Chapter 6

Landscape Conservation

2015

6. Landscapes and the Conservation of Vermont's Species of Greatest Conservation Need

Introduction

Maintaining and enhancing landscape integrity and ecological function across Vermont is fundamental to conserving our natural heritage and Species of Greatest Conservation Need. Large, connected landscapes are particularly important for wide-ranging species (e.g., Northern Goshawk, Bobcat, Black Bear, Canada Lynx, and American Marten). And because landscape conservation is the most efficient strategy for ensuring the persistence of the many smaller-scale habitats found within a landscape, it is critical to the conservation of many not-so-wide-ranging SGCN as well. Moreover, healthy, intact landscapes enhance the capacity of species and communities to shift and adapt to the changing climate. For these reasons landscape-scale conservation is a fundamental strategy of this Wildlife Action Plan.

Wide-ranging species require large areas encompassing a variety of habitats in order to find sufficient food, shelter and mates. The home range requirements of our wide-ranging SGCN vary greatly from species to species, as do requirements of habitat quality and the number of individuals needed to sustain a population. For example, some area-sensitive birds may require a minimum forest block size of 7,500 acres (Robbins et. al. 1989). Bobcat populations of 250 breeding females require approximately 2,000 square miles, and maintaining Vermont's black bear population may require as much as 6,000 square miles of habitat (Vermont Fish & Wildlife Black Bear Management Plan 1999). Canada Lynx, Wolf, and American Marten range so widely that Vermont alone can meet only a portion of their populations' current or potential habitat needs. Therefore, our landscape conservation efforts cannot stop at the state's borders.

This chapter describes the condition of Vermont's landscapes (historic, current and desired), provides a framework for identifying and prioritizing landscapes important to SGCN and natural heritage conservation based on six key landscape components (Interior Forest Blocks, Connectivity Blocks, Surface Waters and Riparian Areas, Riparian Areas for Connectivity, Physical Landscape Diversity Blocks, and Wildlife Road Crossings), identifies SGCN benefitting from landscape conservation, and identifies significant threats and priority conservation strategies. Additional details and maps of our landscape conservation approach can be found in the report Vermont Conservation Design: Maintaining an Ecologically Functional Landscape (Appendix F).

Landscape Condition

Historical condition: Forests have dominated the Vermont landscape for most of the last 4,500 years—predominantly Northern Hardwood, Spruce-Fir Northern Hardwood and Oak-Pine Northern Hardwood Forests. The forests were continuous, covering mountains and valleys, with intact riparian zones, except in those areas with significant, long-term Native American settlement. Wildlife and plants moved freely, streams and rivers meandered across natural floodplains and natural processes were intact. 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 impact to Vermont's landscape was not limited to these cleared areas. 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 or 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).

Aquatic habitat degradation was another result of the extensive land clearing for forestry and agriculture given that aggressive stream clearing of boulders and coarse woody debris was engaged in 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 riverine 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 et al. 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).

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: Currently, Vermont is approximately 8 percent water, 71 percent forest and 21 percent non-forest (including open, agricultural and developed land). These statistics do not, however, express the degree of intactness of these terrestrial and aquatic habitats, nor the barriers in our forest and stream systems.

VFWD conducted an analysis of unfragmented forest blocks in Vermont (Sorenson and Osborne 2014). Each of 4,055 forest blocks was analyzed and ranked for biological and physical diversity factors. Vermont's largest block is 153,000 acres. The average block size statewide is 1,000 acres. But block size is not evenly distributed across the landscape. As seen in figure 1, the largest habitat blocks occur along the spine of the Green Mountains and in the northeastern portion of the State. In the Northeastern Highlands biophysical region, for example, the average block size is its 6,810 acres and 2,694 acres in the Green Mountains. In the Piedmont average block size is 830 acres and in the Champlain Valley it is only 413 acres.

Desired Condition (SGCN Needs): To maintain the full complement of Vermont's Species of Greatest Conservation Need and particularly of wide-ranging species such as American Marten, Canada Lynx and Wolf, Vermont needs landscapes of large, connected habitat blocks with interior forests, surface waters and riparian areas where ecological processes and native species are most likely to persist and adapt to climate change. These areas should represent all natural communities (in all successional stages), habitats and physical landscape diversity. Distributed across all Vermont biophysical regions, these landscapes should be connected locally and regionally, now and in the future as land use and climate change, by way of smaller blocks, riparian areas and rivers to allow for plant and animal movement and migration. Structural and functional connectivity should be maintained and enhanced across and under roads and other transportation structures.

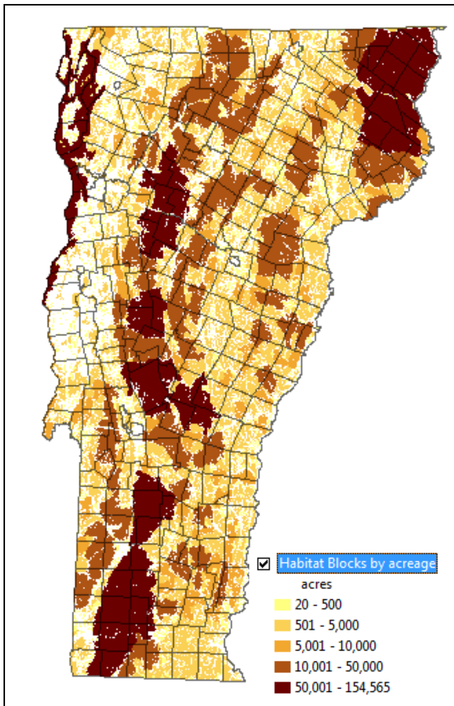


Fig.1. **Habitat Blocks by Size** (acres)
Sorenson & Osborne 2014

Several wide-ranging wildlife species will not persist or re-establish without linkages to other states and Canada. Therefore, regional connectivity (i.e., linkages to New York, New Hampshire, and Canada) must be maintained. Linkages along riparian habitats will also provide connectivity for both semi-aquatic and upland species.

Implementing the 2005 Wildlife Action Plan

Actions by the Vermont Fish & Wildlife Department and partners to implement landscape conservation recommendations of the Wildlife Action Plan since 2005 include:

Contiguous forest/habitat blocks and associated linkages were identified and prioritized as part of the "habitat block project" conducted from 2007 to 2014. Using GIS analysis of existing data, this projected identified 4,055 unfragmented forest blocks in Vermont and ranked each block for its biological and physical landscape diversity values. The project also identified a modeling tool for identifying likely wildlife corridors in Vermont. Partners included Vermont Land Trust, the Forests, Parks & Recreation Department, The Nature Conservancy, Audubon Vermont, and Green Mountain National Forest. The project results are now used extensively in VFWD technical assistance to towns. The project report is "Vermont Habitat Blocks and Habitat Connectivity: An Analysis using Geographic Information Systems."

VFWD has acquired in fee and through conservation easements many high priority sites that further landscape conservation and provide critical landscape connectivity. From 2005-2013, the Department acquired 41 separate parcels (excluding fishing access areas) in fee totaling more than 4,100 acres to be added to WMAs or to create new WMAs. VFWD also acquired more than 2,300 acres under conservation easement during the same period. All of these projects either directly or indirectly benefit SGCN. Partner organizations including the Forests, Parks & Recreation Department, The Nature Conservancy, The Trust for Public Land, Vermont Land Trust and many local land trusts acquired and managed lands similarly benefitting SGCN.

VFWD provided technical assistance to every Vermont Regional Planning Commission and nearly every town on a variety of wildlife and land planning related issues, including SGCN conservation, habitat blocks, and wildlife corridors. Conserving Vermont's Natural Heritage (Austin et.al. 2004) was reprinted and distribution of this planning document continues.

The Vermont Forest Roundtable first convened in 2006 as a venue for information exchange on keeping Vermont's forests as forests. Organized by the Vermont Natural Resources Council, the Roundtable regularly hosts consulting foresters, professional planners, state agency officials (including VFWD and VFPR), landowners, sportsmen, forest products industry representatives, conservation groups, biomass energy organizations and academics. The Roundtable formed with an initial focus on parcelization and forest fragmentation issues. It's since facilitated discussions on trends in Vermont's real estate market and rising forestland values, property tax policy, land use and conservation planning, estate planning, landowner incentive programs such as the Use Value Appraisal program (Current Use), and the long-term sustainability of the forest products industry.

Approximately two million acres of Vermont's forestland is enrolled in the Use Value Appraisal program, which requires active management of enrolled land. In 2009, changes to the program allowed forest areas to be enrolled as "Ecologically Sensitive Treatment Areas," meaning that instead of being managed exclusively for timber, they can be managed for their values as significant natural communities. At the same time, the Use Value Appraisal program was also revised to allow for enrollment and management for significant wildlife habitat. To qualify, Vermont Fish & Wildlife staff review and approve proposals based on the Department's standards of significance for natural communities and wildlife habitat. Staff also work with consulting and county foresters to help them learn about treatment areas.

VFWD and the Vermont Agency of Transportation (VTrans) established a joint Wildlife-Transportation Steering Committee in 2007 to guide and support interagency cooperation to make Vermont's transportation system safer for both people and wildlife. VTrans published its Vermont Transportation & Habitat Connectivity Guidance Document in 2012. Together they currently support three wildlife camera and road tracking projects to advance our understanding of wildlife's use of transportation infrastructure. These studies are providing VTrans with improved infrastructure design criteria and VFWD with an enhanced understanding of wildlife movement at key locations in the state.

The Staying Connected Initiative was established in 2008 to maintain and improve landscape connectivity across the Northern Appalachian/Acadian region of the eastern U.S. and Canada (NY, VT, NH, ME, MA and the eastern provinces) through research, land use planning, land management, land protection and road barrier mitigation. The comprehensive approach of the partnership allows the targeting of specific wildlife movement pinch points and coordinated action and affords some assurance that expensive state investment in wildlife-friendly transportation infrastructure is not undone by conflicting land uses in the near vicinity beyond the transportation right-of-way. Partners include VFWD, TNC, VNRC, VTrans, NWF, Wildlife Conservation Society, and the fish and wildlife and transportation agencies of partner states). VFWD has also worked closely with the North Atlantic Landscape Conservation Cooperative on a pilot conservation design for the Connecticut River watershed.

In 2014-2015 VFWD and partners including Vermont Land Trust, Vermont Forests, Parks & Recreation, The Nature Conservancy, and the Northwoods Stewardship Center produced "Vermont Conservation Design: Maintaining and Enhancing an Ecologically Functional Landscape" (Sorenson et al. 2015) (appendix F). This report identifies coarse-filter conservation targets for landscape scale features including forest blocks, riparian areas, wildlife and landscape connectivity, and physical landscape diversity that are necessary to effectively conserve many finer scale conservation elements in the face of climate change and habitat loss, including natural communities, rare species, and SGCN.

The Natural Resources Conservation Service and the Farm Services Agency are both part of the US Dept of Agriculture and both have riparian buffer restoration programs that have partnered with the USFWS and Vermont Agency of Agriculture. While their focus is on water quality, they've produce sizable riparian forest buffers.

The Partners for Fish & Wildlife program of the U.S. Fish & Wildlife Service, which organizes and supports community-based habitat restorations, partnered with more than 600 landowners on more than 550 projects to restore 294 miles of riparian habitat, 5,476 acres of wetland habitat, 976 acres of upland habitat and 1,200 acres of habitats impacted by invasive species. Partners also reopened 1,438 miles of stream to fish passage; and completed 11 miles of in-stream restoration.

Species of Greatest Conservation Need Benefitting from Landscape Conservation

Without landscape-scale conservation, some species are unlikely to remain on our landscape. These are wide-ranging species, including the American Marten, Canada Lynx, Bobcat, Northern River Otter, Bald Eagle, Red-shouldered Hawk and Northern Goshawk. Wolf and Eastern Mountain Lion likely could not return without secure landscapes. Landscape conservation, however, is also expected to benefit most of Vermont's other Species of Greatest Conservation Need as the landscape functions identified here are necessary for either their immediate habitat and movement needs, or for their long-term genetic exchange and climate adaptation needs.

Landscape Characteristics

As part of the Wildlife Action Plan revision, Vermont conducted a broad-based assessment of landscape-level biological and ecological data to identify lands and waters that are of highest priority and value for maintaining Vermont's ecological integrity. The resulting report, Vermont Conservation Design: Maintaining and Enhancing an Ecologically Functional Landscape (Sorenson et al. 2015) appendix F) identified six landscape elements as most effective at capturing the needs of many Species of Greatest Conservation Need and their habitats. They are Interior Forest Blocks, Connectivity Blocks, Surface Waters and Riparian Areas, Riparian Areas for Connectivity, Physical Landscape Diversity Blocks, and Wildlife Road Crossings and are described below.

The assessment identified the blocks, riparian areas and road crossings that are a parsimonious solution to conserving a functional landscape. High priority areas for each element were mapped and will be made available to conservation practitioners and others via the BioFinder website. The report and maps can also be found in Appendix F.

The goal is to maintain the ecological functions provided by each landscape element. For example, the goal for Interior Forest Blocks is to maintain the unfragmented, interior forest of these areas that provides critical habitat for many species of plants and animals. There is considerable leeway on what can happen within a forest block and still maintain interior forest function. For example, most responsible forest management activities are compatible with maintaining the long-term interior forest functions for these blocks. Each section below provides guidelines on what is needed to maintain ecological functions for that element.

While each landscape element is important on its own, it cannot function in isolation. Maintaining or enhancing an ecologically functional landscape in Vermont depends on both the specific function of the element and the ability of landscape elements to function together. Interactions between elements are what support Vermont's environment and are essential for long-term conservation of Vermont's biological diversity and natural heritage.

By 'conservation' we mean a wide range of activities, from private land stewardship to public ownership and other activities that help maintain ecological function. Many tools can be used to achieve the overall goal. With approximately 80% of Vermont's land privately owned, management and stewardship of private lands will be essential to achieving these goals. Other tools include local planning and zoning, state regulations, conservation easements, and ownership by a state or federal agency or a private conservation organization. This document and these maps do not provide detail as to which of these tools are best suited to specific places, but there are recommendations for further prioritization filters that users can apply to make these decisions.

Interior Forest Blocks: Areas of contiguous forest and other natural communities and habitats (such as wetlands, ponds, and cliffs) that are unfragmented by roads, development, or agriculture.

Forest blocks were identified, mapped, and ranked by Sorenson and Osborne (2014). These forest blocks provide many ecological and biological functions critical for protecting SGCN and the integrity of natural systems (Austin et al. 2004), including:

- Supporting natural ecological processes such as predator-prey interactions and natural disturbance regimes;
- Helping to maintain air and water quality and flood resilience;
- Supporting the biological requirements of many plant and animal species, especially those that require interior forest habitat or require large areas to survive;
- Supporting viable populations of wide-ranging animals by allowing access to important feeding habitat, reproduction, and genetic exchange; and
- Serving as habitat for source populations of dispersing animals for recolonization of nearby habitats that may have lost their original populations of those species.

In addition, large, topographically diverse forest blocks will allow many species of plants and animals to shift to suitable habitat within a forest block in response to climate change within the next century without having to cross developed areas to other forest blocks. (Beier 2012)

Connectivity Blocks: The network of forest blocks that together provide terrestrial connectivity at the regional scale (across Vermont and to adjacent states and Québec) and connectivity between all Vermont biophysical regions.

Landscape connectivity refers to the degree to which blocks of suitable habitat are connected to each other (Noss and Cooperrider 1994). There is a high level of connectivity within individual forest blocks. The proximity of one forest block to another and the characteristics of the intervening roads, agricultural lands, or development determine the effectiveness of the network of Connectivity Blocks in a particular area.

A network of Connectivity Blocks allows wide-ranging animals to move across their range, allows animals to find suitable habitat for their daily and annual life needs, allows young animals to disperse, allows plant and animal species to colonize new and appropriate habitat as climate and land uses change, and contributes to ecological processes, especially genetic exchange between populations (Austin et al. 2004). There is general agreement among conservation biologists that landscape connectivity and wildlife corridors can mitigate some of the adverse effects of habitat fragmentation on wildlife populations and biological diversity (Beier and Noss 1998; Noss and Cooperrider 1994; Haddad et al. 2003; Damschen et al. 2006). Specifically, climate change adaptation is enhanced if the long distance movements of plants and animals is supported by a combination of short movements within large, topographically diverse forest blocks and short corridor movements between forest blocks (Beier 2012).

Surface Waters and Riparian Areas: The network of all lakes, ponds, rivers, and streams, their associated riparian zones and valley bottoms in which geophysical processes occur, and their connections to groundwater.

Vermont's rivers, streams, lakes, and ponds provide vital habitat for a rich assemblage of aquatic species, including fish, amphibians, reptiles, invertebrates (e.g., insects, mussels, snails, worms, freshwater sponges), and plants. This represents an enormous contribution to Vermont's biological diversity. The ecological integrity of an aquatic system is dependent on the condition of the watershed in which it occurs, but is also critically tied to the condition of the riparian area adjacent to the stream or pond. For stability, rivers and streams must have access to their floodplains and freedom to meander within their valley bottoms or river corridors. Naturally vegetated riparian areas provide many critical ecological functions, including stabilizing shorelines against erosion, storage of flood waters, filtration and assimilation of sediments and nutrients, shading of adjacent surface waters to help moderate water temperatures, and direct contribution of organic matter to the surface water as food and habitat structure. Riparian areas are also critical habitat for many species of wildlife that are closely associated with the terrestrial and aquatic interface, including mink, otter, beaver, kingfisher, spotted sandpiper, and wood turtle. Furthermore, the shorelines and riparian areas of rivers and lakes support floodplain forests, several other rare and uncommon natural communities, and many species of rare plants and animals. In addition to these ecological functions that are tied to aquatic systems, the linear network of riparian areas provides a critical element of landscape connectivity for plant and animal movement in response to climate change (Beier 2012). Although many riparian areas and river corridors are highly altered by agriculture, roads, and urbanization, the risk of flooding serves as a natural deterrent for future development. Riparian areas also respond rapidly to restoration efforts (Beier 2012).

Riparian Areas for Connectivity: The connected network of riparian areas in which natural vegetation occurs, providing natural cover for wildlife movement and plant migration.

In addition to supporting the integrity of the lakes, ponds, rivers, and streams that they border, naturally vegetated riparian areas are especially important for providing cover for wildlife movement and other important wildlife habitat, such as nesting habitat for birds. Many wildlife species use riparian corridors for travel to find suitable habitat to meet their life requisites, but certain species are almost entirely restricted to riparian areas, including mink, otter, beaver, and wood turtle. The linear nature of riparian areas contributes to their function as movement corridors for wildlife. Roads, development, and agricultural lands fragment the Vermont landscape. The combination of Riparian Areas for Connectivity and Connectivity Blocks provide the best available paths for connectivity across the landscape.

Physical Landscape Diversity Blocks: Blocks that include physical landscape diversity features that are either rare in Vermont or under-represented in the land and water areas identified as highest priority for Interior Forest Blocks, Connectivity Blocks, and Surface Waters and Riparian Areas.

The Physical Landscape Diversity Blocks complement the other block types and riparian areas to more fully represent the full spectrum of physical landscape diversity that is important for an ecologically functional landscape. Physical landscape diversity is represented in this conservation design by rare Land Type Associations (Ferree and Thompson 2008) and Ecological Land Units stratified by elevation, adapted from Ferree and Anderson (2008).

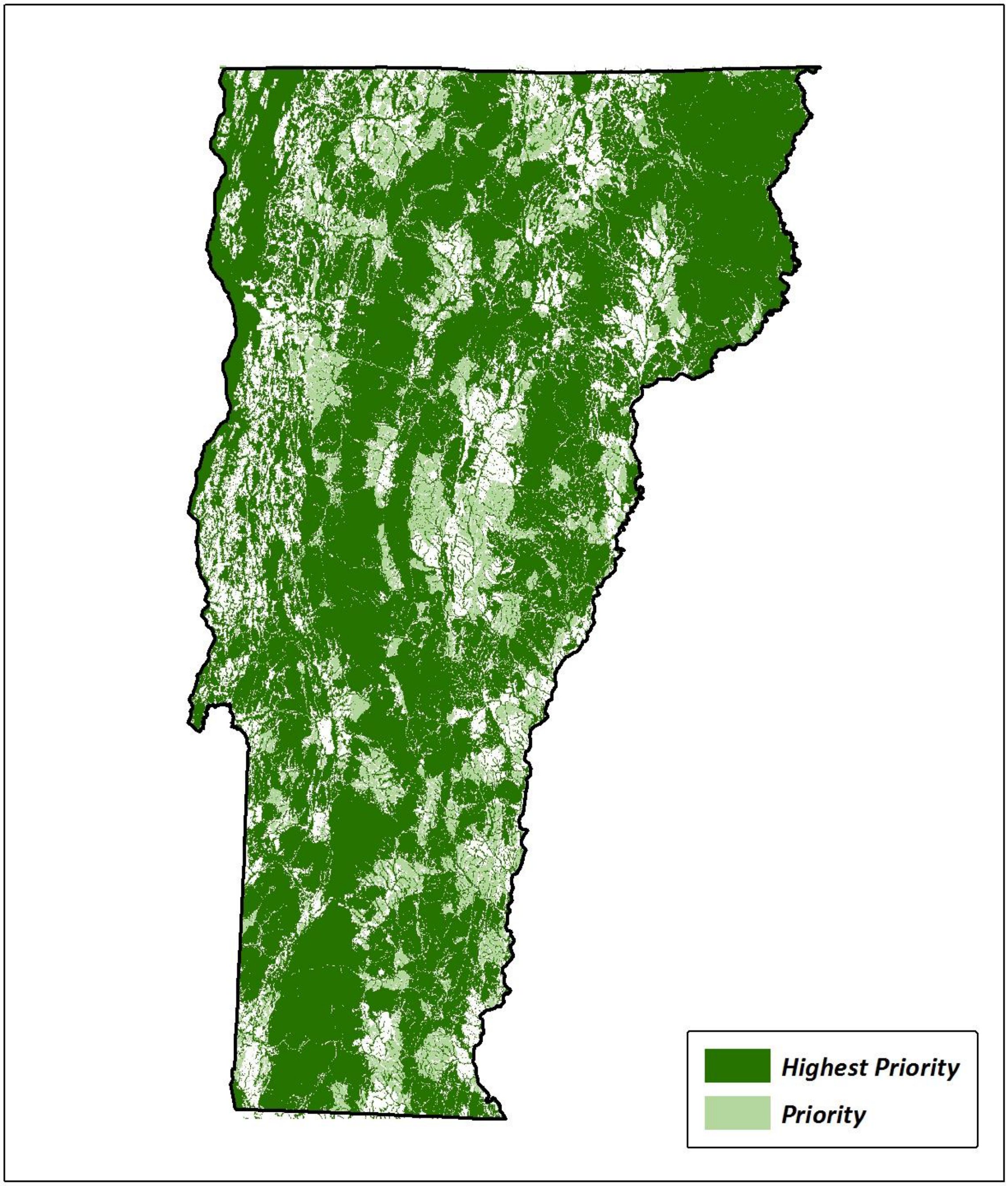
Physical landscapes (often referred to as enduring features) are the parts of the landscape that resist change. They are the hills and valleys, the underlying bedrock, and the deposits left behind by glaciers. They remain constant even when changes in land cover and wildlife occur, as plants and animals move, and even as the climate changes. However, these physical landscapes cannot continue to drive ecological processes or support plants, animals, or natural communities if they are developed or otherwise significantly altered by human activities.

Wildlife Road Crossings: Sections of road that cross a wildlife corridor where the adjacent landscape quality and permeability are high, usually because the road is adjacent to a forest block, and the road is the primary impediment to animal movement. Likely wildlife road crossings are identified statewide in VFWD's habitat block project (Sorenson and Osborne 2014).

Wildlife corridors (also referred to as wildlife connecting habitats) are lands and waters that connect larger patches of habitat together within a landscape and allow the movement, migration, and dispersal of animals and plants (Austin et al. 2004). Roads represent a barrier to wildlife movement and dispersal of many other species, including some plants. Sections of roads that have suitable habitat on both sides are more likely to allow wildlife movement and dispersal of other species and, therefore, these sections of roads are critical components of maintaining or enhancing an interconnected, ecologically functional landscape. Wildlife road crossings that provide connectivity over or under roads are critically important between adjacent forest blocks and along linear riparian area networks.

The Ecologically Functional Landscape

Maintaining and enhancing an ecologically functional landscape in Vermont depends on conservation of the five landscape level elements described above. It is the specific functions of each alone and their complementarity functioning together that are critical for long-term conservation of much of Vermont's biological diversity and natural heritage. The following map shows the ecologically functional landscape conservation design developed for this Wildlife Action Plan revision. It excludes the Surface Waters and Riparian Areas elements which are difficult to display at this scale.



Map 1. The Highest Priority and Priority portions of the Ecologically Functional Landscape, including Interior Forest Blocks, Connectivity Blocks, and Physical Landscape Diversity Blocks (excluding the Surface Waters and Riparian Areas which are difficult to interpret at this scale).

Threats & Information Needs

Problem/ Information Need Category	Problem/ Information Need Detail	Rank
Determine SGCN Habitat Requirements	Some SGCN and RTE species need to be more confidently captured by landscape and natural community/habitat conservation.	High
Habitat Conversion	Permanent conversion of large blocks of forest to housing development, commercial development, and roads	High
Habitat Fragmentation	Fragmentation of large forest blocks, riparian corridors, and migration paths disrupts animal movement and ecological processes.	High
Impacts of Roads	Roads and road usage disrupt animal movements, alter water quality and stream migration and provide pathways for introduction of invasive species.	High
Climate Change	Species will need to shift their distributions in response to climate-driven habitat and environmental changes. This will be more difficult in a fragmented landscape.	High
Invasive Exotic Species	Invasive species can degrade some landscape scale processes such as species movement and migration. For example, riparian corridors dominated by Japanese knotweed are less suitable for native plant and animal movement.	High
Habitat Conversion	River channel straightening and bank hardening contributes to loss of floodplain connectivity, habitat loss, and downstream erosion and flooding.	High
Habitat Fragmentation	Interruption of movement corridors to and from breeding, feeding, and seasonal habitats via conversion, degradation, and road mortality (i.e., herps).	High

Priority Conservation Actions

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
Develop a system to track habitat loss and conversion statewide.	Change in habitat status. Re-run the statewide habitat block analyses every 5 years	ANR, VTrans, ACCD, UVM, VNRC, NOAA, USGS, VLT, TNC	SWG, PR, ANR
Develop systems to better track habitat quality and protection status	-Apply change metrics (e.g., percent conserved) major landscape components (e.g., blocks, connectivity). -For riparian areas compare acres in restoration vs row crop, hay, developed (using Natl. Landcover dataset every 5-yrs). -FIA forest condition	ANR, VTrans, ACCD, UVM, VNRC, NOAA, USGS, TNC, VLT, Staying Connected, NOAA	SWG, PR, ANR, NOAA (CCAP)
Continue reviewing town plans and bylaws every 10 years to determine municipal level conservation status. Develop spatial component to this assessment.	*Metrics in development*	VFWD, VNRC, ACCD, AVCC	VFWD, ACCD

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
Complete the Vermont Conservation Design project by Identifying habitat and species-level conservation goals for SGCN species and make the results widely available.	Identify all habitats and natural communities that are not conserved by landscape-scale features. For each, identify its role as a coarse filter for species, and develop quantitative and/ or spatially explicit conservation targets	FPR, TNC, GMNF, VCE, VLT,	SWG, PR
Refine models of habitat connectivity (e.g., BioFinder's network of Connected land, Local Road Crossings, Staying Connected Linkage Models, Structural pathways)	Number of suitable habitat patches available, miles of riparian corridors & linkages conserved.	TNC, USFWS, USFS, VTrans, NWF	SWG, VHCB, FPR, TNC, VTrans
Support conservation through fee simple purchase and easements on high priority sites	Number of acres conserved	ANR, VLT, TNC, VHCB, other land trusts	VHCB, VLT, USFS, USFWS, LWCF, Forest Legacy
Protect from inappropriate development the highest priority areas identified in the Vermont Conservation Design	Number of acres protected	ANR, VLT, TNC, TPL, VHCB, Towns, RPCs, and other land trusts	VHCB, VLT, USFS, USFWS, LWCF, Forest Legacy
Provide Technical assistance to private landowners, user groups and forest managers to reduce habitat fragmentation and degradation and to restore and enhance degraded habitats.	Number of landowners managing for species of greatest conservation need	NRCS, TNC, VFWD, FPR, Coverts, SAF VWA, NWF	SWG
Restore riparian areas to enhance riparian connectivity at sites identified in Vermont Conservation Design report (appendix F).	Increase in number of acres of riparian habitat restored and/or conserved	ANR, Agency of Agric., VTrans, Rivers Conservancy Municipal Road Managers	
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, Coverts	EQIP
Provide technical assistance to towns and Regional Planning Commissions. Distribute *Conserving Vermont's Natural Heritage* (Austin et.al. 2004) and Community Strategies for Vermont's Forests and Wildlife (VNRC 2013)	Number of towns incorporating wide-ranging species into planning	VFWD, VNRC, 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 providing for Lynx and Marten habitat	ANR, USFWS, USFS	ANR
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 and provinces, VTrans, USDOT, TNC, Staying Connected,	USFWS, AFWA

Strategy	Performance Measure	Potential Partners	Potential Funding Sources
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	
Identify, prioritize and control problematic native and invasive species deleterious to SGCN and prevent introduction of these species. Develop plans at landscape-scale.	Acres surveyed/mapped; acres with dominant native vegetation protected or restored	DEC, FPR, USFWS, GMNF, NRCS, FSA, Ag, municipal & watershed groups, lake associations foresters,	ANR, NRCS, FSA
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.	
Restore aquatic connectivity based on Aquatic Organism Passage recommendations	Miles of passage restored	NRCS, USFWS, VTrans, TU, EBTJV, Watershed Groups	EQIP, CREP, ANR, 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, to identify and maintain (or restore) terrestrial & riparian habitat connectivity and improve aquatic organism passage	Number of functional linkages across highways/roads Increase in % or number of road crossings that do not impede aquatic organism movement	ANR, VTrans, Better Back Roads, USFWS, USFS, AVCC, TNC	SWG, USFWS, LCBP, VTrans
Develop road management BMPs for habitat connectivity and vegetation management		VTrans, VFWD, Staying Connected	FHWA
Increase the number of road structures meeting fish and wildlife passage guidelines	Number of improved/upgraded structures	VTrans, VFWD, Staying Connected, USFWS	FHWA,
Fund and support a natural resource planner position at each RPC (use the RPC transportation planner as a model)	Number of Regional Planning Commissions with natural resource planner. Number of Regional Planning Commissions requesting technical assistance	ANR, USFWS, USFS, EPA, RPC, VFWD, VNRC, Staying Connected	ANR, USFWS, USFS, EPA,
Provide more fish, wildlife & natural resource oriented technical assistance to constituent towns for town plan rewrites and bylaw changes	Number of town plans and bylaws with improved language	VNRC, RPCs, VFWD	
Support municipal-scale natural resource inventories and collaborative efforts by towns to identify, prioritize and protect habitat and natural resources.	Number of towns with completed inventories of their natural resources.	VFWD, VNRC, Enviro Consultants	

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