Staying Connected in the Northern Green Mountains: Identifying Structural Pathways and other Areas of High Conservation Priority

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Summary

This paper describes the process of identifying critical areas of fine-scale wildlife connectivity, or structural pathways, within the Northern Green Mountains of Vermont. The Northern Green Mountains are one of eight large-scale wildlife linkages in the Northern Appalachians Forest. The analyses focused on road crossing areas connecting large habitat blocks of unfragmented forest greater than 3,000 acres. Thirty-four pathways were identified and categorized, and the landowner parcels within them identified and ranked for importance of connectivity within the pathway. In addition, parcels within the habitat blocks themselves were identified and ranked for importance in contributing to *regional* connectivity.

The Staying Connected Initiative

The Staying Connected Initiative (SCI) was formed in 2009 to protect and maintain landscape connectivity across the Northern Appalachians of the United States and Canada for the benefit of wide-ranging, forest dwelling wildlife such as bear, moose, lynx, marten and bobcat. SCI is an innovative 21-member, multi-state partnership that includes 13 non-profit organizations and eight state agencies from Vermont, New Hampshire, Maine, and New York. The initiative focuses on eight priority landscape linkages (Figure 1), most of which were identified by Two Countries, One Forest (2C1forest.org; Trombulak et al. 2008) as important for ecoregional connectivity.

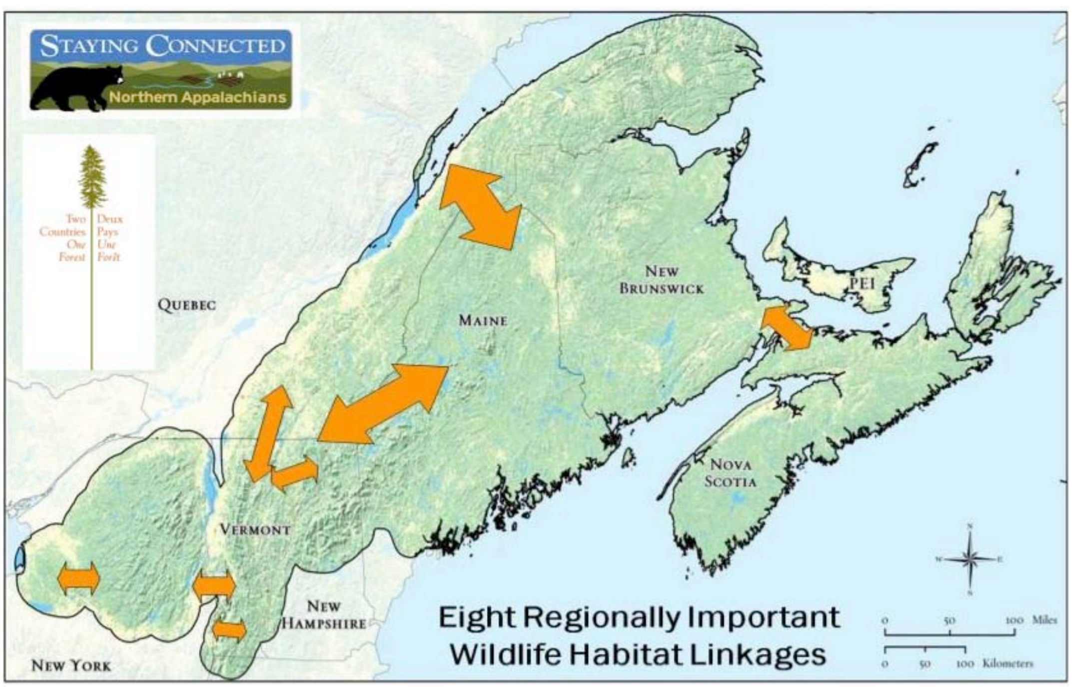

Figure 1. Eight Landscape Linkages originally identified by the Staying Connected Initiative and Two Countries, One Forest (2C1Forest) in response to 2C1Forest's report on conservation priorities in the Northern Appalachians (Trombulak et al. 2008). Northern Appalachian Ecoregion is outlined in black.

SCI defines a landscape linkage as a *broad region of comparatively greater or more concentrated connectivity important to facilitate the landscape or regional-scale movement of multiple species and to maintain ecological processes between core areas*, and where structural connectivity is at risk. Structural connectivity occurs when *similar landscape elements, such as habitat patches or natural vegetation, are physically connected to each other.*

Within each linkage, SCI partners are pursuing a suite of conservation strategies designed to succeed in a region of predominantly private lands. These include: 1) using conservation science and GIS modeling analyses to identify critical areas of fine-scale connectivity within each linkage; 2) providing outreach, education, and assistance to individuals, landowners, municipalities, and community groups to better understand and protect wildlife connectivity; 3) providing technical assistance for municipal land use planning in safeguarding wildlife and other conservation values; 4) collaborating with state and local transportation departments to facilitate better, safer wildlife movement across important crossing areas; and 5) protecting land in targeted areas.

The Northern Green Mountains Landscape Linkage

This document describes the process used to identify and rank Structural Pathways and land parcels within the US portion of the Northern Green Mountains (Figure 2) as well as the process used to refine the Northern Green Mountain Landscape Linkage boundary.

SCI defines a structural pathway as an *area with sufficient structural connectivity to function as a habitat corridor*. A habitat corridor occurs when those *components of the landscape provide a continuous or near continuous pathway that may facilitate the movement of target organisms or ecological processes between areas of core habitat.*

The Northern Green Mountains are among the wildest, yet least protected, landscapes in the Northern Appalachians. Ranging from Mount Mansfield, Vermont, in the south to Mount Orford, Québec, in the north (Figure 2), these mountains and their slopes are remarkably diverse, containing all major ecosystem types of the Northern Appalachians.

The Northern Green Mountains serve a crucial role in regional landscape connectivity, tying the Adirondacks and the central Appalachians to the Northern Appalachians of Maine and Canada, thus providing an important north-south and east-west corridor for wildlife. The complexity of the terrain in the Northern Greens, and the relatively large elevation gain over the surrounding Champlain Valley and Piedmont, provide species with flexibility to move and adapt in face of climate change (Anderson et al. 2011).

Due to initial funding source requirements, the first phase of the SCI project was implemented only in the US portions of the eight linkages.

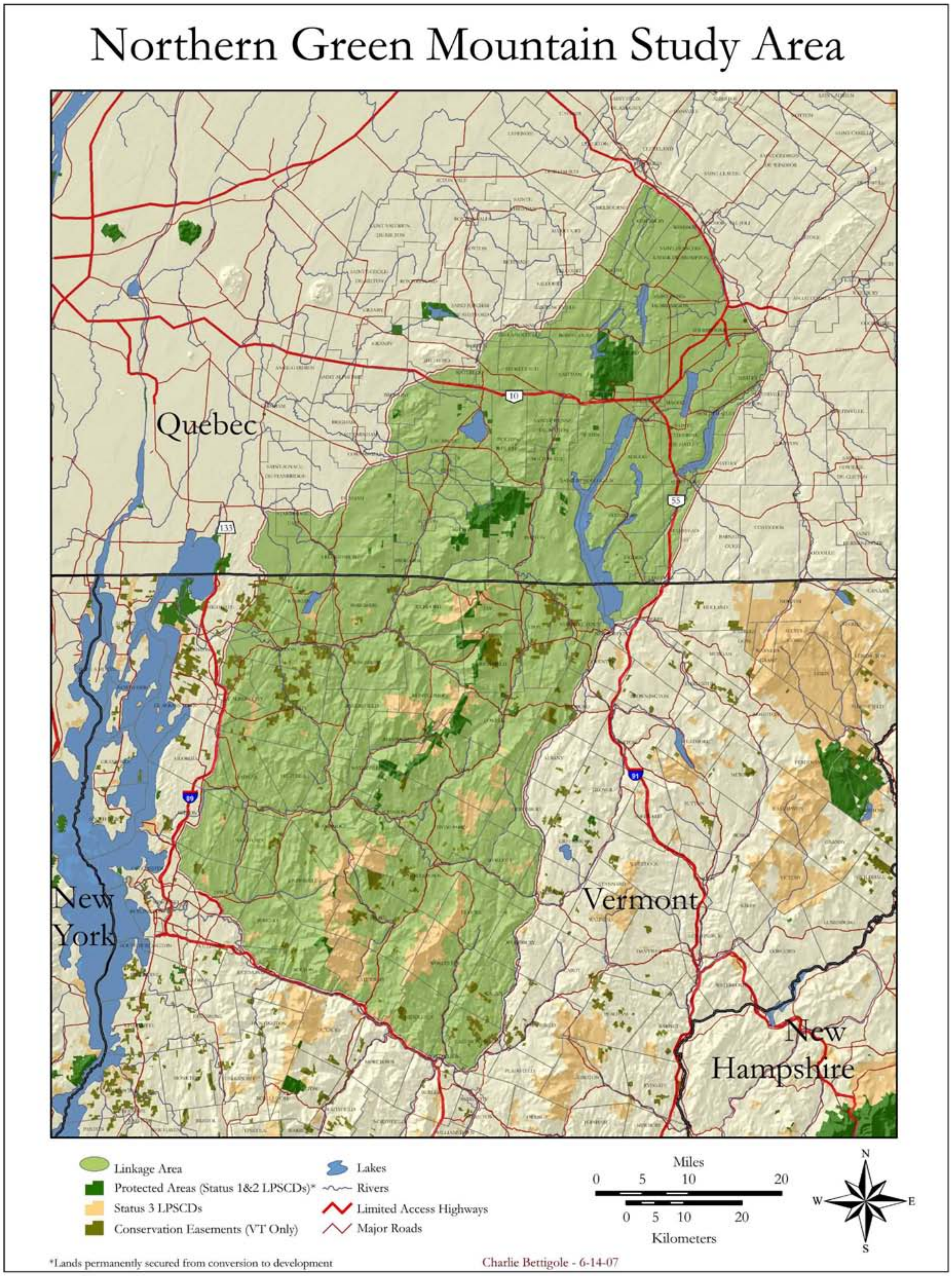

Figure 2. Initial Northern Green Mountain Study Area at outset of process to identify critical areas of fine-scale wildlife connectivity, or structural pathways.

Identifying Structural Pathways in the Northern Green Mountains

The first step the authors (hereafter "we") used to delineate structural pathways was to determine the location of existing unfragmented areas. Vermont Fish and Wildlife Department (VFWD) and Vermont Land Trust (VLT) had previously conducted a study to improve the understanding of the statewide distribution of contiguous habitat blocks. Specific undertakings of the study, finalized in 2011 (Sorenson and Osborne; see Appendix #1 for further details), included:

- Identification of habitat blocks (contiguous areas that are undeveloped, uncultivated, greater than 20 acres, and lacking class 1 – 3 roads) using NOAA & C-CAP Land Cover data (Figure 3);
- Determinations of "cost" to wildlife for crossing each land cover type and creation of a cost grid for Vermont;
- Ranking relative importance of habitat blocks for their contribution to biological and conservation value and the potential threat to them.

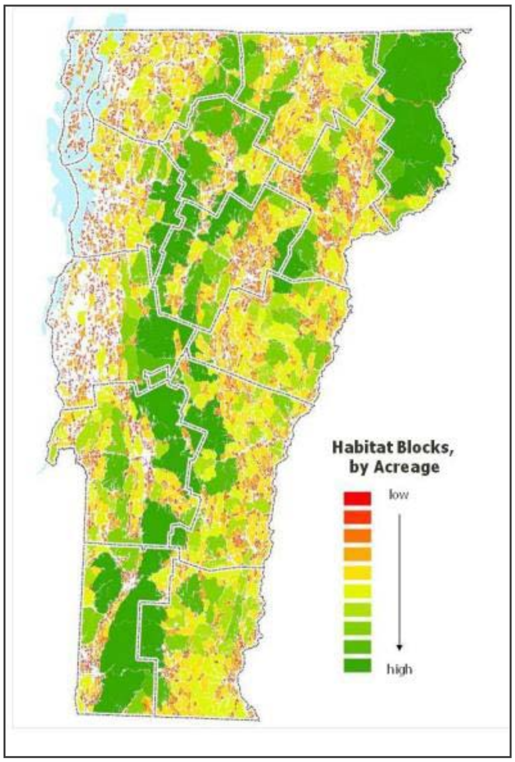

Figure 3. Habitat Blocks across Vermont, colored according to acreage, from Sorenson and Osborne (2011)

We used the Sorenson and Osborne Habitat Block analysis data (2011) to view habitat blocks by acreage in the U.S portion of the Northern Green Mountains Landscape Linkage area. After experimenting with various acreage thresholds, we identified those habitat blocks greater than or equal to 3,000 acres (Figure 4). We consider these large habitat blocks as the core forested area in the Northern Greens, but are aware that appropriate thresholds depend largely on landscape context.

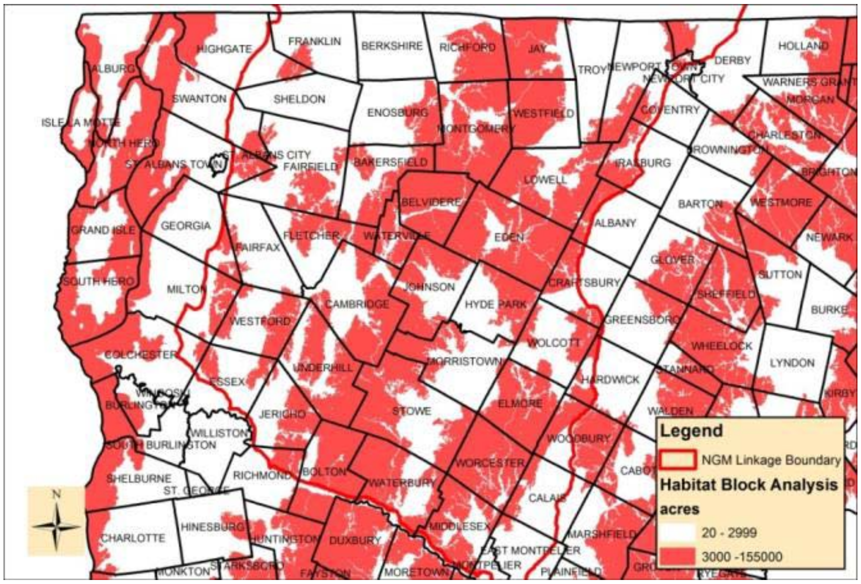

Figure 4. Habitat blocks 3,000 acres or larger are shown in red.

Jens Hilke, a Conservation Biologist with VFWD had used the results of Sorenson and Osborne (2011) to develop a "Habitat Network" of habitat blocks and the lands connecting them, by overlaying a series of Least Cost Path (LCP) analyses. (Figure 5).

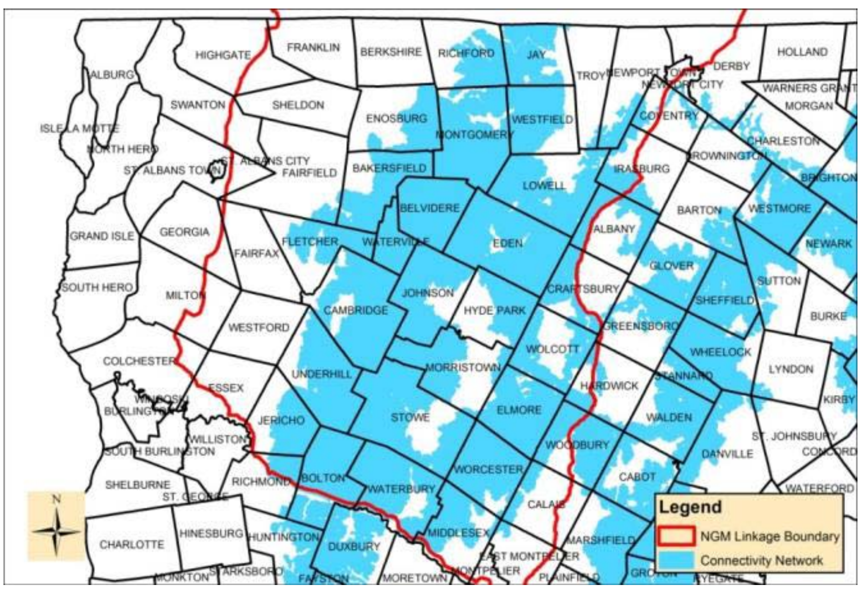

Figure 5. "Habitat Network" as developed by Jens Hilke of VFWD in 2010, based on a draft of Sorenson and Osborne's study.

To highlight areas of connectivity, we overlaid Hilke's Habitat Network with identified habitat blocks greater than 3,000 acres (Figure 6). In Figure 6, areas in purple are the overlap with Hilke's Habitat Network while light blue represents areas of potential connectivity among habitat blocks.

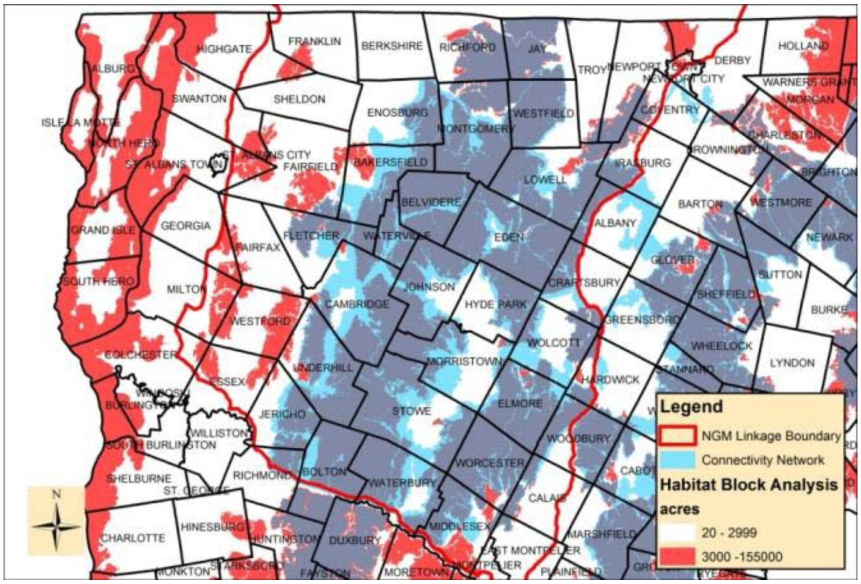

Figure 6. US portion of the Northern Greens showing Habitat Blocks (in red and purple) and areas of potential connectivity (light blue).

To broaden the geography that Hilke covered and refine his analysis for the Northern Greens, we ran additional LCP analyses. Various "start" and "end" points for the LCP analyses were run, acknowledging the region's value for both East-West and North-South connectivity. Eric Sorenson of VFWD assisted in these analyses (Figure 7).

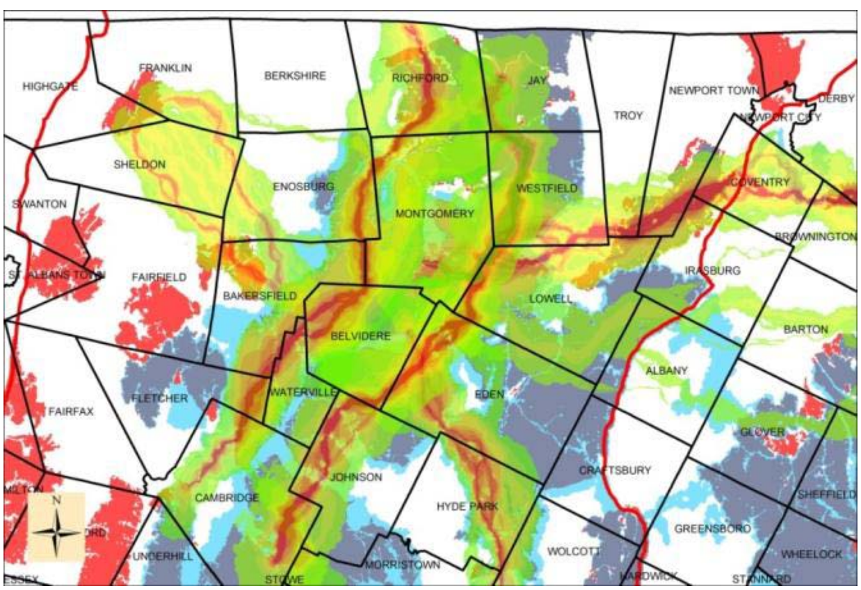

Figure 7. Combined Least Cost Path analyses: Red, yellow, green, and then clear coloration show the paths of increasing resistance between two habitat blocks.

We also took into consideration the results of the Critical Paths Project (Leoniak et al. 2009), which surveyed 38 sites throughout the state where east-west roads cross the spine of the Green Mountains. A team of state biologists and conservation organizations assessed the physical features of the crossings and the natural features of adjacent landscapes. They also tracked and monitored wildlife movement patterns at each crossing, three times each during one winter and one spring.

From this work they were able to identify 11 critical "Priority Crossing Zones" along the spine of the Green Mountains that are essential to North-South wildlife movement. Detailed strategies are being developed for road mitigation, roadside improvements for traffic safety and wildlife crossing, land conservation, and local land use planning for these zones. Where one of these Priority Crossing Zones occurred in the Northern Green Mountain Linkage area, we considered it in our analysis. This is the only work, through 2012, that spoke to *functional* connectivity.

We next identified those general areas (in the light blue "connecting lands") with *best available* current structural connectivity between habitat blocks (Figure 8). These are areas where it is particularly important to maintain connectivity so that blocks stay structurally connected.

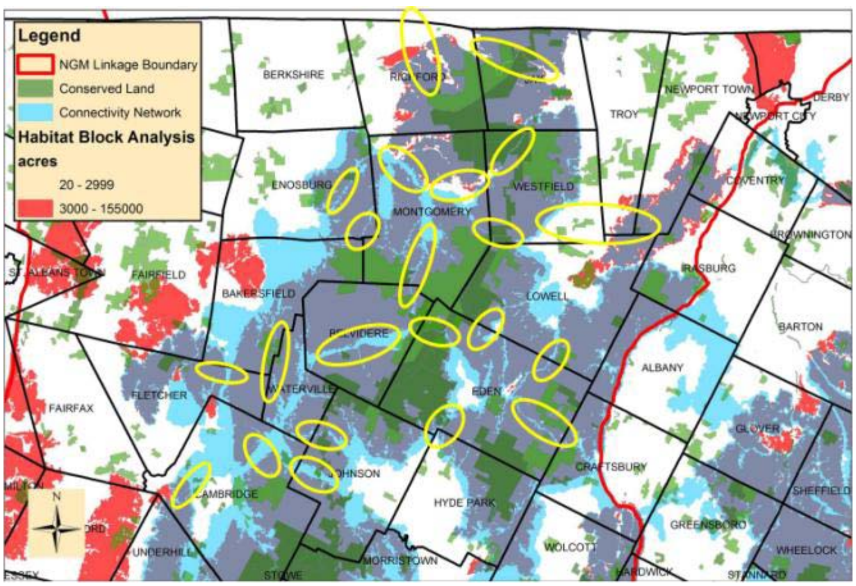

Figure 8. General "Connecting Lands" between habitat blocks.

Although roads fragment the landscape, certain landscape features contribute to or weaken the structural connectivity between large blocks despite roads. In order to further refine the general connecting lands areas, we took into account the presence of these features. Features we considered to promote structural connectivity in our refinement process included: forest cover on both sides of the road, hedgerows, riparian buffers, culverts, bridges, and wetlands. (Identification by the Critical Paths or LCP analyses of likely road crossings also highlighted specific areas). Features that we considered to weaken structural connectivity were human development, roads, agricultural fields, and sometimes guardrails.

With the Connecting Lands defined, we took a systematic approach to delineating the structural pathways. The first step was to isolate a given connecting area and then identify the large habitat blocks and conserved lands around the connecting area (Figure 9).

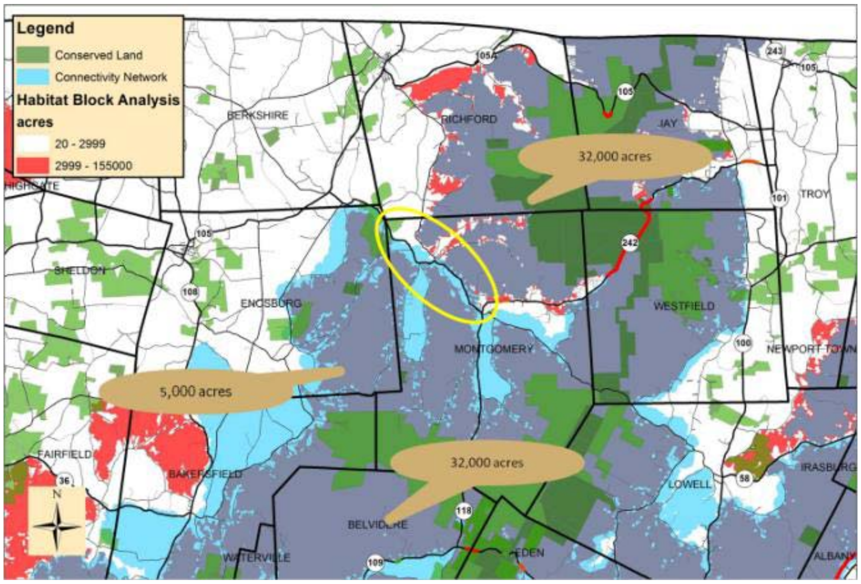

Figure 9. A closer look at a general "Connecting Lands" area in Montgomery, VT. shows surrounding large habitat blocks and conserved land.

We then reviewed high-resolution Ortho photos (Figure 10) and conducted drive-by visual analyses

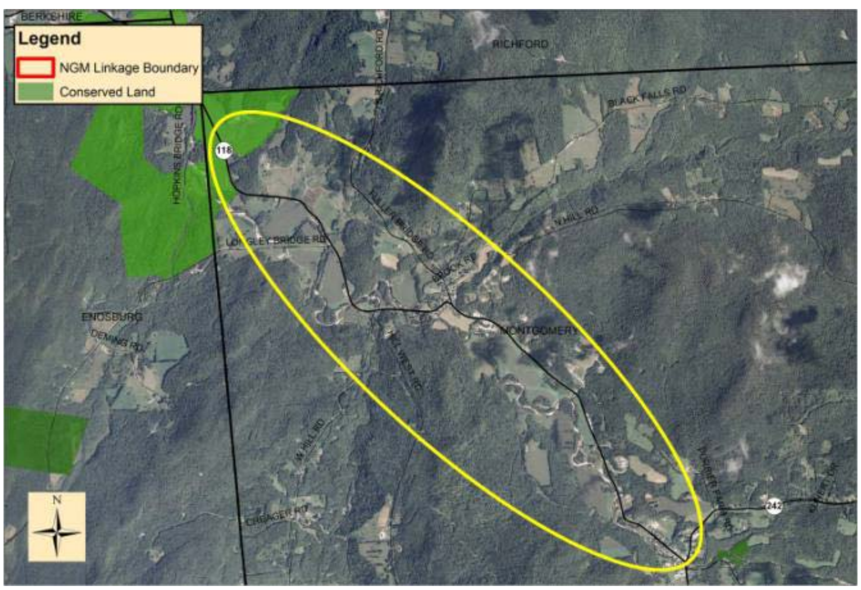

Figure 10. Montgomery, VT, Connecting Lands Area shown on Ortho photograph overlaid with nearby conserved land.

The Ortho photos allowed us to "zoom in" on the connecting area to explore connecting features in more detail. Figure 11shows the general connections between two sets of habitat blocks, as illustrated by the double-headed arrows. These arrows will be the basis for the delineation of a structural pathway.

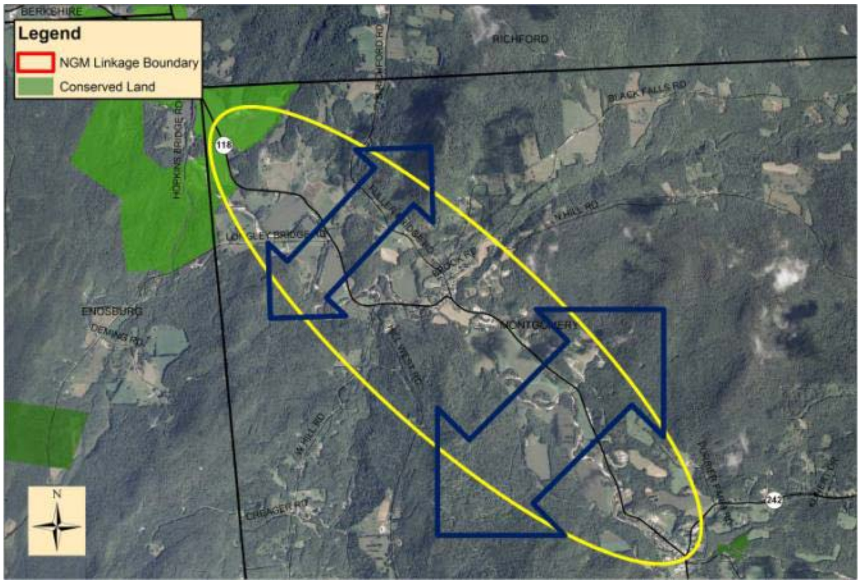

Figure 11. Montgomery, VT. General connections between two sets of habitat blocks shown by dark blue arrows.

Specific features that aid or hinder movement, such as hedgerows, riparian buffers, and agricultural fields, can be tagged at this fine scale of analysis. Figure 12 shows this analysis for one of the double-headed arrows, with red stars highlighting important features.

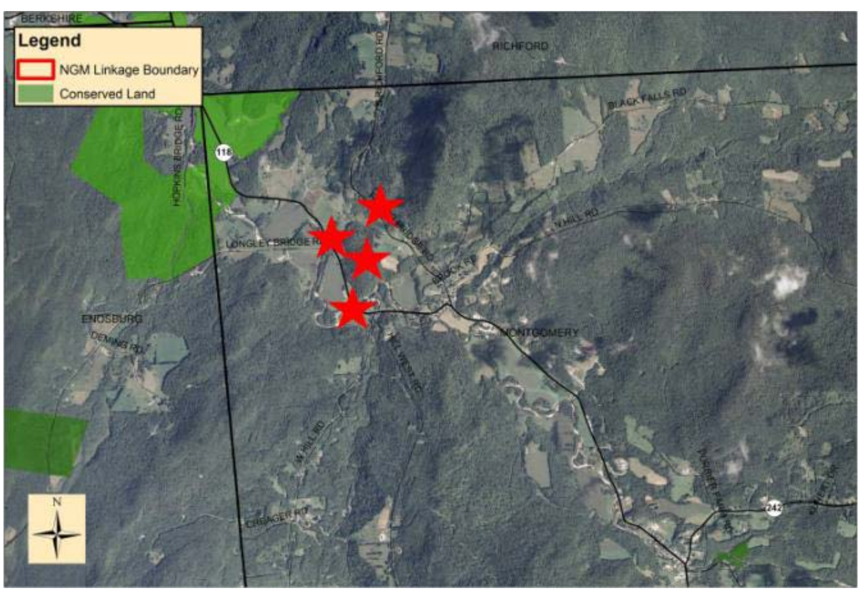

Figure 12. Montgomery, VT. Features that aid movement shown with red stars, including, top to bottom: forest up to both sides of a road, riparian buffers, a forested "stepping stone," and a bridge underpass.

Some of those specific features are highlighted in Figures 13 and 14.

Figure 13. RT 118 bridge over Trout River in Montgomery, VT looking north from West Hill Road. (photo: Bob Hawk, 5/7/12)

Figure 14. RT 118 looking north toward Longley Bridge (on left behind trees). Note riparian buffer on upper left (photo: Bob Hawk, 5/7/12).

Once the connectivity-supporting features were identified, we delineated structural pathway polygons with boundaries 500 meters into the forest (from the road or from the forest edge, whichever was greater). See example in Figure 15.

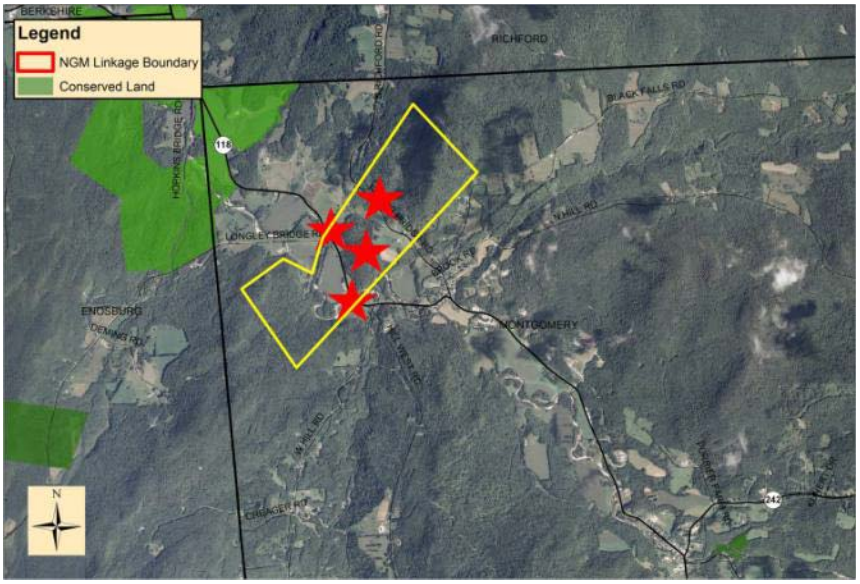

Figure 15. Montgomery, VT. An example of a Structural Pathway polygon extending 500 meters into the habitat block on either side, encompassing connectivity supporting landscape features, and representing the most structurally connected pathway between the two larger blocks.

Using a combination of fieldwork and GIS analysis (described above) we assigned each polygon (ID 1-34) with a category that represents its level of structural connectivity based on the presence or absence of the connectivity promoting and weakening features (Figure 16).

1. Existing Connectivity with *Mostly Intact* Forest Cover (16 total)
2. Existing Connectivity with *Moderately Fragmented* Forest Cover (7 total)
3. Potential Connectivity – *Potential for Improved* Forest Cover, with remediation (e.g. riparian plantings, hedgerow development) (4 total)
4. Possible Future Focus – areas that may become at risk for future disconnection (7 total)

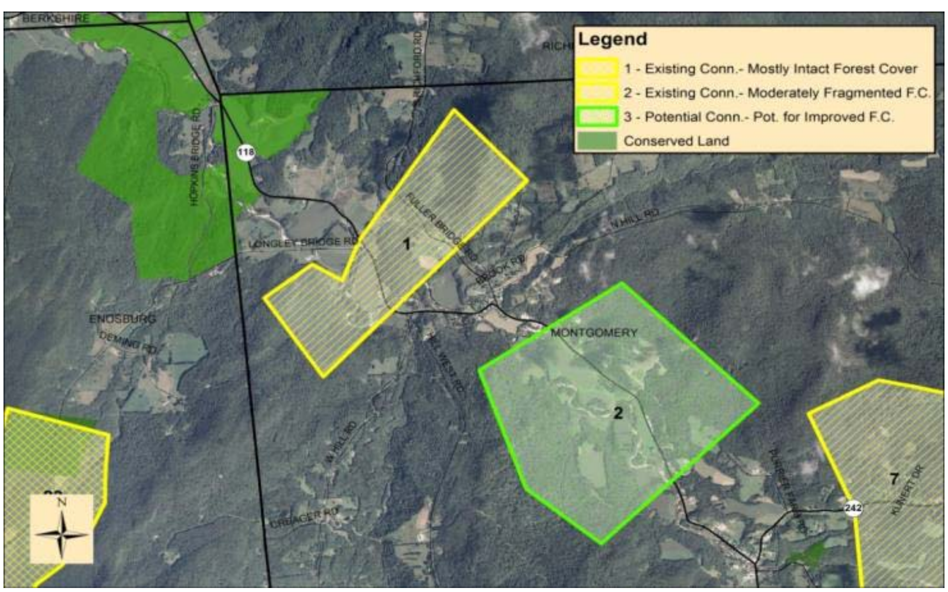

Figure 16. Structural Pathways of varied levels of structural connectivity. The number in the center of the polygon refers to that polygon's ID number (1-34).

We chose to narrow the final analyses to the 27 Structural Pathways with Existing or Potential Connectivity (categories 1-3 above). The final suite of Structural Pathways is shown in Figure 17. **It is imperative to note that Structural Pathways are not synonymous with *actual* wildlife crossings, known as *functional pathways.***

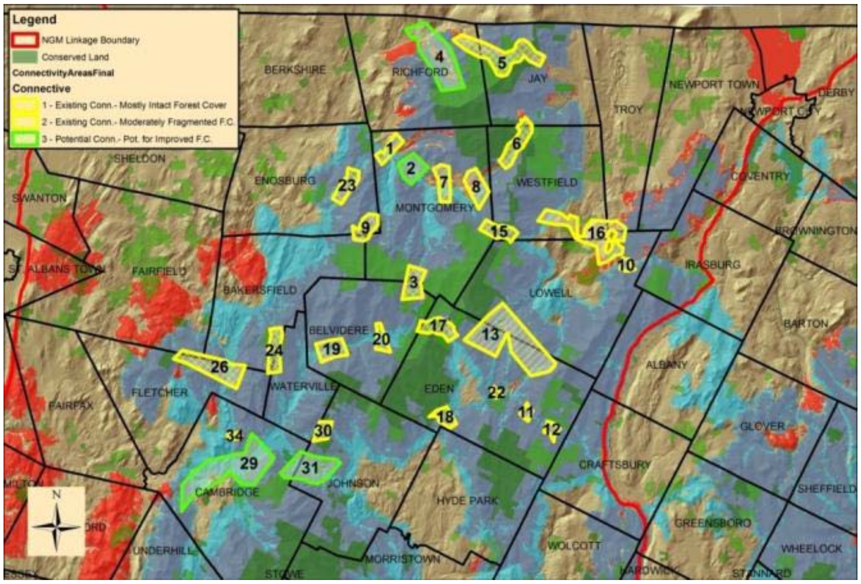

Figure17. Northern Green Mountain Structural Pathways. Again, the numbers are for identification purposes only, and do not indicate rank.

We then further assigned each Pathway a Regional Ranking of Highest, High, Medium, or Low, to prioritize Structural Pathways at the linkage-level. This ranking was based on:

- Acreage of habitat blocks connected by Structural Pathway (larger acreage scored higher);
- Proximity to conserved lands (closer to large areas of conserved land scored higher);
- Distance between habitat blocks (smaller distances scored higher);
- Critical Paths crossing presence within Structural Pathway;
- Centrality to spine of Northern Greens (closer to spine scored higher).

Those Pathways scoring "Highest" are outlined in bright yellow and green in Figure 18.

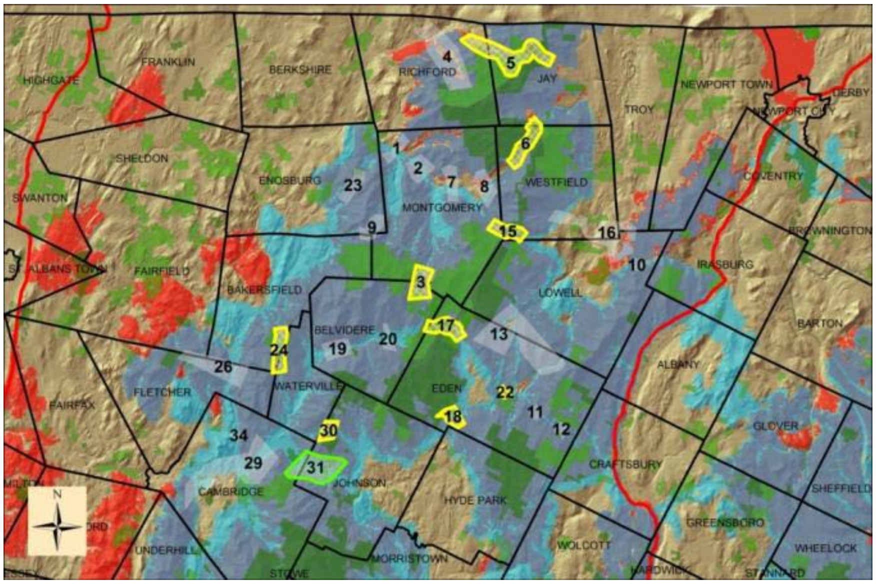

Figure 18. Structural Pathways with "Highest" Regional Rank.

<u>In summary, we took the following steps to define structural pathways</u>:

1) Identified the area's large habitat blocks, among which wide ranging mammals need to be able to travel.

2) Identified areas of connecting lands between habitat blocks.

3) Identified the sections within these connecting lands with best current structural connectivity (considering land cover, culverts and bridge data, topography, wetlands).

4) Created polygons extending 500 meters into the connected habitat blocks in the areas most conducive – in current state – for wildlife crossing. These polygons are the Structural Pathways.

5) Assigned each Structural Pathway polygon to a category representing its level of structural connectivity.

6) Assigned each Structural Pathway a Regional Rank –Highest, High, Medium, Low.

Identifying Unconserved Land Parcels Within Structural Pathways

With the Structural Pathways established we could then overlay parcel data with the boundaries of each Pathway and view all the unconserved land parcels within each Structural Pathway.

Within the GIS database we associated the Structural Pathway ID # with each parcel at least partially within that Pathway's bounds.

Each parcel was then assigned a value, based on its contribution to the structural connectivity across that Pathway. Factors that increased a parcel's value included: predominant forest cover, spanning parcel geometry, large acreage, forested road frontage, spanning across a road (same owner on each side of road), and high habitat value (wetland, riparian area, saddle, ridgeline, beech stand, etc…). Although the assigned value reflects a subjective decision of the authors, specific factors guided the ranking of each parcel. Generally, this scoring method can be described:

- Three or more factors → **High**
- Two or more factors → **Med**
- One factor → **Low**
- No factors → **Un-scored or Lowest**

An example of High and Medium Priority Parcels in the Route 105 Structural Pathway are shown in Figure 19.

Figure 19. Example of High and Medium Priority Parcels in the Route 105 Structural Pathway. Note how high scoring pink parcel is large, spans across the landscape, crosses the road, and encompasses wetlands.

We identified a total of 1,084 unconserved parcels within the 27 structural pathways, 175 of which were deemed "High" or "Med" priority.

Avoiding "Bridges to Nowhere:" Identifying Habitat Block Core Areas (HBCA)

Having delineated structural pathways and important associated parcels we were faced with the question of whether we had created "bridges to nowhere" by not considering the integrity of habitat blocks that are linked together by the pathways. To address this issue, we examined the Sorenson and Osborne habitat blocks themselves for priority parcels. Our focus was on ensuring *regional* connectivity by identifying areas, and ultimately parcels within them, that best connect the Structural Pathways to each other and to already conserved lands within the habitat blocks. As a means to an end (with the end goal being the identification of important parcels in the core habitat blocks), we delineated structurally connected areas of unconserved land (within habitat blocks) between Structural Pathways, and called them Habitat Block Core Areas (HBCA). HBCA boundaries were loosely drawn using a combination of structural pathway boundaries; roads, parcel lines, and forest cover (Figure 20).

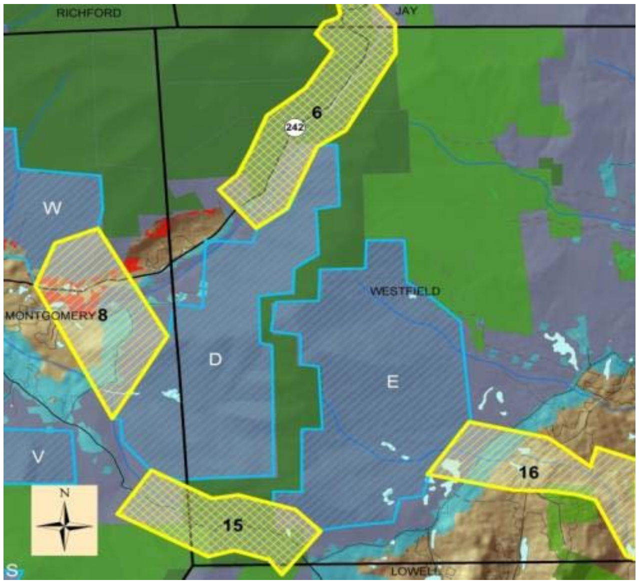

Figure 20. Examples of Habitat Block Core Areas (outlined in light blue) and associated structural pathways (outlined in yellow). Note how HBCAs represent the general area of land connecting Structural Pathways with each other and with conserved land.

As was done within Structural Pathways, we associated all parcels within each HBCA with that area's ID letter (A-Z). The parcels were given a subjective rank of "high", "medium" or "low." Factors that increased a parcel's value included: proximity to conserved land, proximity to a Structural Pathway, predominant forest cover, spanning parcel geometry, large acreage, spanning across a road (same owner on each side of class 4 or higher road), and high habitat value (wetland, riparian area, saddle, ridgeline, beech stand, etc…). The goal was to explain visually how to best connect the Structural Pathways to each other through the Sorenson and Osborne habitat blocks using a regional connectivity lens. See Figure 21for the final set of Structural Pathways and HBCAs, but keep in mind the HBCAs were only a means to identify important parcels within habitat blocks and have no meaning in and of themselves.

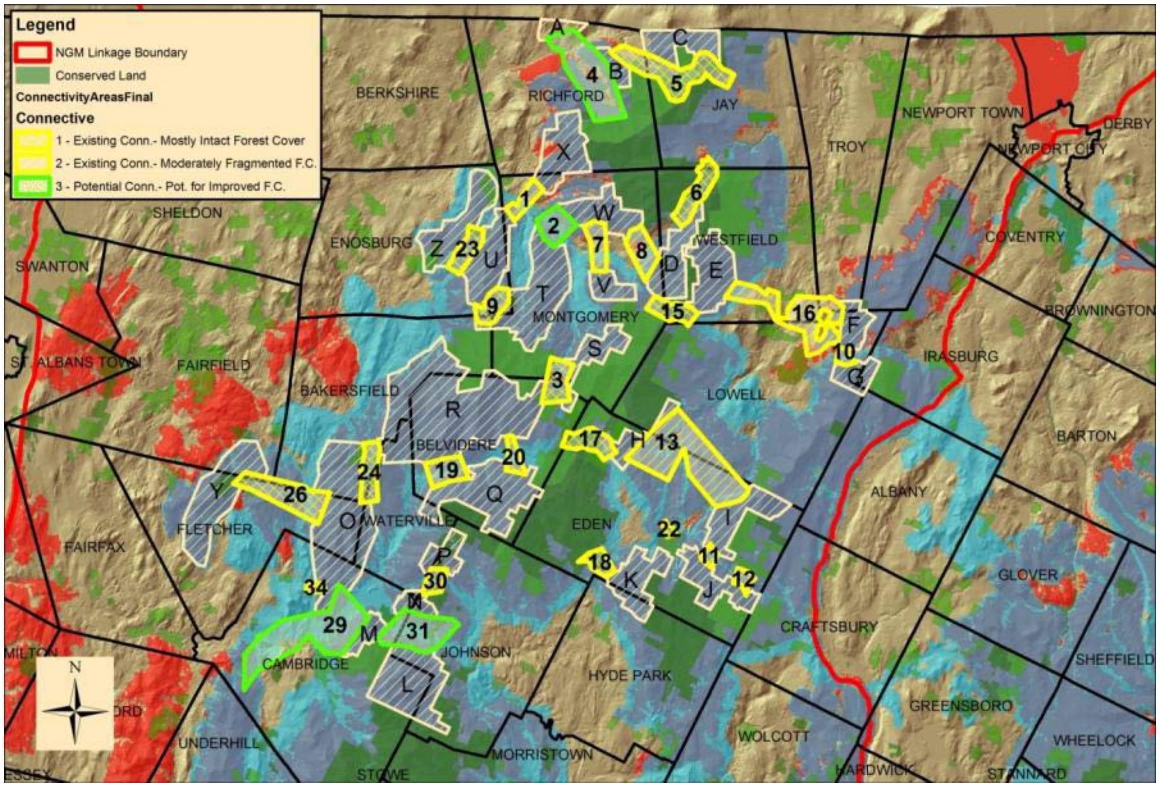

Figure 21. Final set of Structural Pathways (ID=1-34) and Habitat Block Core Areas (ID=A-Z). Together with conserved land, they make up critical network of connectivity in the Northern Greens.

Final Step: Parcel Attributes

We have so far described how we developed two types of spatial polygons: 1) Structural Pathway polygons and 2) HBCA polygons. We have also described how we assigned connectivity values to individual parcels within Northern Greens parcel database to provide information most applicable to the land conservation field. As a final product, we developed on GIS a shapefile of all Northern Greens parcels with associated attribute data related to connectivity (see Appendix 2). This product can be used to prioritize and narrow down important parcels based upon the interests of a given user. Within the attribute table of this shapefile, a parcel can be associated with:

- A Structural Pathway or HBCA that encompasses it – the specific Structural Pathway or HBCA will be identified by ID number or letter;
- The Regional Rank value of the Structural Pathway or HBCA encompassing it;
- Current Landowner feasibility (anecdotal information for CHC region towns only);
- 2C1F Threat/Importance Value for hexagon encompassing it;
- "Cost" for animal to travel through parcel (from Sorenson and Osborne, 2011, Habitat Block Analysis cost surface);
- Identification as a "Phase 1 parcel" – identified on Jan 26, 2011 at priority setting meeting (~88 parcels) among SCI partners. A landowner address is included for approximately 68 parcels;
- Identification as a "Phase 2 parcel" – identified as a priority after Jan 2011 meeting. These are all parcels that scored a "High," "Med," or "Low" (low is still of value, as lowest value

parcels were not scored at all) priority within Structural Pathway or HBCA and includes about 365 parcels.

- ~178 are in Structural Pathway polygons
- ~159 are in HBCA polygon
- ~28 are in both Structural Pathway and HBCA polygons

Refining the Linkage Boundary

During the just discussed process of identifying polygons of significance for connecting the habitat network and sustaining its core, it became clear that our original Northern Greens Landscape Linkage boundary was too broad. To refine the boundary, we followed edges of habitat blocks greater than 3,000 acres as well as connecting lands identified by Hilke (Figure 22). We focused on the spine of the Northern Greens, as opposed to "outlying" large blocks. In an effort to keep the boundary simple and with an eye towards future restoration, we didn't exclude some areas from the polygon, despite their current disconnected status.

The same methodology was used by the Appalachian Corridor in the Quebec portion of the Northern Greens Landscape to identify habitat blocks that delineate the linkage boundary. Structural pathways shown in Figure 22, and in greater detail in Figure 23 ("Corridor naturel"), were identified by LCP analysis followed by field work to ground proof their actual potential (Robidoux and Guérin, 2010). Validating their use by wildlife is ongoing by tracking teams (Robidoux and Bouthot, 2011).

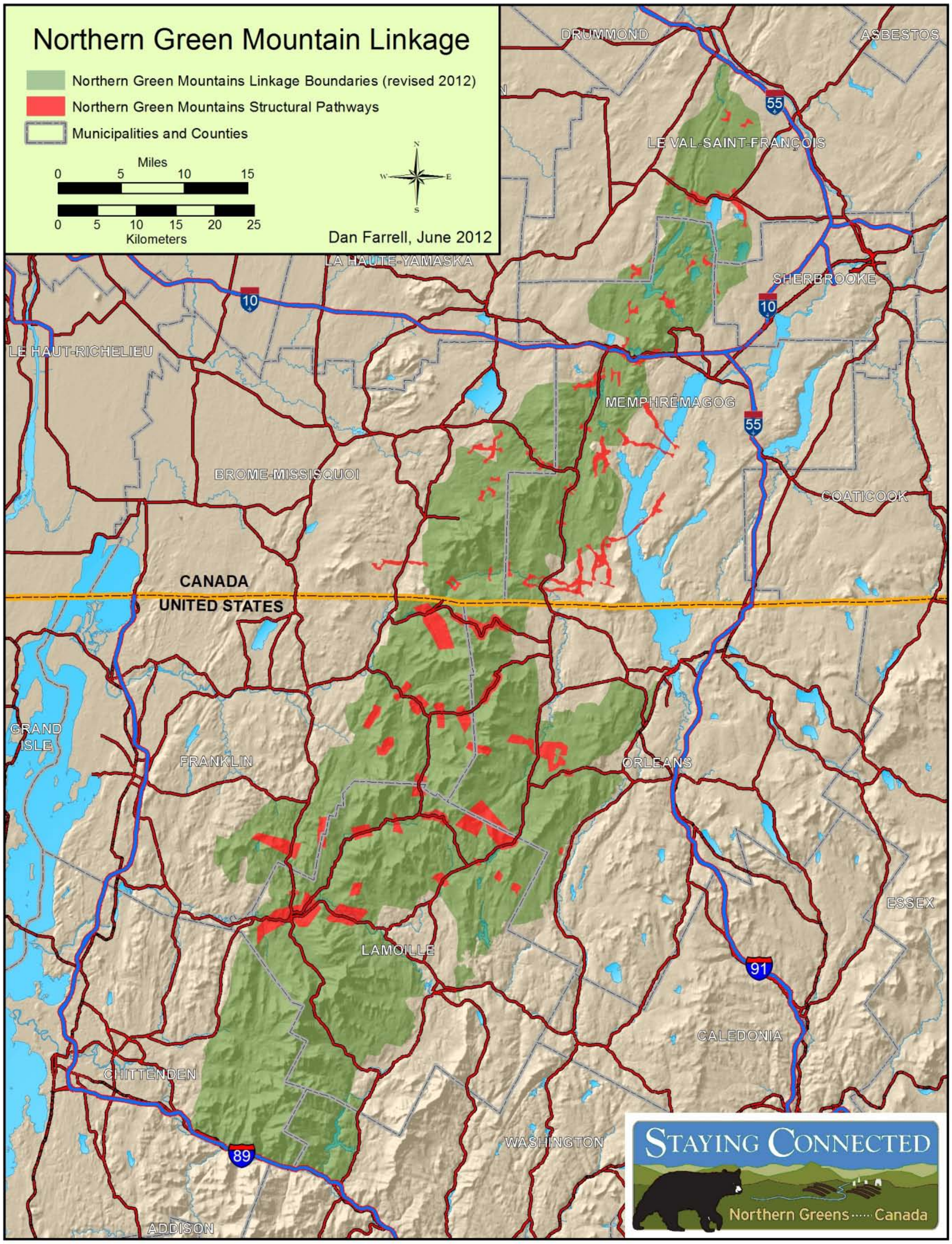

Figure 22. Final, refined boundary of the bi-national Northern Green Mountains Linkage colored green, with Structural Pathways colored red.

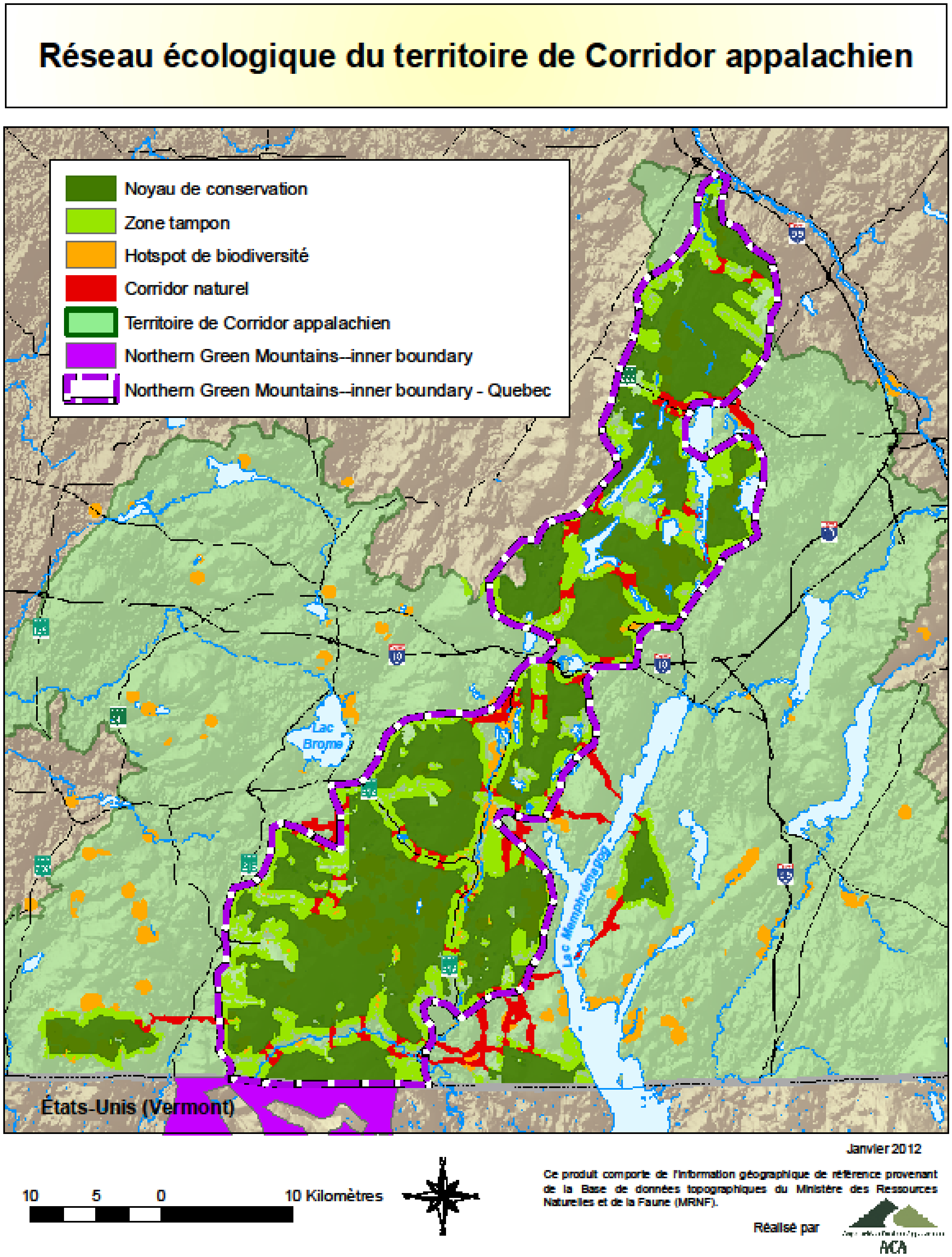

Figure 23 Structural Pathways ("Corridor naturell") in the Canadian section of the Northern Green Mountains.

Discussion

This analysis was developed to give local communities, land trusts, town and regional planning entities, the Vermont Fish and Wildlife Department and the Vermont Agency of Transportation information on those places in the Northern Green Mountains that contribute most significantly to the conservation of landscape connectivity at local and regional scales. We identify a set of Structural Pathways that tie together relatively large habitat blocks in a strategic and efficient manner, as well as those parcels within the pathways whose conservation, and in some cases restoration, will contribute the most to ensuring the long-term structural integrity of those pathways. We also sought to identify those places – the Habitat Block Core Areas – whose conservation will contribute to the long-term viability of the region's Habitat Network.

Many of the Structural Pathways span roads with traffic volumes that exceed 1,000 vehicles per day, and three that exceed 3,000, a rate that likely acts as a barrier for many species of wildlife (Clevenger and Huijser, 2011; Seiler, 2005). The road segments that fall within the structural pathways need greater study to understand just how much of a barrier the roads associated infrastructure constitute, and what might be done to mitigate their effects. A wildlife monitoring system should be established that includes cameras, track plates, GPS/radio collar data, DNA analysis and other tools to provide the hard facts and compelling evidence transportation agencies and conservation organizations need before investing millions of dollars to improve infrastructure or buy conservation land and easements. Such a system can be designed to incorporate data generated by citizen scientists and professionals alike. This could add presently missing functional connectivity information to the puzzle.

The authors acknowledge that this document is a work in progress. Unresolved issues include:

- Where to "stop" the analyses along the edges in East/West connectivity (e.g., towns of Fletcher and Lowell)?
- Different analysis necessary on both sides of the border because Habitat Block Analysis data is only available for Vermont.
- Border complications using least cost path analyses for start/end points in Richford and Jay because of lack of compatible data from Canada.
- Subjectivity of "high," "med," "low".
- Whether this analysis leaves out important terrain/habitat in lower elevations because those habitats aren't available in blocks of 3,000 acres or greater. Some species may prefer or need lower elevation areas, even if they are relatively small, for their life cycles. This study does not capture these smaller, lower elevation blocks.

Despite these issues, we hope that this work contributes to the establishment of a healthy and resilient network of habitat in the region, and that this network will in turn allow for the movement, migration, and dispersal of wide-ranging mammals.

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APPENDIX 1

Habitat Block Weights in Sorenson and Osborne (2011).

Habitat blocks were evaluated using 11 factors to assess their contribution to biological and physical diversity and given a weighted score (see Figure 3):

- Cost distance to core area – 15%
- ELU Weighted Average – 15%
- Element Occurrence count – 10%
- Percent core (250 acre blocks = core) – 15%
- Block size – 15%
- Roads (miles of roads/square miles of habitat block) – 10%
- Percent ponds – 5%
- Percent wetlands – 5%
- Exemplary aquatic features – 5%
- Rivers/Streams (miles) – 5%
- Percent TNC Matrix block – 5%

APPENDIX 2

Description of GIS Shapefiles and Attributes for Structural Pathways, Habitat Block Core Areas and Priority Parcels

Connectivity Areas – "ConnectivityAreasFinal" shapefile

Attributes:

- "ID" = 1:34
- "Connective" =
    - "1 - Existing Conn.- Mostly Intact Forest Cover" (16 total)
    - "2 - Existing Conn.- Moderately Fragmented F.C." (7 total)
    - "3 - Potential Conn.- Pot. for Improved F.C." (4 total)
    - In "ConnectivityAreaFull" shapefile there is also "Connective" = "4 - Future Threat?" (7 total)
- Regional Rank – "RegionRank" =
    - Highest
    - High
    - Med
    - Low

Habitat Block Core Areas – "HabitatBlockCoreArea" shapefile

Attribute:

- "CoreAreaID" = A:Z (26 total)
- Regional Rank
    - High
    - Med
    - Low

Parcels of Interest – "NG_CombinedParcelsFinal"

<u>Attributes:</u>

- *Related to Connectivity Areas*
    - "Focus_2" refers to parcel's location within Connectivity Area and is marked with the Identification Number of that Connectivity Area ("ID" attribute in "ConnectivityAreasFinal" shapefile; "Focus_2" = "1": "34")
    - "Phase1_Par" = "Yes" identifies this parcel as a conservation priority for SCI partnership; determined at meeting on January 24, 2011. We have determined ownership data for these parcels, as possible (80%). "Discarded" refers to parcels that were determined important on January 24, but because location of some Connectivity Areas changed, they are no longer inside a Connectivity Area. 88 of these. 20 with unknown addresses.
    - "Phase2_Par" = "Yes" identifies this parcel as a conservation priority for connectivity in the Northern Greens, at both scales – CA and HBCA; determined by Corrie Miller and Bob Hawk in GIS analysis during Spring 2011. 365 of these (178 CA value only, 159 HBCA value only, 28 that are valuable at both scales).
    - "ConnPriori"- "Phase2_Par" and "Phase1_Par"= "Yes" parcels can have a connectivity priority of either "high," "med," "low," or "lowest." Parcels that made it to Phase 1 list but were determined to be of lowest significance upon a second look are labeled "lowest." "Low" parcels are still important, just lowest tier importance of important parcels.
- *Related to Habitat Block Core Areas*
    - "Focus_3" refers to parcel's location within a Habitat Block Core Area and is marked with the Identification Letter of that Habitat Block Core Area ("CoreAreaID" attribute in "HabitatBlockCoreArea" shapefile; "Focus_3" = "A": "Z")
    - "CorePriori" – all "Focus_3" parcels were determined to have a habitat area core priority of "high," (had 2 or more attributes) "med,"(had 1 attribute) or a blank field (low). If "Focus_3"places parcel in a Habitat Block Core Area, but this field is blank, that's when priority is lowest (note: attributes included adjacent to already conserved, adjacent to connectivity area, large area, good geometry for connectivity, landscape features that would support wildlife (wetlands, ridge top, beech stand, etc…)
- Feasible – Yes Maybe No, blank = unknown; based on Nancy Patch's dataset.
- 2C1Fthreat – Two Countries, One Forest threat and importance value of hexagon containing parcel