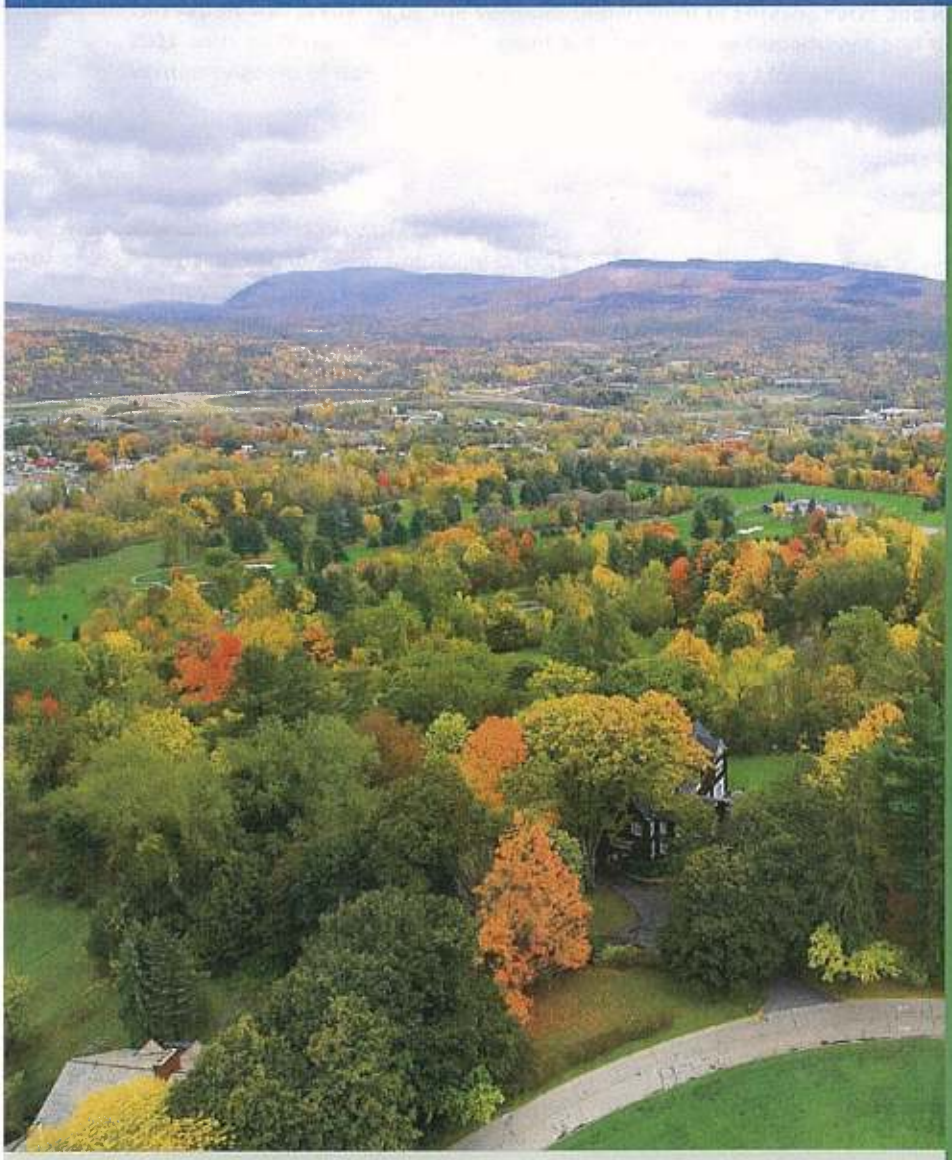
2015 Vermont Forest Fragmentation Report



VERMONT DEPARTMENT OF FORESTS, PARKS AND RECREATION

AGENCY OF NATURAL RESOURCES

APRIL 2015

Submitted to House and Senate Committees on Natural Resources and Energy and the House Committee on Fish, Wildlife, and Water Resources

Report to the Vermont Legislature

This land-based cultural heritage is reflected in the way Vermonters view the landscape. The Center for Rural Studies polled Vermonters and found support (*strongly agree* and *agree* combined; see below box) for working landscapes and the cultural heritage associated with them (Center for Rural Studies 2008):

Statement	Percent
I value the working landscape and its heritage	97.2
I am proud of being from or living in Vermont	93.6
I value Vermont's spirit of independence	93.1
I value the privacy I get in Vermont	91.0
I believe Vermont's creative communities are valuable to the state	89.2
I believe there is a strong sense of community where I live	85.4
I value the participatory government in Vermont	82.9
I believe that private property rights are well respected in Vermont	69.9

N = 699. Source: Center for Rural Studies 2008.

In addition, Vermont has established a successful economic niche by building on the advantage of having smaller cities and towns and their proximity to rural and forested natural landscapes. Furthermore, in Vermont there is strong emphasis on preserving small, local businesses (Aref 2012). Small towns surrounded by undeveloped forests and fields seem to exemplify the Vermont brand and have both economic and intrinsic value for Vermonters: the intangible significance of enjoying forests, the natural surroundings, and the quality of life associated with this working landscape.

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Particular Importance of Forest Blocks

Much of the benefit Vermonters derive from forests can be attributed to forest blocks. Forest blocks are areas of contiguous forest and other natural habitats, often spanning multiple ownerships and frequently unfragmented by roads, development, or agriculture. Vermont's forest blocks are primarily forests, but can also include wetlands, rivers and streams, lakes and ponds, cliffs, and rock outcrops.

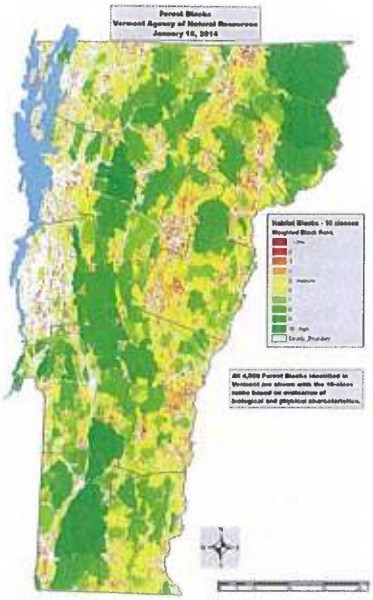


FIGURE 4. VERMONT'S FOREST HABITAT BLOCKS. SOURCE: VERMONT FISH & WILDLIFE DEPARTMENT.

Forest blocks provide many ecological and biological values critical for protecting native species and the integrity of natural systems. These values include (Austin et al, 2004):

- supporting natural ecological processes such as predator-prey interactions and natural disturbance regimes;
- helping to maintain air and water quality;
- 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;
- serving as habitat for source populations of dispersing animals for recolonization of nearby habitats that increase the resiliency of wildlife populations to climate change and other environmental stressors;
- minimizing wildlife mortality from disturbance, conflicts with humans, and roads;

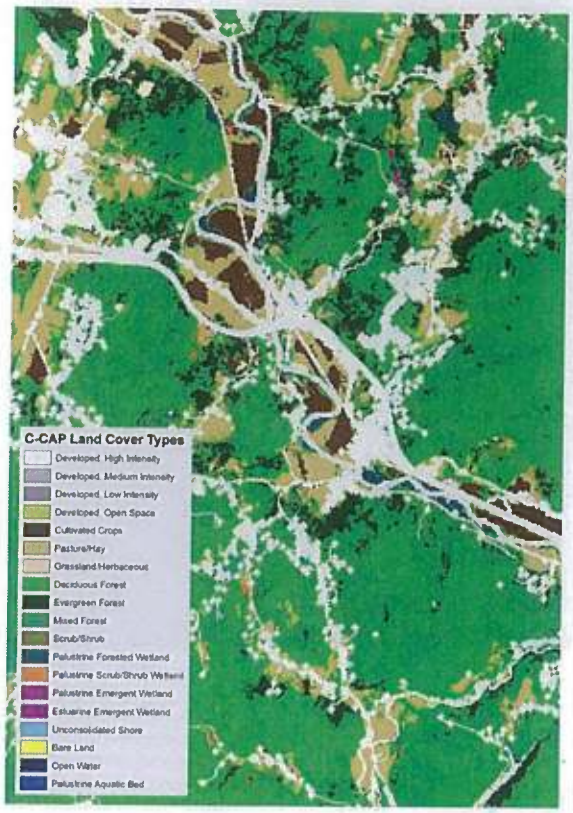
Vermont Habitat Blocks and Habitat Connectivity:

An Analysis using Geographic Information Systems

Vermont Fish and Wildlife Department

April 2014

Eric Sorenson, Vermont Fish and Wildlife Department
Jon Osborne, Vermont Land Trust



The C-CAP land cover data were refined to improve block delineations using several GIS layers, including roads, E911 buildings, and hydrography. These layers are shown in white on the image to the left. The following decisions were used in defining habitat blocks:

- Class 1, 2, and 3 roads were considered block fragmenting features.
- Class 4 roads were not used to define block boundaries as they are mostly narrow and have minimal traffic. It was recognized that the presence of Class 4 roads within habitat blocks causes some fragmentation and these roads are potential locations for future development and fragmentation.
- Power lines were treated similarly to Class 4 roads.
- Open waters of ponds and rivers were included in habitat blocks and not considered fragmenting features. Although bodies of water may represent movement barriers to some wildlife species, ponds and rivers are natural habitats, as are cliffs and wetlands.
- Habitat blocks less than 20 acres were eliminated from the analysis. These small habitat areas may provide some wildlife, biological diversity, or connectivity functions, but they provide little interior forest habitat. Their removal also reduced "noise" in the analysis.

VERMONT CONSERVATION DESIGN

MAINTAINING AND ENHANCING AN ECOLOGICALLY FUNCTIONAL LANDSCAPE

December 2015

Eric Sorenson, Robert Zaino, Jens Hilke - Vermont Fish and Wildlife Department
and
Elizabeth Thompson - Vermont Land Trust

Vermont Land Trust
CONSERVING LAND FOR THE FUTURE OF VERMONT

Conserving Ecological Function

It is important to note that the goal for all of these areas is to maintain the ecological functions provided by that 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 forest management activities are compatible with maintaining the long-term interior forest functions for these blocks, providing these activities are thoughtfully planned.

Many tools can be used to achieve the overall goal of retaining ecological function. With approximately 80% of Vermont's land privately-owned, management and stewardship of private lands will be an essential path to success. Other tools include conservation easements, local planning and zoning, state regulations, and ownership by a state or federal agency or a private conservation organization. This document and these maps do not provide the 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.

Each section below provides guidelines on what is needed to maintain ecological functions for that element.

Landscape Element Descriptions and Maps

Interior Forest Blocks

Definition: 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).

Ecological Function: Forest blocks provide many ecological and biological functions critical for protecting native species 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

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

Ecological Function: 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). Maintaining the landscape connectivity function requires both Connectivity Blocks and Riparian Areas for Connectivity, especially in highly fragmented areas of Vermont. 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).

Priority Areas for Maintaining an Ecologically Functional Landscape:

These are the forest blocks that provide a major supporting connectivity function for the "backbone" of highest priority Connectivity Blocks. They also provide alternative pathways for connectivity, as redundancy is a critical safeguard in ensuring the long term effectiveness of the connectivity network.

Highest Priority: The terrestrial "backbone" of forest blocks is a subset of all Connectivity Blocks that provides connectivity to all biophysical regions. The "backbone" incorporates the spines of the major mountain ranges, connections outside Vermont to unfragmented habitat, and anchor blocks in fragmented biophysical regions based on abundant known occurrences of rare species and significant natural communities. Small forest blocks are included at pinch-points in the connectivity network as they are critical stepping stones.

Guidelines for Maintaining Ecological Function: Similar to Interior Forest Blocks, it is important to maintain the interior forest conditions in Connectivity Blocks by avoiding permanent interior forest fragmentation resulting from development. Connectivity within forest blocks will remain high if they remain unfragmented. For Connectivity Blocks it is also critically important to maintain or enhance the structural and functional connectivity that occurs on the margins of

Surface Waters and Riparian Areas

Definition: The network of all lakes, ponds, rivers, and streams, their associated riparian zones, valley bottoms, and river corridors in which geophysical processes occur, and their connections to groundwater.

Ecological Function: 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 significant 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 very essential 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. 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 crucial 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).

Priority Areas for Maintaining Ecologically Functional Landscape:

All of the aquatic network of lakes, ponds, rivers, and stream and the valley bottoms in which the rivers and streams occur; to be conserved or managed in such a way as to achieve full functioning of all natural processes.

Highest Priority: All of the aquatic network of lakes, ponds, rivers, and streams and the valley bottoms in which the rivers and streams occur, excluding developed land and including the Vermont hydrography layer and a buffer that is proportional to stream order.

Guidelines for Maintaining Ecological Function: Restoration is needed in order for Surface Waters and Riparian Areas to provide full ecological functions. Specifically, river channel equilibriums need to be maintained or restored. Natural vegetation should be maintained or restored in undeveloped riparian areas of rivers, streams, lakes, and ponds of adequate width to maintain water quality, stabilize shorelines, provide shade and biological support for aquatic systems, maintain biological diversity, and provide functional connectivity, both aquatic and terrestrial.

Physical Landscape Diversity Blocks

Definition: A set of forest blocks and other areas of natural vegetation 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 in order 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).

Ecological Function: 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 largely unchanged 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.

If nature is likened to a dramatic play, it's possible to think of the enduring features as the stage and the individual species as the actors. The play is the natural communities, habitats and species that occur in a given place at a given time, but regardless of the action, the stage does not change. The importance of "conserving nature's stage" is that we can be much more confident in our ability to conserve biological diversity and maintain a functional landscape into the future, with the capacity to adapt and be resilient to climate change, if all elements of physical landscape diversity are represented in the conservation design (Anderson & Ferree 2010; Beier and Brost 2010; Beier et al. 2015).

Priority Areas for Maintaining an Ecologically Functional Landscape:

All are in the highest priority category.

Highest Priority: All of the identified forest blocks and other areas of natural vegetation which contain physical landscape diversity features that are either rare, under-represented in other block types or the riparian areas, or for which Vermont has a regional responsibility (especially calcium-rich bedrock).

Guidelines for Maintaining Ecological Function: Maintain or restore natural vegetation and limit development. Forest management that maintains forest structure within and results in a distribution of all age classes is very compatible with maintaining the physical landscape diversity functions.

Further prioritization for conservation could be achieved using the following filters:

1. Blocks containing the rarest landscape diversity features.
2. Blocks containing landscape features that are underrepresented on conserved lands.