Vermont's Wildlife Action Plan

November 22, 2005

Chapter 4 Conserving Vermont's Wildlife Resources

**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
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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

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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
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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.

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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.

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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

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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

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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

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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

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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

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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

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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

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