Albany.

Griggs, M. S., and J. R. Grehan. 2000. Biodiversity of the moth fauna from a light trap survey at Ethan Allen Firing Range. Vermont Army National Guard.

Griggs, M. S., and J. R. Grehan. 2001. Light trap survey of moth biodiversity of Mount Mansfield for 2000. Vermont Monitoring Cooperative, Vermont.

IAFWA Coordinated Bird Monitoring Group. September 2004. Monitoring Avian Conservation: Rationale, Design, and Coordination. www.iafwa.org/bird_conservation/bird_monitoring.htm

Langdon, R., M. Ferguson, and K. Cox. In prep. The Fishes of Vermont. Vermont Fish and Wildlife Department.

Noss, R. and A.Y. Cooperrider. 1994. Saving Nature's Legacy: Protecting and Restoring Biodiversity. Island Press. Washington DC

Rosenberg, K.V. April 2004. Partners in Flight Continental Priorities And Objectives Defined At The State and Bird Conservation Region Levels—Vermont. Cornell Laboratory of Ornithology, Ithaca, NY. www.iafwa.org/bird_conservation/landbird_reports.htm

Salafsky, N, R. Margoluis, and K. Redford. 2001. Adaptive Management: A Tool for Conservation Practitioners. Biodiversity Support Program. www.fosonline.org/Adaptive_Management1.cfm

Schoonmaker, P. and W. Luscombe. March 22, 2005. Habitat Monitoring: An Approach for Reporting Status and Trends, for State Comprehensive Wildlife Conservation Strategies. Illahee. Portland, Oregon. www.biodiversitypartners.org/infomanage/

USFS. November 2004. Recommendations for Monitoring Terrestrial Animal Species and their Habitats: Report of the Wildlife Monitoring Steering Committee, U.S. Forest Service, Washington, D.C.

USGS. 2005. Gap Analysis Program U.S. Geological Survey. www.gap.uidaho.edu

Wharton, E.H.; Widmann R.H.; Barnett, C. H.; Frieswyk, T.S.; Lister, A. J.; DeGeus, B. 2003. The forests of the Green Mountain State. Resource Bulletion NE-158. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station

Action Plan: Implementation

Congressional intent for the Wildlife Action Plan project is to identify and address the needs of all wildlife species in the state that might require help in order to prevent their becoming threatened or endangered. The full import of the word "comprehensive" becomes overwhelmingly clear as numbers in this report are tallied. (1,349 problems identified, 593 conservation strategies (setting the stage for hundreds or thousands of potential conservation actions), for 143 vertebrate species, 188 invertebrates, 577 plants and more than 100 habitat/community/landscape categories). The next steps, conducting the recommended research, setting species and habitat goals and objectives, implementing strategies and designing and implementing the monitoring programs outlined in this report requires the continued help and support of all conservation partners—those that participated in the Action Plan development and new partners as well.

Congress has designated state Fish & Wildlife Departments as Action Plan and State Wildlife Grants (SWG) custodians because they are the entities mandated by state law to manage and protect wildlife. Custodial responsibilities include not only delivering the completed Action Plan by Oct 1, 2005 but also for regular review and updating of the Action Plan report and administrating SWG funds. To carry out these responsibilities the VFWD will assign sufficient staff and resources to this program to manage projects, coordinate efforts and monitor overall program operations.

The VFWD will take the lead in coordinating the implementation of the research and monitoring recommendations and conservation strategies described in this report. While the department may be responsible for implementing much of the research, monitoring and conservation strategies, it will be Conservation partners, however, that may be the more logical and appropriate leaders for other research and strategy implementation, due to their skills and expertise, staffing, history, location, available resources and constituencies.

The Action Plan will remain a work in progress for many years, an experiment in long-term multi-species conservation on a scale not experienced before. Much of the work in this document is ground breaking. Many of the species examined here have not received focused attention before. The next few cycles of implementation, review and updating of individual strategies and the Action Plan report overall will be the particularly important for working out kinks, testing methods, and improving aspects of the Action Plan.

Implementation and Participation

As a wildlife conservation plan for the entire state, the Action Plan includes some strategies that almost any individual or organization can implement. Any and all interested partners are encouraged to take part. Though many of these actions will not require the notification of VFWD, tracking the implementation and outcomes of each action is vital to the monitoring and adaptive management goals outlined elsewhere in this chapter. All participating partners are encouraged to consult with VFWD prior to taking action.

Impacts on other species, habitats and ecological processes and functions should always be considered when implementing conservation actions to benefit Species of Greatest

Conservation Need (SGCN). Implementation may also be subject to changing conditions and regulatory review (where required) and should be conducted in cooperation with land managers, land owners and key stakeholders. Large scale conservation efforts (e.g., broad scale monitoring) should be coordinated through VFWD, interagency workgroups and formal agreements where applicable.

Coordination and Collaboration

As noted throughout this report, coordination of efforts is vital to leveraging available resources to ensure maximum wildlife benefit. VFWD will take the lead in facilitating communications among Conservation Partners, including local, state and federal agencies, through email networks, SWG annual reporting and a yearly conservation partner meeting open to any and all interested parties.

Coordination between states (regionally and nationally) will be spearheaded by the International Association of Fish & Wildlife Agencies (IAFWA) and the US Fish & Wildlife Service. Plans are already underway to help states effectively implement their Action Plans, to facilitate projects spanning multiple states and to improve agency capacity to implement their Action Plans (IAFWA 2005).

Prioritizing Conservation Need

During the identification and assessment of SGCN our Action Plan technical teams began the process to prioritize conservation need through the following actions: SGCN were assigned either medium or high priority status (low priority species are deemed relatively secure for now, see Action Plan development, chapter 3 for ranking criteria), species conservation strategies, research and monitoring needs and habitat problems were ranked medium and high based on the combined expertise of each technical team.

We did not prioritize needs and strategies beyond this. The Action Plan is a conservation guide for the state—not only VFWD or the Agency of Natural Resources. It is meant to provide guidance to organizations, agencies and individuals who wish to conserve wildlife. The goals and missions of the many and varied partners involved in the project span a broad spectrum of wildlife interests, skills and reach (some are very local, others are state, regional and federal entities). It was clear that there would be no prioritization that would satisfy all partners and that conservation need is so great that there is room for everyone to select the species and habitats they find most important and implement the strategies they are most capable of working on.

When it comes to allocating SWG funds to specific projects, further prioritization is required. Prioritization will take into account the goal of the SWG program—to keep wildlife populations from declining to the point that they require protection under the federal Endangered Species Act (ESA)—and Congressional intent— that SWG funds benefit wildlife that have not historically been the primary beneficiaries of the Federal Aid in Wildlife Restoration Act, Federal Aid in Sport Fish Restoration Program or the federal ESA. Prioritization will also be based on the impact of problems to SGCN and habitats, the project's ability to affect positive change, other conservation and social impacts and the

availability of matching funds (see the draft process outlined below and Appendix J for the SWG Competitive Grants Proposal Evaluation form).

Conservation Opportunity Areas: The Action Plan monitoring program (discussed earlier in this chapter) will help identify areas of land and water within each biophysical region that provide the best prospects for conservation actions to benefit SGCN and their habitats. VFWD and partners can prioritize (though not limit) efforts on these "Conservation Opportunity Areas" in order to achieve a greater likelihood of success and to use limited conservation funds most efficiently.

Implementation Funds and Resources

Most of the conservation strategies in this report are eligible for State Wildlife Grants program funds, and there is the rub. Conservation need and opportunity far outstrips current financial resources. To strategically allocate funds to the species and habitats in greatest need *and* to those projects that are likely to show the most promising results, we have drafted a process for soliciting, evaluating and selecting projects to receive SWG funding. That process is described in the next section below.

Agencies, organizations and individuals seeking funding for Action Plan conservation projects through sources other than SWG are encouraged to reference the Action Plan in grant applications and seek letters of support from other Conservation Partners including the VFWD. Entities wishing to implement conservation strategies should consider calling on the VFWD and other Conservation Partners for their expertise, advice, training and needed equipment and where appropriate collaborations should be considered.

Allocating State Wildlife Grant Funds

Congress, through annual Interior Appropriations legislation has allocated funds to the State Wildlife Grants program yearly since 2001. Vermont's share of these appropriations has averaged approximately $600,000 each year. Interior appropriations bills are generally approved in the fall of each year. In the spring of the following year VFWD submits proposals for use of SWG funds to the US Fish & Wildlife Service Division of Federal Assistance (USFWS-FA), the entity responsible for administering and managing the SWG program nationwide. Funds for accepted proposals are made available later that year and will generally remain available several years thereafter. A portion of each year's SWG appropriation will be made available to Conservation Partners for Action Plan implementation through a grants program. All eligible entities may submit applications.

The following is an outline of the draft schedule and process for applying and selecting recipients of SWG grant funds. Full procedures and proposal guidelines will be ready in October 2005.

Timeline / Process (draft)

November: The VFWD determines the availability of funds for the coming year and the percentage of funds available for the SWG Small Grants program (this determination may be delayed if the federal budget is not approved on time, as is sometimes the case).

November/December: Meeting of Conservation Partners to discuss the past year's progress on Action Plan implementation and needs and opportunities for the coming year. Recommendations will be taken regarding the proportion of SWG funds to be allotted to conservation categories such as research, monitoring, habitat restoration, species recovery activities, etc. Final allocation will be determined by the VFWD Grants Committee (see below).

December: A request for proposals for use of SWG funds for Action Plan implementation will be announced by VFWD.

March Proposal submission deadline.

March-May Proposals will be reviewed as follows:

SWG Coordinator (VFWD staff): reviews proposals for completeness and eligibility. Complete proposals that meet the minimum eligibility standards are deemed accepted and are sent to the SWG Technical Committee.

SWG Technical Committee (VFWD staff and selected Conservation Partners): reviews & scores accepted proposals. Scoring will be based on draft criteria found here in Appendix J. The Technical Committee selects a slate of recommended proposals. All proposals are sent to the Grants Committee

Grants Committee (VFWD Division Directors and NNHP Coordinator): The Grants Committee selects finalists from both within and outside the Department based on proposal scoring, recommendations of Technical Committee, available funds and Department priorities.

VFWD Commissioner: receives finalists from Finalists are sent to the Commissioner for final approval.

References

Derr T., A. Moote, M. Savage, M. Schumann, J. Abrams, L. McCarthy, and K. Lowe. 2005. The Multiparty Monitoring Handbook Series. USDA Forest Service's Collaborative Forest Restoration Program. www.fs.fed.us/r3/spf/cfrp/monitoring.

IAFWA. May 2005. Memo Comprehensive Wildlife Conservation Strategies: National Support for Coordinated Implementation. Washington D.C.

Action Plan Review

Element number six of the eight required elements for an Action Plan (see Chapter 1: Congressional Guidelines) requires that states provide "descriptions of procedures to review the strategy at intervals not to exceed ten years."

Vermont will update its Action Plan on a 10-year cycle. Ten years will allow for planning, and implementation of actions and for detectable responses for many SGCN. Vermont's adaptive management approach to Action Plan implementation, however, means that species and habitat monitoring, formal project reporting and financial tracking will be ongoing and will provide a constant flow of information during the intervening years. Managers, wildlife planners and biologists will use this data to hone strategies, fine tune operations and make mid-course corrections within each ten year cycle. Review activities will include:

- Twice yearly expenditure tracking for individual projects by SWG project managers.
- Annual financial reporting of all in-kind match for individual projects by SWG project managers.
- Full project reports due within 90 days of completion of Individual SWG projects by SWG project managers.
- Providing regular Federal Assistance reports to the US Fish & Wildlife Service Division of Federal Assistance.
- A biannual Action Plan meeting for Conservation Partners will be organized by VFWD to review the year's efforts, identify goals for the coming year and to share information about Vermont SGCN, successes, obstacles and needs related to wildlife conservation and Action Plan project implementation.
- A biannual report on the Action Plan to stakeholders, the general public and policy makers will review the past year's efforts and outline goals for the coming year.

Interstate Coordination and Information Sharing

With 49 other states and 6 territories all implementing their own Strategies in the coming months it is likely that there will be successful projects and programs that could benefit Vermont SGCN. There will undoubtedly be many regional and national efforts to share this information. Vermont should make it a priority to attend these meetings and perform a thorough review of methods and results from other states.

Ten Year Review

The process to review and update the Action Plan in 2015 should begin at least two years prior to the deadline. The current thinking is that the review process should mirror the original Action Plan development process. This will include full participation by Conservation Partners (including local, state and federal agencies) on teams and committees, analyses of the work completed to date, evaluation of monitoring data and the updating of each of the eight elements from the original congressional guidelines as follows:

1) Revise the list of SGCN and update information on the distribution and abundance of SGCN. Which species can be removed from the list, which should be added?
2) Update information on the location and condition of key habitats. Describe key habitats of any new SGCN.
3) Describe threats and problems impacting SGCN and their habitats. Update research needs.
4) Review the success of conservation actions implemented to date. Identify conservation actions to conserve SGCN and their habitats.
5) Review Action Plan monitoring efforts to date. Describe plans to monitor species, habitats and conservation actions for the future.
6) Update and describe the process for the next plan review.
7) Review coordination efforts to date. Update plans to coordinate with other plans and planning entities.
8) Revise and describe plans to include the public in the design and implementation of the next Action Plan report.

Vermont's
Wildlife Action Plan*

November 22, 2005

Chapter 6
Glossary & Acronym Key

Wildlife Action Plan Glossary..... 1
Acronym Key 4

**formally the Comprehensive Wildlife Conservation Strategy (CWCS)*

Chapter 6: Vermont Wildlife Action Plan Glossary & Acronym Key

This glossary contains definitions to many of the terms used in this document.

Actively managed: For wildlife this means that a management plan for the species or a suite of species exists. (E.g. an osprey plan, waterfowl plan, spruce grouse plan.)

Anthropogenic: Conditions that result from human activities. "Anthropo-" meaning human and "-genic" meaning produced from.

Comprehensive Wildlife Conservation Strategy (CWCS): This Wildlife Action Plan was developed under the working title of Comprehensive Wildlife Conservation Strategy (CWCS). Upon federal approval the name was changed to Wildlife Action Plan (Action Plan). The Action Plan/CWCS sets a plan of action for conserving Vermont's wildlife by addressing conservation issues, management needs, and priorities. It is intended to be used by anyone with an interest in wildlife conservation.

Conservation: Plans and actions that will help restore and/or sustain Vermont's wildlife populations, with a focus on Species of Greatest Conservation Need (SGCN), and utilizing the full array of traditional conservation tools such as management (.e.g. habitat manipulation, restoration (e.g. acquisition, fee-simple easements), landowner education and incentives.

Conservation Opportunity Areas: areas of land and water where the likelihood of successful conservation is strongest and the conservation needs of wildlife and their habitats would be best met.

Conservation Partners: The wildlife biologists, ecologists, sportsmen and other conservationists, non-governmental organizations, business leaders, colleges and universities and state and federal agencies representing more than 60 entities (table 1-1) that worked with the Vermont Fish & Wildlife Department to create Vermont's Comprehensive Wildlife Conservation Strategy. When implementation of the Action Plan begins, any and all individuals, organizations, agencies and other entities wishing to participate will be considered conservation partners.

Conservation Reserve Program (CRP): provides annual land rental payments up to 15 years and cost sharing assistance to install water quality enhancement practices on environmentally sensitive land.

Conservation Reserve Enhancement Program (CREP): State and Federal partnership allowing incentive payments to landowners who set aside environmentally sensitive land along streams or field boundaries.

Common Species: "Keeping Common Species Common" is a phrase Congress used to describe its goal for the SWG program and the Action Plan. Common in this situation refers to any species that is not on the federal Endangered Species List (Threaten or Endangered).

Contiguous Forest: An area of forested land with either no roads or low densities of class IV roads, and little or no human development (buildings, parking areas, lawns, gravel pits). Contiguous forest may have various age classes of forest cover and include other habitat types such as wetlands or grasslands that are part of the overall contiguous habitat complex.

Corridor: A route that permits the direct travel or spread of animals or plants from one area or region to another, either by the gradual spread of a species' population along the route or by the movement of individual animals, seeds, pollen, spores, or microbes.

Cultural Habitat: (sometimes referred to as anthropogenic habitat) communities and sites that are either created and/or maintained by human activities or are modified by human influence to such a degree

that the physical condition is substantially different from what existed prior to human influence (e.g. old mines, hayfields used by grassland birds, buildings and structures used by bats).

Data Gap: A clear data need identified in the Action Plan as important to the conservation of a species or habitat.

Ecosystem: A complex array of organisms, their natural environment, the interactions between them, and the ecological processes that sustain the system. Ecosystems can be defined at any scale, from rotting logs, to Lake Champlain, to the Green Mountains.

Endangered Species: A species in danger of becoming extinct that is protected by either the federal Endangered Species Act or the Vermont Endangered Species Act.

Endemic species Found only in a certain place. For the purposes of this document endemic refers to species found *only* in Vermont. There are no known endemic species in Vermont. The most likely possibilities are invertebrates.

Exotic Invasive & Pest Species: An invasive species is defined by the as a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Environmental Quality Incentives Program (EQIP): provides cost sharing payments to participants who install enduring conservation practices to help control soil erosion and improve water quality.

Forest Cover Type: A descriptive classification of forestland based on present occupancy of an area by tree species (Society of American Foresters).

Game Species: Wildlife species that are subject to legal hunting, fishing or harvesting.

Habitat: A place where a plant or animal lives. A place where an organism lives. Habitat is generally thought of in terms of single species such as bear or calypso orchid habitat.

Herp: an abbreviation for herptile, which includes both amphibian and reptile species.

Herptile: amphibian and reptile species

Indicator species: A species, or community whose presence in an area indicates the presence of certain environmental conditions.

Indicators: Indicators are measures that track inputs, outputs, and outcomes by stating them in specific and observable terms. They are also used to monitor natural resource conditions and the threats that can degrade natural ecosystems (.e.g. the number lakes infested with Eurasian watermilfoil; the distribution of lakes infested with Eurasian watermilfoil # of boat checks conducted; % of boaters aware of exotic species laws)

Landscape: A heterogeneous area of land containing groups of natural communities and clusters of interacting ecosystems. These can be of widely varying scales, but normally include a range of elevations, bedrock, and soils.

Life-history traits: Examples include be species with low fecundity, that take a long time to reach sexual maturity, that take a long time between reproductive events (sturgeon, wood turtle)

Limiting factor: The factor that limits the growth, abundance, or distribution of a population of organisms or a habitat.

Metadata: Definitional information that provides information about or documentation of other data

Metapopulation: A small number of relatively isolated populations that may occasionally exchange individuals

Mosaic: A pattern of vegetation in which two or more different plant communities are interspersed in patches.

Natural Community: An interacting assemblage of plants and animals, their physical environment, and the natural processes that affect them.

Neotropical Migrants: Birds especially songbirds, that summer and breed in North America but migrate to the tropics for the winter. Neotropical refers to the region south of the Tropic of Cancer that includes southern Mexico, Central and South America, and the West Indies

Nongame Wildlife: Wildlife species that are not subject to legal hunting, fishing or harvesting.

Pathogen: Any disease producing microorganism or material

Problem: A force causing a negative impact at the species, population, habitat and landscape levels (e.g., habitat conversion, pollution, illegal pet trade). A problem can also be the lack of information or a data gap vital to the successful management of a species. Because this report addresses an extremely broad range of problems affecting species and their habitats, the term "problem" may not always be the most appropriate term: threat, stress, stressor, issue, concern and limiting factor may at times be more accurate.

Regulated Hunting/Fishing/Trapping: The harvest of wildlife under regulations stipulating setting of seasons, time frame of lawful harvest, open and closed zones, methods of take, bag limits, possession limits, and reporting or tagging of species.

Responsibility Species: Species for which Vermont has a long-term stewardship responsibility because they are not doing well regionally, even if populations are stable in Vermont. E.g. bobolink

SGCN: see Species of Greatest Conservation Need

Species of Greatest Conservation Need (SGCN): According to federal legislation and guidance from the USFWS on the development of Comprehensive Wildlife Conservation Strategies, "each State will determine these species in the context of developing its [Wildlife Conservation Strategy]. These species must be fauna, and not flora, and may include aquatic species and invertebrates. A State's list of "species of the greatest conservation need" may include currently listed Federal and State wildlife species and other species of concern. We anticipate that the composition of this list will change over time as the status and conservation need of species changes within the State." The term Species of Greatest Conservation Need is not a statutory designation similar to the terms "endangered" or "threatened" codified by federal and state Endangered Species Acts.

Take/Taking: "Take" and "Taking" mean pursuing, shooting, hunting, killing, capturing, trapping, disturbing, harrying, worrying, or wounding snaring and netting fish, birds and quadrupeds and all lesser acts including placing, setting, drawing or using any net or other device commonly used to take fish or wild animals, whether they result in taking or not. It includes every attempt to take and every act of assistance to another person in taking or attempting to take fish or wild animals.

Threatened Species: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range that is protected by either the federal Endangered Species Act or the Vermont Endangered Species Act

Wildlife: According to State Wildlife Grants legislation, wildlife is any species of wild, free-ranging fauna including fish, and invertebrates and also fauna in captive breeding programs the object of which is to reintroduce individuals of a depleted indigenous species in a previously occupied range.

Wildlife Action Plan (Action Plan) The Action Plan sets a plan of action for conserving Vermont's wildlife by addressing conservation issues, management needs, and priorities. It is intended to be used by anyone with an interest in wildlife conservation. It was developed under the working title of Comprehensive Wildlife Conservation Strategy (CWCS).

Acronym Key

This key includes many of the acronyms used in this document. Please let the authors know if additional entries are warranted. A full list of the Conservation Partners collaborating on the development of this report can be found in Chapter 1: Introduction.

AFS: American Fisheries Society
AMP: Acceptable Management Practice
ANR: Vermont Agency of Natural Resources (comprised of VFWD, DEC, FPR)
AOT: Vermont Agency of Transportation
AVCC: Association of Vermont Conservation Commissions
BBS: Breeding Bird Survey
BCR: Bird Conservation Region
BMP: Best management practice
CBC: Christmas Bird Count
CITES: Convention on International Trade in Endangered Species of Flora and Fauna
CRASC: Connecticut River Atlantic Salmon Commission
CRJC: Connecticut River Joint Commission
CRP: Conservation Reserve Program (a program of FSA)
CWCS: Comprehensive Wildlife Conservation Strategy, the original name for the Wildlife Action Plan. The name change occurred when the CWCS received federal approval.
DEC: Vermont Department of Environmental Quality, also VDEC
DJ: Dingell-Johnson Act of 1950, Federal Aid in Sport Fish Restoration Act
EO: Element Occurrence
EQIP: Environmental Quality Incentives Program (a program of NRCS)
ESC: Endangered Species Committee
FIA: Forest Inventory Analysis
FIP: Forest Incentives Program (USFS)
FPR: Vermont Department of Forests, Parks & Recreation
FSA: Farm Service Agency (a USDA agency) (www.fsa.usda.gov/vt/)
FWD: Vermont Fish & Wildlife Department
GIS: Geographic Information Systems
GRP: Grassland Reserve Program
HAT: Hunters, Anglers & Trapper of Vermont
HAT: Hunters, Anglers & Trappers Assoc of Vermont
IAFWA: International Association of Fish and Wildlife Agencies
IBA: Important Bird Areas
LCBP: Lake Champlain Basin Program
LCC: Lake Champlain Committee
LCLT: Lake Champlain Land Trust
LIP: Landowner Incentive Program (a USFWS program, managed in Vermont by VFWD)
MBTA: Migratory Bird Treaty Act of 1940
NABCI: North American Bird Conservation Initiative
NASA: National Aeronautical and Space Administration
NEPCoP: New England Plant Conservation Program (http://www.newfs.org/)
NNHP: Nongame & Natural Heritage Program (of the Vermont Fish & Wildlife Department)

NRCS: Natural Resources Conservation Service (a USDA agency)
NRCS: U.S. Natural Resource Conservation Service (habitat programs include WHIP, EQIP, CRP)
NWI: National Wetlands Inventory
NWR: National Wildlife Refuge
NWTF: National Wild Turkey Federation
PARC: Partners in Amphibian and Reptile Conservation
PIF: Partners in Flight
PR: Pittman-Robertson Act of 1937, the Federal Aid to Wildlife Restoration Act
RGS: Ruffed Grouse Society
RPC: Regional Planning Commissions (see http://www.vapda.com/)
SAF: Society of American Foresters
SGCN: Species of Greatest Conservation Need
SWG: State Wildlife Grants
TNC: The Nature Conservancy
TU: Trout Unlimited
USACE: United States Army Corps of Engineers
USDA: United States Department of Agriculture
USEPA: United States Environmental Protection Agency
USFS: United States Forest Service
USFWS: United States Fish & Wildlife Service
USGS: United States Geological Service
VCGI: VDHCA: Vermont Department of Housing & Community Affairs
VFS: Vermont Forum on Sprawl
VFWD: Vermont Fish & Wildlife Department
VHCB: Vermont Housing & Community Board
VINS: Vermont Institute of Natural Sciences
VLCT: Vermont League of Cities & Towns
VLT: Vermont Land Trust
VLT: Vermont Land Trust
VNRC: Vermont Natural Resources Council
VT Coop: Vermont Cooperative Fish and Wildlife Research Unit (of the US Geological Service)
VTA: Vermont Trappers Association
VTFSC: Vermont Federation of Sportsmen's Clubs
VWA: Vermont Woodlands Association
VTrans: Vermont Agency of Transportation (also AOT)
WHIP: Wildlife Habitat Incentives Program (a program of NRCS)
WMA: Wildlife Management Area (managed by VFWD)
WRP: Wetland Reserve Program (NRCS)