

**ATTORNEY GENERAL
DEPARTMENT OF JUSTICE**

33 CAPITOL STREET
CONCORD, NEW HAMPSHIRE 03301-6397

JOSEPH A. FOSTER
ATTORNEY GENERAL



ANN M. RICE
DEPUTY ATTORNEY GENERAL

September 15, 2014

Ms. Jane Murray
Department of Environmental Services
29 Hazen Drive
P.O. Box 95
Concord, New Hampshire 03302-0095

Re: Granite Reliable Power, LLC; SEC Docket No. 2014-03

Dear Ms. Murray:

Enclosed for filing are an original and one copy of Dr. Charles William Kilpatrick and Christopher Gray's Testimony on behalf of Counsel for the Public in the above-referenced matter. Please note that an electronic copy of their testimony will be sent out to those listed on the Service List in this matter.

If you have any questions, please do not hesitate to contact me. Thank you for your attention to this matter.

Sincerely,

A handwritten signature in cursive script that reads "Laura L. Maynard".

Laura L. Maynard
Paralegal II
Environmental Protection Bureau
(603) 271-1249

/llm
Enclosures
cc: Service List

STATE OF NEW HAMPSHIRE
SITE EVALUATION COMMITTEE

SEC Docket No. 2014-03

Motion of Granite Reliable Power, LLC
to Amend a Certificate of Site and Facility
with Request for Expedited Relief

Testimony of Dr. Charles William Kilpatrick

**For
Peter Roth, Counsel for the Public, New Hampshire Department of Justice**

September 15, 2014

1 **Please state your name, profession and business address.**

2 My name is Charles William Kilpatrick. I am a Professor of Biology at the University of
3 Vermont and my office is located at Marsh Life Sciences Building, Rm. 305, University of
4 Vermont, Burlington, Vermont.

5
6 **What is the purpose of your testimony?**

7 I have been retained by Peter Roth, Counsel for the Public to provide an independent
8 assessment of the High Elevation Mitigation Plan and amendments proposed for it in this
9 docket. I submit with this testimony and incorporate here as though stated in its entirety, my
10 report entitled: *Evaluation of the Proposed Amendment to the High Elevation Mitigation*
11 *Agreement to Wildlife and Wildlife Habitat on Mt. Kelsey, Coos Co., NH*, dated September
12 12, 2014.

13
14 **What are your qualifications for assessing the High Elevation Mitigation Plan on Mt.**
15 **Kelsey?**

16 My CV is provided. I have served as a Professor in the Department of Biology at UVM
17 since 1974 and I currently hold an endowed chair as the Howard Professor of Zoology and
18 Natural History. I have spent nearly 50 years studying mammals and other vertebrates
19 (including birds) that have resulted in the publication of over 80 papers and book chapters in
20 addition to approximately 15 reports. During my nearly 40 year tenure at the University of
21 Vermont I have conducted extensive research on mammals in Vermont including surveys of
22 mammals at a number of high elevation sites. In addition, I have conducted research in high
23 elevation habitats in Pakistan and China and currently have a graduate student working in

1 high elevation habitats in Nepal. Although much of my work has dealt with small mammals
2 (shrews, bats, and rodents), I have studied populations of several carnivores in Vermont and
3 adjoining states. Several papers of my carnivore work have been published, others have been
4 submitted or are in preparation, and I am currently pursuing a study of the recently detected
5 American marten populations in northern and southern Vermont. I serve as the chair of the
6 Scientific Advisory Group for Mammals which provides advice to the Vermont Endangered
7 Species Committee and the Vermont Agency of Natural Resources. In connection with this
8 advisory role, I have reviewed post-construction mortality studies of birds and bats in
9 association with request for taking permits for threatened and endangered species by the
10 operating wind facilities in Vermont. I have testified as an expert witness before the
11 Vermont Public Service Board on several occasions regarding the impacts of wind farm
12 development on wildlife and wildlife habitat at high elevation sites.

13

14 **Please explain how you evaluated the proposed wind project?**

15 I reviewed a number of documents that addressed the Mt. Kelsey mitigation agreements that
16 include but are not limited to the High Elevation Mitigation Settlement Agreement and its
17 associated Restoration Plan, the Proposed Amendment to High Elevation Settlement
18 Agreement and its associated Amended Restoration Plan, Decision granting certification of
19 site and facilities with conditions, the testimony of Dr. Kenneth D. Kimball, the testimony of
20 Mr. Tyler B. Phillips, GRP's responses to data requested from July 24 Technical Session,
21 GRP's responses to data requested from Windaction Group, GRP's responses to data
22 requested from Peter Roth. I also attended and participated in the Technical Session on July
23 24, 2014, and have communicated with Dr. Kenneth D. Kimball and Mr. Will Staats of the

1 New Hampshire Department of Fish and Game. I also have reviewed a number of reports or
2 publications addressing the condition of the habitat, survey of wildlife, or studies of wildlife
3 species in association with the construction of this windpark including but not restricted to a
4 report from Melissa Coppola (dated Nov. 12, 2008), reports of surveys conducted by Curry
5 and Kerlinger, reports of surveys conducted by Stantec, and M.S. theses by C. R. Parrish and
6 A. P. K. Siren. Earlier testimony provided by Adam Gravel and by David Publicover were
7 also reviewed. A readable copy of the restoration plans (scaled site maps) prepared by Tyler
8 B. Phillips has been examined repeatedly. My field assistant, Chris Gray, made a site visit to
9 Mt. Kelsey on August 29, 2014 and has provided notes, photos and additional insight
10 through conversations. In addition, I have reviewed a large amount of scientific literature,
11 some of which is cited in my report, that addresses the biology of species of interest, that
12 were related to the known effects of roads, habitat edges, gaps in the habitat, wind facilities,
13 and noise on wildlife, or that were associated with features of the current mitigation plan or
14 other possible mitigations. Last, I have used the knowledge that I have accumulated over the
15 past 40 years as a professional biologist that includes the study of mammals at a number of
16 high elevation sites in Vermont, New York, Hispaniola, Pakistan, and China.

17

18 **Please summarize your conclusions concerning the efficacy of the High Elevation**
19 **Mitigation Plan and the proposed changes to it.**

20 It is my conclusion that at present the project upon Mt. Kelsey is having a significant adverse
21 impact upon the natural environment on Mt. Kelsey. In my opinion the present High
22 Elevation Mitigation Plan is performing little or no mitigation of the impacts of the project

1 on Mt. Kelsey. It is also my opinion that the proposed changes to the plan will do nothing to
2 improve the efficacy of the plan and may actually make things worse.

3

4 **Does this conclude your testimony?**

5 Yes, this concludes my testimony.

REPORT

Evaluation of the Proposed Amendment to the High Elevation Mitigation Agreement to Wildlife and Wildlife Habitat on Mt. Kelsey, Coos Co., NH

September 15, 2014

Dr. C. William Kilpatrick

Professor of Biology

University of Vermont

Summary

The habitat alterations on Mt Kelsey resulting from the construction and maintenance of a windpark have produced substantial adverse impacts on two threatened species, the American marten and Bicknell's thrush. These adverse impacts are caused by loss of habitat, creation of over 5 miles of edge habitat, construction and year round maintenance of a road, and the production of sound. The proposed restoration plans of the mitigation only address the loss of habitat. The lack of any consideration of the other factors impacting these two species, results in plans that likely will do little to mitigate the adverse impacts of the windpark on these species. Furthermore, there is no clear indication that either of the proposed restoration plans will result in any substantial acceleration of the rate of reforestation (their primary objective) and both have the potential for doing additional harm.

Introduction

At elevations of 2700 ft or higher in northern New England along ridgelines and upper mountain slopes, spruce (*Picea rubens*) fir (*Abies balsamea*) forest dominate the landscape. Areas off of the ridgelines are interspersed with mixed forest of sugar maple (*Acer sacharrum*) and yellow birch (*Betula alleghaniensis*) in addition to spruce and fir. These high elevation forests provide complex stand structure including large diameter cavity trees, snags, and large woody debris for wildlife. Within these complex stands are patches of blown down trees, a result of "fir waves" and insect and wind events, that create small openings and dense early successional spruce and fir growth that provides habitat for other species. Mountain ash (*Sorbus americana*) also occurs among the interspersed mixed forest species and provides an important soft mast food source for several species of wildlife. Such high elevation spruce-fir forest account for less than 5% of New Hampshire's land area but have been identified as important habitat for a number of threatened or endangered species including the American marten (*Martes americana*), Canada lynx (*Lynx canadensis*), Bicknell's thrush (*Catharus bicknelli*), and the three-toed woodpecker (*Picoides dorsalis*).

A 2008 site visit to Mt. Kelsey by a representative of the New Hampshire Natural Heritage Bureau (Coppola 2008) found evidence of recent timber harvest on both the southern and northern most summits of Mt. Kelsey, however these timber harvests were below 2700 feet. Although these timber harvests at lower elevations may have impacted the overall quality of this high elevation forest on Mt. Kelsey, the remaining forest still represented a large intact tract of locally

significant high elevation forest prior to construction of a windpark by Granite Reliable Power.

The construction of the windpark on Mt. Kelsey, including eight turbine pads and over 2 miles of access roads, resulted in removal of locally substantial amounts of high elevation forest habitat, creation of edge habitat, creation of roads and insertion of sources of noise into a remote habitat. Roads like all anthropogenic structures have both negative and positive impacts on wildlife species. Our knowledge of the impact of roads on wildlife is far from being complete (see Adams and Geis 1981; Forman and Alexander 1998; Hourdequin 2000; Sherwood et al. 2003; Trombulak and Frissell 2000; Fahrig and Rytwinski 2009; Benítez-López et al. 2010; van der Ree et al. 2011). However, it is clear that roads can serve as travel corridors for some species (Huey, 1941; Getz et al. 1978) and result in the fragmentation of the habitat utilized by other species (Oxley et al. 1974; Swihart and Slade 1984; Merriam et al. 1989; Andrews 1990). Habitat fragmentation caused by roads have generally been documented in large mammals (Rost and Bailey 1979; van Dyke 1986; McLellan and Shackleton 1988; Brody and Pelton 1989) and result from disturbance effects that may or may not be independent of traffic volume. Roads may also create barrier effects that include both physical and behavioral barriers to the movement of wildlife. These barriers may result from an edge effect (Mader 1984; Bakowski and Kozakiewicz 1988) between different habitats where individuals are reluctant to move from one of the habitats into the other or by gaps, such as a breadth of a road or clearing (van der Ree 2010; Chen and Koprowski 2014), where individuals are reluctant to move across a barrier of open habitat.

The High-Elevation Mitigation Settlement Agreement (Section V, Certificate of Site and Facilities with Conditions, July 15, 2009) contained a number of mitigation provisions focused on the conservation, further protection and recovery of high-elevation forest habitats including the following.

1. Securing the permanent conservation of approximately 1281 acres of land above 2700 feet on Mount Kelsey to be transferred to New Hampshire Fish and Game (NHFG) or other state agency approved by NHFG.
2. One time payment of \$750,000 to NHFG to secure or assist with the permanent conservation of comparable habitat outside of the project area.
3. Only those trees necessary for project construction will be cut within the retained lands (500 feet around each wind turbine tower and a width of 75 feet in both directions from the centerline of each access road) on Mt Kelsey. Once construction is completed there shall be no commercial timber harvesting within this area. After project construction the roadway shall be re-vegetated so that the roadbed is limited to 12 feet in width.

A High Elevation Restoration Plan (dated August 2010) was apparently developed with the objectives to minimize the temporary and permanent disturbance, restrict access, and to establish a plan to stabilize and re-plant the areas of roadbed above 2700 feet with native species on Mt. Kelsey following construction when the roads were to be limited to 12 feet in width. This plan called for the planting of 3 to 4 year old balsam fir and red spruce seedlings at a density of approximately seven seedlings per 100 linear feet of road along the

roadbed areas to be re-vegetated. This plan also called for the re-vegetated areas to be mulched and seeded with native grasses after the planting of the seedlings to stabilize the soil during the regeneration of high elevation forest. Monitoring was required to evaluate seedling survival for two years with the expected replacement of seedlings as needed to obtain a 75% survival rate.

The Amendment to the High-Elevation Mitigation Settlement Agreement proposes to delete the sentence “After project construction the roadway shall be re-vegetated so that the roadbed is limited to 12 feet in width” and add a sentence that Granite agrees to comply with and to reasonably perform all restoration procedures defined in Granite’s High Elevation Restoration Plan. This Revised High Elevation Restoration Plan (dated March 3, 2014) primarily addresses changes to the areas to be stabilized and re-vegetated above 2700 feet on Mt. Kelsey. The plan calls to maintain roads at a width of 16 feet and with widths of 18 to 26 feet on 6 corners. Areas of widths of 30 to 34 feet designated for crane assembly and crane walk (approximately 4600 feet or over 0.8 miles) would not be re-vegetated once habitat was impacted for repairs to turbines requiring cranes. Re-planted trees in these crane assembly and walked areas would be cut at a height of 1 to 3 feet from the ground to allow passage of equipment and then allowed to re-grow in this pruned condition. This increase in road widths is claimed to result in an aggregate increase of approximately 55,600 square feet or 1.28 acres of gravel covered area. To compensate for this increase in areas that will not be re-vegetated, the revised restoration plan calls for the planting of 4,030 seedlings on selected areas on turbine pads and at areas along the disturbed area where no seedlings are present or natural seedlings occur at a low density. The proposed additional plantings are claimed to result in an aggregate decrease in gravel surface area by approximately 9,200 square feet or 0.21 acres. These calculations are based on an assumption of high long term survivorship of planted trees and does not consider that though the crane assembly and walk areas will not be gravel ‘habitat’ they also will never recover to typical high elevation spruce-fir forest.

Both of these restoration plans, however, have focused nearly entirely on simply trying to restore native forest to some of the impacted areas rather than how the design of the restoration might reduce the impact on wildlife and wildlife habitats of species of concern. The High-Elevation Mitigation Settlement Agreement also included a one time payment of \$200,000 to conduct studies of the impact of development on use of area by American marten, Bicknell’s thrush, and/or other wildlife species of concern with the studies to be designed by NHFG and conducted by NHFG or another party or parties designated by NHFG. These studies have been completed (Parrish, 2013; Siren 2013) and their findings should be considered in evaluating the revised restoration plan.

Threatened Species on Mt. Kelsey

The American marten is currently listed as a threatened species in New Hampshire. The high mountain forest habitat on Mt. Kelsey is known to contain core habitat for the American marten (Kelly 2005). The northeastern United

States (Gibilisco 1994) is the southern edge of marten distribution and snow depth, interactions with fishers (*Pekanea pennanti*) and forest fragmentation are factors thought to limit southward range expansions (Krohn et al. 2004; Kelly 2005; Carroll 2007; Jensen 2012). Martens typically occupy forest with complex structure, greater than 30% canopy closure, and trees greater than 6 meters in height (Katnik 1992; Thompson and Harestad 1994; Payer and Harrison 2003). Forest habitat with these features provides martens refuge from predators (Buskirk and Ruggiero 1994; Hodgman et al. 1997), prey access (Sherburne and Bissonette 1994), structure for denning and resting (Ruggiero et al. 1998), and thermoregulatory advantage (Buskirk et al. 1989). Seasonal requirements indicate that marten use forests with highest canopy cover during winter (Steventon and Major 1982; Buskirk and Powell 1994; Hodgman et al. 1997; Fuller and Harrison 2006) and avoid clear-cuts and partially harvested stands except during the summer when canopy cover increases (Soutiere 1979; Steventon and Major 1982; Fuller and Harrison 2005). Martens with their lower foot-load ratio (Raine 1983; Krohn et al. 2004) are well adapted for movement in deep mid-winter snow (Krohn et al. 1995) and their distribution in New Hampshire is correlated with annual snow depths (Kelly 2005).

Although the population of marten did not decline following the windpark construction on Mt. Kelsey, the activity of martens shifted to areas further from the ridgeline (Siren 2013). It would appear that disturbance and presence of open habitats were factors that caused a shift in the proximal use of habitat away from the ridgeline, caused behavioral shifts, and lowered habitat quality (Siren 2013). Roads are known to be travel corridors used by foxes (Bennett 1990) and recent studies (Buskirk et al. 2000; Bunnell et al. 2006) have found that snow compacted roads and trails provide access into winter habitats otherwise inaccessible to some mesocarnivores. Pre-construction winter track surveys (Stantec 2007) conducted on snowshoes on three occasions identified 94 sets of marten tracks, 66 fisher, 4 coyote and 1 fox during the winter of 2007. Post-construction winter track surveys along the road, snowmobile trails and by snowshoe (Siren 2013) detected 258 sets of fox tracks, 97 coyote, 122 marten, and 5 sets of fisher tracks, clearly indicating an increased presence of foxes and coyotes on Mt. Kelsey. Coyote and fox tracks were found predominantly along transects on the road and snowmobile trails and frequently went up or down the road or trail. Fox and coyote use roads and edge habitat in part because of the increased prey abundance (Arjo and Pletsher 2004; Atwood et al. 2004; Silva et al. 2009; Boisjoly et al. 2010) and both species consume similar food items as marten (Halpin and Bissonette 1988; Murray et al. 1994) and are predators of marten (Thompson 1994; Hodgman et al. 1997). Evidence of predation of martens by foxes and coyotes were detected both during and following construction by Siren (2013).

Due to population declines (Rimmer et al. 2001; Rimmer and McFarland 2013) and loss of winter habitat (Townsend et al. 2010; Rimmer and McFarland 2013), Bicknell's thrush is a species of elevated conservation status (see IUCN's Red List, Audubon Watch List). This species is under review for inclusion under the Federal Endangered Species Act (Federal Register 2012) and it is currently

listed as Threatened in New Hampshire. Bicknell's thrush breeds exclusively in high-elevation montane forest in the southern portions of its range in northeastern United States and southeastern Canada (Atwood et al. 1996; Rimmer et al. 2001; Connolly et al. 2002). Natural disturbed habitats in high elevation spruce-fir forest, such as those caused by wind, ice and snow damage, fire and insects, that promote patches of dense regenerating forest with high stem density are the preferred habitat in the breeding range (Wallace 1939, Atwood et al. 1996; Rimmer et al. 2001; Connolly et al. 2002). This species has a complex polygynandrous breeding system in which nests are usually tended by two or more males and all broods are from mixed paternity (Goetz et al. 2003; McFarland et al. 2008).

Drewitt and Langston (2006) list four primary effects of windfarms on avian populations that include collisions, displacement from disturbance, barrier effects, and habitat loss. Direct mortality can result from collisions with turbine blades, nacelles, towers, and associated structures. Post-construction mortality studies completed for 2012 & 2013 (Kerlinger et al. 2013) indicate an estimated mortality of 2 to 3 birds per turbine per year, a value below the average found at wind farms (Erickson et al. 2001; Kerlinger et al. 2010). Although Parrish (2013) did not detect any significant reduction in either avian abundance or species diversity between 2010 and 2012 at high elevation habitats associated with the Granite Windpark, Kerlinger et al. (2012) noted a significant reduction of between 59 and 62% in avian abundance between 2009 and 2012. Much of this reduction in species abundance is likely due to the direct loss of forest habitat. In addition, changes in the avian community on Mt. Kelsey were detected by Parrish (2013) with a decrease in the detection of forest interior species and increases in edge generalist species such as American robin (*Turdus migratorius*) and red-eyed vireo (*Vireo olivaceus*).

Few studies of displacement due to disturbance are conclusive and are often complicated by the lack of appropriately designed experiments and site fidelity. Stantec (2009) detected Bicknell's thrush at 3 point count stations in 2009 on Mt. Kelsey whereas Kerlinger et al (2012) detected none in 2012. While the number of detections of Bicknell's thrushes did decrease between 2010 and 2012 from 21 to 13 (Parrish 2013), this decrease may be due to experimental error in detection resulting from turbine noise in 2012. The modeled abundance estimates of Bicknell's thrush are relatively constant between 2010 and 2012 but this modeling does include monitoring of new point sites situated away from the turbines once the windpark became operational in 2012. Significant increases in the home ranges of male Bicknell's thrush were observed when turbine blades were emitting moderate to high levels of noise (Parrish 2013). Avoidance of turbine pads was not observed by Parrish (2013) as male Bicknell's thrush occupied area immediately adjacent to turbine pads when preferred habitat was present. However, a radio tagged individual was captured in 2012 after the windpark was operational over 1 km from its previous known home range (Parrish 2013).

The full impacts of the construction of the Granite Windfarm on the avian community and specifically Bicknell's thrush on Mt. Kelsey are limited due to a

single year of post-construction studies (Kerlinger et al. 2012; Parrish 2013). The shift in the avian community with the decline in the numbers of forest interior specialists and an increase in the numbers of edge habitat generalists in response to the approximately 5 miles of edge habitat created on Mt. Kelsey will likely lead to increased interspecific competition, increased avian predation, changes in site fidelity and shifts of home ranges. In addition to the edge habitat, the road system creates a linear gap over 2.3 miles in length and currently at a breath of approximately 75 feet. While Bicknell's thrush will readily cross gaps of this width, these openings act as a boundary for a male's core home range (Parrish 2013). The polygynandrous mating system of Bicknell's thrush may be driven by food limitations within the female home range (Davies and Hartley 1996; Strong et al. 2004; McFarland et al. 2008) and any barriers to male home ranges may impact brood survival.

The effects of noise on animals are just beginning to be understood (Bowles 1995). Recent studies have demonstrated that noise can increase stress levels (Campo et al. 2005; Francis et al. 2009), lower foraging success and alter behaviors (Rabin et al. 2006; Siemer and Schaub 2011), impact fecundity (Knight et al. 2012), mask communication (Brumm 2004; Sun and Narins 2005; Wood and Yezerinac 2006; Slabbekoorn and Ripmeester 2007; Francis et al. 2012) and alter community structure (Francis et al. 2009). Turbine noise was likely a contributing factor to the increase in the size of male Bicknell's thrush home ranges that occurred in habitat adjacent to turbine pads observed by Parrish (2013) on Mt. Kelsey.

Impacts of the Windpark Construction and Management on Mt. Kelsey

The temporary loss of 60 plus acres of high elevation forest habitat on Mt. Kelsey due to the construction of 8 turbine pads and over 2.3 miles of road as part of Granite Reliable Windpark has resulted in adverse impacts on both the high elevation forest habitat and at least two threatened species: the American marten and Bicknell's thrush. Other threatened or endangered species such as the Canada lynx and the three-toed woodpecker likely have also been impacted, but the adverse impacts to the American marten and Bicknell's thrush have been partially documented. Siren (2013) found that American marten on Mt. Kelsey were adversely impacted when the road was constructed and maintained as a packed surface during the winter. This packed surface allowed coyotes and red foxes access to these high elevation habitats from which they otherwise would be excluded by snow depth. These maintained roads will potentially allow fishers winter access as well. The construction and maintenance of roads required for this windpark on Mt. Kelsey provides year-round access to competing predators. This, combined with the creation of edge habitat and the removal of habitat associated with this road and the turbine pads, led Siren (2013) to conclude that these factors would increase the competition and predation on martens which will likely reduce marten fitness over time.

Parrish (2013) found that the road and turbine pads constructed on Mt. Kelsey had resulted in changes in the avian community with a decrease in the

abundance of forest interior species and a decrease in edge habitat generalists. This clearly would appear to be in response to the over 5 miles of edge habitat created on Mt. Kelsey from the construction of this windpark. The long term impacts of these changes in the avian community are unknown but likely will impact interspecies interaction that will result in shifts in the size and location of home ranges. The extent of adverse impacts on the Bicknell's thrush is unclear from a single year of post-construction monitoring but includes significant increases in sizes of home ranges of male birds near turbine pads, relocation of home ranges well away from the windpark, and barriers to home ranges created by the turbine pads. The long term effects of these shifts in the size and configuration of home ranges of Bicknell's thrush are unknown, but given the polygynandrous mating system that may be driven by food limitations within the female home range, reduced productivity would be predicted. The questions now become can these adverse effects on the American marten and Bicknell's thrush populations on Mt. Kelsey be sustained and does either the initial High Elevation Mitigation Agreement or the Proposed Amendment do anything to address these adverse impacts.

Assessment of the Effectiveness of the Competing Mitigation (Restoration) Plans

On paper the differences between the High Elevation Mitigation Agreement and the proposed Amendment to that agreement seem rather minor. The objective of both plans is to hasten the reforestation of a substantial portion of the 60 plus acres of deforested habitat. The major difference appears to be whether the gravel road will be maintained long term at a width of 16 feet (larger in some corners) rather than at a width of 12 feet. Most of the increased amount of gravel habitat resulting from the wider road is to be offset by additional plantings on some selected areas on turbine pads and at other sites. These descriptions provide an image of a recovery to high elevation forest on either side of a road that is either 12 or 16 feet wide. At present the deforested areas along the road are approximately 75 feet wide. While the areas near the forest edge are showing signs of natural regeneration of seedlings, the edge of the older forest is dying in many areas. Areas that were planted last summer have given mixed results with some areas showing relatively good survival and other areas with relatively few surviving trees. Dr. Kimball (pers. comm.) indicated that part of the lack of survival was due to the planting of bare root stock. The amount of habitat that will not be able to be reforested, however, is greater than just the road bed and the maintained turbine pads. Many areas along the "12 foot" road bed are lined with large boulders that results in a total span of 15 to 16 feet with little or no vegetation. While these boulder lined areas are not part of the 12 or 16 foot wide road beds, there does not appear to be any mitigation of these areas to hasten reforestation as the substrate is primarily gravel. In addition, there are sites along the road and turbine pads which are talus slopes. While both of these types of areas may eventually become reforested, the rate of reforestation will be slower.

The Amendment to the High-Elevation Mitigation Settlement Agreement incorporated suggestions for planting of spruce and fir trees provided by Dr. Kenneth D. Kimball on behalf of the Appalachian Mountain Club. The revised restoration plan utilizes 4 inches of organic soil covered with 4 inches of root grindings for the substrate for planting of trees along the road and on selected areas on turbine pads. It is believed that this protocol will prevent erosion, promote moisture retention that will increase survival of planted trees, provide favorable seed beds condition for germination of seeds from native trees, and will not inhibit recruitment of native tree seedling while lowering the potential for introducing species of plants not typically found at higher elevations (see letter from Kyle Murphy dated July 11, 2014; GRPS response 7 to Tech. Ses. Data Request). However, these appear to be beliefs as Dr. Kimball was unable to provide much documentation that would serve as their basis (see Cornett et al. 1998 provided by Dr. Kimball in Litt.). While the work of Cornett et al. (1998) does indicate that the early regeneration of balsam fir does benefit from the reduction of competition from understory vegetation, it does not specifically address grasses. Furthermore, this work (Cornett et al. 1998) also found that balsam fir regeneration also benefitted from reduced thickness of the forest floor. Thus, it is not clear how well balsam fir will regenerate in these areas with 4 inches of root grindings. This protocol has been used this summer for planting of trees but the length of time since the trees were planted is too short to reach any conclusion regarding survival.

In addition, Dr. Kimball is of the opinion that this utilization of mulch from root and stump grindings rather than mulching with hay will result in a more natural substrate for forest regeneration. Dr. Kimball considers that the grasses that were planted and introduced from the hay mulch as part of the original restoration plan, are the primary cause of the increased numbers of rodents which are attracting carnivores to the edge habitat along the road. His conclusion is based in part on the work of Johnson et al. (1977) and Getez et al. (1978) that he provided. However, in New Hampshire there is only a single rodent species, the meadow vole (*Microtus pennsylvanicus*), that occurs predominantly in grasslands and the increased rodent abundance is in response to the edge habitat (Johnson et al. 1977; Adams and Geis 1983; Tattarsall et al. 2002.) rather than the presence of grass. In addition, roads and edge habitat are used by foxes and coyotes not only because of the increased prey abundance (Arjo and Pletscher 2004; Atwood et al. 2004; Silva et al. 2009; Boisjoly et al. 2010) but also to avoid competing predators (Thurber et al. 1992; Arjo and Pletscher 2004) and because of the ease of travel (Halpin and Bissonette 1988; Crête and Larivière 2003; Bunnell et al. 2006). It is my opinion that the planting protocol proposed by Dr. Kimball and incorporated into the proposed Amendment will have no impact on the abundance of rodents or the utilization of the road and edge habitat on Mt. Kelsey by coyotes and foxes.

At present the construction and maintenance of a windpark on Mt. Kelsey has deforested 60 plus acres of high elevation forest and produced a 2.3 mile linear gap currently with a width of approximately 75 feet. The edges of this deforested area are now at early stages of forest regeneration and spruce and fir

trees have recently been planted at numerous locations along the road. However, the reforestation proposed for much of this area, even with the planting of over 5,000 trees, will take decades and it is not clear that the populations of American marten and Bicknell's thrush that were adversely impacted by these habitat alterations will survive long enough to benefit from this reforestation. Both of these species were adversely impacted by factors in addition to just the loss of habitat. These other factors, including the construction and year round maintenance of a road on Mt. Kelsey, production of over 5 miles of edge habitat, and production of noise in areas adjacent to an animal's home range, are not addressed in either of the mitigation plans. Since these other factors are not addressed, it is not clear that a mitigation where most of the deforested habitat were to be reforested within a few decades would provide any substantial benefits to these threatened species that have been adversely impacted. The road, the edge habitat and the noise sources will remain regardless of the success of the currently proposed mitigation. The windpark constructed and maintained on Mt. Kelsey has resulted in a substantial adverse impact on the populations of these two threatened species and it is not clear that populations of either species will be able to maintain populations in the habitat that will be eventually reforested. A revised mitigation plan should address methods that would reduce the use of the road and edge habitat by coyotes and foxes.

Moreover, the likelihood that either of the proposed restoration plans will have any substantial impact on the rate of reforestation is unknown. However, rather than just continue to move forward with the planting of spruce and fir trees, I would recommend that the amended mitigation plans include the development of an experimental design that would allow some evaluation of the effectiveness of the protocol. Rates of regeneration could be compared between control sites (areas of natural regeneration) and treatment sites, where treatments could include the use of straw as mulch, the use of 4 inches of root grindings, and the use of lesser amounts of root grindings. An experimental design that would allow the removal of variables such as elevation and orientation must be included.

A number of additional issues should be considered in the revised restoration plan before it is approved. At present, there is evidence of heavy browsing of seedlings and some mitigation to reduce the extent of browsing should be considered. In addition, I have some concerns about root grinding being transported to this site from other locations, as this has the potential to introduce undesirable organisms (insects and fungal pest). I would favor only material being used from on site which may be possible if the depth of the root grindings is included as an experimental variable as suggested above.

Conclusions

Most of the damage has been done and mitigation will not be able to put the genie back in the bottle. The adverse impacts of this windpark on the populations of American marten and Bicknell's thrush on Mt. Kelsey were unreasonable. The mitigation agreement does nothing to address most of the factors that have adversely impacted the populations of these two threatened

species. Rather it focuses on an attempt to accelerate the reforestation of the deforested area by the planting of slightly more than 5,600 trees. In addition, the high elevation restoration plan associated with this mitigation seems to suffer from lack of planning, poor implementation, development of protocols that are based on beliefs rather than knowledge, and possibly insufficient funding. It is my conclusion that neither of the restoration plans associated with either a 12 foot road or associated with a 16 foot road will likely have any substantial effect on the rate of reforestation of the disturbed areas. However, these restoration plans either have or may have unintended affects of introducing species that may not be desirable. I am of the opinion that future mitigation at this windpark should provide for controlled studies of the restoration protocols to determine how reforestation can be accelerated, longer term studies on the impacts of the construction and maintenance of this windpark on populations of American marten and Bicknell's thrush, and studies of how the factors that are causing adverse impacts, other than loss of habitat, might be mitigated.

Suggested Mitigations:

1. Develop a restoration plan that is knowledge based and incorporates a funded study with an experimental design that will allow increasing the knowledge of restoration of high elevation forest. Greatly increase the number of trees to be planted and continue the monitoring and replacement of trees that do not survive. Provide adequate funding for this study and restoration.
2. Provide additional funding for post-construction study of the American marten on Mt. Kelsey that would include two studies with similar protocols as those used by Siren (2013) but 1 study conducted at years 4, 5, 6 following construction and study 2 at years 9, 10, 11 following construction.
3. Provide additional funding for post-construction study of Bicknell's thrush on Mt. Kelsey modifying the protocol used by Parrish (2013) to include radio-telemetry of female as well as male birds to also be conducted as two studies at time intervals similar to those proposed for the American marten. One of these studies could also include a design to differentiate between the edge effect and noise on the home ranges of these birds.
4. While I do not favor lethal predator control methods, other methods that would discourage the movement of canids along the road and edge habitat should be solicited and tested. I would suggest consideration of electric fences that have shown some success in controlling foxes (Patterson 1977) and coyotes (Gates et al. 1978; Dorrance and Bourne 1980) and might reduce the

use of the road and edge habitat on Mt. Kelsey by these two canids.

Literature Cited

- ADAMS, L. W., AND A. D. GEIS. 1981. Effects of highways on wildlife. Federal Highway Administration Technical Report No. FHWA/RD-81/067.
- ANDERSON, S. H., K. MANN, AND H. H. SHUGART. 1977. The effects of transmission-line corridors on bird populations. *American Midland Naturalists*, 97:216-221.
- ANDREWS, A. 1990. Fragmentation of habitat by roads and utility corridors: a review. *Australian Zoologist*, 26:130-141.
- ARJO, W. M., AND D. H. PELTSCHER. 2004. Coyote and wolf habitat use in northwestern Montana. USDA National Wildlife Research Center-Staff Publication, 71.
- ATWOOD, J. A., C. C. RIMMER, K. P. MCFARLAND, S. H. TSAI, AND L. N. NAGY. 1996. Distribution of Bicknell's thrush in New England and New York. *Wilson Bulletin*, 108:650-661.
- ATWOOD, T. C., H. P. WEEKS, AND T. M. GEHRING. 2004. Spatial ecology of coyotes along a suburban-to-rural gradient. *Journal of Wildlife Management*, 68:1000-1009.
- BAKOWSKI, C., AND M. KOZAKIEWICZ. 1988. The effects of forest road on bank voles and yellow-necked mouse population. *Acta Theriologica*, 33:345-353.
- BENÍTEZ-LÓPEZ, A., R. ALKEMADE, AND P. A VERWEIN. 2010. The impacts of roads and other infrastructure on mammal and bird populations: a meta-analysis. *Biological Conservation*, 143:1307-1316.
- BENNETT, A. F. 1988. Roadside vegetation: a habitat for mammals at Naringal, South-western Victoria. *Victorian Naturalists*, 105:107-113.
- BOISJOLY, D., J. P. QUELLET, AND R. COURTOIS. 2010. Coyote habitat selection and management implications for the Gaspésie caribou. *Journal of Wildlife Management*, 54:3-11.

- BOWLES, A. E. 1995. Responses of wildlife to noise. Pp. 109-154, in *Wildlife and Recreationists, Coexistence through Management and Research* (R. L. Knight and K. J. Gutzwiller, eds.). Island Press, Washington, D.C.
- BRODY, A. J., AND M. R. PELTON. 1989. Effects of roads on black bear movements in western North Carolina. *Wildlife Society Bulletin*, 17:5-10.
- BRUMM, H. 2004. The impact of environmental noise on song amplitude in a territorial bird. *Journal of Animal Ecology*, 73:434-440.
- BUNNELL, K. D., J. T. FLINDERS, AND M. L. WOLFE. 2006. Potential impacts of coyotes and snowmobiles on lynx conservation in the Intermountain West. *Wildlife Society Bulletin*, 34:828-838.
- BUSKIRK, S. W., AND R. A. POWELL. 1994. Habitat ecology of fishers and American marten. Pp 283-296, in *Martens, Sables, and Fishers: Biology and Conservation* (S. W. Buskirk, A. Harestad, and M. Raphael (eds)). Cornell University Press, Ithaca, NY.
- BUSKIRK, S. W., AND L. F. RUGGIERO. 1994. American marten. Pp 7-37, in *The Scientific Basis for Preserving Forest Carnivores: American Marten, Fisher, Lynx, and Wolverine in the Western United States* (L. F. Ruggiero, K. B. Aubrey, S. W. Buskirk, L. J. Lyon, and W. J. Zielinski (eds.)). U.S. Forest Service General Technical Report RM254.
- BUSKIRK, S. W., S. C. FORREST, M. G. RAPHAEL, AND H. J. HARLOW. 1989. Winter resting site ecology of marten in the Central Rocky Mountains. *Journal of Wildlife Management*, 53:191-196.
- BUSKIRK, S. W., L. F. RUGGIERO, AND C. J. KREBS. 2000. Habitat fragmentation and intraspecific competition: implications for lynx conservation. Pp. 83-100, in *Ecology and Conservation of Lynx in the United States* (L. F. Ruggiero, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires, eds.). University Press of Colorado, Bolder, CO.
- CAMPO, J. L., M. G. GIL, AND S. G. DÁVILA. 2005. Effects of specific noise and music stimuli on stress and fear levels of laying hens of several breeds. *Applied Animal Behavior Science*, 91:75-84.
- CARROLL, C. A. 2007. Interacting effects of climate change, landscape, conversion, and harvest on carnivore populations at the range margins: marten and lynx in the northern Appalachians. *Conservation Biology*, 21:1092-1104.
- CHEN, H., AND J. KOPROWSKI. 2014. Barrier effects of roads for an endangered forest obligate: gap, edge and traffic effects. Abstract 103, Meeting of the

American Society of Mammalogy, Oklahoma City.

- CONNOLLY, V., G. SEUTIN, J. SAVARD, AND G. ROMPRE. 2002. Habitat use by the Bicknell's Thrush in the Estrie region, Quebec. *Wilson Bulletin*, 114:333-341.
- COPPOLA, M. 2008. Memo to Site Evaluation Committee, November 12, 2008, Progress Report: Site Evaluation Committee No 2008-004 Application of Granite Reliable Power, LLC. 8 pp.
- CORNETT, M. W., K. J. PUETTMANN, AND P. B. REICH. 1998. Canopy type, forest floor, predation, and competition influence conifer seedling emergence and early survival in two Minnesota conifer-deciduous forest. *Canadian Journal of Forest Research*, 28:196-205.
- CRÊTE, M., AND S. LARIVIÈRE. 2003. Estimating the cost of locomotion in snow for coyotes. *Canadian Journal of Zoology*, 81:1808-1814.
- DAVIES, N. B., AND I. R. HARTLEY. 1996. Food patchiness, territory overlap and social systems: An experiment with Dunnocks *Prunella modularis*. *Journal of Animal Ecology*, 65:837-846.
- DORRANCE, M. J., AND J. BOURNE. 1980. An evaluation of anti-coyote electric fencing. *Journal of Range Management*, 33:385-387.
- DREWITT, A. L., AND R. H. W. LANGSTON. 2006. Assessing the impacts of wind farms on birds. *Ibis*, 148:29-42.
- ERICKSON, W. P., G. D. JOHNSON, M. D. STRICKLAND, D. P. YOUNG, JR., K. J. SERNKA, AND R. E. GOOD. 2001. Avian collisions with wind turbines: a summary of existing studies and comparisons with other sources of avian collision mortality in the United States. National Wind Coordinating Committee (NWCC) Resource Document
- FAHRIG, L., AND T. RYTWINSKI. 2009. Effects of roads on animal abundance: an empirical review and synthesis. *Ecology and Society*, 14(1):21.
- FEDERAL REGISTER. 2012. Proposed rules, Vol. 77, No. 158, August 15, 2010.
- FRANCIS, C. D., C. P. ORTEGA, AND A. CRUZ. 2009. Noise pollution changes avian communities and species interactions. *Current Biology*, 19:1415-1419.
- FRANCIS, C. D., C. P. ORTEGA, AND A. CRUZ. 2011. Noise pollution filters bird communities based on vocal frequency. *PLoS ONE*, 6:e27052.
- FORMAN, R. T. T., AND L. E. ALEXANDER. 1998. Roads and their major ecological

- effects. *Annual Review of Ecology and Systematics*, 29:207-231.
- FULLER, A. K., AND D. J. HARRISON. 2005. Influence of partial timber harvesting on American martens in northcentral Maine. *Journal of Wildlife Management*, 69:710-722.
- GATES, N. L., J. E. RICH, D. D. GODTEL, AND C. V. HULET. 1978. Development and evaluation of anti-coyote fencing. *Journal of Range Management*, 31:151-153.
- GETZ, L. L., F. R. COLE, AND D. L. GATES. 1978. Interstate roadsides as dispersal routes for *Microtus pennsylvanicus*. *Journal of Mammalogy*, 59:208-212.
- GIBILISCO, C. J. 1994. Distributional dynamics of modern *Martes* in North America. Pp. 59-71, in *Martens, Sables, and Fishers: Biology and Conservation* (S. W. Buskirk, A. Harestad, and M. Raphael (eds)). Cornell University Press, Ithaca, NY.
- GOETZ, J. , K. MCFARLAND, AND C. RIMMER. 2003. Multiple paternity and multiple male feeders in Bicknell's thrush (*Catharus bucknelli*). *Auk*, 120:1044-1053.
- HALPIN, M., AND J. A. BISSONETTE. 1988. Influences of snow depth on prey availability and habitat use by red fox. *Canadian Journal of Zoology*, 66:587-592.
- HODGEMAN, T. P., D. J. HARRISON, D. M. PHILLIPS, AND K. D. ELWE. 1997. Survival of American marten in an untrapped forest preserve in Maine. Pp. 86-99, in *Martes: Taxonomy, Ecology, Techniques, and Management* (G. Proulx, H. N. Bryant, and P. M. Woodward (eds.)). Provincial Museum of Alberta, Alberta, Canada,
- HOURDEQUIN, M. (EDITOR). 2000. The ecological effects of roads. Special Issue of *Conservation Biology*, 14:16-94.
- HUEY, L. M. 1941. Mammalian invasions via the highway. *Journal of Mammalogy*, 22:383-385.
- JENSEN, P. 2012. Ecology of American marten in northern hardwood forest: resource pulses and resource selection across temporal and spatial scales. Ph.D. Dissertation, McGill University, Montreal, Quebec, Canada.
- JOHNSON, W. C., R. K. SCHREIBER, AND R. L. BURGESS. 1979. Diversity of small mammals in a powerline right-of-way and adjacent forest in East Tennessee. *American Midland Naturalists*, 101:231)235.

- KATNIK, D. D. 1992. Spatial use, territoriality, and summer-autumn selection of habitat in an intensively harvested population of martens on commercial forestland in Maine. M.S. Thesis, University of Maine, Orono, Maine.
- KELLY, J. R. 2005. Recent distribution and population characteristics of American marten in New Hampshire and potential limiting factors affecting their occurrence. M.S. Thesis, University of Massachusetts, Amherst, MA.
- KERLINGER, P., R. CURRY, L. SLOBODNIK, A. LYNDAKER, J. GUARNACCIA, D. RISER-ESPINOZA, AND A. CURRY. 2013. Post-construction mortality study Granite Reliable Power Wind Park, Coos Co., New Hampshire. Prepared for Granite Reliable Power, LLC . Prepared by Curry and Kerlinger, LLC, McLean, VA.
- KERLINGER, P., J. GEHRING, W. P. ERICKSON, R. CURRY, A. JAIN, AND J. GUARNACCIA. 2010. Night migrant fatalities and obstruction lighting at wind turbines in North America. *Wilson Journal*, 122:744-754.
- KERLINGER, P., J. GUARNACCIA, AND B. ZITSKE. 2012. Post-construction breeding bird survey, Spring 2012 Granite Reliable Power Wind Project, Coos Co., New Hampshire. Prepared for Granite Reliable Power, LLC . Prepared by Curry and Kerlinger, LLC, McLean, VA.
- KNIGHT, C. R., M. S. SAHJA, AND J. P. SWADDLE. 2012. Anthropogenic noise is associated with reduction in productivity of breeding Eastern bluebirds (*Sialia sialis*). *Ecological Applications*, 22:1989-1996.
- KROHN, W. B., C. HOVING, D. HARRISON, D. PHILLIPS, AND H. FROST. 2004. *Martes* foot-loading and snowfall patterns in eastern North America: implications to broad-scale distributions and interactions of mesocarnivores. Pp. 115-131, *in* Martens and Fishers (*Martes*) in Human-Altered Environments (D. J. Harrison, A. K. Fuller, and G. Proulx (eds.)). Springer Science and Business Media, Inc., New York, NY.
- MADER, H. J. 1984. Animal habitat isolation by roads and agricultural fields. *Biological Conservation*, 29:81-96.
- McFARLAND, K. P., C. C. RIMMER, S. J. K. FREY, S. D. FACCIO, AND B. B. COLLINS. 2008. Demography, ecology, and conservation of Bicknell's thrush in Vermont, with a special focus on the Northeast Highlands. Vermont Center for Ecostudies. Norwich, VT. Technical Report 08-03.
- McLELLAN, B. N., AND D. M. SHACKLETON. 1988. Grizzly bears and resource-extraction industries: effects of roads on behavior, habitat use and demography. *Journal of Applied Ecology*, 25:451-460.

- MERRIAM, G., M. KOZAKIEWICZ, E. TSUCHIYA, AND K. HAWLEY. 1989. Barriers as boundaries for metapopulations and demes of *Peromyscus leucopus* in farm landscapes. *Landscape Ecology*, 2:227-236.
- MURRAY, D. L., S. BOUTIN, AND M. O'DONOGHUE. 1994. Winter habitat selection by lynx and coyotes in relation to snowshoe hare abundance. *Canadian Journal of Zoology*, 72:1444-1451.
- OXLEY, D. J., M. B. FENTON, AND G. R. CARMODY. 1974. The effects of roads on populations of small mammals. *Journal of Applied Ecology*, 11:51-59.
- PARRISH, C. R. 2013. Impacts of wind development on the abundance and distribution of high-elevation birds in northern New Hampshire, with a focus on Bicknell's thrush (*Catharus bicknelli*). M.S. Thesis, Portland State University, 141 pp.
- PATTERSON, I. J. 1977. The control of fox movement by electric fencing. *Biological Conservation*, 11:267-278.
- PAYER, D. C., AND D. J. HARRISON. 2003. Influence of forest structure on habitat use by American marten in an industrial forest. *Forest Ecology and Management*, 179:145-156.
- RABIN, L. A., R. G. COSS, AND D. H. OWING. 2006. The effects of wind turbines on antipredator behavior in California ground squirrels (*Spermophilus beecheyi*). *Biological Conservation*, 131:410-420.
- RIMMER, C. C., AND K. P. MCFARLAND. 2013. Bicknell's thrush: a twenty-year retrospective on the Northeast's most vulnerable songbird. *Bird Observer*, 41:9-16
- RIMMER, C. C., K. P. MCFARLAND, W. G. ELLISON, AND J. E. GOETZ. 2001. Bicknell's Thrush (*Catharus bicknelli*). Number 592, in *The Birds of North America* (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- ROST, G. R., AND J. A. BAILEY. 1979. Distribution of mule deer and elk in relation to roads. *Journal of Wildlife Management*, 43:634-641.
- RUGGIERO, L. F., E. PEARSON, AND S. E. HENRY. 1998. Characteristics of American marten den sites in Wyoming. *Journal of Wildlife Management*, 62:663-673.
- SHERBURNE, S. S., AND J. A. BISSONETTE. 1994. Marten subnivean access point use: response to subnivean prey levels. *Journal of Wildlife Management*, 58:400-405.

- SHERWOOD, B. R., D. F. CUTLER, AND J. A. BURTON. 2003. Wildlife and Roads: The Ecological Impact. Imperial College Press, London.
- SIEMERS, B. M., AND A. SCHAUB. 2011. Hunting at the highway: traffic noise reduces foraging efficiency in acoustic predators. *Proceedings of the Royal Society B: Biological Sciences*, 278:1646-1652.
- SILVA, M., K. M. JOHNSON, AND S. B. OPPTS. 2009. Habitat use and home range size of red foxes in Prince Edward Island (Canada) based on snow-tracking and radio-telemetry data. *Central European Journal of Biology*, 4:229-240.
- SIREN, A. P. K. 2013. Population ecology of American marten in New Hampshire: impacts of wind farm development in high elevation habitat. M.S. Thesis, University of New Hampshire, 172 pp.
- SLABBEKOORM, H., AND E. A. P. RIPMESSTER. 2007. Birdsong and anthropogenic noise: implications and applications for conservation. *Molecular Ecology*, 17:72-83.
- STANTEC. 2007. Winter track survey at the proposed windpark in Coos County, New Hampshire by Granite Reliable Power, LLC.
- STANTEC. 2009. 2009 baseline breeding bird survey at the Granite Reliable Power Project in Coos County, New Hampshire. Prepared for Granite Reliable Power, LLC. Prepared by Stantec Consulting, Topsham, ME.
- STRONG, A. M., C. C. RIMMER, K. P. MCFARLAND, AND M. T. MURPHY. 2004. Effects of prey biomass on reproductive success and mating strategy of Bicknell's thrush (*Catharus bicknelli*), a polygamous songbird. *Auk*, 121:446-451.
- SOUTIERE, E. C. 1979. Effects of timber harvesting on marten in Maine. *Journal of Wildlife Management*, 43:850-860.
- STEVENTON, D., AND J. T. MAJOR. 1982. Marten use of habitat in a commercially clear-cut forest. *Journal of wildlife Management*, 46:175-182.
- SUN, J. W. C., AND P. M. NARINS. 2005. Anthropogenic sounds differentially affect amphibian call rates. *Biological Conservation*, 121:419-427.
- SWIHART, R. K., AND N. A. SLADE. 1984. Road crossing in *Sigmodon hispidus* and *Microtus ochrogaster*. *Journal of Mammalogy*, 65:357-360.

- TATTERSALL, F. H., D. W. MACDONALD, B. J. HART, P. JOHNSON, W. MANLEY, AND R. FEBER. 2002. Is habitat linearity important for small mammal communities on farmlands? *Journal of Applied Ecology*, 39:643-652.
- TOWNSEND, J. M., C. C. RIMMER, AND K. P. MCFARLAND. 2010. Winter territorial and spatial behavior of Bicknell's thrush (*Catharus bicknelli*) at two ecologically distinct sites in the Dominican Republic. *Auk*, 127:514-522.
- TROMBULAK, S. C., AND C. A. FRISSELL. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology*, 14:18-30.
- THOMPSON, I. D. 1994. Marten populations in uncut and logged boreal forests in Ontario. *Journal of Wildlife Management*, 58:272-280.
- THOMPSON, I. D., AND A. S. HARESTAD. 1994. Effects of logging on American martens and models for habitat management. Pp 355-367, *in* Martens, Sables, and Fishers: Biology and Conservation (S. W. Buskirk, A. Harestad, and M. Raphael (eds). Cornell University Press, Ithaca, NY.
- THURBER, J. M., R. O. PETERSON, J. D. WOOLINGTON, AND J. A. VUCETICH. 1992. Coyote coexistence with wolves on the Kenai Peninsula, Alaska. *Canadian Journal of Zoology*, 70:2494-2498.
- VAN DER REE, R., S. CESARINI, P. SUNNUCKS, J. L. MOORE, AND A. TAYLOR. 2010. Large gaps in canopy reduce road crossing by a gliding mammal. *Ecology and Society*, 15(4):35.
- VAN DER REE, R., J. A. G. JAEGER, E. VAN DER GRIFT, AND A. P. CLEVENGER. 2011. Effects of roads and traffic on wildlife populations and landscape functions. *Ecology and Society*, 16(1):48.
- VAD DYKA, F. G., R. H. BROCHE, AND H. G. SHAW. 1986. Use of road track counts as indices of mountain lion presence. *Journal of Wildlife Management*, 50:102-109.
- WALLACE, G. J. 1939. Bicknell's thrush, its taxonomy, distribution, and life history. *Proceedings of the Boston Society of Natural History*, 41:211-402.
- WOOD, W. E., AND S. M. YEZERINAC. 2006. Song sparrow (*Melospiza melodia*) song varies with urban noise. *Auk*, 123:650-659.

Curriculum Vitae

VITAE

Personal Data:

Name: C. William Kilpatrick

Current Address: Department of Biology
University of Vermont
Burlington, VT 05405-0086

Phone: (802) 656-0453

Fax: (802) 656-2914

E-mail: C-William.Kilpatrick@uvm.edu

Education:

Doctor of Philosophy, North Texas State University, 1973
(Major in Zoology with Dr. Earl G. Zimmerman)

Master of Science, Midwestern State University, 1969
(Major in Zoology with Dr. Walter W. Dalquest)

Bachelor of Science, Midwestern State University, 1968,
(Major: Zoology, Minor: Geology)

Faculty Appointments:

University of Vermont, 1974-present
Professor, Department of Biology, UVM, 2009-present
Associate Professor, Department of Biology, UVM, 1980-2009
Curator of Vertebrates, Zadock Thompson Museum of Natural History,
1982-present
Assistant Professor, Department of Zoology, UVM. 1974-1980
Graduate Faculty, 1977-present

University of Florida, Gainesville, FL, Spring 1981
Visiting Associate Professor

St. Lawrence University, Canton, NY, 1973-1974
Visiting Assistant Professor

North Texas State University, Denton, TX, 1970-1973
Teaching Fellow (Lecturer), Fall 1971, Spring 1973

Midwestern University, Wichita Falls, TX, Lecturer, 1969-1970

Administrative Appointments:

Acting Chair, Department of Zoology, 1985

Grants Awarded:

Extramural Research Grants:

National Science Foundation, 1978-1980, \$54,837; 2014-2017, \$470,000
U. S. Fish and Wildlife Service, 1979-1980, \$15,000
National Science Foundation, 1982-1985, \$70,000
Center for Field Research, 1986, \$16,000
Vermont EPSCoR, 1988-1990, \$84,806; 2001, \$6,000; 2003, \$2,100
Vermont Fish and Wildlife, 1990-1991, \$2,600; 2000-2003, \$8,800,
collaborator with Dave Hirth; 2007-2008, \$14,000; 2009-2010, \$13,000,
collaborator with Donna Parrish; 2010, \$8,000; 2013, \$37,688, collaborator
with Ellen Marsden and William Ardren; 2013-2015, \$14,900
Vermont Department of Forest, 2002, \$5,000
Nature Conservancy, 1991-1992, \$2,100
Nature Conservancy, 1992-1993, \$2,600
U. S. Fish and Wildlife Service, 1991-1999, \$300,000 (in Pakistan
Rupies), collaborator on grant to Charles A. Woods
Royal Geological Society of London, University of Glasgow/University of
Peshawar 1999 Hindu Kush Expedition, \$50,000, one of about 15
invited participants, Peter Meadows PI.
U. S. Forest Service, 2005-2006, \$17,350, CoPI with Donna Parrish; 2006-2007,
\$15,817, CoPI with Donna Parrish
Nature Conservancy, 2000, \$11,493
Conservation International, 2007, \$2,660 grant to Dr. Jan Decher, Research
Associate, CoPI
National Geographic Grant to Dr. Jan Decher, Research Associate, CoPI
Davis Conservation Foundation, 2006, \$5,000, Laura Farrel, CoPI

Extramural Program Grants:

National Science Foundation Training Grant, 1995-2000, participant
Vermont EPSCoR, 1993-1998, \$120,000 to retool my laboratory
Computational Biology/Bioinformatics Cluster of DOE - EPSCoR

Research Support Pending:

Institutional Grants:

URS Grants, University of Vermont, 1974, \$3,405; 1974, \$1,700; 1975, \$400;
1978, \$1,800; 1979, \$2,085; 1981, \$2,300; 1984, \$5,300; 1987, \$5,275;
1990, \$5,000; 1993, \$5,000; 1999, \$5,000

Faculty Development Initiative, 1987, \$5,000
Vermont Genetics Network, 2002, \$3,410
Instructional Development Grants, University of Vermont, 1982, \$2,000;
1987, \$1,800
RAC Grants, University of Vermont, 1991, \$11,000, \$4,000

Fellowships and Honors:

Hartley Jackson Award, American Society of Mammalogists, 2013
Outstanding Alumnus, College of Science and Mathematics, Midwestern
State University, 2003
Howard Professorship of Zoology and Natural History, University of
Vermont, 2001 to present
National Defense Educational Act Doctoral Fellowship, 1972-1973
A. Brazier Howell Honorarium, American Society of Mammalogists, 1973
Wilks Award, Southwestern Association of Naturalist, 1973
Society of Sigma Xi, 1974
New York Academy of Science, 1979

Professional Societies:

Membership:

American Society of Mammalogists (Life Member)
Northeastern Association of Naturalists
Society of Molecular Biology and Evolution
Society for the Study of Mammalian Evolution
Society of Systematic Biology
Southwestern Association of Naturalists

Committees:

American Society of Mammalogists:
Board of Directors, 2010-2013; 2014-present
Education and Graduate Students, 1984-1987
Grants-in-Aid, 2001-2004, Chair 2004-2011
Checklist, 2002-present
Legislation and Regulations, 1977
Program Committee, 1994-1998, hosted Annual Meeting in 1995
Publications Committee 2011- present

North American Symposium on Bat Research
Board of Directors, 2001-2003
Program Committee, 2001-2003, hosted Annual Meeting 2002

State of Vermont:

Fragile Area Advisory Committee, 1981-1983
Endangered Species Committee
Mammal Advisory Group, 1982-1989; Chair 1989-present
Reptile and Amphibian Advisory Group, 1981-present

Comprehensive Wildlife Conservation Strategy Mammal Team,
2004

Host of Annual Meetings:

North American Symposium of Bat Research (32 Annual Meeting),
November 6-10, 2002
New York/New England Bat Working Group, November 6, 2002
American Society of Mammalogist, (74th Annual Meeting) June 1995

Reviewer:

Manuscripts Reviewed for:

ACTA Theriologica
American Midland Naturalists
American Naturalist
Animal Conservation
Belgian Journal of Zoology
BioTechniques
Biotropica
BMC Evolutionary Biology
Caribbean Journal of Science
Cladistics
Conservation Biology
Coral Reefs
Ecology
Evolution
International Journal of Animal Biology
Journal of Biogeography
Journal of Heredity
Journal of Mammalogy
Journal of Mammalian Evolution
Journal of Wildlife Management
Journal of Wildlife Management and Wildlife Monographs
Journal of Zoological Systematics and Evolutionary Research
Journal of Zoology
Mammalian Species Accounts (American Society of Mammalogists)
Molecular Biology and Evolution
Molecular Phylogenetics and Evolution
Naturwissenschaften
Northeastern Naturalist
Pakistan Journal of Zoology
PLOS ONE
Proceedings of Biological Society of Washington
Revista de Biología Marina y Oceanografía
Science
Southwestern Naturalist
Systematic Biology
Transactions American Fisheries Society
Wildlife Society Bulletin

Zoological Journal of the Linnean Society

Guest Editor, Northeastern Naturalist, 2002-2003, 2005-2006
Associate Editor for Mammalian Species (American Society of Mammalogists), 2011-2013
Editorial Board, Associate Editor, American Society of Mammalogists, 2014-present

Grant Proposals Reviewed for:
American Philosophical Society
Auburn University
Binational Agricultural Research and Development Fund
Center for Field Research
National Geographic Society
National Institute of Health
National Science Foundation
OTKA (Hungarian Science Foundation)

Academic Committees:

Departmental:

Academic Committee, 1988-1992
Advisory Council, 1978-1979; 1981-1984; 1986-1987; 1990-1991; 1995-1996; 1997-1998; 2002-2003; 2009-present
Animal Room Committee, 1977-1978; Chairman 1979-1987; 1988-1994
Curriculum Review Committee, 1976-1978
Field Station Committee, 1978-1980
Graduate Committee, 1975-1978
Graduate Recruitment Committee, 1979-1980; 1986-1990
Search Committees, many
Seminar Committee, 1986-1987
Committee on Undergraduate Majors in Basic Life Sciences, Co-Chair, 1989
Senate Representative, 2000-2002; elected representative 2002-2009

College:

Zoology Chairman Search Committee, 1977-1978
Zoology Chairman Review Committee, 1979-1980; 1989
Psychology Chairman Review Committee, Chairperson, 1984
Nomination Committee, 1982-1985
GTF Retention Committee, 1995
George Aiken Conference Planning Committee for 1996-1998
Howard Professorship, 1997

University:

DNA Analysis Facility Users Oversight Committee, 1998-2010
University Animal Care Committee, 1979-1980; 1981-1985

Institutional Animal Care and Use Committee, 1986-1987, 1988-1990;
Vice Chair 1990-1992; 1993-1995
Biological Sciences Study Section, University Committee on Research
and Scholarship, 1979-1980; 1981-1983
University Committee on Research and Scholarship, 1985-1987
Undergraduate Research Advisory Committee, 2012-present
Task Force on Animal Care and Use, 1987
Senate Faculty Affairs Committee, 1996; 2000-2002
Senate Professional Standards Committee, 2002-2005

Other Service:

Public Presentations:

Bat Biology:
Fairbanks Museum, St. Johnsbury, July 13, 2001
Kill Kare State Park, July 21, 2001
Lake Champlain Science Center, October 3, 2001
Aiken Lecture: Environmental Sciences and Public Policy: Bringing
Interest Together, Co-leader of workshop on Biodiversity, April 7, 1998.
ECHO, Turtles and Environmental Conditions for their Survival, December,
2005
SMT Career Day Speaker (DNA Forensics), Vt-EPSCoR, May 21, 1998
Sigma Xi lecture of DNA Fingerprinting, Trinity College, Burlington
Vermont, 1994

Other:

Vermont Public Television, Rural RFD, Bat Biology
National Public Radio, Guest on "All Things Considered", Northward
Movements of Opossums
Interviews:
USA Today in August 2002, Origin of Dogs
Science News: December 2000, Afrotheria; September 2003,
Ratzilla
Burlington Freepress, Several topics concerning local mammals
Vermont Quarterly (University of Vermont publication), Northward
Movement of Opossums and Origin of Dogs

Consulting:

Paid:

DNA Forensics:

Expert witness for the State of Vermont - 1993, 1994, 1995, 1996, 1997, 2013, 2014
Expert witness for the State of New York - 1993, 1994, 1996
Expert witness for the State of New Hampshire - 1993, 1995
Expert witness for the State of Connecticut - 1995
Expert witness for the State of Massachusetts - 1993
Expert witness for the State of New Jersey - 1994
Conducted Audit of Vermont State Crime Lab - 1996

International Program, U.S. Fish and Wildlife - Visited lab in Pakistan and prepared report (site visit for contract work)

Wildlife Biology:

Expert witness for Kingdom Commons Group, Public Service Board 2005

U.S. Forest Service Panel: Endangered and Threatened Mammal

Species Viability, Northeastern Region - May 21-23, 2002; Finger Lakes – August 14, 2003

Expert witness for Ridge Protectors, Public Service Board 2006-2007

Northeastern Wildlife Genetics, Inc.

Position: Owner and Director

Indiana bat surveys in the Champlain Valley of Vermont – 3 surveys 2006

Wildlife Consultant for the Glebe Mountain Group conducting wildlife surveys on Glebe Mountain in relation to proposed wind farm, 2007

Genetic analysis of spruce grouse populations, Vermont Fish and Wildlife Department 2008-present

Wildlife Consultant for town of Wilmington and Save Vermont Ridgelines on the impacted of the proposed Deerfield Wind Farm on wildlife, 2008-2009

Expert witness Town of Wilmington and Save Vermont Ridgelines, Public Service Board 2008-2009

Genetic analysis of Vermont white-tailed deer populations, Vermont Fish and Wildlife Department 2009-present

Expert witness of State Vermont (ANR), Public Service Board 2010

Expert witness Town of Newark, Public Service Board, 2013

Wildlife DNA forensic case work for Vermont Fish and Wildlife Department 2012-present

Gratis:

Bear Mountain Natural History Center

Position: Director of Research

Grants:

Vermont Monitoring Cooperative, \$5000, June 1, 2002.

Dr. Jan Decher, Research Associate

Co-PI on Contract for Small Mammal Survey, Colby Hill Ecological Project - 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007,

NorthWoods Stewardship Center (Vermont Leadership Center)

Board of Directors – 2005 - 2011

Workshop on Small Mammals - 2001, 2002, 2003, 2004, 2005

Workshop on Bats, 2000

Audubon “Take PART program” August 2005, August 2006, July 2007, July 2008

Seminars:

August 2008, Update of White-nosed Syndrome

May 2008, White-nosed Syndrome

April 2007, Impacts of Noise on Wildlife

2005, East Mountain Mammal Surveys

August 17, 2002, Vermont Black Bears

August 3, 2001, Wolves of the Northeast
November 3, 2001, Bats of Vermont
August 24, 2000, Bats of Vermont
Grant: Vermont Fish and Wildlife Department, State Wildlife Grant,
Mammals of Vermont: A distributional and habitat association
reference - Phase I, 2007-2009, \$40,000, CoPIs J. Decher, F.
Gerhardt, D. Hirth, P. Smith, S. Trombulak, and C. A. Woods.
\$20,000.00 year 1 (2008) funded, \$20,000 year 2 (2010) funded.

Advisory Panel, Dalquest Research Site – 2008-2009 (panel for preliminary
work funded by NSF)

Graduate Students:

Charles F. Aquadro, M.S., 1978	Professor, Cornell University
Robert T. Beaumont, M.S., 1979	Field Biologist, BLM
Michael A. Romano, M.S., 1979	Professor, Western Illinois State
Thomas P. Dowhan, M.S., 1981	Ophthalmic Surgeon
Debra J. Boles, M.S., 1984	Research Prof., ATTC
Paul D. Rennert, M.S., 1986	Research Assoc., Mass. General
Darrin Werbitsky, M.S., 1987	Investment Banker
Donald B. Hoagland, Ph.D., 1988	Professor, Westfield State
John M. Sullivan, M. S., 1990	Professor, Univ. Idaho
Steve M. Rich, M.S., 1993	Associate Prof., Univ. Mass, Amherst
Pedro E. Nunez, M.S., 1994	DVM, Puerto Rico
Jeff A. Markert, M.S., 1996	Postdoc, Univ. Cincinnati
Ryan W. Norris, M.S., 2001; Ph.D.2008	Assistant Prof., Ohio St. Univ. (Lima)
Paul Hapeman, Ph.D., 2006	Assistant Prof., Central Conn. St. Univ.
Laura Farrell, Ph.D., 2012	Instructor, Sterling College
Lucas Bernachi, Ph.D	Visiting Prof., Saint Joseph's College
Chris Gray, M.S.	present
Nelish Pradhan, Ph.D.	present

Visiting Scientist:

Dr. Michael Romano, Western Illinois University - Fall 2004
Dr. Rafael Borroto Paez, University of Havana, Cuba - Fall 2001
Dr. Marc W. Allard, Visiting Associate Professor on Sabbatical from
George Washington University - Fall 2000
Catherine Langtimm, Wildlife Biologist, - U.S. Geological Survey
visited lab to learn techniques - 1997
Charles Maisonneuve, Biologist, Ministere de l'Environnement et
de la Faune, Gouvernement du Quebec - 1997.
Jacques Jutras, Direction de la Fauna et des Habitats, Ministere
de l'Environnement et de la Faune, Gouvernement du Quebec -
visited lab to learn techniques - 1997
Dr. Eric Buel, Director Vermont State Crime Lab - Current topics in
population genetics STR, Spring 1997

Mohammad Rafique, Pakistan Museum of Natural History,
Islamabad, Pakistan - learned DNA sequencing, summer 1996
Waseem Khan, Government College, Islamabad, Pakistan -
learned some molecular techniques, summer 1996
Dr. Thomas Husband, Sabbatical from the University of Rhode Island, fall
1995

Research Associates:

Dr. Charles A. Woods, Adjunct Professor and Research Associate

Publications:

- Submitted May-Collado, L. J., C. W. Kilpatrick, and I. Agnarsson. Mammals from 'down under': a multi-gene species-level phylogeny of marsupial mammals (Mammalia, Marsupialia). Submitted to *Molecular Phylogenetics and Evolution*.
- Submitted Perlut, N. G., C. R. Freeman-Gallant, A. M. Strong, T. M. Donovan, and **C. W. Kilpatrick**. Habitat management and variable patterns of sexual selection in Savannah Sparrows *Passerculus sandwichensis*. Submitted to *Ibis*.
- Submitted Hapeman, P., E. Latch, O. E. Rhodes, B. Swanson, and **C. W. Kilpatrick**. A genetics synthesis of fishers (*Pekania pennanti*) reintroduction with an emphasis on their eastern range. Submitted *Wildlife Research*.
- Submitted Li, S., S. Lu, **C. W. Kilpatrick**, P. M. McGuire, J. Yang, and F. Yu. Phylogeny and biogeography of *Eoglaucomyx* and *Hylopetes* (Rodentia: Sciuridae), inferred from molecular and morphometric analyses. Submitted to *Zoologica Scripta*.
82. De la Rúa, N. M., M. Menes, D. Bustamante, M. C. Monroy, **C. W. Kilpatrick**, D. Rizzo, L. Stevens, S. Klotz, J. Schmidt, and P. Dorn. Towards a Phylogenetic Approach to the Composition of Species Complexes in the North and Central American *Triatoma*, Vectors of Chagas Disease. Accepted in *Infection, Genetics and Evolution*.
81. Kohli, B. A., K. A. Speer, **C. W. Kilpatrick**, N. Batsaikhan, D. Damdinbaza, and J. A. Cook. 2014. Non-punctuated evolution in north Asia: Multilocus systematics of a recent tribe of Holarctic rodents (Arvicolinae: Myodini). *Molecular Phylogenetics and Evolution*, 76:18-29.
80. Hapeman, P., E. Latch, O. E. Rhodes, and **C. W. Kilpatrick**. When recent and evolutionary histories meet: deciphering temporal events from contemporary patterns of mtDNA from fishers (*Martes pennanti*) in

Northeast North America. Accepted Journal of Zoological Systematics and Evolutionary Research.

79. Bradley, R. D., N. Ordóñez-Garza, C. G. Sotero-Caio, H. M. Huynh, **C. W. Kilpatrick**, L. I. Iñiguez-Dávalos, and D. J. Schmidly. 2014. Morphometric, karyotypic, and molecular evidence for a new species of *Peromyscus* (Cricetidae: Neotominae) from Nayarit, México. *Journal of Mammalogy*, 95:176-186.
78. Shahabi S., M. Aliabadian, J. Darvish, and **C. W. Kilpatrick**. 2013. Molecular phylogeny of brush-tailed mice of the Genus *Calomyscus* (Rodentia: Calomyscidae) inferred from mitochondrial DNA sequences (*Cox1*gene). *Mammalia*, DOI 10.1515.
77. Yu, F., S. Li, **W. C. Kilpatrick**, P. M. McGuire, K. He, and W. Wei. 2012. Biogeographical study of plateau pikas *Ochotona curzoniae* (Lagomorpha, Ochotonidae). *Zoological Sciences*, 29:518-526.
76. Liu, Q, P. Chen, K. He, **C. W. Kilpatrick**, S-Y. Liu, F. Yu, and X. Jiang. 2012. Phylogeographic study of *Apodemus ilex* (Rodentia: Muridae) in southwestern China. *PLoS ONE*, 7(2):e31453.
75. Borroto-Páez, R., C. A. Mancina, C. A. Woods, and **C. W. Kilpatrick**. 2012. Updated checklist of endemic terrestrial mammals of the West Indies. Pp. 389-415, *in* Terrestrial Mammals of the West Indies Contributions (R. Borroto-Paez, C. A. Woods, and F. E Sergil, eds.). Florida Museum of Natural History and Wacahooto Press, Gainesville, 482 pp.
74. **Kilpatrick, C. W.**, R. Borroto-Páez, and C. A. Woods. 2012. Phylogenetic relationships of recent capromyid rodents: A review and analyses of karyological, biochemical and molecular data. Pp. 51-69, *in* Terrestrial Mammals of the West Indies Contributions (R. Borroto-Paez, C. A. Woods, and F. E Sergil, eds.). Florida Museum of Natural History and Wacahooto Press, Gainesville, 482 pp.
73. Hapeman, P., E. Latch, J. Fike, O. E. Rhodes, and **C. W. Kilpatrick**. 2011. Landscape genetics of fishers (*Martes pennanti*) in the northeast: Dispersal barriers and historical influences. *Journal of Heredity*, 102:251-259.
72. Ardren, W. R., P. W. DeHaan, S. T. Smith, E. B. Taylor, R. Leary, C. Kozfkay, L. Godfrey, M. Diggs, W. Fredenberg, J. Chan, **C. W. Kilpatrick**, M. P Small, and Denise K. Hawkins. 2011. Genetic structure, evolutionary history, and conservation units of Bull Trout in the Coterminous United States. *Transactions of the American Fisheries Society*, 140:506-525.

71. Feroze, A., S. A. Malik, and **W. C. Kilpatrick**. 2010. Phylogenetic relationships of medically important vipers of Pakistan inferred from cytochrome B sequences. *Journal of Animal and Plant Science*, 20:147-157.
70. Norris, R. W., and **C. W. Kilpatrick**. 2008. A high elevation record of the star-nosed mole (*Condylura cristata*) in northeastern Vermont. *Canadian Field-Naturalist*, 121:206-207.
69. Norris, R. W., C. A. Woods, and **C. W. Kilpatrick**. 2008. Taxonomic status of *Calomyscus hotsoni* (Rodentia: Muridae: Calomyscinae): Based on morphological and molecular data. *Journal of Mammalogy*, 89:306-315.
68. Perlut, N. G., C. R. Freeman-Gallant, A. M. Strong, T. M. Donovan, **C. W. Kilpatrick**, and N. J. Zalik. 2008. Agricultural management affects evolutionary processes in a migratory songbird. *Molecular Ecology*, 17:1248-1255.
67. Bradley, R. D., N. D. Durish, D. S. Rogers, J. R. Miller, M. D. Engstrom, and **C. W. Kilpatrick**. 2007. Toward a molecular phylogeny for *Peromyscus*: Evidence from mitochondrial cytochrome-*b* sequences. *Journal of Mammalogy*, 88:1146-1159.
66. McPartland, J. M., R. W. Norris, and **C. W. Kilpatrick**. 2007. Tempo and mode in endocannabinoid system evolution. *Journal of Molecular Evolution*, 65:267-276.
65. Janecka, J. E., T. L. Blankenship, D. H. Hirth, **C. W. Kilpatrick**, M. E. Tewes, and L. I. Grassman, Jr. 2007. Evidence for male-biased dispersal in bobcats using relatedness analysis. *Wildlife Biology* 13:38-47.
64. McPartland, J. M., R. W. Norris, and **C. W. Kilpatrick**. 2007. Coevolution between cannabinoid receptors and endocannabinoid ligands. *Gene*, 397:126-135.
63. Huchon, D., P. Chevret, U. Jordan, **C. W. Kilpatrick**, V. Ranwez, P. D. Jenkins, J. Brosius, and J. Schmitz. 2007. Multiple molecular evidence for a living mammalian fossil. *Proceedings of the National Academy of Science*, 104:7495-7499.
62. McPartland, J. M., M. Glass, I. Matias, R. W. Norris, and **C. W. Kilpatrick**. 2007. A shifted repertoire of endocannabinoid genes in the zebrafish (*Danio rerio*). *Molecular Genetics and Genomics*, 277:555-570.
61. Janecka, J. E., T. L. Blankenship, D. H. Hirth, M. E. Tewes, **C. W. Kilpatrick**, and L. I. Grassman, Jr. 2006. Kinship and social structure of bobcats (*Lynx rufus*) from microsatellite and radio-telemetry data. *Journal of Zoology*,

269:494-501.

60. Reeder, S. A., D. S. Carroll, C. W. Edwards, **C. W. Kilpatrick**, and R. D. Bradley. 2006. Neotomine-Peromyscine rodent systematics based on combined analyses of nuclear and mitochondrial DNA sequences. *Molecular Phylogenetics and Evolution*, 40:251-258.
59. Yu, F., F. Yu, J. Pang, **C. W. Kilpatrick**, P. M. McGuire, Y. Wang, S. Lu, and C. A. Woods. 2006. Phylogeny and biogeography of the *Peturista philippensis* complex (Rodentia: Sciuridae), inter- and intraspecific relationships inferred from molecular and morphometric analysis. *Molecular Phylogenetics and Evolution*. 38:755-766.
58. Lehr, M. A., **C. W. Kilpatrick**, R. C. Wilkerson, and J. E. Conn. 2005. Cryptic species in the *Anopheles (Nyssorhynchus) albitarsis* (Diptera: Culicidae) complex: incongruence between rapid arbitrary polymorphic detection polymerase chain reaction identification and analysis of mtDNA *COI* gene sequences. *Annals of the Entomological Society of America*, 98: 908-917.
57. Fairley, T. L., **C. W. Kilpatrick**, and J. E. Conn. 2005. Intragenomic heterogeneity of rDNA internal transcribed spacers 1 and 2 in the Neotropical malaria vector, *Anopheles aquasalis* (Diptera: Culicidae). *Journal of Medical Entomology*, 42:795-800.
56. Woods, C. A., and **C. W. Kilpatrick**. 2005. Infraorder Hystricognathi. Pp. 1538-1600, *in* *Mammal Species of the World, A Taxonomic and Geographic Reference* (D. E. Wilson and D. M. Reeder, eds.). Third edition, John Hopkins University Press, Baltimore MD.
55. Borroto-Páez, R., C. A. Woods, and **C. W. Kilpatrick**. 2005. Sistemática de las Jutías de las Antillas (Rodentia, Capromyidae). Pp. 33-50, *in* *Proceedings of the International Symposium "Insular Vertebrate Evolution: the Palaeontological Approach"* (J. A. Alcover and P. Bover, eds.). *Monografies de la Societat d'Història Natural de las Balears*, 12.
54. Jenkins, P. D., **C. W. Kilpatrick**, M. F. Robinson, and R. J. Timmins. 2005. Morphological and molecular investigations of a new family, genus and species of rodent (Mammalia: Rodentia: Hystricognatha) from Lao PDR. *Systematics and Biodiversity*, 2:419-454.
53. **Kilpatrick, C. W.** 2005. DNA Storage. Pp. 360-363, *in* *Encyclopedia of Diagnostic Genomics and Proteomics*. Marcel Dekker, New York.
52. Bradley, R. D., D. S. Carroll, M. L. Haynie, R. M. Martinez, M. J. Hamilton, and **C. W. Kilpatrick**. 2004. A new species of *Peromyscus* from Western Mexico. *Journal of Mammalogy*, 85:1184-1193.

51. Durish, N. D., K. E. Halcomb, **C. W. Kilpatrick**, and R. J. Bradley. 2004. Molecular systematics of the *Peromyscus truei* species group. *Journal of Mammalogy*, 85:1160-1169.
50. Yu, F., P. M. McGuire, **C. W. Kilpatrick**, J. Pang, Y. Wang, S. Lu, and C. A. Woods. 2004. Molecular phylogeny of woolly flying squirrel (Rodentia: Sciuridae), inferred from mitochondrial cytochrome *b* gene sequences. *Molecular Phylogenetics and Evolution*, 33:735-744.
49. Bradley, R. D., C. W. Edwards, D. S. Carroll, and **C. W. Kilpatrick**. 2004. Phylogenetic relationships of Neotomine-Peromyscine rodents: based on DNA sequences from the mitochondrial cytochrome *b* gene. *Journal of Mammalogy*, 85:389-395.
48. Norris, R. W., K. Zhou, C. Zhou, G. Yang, **C. W. Kilpatrick**, and R. L. Honeycutt. 2004. The phylogenetic position of the zokors (Myospalacinae) and comments on the families of muroids (Rodentia). *Molecular Phylogenetics and Evolution*, 31: 972-978.
47. Norris, R. W., S. Morshed, **W. C. Kilpatrick**, C. A. Woods, P. L. Perelman, S. A. Romanenko, and V. G. Malikov. 2003. The new data on diversity of *Calomyscus* Thomas, 1905 (Rodentia, Calomyscinae). Pp. 166-169, *in* Systematics, Phylogeny and Paleontology of Small Mammals, Proceedings of International Conference, devoted to the 90th anniversary of Prof. I. M. Gromov (A. Averianov and N. Abramson, eds.). Russian Academy of Science, Saint Petersburg, Russia.
46. Hirth, D. H., J. A. M. Petty, AND **C. W. Kilpatrick**. 2002. Black bear, *Ursus americanus*, hair and apple trees, *Malus pumila*, in northeastern North America. *Canadian Field Naturalist*, 116:305-307.
45. **Kilpatrick, C. W.** 2002. Non-cryogenic preservation of mammalian tissues for DNA extraction: an assessment of storage methods. *Biochemical Genetics*, 40:53-62.
44. Allard, M. W., S. D. Baker, G. L. Emerson, J. Ottenwalder, and **C. W. Kilpatrick**. 2001. Characterization of the mitochondrial control region in *Solenodon paradoxus* and the implications for biogeographic, systematics and conservation management. Pp. 329-332, *in* Biogeography of the West Indies: New Patterns and Perspectives (C. A. Woods and F. E. Sergile, eds.). CRC Press, Boca Raton, FL.
43. Woods, C. A., R. Borroto Paez, and **C. W. Kilpatrick**. 2001. Insular patterns and radiation of West Indian rodents. Pp. 333-351, *in* Biogeography of the West Indies: New Patterns and Perspectives (C. A. Woods and F. E. Sergile, eds.). CRC Press, Boca Raton, FL.

42. Horst, G. R., D. B. Hoagland, and **C. W. Kilpatrick**. 2001. The mongoose in the West Indies-the biogeography of an introduced species. Pp. 407-422, in *Biogeography of West Indies: New Patterns and Perspectives* (C. A. Woods and F. E. Sergile, eds.). CRC Press, Boca Raton, FL.
41. Tiemann-Boege, I., **C. W. Kilpatrick**, D. J. Schmidly, and R. D. Bradley. 2000. Molecular phylogenetics of the *Peromyscus boylii* species group (Rodentia: Muridae) based on mitochondrial cytochrome *b* sequences. *Molecular Phylogeny and Evolution*, 16:366-378.
40. Bradley, R. D., I. Tiemann-Boege, **C. W. Kilpatrick**, and D. J. Schmidly. 2000. Taxonomic status of *Peromyscus boylii sacarensis*: Inferences from DNA sequences of the mitochondrial cytochrome-*B* gene. *Journal of Mammalogy*, 81:875-884.
39. Emerson, G. L., **C. W. Kilpatrick**, B. McNiff, J. Ottenwalder, and M. W. Allard. 1999. Phylogenetic relationship of the order insectivora based on complete 12S rRNA sequence from mitochondria. *Cladistics*, 15:221-230.
38. Hoagland, B. D., and **C. W. Kilpatrick**. 1999. Genetic variation and differentiation among insular populations of the small Indian mongoose (*Herpestes javanicus*). *J. Mamm.*, 80:169-179.
37. Sullivan, J., J. A. Markert, and **C. W. Kilpatrick**. 1997. Phylogeography and molecular systematics of the *Peromyscus aztecus* species group (Rodentia: Muridae) inferred using parsimony and likelihood. *Systematic Biology*, 46:426-440.
36. Woods, C. A., and **C. W. Kilpatrick**. 1997. Biodiversity of small mammals in the mountains of Pakistan. Pp. 437-467, in *Biodiversity of Pakistan* (S. A. Mufti, C. A. Woods, and S. A. Hasan, eds.), Pakistan Museum of Natural History, Islamabad, Pakistan, 537 pp.
35. Woods, C. A., **C. W. Kilpatrick**, M. Rafique, W. Khan, and M. Shah. 1997. Biodiversity and conservation of the Deosai Plateau. Pp. 33-61, in *Biodiversity of Pakistan* (S. A. Mufti, C. A. Woods, and S. A. Hasan, eds.), Pakistan Museum of Natural History, Islamabad, Pakistan, 537 pp.
34. Rich, S. M., **C. W. Kilpatrick**, J. L. Shippee, and K. L. Crowell. 1996. Morphological differentiation and identification of *Peromyscus maniculatus* and *P. leucopus* in northeastern North America. *J. Mamm.*, 77:985-991.
33. **Kilpatrick, C. W.** 1996. An ancient duplication of the salivary amylase locus in Arvicoline rodents. *Biochem. Syst. Ecol.*, 24:309-318.

32. Bradley, R. D., D. J. Schmidly, and **C. W. Kilpatrick**. 1996. The relationship of *Peromyscus sagax* to the *P. boylii* and *P. truei* species groups in Mexico based on morphometric, karyotypic, and allozymic data. Page 95-106, *in* Memorial Volume Honoring Dr. J. Knox Jones, Jr. (H. H. Genoways, ed.), Museum of Texas Tech University, 313 pp.
31. Andrews, J., W. Barnard, M. DesMeules, C. Fichtel, **W. Kilpatrick**, G. Nielsen, and S. Trombulak. 1995. A preliminary atlas of the reptiles and amphibians of Vermont. Vermont Field Office of The Nature Conservancy and Vermont Department of Fish and Wildlife, Nongame and Natural Heritage Program. 64 pp.
30. **Kilpatrick, C. W.**, S. M. Rich, and K. L. Crowell. 1994. Distribution of the genus *Peromyscus* in coastal and inland-southwestern Maine. *Maine Naturalist*, 2:1-10.
29. Rand, P. W., E. H. Lacombe, R. P. Smith, Jr., S. M. Rich, **C. W. Kilpatrick**, C. A. Dragoni, and D. Caporale. 1993. Competence of *Peromyscus maniculatus* (Rodentia: Cricetidae) as a reservoir host for *Borrelia burgdorferi* (Spirochaetales: Spirochaetaceae) in the wild. *J. Med. Entomol.*, 30:614-618.
28. Sullivan, J. M., **C. W. Kilpatrick**, and Paul D. Rennert. 1991. Biochemical systematics of the *Peromyscus boylii* species group. *J. Mamm.*, 72:669-680.
27. Sullivan, J. M., and **C. W. Kilpatrick**. 1991. Biochemical systematics of the *Peromyscus aztecus* assemblage. *J. Mamm.*, 72:681-696.
26. Hoagland, D. B., G. R. Horst, and **C. W. Kilpatrick**. 1989. Biogeography and population biology of the mongoose in the West Indies. Pp. 611-634, *in* Biogeography of the West Indies (C. A. Woods and H. H. Genoways, eds.). Sandhill Crane Press, Inc., Gainesville, Florida, 896 pp.
25. Rennert, P. D., and **C. W. Kilpatrick**. 1987. Biochemical systematics of *Peromyscus boylii*. II. Chromosomally variable populations from eastern and southern Mexico. *J. Mamm.*, 68:799-811.
24. Werbitsky, D., and **C. W. Kilpatrick**. 1987. Genetic variation and genetic differentiation among allopatric populations of *Megadontomys*. *J. Mamm.*, 68:305-312.
23. Rennert, P. D., and **C. W. Kilpatrick**. 1986. Biochemical systematics of populations of *Peromyscus boylii*. I. Populations from east-central Mexico with a low fundamental number. *J. Mamm.*, 67:481-488.

22. **Kilpatrick, C. W.**, S. Forrest, and T. W. Clark. 1986. Estimating genetic variation in the black-footed ferret - a first attempt. Black-footed Ferret Monograph, Great Basin Natur. Memoirs., 8:145-149.
21. **Kilpatrick, C. W.**, and K. L. Crowell. 1985. Genetic variation of the rock vole, *Microtus chrotorrhinus*. J. Mamm., 66:94-101.
20. **Kilpatrick, C. W.** 1984. Molecular evolution of the Texas mouse, *Peromyscus attwateri*. Pp. 87-96, in Festschrift for Walter W. Dalquest in honor of his sixty-sixth birthday (N. V. Horner, ed.). Midwestern State University, Wichita Falls, Texas, 163 pp.
19. Ralin, D. B., M. A. Romano, and **C. W. Kilpatrick**. 1983. Genetic characterization of a northeastern population of the tetraploid treefrog, *Hyla versicolor*. Herpetologica, 39:212-225.
18. Woods, C. A., W. O. Post, and **C. W. Kilpatrick**. 1982. *Microtus pennsylvanicus* (Rodentia: Muridae) in Florida: A Pleistocene relic in a coastal salt marsh. Bull. Florida State Mus., Biol. Sci., 28:25-52.
17. **Kilpatrick, C. W.**, and C. A. Woods. 1982. *Hemidactylum scutatum*. Herp. Rev., 13:23-24.
16. **Kilpatrick, C. W.**, and M. A. Romano. 1982. *Elaphae obsoleta obsoleta*. Herp Rev., 13:25.
15. **Kilpatrick, C. W.** 1981. Genetic structure of insular populations. Pp. 28-59, in Mammalian Population Genetics (M. H. Smith and J. Joule, eds.). University of Georgia Press, Athens, 380 pp.
14. Aquadro, C. F., and **C. W. Kilpatrick**. 1981. Morphological and biochemical variation and differentiation in insular deer mice, *Peromyscus maniculatus*. Pp. 214-230, in Mammalian Population Genetics (M. H. Smith and J. Joule, eds.). University of Georgia Press, Athens, 380 pp.
13. **Kilpatrick, C. W.**, J. W. Kilpatrick, and S. M. Kilpatrick. 1981. A white-footed mouse (*Peromyscus leucopus*) nest site in a hornet's nest. Amer. Midl. Nat., 105:208.
12. Aquadro, C. F., **C. W. Kilpatrick**, and K. L. Crowell. 1980. Colonization of suitable habitat by *Peromyscus leucopus* in coastal Maine. J. Mamm., 61:727-730.
11. Zimmerman, E. G., **C. W. Kilpatrick**, and B. J. Hart. 1978. The genetics of speciation in the rodent genus *Peromyscus*. Evolution, 32:565-579.

10. **Kilpatrick, C. W.**, and E. G. Zimmerman. 1976. Biochemical variation and systematics of *Peromyscus pectoralis*. J. Mamm., 58:506-522.
9. **Kilpatrick, C. W.**, and E. G. Zimmerman. 1976. Hemoglobin polymorphism in the encinal mouse, *Peromyscus pectoralis*. Biochem. Genet., 14:137-143.
8. Zimmerman, E. G., B. J. Hart, and **C. W. Kilpatrick**. 1975. Biochemical genetics of the *truei* and *boylii* groups of the genus *Peromyscus* (Rodentia). Comp. Biochem. Phys., 52b:541-545.
7. **Kilpatrick, C. W.**, and E. G. Zimmerman. 1975. Genetic variation and systematics of four species of mice of the *Peromyscus boylii* species group. Syst. Zool., 24:143-162.
6. Zimmerman, E. G., and **C. W. Kilpatrick**. 1975. Genetic control of erythrocyte esterase (Es-1) in the pinon mouse, *Peromyscus truei* (Shufeldt). Experientia, 31:420-421.
5. Zimmerman, E. G., and **C. W. Kilpatrick**. 1973. Karyology of North American crotaline snakes (Family Viperidae) of the genera *Agkistrodon*, *Sistrurus*, and *Crotalus*. Canadian J. Genet. Cytogenet., 15:389-395.
4. **Kilpatrick, C. W.**, and E. G. Zimmerman. 1973. Karyology of North American natricine snakes (Family Colubridae) of the genera *Natrix* and *Regina*. Canadian J. Genet. Cytogenet., 15:355-361.
3. **Kilpatrick, C. W.**, and W. Caire. 1973. First records of *Peromyscus pectoralis* for Oklahoma, and additional records for north-central Texas. Southwest. Nat., 18:352.
2. Dalquest, W. W., and **C. W. Kilpatrick**. 1973. Dynamics of pocket gopher distribution on the Edwards Plateau of Texas. Southwest. Nat., 18:1-9.
1. **Kilpatrick, C. W.** 1971. Distribution of the brush mouse, *Peromyscus boylii*, and the encinal mouse, *Peromyscus pectoralis*, in northcentral Texas. Southwest. Nat., 16:211-213.

Reports:

- 2012 Decher, J., C. R. Gray, and C. W. Kilpatrick. Small Mammals of the Guthrie-Bancroft Farm - Year 8 submitted to the Colby Hill Ecological Project, Lincoln and Bristol, Vermont, 20 pp.
- 2011 Kilpatrick, C. W., and I. C. Chellman. Genetic Studies of the Mudpuppy

(*Necturus maculosus*) in Lake Champlain and the Connecticut River submitted to the Vermont Fish and Wildlife Department, 47 pp.

- 2011 Kilpatrick, C. W. and J. Benoit. Small Mammal Report submitted to the Vermont Fish and Wildlife Department, 92 pp.
- 2011 Kilpatrick, C. W. Genetic Studies of Lake Champlain Spiny Softshell Turtle (*Apalone spinifera*) submitted to the Vermont Fish and Wildlife Department, 45 pp.
- 2011 Decher, J., C. R. Gray, C. W. Kilpatrick and N. Pradhan. Small Mammals of the Guthrie-Bancroft Farm - Year 7 submitted to the Colby Hill Ecological Project, Lincoln and Bristol, Vermont, 22 pp.
- 2007 Decher, J., and C. W. Kilpatrick. Small Mammals of the Guthrie-Bancroft Farm - Year 6 Colby Hill Ecological Project, Lincoln and Bristol, Vermont.
- 2006 Decher, J., and C. W. Kilpatrick. Small Mammals of the Guthrie-Bancroft Farm - Year 5 Colby Hill Ecological Project, Lincoln and Bristol, Vermont.
- 2005 Decher, J., and C. W. Kilpatrick. Small Mammals of the Guthrie-Bancroft Farm - Year 4 Colby Hill Ecological Project, Lincoln and Bristol, Vermont
- 2005 Kilpatrick, C. W. East Mountain Mammal Surveys August 2004 – December 2004, Kingdom Commons Group, East Burke, Vermont
- 2002 Kilpatrick, C. W. Small Mammal Survey of the Vermont Ecosystem Management Project Plots, Stevensville Brook Research Area, Mount Mansfield State Forest
- 2002 Decher, J., and C. W. Kilpatrick. Small Mammals of the Guthrie-Bancroft Farm - Year 3 Colby Hill Ecological Project, Lincoln and Bristol, Vermont
- 2001 Kilpatrick, C. W. Small mammal survey of the Nulhegan Basin Division of the Silvio O. Conte NFWR and the State of Vermont's West Mountain Wildlife Management Area, Essex County, Vermont
- 2001 Decher, J., and C. W. Kilpatrick. Small Mammals of the Guthrie-Bancroft Farm - Year 2 Colby Hill Ecological Project, Lincoln and Bristol, Vermont
- 2000 Decher, J., and C. W. Kilpatrick. Small Mammals of the Guthrie-

Bancroft Farm - Colby Hill Ecological Project, Lincoln and Bristol,
Vermont

- 1999 Decher, J., C. W. Kilpatrick, and K. L. Bahian. Small mammal zoogeography and diversity in West African forest remnants. Report National Geographic Society Committee for Research and Exploration
- 1992 Kilpatrick, C. W. Status of the long-tailed shrew (*Sorex dispar*) in Vermont. Report to Vermont Fish and Wildlife, Natural Heritage Program

Presentations:

- 2014 American Society of Mammalogists, Oklahoma City, Oklahoma, June 2014
- 2014 Northeastern Natural History Conference, Springfield, Ma, April 2014
- 2009 American Society of Mammalogists, Fairbanks, Alaska, June 2009
- 2008 American Society of Mammalogists, South Dakota State University, Poster, June 2008
- 2007 Seminar at Kunming Institute of Zoology, Kunming, China, November 2007
- 2007 Seminar at University of Yangzhou, Yangzhou, China, November 2007
- 2007 Keynote address, Annual Workshop: The Current Science of Wildlife Genetics, New England Chapter of the Wildlife Society, Hadley Massachusetts, October 2007
- 2007 American Society of Mammalogists, University of New Mexico, Poster, June 2007
- 2007 Genetics Workshop, Vermont Department of Fish and Wildlife, April 2007
- 2006 American Society of Mammalogists, University of Massachusetts, Amherst, oral presentation, June 2006
- 2006 Northeast Fish and Wildlife Conference, Burlington, VT. Oral presentation, April 2006
- 2006 Vermont Bear Biologist Team, January 2006, Barre, VT
- 2005 American Society of Mammalogists, Southwestern Missouri State University, oral presentation

- 2003 Northeastern Bat Working Group, Rosendale, NY, December 2003
- 2003 Wildlife Society Conference, Burlington, VT, oral presentation and poster, September 2003
- 2003 Vermont Genetics Network, Burlington, VT, August 2003
- 2003 American Society of Mammalogist, Texas Tech University, Lubbock, TX, oral presentation and poster, June 2003
- 2003 Midwestern State University, Wichita Falls, TX, June 2003
- 2001 American Society of Mammalogist, University of Montana, oral presentation and poster, June 2001
- 2001 New York/New England Bat Working Group, Rutland, Vermont, January 2001
- 2001 American Museum of Natural History, New York, January 2001
- 2001 Vermont Bear Biologist Team, May 2001
- 2000 American Society of Mammalogist, University of New Hampshire, presentation and poster, June 2000
- 2000 New England Bat Working Group, Rutland, Vermont, March 2000
- 1999 Annual Meeting of the American Society of Mammalogists, Seattle, Washington, June 1999 - poster presentation
- 1998 Annual Meeting of the American Society of Mammalogists, Virginia Tech, Blacksburg, VA, June 1998
- 1998 Invited Symposium Speaker, Landscape Structure, Population Genetics, and Gene Flow, Euro-American Mammal Congress, Universidad de Santiago de Compostela, Spain, in July 1998
- 1998 Invited Speaker, Regional Meeting of the American Association of Laboratory Animal Science, University of Vermont, November 1998
- 1997 Organizer of Symposium on the Molecular Systematics of Peromyscine-Neotomine Rodents for International Theriological Congress, ITC VII, Acapulco, Mexico, September 1997
- 1996 American Society of Mammalogist Meeting, University of North Dakota, Grand Forks, June 1996,

- 1996 Joint Meeting of the Society of Systematic Biology and Society for the Study of Evolution, St. Louis, Missouri, June 1996,
- 1996 Department of Zoology, University of New Hampshire April, 1996
- 1995 Joint Meeting of the Society of Systematic Biology, Society for the Study of Evolution, American Naturalist, and Numerical Taxonomy Group, McGill University, Montreal, June 1995
- 1995 International Symposium on the Biodiversity of Pakistan, Pakistan National Science Foundation, Islamabad, Pakistan, November 1995, (Organization Committee and presentation)
- 1994 American Society of Mammalogist Meeting, Smithsonian Institution, Washington DC, June 1980,
- 1994 Harvard University, Systematics Group, Cambridge, MA, April 1994
- 1993 Sixth International Theriological Congress, University of New South Wales, Kensington, Sydney, Australia, July 1993
- 1993 American Society of Mammalogist Meeting, Huxley College of Environmental Studies, Western Washington University, June 1993
- 1992 Annual North American Symposium on Bat Research, Universite de Sherbrooke, Sherbrooke, Canada, October 1992
- 1990 Joint Meeting American Society of Mammalogists and Argentine Society of Mammalogists, Buenos Aires, Argentina, June 1990
- 1990 Western Illinois University, Department of Biology, Macomb, Illinois, April, 1990
- 1987 St. Lawrence University, Biology Department, Canton, New York, October, 1987
- 1987 Symposium on the Biogeography of the West Indies, University of Florida, Gainesville, Florida, September, 1987
- 1987 American Society of Mammalogist Meeting, University of New Mexico, Albuquerque, New Mexico, June 1987
- 1987 International Symposium on Latin American Mammalogy, Cancun, Mexico, June 1985
- 1986 State University of New York at Binghamton, Biology Department, Binghamton, New York, March 1986

- 1985 Society for the Study of Evolution, Chicago, June, 1985
- 1985 American Society of Mammalogist Meeting, University of Maine at Orono, June 1985
- 1984 American Society of Mammalogist Meeting, Humbolt State University, Arcata, California, June 1984
- 1984 Hofstra University, Department of Biology, Hofstra, New York, March, 1984
- 1983 State University of New York at Oswego, Department of Biology, Oswego, New York, November 1983
- 1983 Colby College, Department of Biology, New York, September 1983
- 1983 State University of New York at Potsdam, Department of Biology, Potsdam, New York, April 1983
- 1983 Utica College of Syracuse University, Department of Biology, Utica, New York, March 1983
- 1982 American Society of Mammalogist Meeting, Brigham Young University, Snowbird, Utah, June 1982
- 1981 University of Massachusetts, Department of Biology, October 1981
- 1981 American Society of Mammalogist Meeting, Miami University, Oxford, Ohio, June 1981
- 1980 American Society of Mammalogist Meeting, University of Rhode Island, Kingston, June 1980
- 1979 Joint Meeting of the Society for the Study of Amphibians and Reptiles, Herpetologists' League, and American Society of Ichthyologists and Herpetologists, University of Tennessee, Knoxville, Tennessee, June 1979
- 1978 Society for the Study of Evolution, University of Georgia, Athens, Georgia, June 1978
- 1978 American Society of Mammalogist Meeting, University of Georgia, Athens, Georgia, June 1978 (Invited Symposium Speaker)
- 1978 Joint Meeting of the Society for the Study of Amphibians and Reptiles, Herpetologists' League, and American Society of Ichthyologists and Herpetologists, Arizona State University, Phoenix, Arizona, June 1978

- 1977 American Society of Mammalogist Meeting, Michigan State University,
East Lansing, Michigan, June 1977
- 1976 Boston University, Department of Biology, October 1976
- 1976 American Institute of Biological Sciences, Tulane University, New
Orleans, Louisiana, August 1976
- 1976 American Society of Mammalogist Meeting, Texas Tech University,
Lubbock, Texas, June 1976
- 1975 American Society of Mammalogist Meeting, University of Montana,
Missoula, Montana, June 1975
- 1974 American Society of Mammalogist Meeting, State University of New
York at Binghamton, June 1974
- 1973 American Society of Mammalogist Meeting, Asilomar Conference
Grounds, Pacific Grove, California, June 1973
- 1973 Southwestern Association of Naturalists Meeting, Kansas State
Teachers College, Emporia, Kansas, June 1973

Field Experience:

Pakistan, 7 field trips	India, 3 field trips
China, 2 field trips	Ghana, West Africa
Nicaragua, 3 field trips	Costa Rica
El Salvador	Mexico, 12 field trips
Hispaniola, 6 field trips	Cuba, 3 field trips
Jamaica, 2 field trips	St. Croix, 6 field trips
Bolivia	Argentina
Hawaii, 2 field trips	Alaska, 2 field trips
Southwestern US	Canada, most provinces
Northeastern US	Florida

STATE OF NEW HAMPSHIRE
SITE EVALUATION COMMITTEE

SEC Docket No. 2014-03

Motion of Granite Reliable Power, LLC
to Amend a Certificate of Site and Facility
with Request for Expedited Relief

Testimony of Christopher Gray

For
Peter Roth, Counsel for the Public, New Hampshire Department of Justice

September 15, 2014

1 **1. Please state your name, title, and professional address for the record.**

2 Christopher Gray, Master Student at the University of Vermont at Marsh Life Science
3 Building, 109 Carrigan Drive, Burlington, VT 05405

4
5 **2. Please briefly summarize your education and professional background.**

6 I received my Bachelor's degree from the University of Vermont in biology. I have been
7 working toward my Masters degree in biology at the University of Vermont for parts of 6
8 years and will be finishing my thesis this fall. My thesis title is "Investigating bobcat
9 population structuring using both microsatellite markers and mitochondrial D-loop
10 sequences". Analysis of molecular data collected for my thesis requires an understanding
11 of the natural history (distribution, life history, habitat preferences, etc.) of bobcat
12 populations to provide informed results.

13 I perform small mammal surveys during the summer at Colby Hill Ecological Project
14 (CHEP) in Lincoln, VT for Vermont Family Forests. This is a long term study of small
15 mammal diversity and species diversity as well as setting camera traps to observe the
16 diversity of mesomammals at the site. During the summer of 2011, I was an assistant to Dr.
17 Jan Decher on the small mammal survey and I have subsequently become the leader of the
18 small mammal survey for 2012, 2013, and 2014. Work at CHEP involves identifying
19 habitat types and understanding the mammal species frequently associated with those
20 habitat types.

21 I have also traveled to Liberia twice to perform small mammal surveys for a mining
22 company in 2010 and 2012. The first of the two trips I was the assistant to Dr. Jan Decher

1 and the second trip I was the survey leader with Dr. Jan Decher assisting me during the end
2 of the trip. The survey in 2010 was to investigate small mammal diversity. We captured an
3 endangered species during our first trip, so we were asked to return for a second survey to
4 see if we could find the endangered species outside of the area impacted by the mining.
5 This work involved describing rainforest habitats that were unfamiliar to me. In addition, it
6 was an entirely new set of small mammal fauna to become familiar with.

7

8 **3. Have you ever visited the Granite WindPark?**

9 Yes, I visited the Granite WindPark on 29 August 2014.

10

11 **4. Why did you participate in this site visit to Mt. Kelsey?**

12 I participated in the site visit to Mt. Kelsey because Dr. Kilpatrick was unable to attend.

13

14 **5. Please briefly summarize what you observed with regards to replantings that**
15 **were implemented prior to this summer compared to those that were**
16 **implemented this summer on Mt. Kelsey.**

17 The treatment implanted this summer was comprised of 4 or more inches of topsoil on the
18 roadway with 4 inches of wood chips/mulch on top with a combination of spruce and fir
19 trees planted in rows. The mulch on top was recommended to hold in moisture and to
20 prevent grasses and other herbs and forbs from colonizing the roadway. This treatment was
21 present only in areas where the previous roadway replanting had been rolled back due to
22 turbine repairs. The trees planted were all still alive although there were a small percentage

1 of them with needles that were yellow/red. The trees had only been planted 1-2 months
2 ago.

3 The treatment prior to this summer consisted of topsoil on the roadway on which the spruce
4 and fir trees were planted. The topsoil has allowed for the growth of grasses, herbs and
5 forbs, and even small coniferous and deciduous saplings to colonize in the year or so that
6 this treatment has been in place. The trees in this treatment were commonly browsed
7 especially near the tops. There were stretches in the replanting where over 50% of the trees
8 were dead and/or missing completely.

9 The roadway replanting implemented this summer was the entire 20 feet of the replanted
10 area for the first 500 feet. After the first 500 feet the new and old replanting treatments
11 were both in place in the approximate 20 feet of the replanted area. The newly
12 implemented replanting treatment was typically only 4-6 feet wide with 1 row of newly
13 planted trees, but on the corners, where the trucks had to swing wide, the rollback was up to
14 18 feet.

15

16 **6. Please summarize your observations of areas that were proposed for tier 1**
17 **planting of trees on Mt. Kelsey.**

18 The tier 1 planting areas that I observed were all located on the wind turbine pads. The tier
19 1 locations were yet to be replanted. The tier 1 areas had high levels of exposure to wind
20 and sun. The tier 1 locations were mostly flat gravel areas. The tier 1 location at pad 15
21 was a long flat mound of fist-sized rocks.

22

1 **7. Please summarize your observations of the areas that were proposed for tier 2**
2 **planting of trees on Mt. Kelsey.**

3 The tier 2 areas for planting were yet to be replanted. The tier 2 areas that I observed were
4 primarily locations where there was a lack of natural regrowth along the verges of the
5 roadway. The tier 2 locations were over varying slopes and varying substrates, from grass
6 covered verges to mulch/wood grindings.

7

8 **8. What was the approximate width of the road within the High Elevation Area**
9 **on Mt. Kelsey? What would be the resulting gap if the re-vegetation plan was**
10 **successful?**

11 The approximate roadway width was on average 12-15 feet. I was told that this variation
12 was due to the imprecise manner by which roadways are built. There is also a row of
13 boulders bordering the roadway, which typically is another 3-4 feet adjacent to the road.

14

15 **9. Please summarize your observations with regards to the forest edge along the**
16 **areas cleared for this windpark on Mt. Kelsey.**

17 The forest edge along the roadway had sections of dead trees. In those stretches, the first
18 row of trees along the edge was dead, likely from exposure to sun and wind. In those areas,
19 I regularly observed the leaves of the second row of trees were yellowing, which indicated
20 that those trees were stressed as well.

1 There was a finger of trees at pad 8 that came out between the pad and the roadway. This
2 finger of trees was exposed on 3 sides and all of those trees were dead, likely from
3 exposure to sun and wind.
4

5 **10. What opinions have you formed about the nature of the effects of the project**
6 **upon the natural environment on Mt. Kelsey?**

7 I believe that the project has exposed the natural environment on Mount Kelsey to a
8 number of issues. First and foremost is the reduction of valuable and unique high elevation
9 habitat, which is critical habitat for American Pine Marten populations. Second, the
10 roadways to the windpark and between the wind turbine pads allows for easy access of
11 coyotes, foxes, and other predators to move up Mount Kelsey and increase competition for
12 prey with the American Pine Marten.

13 In addition, the forest along the edge of the roadway shows significant signs of stress.

14 There were large stretches of trees along the edge of the roadway that were all dead in the
15 first row, and in some places several rows of trees were dead due to exposure to sun and
16 wind. There were also a number of places where the trees in the second or third rows were
17 still alive, but where the leaves/needles were yellowing showing the stress of exposure as
18 well.
19

1 **11. What value do the present mitigations or those proposed have for protection of**
2 **the natural environment on Mt. Kelsey?**

3 The roadway replanting implemented this summer with the mulch on top will reduce the
4 amount of grasses, herbs and forbs, and saplings, which was believed to be fostering
5 increased prey numbers and thus enticing movement of predators up the mountain. I do not
6 believe that the replanting implemented this summer in the rolled back areas will have a
7 large impact on the presence of predators. The verges of the roadway are typically wider
8 than the 20 feet of replanted roadway and are being colonized by grasses, herbs and forbs,
9 and saplings which will harbor prey populations and thus entice predators to move up the
10 mountain. I don't believe that the roadway replanting prior to this summer will greatly
11 increase the movement of predators versus the replanting strategy implemented this
12 summer.

13 The roadway replanting this summer also would appear to increase exposure to wind and
14 sun because of the lack of other plants (grasses, herbs and forbs, and saplings) around the
15 trees. In addition, succession works in stages with the fast growing colonizers such as
16 grasses, herbs and forbs, and saplings coming first, and then followed by establishment of
17 the natural forest species. I question whether the replanting treatment implemented this
18 summer will allow the habitat to skip the typical stages of recolonization and establish the
19 natural forest species because I don't believe much will be able to grow on the mulch for a
20 number of years.

21 The tier 1 areas are located on the wind turbine pads. These areas are highly exposed to
22 sun and wind. I question whether the trees scheduled for replanting those areas will survive

1 the harsh conditions. The tier 2 areas appear to be chosen because they are areas that are
2 not being colonized and thus might benefit from replanting.

3 The level of browsing observed is a large problem for the long term success of the
4 replanting efforts.

5

6 **12. What additional mitigations do you recommend for protection of the natural**
7 **environment upon Mt. Kelsey?**

8 I would recommend discontinuing the use of the replanting implemented this summer with
9 the mulch. I believe that replanting prior to this summer allows a more natural progression
10 of colonization of the disturbed areas. Based on the level of browsing observed on the
11 replanting prior this summer, increasing the number of trees in the replanting effort might
12 increase the number of trees that survive from year to year.

13

14 **13. Does this conclude your testimony?**

15 Yes, this concludes my testimony.

16

Curriculum Vitae

CURRICULUM VITAE CHRISTOPHER GRAY

University of Vermont
Marsh Life Science Building
109 Carrigan Drive, Room 305
Burlington, VT 05405
(802) 274-8824
cgray1@uvm.edu

EDUCATION

M. A. in Biology, University of Vermont, Burlington, VT expected December 2014

B. A. in Biology, University of Vermont, Burlington, VT 2008

ACADEMIC EXPERIENCE

Research Experience

Masters student, Department of Biology, University of Vermont, 2008-present

Investigating bobcat population structuring using both microsatellite markers and mitochondrial D-loop sequences.

Undergraduate student, Department of Biology, University of Vermont, 2007-2008

Gained laboratory experience for extraction of DNA and began preliminary work on bobcat mitochondrial D-loop sequencing.

Field Experience

Small Mammal Survey Team Leader, Grant from Vermont Department of Fish and Wildlife to Northwoods Stewardship Center, July-October 2008 & July-October 2009

- Trapped small mammals at 22 sites across central and southern Vermont of the two summer trapping seasons. Three nights of trapping per site with 100 traps set out each night.
- Familiar with Sherman live traps, Museum Special snap-traps, and pitfalls.
- Maintained trapline reports documenting each individual captured.
- Prepared study skins of any small mammals that perished and of any rarely trapped species.
- Managed and maintained trapping gear.
- Coordinated field work with volunteer assistants.
- Instructed inexperienced volunteers in the proper methods to prepare study skins.

Small Mammal Survey Team Member and Team Leader, Environmental Assessment of potential waste water and development areas surrounding Bromley Mountain Ski Area, June-September 2009

- Trapped small mammals at 6 sites in the immediate vicinity of Bromley Mountain Ski Area. Three nights of trapping per site with 100 traps set out each night.
- Set out and maintained camera traps in addition to Sherman live traps, Museum Special snap traps, and pitfalls.
- Set up bat nets at 2 sites, which were monitored during the evening hours.
- Maintained trapline reports documenting each individual captured and the surrounding environment.
- Prepared study skins of any small mammals that perished and of any rarely trapped species.
- Managed and maintained trapping gear.
- Coordinated field work with paid assistants.
- Instructed inexperienced team members in the proper methods to prepare study skins.

Small Mammal Survey Team Member, Environmental Assessment of potential mining and offset areas surrounding the Putu Mountain Range in Liberia, West Africa, October-November 2010

- Trapped small mammals at 6 sites in the immediate vicinity of Putu Iron Ore Mining Area. Three nights of trapping per site with 120-150 traps set out each night.
- Set out and maintained camera traps in addition to Sherman live traps, Museum Special snap traps, Tomahawk traps, and pitfalls.
- Maintained trapline reports documenting each individual captured and the surrounding environment.
- Prepared study skins of any small mammals that perished and of any rarely trapped species.
- Managed and maintained trapping gear.
- Instructed inexperienced Liberian counterpart in the proper methods to prepare study skins.

Small Mammal Survey Team Leader, Environmental Assessment of potential mining and offset areas surrounding the Putu Mountain Range in Liberia, West Africa, October-December 2012 focusing specifically on recapturing the Nimba Otter Shrew (*Micropotamogale lamottei*) which was captured on the initial survey in 2010

- Trapped small mammals at 6 sites in the immediate vicinity of Putu Iron Ore Mining Area and Sapu National Park. Three nights of trapping per site with 120-150 traps set out each night.
- Set out and maintained camera traps in addition to Minnow Traps, Sherman live traps, Museum Special snap traps, Tomahawk traps, and pitfalls.
- Maintained trapline reports documenting each individual captured and the surrounding environment.

- Prepared study skins of any small mammals that perished and of any rarely trapped species.
- Managed the logistics of camping out in the rainforest while trapping mammals.
- Instructed inexperienced Liberian counterpart in the proper methods to prepare study skins.

Small Mammal Survey Team Member and Team Leader, Survey for the Colby Hill Ecological Project, Lincoln and Bristol, Vermont, July-August 2011, 2012 (leader), 2013 (leader), 2014 (leader)

- Trapped small mammals at 4 ecosystem sites in the Guthrie-Bancroft parcel of Colby Hill. Three nights of trapping per site with 70 traps set out each night.
- Set out and maintained camera traps in addition to Sherman live traps and pitfalls.
- Maintained trapline reports documenting each individual captured and the surrounding environment.
- Prepared study skins of any small mammals that perished and of any rarely trapped species.
- Managed and maintained trapping gear.
- Instructed inexperienced assistant in the proper trapping methods as well as methods for preparing study skins.

Teaching Experience

Teaching Assistant, Mammalogy, University of Vermont, 2008-2010

- Attended lectures to refresh knowledge of mammalian families and up-to-date systematics.
- Taught two lab sections weekly which focused on identification of species, natural history, systematics, and phylogenetic methods.
- Gained familiarity with mammals of New England.
- Maintained the mammalogy teaching collection.
- Wrote quiz and practical questions.
- Graded quizzes, lab assignments, and lab reports.
- Instructed students how to properly prepare mammalian study skins.
- Supervised 2-3 field trips.

Teaching Assistant, Introductory Biology II, University of Vermont, 2008-2011

- Taught two lab sections weekly.
- Wrote quizzes, homework assignments, and practical quizzes.
- Graded quizzes, assignments, and lab reports.

Teaching Assistant, Population Genetics, University of Vermont, 2013

- Taught two lab sections weekly.
- Created the lab manual from scratch which required writing lab manuals, homework, created walk-throughs for various analysis software used, organized, manipulated and created data sets (mitochondrial sequence data and microsatellites) for different analysis methods, etc.
- Graded lab assignments.

WORK EXPERIENCE

Construction Inspector, Internship in the Department of Transportation, State of Vermont, May-August 2006 & 2007

- Became familiar with the plans for each project and State of Vermont's specifications for a number of different activities (pouring sidewalks and curbs, laying down pavement, etc) which the contractor's work crews were responsible for performing.
- After the work crews finished each specific task I was responsible for making sure that the work had been performed to the specifications set forth by the State of Vermont.
- Wrote daily reports on various work crews progress, calculated quantities of how much each crew performed daily which allowed the State of Vermont to pay the contractor for their work.

Package Handler, Part-time position, FedEx Ground, September 2011 – March 2012

- Physical labor to unload and load trucks and vans.

Overnight Stocker, Part-time position, Christmas Tree Shops, January 2012 – May 2012 and December 2013 – May 2014

- Stocking shelves with freight, which requires problem solving and working quickly and efficiently.

Delivery Driver, Part-time position, Dominos, April 2014 – current

- Delivering food, which requires handling money (cash and credit card slips) as well as customer service.
- Answering phones and serving carry-out customers.
- Minor food preparation activities.

PROFESSIONAL MEMBERSHIPS

The American Society of Mammalogists

REFERENCES

Bill Kilpatrick, Professor of Biology
University of Vermont
(802) 656-0453, C-William.Kilpatrick@uvm.edu

Jan Decher, Curator of Mammal Collections
Zoologisches Forschungsmuseum Alexander Koenig
Bonn, Germany
j.decher@zfmk.de

David Brynn
Vermont Family Forests
(802) 453-7728, info@familyforests.org