BioFinder 4.0 Technical Abstracts

Prepared by the

Vermont Agency of Natural Resources'
BioFinder/ Vermont Conservation Design Team

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Technical Abstracts for Vermont Conservation Design Components

Interior Forest Blocks

Description

Interior Forest Blocks are a selection of habitat blocks that best provide interior forest conditions in each Biophysical region. Habitat blocks themselves are areas of contiguous forest and other natural habitats that are unfragmented by roads, development, or agriculture. This dataset is a selection of the largest habitat blocks in each biophysical region and has the best likelihood of offering interior forest conditions. Vermont's habitat blocks are primarily forests, but also include wetlands, rivers and streams, lakes and ponds, cliffs, and rock outcrops. Forests included in habitat blocks may be young, early-successional stands, actively managed forests, or mature forests with little or no recent logging activity. The defining factor is that there is little or no permanent habitat fragmentation from roads, agricultural lands and other forms of development within a habitat block. Developed lands, most roads and lands in most agricultural cover classes (including cultivated crops, grasslands and pasture) are not considered natural cover. To more accurately identify interior forest conditions, buffers were assigned to roads with wider buffers assigned to larger and busier roads. Class four roads and most logging roads are fragmenting features for some species, but not necessarily for wide-ranging species that are the focus of the habitat block analysis.

Interior Forest Blocks serve as a course filter for a host of finer scaled elements detailed in the attached matrix. (Panzer and Schwartz 1998; Molina et al. 2011; Shuey et al. 2012)(Hunter 1991; NCASI 2004; Schulte et al. 2006). (Jenkins 1985; Noss 1987; Hunter et al. 1988;; Noss and Cooperrider 1994; Haufler et al. 1996; Jenkins 1996; Poiani et al. 2000; USDA 2004).

Highest Priority Forest Blocks: are the largest forest blocks with a minimum amount of core forest from all biophysical regions that provide the foundation for interior forest habitat and associated ecological functions. Priority Interior Forest Blocks are smaller forest blocks from all biophysical regions that provide important interior forest habitat and provide ecological support to the highest priority Forest Interior Blocks.

Ecological Function:

Interior forest blocks support the biological requirements of many native plants and animals. They support viable populations of wide-ranging animals, including bobcat, American Marten, and black bear, that require large areas to survive by allowing access to important feeding habitat, the ability to move and find mates for reproduction, and as a result ensure genetic integrity of populations. Larger forest blocks serve as habitat for source populations of dispersing animals for recolonization of nearby areas that may have lost their original populations of those species. Such habitat, together with other important habitats such as wetlands, also supports natural ecological processes such as predator/prey interactions, hydrologic regimes and natural disturbance. They also serve to buffer species against the negative consequences of fragmentation, maintain air and water quality.

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).

The coarse-filter conservation approach can provide for the habitat needs of many of Vermont's species, allowing for efficiency in conservation planning and design. We have very high confidence that this conservation design identifies areas essential for the long-term functioning of Vermont's landscape and the species it contains.

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.

Guidelines for Maintaining Ecological Function

The primary goal is to maintain the interior forest conditions that forest blocks provide by avoiding permanent interior forest fragmentation resulting from development. Limited development on the margins of existing large forest blocks may not have significant adverse effects as long as it does not reduce connectivity between blocks and does not encroach into the forest block interior. Forest management that maintains forest structure within the block and results in a distribution of all age classes is compatible with maintaining interior forest conditions over the long term.

Interior Forest Blocks Conservation Goal

To conserve interior forest blocks across Vermont that support interior forest ecological processes as well as viable populations of Vermont's native fish and wildlife, including a variety of interior forest birds, wide ranging species such as black bear, bobcat, and American marten, and form a network of lands and waters that include representation of the state's physical landscape diversity.

Component Mapping Goal

To identify the best examples of habitat blocks across Vermont and include appropriate representation of habitat blocks in all biophysical regions.

Source Data and Selection Criteria

Interior Forest Blocks were created by choosing a selection of Habitat Blocks from the updated 2023 Habitat Blocks dataset of the largest blocks in each biophysical region with minimum core forest.

Vermont Habitat Blocks, Hawkins-Hilke et al. 2023. Vermont Fish & Wildlife Department.

Description

Habitat blocks show all areas of natural cover (Combining 2016 Forest canopy, Shrubland, & Wetland landcover data from University of Vermont Spatial Analysis Lab) surrounded by roads, development and agriculture, ranging in size from 150-acres to 150,000-acres and prioritized for biological importance.

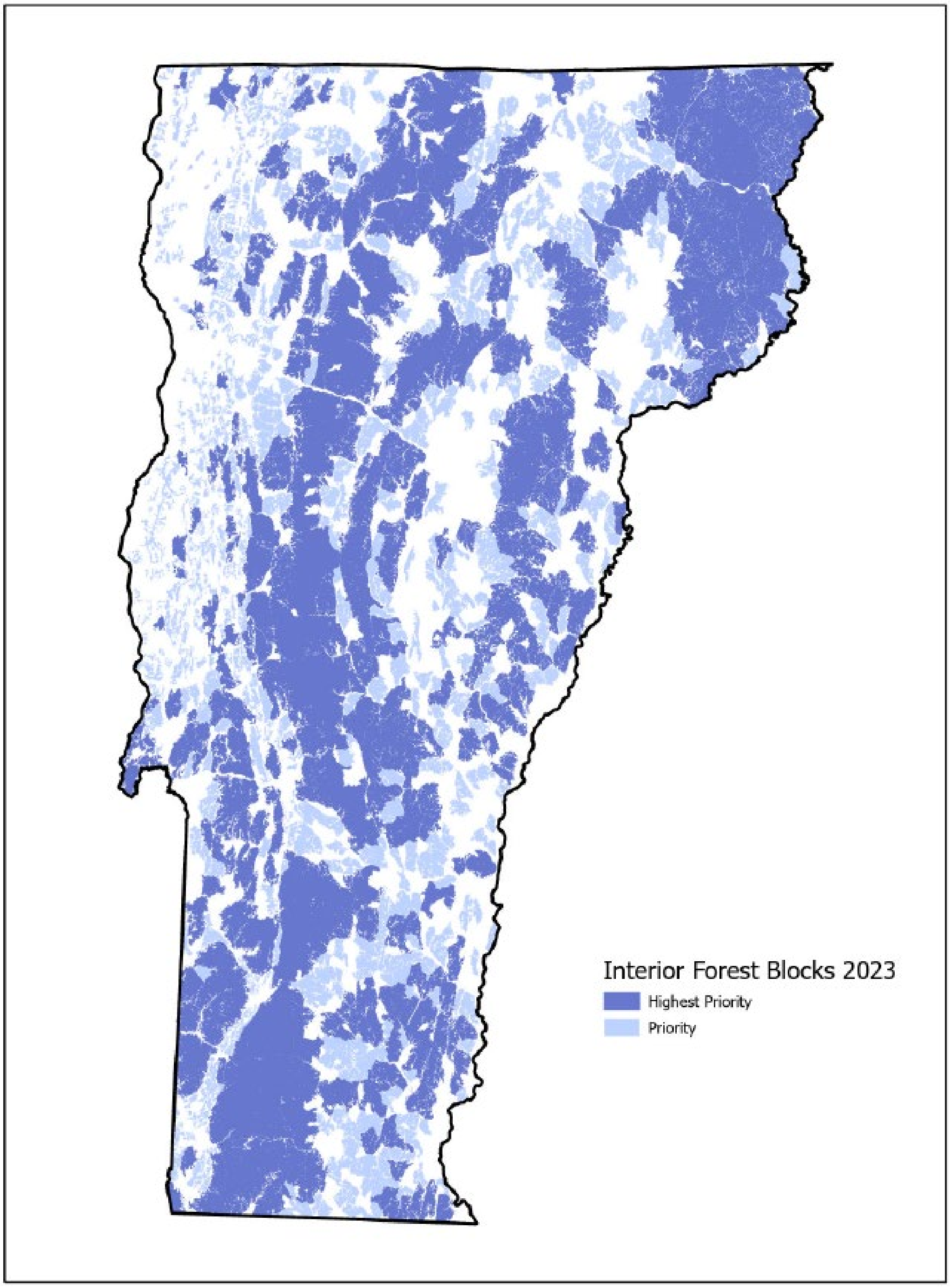
Selection Criteria

215 Habitat blocks were selected as Highest Priority Interior Forest & an additional 784 were selected as Priority. Habitat block selection criteria were designed to consider the varying land use patterns within each biophysical region as follows:

Figure 1.1 Minimum Acreage and Core Forests Acreage that define Highest Priority and Highest Priority Interior Forest Blocks

Biophysical Region	Highest Priority		Priority	
	Minimum Acreage	Minimum Core Forest Acreage	Minimum Acreage	Minimum Core Forest Acreage
Champlain Valley	1000 ac	250 ac	150 ac	0 ac
Taconics	2000 ac	1,000 ac	500 ac	250 ac
Northern Green Mountains	5000 ac	2,500 ac	500 ac	250 ac
Northeast Highlands	5000 ac	2,500 ac	500 ac	250 ac
Champlain Hills	2000 ac	1,000 ac	500 ac	250 ac
Southern Green Mountains	5000 ac	2,500 ac	500 ac	250 ac
Southern Vermont Piedmont	2000 ac	1,000 ac	500 ac	250 ac
Northern Vermont Piedmont	2000 ac	1,000 ac	500 ac	250 ac
Vermont Valley	1000 ac	250 ac	150 ac	0 ac

Figure 1.2 Map of the Highest Priority and Priority Interior Forest Blocks



Component Strengths

Interior Forest Blocks are spatially accurate. They are not modeled, but rather are based on land cover data. They reflect a mix of different land cover types, and hence serve as a coarse filter for a wide variety of plant and wildlife species. This dataset includes its own ranking. This ranking system evaluated biological values and physical landscape characteristics for each block allowing for a full range of biological diversity present within the blocks to be highlighted. This dataset excludes roads, development, and agriculture, ensuring that only unfragmented habitat is included.

Component Limitations

The Interior Forest Blocks dataset is biased towards higher elevation lands away from larger river valleys and lowlands as it excludes roads and a buffer around each road, and most of Vermont's roads and development are along rivers and in lowlands. This is a very typical development pattern in Vermont, where roads often closely follow streams and rivers where it is easiest to build. It results in some areas of streams not being considered due to their proximity to roads and development. However, the important influence of aquatic habitats is captured through other data sources, as described later, for purposes of this project.

Component Priority & Justification

The Interior Forest Blocks dataset is divided into Highest Priority and Priority based on size.

Highest Priority Forest Blocks: are the largest forest blocks with a minimum amount of core forest from all biophysical regions that provide the foundation for interior forest habitat and associated ecological functions.

Priority Interior Forest Blocks are smaller forest blocks from all biophysical regions that provide important interior forest habitat and provide ecological support to the highest priority Forest Interior Blocks.

References

Hawkins-Hilke, J., Zaino, R, Goodwin, G. Kosiba, A. Perry, S. & Wood, A. 2023 Vermont Habitat Blocks. Vermont Fish & Wildlife Department.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Connectivity Blocks

Description

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.

The composition and functions of connecting land are based on the scale at which it is considered. At the coarsest, eco-regional scale, connecting land in Vermont can be thought of as a "network" supporting genetic heterogeneity and movement of populations of wide-ranging mammal species across huge swaths of the landscape; such as between the Adirondacks Mountains of New York, Vermont's Green Mountains and the White Mountains of New Hampshire. It is a network in the sense that it includes 1)the largest blocks of contiguous, unfragmented core habitat, (the source and principle home area of many species as well as areas of diversity in the physical landscape), 2) connecting forest or "stepping stone blocks" (These may be smaller, but their landscape position between larger blocks make them integral to maintaining the network) and 3) local connections including riparian connectivity and wildlife road crossings.

Habitat is also connected at fine scales, for example by Riparian Connectivity and Wildlife Road Crossings, where individual terrestrial animals move along waterways and cross roads. This most local scale of movement may not necessarily be of regional significance, but of course, the regional connections cannot function without local movement. There can be no genetic exchange between wildlife populations in New York and Vermont, for example, without individual animals making sections of the trip, crossing roads and eventually breeding with other individuals. Therefore, local and regional connectivity are both vital to the long-term sustainability of wildlife populations and the ecological functions that they support. Habitat connectivity is captured in the following components:

Table 2.1 Habitat Connectivity at Regional & Local Scales

Scale	Component	Description
Regional Connectivity	Connectivity Blocks (Highest Priority)	Habitat blocks that are of the greatest importance for wildlife movement and genetic exchange
	Connectivity Blocks (Priority)	Habitat blocks that are perhaps of importance for wildlife movement and genetic exchange
	Riparian Connectivity	Lands along streams, rivers, lakes and ponds in natural-cover types. Does not include developed

Local Connectivity		lands and agricultural lands with cultivated crops, or pasture/hay.
	Wildlife Road Crossings	Locations where wildlife is likely to cross roads based on the presence of adjacent natural cover.

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 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).

Guidelines for Maintaining Ecological Function

It is critically important to maintain or enhance the structural and functional connectivity that occurs on the margins of these blocks where they border other blocks. This can be accomplished by maintaining forest cover along the margins and by limiting development in these areas of block-to-block connectivity. 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.

Connectivity Blocks Conservation Goal

Conserve connecting habitats that support seasonal and spatial patterns of wildlife movement and allow for movement between habitat patches across potential barriers. The larger conservation goal for landscape connectivity is to conserve a connected network of lands, waters, and riparian areas that allow for functioning of ecological processes across the landscape and dispersal, movement, and migration of plant and animal species in response to changing environmental conditions.

Component Mapping Goal

To identify and map the most vulnerable lands that contribute to connectivity at several scales. These important pinch points and stepping stones help form a multi-scaled network of connected land and water that includes core habitat, natural communities and connecting features.

Source Data and Selection Criteria

Connectivity Blocks were created by choosing a selection of Habitat Blocks from the updated 2023 Habitat Blocks dataset that form a connected pattern of forest that allows for wildlife movement across VT and beyond. The selection of blocks was made with reference to a variety of region-wide connectivity data and is the most current update of the network of connected lands and waters that the Fish & Wildlife Department first created in 2012.

Description

1. Vermont Habitat Blocks, Hawkins-Hilke et al. 2023. Vermont Fish & Wildlife Department.

Habitat blocks show all areas of natural cover (Combining 2016 Forest canopy, Shrubland, & Wetland landcover data from University of Vermont Spatial Analysis Lab) surrounded by roads, development and agriculture, ranging in size from 150-acres to 150,000-acres and prioritized for biological importance.

2. Northern Appalachian/Acadian Ecoregion: Priority Locations for Conservation Action Trombulak et al., 2008. This work identifies priority linkages at the ecoregional scale.

3. Resilient sites for terrestrial conservation in the Northeast and Mid-Atlantic region. Anderson et al., 2012. Using Circuitscape software this work models flow concentration areas to assess regional-scale connectedness and pinch points.

4. From the Adirondacks to Acadia: A Wildlands Network Design for the Greater Northern Appalachians. Reining et al., 2006). This work identifies a network design for regional connectivity based on habitat models for far-ranging mammals.

5. Linkage Areas of the Northern Appalachian and Acadian Ecoregion. 2012. Staying Connected Initiative. Staying Connected used models and field data to identify high priority linkages which were incorporated in their entirety because of their finer granularity.

6. Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.

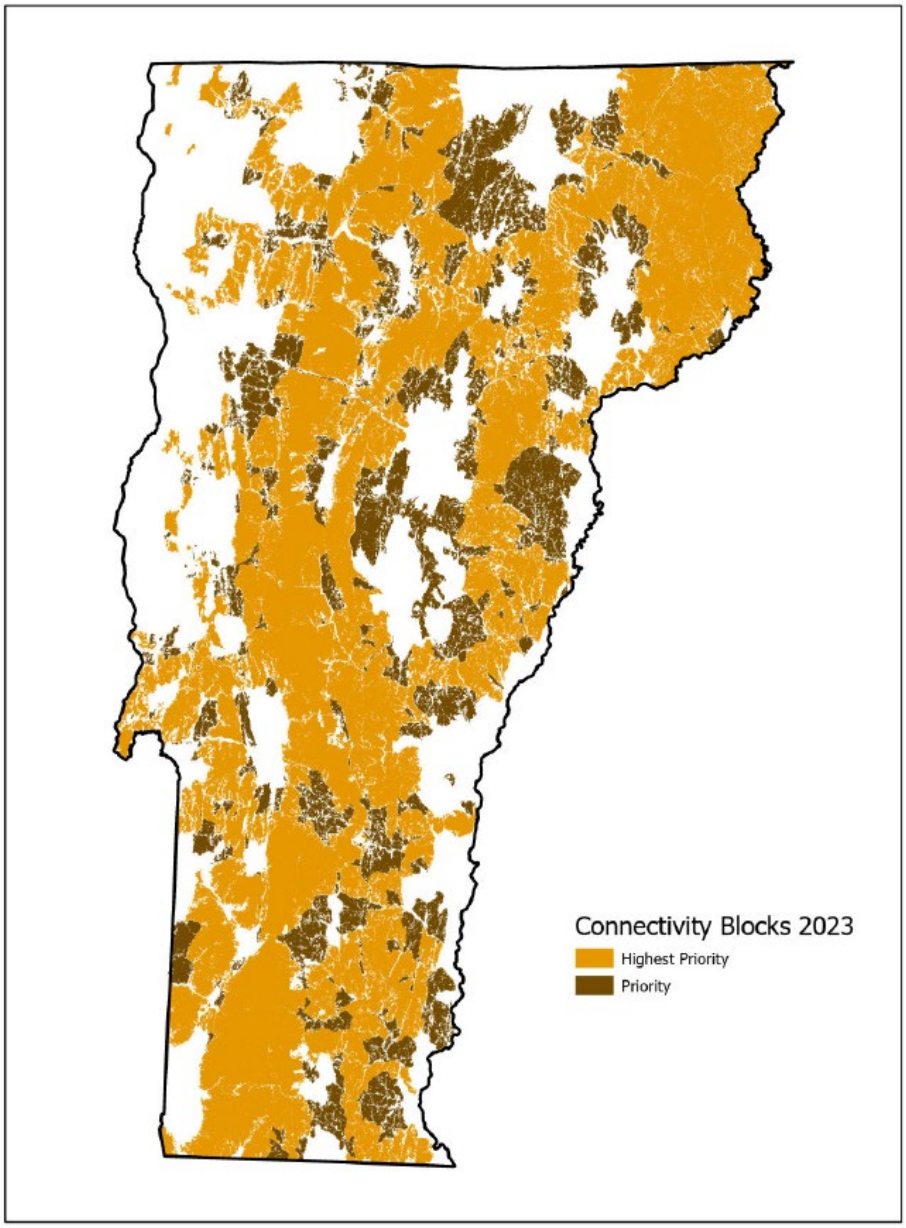
Selection Criteria

The 2023 Connectivity Blocks dataset is a refinement of the 2016 Connectivity Blocks, which was an update to the 2012 Network of Connected Lands. The 2016 edits refined the network into two tiers, highest priority and priority based on a review by the BioFinder Core team that included where blocks connect to areas of diversity in the physical landscape and the riparian network. In 2023, additional habitat blocks were selected for inclusion by the Core Team, to further fine tune the network with inclusion of additional smaller connecting blocks within the larger network. The Connectivity Blocks dataset reflects an understanding of connectivity that connects core habitat, areas of diversity in the physical landscape and the riparian network.

Connectivity Blocks is a selection of 1,528 habitat blocks. Of those, 548 Habitat Blocks were selected to be Highest Priority Connectivity Blocks and 980 were selected as Priority. The 2023 Habitat blocks were selected based on overlap with the regional scale datasets (*Northern Appalachian/Acadian Ecoregion: Priority Locations for Conservation Action* Trombulak et al., 2008, *Resilient sites for terrestrial conservation in the Northeast and Mid-Atlantic region*. Anderson et al., 2012, *From the Adirondacks to Acadia: A Wildlands Network Design for the Greater Northern Appalachians*. Reining et al., 2006, & S*taying Connected's Linkage Areas of the Northern Appalachian and Acadian Ecoregion*. 2012.) to represent connectedness within Vermont and outside of the state to the Adirondacks, Whites, Berkshires, Mahoosics, and Sutton Mountains, as well as numerous locations across the Connecticut River. Blocks were then split into Highest Priority and priority. The selection process for highest priority connectivity blocks focused on blocks that were critical in maintaining the ecological function of connectivity (highest priority) vs. those that supported connectivity but were somewhat "exchangeable" with other blocks (priority)

The Connectivity Blocks dataset is the best effort so far to map not only areas between core habitats for far ranging mammals, but also between areas of diversity in the physical landscape and connections to and with the riparian network. Together, these different types of connectivity combined offer us important insights into a resilient connected network that will maintain species movement and diversity into the future

Figure 2.2 Map of the Highest Priority and Priority Connectivity Blocks Component



Component Strengths

The Connectivity Blocks dataset addresses regional scale habitat connectivity and associated wildlife and ecological movement. It uses the regional flow data developed by The Nature Conservancy, as well as habitat linkage areas identified by the Vermont Habitat Block project. This gives us a sense of lands within the State that play a role in connectivity well beyond the state's borders. This makes it possible to identify a network within Vermont important for climate change adaptation and other regionally pressing issues that occur at regional scales

The Connectivity Blocks component has the strength of focusing on several types of connectivity. It includes the large core habitats and stepping stone blocks in between them important for far-ranging mammal movement, but also includes some habitat blocks that are connected through the Surface Waters & Riparian Areas dataset, which is to say, wildlife or ecological processes moving to or from this forest block would do so through the riparian system. In some cases, habitat blocks that connect areas of diversity in the physical landscape were selected and included in this dataset. Together, these different types of connectivity combined offer us important insights into a resilient connected network that will maintain species movement and diversity into the future

Component Limitations

The Connectivity Blocks dataset focuses on lands important for regional-scale habitat connectivity. Only places that allow for movement between contiguous habitat (such as the Adirondacks or Green Mountains) are considered important. This leaves out areas of the state that are critically important for wildlife at a local scale. Movement between patches of habitat remains important even if the wildlife populations in question aren't operating at a regional scale of movement.

The Connectivity Blocks component is a selection of habitat blocks, so by definition, this leaves out roadsides, agricultural and developed land. Connectivity Blocks are a statewide prioritization and as such, do not show the full extent of locally important connectivity areas, especially for amphibians and reptiles. We rely on the use of the Wildlife Road Crossings dataset and Riparian Connectivity dataset to address more local scale movement areas. The Connectivity Blocks component is not based on field data and site visits are always needed to identify specific locations of functioning connectivity within the mapped polygons.

Component Priority & Justification

Connectivity Blocks were separated into Highest Priority and Priority areas. The selection process for highest priority connectivity blocks focused on blocks that were critical in maintaining the ecological function of connectivity (highest priority) vs. those that supported connectivity but were somewhat "exchangeable" with other blocks (priority).

Priority: 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.

References

Anderson, M.G., M. Clark, and A.O. Sheldon. 2012. Resilient sites for terrestrial conservation in the Northeast and Mid-Atlantic region. The Nature Conservancy.

Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. Hawkins-Hilke et al. 2023. Vermont Habitat Blocks, Vermont Fish & Wildlife Department

Reining, C., K. Beazley, P. Doran and C. Bettigole. 2006. From the Adirondacks to Acadia: A Wildlands Network Design for the Greater Northern Appalachians. Wildlands Project Special Paper No. 7. Richmond, VT: Wildlands Project.

Linkage Areas of the Northern Appalachian and Acadian Ecoregion. 2012. Staying Connected Initiative

Trombulak, S.C., M.G. Anderson, R.F. Baldwin, K. Beazley, J.C. Ray, C. Reining, G. Woolmer, C. Bettigole, G. Forbes, and L. Gratton. 2008. The Northern Appalachian/Acadian Ecoregion: Priority Locations for Conservation Action. Two Countries, One Forest Special Report No. 1.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Surface Waters and Riparian Areas

Description

This component includes all rivers, streams, lakes, and ponds – all aquatic habitats in Vermont. In addition, this component includes the valley bottoms in which rivers and streams flow. Specifically, the valley bottoms are the areas of alluvial soils (soils deposited by flowing water) through which rivers and streams migrate over time and where seasonal river or stream flooding is expected. Finally, this component includes a band of riparian habitat adjacent to all rivers, streams, lakes, and ponds or to the valley bottom.

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).

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.

Surface Waters and Riparian Areas Conservation Goal

To conserve the ecological integrity of all rivers, streams, lakes, and ponds and the aquatic biota they support and to contribute to a landscape that is more resilient in the face of increasingly frequent and severe flood events, by conserving and restoring watershed processes that support properly functioning aquatic habitats and riparian areas, and by maintaining or restoring river channel equilibriums.

Component Mapping Goal

To map all rivers, streams, lakes, and ponds and their associated riparian areas and river and stream valley bottoms.

Source Data and Selection Criteria

The Surface Waters and Riparian Areas dataset brings together three different mapped layers. First is all lakes and ponds from the Vermont Hydrographic Dataset with a 100' buffer to capture shore habitats. Second is all rivers and streams from the Vermont Hydrographic Dataset with a buffer to include adjacent streamside vegetation (Buffer changes based on how far up the watershed the stream is – called "Stream Order". And third is a model of "Valley Bottom" Land Type Associations that was created by Ferree & Thompson in 2008.

1. Vermont Hydrographic Dataset (VHD) 1:5,000

Description
The Vermont Hydrographic Dataset 1:5,000 is a spatially accurate statewide mapping of rivers, streams, lakes, and ponds.

Selection Criteria
All rivers, streams, lakes, and ponds mapped as lines or polygons. For those smaller rivers and streams mapped as line features in the VHD 1:5,000, the expected stream width from Table 6 is used to map these rivers and streams as polygons. Use the VHD 1:5,000 polygons for larger rivers and all lakes and ponds.

2. Valley Bottom Land Type Associations (Ferree & Thompson 2008)

Description
Valley Bottom LTAs, developed by Ferree & Thompson (2008), are used to map the valley bottoms, floodplains, and river corridors statewide. The Valley Bottom LTA data provides a statewide modeled map of river and stream valley bottom that effectively captures flat valley bottoms and associated alluvial soils, wetlands, and floodplains without extending mapped areas beyond the valley floors. Although partially a GIS model, major portions of the Valley Bottom LTA are based on soil mapping by Natural Resources Conservation Service and wetland mapping by National Wetlands Inventory.

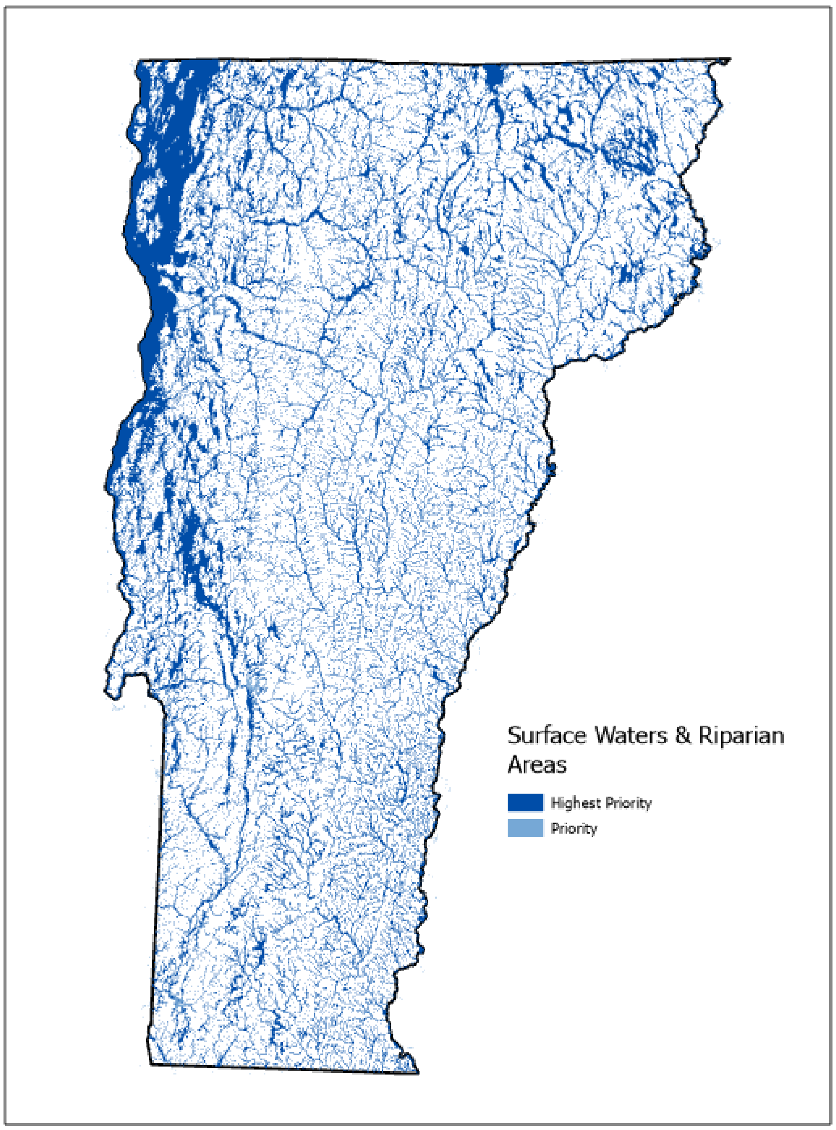
Selection Criteria
All Valley Bottom LTAs are included. Riparian area widths are added to all streams and rivers as described in Table 1. This river and stream riparian area is measured from the outer edge

of each side of the mapped river or stream polygon or the outer edge of the Valley Bottom LTA, whichever is wider. A 100 foot riparian area is mapped for all lakes and ponds.

Table 3.1 Stream Widths & Riparian

Stream Order	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Stream Width (feet)	4	10	20	33	66	150	230	
Riparian area (feet) measured from the outer edge of Valley Bottom LTA (if one exists) or the outer edge of stream width (whichever is wider).	50	50	50	100	100	100	100	100

Figure 3.2 Map of the Surface Waters and Riparian Areas Component



Component Strengths

The Vermont Hydrographic Dataset 1:5,000 is a spatially accurate statewide mapping of rivers, streams, lakes, and ponds. The Valley Bottom LTA data provides a statewide modeled map of river and stream valley bottom that effectively captures flat valley bottoms and associated alluvial soils, wetlands, and floodplains without extending mapped areas beyond the valley floors. Although partially a GIS model, major portions of the Valley Bottom LTA are based on soil mapping by Natural Resources Conservation Service and wetland mapping by National Wetlands Inventory, for which there is relatively high confidence in the mapping accuracy. Valley bottom LTAs and riparian areas includes many of the ecological processes associated with these areas.

Component Limitations

The Vermont Hydrographic Dataset 1:5,000 does not include many small headwater streams which are critically important habitat for some species and the primary source of cool water to lower stream segments. The Valley Bottom LTA is constructed partially as a GIS model, so these portions are not based on field data.

Component Priority & Justification

Surface waters and riparian areas were divided into highest priority & priority based on land cover and land use data.

Priority: 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.

These areas are of critical importance for water quality, flood attenuation, erosion prevention and wildlife movement. This is based on the very high value of this component in its contribution to biological diversity along with the recognition that the values of these areas will also be represented by other components, including Riparian Wildlife Connectivity, Important Aquatic Habitats and Species Assemblages, and Representative Lakes.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Riparian Connectivity

Description

Riparian areas are ecosystems comprised of streams, rivers, lakes, wetlands, and floodplains that form a complex and interrelated hydrological system. These ecosystems extend up and down streams and along lakeshores and include all land that is directly affected by surface water (Verry et al., 2000). Riparian ecosystems are generally high in 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 et al., 2000).

Riparian connectivity is the connected network of riparian areas in which natural vegetation occurs, providing natural cover for wildlife movement and plant migration. It includes all tree canopy, wetlands and shrublands down to 1 ac patches. This identifies stream reaches that haven't been developed and are critical travel corridors for a variety of wildlife species. Many stream sides are actively used for agriculture, which compromises their functionality as travel corridors.

Ecological Function

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 Connectivity and Connectivity Blocks provide the best available paths for connectivity across the landscape, especially in highly fragmented areas of Vermont.

Guidelines for Maintaining Ecological Function:

Restoration is needed to provide a fully functioning network of riparian areas that support connectivity. Restoration of natural vegetation is needed for river and stream shorelines where it does not exist now, and especially in riparian areas that provide the best available terrestrial connectivity between relatively isolated Connectivity Blocks. The width of naturally vegetated riparian areas needed to provide riparian connectivity varies from 100 feet or less on some small streams (50 feet each side) to 600 feet or more (300 feet on each side) for larger rivers or riparian areas that span long distances of otherwise unsuitable habitat.

Riparian Wildlife Connectivity Conservation Goal

Conserve a connected network of lands, waters, and riparian areas that allow for functioning of ecological processes across the landscape and dispersal, movement, and migration of plant and animal species in response to changing environmental conditions. Restoration and conservation of riparian connectivity is especially important in areas of Vermont that are highly developed.

Component Mapping Goal

To identify riparian areas statewide with natural vegetation cover.

Input Datasets and Selection Criteria

Riparian Connectivity was created by using a 1ac Habitat Patches dataset that uses a 1ac minimum threshold (rather than the 20ac version that was publicly released). This includes natural cover in patches of 1ac and greater consisting of tree canopy, shrublands and wetlands surrounded by roads development and agriculture. The Surface Water and Riparian Areas dataset was clipped to the 1-acre Habitat Block dataset. This Riparian Connectivity product was further refined by removing all Developed Land (derived from the 2016 0.5m pixel UVM Land Cover data). These Developed Lands included Bare Soil, Buildings, Roads, Railroads, and Other Paved surfaces.

1. **1ac Habitat Patches**, Hawkins-Hilke et al. 2023. Vermont Fish & Wildlife Department. (not released)

Description

The 2023 Habitat Blocks dataset uses a 20ac minimum threshold to define a habitat block, But the dataset was first built to include up to 1ac minimum patch size before the steering committee reviewed it for minimum acreage that should be considered a forest block. While insufficient to be called full on "forest" these > 1ac habitat patches were useful for showing riparian vegetation, particularly when these patches are more frequent and closer together. These include tree canopy, shrublands and wetlands just as the Habitat Blocks do.

Selection Criteria

All 1ac and greater habitat patches were included as the input for the Riparian Connectivity dataset and then clipped with the Surface Waters & Riparian Areas.

2. **Surface Waters & Riparian Areas Component**, VT Agency of Natural Resources, Natural Resources Mapping Project, BioFinder. 2012.

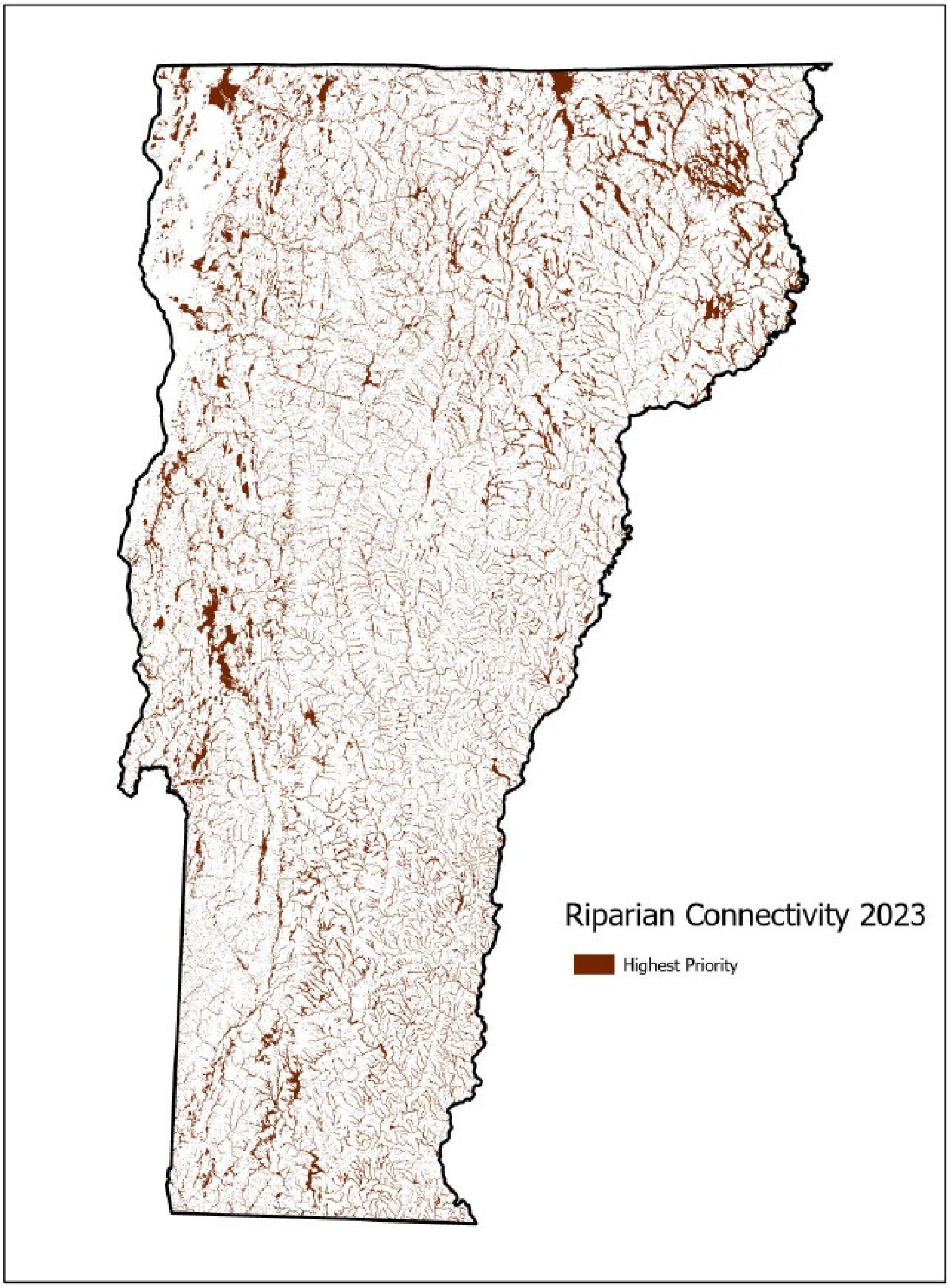
Description

The Surface Waters and Riparian Areas dataset combines buffers on the VHD stream centerlines with the Valley Bottom Land Type association.

Selection Criteria

Surface Waters and Riparian Areas component dataset was used as the maximum outer extent (clip feature) for the habitat patches.

Figure 4.1 Map of the Riparian Connectivity Component



Component Strengths

The Riparian Connectivity dataset has been reworked to reduce errors in the previous version by using the 1ac Habitat Patches dataset that itself is based on 0.5m Tree Canopy dataset from the University of Vermont Spatial Analysis Lab. This increased resolution leads to a substantially better product than previous versions. It identifies all river and lake riparian areas that have natural or semi-natural vegetation cover – a critical part of landscape connectivity. The other datasets related to habitat connectivity all focus on terrestrial animals and are generally focused on far-ranging mammals. This dataset includes all riparian habitats along rivers and streams that aren't currently developed to support movement along rivers, streams, and valley bottoms in general. It is focused on terrestrial animal movement, but gets at the critically-important land-water interface. There is relatively high confidence that riparian connectivity dataset accurately maps the portions of valley bottoms with natural cover

Component Limitations

The Riparian Connectivity dataset does not factor in aquatic organism passage or other within-stream connectivity functions, but instead looks at stream-side connectivity. This is a limitation given that both of these types of connectivity are ecologically important.

Component Priority & Justification

All Riparian Connectivity was ranked as highest priority because it is critically important component of the larger system of wildlife movement and genetic exchange.

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 agricultural land.

References

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For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Geological Diversity Blocks

Description

Geological Diversity Blocks (which have also been referred to as enduring features, or physical landscape diversity) 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 unaffected when changes in land cover and wildlife occur, as plants and animals move, and even as the climate changes. Geological Diversity Blocks are able to help drive ecological processes or support plants, animals, or natural communities when they are not developed or otherwise significantly altered by human activities.

If nature is likened to a dramatic play, it's possible to think of the physical landscape 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 a landscape-scale conservation design (Anderson & Ferree 2010; Beier and Brost 2010; Beier et al. 2012).

Geologic Diversity Blocks has two key elements. First it is an assessment of the representation of geological and physical landscape settings in the Highest Priority area of all the other 2023 landscape scale components (Interior forest blocks, Connectivity blocks, Surface Waters and Riparian Areas, and Riparian Connectivity). Second, because it adds additional selections beyond what is highest priority for other components, it is in and of itself, a selection of habitat blocks that represent the range of physical landscapes across VT. See Selection Criteria.

BioFinder recognizes three broad categories of Geological Diversity Blocks.

> ***Representative Physical Landscapes***: those that occur commonly in Vermont, based on percent of the landscape covered. Examples include Low Rolling Upland and Mountain Slopes. Areas mapped as Representative Physical Landscapes have been included in Vermont Conservation Design because of their contribution to another landscape scale component. They represent important interior forest blocks, connectivity blocks, or surface waters and riparian areas. In some cases, they also include the forest that surrounds a rare or responsibility physical landscape. Representative Physical Landscapes are important to consider alongside rare and responsibility landscapes because the majority of Vermont species occur in these areas. The areas mapped here represent high-priority lands and waters that contain these common landscape types.

> ***Rare Physical Landscapes***: those that are least commonly found in Vermont, based on percent of the landscape covered. Examples include the Vermont Escarpment and waterdeposited sediments along major rivers and streams. Because rare physical landscapes often correspond with the presence of rare species or natural communities, they can be used as a

filter for maintaining the state's overall biodiversity. This is particularly important because there are many species about which we know very little—insects, plants, or mosses, for example—and identifying rare physical landscapes can help us to predict where diversity among these unstudied species may occur.

Responsibility physical landscapes: those that occur more commonly in Vermont than in other areas of the northeastern United States and adjacent Canada, and for which we therefore have a regional responsibility to protect. Examples include Calcareous Metamorphic High Hills/Low Mountains and Ct River Valley-Hitchcock sediments.

Ecological Importance

Diversity in the physical landscape corresponds with diversity in species present. Therefore, understanding where there is physical landscape diversity can serve as a surrogate for information on natural communities and species diversity when that information is not available. This is particularly important in the face of global climate change. As changes occur over time, plant and animal species adjust their ranges to more climatically suitable conditions. Conserving and providing stewardship for a connected network of diverse physical landscapes physical landscapes will allow for these adjustments to be made more easily and in turn help protect the diversity of natural communities and species.

Some physical landscapes are helpful in locating specific natural communities and species. For example, the Valley Clayplain Forest is a natural community that is associated with Valley Floor Glacial Lake/Marine Plains and is found exclusively on clay soils. Two of its component plant species, bur oak and barren strawberry, are also most common on those soils. Therefore, it is possible to examine information on surficial geology to determine where clay deposits exist and, with that information, predict the potential location of a Valley Clayplain Forest and its component species. Conservation scientists and practitioners have used specific physical landscape features successfully to locate places to search for particular natural communities or rare species.

Geological Diversity Conservation Goal

Represent all of the geophysical settings that occur in Vermont in a naturally vegetated network of connected lands to provide the "stage" for present and future biota and natural ecological processes (the "actors" and the "play").

Specifically, each of the three broad categories of physical landscapes included in BioFinder has a conservation goal.

Rare Physical Landscapes: In the design, capture 100% of these whenever possible.

Representative Physical Landscapes: In the design, capture 70% of these whenever possible.

Responsibility geophysical settings: In the design, capture 100% of these where possible.

Component Mapping Goal

To identify Vermont's enduring physical features, especially those places with considerable landscape diversity that may continue to foster biological diversity in the future, even as the climate changes and species composition shifts.

Data Source(s) & Selection Criteria

Unlike other BioFinder components, Geological Diversity Blocks was created using a multi-step, iterative process to incorporate physical landscape settings into the design. This began with an assessment of Land Type Associations (LTA). LTAs are landscape scale map units defined by multiple biotic and abiotic factors. See table 5.1 for a list. The proportion LTAs across all of Vermont (regardless of land cover) was compared with LTAs represented in the Highest Priority area of all the other 2023 landscape scale components.

Goals were set for representation of these settings. Goals for Rare and Responsibility settings were set at 100% because of their regional significance, While goals for more common, Representative settings, were set at 70% because that's the area of VT included in the 2023 Highest Priority Landscape Scale components.

After assessing the representation of these different settings within the 2023 Highest Priority Landscape Scale components, an additional 956 Habitat Blocks were selected as Highest Priority for Geological Diversity because they included a high percentage of LTA types that were underrepresented in the other Highest Priority component area. These were largely Valley Floor Glacial Lake/Marine Plains, Marine-lacustrine-glaciofluvial coarse sediments, Ct River Valley-Hitchcock sediments, & Water-deposited glacial sediments along major riverways.

The remaining 603 Habitat Blocks (first selected as Highest Priority for Interior Forest and Connectivity Blocks) were then split into Highest Priority and Priority. This was done using a finer unit, Elevationally grouped-Ecological Land Unit (EELU). Ecological Land Units are a modeled product for use as analysis units to organize small areas by suitability, identify restoration priorities, and serves as a coarse filter for protecting biodiversity. First each EELU was put into categories of Rare, Representative and Responsibility. Then we calculated % rare, % responsibility & % representative for every habitat block. For each Habitat Block we also calculated the Shannon Diversity Index for their composition of EELU. Highest Priority Blocks were selected based on the following:

- Shannon index >2.5
- % Rare >0.5
- % responsibility >0.5

In total there are 1,301 Highest Priority Geological Diversity blocks (= 956 + 345) and 258 Priority Geological Diversity Blocks.

Habitat Blocks, Hawkins-Hilke et al. 2023. **Vermont Fish & Wildlife Department**

1. Land Type Associations, Ferree & Thompson 2008.

Description

Land Type Associations are a modeled product for use as analysis units to organize broad areas by suitability, identify restoration priorities, and serves as a coarse filter for protecting biodiversity. LTAs are landscape scale map units defined by multiple biotic and abiotic factors.

Selection Criteria

Land Type Associations (LTA) were used to compare the proportion statewide with their proportion within other 2023 Highest Priority landscape scale components, to add 956 Habitat Blocks as Highest Priority for Geological Diversity to ensure all geological settings were represented.

Figure 5.1 Land Type Associations

Land Type Associations	Statewide Proportion of each LTA type	REPRESENTATION GOAL
Valley Floor Glacial Lake/Marine Plains	4.4%	100.0%
Marine-lacustrine-glaciofluvial coarse sediments	0.9%	100.0%
Ct River Valley-Hitchcock sediments	0.8%	100.0%
Water-deposited glacial sediments along major riverways	2.0%	100.0%
Precambrian Plateau	2.2%	100.0%
Granitic Mid-Elevation Hills	1.1%	100.0%
Low rolling upland	9.4%	70.0%
Rolling low to mid-elev calc/metamorphic hills	12.3%	70.0%
Enriched slopes	0.6%	100.0%
Temperate oaky hills of southeastern Vermont	6.1%	70.0%
Granitic basin	0.4%	100.0%
Granitic high hills/low mtns	0.5%	100.0%
Upper Mtn Slopes/Mountaintops	2.7%	100.0%
Calcareous Metamorphic High Hills/Low Mountains	0.3%	100.0%
Vermont Escarpment	0.8%	100.0%
Lake/reservoir gt 200 acres	3.4%	100.0%
Hills/footslopes; Bedrock hills (Champlain Valley)	22.7%	70.0%
Dissected low to mid-elev calc/metamorphic hills	5.3%	70.0%
Mountain Slopes	16.2%	70.0%
Valley bottom; Floodplain-riparian (Champlain Valley)	8.0%	70.0%

2. Ecological Land Units, Ferree & Anderson 2008.

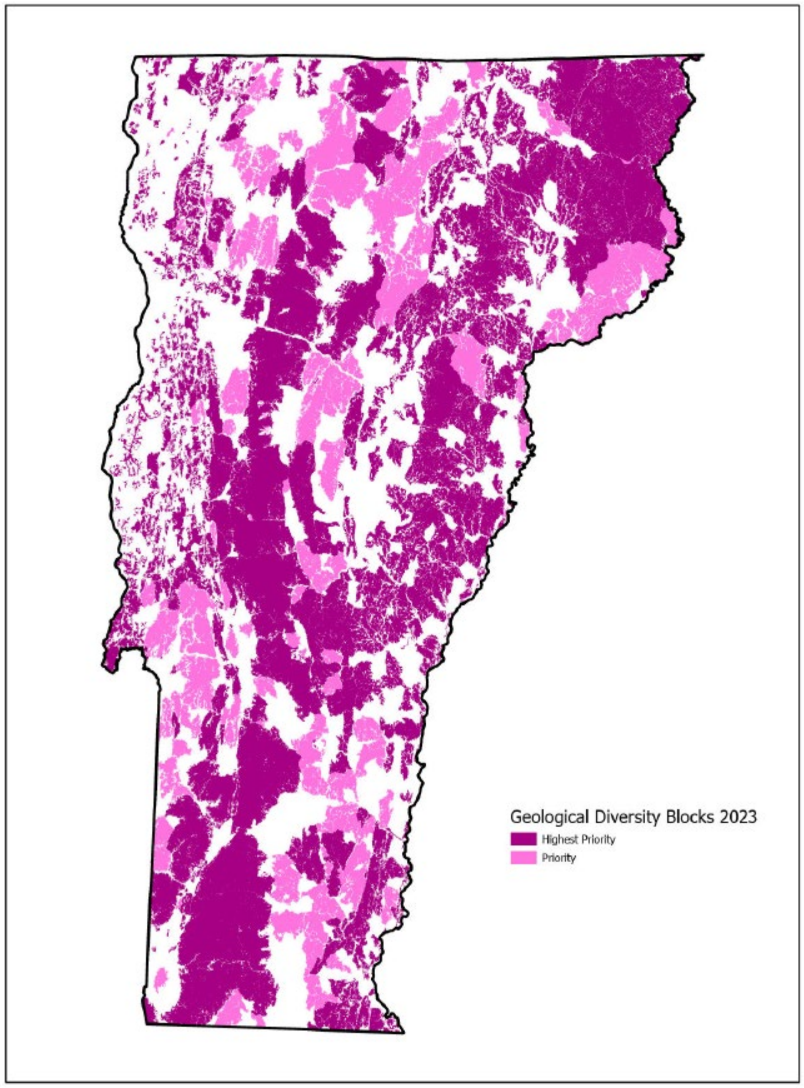
Description

Ecological Land Units are a modeled product for use as analysis units to organize small areas by suitability, identify restoration priorities, and serves as a coarse filter for protecting biodiversity. LTAs are fine-scale map units defined by multiple biotic and abiotic factors.

Selection Criteria

Elevationally grouped-Ecological Land Unit (EELU) were used to divide 603 Habitat Blocks that were selected for Interior Forest and Connectivity values into Highest Priority and Priority for Geological Diversity.

Figure 5.2 Map of Geological Diversity Blocks Component



Component Priority & Justification

Geological Diversity Blocks are divided into Highest Priority and Priority.

Priority Geological Diversity Blocks are Habitat Block with a Shannon index <2.5, or % Rare <0.5, or % responsibility <0.5.

Highest Priority Geological Diversity Blocks are Habitat Blocks that contain high percentages of under-represented LTA types or are Habitat Block with a Shannon index >2.5, or % Rare >0.5, or % responsibility >0.5.

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For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Natural Communities

Description

A natural community is an interacting assemblage of plants and animals, their physical environment, and the natural processes that affect them. As these assemblages of plants and animals repeat across the landscape wherever similar environmental conditions exist, it is possible to describe these repeating assemblages as natural community types. The Vermont Fish and Wildlife Department uses a ranking scheme that is part of the national Natural Heritage methodology to describe the relative rarity of natural community types in Vermont. The range is from S1 (very rare) to S5 (common and widespread).

Ecological importance

Natural communities are one of the most important "coarse filters" for conserving biological diversity (Hunter 1991, Thompson and Sorenson 2000). This is because there are relatively few natural community types—97 in Vermont—compared to the tens of thousands of plant and animal species. Collectively, these 97 types in Vermont encompass the full range of habitat conditions that native flora and fauna evolved with and are adapted to. Therefore, conserving high-quality examples of all the natural community types is an efficient way to conserve most species.

Natural communities are relatively stable in a human timeframe, but their species assemblages have changed over thousands of years and will continue to shift in response to a changing climate. Sites with high-quality natural communities today represent places that are expected to continue to support important natural communities, and associated species, into the future.

Natural Community Conservation Goal

Vermont Conservation Design identifies conserving state-significant examples of each of the natural community types as a highest priority for maintaining ecological function. Specifically, this means conserving all significant examples of rare natural community types, and 50% of the significant examples of more common types, distributed across biophysical regions, and within an intact and connected natural landscape whenever possible. Some community types can be effectively conserved by other coarse filters. Matrix community types, such as Northern Hardwood Forest, are effectively captured by forest blocks and old forests. Seeps and vernal pools are captured by forest blocks and wetlands, respectively.

These natural communities should be maintained in, or restored to, a state of high ecological integrity. This translates into several measurable characteristics. Each natural community should be dominated by the native species characteristic of that community type. The species composition and physical conditions (soils, hydrology, etc.) should be largely unaltered by, or mostly recovered from, human disturbances. Natural disturbance processes should predominate. In general, high ecological integrity will correspond to an A or B- ranked element occurrence, and A-ranked condition, using Vermont Fish and Wildlife Department's Natural Community Ranking Specifications.

Component Mapping Goal

To identify and map all of Vermont's documented natural communities using the best available data.

Source Data and Selection Criteria

Natural Heritage Database, Vermont Fish and Wildlife Department

Description

The Natural Heritage Database contains detailed, geographically-referenced information on Vermont's uncommon, rare, threatened, and species and on Vermont's significant natural communities. The database is periodically updated as new information on species and natural communities becomes available. The data used for BioFinder are current as of November 2023.

Selection Criteria

Highest Priority:

- All natural communities with a state rank of S1-S4 & all old forest natural communities

Priority

- All natural communities with a state rank of S5 that are not old forest

Component Strengths

Natural community Element Occurrences from Natural Heritage Inventory are based on detailed site surveys and data collected by consistent methods. Inventories for rare and uncommon natural community types are more complete than for common types. Natural communities represent critical coarse-filter elements for conserving biological diversity and overall natural heritage.

Component Limitations

Statewide natural community inventories are on-going and therefore our knowledge of natural community locations is incomplete. Inventories for rare communities are more complete than for uncommon and common communities. Of uncommon communities, inventories for S3 communities are more complete than for S4 community types. A field assessment is always needed to identify whether rare natural communities occur on a site.

The majority of mapped examples of common natural communities are on state-owned land. Statewide inventory of Northern Hardwood Forest, the most widespread natural community type in Vermont, is especially incomplete.

Component Priority & Justification

Highest Priority - All natural communities with a state rank of S1-S4 & all old forest natural communities were ranked as Highest Priority.

Priority -Common natural communities S5 that are not old forest were ranked Priority. This is based on the high importance of all high quality natural communities in their contribution to biological diversity, but the low level of inventory that has been completed for common community types and the overall low threat to these common community types.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Important Aquatic Habitats and Species Assemblages

This dataset is the combination of two different sources, Rivers & Streams as well as Lakes & Ponds. The two are described separately below.

Rivers and Streams

Description

These are set of river and stream reaches with known concentrations of rare species or high species diversity, or which are good examples of aquatic habitat conditions. Collectively, they are representative of the full range of stream sizes, gradients, and temperature conditions in Vermont, as identified by Anderson et al (2013).

Ecological Function

Rivers and streams are a fundamental component of an ecologically functional landscape, and provide essential habitat for aquatic species, including fish, amphibians, reptiles, invertebrates, and plants. Particular river and stream reaches make exceptional contributions to Vermont's biological diversity, because of their unique physical characteristics arising from geology or topography, or because they are good examples of aquatic habitats. These places support many species and are crucial parts of Surface Waters and Riparian Areas network, but they also depend on the successful functioning of the entire aquatic network.

Representing elements of physical diversity increases the likelihood that species can shift on the landscape – or in this case, within the aquatic network – to find suitable habitat in response to climate change (Anderson and Ferree 2010; Beier and Brost 2010; Beier et al. 2015). Conserving the physical diversity of rivers and streams helps aquatic systems adapt and be resilient to climate change.

Priority Target for an Ecologically Functional Landscape

The following river and stream reaches:

- Lake Champlain tributaries upstream to the fall line
  - Large rivers: Missisquoi River, Lamoille River, Winooski River, Mallets Creek, LaPlatte River, Lewis Creek, Otter Creek, Poultney River, East Creek
  - All other small rivers and streams that drain directly into Lake Champlain
- Large coldwater streams
  - Batten Kill from New York-Vermont border upstream on the main stem Batten Kill to elevation 798 feet (East Dorset) and on the West Branch to elevation 926 feet (Dorset Marsh in Dorset).
  - Castleton River from Whipple Hollow Road in West Rutland Marsh (West Rutland) to confluence with Poultney River (Fair Haven).
- High elevation coldwater streams

    - All streams above 1,400 feet elevation
- Connecticut River
    - Upper Connecticut River: this reach is delineated to the north by the state line (River Mile 319.0) and just upstream of Moore Reservoir (River Mile 247.0).
    - Lower Connecticut River below River Mile 120.0 to the state line.
- Connecticut River tributaries that are part of important wetland complexes
    - Nulhegan River complex; Manchester Brook/Symes Pond complex; Jewett Brook complex; Moose River/Victory Bog complex; Wheeler Stream/Dennis Pond Brook complex
- High-quality reaches with representative physical diversity
    - As mapped, including but not limited to reaches of: Barton River, Black River (Memphremagog), Clyde River, Furnace Brook, Hubbardton River, Huntington River, Lamoille River, Mettawee River, Middlebury River, Missisquoi River, Moose River, Neshobe River, New Haven River, Nulhegan River, Otter Creek, West River, White River, and Winhall River.

Highest Priority: All the river and stream reaches described above.

Guidelines for Maintaining Ecological Function

River and stream reaches with important aquatic habitats and species assemblages must be part of a fully functioning network of surface waters and riparian areas. Although reaches with exceptional biological contributions can be identified, they cannot function independent of this larger network.

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 adjacent riparian area. River channel equilibriums need to be maintained or restored. Artificial barriers to aquatic organism movement (culverts, dams, etc.) should be removed or mitigated. Natural riparian vegetation should be maintained or restored to protect water quality, stabilize shorelines, and provide shade and the recruitment of downed wood and other natural organic matter. For full ecological function, this naturally vegetated area should encompass the entire mapped valley bottom riparian area. When this is not possible, a minimum 100-foot wide vegetated area adjacent to the stream or river will protect many, but not all, riparian functions. Aquatic vegetation should be maintained. The underwater physical substrate should be maintained or restored to provide suitable habitat conditions for foraging, shelter, and reproduction of aquatic organisms.

Restoration Needs

Removal of artificial barriers and restoration of natural riparian vegetation is needed to reach full ecological function.

Methods and Rationale

River and stream reaches that are targeted as Important Aquatic Habitats and Species Assemblages were selected using professional judgement. Specific reasoning behind each selection is listed below:

- Lake Champlain tributaries upstream to the fall line: Due to the influence of biogeography, these waters support native fish and mussel species from two glacial refugia. Unlike the remainder of Vermont waters which were populated only by eastern species, the mid- and lower elevation waters in the Champlain drainage contain both eastern and western species resulting in streams that support greater numbers of species than streams of similar size elsewhere in Vermont. Due to the direct connection with Lake Champlain, these waters also provide habitats necessary for the support of Lake Champlain populations.
- Large coldwater streams: Large streams with specific geologic and hydrologic features that support coldwater species assemblages due to the combination of high alkalinity and abundant cold baseflow from groundwater inputs.
- High elevation coldwater streams: Streams characterized by simple, cold water obligate aquatic communities dominated by native species, especially brook trout and sculpin. These streams will be the refugia for cold water obligate taxa under predicted climate change warming in the next century.
- Upper Connecticut River: supports burbot, round whitefish, and coldwater fish communities.
- Lower Connecticut River: the historic upper limit of American shad in the river, and habitat for American eel, anadromous sea lamprey, blueback herring and alewife floater (mussel).
- Connecticut River tributaries that are part of important wetland complexes: good examples of wetland-influenced aquatic habitats and known occurrences of rare species
- Reaches representing the range of physical conditions in aquatic features, as categorized by stream size, gradient, and temperature setting, providing a coarse filter for capturing the habitat and needs of many aquatic species including invertebrates and aquatic plants.

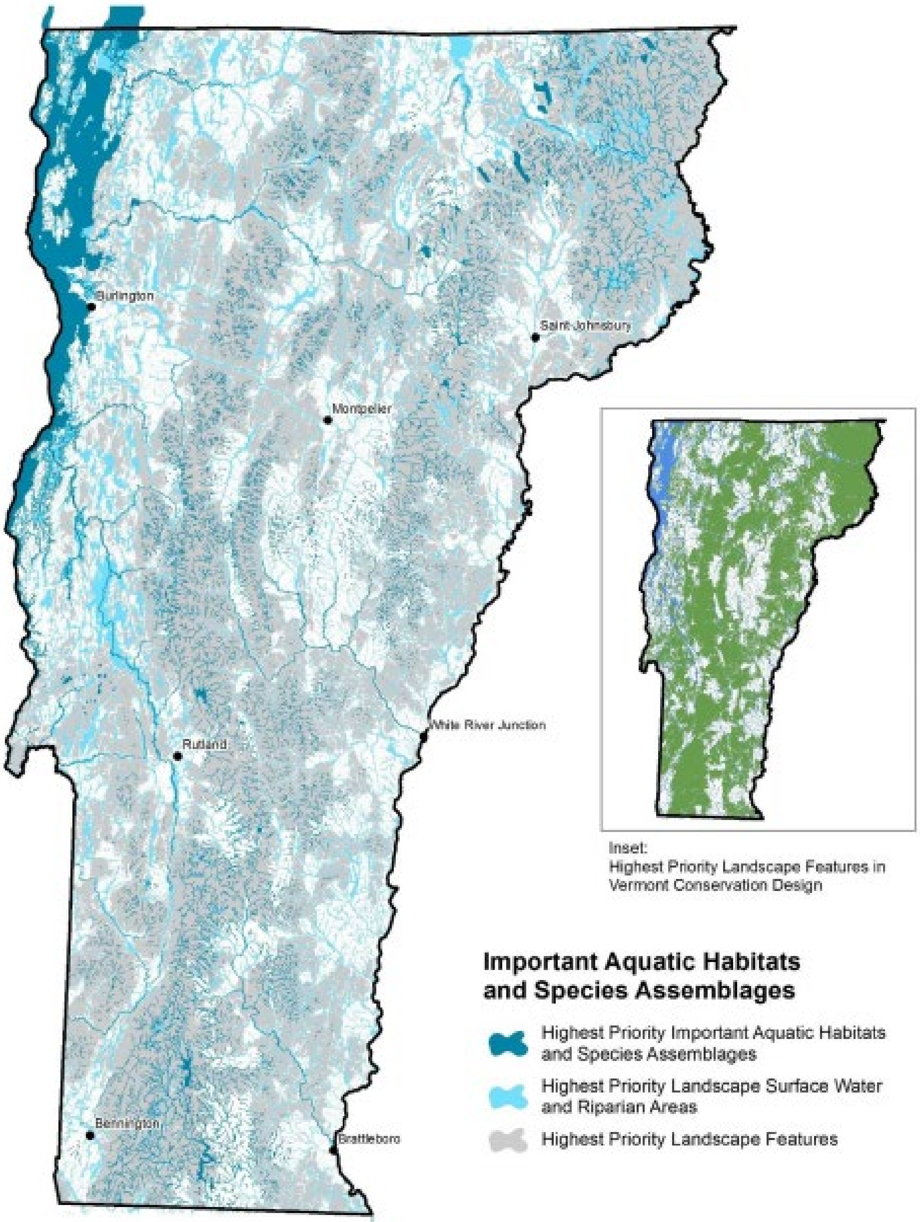
Mapping Comments

The map layer is a complete representation of the priority and highest priority targets, except it does not show all streams above 1,400 feet in elevation. These streams, regardless of mapping, are considered highest priority at this scale. Otherwise, all highest priority river and stream reaches with important aquatic habitats and species assemblages are mapped as part of the "Important Aquatic Habitats and Species Assemblages" layer. This layer also includes lakes and ponds with equivalent contributions to biological diversity.

Map: Important Aquatic Habitats and Species Assemblages

River and stream, and lake and pond targets for Important Aquatic Habitats and Species Assemblages are mapped together.

Map 4: Important Aquatic Habitats and Species Assemblages



Important Aquatic Habitats and Species Assemblages targets, including both lakes and ponds as well as rivers and streams.

Lakes and Ponds

Definition

These are lakes and ponds with known concentrations of rare species, exceptional species diversity, or which are examples of high-quality aquatic habitat.

Ecological Function

Lakes and ponds are essential habitat for many of Vermont's aquatic species, including fish, amphibians, reptiles, invertebrates, and plants. Some lakes and ponds make exceptional contributions to Vermont's biological diversity, because of their unique physical characteristics arising from their water chemistry and physical setting, or because they support concentrations of rare or uncommon species. These lakes and ponds are crucial parts of Surface Waters and Riparian Areas network, but they also depend on the successful functioning of the entire aquatic network.

Priority Target for an Ecologically Functional Landscape

The following lakes and ponds:

- Lake Champlain
- Lakes and ponds supporting round whitefish and/or naturally reproducing lake trout: Great Averill, Little Averill, Beaver, Caspian, Crystal, Echo (Charleston), Elligo, Seymour, Willoughby
- Rutland County Lakes: Austin, Beebe, Black, Breese, Burr, Choate, Doughty, Echo, Halfmoon, High, Hinkum, Hough, Huff, Johnson, Mill (Benson), Mud (Benson), Mudd (Hubbardton), Perch, Roach, Spruce, Sunrise, Sunset, Walker
- High elevation ponds: Bourn and Branch (Sunderland), Stratton (Stratton), Lake Pleiad (Hancock), North Pond (Chittenden), Griffith Lake (Mount Tabor), Big Mud (Mount Tabor), and Little Rock (Wallingford)
- Wild Brook Trout ponds: Beck Pond, Cow Mountain Pond, Hidden Pond, Jobs Pond, Lake Pleiad (Hancock), Martins Pond, North Pond (Chittenden), Unknown Pond (Avery's Gore), West Mountain Pond

Highest Priority: All the lakes and ponds listed above.

Guidelines for Maintaining Ecological Function

Lakes and ponds with important aquatic habitats and species assemblages must be part of a fully functioning network of surface waters and riparian areas.

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 adjacent riparian area. Natural riparian vegetation should be maintained or restored to protect water quality, stabilize shorelines, and provide shade and the recruitment of downed wood and other natural organic matter. For full ecological function, this naturally vegetated area should encompass the entire mapped valley bottom riparian area. When this is not possible, a minimum 250-foot wide vegetated area adjacent to the lake or pond will protect many, but not all, riparian functions.

Developed shorelines that cannot be fully restored should minimize runoff, erosion, and other negative impacts to water quality and shoreline stability. Aquatic vegetation should be maintained, and invasive species controlled. The underwater physical substrate should be maintained or restored to provide suitable habitat conditions for foraging, shelter, and reproduction of aquatic organisms.

Restoration Needs

Restoration of natural riparian vegetation is needed to reach full ecological function.

Methods and Rationale

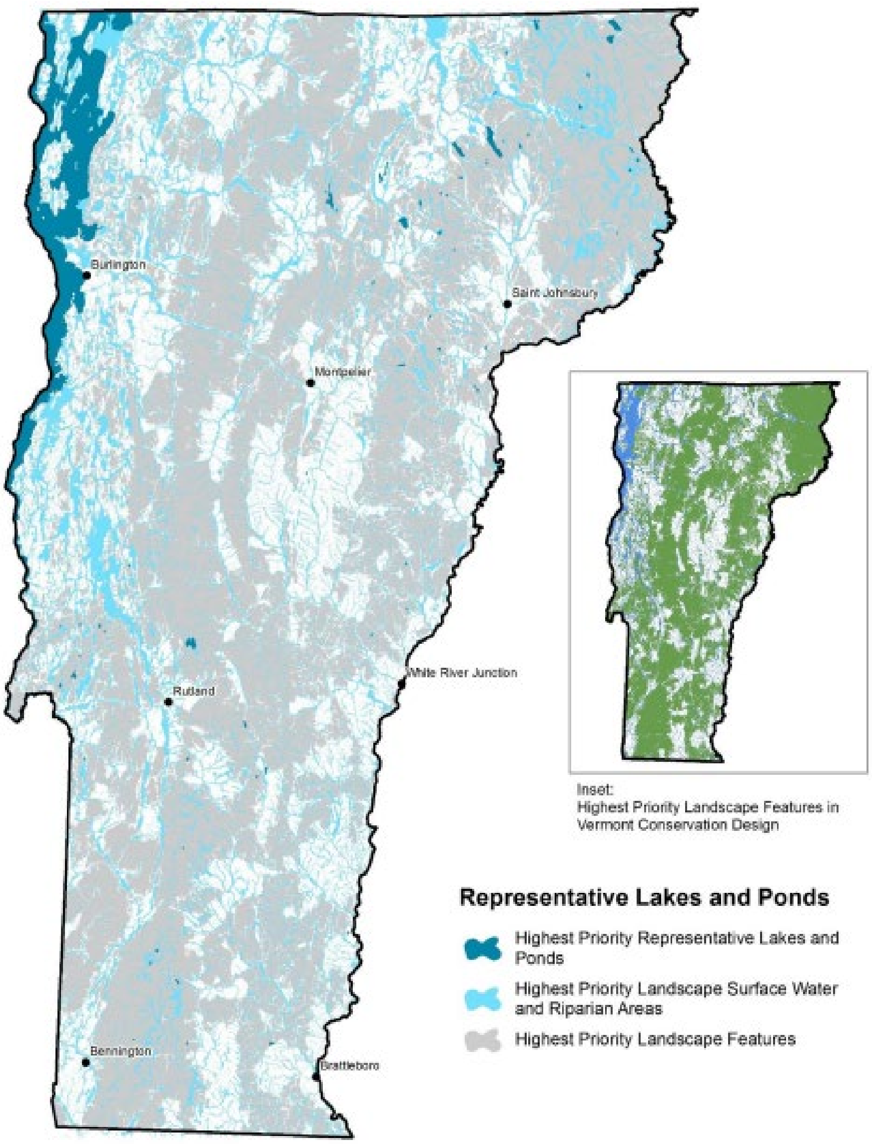
Conserving lakes and ponds with known contributions to biological diversity helps ensure that all aquatic species are maintained as part of the ecologically functional landscape. Lakes and ponds that are targeted as Important Aquatic Habitats and Species Assemblages were selected using professional judgement. Specific reasoning behind each selection is listed below:

- Lake Champlain: due to the influence of biogeography, Lake Champlain supports native fish and mussel species from two glacial refugia.
- Lakes and ponds supporting round whitefish and/or naturally reproducing lake trout are limited in the state and conserve these rare and uncommon species
- Rutland County Lakes: supporting or expected to support species assemblages including blackchin shiner, bridle shiner, blacknose shiner, and redfin pickerel.
- High elevation ponds: habitats characterized by simple, cold water obligate aquatic communities.
- Wild brook trout ponds: the presence of self-sustaining wild brook trout populations in ponds indicates good water quality and habitat conditions expected to benefit many aquatic species.

Mapping Comments

The map layer is a complete representation of the priority and highest priority targets. All highest priority lakes and ponds with important aquatic habitats and species assemblages are mapped as part of the "Important Aquatic Habitats and Species Assemblages" layer. This layer also includes river and stream reaches with equivalent contributions to biological diversity.

Map 5: Representative Lakes and Ponds Targets



For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Wetlands

Definition

Wetlands are vegetated ecosystems characterized by abundant water. All wetlands have three characteristics in common. First, all are inundated by or saturated with water during varying periods of the growing season. Second, they contain wetland or hydric soils, which develop in saturated conditions and include peat, muck, and mineral soil types. Finally, wetlands are dominated by plants that are adapted to life in saturated or inundated soils. Vermont's wetlands range in size from vernal pools and seeps that may be a few hundred square feet or less to vast swamps and marshes occupying thousands of acres along Otter Creek and Lake Champlain. (Note that vernal pools, although a type of wetland, are treated separately in this project because of their unique ecological functions.)

Ecological Function

Few natural systems have been studied as much for their ecological functions as have wetlands. Wetlands store large volumes of water and attenuate downstream flooding, a function that is likely to increase in importance in Vermont as climate change brings more frequent and larger storm events. Wetlands help maintain surface water quality by trapping sediments and removing nutrients and pollutants from surface waters before that water reaches streams or lakes. Vegetated wetlands along the shores of lakes and rivers can protect against erosion caused by waves along the shorelines during floods and storms. Many wetlands are associated with groundwater discharge and form the headwaters of many cold-water streams, another function that is likely to increase in importance with the expected warming and reduction in snowpack associated with climate change. Wetlands are well known for the critical wildlife habitat they provide for many species of birds, mammals, reptiles, amphibians, and insects, but some wetlands also provide critical spawning and nursery habitat for fish species. Although wetlands occupy only about five percent of the land area in Vermont, they provide necessary habitat for the survival of a disproportionately high percentage of the rare, threatened, and endangered species in the state. Examples of wetland dependent rare species include Calypso orchid, Virginia chain fern, marsh valerian, sedge wren, spotted turtle, and four-toed salamander.

Priority Target for an Ecologically Functional Landscape

All wetlands in Vermont with significant functions (Class 1 or 2). Note that vernal pools, a specific type of wetland, are treated separately.

Highest Priority: Any wetland that meets one or more of the following conditions:

- Is designated as a Class 1 wetland, or has characteristics and functions likely to meet the Class 1 standards (Potential Class 1)
- Is an exemplary (state-significant) wetland natural community occurrence, or is immediately adjacent to one
- Is wholly or partially within any of the highest priority landscape scale elements of Vermont Conservation Design
- Is wholly or partially within a small watershed with >50% of the land area developed

- Is wholly or partially within an important watershed for Lake Champlain water quality: o Missisqoui River watershed
- South Lake A & B watersheds

Guidelines for Maintaining Ecological Function

Maintain or restore natural ecological processes, including unaltered soils and hydrology, native vegetation appropriate to the site, and suitable conditions for native fish and wildlife species. Effective conservation should include appropriate upland buffer zones, the ecological processes that support wetlands (especially hydrology), and a network of connected lands, waters, and riparian areas to allow ecological exchange between wetlands, including the ability of component species to shift over time in response to changing environmental conditions.

Restoration Needs

More than 35% of the original wetlands in Vermont have been lost to agriculture, development, and other land uses. Restoration of these wetlands is needed to achieve full ecological function.

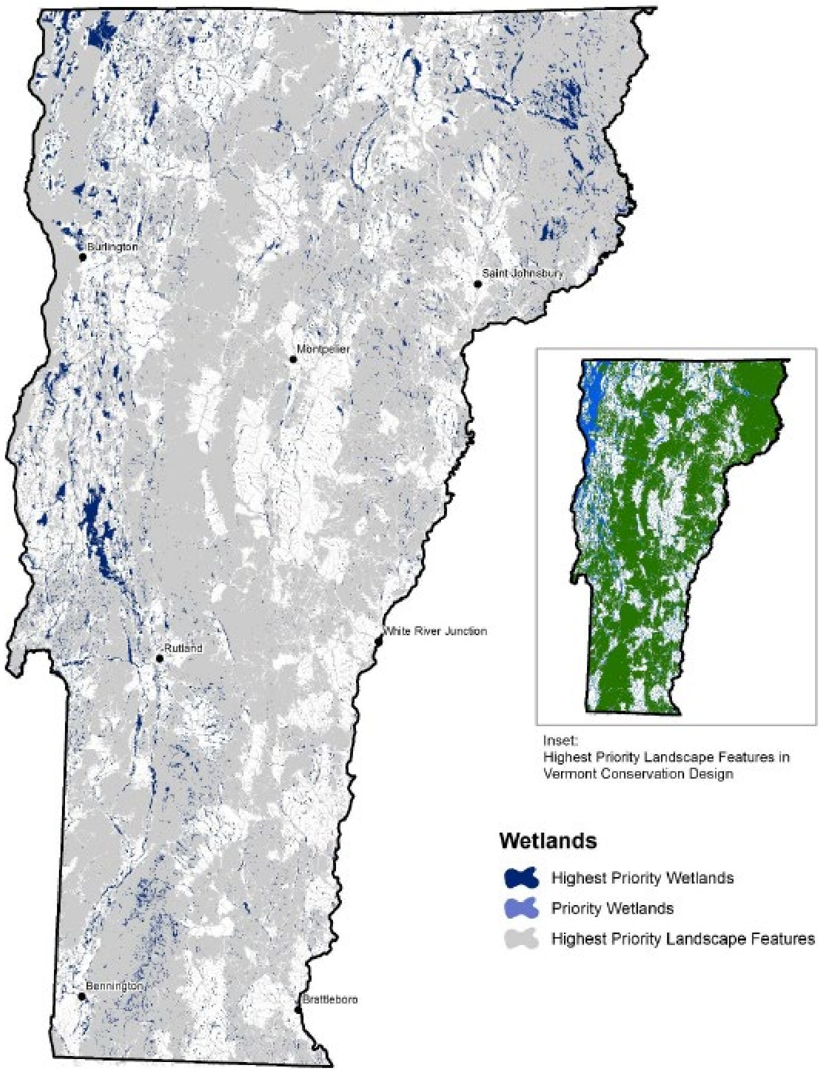
Methods and Rationale

Wetlands occupy a small portion of the Vermont landscape but contribute crucial ecological functions. Criteria for highest priority wetlands were selected in order to identify wetlands that make exceptional contributions to biological diversity or water quality, or which are inseparable from the functioning of the landscape scale elements of Vermont Conservation Design.

Mapping Comments

The map layer is an incomplete representation of the priority and highest priority targets. Mapping represents the best current knowledge of the location of targets on the ground. The approximate location of wetland targets is shown using VSWI, NWI, and Natural Heritage data sources. All polygons are approximate. Additional wetlands exist that are not represented in the map data. Field verification may be needed to confirm that any wetland meets the target criteria and provides appropriate ecological functions.

Map 6: Wetland Targets



Note that wetlands mapping is incomplete and there are additional wetlands that meet target criteria.

Vermont Conservation Design 30 Natural Communities & Habitats

For more information

For more information specific to this component, contact Laura Lapiere, Vermont Department of Environmental Conservation, Wetlands Division, laura.lapiere@vermont.gov

Vernal Pools

Description

Vernal pools and their surrounding 650' life zone. Vernal Pools are small (generally less than one acre), ephemeral pools that occur in natural basins within upland forests. They typically have no permanent inlet or outlet streams and have very small watersheds. Vernal pools are defined by the physical and hydrologic characteristics of the basin and by the animal species associated with the pool, including mole salamanders, wood frogs, and invertebrates.

Ecological Function

Vernal pools are best known as critical breeding habitat for mole salamanders (spotted salamander, blue-spotted salamander, and Jefferson salamander), eastern four-toed salamander, and wood frog. These species are considered vernal pool indicator species, meaning they cannot reproduce without access to a vernal pool. All these species migrate to vernal pools for spring breeding from adjacent upland forests where they spend the majority of their life cycles. Eggs are laid in the pools and amphibian larvae develop and mature there and then move to the adjacent forest. Studies indicate that the majority of the amphibians using a pool for breeding are found within 650 feet of the pool during the non-breeding season (Semlitsch 1998). Vernal pools are also important for other species, including fairy shrimp, fingernail clams, spring peepers, American toad, and several plant and wildlife species. Vernal pools and the species that rely on them are particularly vulnerable to hydrologic changes to their small watersheds. For example, development and climate driven changes in runoff volume and pool duration may render them less suitable amphibian breeding habitat.

Priority Target for Maintaining an Ecologically Functional Landscape

All vernal pools that are regularly used by spotted salamander, Jefferson salamander, bluespotted salamander, or wood frog.

Highest Priority: All vernal pools within a VCD highest priority forest block or the VCD highest priority surface water and riparian areas, that are regularly used by spotted salamander, Jefferson salamander, blue-spotted salamander, or wood frog.

Guidelines for Maintaining Ecological Function

Maintain or enhance conditions in and around the pool for pool-breeding obligate species. The pool's small watershed should have little if any alteration to natural hydrology that would affect runoff volume, pool duration, or water quality. The pool structure should be unaltered by, or mostly recovered or restored from, past human disturbances. Maintain or restore a closed forest canopy with native species, abundant coarse woody debris, and a lack of artificial barriers to salamander movement in the 650 feet of forest adjacent to the vernal pool.

Restoration Needs

As with other wetland types, many of Vermont's original vernal pools have been lost to development or other land uses. Restoration of vernal pools may be beneficial in some parts of the state.

Methods and Rationale

Vernal pools contribute unique ecological functions. Those that occur within the highest priority landscape scale elements of Vermont Conservation Design are most likely to provide for the full life needs of pool obligate species.

Mapping Comments

The map layer is an incomplete representation of the priority and highest priority targets. Mapping represents the best current knowledge of the location of targets on the ground. Vernal pool mapping includes pool locations and the 650' upland forest zone. Mapped data include both confirmed pool locations and locations that have a very high likelihood of pool occurrence and are noted as such in attribute data. Field verification is needed to confirm that these likely pools meet the target criteria and provide appropriate ecological functions. Additional target pools exist that are not represented in the map data.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Wildlife Road Crossings

Description

Wildlife Road Crossings are locations where wildlife are likely to cross roads based on the presence of forests, shrublands and wetlands on both sides of the road. The dataset is the result of an assessment of structural components (i.e., where there is forest and/or other natural vegetation on both sides of a road) to predict the ease of movement for a variety of wildlife species. This assessment is not specific to particular species as it offers a generalized sense of where the greatest variety of species is likely to move.

Wildlife Road Crossings are the finest scale of Habitat Connectivity in Vermont Conservation Design. Landscape connectivity refers to the degree to which blocks of suitable habitat are connected to each other (Noss and Cooperrider 1994). At the coarsest, eco-regional scale, connecting land in Vermont can be thought of as a "network" supporting genetic heterogeneity and movement of populations of wide-ranging mammal species across huge swaths of the landscape; such as between the Adirondacks Mountains of New York, Vermont's Green Mountains and the White Mountains of New Hampshire. It is a network in the sense that it includes 1)the largest blocks of contiguous, unfragmented core habitat, (the source and principle home area of many species as well as areas of diversity in the physical landscape), 2) connecting forest or "stepping stone blocks" (These may be smaller, but their landscape position between larger blocks make them integral to maintaining the network) and 3) local connections including riparian connectivity and wildlife road crossings.

Ecological Importance

Wildlife road crossings are a critical and vulnerable component of the network of connecting lands. These areas of habitat fragmentation are locations where wildlife species are most likely to cross roads, based on remote assessment of structural connectivity features. Movement of animals from one habitat patch to another is the most common function associated with connecting habitat. This function is particularly important for wide-ranging animals, such as bobcats and black bears, or for animals that require a great deal of space to meet their daily life needs, such as barred owls or otter. Although connecting habitat is often associated with wide-ranging mammals, it is equally important for animals with relatively small ranges. Spotted salamanders, for example, use connecting habitat in spring to move from their hibernation sites to breeding pools. The value of connecting habitat is a function of both seasonal and spatial patterns of wildlife behavior. For example, connecting habitat may allow black bears to access important food resources during a specific time of year (seasonal), or it may prevent isolation of bear populations by allowing free exchange of breeding adults (spatial). Ultimately, connecting habitat can ensure that the habitat, movement, migration, and behavior requirements of most native plants and animals are conserved across a broad landscape. The broader ecological value of connecting habitat is to join fragmented pieces of habitat, thereby reducing the deleterious effects of habitat fragmentation and population isolation. Linking small or otherwise isolated habitat patches may reduce the risk of local population extinctions by ensuring immigration, recolonization, reproduction, and exchange of genes for some plant and animal species. While conserving corridors has great merit, do not assume that conserving threads of vegetative cover within a developing landscape will maintain an area's ecological values and biological diversity. Nor will corridors alone meet the habitat needs of all of an area's plant and animal species. Only in conjunction with the conservation of large areas of undeveloped land with diverse habitat conditions, will vegetative corridors assist in supporting ecosystem functions and related public benefits.

Wildlife Road Crossing Conservation Goal

Conserve wildlife road crossings wherever possible, especially in fragmented landscapes. Wildlife Road Crossings are of critical importance in this network as they are the most threatened by future development.

Component Mapping Goal Statement

To map locations of potential wildlife road crossings statewide based on structural connectivity features.

Input Datasets (s) & Selection Criteria

All roadsides were divided into study plots of 60m along the road and 75m perpendicular. For each plot, the % Habitat Block was calculated. Where both sides of the road included the requisite amount of cover, that road segment was flagged as Highest Priority or Priority.

Vermont Habitat Blocks, Hawkins-Hilke et al. 2023. Vermont Fish & Wildlife Department.

Description

Habitat blocks show all areas of natural cover (Combining 2016 Forest canopy, Shrubland, & Wetland landcover data from University of Vermont Spatial Analysis Lab) surrounded by roads, development and agriculture, ranging in size from 150-acres to 150,000-acres and prioritized for biological importance.

Selection Criteria

Highest Priority Wildlife Road Crossings are those with greater than 75% of the land on both sides of the road in natural cover. Priority Wildlife Road Crossings are those with greater than 50% of the land on both sides of the road in natural cover.

Source Data Strengths

This dataset provides our best look at local-scale movement areas. While areas such as the Champlain Valley of Vermont are not considered important for regional scale movement between the Adirondacks and the Green Mountains, a network of patches of intact forest and small connecting lands between them still exist. Though fragmented habitat, they nonetheless provide connectivity to help wildlife populations persist into the future. This dataset is the best we have for addressing fine scale connectivity.

Component Limitations

Field surveys to document wildlife movement have not been performed in most of these areas. Wildlife road crossings were selected based on the presence of adjacent natural cover (e.g., forest, wetlands and waters). This dataset does not rank crossing areas based on ecological importance. For example, a wildlife road crossing on I-89 may be significantly more important to the overall connectivity network than a rural road in that the interstate is one of the state's most significant barriers to wildlife movement. Under the time limitations of this project we could not discriminate between a crossing of this most significant barrier and the crossing of a small rural road. As with all features included in Vermont Conservation Design, we recommend site-specific surveys prior to making any land-use decision.

Component Priority & Justification

Priority Wildlife Road Crossings are those with greater than 50% of the land on both sides of the road in natural cover.

Highest Priority Wildlife Road Crossings are those with greater than 75% of the land on both sides of the road in natural cover.

References

Hawkins-Hilke et al. 2023. Vermont Habitat Blocks, Vermont Fish & Wildlife Department

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Rare & Uncommon Species

Description

The species component includes both rare and uncommon species tracked by the Vermont Fish & Wildlife Department Natural Heritage Inventory. Uncommon species are defined as facing a "moderate risk of extinction or extirpation due to restricted range, relatively few populations or occurrences (often 80 or fewer), recent and widespread declines, or other factors." In contrast, rare species face a higher risk of extirpation and generally have 20 or fewer populations statewide. The Vermont Fish and Wildlife Department uses a ranking scheme to describe the relative rarity of species in Vermont, using a national Natural Heritage methodology.

Ecological importance

A species may be rare in Vermont for several reasons, including the following: the species is near the edge of the geographic range; the species only occurs in specialized habitats or rare natural communities; or human activities have resulted in a direct loss of the species or the habitat it requires. Uncommon species of plants and animals are restricted in their distribution because of limited suitable habitat, either from natural causes or due to habitat loss and fragmentation associated with development. Some uncommon species in Vermont may be at or near the edge of their geographic range. Rare and uncommon species are important for their intrinsic values – as organisms that have evolved over millennia. Each species is assumed to serve an important role in maintaining ecological integrity. Sometimes the details of this role may not be known until a species is lost or becomes extinct. Rare and uncommon species, especially populations occurring at the edge of the species' geographic range, provide important genetic diversity which may be especially significant in allowing species to adapt and evolve to changes in the environment.

Species Conservation Goal

To conserve viable populations of all rare & uncommon plant and animal species in Vermont, the habitat they need to survive, the ecological processes that support them, and landscape connectivity to allow individuals to disperse and populations to shift distribution over time in response to changing environmental conditions. Uncommon species are less at risk than rare species, but conserving all of these species is critical to conserving biological diversity. Understanding trends in uncommon species and taking appropriate conservation action is important in preventing uncommon species from becoming rare.

Component Mapping Goal

To identify and map all of Vermont's documented uncommon species populations using the best available data.

Source Data and Selection Criteria

Natural Heritage Database, Vermont Fish and Wildlife Department

Description

The Natural Heritage Database contains detailed, geographically-referenced information on Vermont's uncommon, rare, threatened, and species and on Vermont's significant natural communities. The database is periodically updated as new information on species and natural communities becomes available. For these purposes, the publicly-available rare, threatened & endanger species layer was combined with the uncommon species layer. Both are the products of the Natural Heritage Database. The data used for BioFinder are current as of August 2019.

Selection Criteria

Highest Priority - All Rare, Threatened, & Endangered species are included as highest priority.

Priority - All uncommon species are included as priority.

Component Strengths

Rare & Uncommon species records from the Natural Heritage Inventory are based on detailed site surveys and data collected by consistent methods. Element occurrence data for rare species are mapped using consistent methodology developed by the Vermont Fish and Wildlife Department and NatureServe. Rare species records are typically considered one of the most important "fine filters" for conserving biological diversity. More recent records have high spatial accuracy.

Component Limitations

Inventories of rare & uncommon species of plants and animals are incomplete, especially for many invertebrate animals and bryophytes (non-vascular plants). Many rare & uncommon species populations that are mapped in the Natural Heritage Database are mapped as circles, with the circle centered on the expected location of the population and the size of the circle representing uncertainty in the mapping accuracy. For older records with poor mapping accuracy this means that more area is mapped for the species population than it actually inhabits.

Component Priority & Justification

Highest Priority - Rare species are designated Highest Priority due to the critical importance of rare species for conserving biological diversity.

Priority - Uncommon species were ranked as Priority. This is based on the high importance of all species in their contribution to biological diversity, but the relatively moderate risk of extirpation of these species, compared to rare species. The priority ranking also reflects the relatively incomplete set of occurrence records for uncommon species in the Natural Heritage Database.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Conservation Targets

Young Forest

Definition

Young forest is forest habitat that is regenerating from natural or human disturbance and dominated by seedlings and saplings, regardless of natural community type (King and Schlossberg, 2014). It is defined as an area with greater than 50 percent cover of woody seedlings, shrubs, or saplings, up to 4.9" diameter, and at least 450 stems/acre. It includes early successional stands of shade intolerant pioneer species, as well as regenerating forest of mature forest species, such as sugar maple, hemlock, or red spruce. In general, young forest is comprised of trees less than 15-20 years old.

Ecological Function

Young forest habitat is recognized as essential to maintain viable, healthy populations of at least 65 species of wildlife in the northeast states (Gilbart 2012). Fifty-four Vermont Species of Greatest Conservation Need (SGCN) and 4 categories of insects (bumble bees, butterflies, moths, Carabid beetles) require or depend heavily upon young forest or old field/shrub habitat to maintain healthy populations. Young forest also supports many common species. Prior to European settlement in Vermont almost all young forest was created by natural disturbance. Currently, forest management creates the majority of young forest in the state.

Priority Target for an Ecologically Functional Landscape

A percentage of the forest in each biophysical region should be young forest:

- 5% of the forest in young forest condition: Northeastern Highlands, Northern Vermont Piedmont, and Northern Green Mountains
- 3-4% of the forest in young forest conditions: All other biophysical regions

Highest Priority:
Achieve the above percentage targets for young forest within VCD highest priority forest blocks, using the following acreages:

- Northeastern Highlands - 22,000 acres
- Northern Vermont Piedmont - 31,000 acres
- Northern Green Mountains - 36,000 acres
- Southern Green Mountains - 22,000 to 30,000 acres
- Southern Vermont Piedmont - 8,400 to 11,200 acres
- Taconic Mountains - 8,000 to 11,000 acres
- Vermont Valley - 1,050 to 1,400 acres
- Champlain Hills - 3,600 to 4,800 acres
- Champlain Valley - 5,700 to 7,700 acres

Guidelines for Maintaining Ecological Function

Provide young forest in discrete, contiguous blocks of at least 5 acres, with a minimum diameter of 375 feet, or in "Functional Equivalent Units." A Functional Equivalent Unit is created when a patch of young forest is created adjacent to an existing area of young forest <5 acres in size, so that the combined area is >5 contiguous acres of young forest with a combined diameter at of least 375 feet. Combined adjacent young forest may be a patch of regenerated forest, an area maintained by mowing, burning or herbicide such as a utility right-of-way, a successional old field, and/or young forest created by natural disturbance such as windthrow or beaver activity adjacent to these areas.

When creating young forest through active management, locate young forest in common and widespread matrix natural communities. Design patches so they have a high interior to edge ratio. Prevent or control the spread of invasive plant species in young forest patches. The creation of young forest has the potential to impact other conservation targets and should be planned to avoid conflicts with other targeted elements.

Although the majority of young forest is expected to be created through active forest management, young forest resulting from natural disturbance also contributes to these targets. When practical, allow these disturbances to proceed under natural dynamics with little or no intervention. Maintaining residual structures such as downed wood and root tip ups can provide important habitat diversity in these places.

Restoration Needs

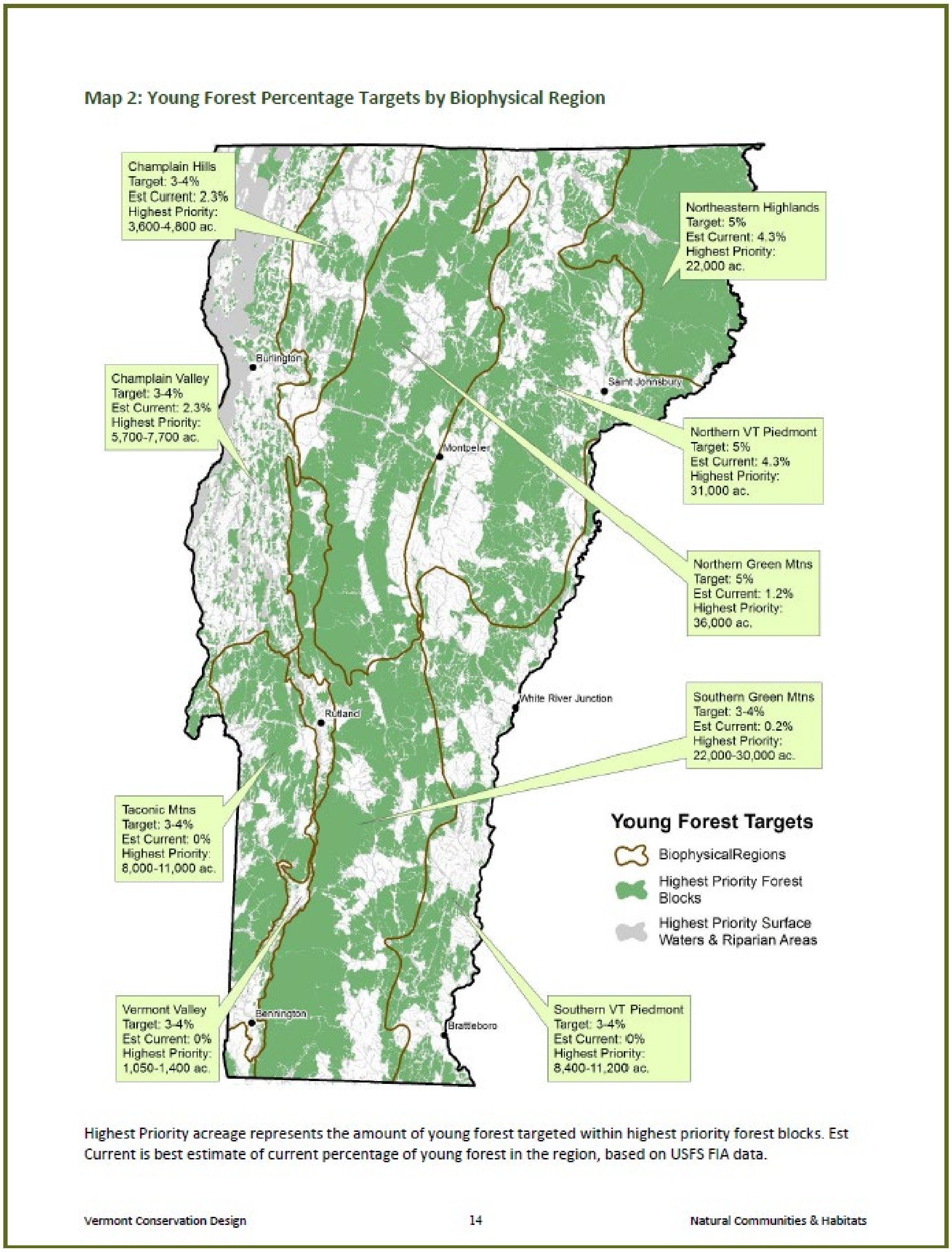
At present young forest is not adequately represented in all biophysical regions in Vermont. Creation of young forest through a combination of forest management and natural disturbance is needed to achieve these targets.

Methods and Rationale

Species requiring young forests have evolved with that habitat created by natural disturbance regimes. Since European settlement in Vermont, the abundance of young forest has varied widely, reaching a peak during the reforestation of the mid-20th century. Today, there is less young forest than before European settlement. A return to the pre-European abundance of young forest would reverse a declining trend and reach a level that at one time supported all of Vermont's native species that require young forest. Thus, target percentages of young forest condition in each biophysical region are based on the expected percentages of the regional landscape occupied by the 1-15 year age class before European settlement (Lorimer and White 2003) as applied to Vermont's forest cover (Darling et al. 2001). The patch size characteristics are recommended based habitat needs of young forest obligates as identified by multiple sources (Schlossberg and King 2007, Schlossberg and King 2015, Roberts and King 2017, Yamasaki et. al. 2014, Chandler et. al. 2009).

Mapping Comments

Young forest targets are not mapped. Spatial locations of young forest are dynamic and expected to change as a result of harvesting and natural disturbance patterns over time.



For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Old Forest

Definition

Old forests are biologically mature forests, often having escaped stand-replacing disturbance for more than 100 years and exhibiting minimal evidence of human-caused disturbance as well as continuity of process, senescence of trees, and regeneration response. In addition, these forests may exhibit many of the following associated characteristics: 1) some trees exceeding 150 years in age for most forest types (100 years for balsam fir, 200 years for eastern hemlock); 2) native tree species characteristic of the forest type present in multiple ages; and 3) complex stand structures that include a broad distribution of tree diameters, multiple vertical vegetative layers, natural canopy gaps, abundant coarse woody material (reflecting the diameters of the standing trees) in all stages of decay and numerous large standing dead trees. It is expected that old forests operate under natural disturbance regimes and may include small areas of regenerating forest as a result of these disturbances.

Ecological Function

Historically, the vast majority of Vermont's landscape was old forest, and it is the original habitat condition for many species. The state's native flora and fauna that have been here prior to European settlement are adapted to this landscape of old, structurally complex forest punctuated by natural disturbance gaps and occasional natural openings such as wetlands or rock outcrops. The complex physical structure of old forests creates diverse habitats, many of which are absent or much less abundant in younger forests.

As a result of the persistent structural and vegetative complexity above ground and the diverse biome belowground and associated complex biotic and abiotic relationships that develop over time, old forests also protect water quality, and sequester and store carbon, provide opportunities for adaptation of species and community relationships to climate and other environmental changes, and an ecological benchmark against which to measure active management of Vermont's forests.

Priority Target for an Ecologically Functional Landscape

Within the matrix forest in the highest priority forest blocks in each biophysical region, 15% should be managed as, or for, an old forest condition. 4,000-acre minimum patch sizes are preferred as they are most likely to accommodate large-scale natural disturbance events. Smaller minimum patch sizes are offered for biophysical regions that are more fragmented and where only smaller forest blocks remain. Total Acres/minimum preferred patch sizes as follows:

- Champlain Hills - 13,000/1,000
- Champlain Valley - 15,000/500
- Northeastern Highlands - 59,000/4,000
- Northern Green Mountains - 95,000/4,000
- Northern Vermont Piedmont - 78,000/1,000
- Southern Green Mountains - 91,000/4,000

- Southern Vermont Piedmont - 31,000/1,000
- Taconic Mountains - 33,000/1,000
- Vermont Valley - 4,000/500

Matrix forest communities should be represented as old forest according to their natural distribution in each biophysical region. Patches of old forest that are smaller than the minimum preferred patch size also provide important ecological functions and contribute to the numerical goals for each biophysical region, but with the acknowledgement that these small patches are more susceptible to stand-replacing natural disturbance events and likely do not provide all the functions of larger, connected patches.

Highest Priority:
All of the above targets for old forest are highest priority.

Guidelines for Maintaining Ecological Function

Old forests should operate under natural disturbance regimes, and need to be maintained in patches large enough to accommodate natural disturbance regimes without compromising old forest characteristics dominating the patch. Species composition and structures should be appropriate to the natural community type. The forest and natural community condition should not be significantly impacted by non-native plant species. Management may be needed to control invasive species or remediate human impacts, but management should not interfere with normal natural process or alter native species composition.

Restoration Needs

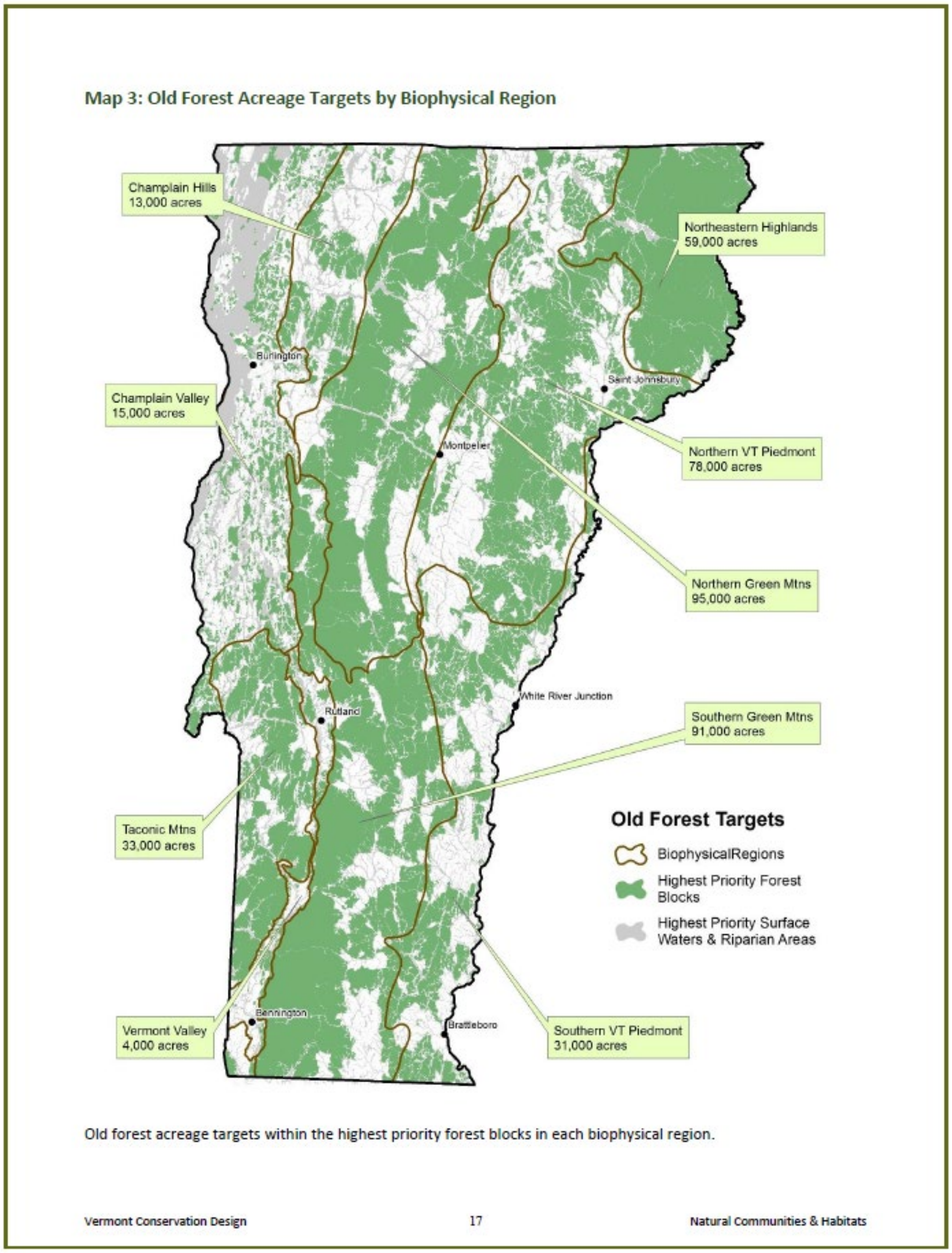
Although there are small patches of old forest scattered around the state, old forest is absent in Vermont as a functional component of the landscape. In most forests, passive restoration will result in old forest conditions. In some cases, active forest management may be beneficial to promote forest composition and structure suitable for subsequent passive restoration.

Methods and Rationale

The native species of Vermont evolved in a landscape dominated by old forest. Many of these species are well-adapted to the complex and diverse structure that develops in large areas of old forest. The closer the target is to the historic old forest condition, the greater the likelihood that the landscape will support all of Vermont's native forest species and fully provide the forest's ecological services. There are no known thresholds between the current forest condition (essentially no old forest) and the historic condition. We used professional judgement and consideration of natural disturbance regimes and the various ecological functions provided by old forest (Appendix C) to arrive at a target level we felt confident would reintroduce functioning old forest to the Vermont landscape. Minimum preferred patch sizes were established based on expected disturbance regimes (Lorimer and White 2003). These preferred patch sizes were adjusted down in biophysical regions where contiguous forest was limited by fragmentation and non-forest area.

Mapping Comments

Old forest targets are not mapped due to a lack of spatial information at this time.



For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Upland Shrub-Forb

Definition

These are upland sites dominated by forbs and shrubs, with at least 50% shrub canopy cover and few if any trees. Forb- and shrub-dominated areas are often variable and inter-mixed across space due to variable disturbance intensities and across time because disturbance drives areas to forbs which then develop into shrubs.

Ecological Function

Many wildlife species require shrub and forb meadows for breeding and foraging. These species include American woodcock, brown thrasher, prairie warbler, field sparrow, eastern bluebird, eastern kingbird, orchard oriole, northern shrike, eastern towhee, and eastern cottontail. This element seeks to complement naturally occurring shrubland (such as alder swamps) and young forest. Together these three elements should provide sufficient quantities and types of forb and shrubland, distributed across the state to support the many of the wildlife species the rely on forb and shrub habitat.

Priority Target for an Ecologically Functional Landscape

Forb-shrub targets are stated as percentages of undeveloped land area in each Biophysical Region:

- Northern Green Mountains, Southern Green Mountains, and Southern Vermont Piedmont: 0.5%
- Northeast Highlands, Taconic Mountains, Vermont Valley, Champlain Highlands, and Northern Vermont Piedmont: 1%
- Champlain Valley: 2-3%

Highest Priority: Any forb- or shrubland dominated by noninvasive vegetation and near forest, wetland, open areas, or other non-developed habitats

Guidelines for Maintaining Ecological Function

Disturbance (mowing, grazing, burning, etc.) should occur outside the growing season (preferably April-early May or October-November) to minimize mortality to foraging and nesting birds, reptiles, and insects. Disturbance should be regular enough to prevent trees from gaining dominance. To allow successful breeding of many shrubland birds, patches should be at least 5 acres and should be blocky or circular in shape to maximize interior area. Forb and shrublands should be composed primarily of non-invasive vegetation.

Locations of shrub and forb patches should be carefully chosen to prevent impacts to other higher priority features. Small patches of shrub-forb (less than 5 acres) have the least impact to forest blocks, but in some situations larger patches can still be appropriately placed in large forest blocks. All shrub-forb areas should be in proximity with others to provide increased function for shrubland birds. Patches of managed forb-shrubland that are smaller than the minimum size may provide habitat of a lower quality, but still have value, particularly for reptiles.

Restoration Needs

Efforts should focus on maintaining and improving existing areas. Establishment of new shrubland should take place outside of the highest-priority landscape-scale elements, and in locations that avoid conflicts with other habitat and natural community-scale targets.

Mapping Comments

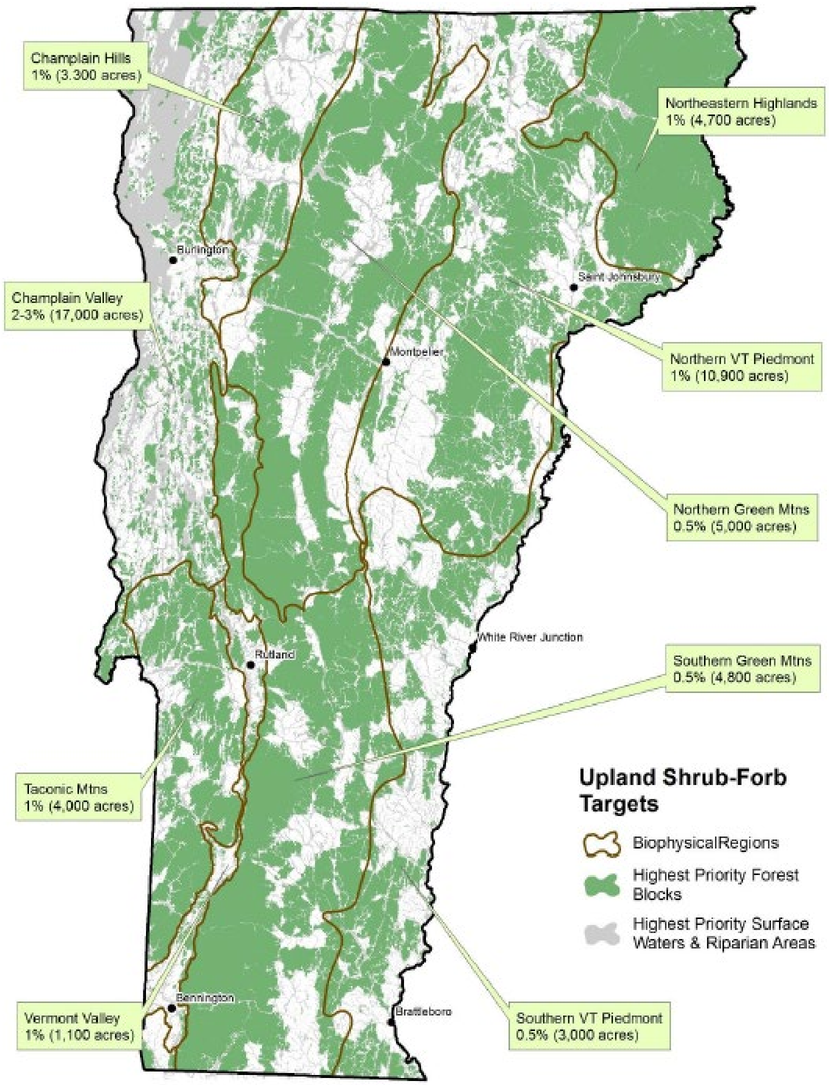
Spatial locations for upland shrub-forb targets are dynamic and expected to change as a result of land use and natural disturbance patterns over time. Upland shrub-forb targets are not mapped.

Methods and Rationale

The wildlife species that rely on shrublands are experiencing significant declines across the US and the northeast. Habitat loss is the primary threat to these species in Vermont. Maintaining and enhancing shrub- and forb-land of sufficient quality, size, and arrangement will enable populations of birds, plants, and other animals to persist in Vermont into the future.

Shrub-forb targets were selected to maintain the current levels (based on available data) of forb and shrubland in most of the state, while increasing the level in the Champlain Valley, the location of the greatest shrub-dependent bird diversity in the state. These targets complement those set for young forest and wetland shrub habitats. The variety of types is important both within and between these groups, as the range of species using these habitats prefer a variety of conditions.

Map 11: Upland Shrub-Forb Percentage Targets



Upland Shrub-Forb Targets as a percentage of undeveloped land in each biophysical region.

Vermont Conservation Design 45 Natural Communities & Habitats

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Grasslands – Refuges

Definition

Grasslands are anthropogenic areas dominated (>50%) by noninvasive (but often non-native) grass with a lesser abundance of forbs. They are typically cultivated for livestock forage, and do not include fields of cereal grains.

Ecological Function

The primary function of grasslands is as habitat for species of birds that require grassland for breeding and foraging, particularly Bobolink, Eastern Meadowlark, and Savannah Sparrow. This element seeks to provide a minimum area and configuration of productive breeding habitat capable of supporting numbers of bobolinks, meadowlarks, and savannah sparrows that would prevent state listing as Threatened or Endangered. These areas also provide habitat for plants and numerous other species of wildlife that use grasslands for their life requirements.

Priority Target for an Ecologically Functional Landscape

Three Refuges, covering a total of 7,500 acres, managed specifically for grassland birds in Addison, Franklin, and Orleans Counties, and located outside highest-priority landscape-scale elements. In Orleans County, 500 acres of Refuge areas should be located within the Lake Memphramagog watershed, in minimum contiguous suitable habitat areas of 100 acres. In Addison and Franklin Counties, 7000 acres of Refuge areas should be divided between the two counties, in minimum contiguous suitable habitat areas of 250 acres. Fields should be adjacent or in as close proximity as possible. Patches of managed grassland that are smaller than the minimum size may provide habitat of a lower quality, but still have value, particularly if grouped near larger patches.

Highest Priority:
All reserve areas are Highest Priority

Guidelines for Maintaining Ecological Function

The management regime of grasslands is essential. Disturbance must be often enough to maintain quality grassland, and (optimally) remove thatch to allow vigorous growth. Management must not, however, destroy nests during the breeding season (generally, May to early August).

In grassland refuges, mowing or other management should take place after August 1. Grassland patches should be larger than 25 acres, which will meet the needs of bobolink and savannah sparrow and will contribute to the needs of other species. Patches that are blocky or circular have more interior grassland area and will support more birds. Trees within the grassland will generally lower the habitat use and should be absent or limited to a small number of individual trees (not a treeline or island). Mowing regimes should be designed to incorporate best management practices for birds and reptiles.

Mapping Comments

Inventory is needed to identify and assess suitable locations for achieving these targets. Grassland refuges are not mapped at this time.

Restoration Needs

Efforts on grassland should focus on maintaining and improving existing grassland areas and supporting grass-based agriculture over intensive row crops or other land uses.

Methods and Rationale

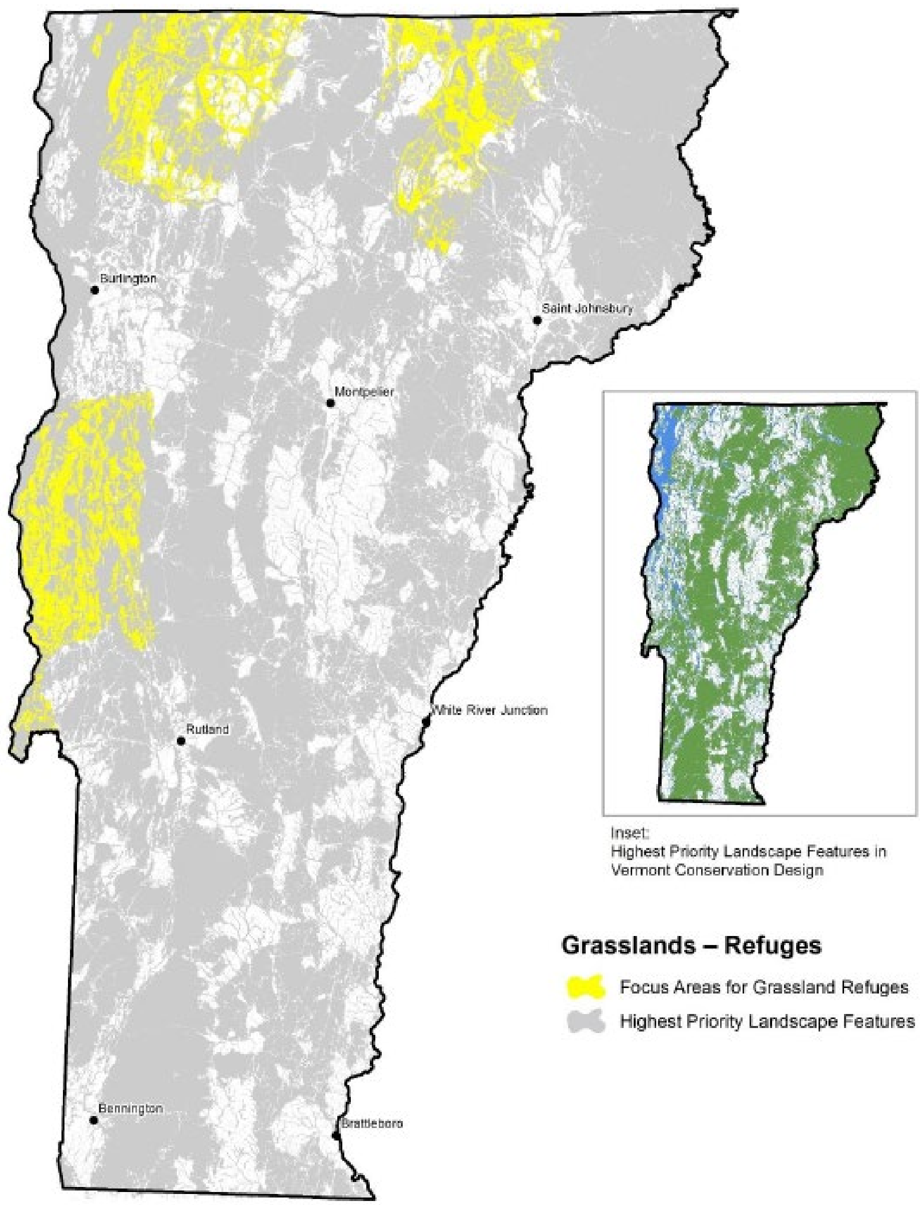
The wildlife species that rely on grasslands are experiencing some of the gravest declines across the both the US and the northeast. Habitat loss from development and loss of functional habitat through agricultural intensification are the primary threats to these species in Vermont.

Maintaining and enhancing grasslands of sufficient quality, size, and arrangement will enable populations of birds, plants, and other animals to persist in Vermont into the future.

Specifically, these targets were developed based on the habitat needs of three umbrella species: bobolink, eastern meadowlark, and savannah sparrow. These common grassland species and their biological needs are broad enough to reflect the needs of the majority of obligate and facultative grassland wildlife species, though they do not capture the needs of all grassland dependent species. Very rare species (e.g., vesper sparrow) and species with unique requirements (e.g. northern harrier, American kestrel) likely need fine filter consideration.

Long-term persistence of these three umbrella species is best achieved with dedicated habitat management. Acreages were derived by calculating the area needed to support a breeding population of at least 500 pairs. This ensures populations are above the threshold for listing as State Threatened or Endangered. Focus regions were chosen based on the presence of large areas of grassland and abundant grassland birds.

Map 9: Grassland Refuge Target Regions



Refuges are targeted outside of the highest priority landscape-scale elements.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Grasslands – Managed Agricultural Lands

Definition

Grasslands are anthropogenic areas dominated (>50%) by noninvasive (but often non-native) grass with a lesser abundance of forbs. They are typically cultivated for livestock forage, and do not include fields of cereal grains.

Ecological Function

The primary function of grasslands is as habitat for species of birds that require grassland for breeding and foraging, particularly Bobolink, Eastern Meadowlark, and Savannah Sparrow. This element seeks to improve the favorability of existing agricultural grassland management for grassland birds, particularly to reduce the incidence of breeding-season mowing that causes substantial mortality for nesting birds. These areas also provide habitat for plants and numerous other species of wildlife that use grasslands for their life requirements.

Priority Target for an Ecologically Functional Landscape

All anthropogenic grasslands in Vermont are targets for improving grassland bird survival and productivity for as long as the grassland field remains in active agricultural use.

Highest Priority:
Regions that currently have high concentrations of grasslands: Champlain Valley biophysical region, the Northern Vermont Piedmont biophysical region, the Connecticut River region (within approximately 10 miles of the Connecticut River).

Guidelines for Maintaining Ecological Function

The management regime of grasslands is essential. Disturbance must be often enough to maintain quality grassland, and (optimally) remove thatch to allow vigorous growth. Management must not, however, destroy nests during the breeding season (generally, May to early August).

In Grassland Management areas, mowing or other management should take place after August 1, or practice "deferred mowing" where management takes place early in the breeding season then is withheld until after the end of the breeding season, to allow a window between for successful breeding. Grassland patches should be larger than 10 acres, which will meet the needs of bobolink and savannah sparrow and will contribute to the needs of other species. Patches that are blocky or circular have more interior grassland area and will support more birds. Trees within the grassland will generally lower the habitat use and should be absent or limited to a small number of individual trees (not a treeline or island). Patches of managed grassland that are smaller than the minimum size may provide habitat of a lower quality, but still have value, particularly if grouped near larger patches.

Restoration Needs

There are no restoration needs at this time. Efforts should focus on maintaining and improving grassland areas in active agricultural use, and support grass-based agriculture over intensive row crops or other land uses.

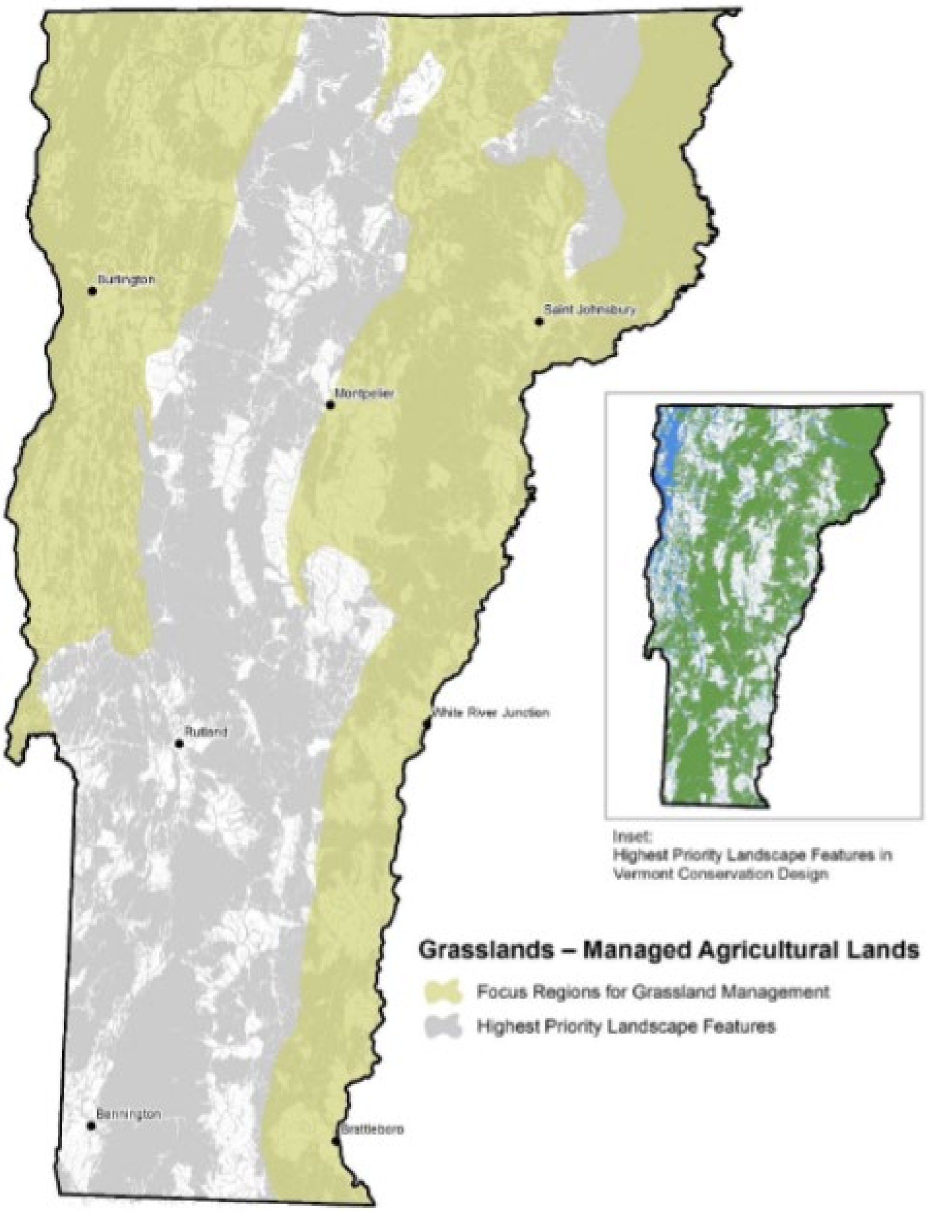
Mapping Comments

Grasslands are relatively widespread and may be ephemeral depending on agricultural activity. For this reason, grassland management targets are not mapped.

Methods and Rationale

The wildlife species that rely on grasslands are experiencing some of the gravest declines across the both the US and the northeast. Habitat loss and loss of functional habitat through agricultural intensification are primary threats to these species in Vermont. Maintaining and enhancing grasslands of sufficient quality, size, and arrangement will enable populations of birds, plants, and other animals to persist in Vermont into the future.

Map 10: Grassland Management Focus Areas



Management is targeted outside of the VCD Ecologically Functional Landscape.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov

Caves

Definition

These are naturally occurring underground cavities that are large enough to have a different environment (temperature, humidity, etc.) than conditions outside the cave.

Ecological Function

Caves provide a very consistent environment of temperature, relative humidity, and air flow. Changes in structure and hydrology could greatly affect the habitat provided by subterranean areas. Bats are one of the better studied orders of wildlife species associated with subterranean areas and have been surveyed in caves going back into the 1930s. There are 6 species of bats known to hibernate in Vermont caves. Recent surveys indicate that caves may hold as few as less than 10 bats to as many as over 70,000. Bats use these sites for hibernation, but also spend a disproportionate amount of the year in the surrounding area (e.g., fall swarming).

Interest and understanding in the invertebrate community associated with caves is just beginning. Little is known about the condition of the subterranean aquatic habitats. At the national and global scale, it is well-documented that caves provide habitat for specialized invertebrates (Peck 1998). Caves are expected to function as a coarse filter for these species which are poorly understood.

Priority Target for an Ecologically Functional Landscape

Fifty percent of known caves in Champlain Valley (CV) and Taconic Mountains/Vermont Valley (TM/VV), and all caves in all other biophysical regions, are targeted to maintain an ecologically functional landscape.

Currently, there is insufficient inventory of caves to identify specific numerical targets to achieve 50% representation of caves in the CV and TM/VV regions, and even less information to fully assess representation of bedrock and formation of targeted caves. Additional study is needed to refine these targets. In lieu of a numerical target, the highest priority list of caves below (next page) represents our current best knowledge of the caves most critical for ecological function and maintaining an ecologically functional landscape.

Highest Priority: All targeted caves. At this time, the following list of caves:

Cave	Biophysical Region
1867 Cave	TM/VV
Aeolus Cave	TM/VV
Barrel Cave	CV
Bear Bones Cave	TM/VV
Bristol Cave	CV
Calvin Cave	TM/VV
Carbide Cave	Other BPR
Chimney Cave	TM/VV
Easter Cave	Other BPR

Kent (Wyman's) Cave	TM/VV
Little Skinner Hollow	TM/VV

Cave	**Biophysical Region**
Milton Cave	CV
Morris Cave	TM/VV
Nickwackett Cave	CV
Philadelphia Cave	CV
Plymouth Cave	Other BPR
Porcupine Caves	CV
Quarry Cave	TM/VV
Skinner Hollow Cave	TM/VV
Trap Spring Cave	CV
Vermonster Cave	TM/VV
Williams Cave	TM/VV

Guidelines for Maintaining Ecological Function

Subterranean areas should remain intact, with limited human alteration or influence from above-ground pollutants. Maintain natural processes, including temperature regime, airflow, humidity, and hydrology; natural vegetation conditions above the cave footprint and a 50m buffer to moderate air and temperature conditions; and natural groundwater sources. Recreational exploration of caves can pose a threat to physical conditions and cave species. Within a 0.25-mile zone around the cave entrance, maintain or restore a closed forest canopy with native species and abundant potential live or dead roost trees with cavities, cracks, crevices, and/or peeling bark.

Restoration Needs

For some caves, restoration of natural vegetation around cave entrances and the cave footprint is needed to achieve full ecological function.

Mapping Comments

Cave locations are not mapped or described to protect sensitive species from disturbance. Locations of caves are provided to landowners and may be available upon request for conservation purposes.

Methods and Rationale

Cave targets were selected in an effort to represent all cave types (e.g. solutional, non-solutional) and bedrock types across all biophysical regions. Unfortunately, there is no classification or comprehensive inventory of caves in Vermont. Specific cave targets were selected because they are known sites with documented use by bats and/or invertebrates.

Abandoned Mines

Definition

Abandoned mines that provide suitable habitat used by hibernating bats, and the mines' surrounding naturally vegetated zone necessary for full ecological function. These targeted abandoned mines are large enough to have a different environment (temperature, humidity, etc.) than conditions outside the mine.

Ecological Function

Abandoned mines may provide many or all of the habitat qualities of natural caves and can even provide better habitat in some instances. These human-created cultural habitats are found statewide due to the history of Vermont. Although not of natural origin, they augment the natural habitats available to wildlife. In particular, bats are known to use some mine sites as hibernacula, and some mines support large bat populations. It is also possible that mines also support subterranean invertebrates, but this needs additional study.

Priority Target for an Ecologically Functional Landscape

All abandoned mines used (or formerly used, prior to white-nose syndrome) as bat hibernacula are targeted. At present, 19 known abandoned mines are targeted.

Highest Priority: All abandoned mines used (or formerly used, prior to white-nose syndrome) as bat hibernacula. Currently, 19 abandoned mines:

Cave	Biophysical Region
Brandon Silver Mine	SGM
Bridgewater Mine #1	SGM
Bridgewater Mine #2	SGM
Camp Brook Mine	NGM
Clifton Adit Mine	SGM
Dover Iron Mine	SGM
Elizabeth Mine	SVP
Ely Copper Mine	NVP
Fox Gold Mine (Rook's)	SGM
Greely 2 Mine	NGM

Cave	Biophysical Region
Greely Talc Mine	NGM
Hammondsville Mine	SGM
Johnson Talc Mine	NGM
Luzenac Mine - Frostbite	SGM
Luzenac Mine - Yager	SGM
Moretown (Eastern Magnesia) Talc Mine	NGM
Pike Hill Mine	NVP

Rochester Iron Mine	NGM
Rousseau Talc Mine	NGM

Guidelines for Maintaining Ecological Function

Subterranean areas should remain intact, with limited human alteration or influence from above-ground pollutants. Maintain natural processes, including temperature regime, airflow, humidity, and hydrology; natural vegetation conditions above the mine footprint and a 50m buffer to moderate air and temperature conditions; and natural groundwater sources. Recreational exploration of mines can pose a threat to physical conditions and mine species. Within a 0.25-mile zone around the mine entrance, maintain or restore a closed forest canopy with native species and abundant potential live or dead roost trees with cavities, cracks, crevices, and/or peeling bark.

Restoration Needs

There may be opportunities to restore natural vegetation around mine entrances and the mine footprint.

Mapping Comments

Abandoned mine locations are not mapped or described to protect sensitive species from disturbance. Locations of abandoned mines may be available upon request for conservation purposes.

Methods and Rationale

Abandoned mines provide unique habitat conditions. Those known to be used as bat hibernacula make important contributions to Vermont's ecologically functional landscape.

For more information

For more information specific to this component, contact Vermont Fish & Wildlife Department, Jens Hilke, at 802-461-6791, jens.hilke@vermont.gov and Bob Zaino, at 802-476-0128, Robert.Zaino@vermont.gov