STATE OF VERMONT
PUBLIC SERVICE BOARD

Petition of Deerfield Wind, LLC, for a certificate of public good authorizing it to construct and operate up to a 45 MW wind generation facility, and associated transmission and interconnection facilities, comprised of between 15 and 24 wind turbines on approximately 80 acres in the Green Mountain National Forest, located in Searsburg and Readsboro, Vermont, with turbines to be placed both on the east side of Route 8 on the same ridgeline as the existing GMP Searsburg wind facility (Eastern Project Area) and along the ridgeline to the west of Route 8 in a northwesterly orientation (Western Project Area)	DOCKET NO. 7250

CORRECTED PREFILED TESTIMONY OF WILLIAM KILPATRICK

ON BEHALF OF SAVE VERMONT RIDGELINES and THE TOWN OF WILMINGTON

Dr. C. William Kilpatrick is an associate professor in the department of biology at the University of Vermont and a specialist in wildlife biology. Dr. Kilpatrick will provide testimony with regard to the potential impacts on the wildlife and wildlife habitat in the vicinity of the proposed Deerfield Wind industrial wind project resulting from the proposed wind turbines and associated activities identified in this petition.

Q1. Please state your name and occupation.

A1. C. William Kilpatrick, Associate Professor of Biology (Howard Professor of Zoology and Natural History) at the University of Vermont and owner and director of Northeastern Wildlife Genetics, Inc.

Q2. Have you previously filed testimony in this proceeding?

A2. No.

Q3. What is the purpose of your prefiled testimony?

A3. The Town of Wilmington and Save Vermont Ridgelines, Inc. have retained me to assess the impacts of the proposed Deerfield Wind Farm, being proposed by Deerfield Wind, LLC on wildlife and wildlife habitat pursuant to 30 V.S.A. 248 (b) (5).

Q4. Dr. Kilpatrick, can you describe for the Public Service Board your educational background?

A4. I received a Bachelor of Science and a Masters of Science from Midwestern State University in Wichita Falls, Texas, and a Ph.D. from North Texas State University in Denton, Texas.

Q5. Please describe for the Board your employment and teaching experience?

A5. I have been employed by the University of Vermont for 34 years. I am currently an Associate Professor in the Department of Biology and hold the Honorary Position as the Howard Professor of Zoology and Natural History. In addition, I am a member of the Graduate Faculty and Curator of Vertebrates of the Zadock Thompson Natural History Collections at the

University of Vermont. During the past 34 years at the University of Vermont, I have taught Introductory Biology, Genetics, Human Genetics, Evolution, Modern Evolutionary Theory, Comparative Vertebrate Anatomy, Mammalogy, Speciation and Phylogeny, Molecular Ecology, Molecular Techniques for Evolutionary and Ecological Studies, and a variety of Graduate Colloquia. My current teaching assignments include Mammalogy, Speciation and Phylogeny, Molecular Ecology, and a Forensic Biology Seminar. In addition, I have served as the major professor for 17 graduate students directing their dissertation and thesis research and have served on the studies and thesis committees of numerous other graduate students. My research laboratory has served as host to visiting scientists from several countries and provided research opportunities to numerous undergraduate students.

Q6. Please describe for the Board what types of projects and research you have led or participated in since 1980.

A6. Since 1980 my research laboratory has been retooled to a modern molecular laboratory capable of conducting DNA analyses. We use the same techniques that are used in human forensics to address ecological and evolutionary questions concerning other species of mammals. This research has included work on introduced populations of the small Asian mongoose, molecular ecology studies of fishers from New York and New England, studies of the genetic structure of New England black bears and molecular ecology of bobcat populations in Texas and Vermont. My laboratory has the expertise of genetic analyses from non-invasive collected materials such as hair, scat, and egg shells as well as more traditional invasively collected tissues.

Other work in the laboratory primarily addresses questions of evolutionary relationships of various groups of rodents. My laboratory did the DNA analysis on the recently described new family (now thought to be a living form of a family previously only known from fossils) of rodents from Laos. As part of these studies on rodent systematics I have conducted field work in Pakistan, India, China, Nicaragua, El Salvador, Costa Rica, Mexico, Ghana, and Cuba since 1980. In addition, members of my research lab have been contracted to conduct biodiversity studies of small mammals in West Africa (Ghana, Guinea, Sierra Leone, and Ivory Coast). In addition, my graduate students, research assistants and I have been involved in several mammal surveys in various areas of Vermont. Some of these are long-term studies in association with my mammalogy course but others have been contracted or supported by various agencies and organizations. This would include mammal surveys of the Nulhegan Basin and West Mountain Wildlife Management Area (2001), East Mountain (2005), Colby Hill Ecological Project in Lincoln and Bristol (2000 to present) Mt. Mansfield State Forest (2002, 2005) and the Army Corp of Engineers lands in Southeastern Vermont (2003).

Q7. Can you briefly list for the Board the publications you have authored and any associations or organizations in which you hold membership?

A7. I have published 54 peer reviewed papers, 11 book chapters, 4 other papers and I have prepared 14 reports. I have 3 additional papers or chapters in press, 4 other papers that are in review or revision, and 8 papers that are in preparation. I am a life member of the American Society of Mammalogists where I serve as the Chair of the Grants-in-Aid Committee (that awards about $84,000 annually to support the research of graduate students) and as a member of the Checklist Committee (that serves as the authors of Mammal Species of the World). I am also a member of seven additional Scientific Societies and I have served on the Board of Directors of the North American Symposium on Bat Research. In addition, I am the chair of the scientific advisory group for mammals for the Vermont Endangered Species Committee, I served on the Comprehensive Wildlife Conservation Strategy Mammal Team for the State, and I am active in the Northeastern Bat Working Group. My current curriculum vitae is attached as Exhibit SVR-WK-1 and is a more complete description of my qualifications and experience.

Q8. Dr. Kilpatrick, have you had an opportunity to review the prefiled testimony and exhibits submitted in this matter by Jeffrey A. Wallin?

A8. Yes, I have had the opportunity to review the prefiled direct testimony of Jeffrey Wallin and exhibits DFLD-JW-2 (a physical site assessment to map bear scarred beech (BSB) trees within 150 feet of the proposed turbine locations), DFDL-JW-3 (a sample plot study to determine density and distribution of bear scarred beech trees in Green Mountain National Forest management compartments surrounding the proposed project), DFDL-JW-4 (a summary report on previous research (Wallin 1998) into potential bear corridors in the vicinity of the Searsburg Wind Turbines), DFDL-JW-5 (2005 remote camera study), DFDL-JW-6 (overview map of black bear studies), DFDL-JW-7 (2006 remote camera study) and DFDL-JW-8 (estimated average Vermont bear populations).

Q9. Please explain to the Board what, if any, comments you have regarding Mr. Wallin's studies that serve as the basis of his conclusions that the proposed project is likely to have limited indirect impacts on bears and bear habitat.

A9. First, much of the data that Mr. Wallin has collected with regards to bear activity in the vicinity of the Searsburg Wind Farm anecdotal, that is, although it was observed in the vicinity of the wind turbines it is not known that at the time a scat was left or a beech tree was scarred that the closest or any turbine was operational. Thus, the detection of approximately a dozen BSB trees within 250 to 650 feet of the Searsburg facility does not demonstrate that any of these trees were scarred and thus visited during times when the turbines were operating. Likewise observations of bear activity in the form of tracks, scats and hair, although clearly indicating the presence of at least one bear visiting the site, provides no evidence as to whether the bear visited the site when turbines were active or when they were not active. Second, most of Mr. Wallin's studies have design problems, large or unknown experimental errors, and insufficient sample sizes to support the conclusions reached by Mr. Wallin based on these studies. In general, the results of Mr. Wallin's studies do not provide sufficient data collected in a manner to minimize experimental error that allows for hypothesis testing to address the objectives of the studies.

Q10. Dr. Kilpatrick, can you explain to the Board the problems with the design of Mr. Wallin's (1998) movement study of black bears in the vicinity of the Searsburg Wind Farm?

A10. Yes, the concern raised by the VDFW that this study was designed to address was whether the construction of the Searsburg Wind Farm would interfere with movement of black bears between blocks of beech habitat west of Route 8 and those in Lamb Brook Valley on the easterly side of the ridge upon which the turbines were erected. The original design of the study didn't allow clear interpretation of data collected to infer movement through the potential barrier (construction site or post-construction wind turbines). To determine preconstruction bear activity, a 3 mile long single strand of 15 gauge barbed wire was placed 23 inches from the ground on the NW side (along Sleepy Hollow Rd.) of the Searsburg construction site to be monitored for snags of bear hair from May to December of 1995. However, since the hair trap (strand of barbed wire) was located only on one side of the proposed construction site it is not clear that a hair snag equals a bear that transversed the site. A hair snag may very well represent a bear that crossed the hair trap but for what ever reason never crossed the ridge line.

In late August of 1995 the study was first modified and a second upper fence (strand of barbed wire 23 inches off of the ground) was added. Although this second hair trap was constructed about 1000 feet from the lower fence, it was still located on the same (NW) side of the proposed construction site. Thus even if snags of bear hair detected on both fences were assumed or were genetically determined to be from the same individual that still would not provide evidence to infer that a bear had transversed the area of interest (the ridge line).
The construction caused removal of sections of the hair trap and the second modification to the study occurred in 1996 when the hair traps (both upper and lower) were replaced with 12 gauge

barbed wire rather than the 15 gauge used in 1995. This change in the experimental design introduced an additional experimental error, that is the difference (in probability) between 15 gauge and 12 gauge wire in collecting a snag of hair from a bear crossing the wire. In an attempt to determine the experimental error introduced by changing wire gauge during the study, the study was further modified and a second run of wire (15 gauge) was placed 5 to 10 feet from and parallel to the lower fence (12 gauge). The difference in the hair snags collected between these two parallel hair traps only 5 to 10 feet apart was designed to estimate the difference in sampling probabilities between the two different gauges of wire.

Q11. Did the further modifications of the study design allow resolution of the introduced experimental error by changing wire gauge?

A11. No, the data collected by the parallel fences (hair traps) of different gauge wires (15 vs. 12 gauge) only 5 to 10 feet apart provided no estimate of the difference in sampling probability of 15 gauge vs.12 gauge wire. The number of hair snags found on the 12 gauge wire was identical to the number found on the 15 gauge wire, 4 each. However, the two fences never produced hair snags in the same sampling period (fences were inspected every two weeks for hair snags), thus in all 8 cases the bear sampled while crossing one fence was not sampled when crossing the other. These data are disturbing and bring to question the reliability of the basic experimental design of a single strand of barbed wire.

Although Mr. Wallin states that the success rate of snagging (inferred from the double fence) was as low as 50%, I would argue that it may be much lower. With a success rate of snagging of bear hair as a bear crossed a single fence of 50%, the expected probability of a bear getting snagged on both fences in the double fence experiment would be 25% and we would have expected 2 of the 8 bears that crossed the double fence to have left snags of both fences. Although the size of the data set obtained from the double fence is too small to allow an accurate estimation of the snagging probability, it could be much lower than 50% and an estimate of slightly above 35% is obtained based on the data provided. Thus, the experimental design of a single strand of barbed wire, regardless of gauge, 23 inches from the ground may have a detection probability as low as 35%.

Q12. How does the low detection probability effect the interpretation of the data obtained in this study?

A12. The idea detection probability in this study would be 100%, every time a bear crosses one of the fences it leaves a snag of hair. With a 100 % detection probability a sample of 10 snags on the lower fence and 4 on the upper fence would allow a reasonable inference that a number of bears that crossed the lower fence did not transverse the intervening area as they did not cross the upper fence. However, with a 50% or lower detection probability it is difficult to make any reasonable inference, as any difference in samples collected between the two fences might simply result from experimental error from the low probability of snagging.

Q13. Does this study contain other experimental errors that effects the interpretation of the data obtained?

A13. There are at least two other areas with experimental errors resulting in unknown detection probabilities. The first was discussed earlier, the difference in detection probabilities between 15 gauge and 12 gauge wire, if any, is unknown. The error rate in the identification of hair as being from a bear rather than some other mammal such as a moose is also unknown. Although two published keys (neither of which was peer reviewed) were identified as the sources for hair identification, the characteristics used to differentiate bear hair from other species were not specified. Hair identification is rather subjective even with a key and the error rate of misidentification is greater than zero. These unknown error rates and detection probabilities make the interpretation of the data presented more difficult.

Q14. Do you agree with the conclusions presented in Wallin (1998) and the conclusions reached by Mr. Wallin in his prefiled Direct Testimony based on that study?

A14. No. In Wallin (1998) the conclusion was that "These numbers appear to lead toward the conclusion that black bear behavior may have been disrupted during the peak construction, however, first year post-construction operation and maintenance of the wind turbines does not appear to disrupt historical movement patterns." He asserts in his prefiled testimony that the results of this study showed the number of bears falling dramatically during the year of construction but rebounding the first year following construction disturbance.

Given the experimental errors discussed above, but especially the low detection probability, there are many possible interpretations of the data obtained.

Data from Wallin (1998):

Year	1995	1996 (construction)	1997
Lower fence	11	1	8 (4*)
Upper fence	4**	5	13

* 8 snags reported but twice the length of fence thus sampling bias - reduce to number on any single lower fence

** 4 snags presented but sampling bias, underestimation as fence only operational from late August

Given the two sampling biases identified above, there are several ways to examine the data to remove those biases. First, constrain interpretation to the data that was collected during the same time period (September to December) and with the same sampling effort (upper fence) for all three years.

Year	1995	1996 (construction)	1997
Upper fence	4	5	7

Conclusion: no differences from pre-construction to post construction

Second, examine lower fence data for full sampling period but use only one of the lower parallel fences used in 1997:

Year	1995	1996 (construction)	1997
Lower fence	11	1	4

Conclusion: Post-construction level doesn't appear to return to pre-construction level. Substantial decrease in activity as post-construction activity is only 36 % of pre-construction activity.

Wallin (1998) was designed to measure the number of bears that transversed the area between the lower and upper fences. A snag on one fence was expected to result in a snag on the other fence within the same sampling period, thus indicating a bear had transversed the area. The number of multiple snags (snag on the upper and lower fences within a sampling period) is very low:

Year	1995	1996 (construction)	1997
Multiple snags	0	0	3*

* 3 shown in Table 1 of Wallin (1998) but only 2 indicated in text.

The sample sizes are much too small and the experimental errors and variables among years much too great to allow any conclusion other than some bears crossed the fence and were snagged. This study provides **no** data to support a conclusion that bear activity near an operating wind farm rebounded or returned to pre-construction levels.

Mr. Wallin and Mr. Parsons use the results of this study (Wallin 1998) as summarized in DFLD-JW-4 as the basis for their assumption that black bears will acclimate to operating wind farms and that bear activity will return to preconstruction levels following the decline of bear activity during the construction phase. This study also serves to support their assumption that operating wind farms will not have a substantial indirect impact on black bears. As outlined above this study provides no clear data that supports any of their assumptions or their conclusions.

Q15. Do you find any evidence presented by Mr. Wallin to support his conclusion that the project will not have any lasting indirect effects of travel corridors used by bears?

A15. No, the experimental design of Wallin (1998) can not provide any evidence that any bear transversed the ridgeline with the wind turbines as both the upper and lower fences (hair traps) are located on the same side of the project. Thus, his 1998 study (Wallin 1998) provides no information to demonstrate whether or not the erected wind turbines impacted the movement of bears through the Cemetery Crossing to transverse the ridge line to food sources on either side of the string of wind turbines.

The easterly expansion of the proposed project will potentially disrupt an identified travel corridor, known as the Forest Service Crossing, while the westerly expansion will potentially disrupt an identified travel corridor, known as the Powerline Crossing (DFLD-JW-4). However, Mr. Wallin is of the belief that the proposed project expansions which will now potentially disrupt three separate identified travel corridors will not have any lasting impacts on the use of these travel corridors. Science is based on data, not beliefs, and no data are presented by Mr. Wallin to support his belief that the existing project has not disrupted movement of bears through the Cemetery Crossing and that the proposed expansions will not disrupt movements of bears through two other identified travel corridors.

Q16. Do the camera studies conducted by Mr. Wallin support his conclusions that bear activity will likely return to preconstruction levels following a decline in activity during the construction phase and that the proposed operational wind facility will not have any long term indirect impacts on bears?

A16. While his remote camera studies (DFLD-JW-5 & DFLD-JW-7) do document the presence of wildlife near (within approximately 250 feet) a turbine (WT7) and do allow documentation of whether the visit by the wildlife species occurred during times when the turbine was operational or not operational, they do not justify his conclusions about the expected lack of indirect impacts. Although his data clearly documented that at least one or perhaps two bears have habituated to the activity and noise of the Searsburg Wind Farm, the data do not appear to support his conclusion of no expected indirect impacts on bear and other wildlife. It is important to look more closely at the photographic data presented from Mr. Wallin's camera studies for 2005 (DFLD-JW-5) and 2006 (DFLD-JW-7) for black bears. In 2005, a single photograph of a bear was obtained on the night of 6 November when wind turbine 7 was generating. In 2006, 7 photographs of bears were obtained, 5 when turbine 7 was operational and 2 when turbine 7 was not operational. The photograph of the sow and cub were obtained in the early morning hours of 17 July when turbine 7 was NOT operational. Although a total of 6 bear photos were taken when the closest turbine was operational and 2 were taken when the turbine was not operational, all 6 of the photos obtained while the turbine was operational may be of the same 1 or 2 bears that have habituated to the site. Although the data is very limited, it does suggest that other bears (sow with cub) are impacted by the wind turbines and only approach the area at times when the turbine is not operational.

The data collected by Mr. Wallin's camera studies has the potential to allow some evaluation of the potential impact of the indirect impacts of operational wind farms on various species of wildlife. However, additional data would be needed and current sample sizes are too small for a critical evaluation of most species. First, it is important to know the proportion of the time during the camera studies that wind turbine 7 was operational. This data is provided for the 2005 (DFLD-JW-5) camera study (turbine 7 was generating 80% of the time) but is not provided for the 2006 (DFLD-JW-7) camera study. Second, to better interpret the photographic data the noise level at the location of the camera is needed. The pre-construction noise contour mapping would suggest that the noise level near the camera location is 30-40 dB(A). With the data on the proportion of time the turbine nearest the camera was operating, it would be possible to test the photographic data to determine if the activity of a species was impacted by the turbine operation by determining if the proportion of photos taken during the time the turbine was not operational was greater than expected by chance. For the 2005 camera study (DFLD-JW-5) one would expect 80% of the photos to be taken during the time turbine 7 was operational and 20% of the photos to have been taken during times when turbine 7 was not operational if the turbine operation had no indirect impact on a given species of wildlife. Unfortunately, the sample sizes of photographs for any one species are not sufficient to allow statistical analysis.

Given the information available on body weights of female black bears and low cub to yearling survival rates of the southern Vermont bear population from Stratton Mountain Black Bear Study (Hammond 2002), it is clear that this southern Vermont black bear population faces nutritional challenges for its survival. Given our genetic analyses indication of the degree of isolation and substantially smaller population size of this southern Vermont bear population, further decline in the probability of reproductive success (production of young that survive to sexual maturity) in this population pushes the population closer to crossing a threshold of the level of reproductive success needed to maintain a viable population. Further fragmentation of the southern Vermont bear population and the direct and indirect loss of critical bear habitat by the proposed project will push this population closer to this threshold and endanger the survival of the southern Vermont black bear population. Once that threshold is crossed it will be difficult for the southern Vermont bear population to recover due in part to its isolation from bear populations to the north and to its already smaller population size.

Q17. Dr. Kilpatrick are you aware of any additional camera studies that have been conducted at the Searsburg Wind Facility?

A17. Yes, Mr. Wallin presented an update (JW-RB-09) to his ongoing 2006 camera study in his rebuttal testimony in Docket 7156 where he showed the location of a second camera situated between wind turbines 3 and 4 and reported 4 photos including 2 white-tailed deer and 2 moose (a cow and a bull) obtained between July 27 and August 12, 2006 from this camera. Although he did not provide any details as to the operation of the nearby turbines when the photos were collected, it was my understanding that this second camera would collect data through November.

Q18. Do you have an opinion about the validity of Mr. Wallin's conclusion that black bears will continue to utilize beech habitat located with ¼ to ½ miles of existing turbines based on his 2003 mapping of bear scarred beach trees (DFLD-JW-2)?

A18. While the detection of recent scarring of beech trees by bears does indicate the utilization of this habitat, the data presented by Mr. Wallin does not allow either a determination of the level of bear activity presently utilizing this habitat compared to the level of activity prior to construction of the Searsburg Wind Project or to determine if the activity is limited to one or two bears that have habituated to the facility. In addition, Mr. Wallin has no idea if the recent scarring of any tree occurred when the closest turbines were generation or when they were not generating.

The available data strongly indicates that the black bear utilization of beech stands within ¼ mile of roads or other human activities is negatively impacted with a means fidelity rating of 5.48 compared to beech stands within a ½ mile with a mean fidelity rating of 17.3, within 1 mile with a mean fidelity rating of 19.0 and greater than 1 mile with a mean fidelity rating of 20.7 (Hammond 2002). It is not clear why Mr. Wallin chooses to ignore this data that is presented in the Stratton Mountain Bear Study (Hammond, 2002) and to argue that there is no data to support indirect impacts on bear habitat for a distance of a ¼ mile. Given the lack of any substantial data contrary to the data presented by Hammond (2002), it is difficult to see how anyone can conclude that the noise and lights produced by wind turbines will not likely have an indirect impact on the utilization of bear habitat for a distance of ¼ mile or greater.

Q19. Do you agree with Mr. Wallin that the direct impact of the proposed project will not have an undue adverse impact on bears?

A19. Mr. Wallin suggests that the direct loss of 643 BSB trees as a result of the proposed project will not have an undue impact on the local bear population because this potential loss of BSB trees represents somewhere on the order of 2% of the total beech habitat in the area. First, it is not clear that Mr. Wallin has an objective criterion upon which he can determine the number of BSB that could be removed without having an adverse effect on the local bear population. He simply assumes that removal of approximately 2% of the habitat will not have an undue adverse effect and offers nothing more to support his conclusion than this estimate of the overall proportion of the habitat that will be directly impacted.

The 2% estimate of habitat directly impacted provided by Mr. Wallin is based on his average estimate of the amount of bear habitat in 4 surrounding forest compartments totaling approximately 5120 acres that contain an estimated 27,898 BSB trees. Mr. Wallin provides a 95% confidence interval for his estimate of the number of BSB in each of these 4 compartments (DFLD-JW-3) and based on those confidence intervals the amount of bear habitat directly impacted could be as small as less than 1% or greater than 4%. Within the statistical confidence of Mr. Wallin's study (DFLD-JW-3) the direct habitat loss of the proposed project could result in a loss of more the 4% of the bear habitat in the area.

In addition, Mr. Wallin fails to consider what proportion of the historical bear habitat of the region has already been lost due to road construction and other human activities. Thus, while the direct impact of the proposed project represents a 4% loss of the remaining habitat in the area, it may contribute to a total cumulative loss of 20% of the habitat over the past 50 years. It is clear that the westerly expansion proposed by this project is situated in an area of prime black bear habitat that contains thousands of BSB trees and Mr. Wallin presents no data to substantiate his belief that direct loss of 4% of the habitat will not have an undue adverse impact on bears.

Q20. Dr. Kilpatrick do you have any other comments about the studies conducted by Mr. Wallin that serve as the basis of his prefiled testimony?

A20. Yes, the study by Mr. Wallin and Dr. Capen (DFLD-JW-3) entitled "Study of Sample Plots to Determine Density and Distribution of Bear Scarred Beech Trees in Green Mountain National Forest Management Compartments 121, 122, 123, and 124", fails to provide needed details concerning the distribution of BSB trees within a ½ mile buffer of the proposed wind project. Although this study provides an estimate of the density of BSB trees in each of the four Management Compartment studies and demonstrates that the density of BSB trees is not uniform across the surrounding area of the proposed project, it does not provide information to determine if the distribution of BSB is clumped and thus occurring at a higher density along the ridgeline of the proposed westerly expansion. Information on the density of BSB within a ½ mile buffer on either side of the proposed turbine expansion is needed and was requested by the VFWD to better assess the direct and indirect impacts of the proposed project and especially the proposed westerly expansion. Although approximately 38 of the 120 random 1/3 acre plots (DFLD-JW-3) appear to be within approximately ½ mile of the proposed project expansions, those plots are not identified by number and the estimated density of BSB in each of those plots cannot be determined from the information provided.

Given the high average density of BSB (24/acre) and even higher local densities (33/acre) along the 300 foot buffer of the westerly proposed expansion surveyed by Mr. Wallin (DFLD-JW-2) compared to the average densities of BSB in the two surrounding Management Compartments (121 and 122) of 1.2 to 6 BSB/acre (upper 95% confidence estimate of 2.1 to 9.4 BSB/acre) (DFLD-JW-3), the available data suggest that the distribution of BSB is highly clumped along the ridgeline of the proposed westerly expansion. This apparent concentration of critical bear habitat along parts of the ridgeline of the proposed westerly expansion would increase the potential direct and indirect impact of the proposed project on black bears. Without additional data to the contrary, it is difficult to see how anyone could reach the conclusion that the proposed westerly expansion would not have a negative impact on this critical bear habitat and a negative impact on the use of this important regional habitat by black bears.

Q21. Is Mr. Wallin's conclusion that the proposed project will not result in an adverse impact on the local black bear population scientifically credible?

A21. I have a difficult time finding any scientific basis for Mr. Wallin's conclusions as they seem to be based on his beliefs rather than data or published studies. His studies appear to provide the basis of many of his opinions even though those studies, as discussed above, do not contain sufficient data to support his conclusions. It appears that Mr. Wallin's opinions are primarily based on his beliefs, anecdotal observations, and his unpublished studies and that he chooses to ignore or even discount published studies on black bears.

While male black bears may have home ranges that exceed 150 square miles as indicated by Mr. Wallin, they also may have substantially smaller home ranges. In Vermont, Hammond (2002) found that the home range of an adult male black bear averaged 61.6 square miles and ranged in size from 151.2 to 22.4 square miles, whereas the home ranges of adult females averaged 14 square miles and ranged from 28 to 4.8 square miles. Black bears, however, exhibit little spatial or temporal avoidance of each other and home ranges of both sexes often overlap (Horner and Powell 1990) the home ranges of other bears. Typically, the home ranges are larger in years with low food abundance and smaller in years with high food abundance (Lariviere 2001) and the home range data available for black bears in Vermont supports this trend of larger home ranges in years with relatively low food abundance (Hammond 2002). Subadult and adult male black bears in Vermont travel widely moving outside their home ranges by an average distance of nearly 14 Km whereas females (both adults and subadults) stay primarily in their home ranges during years when late summer and fall mast are available (Hammond 2002). However, during years with local food shortages, females abandon their home range in Vermont and move an average of over 14 Km and as much as 27 Km to find food (Hammond 2002).

It is this proportion of the population, females moving outside of their home range in search of food that would especially be impacted by the proposed project. These are non-resident bears and would not have habituated to the wind turbines but are traveling to historical regional bear habitat (concentrated BSB stands) in search of food. The proposed wind project would have directly destroyed as much as 4% of that critical habitat for bears in search of food, and the noise and lights from the operating wind farm will likely prevent habitat utilization of these food resources for a distance of at least ¼ mile. Although a few resident bears may have habituated to the activities of the operating wind farm, the non-resident bears (including both male and female animals) would likely avoid use of a ¼ mile buffer along the proposed westerly expansion that consists of over 560 acres of critical prime bear habitat that likely contains over 10,000 BSB trees. The proposed easterly expansion would likely have an indirect impact of avoidance of some 370 acres of habitat containing more than 1000 BSB trees. It is difficult to imagine how the loss of such a large area of critical bear habitat containing such a large number of BSB trees would not have a substantial and noticeable impact on the regional bear population.

Q22. Mr. Wallin is skeptical of the importance of beechnuts as a necessary resource for bear populations. He argues that beechnuts are not a necessary resource for black bear populations as this food resource is not a reliable nutritional source for black bears in Vermont. Do you agree with Mr. Wallin's skepticism about the importance of beechnuts as a necessary resource for bear populations and do you find any scientific basis for his conclusion that because of the lack of reliability of this resource (beechnuts) it is not critical to the survival of black bear populations?

A22. Mr. Wallin's skepticism of the importance of beechnuts as a necessary resource for Vermont black bear populations appears to stem from three sources of information. First, his observations and records of the frequency of beechnut crops. Second, the data presented by Hammond (2002) that cubs were born each year regardless of the previous year's beechnut crop. Finally, data taken from the VFWD (DFLD-JW-8) on the estimated average bear population size. Clearly, beechnut crops are not produced at the same proportions annually. In some years there will be an abundance of beechnuts and in other years relatively few beechnuts. The beechnut crop is variable from year to year and when beechnuts production is low, black bears utilize other sources of food in addition to beechnuts by expanding the size of their home range and even abandoning their home range to travel greater distances in search of food. With this increase in the size of the home range and the increase in daily movement comes addition energy expenditure and increased risk of mortality. The observation that the beechnut crop is not abundant every year does not falsify or allow one to reject a hypothesis that beechnuts are a critical resource for Vermont black bears.

Mr. Wallin also points to the data reported by Hammond (2002; Table 4.2) that shows that cubs were produced in every year of the study regardless of the quality of the beechnut crop. If we examine the other data presented in Table 4.2 (Hammond 2002), it shows that of the 23 cubs monitored during the study, only 6 of those cubs survived to den with their mother as yearlings. This is a mean survivorship for the first year of life of only 17.6 % indicating that the majority of the cubs born (83%) do not survive to become yearlings. Although the data presented by Hammond (2002) show neither evidence of female synchronized cub production to years following good mass production nor increased survivorship of cubs following years of good mass protections, the sample sizes are relatively small (17 litters, 23 cubs) and the study is relatively short. Numerous studies including Clark et al. (2005), Elowe and Dodge (1989), McLaughlin et al. (1992), and Schooley (1990) have demonstrated that the availability of hard mass (acorns and/or beechnuts) affects age of first reproduction, productivity, and cub survival. McLaughlin et al. (1992) and Schooley (1990) have demonstrated the importance of beechnuts to cub production in Maine and McLaughlin (1998) expressed concern of a decline in reproductive rates with the decline of beech trees.

Mr. Wallin also points to DFLD-JW-8, a graph depicting the change in the estimated size of the black bear population in Vermont since 1983 as a source of data that support his skepticism of the importance of beechnuts as a necessary resource for Vermont black bear populations. Mr. Wallin interprets this graph (DFLD-JW-8) to show that the size of the Vermont black bear population continues to grow despite the variation in the quality of the beechnut crop. While the trend presented by the graph certainly depicts a nearly continued population growth with a couple of brief declines, the data upon which the graph is based do not provide statistical support for much if any population growth. First, the error bars shown on the graph are 80% confidence intervals rather than the traditional 95% confidence intervals. If 95% confidence intervals were depicted, then each line would be something on the order of 30% longer. With the 95% confidence intervals depicted, then estimates would only be significantly different if their error bars didn't overlap. Thus, there is no statistical significance to the differences in the estimated population size of the Vermont black bear population between any two adjacent five year estimates. Furthermore, the mean estimate of the population size based on the 1983-1987 harvest data of approximately 3300 bears is not statistically significant from the size based on the 2000-2004 harvest data of a little over 5000. That is both of these estimates of population size could have been obtained from the same population with our 95% confidence interval and therefore do not statistically support any population growth. Thus, the data graphed in DFLD-JW-8 does not support any significant population growth of the size of the black bear population over the period sampled.

In my opinion there is strong scientific evidence to support the conclusion that beechnuts are a necessary resource for the survival of Vermont black bear populations. In the following discussion I will show the stages in the reproductive cycle where beechnuts and other hard mast provide a critical resource necessary to the survival of the population. In order for a population to survive (maintain a rather constant population size) each mated pair of individuals must on average replace themselves. For relatively long-lived animals (black bears can live up to 23 years in the wild) with relatively low annual survivorship, this replacement is probably best considered as producing replacements that survive to reproductive age. Since black bears are promiscuous a single male may sire multiple females, however, multiple mating is practiced by both sexes. Thus, because of the male promiscuity each mating on average may produce something less than two replacements and still maintain a stable population size. Female black bears reach sexual maturity at 2-8 years of age and the age of first reproduction has been shown related to the availability of hard mast in the fall. Thus, the availability of beechnuts in the fall will allow younger females to reach sexual maturity the following spring and thus begin their reproductive quest of replacement. Annual survivorship differs between males and females because of behavioral differences of the two sexes. Black bears have male biased dispersal, where males tend to disperse from their natal range (area where they were born) and as a result have a higher mortality rate and thus a lower survival rate. Female black bears are philopatric, meaning that female offspring tend to establish home ranges adjacent or even overlapping portions of the natal home range. As a result of the philopatry and their lack of dispersal, females have lower mortality rates and higher annual survivorship. Although there are regional differences in mean annual survivorship of males and females, for the eastern United States it is on the order of 59% for males and 87% for females (Hellgren and Vaughan 1989). With regard to a reproductive female that has mated during the summer, if there is a good beechnut crop in the fall she will enter hibernation with a higher body weight and her cubs that will be born in January and February will have a higher probability of surviving that first year to enter hibernation the following year with her as yearlings. If there is not a good beechnut crop that fall, she will enter hibernation with a lower body weight and even though she may give birth in January or February her cubs have a lower probability of surviving that first year. A reproductive female whose cubs do not survive to yearlings has a 75% chance of surviving to mate and give birth with a 2 year breeding interval, a 57% chance of surviving to her third breeding interval, a 43% chance of making her 4^{th} breeding interval and so on. The availability of beechnuts impacts the age at which she reaches sexual maturity (age of first reproduction) and the probability that cubs will survive to become yearlings. Loss of beech habitat will increase the average time required for female black bears to reach sexual maturity and will further decrease the survival rate of cubs to yearlings. In my opinion, it would not take much of a further decline in the mean survivorship of cubs to yearlings before local black bear populations in southern Vermont would begin to decline in numbers.

Q23. Have you had a chance to review the prefiled direct testimony of Mr. Jeffrey Parsons?

A23. Yes, I have reviewed Mr. Parsons prefiled direct testimony and his assessment of the potential direst and indirect impacts to black bears at the proposed Deerfield Wind Farm based on his literature review (DFLD-JP-2).

Q24. Dr. Kilpatrick do you have any comments regarding the literature review conducted by Mr. Parsons?

A24. While it is unclear to me why Mr. Parsons included information on grizzly and brown bears (*Ursus arctos*) in his literature review rather than restricting the review to American black bear (*Ursus americanus*); my major concern is the rather large amounts of literature that Mr. Parsons' search of electronic databases failed to find. In a very quick search of the UVM electronic databases, I identified a number of papers on black bears that seemed relevant to the objectives of Mr. Parsons' literature review. In addition, Mr. Parsons failed to indicate that he was aware of two major reviews on the effects of roads on wildlife (Adams and Geis 1981, Forman and Alexander 1998) or any of the literature on the effects of noise on wildlife. His review also appeared to be limited specifically to bears and failed to include examples of impacts that had been identified in other species that might be applicable to black bears.

Q25. Does Mr. Parsons' prefiled direct testimony provide any data or information to support his opinion that the proposed project will not result in any permanent displacement or avoidance by black bears?

A25. No, Mr. Parsons' opinion appears to be based on the prefiled testimony of Mr. Wallin and the studies conducted by Mr. Wallin in the vicinity of the Searsburg Wind Farm. He fails to refer to any statement or reference in his literature review or testimony which demonstrates how the information contained in this report (DFLD-JP-2) support his or Mr. Wallin's opinions and conclusions.

Q26. Dr. Kilpatrick have you had the opportunity to review Mr. Hammond's prefiled direct testimony?

A26. Yes, I have reviewed Mr. Hammond's prefiled direct testimony.

Q27. Mr. Hammond testified to some research conducted in your laboratory that suggest bears living south of State Highway 11 may form a population that is genetically distinct from bears in other parts of the state. Could you describe that research to the board?

A27. Over the past 10 years I have had a number of undergraduate and graduate students work on a genetic study of black bears in Vermont. The study started as a technique problem of extracting DNA from the roots of hairs, however, preliminary data suggested a considerable amount of genetic structuring within the Vermont black bear populations. We have now examined genetic variation at a mitochondrial marker known as the D-loop, a DNA profile (fingerprint) based on 5 microsatellite nuclear markers, and are able to identify the sex of a bear from the gender markers in the DNA of a single hair. Our current genetic analysis of the mitochondrial D-loop from samples of approximately 150 bears has identified 7 different genetic patterns, known as haplotypes, among bears sampled from the state. The distribution of these haplotypes indicates considerable subdivision of the Vermont black bear population as shown in Exhibit SVR/Wilmington-WK-2. As you will note, haplotype 4 is only found in southern Vermont, haplotype 2 is found only in the central portions of the Green Mountains, haplotype 1 predominantly in the northern Green Mountains and in the northern portion of the southern Green Mountains and haplotype 3 in the Northeast Kingdom. We have also sampled back bears from western Massachusetts, New Hampshire and central Maine. The same haplotype 4 that is restricted to southern Vermont also occurs in the Berkshires of western Massachusetts. We conducted a statistical analysis, known as nested clade analysis, on this haplotype data. That analysis shows that the distribution of haplotype 4 in southern Vermont and the Berkshires and haplotype 2 in the central Green Mountains are significantly restricted in their distributions. Furthermore, we examined the pattern of genetic substructuring of the Vermont black bear populations and it's relation to major roads and we could not exclude roads as being a major contributing factor to the current structuring. In our estimates of gene flow between areas bounded by major roads we found that the number of female migrants across Route 9 was on the order of 0.7 migrants per generation or only about 0.14 migrant a year.

Q28 What is the significance of this research?

A28. Our genetic analysis indicates the bear population in the state does not consists of a single large freely interbreeding population but rather several partially isolated populations. One of the partially isolated populations of black bears is found in southern Vermont (south of Route 11) and extends down into the Berkshires of western Massachusetts. Genetic analysis of samples from this southern Vermont bear population indicate that the size of this population is substantially smaller in numbers than bear populations found in central and northern Vermont. The significance of this research is that our analyses indicate that the black bear population in southern Vermont is genetically isolated to some degree from bear populations to the north and has a substantially smaller population size. Thus, because of the smaller population size this population of southern Vermont bears is more vulnerable to loss of habitat, and southern Vermont is in danger of becoming an ecological sink for black bears. An ecological sink is an area where a population can not maintain itself through reproduction and the presence of the species is only maintained by migration (immigration) of individuals (predominantly males in bears) from other populations.

Given the information available on body weights of female black bears and low cub to yearling survival rates of the southern Vermont bear population from Stratton Mountain Black Bear Study (Hammond 2002), it is clear that this southern Vermont black bear population faces nutritional challenges for its survival. Given our genetic analyses indication of the degree of isolation and substantially smaller population size of this southern Vermont bear population, further decline in the probability of reproductive success (production of young that survive to sexual maturity) in this population pushes the population closer to crossing a threshold of the level of reproductive success needed to maintain a viable population. Further fragmentation of the southern Vermont bear population and the direct and indirect loss of critical bear habitat by the proposed project will push this population closer to this threshold and endanger the survival of the southern Vermont black bear population. Once that threshold is crossed it will be difficult for the southern Vermont bear population to recover due in part to its isolation from bear populations to the north and to its already smaller population size.

Q29. Do you agree with Mr. Hammond's conclusion that the project as currently proposed would result in significant adverse impact on black bear habitat?

A29. Yes, Mr. Hammond presents a review of the literature including his own work in southern Vermont that clearly demonstrates and documents the dependence of black bears on concentrated stands of American beech as an essential high nutrient food that directly affects reproductive success of black bear populations. This is a more extensive discussion of the significance of beechnuts on reproductive success than I have discussed above.

Given the well documented affects of beechnuts on reproductive success of the population, the documented current low reproductive success of black bear populations in southern Vermont (Hammond 2002), and our genetic work that indicates both the genetic uniqueness of the southern Vermont and Berkshire black bear population and the apparent reduction in gene flow in the vicinity of Route 9 with bear populations to the north, it is clear that the direct impact resulting in the removal of over 600 BSB trees and the indirect impact of making thousand more unavailable to the bear population of this region would cause undue adverse long-term harm to the black bear population of southern Vermont.

Q30. What is the definition of critical wildlife habitat in Vermont under Act 250?

A30. Critical wildlife habitat is defined under Vermont's Act 250 as a concentrated habitat which is identifiable and is demonstrated as being decisive to the survival of a wildlife species at a particular period in its life including breeding and migratory periods.

Q31. What is critical wildlife habitat for bears in Vermont?

A31. Critical habitat for black bears in Vermont includes mast producing forest stands (beech, hickory, cherry, and oaks), forested wetlands, and travel corridors that allow for movement of bears among patches of seasonally important foods. Although travel corridors are necessary habitat for bears, they often are not concentrated and are difficult to identify. Most of the available information about the location of bear travel corridors has been inferred from location where bears frequently attempt to cross roads. Forested wetlands utilized by bears and bear scarred beech stands, however, are concentrated identifiable habitats that are well documented as being necessary habitats for the survival of bears in eastern North America. Beechnuts are an important, necessary resource for reproductive success and survival of bear populations.

Q32. Dr. Kilpatrick what are the necessary wildlife habitats for black bears?

A32. Necessary habitat for black bears in Vermont includes large blocks of forest with mast producing stands (beech, hickory, cherry, and oaks), forested wetlands; secluded habitat with suitable denning sites; and extensive connectivity among forest habitats to allow for movements of bears among patches of seasonally important foods. Beech stands are a necessary habitat for black bears. Although black bears may survive during periods when beechnut production is not abundant, reproductive success rates and cub to yearling survival rates have been clearly demonstrated to be dependent on beechnut production. Thus, beech stands are necessary habitat for the survival of bear populations in Vermont and are especially critical to the survival of the bear population in southern Vermont.

Furthermore the utilization of beech habitat by bears is relatively easy to document by the scarring of the beech trees when bears climb the trees to reach the beechnuts. Concentrated areas of American beech trees with a history of bear feeding as demonstrated by scarring clearly represents "necessary wildlife habitat" as defined by Act 250. As outlined above this habitat is critical to the long-term survival and reproductive success of bear populations in Vermont.

Vermont's Comprehensive Wildlife Conservation Strategy (2005) designates a list of mammals as "species with the greatest conservation needs (SGCN)" and the black bear is among the species with greatest conservation needs. Although this species appears to be secure at the present moment, it is at risk of survival over the next 20 to 30 years due to the loss of critical habitat and population declines due to habitat loss and other factors. Currently an average of 6500 acres of wildlife habitat is lost to development in Vermont each year.

Q33. What would be the impact of the loss of the southern Vermont black bear population?

A33. The loss of a black bear population from southern Vermont would have two major impacts on black bear populations of the region. First, this would further fragment the connectivity among bear populations of western Massachusetts and central Vermont making populations in each of the areas more susceptible to habitat alterations and changes and decreasing the probability of long-term survival of those populations. Second, this would result in the conversion of productive (reproductively) bear habitat in southern Vermont to an ecological sink. Increase in the amount of sink habitat is an indicator in the decline in the quantity and quality of habitat for a species.

This fragmentation and habitat loss would impact other species of wildlife, such as moose, by further isolation of wildlife habitat and further reduction in the size and connectivity of these patches of forest habitat. The areas in the vicinity of Route 4 to the north, already seriously disrupts the connectivity of bear habitat as well as connectivity of forested habitat for other species of wildlife.

Due primarily to conscious choices made by the citizens of Vermont over the past 100 years, many species of wildlife (including white-tailed deer, moose, black bear, fisher, bobcats, and turkey) have recovered or have been restored to pre-settlement levels. This abundance of wildlife is a part of the appeal and attraction of Vermont. Wildlife brings revenue into the state in the terms of hunting, wildlife viewing, and tourism. Presence or proximity to wildlife is now a common feature list in the description of property when it is placed on the market. My own experiences working as a ranger-naturalist in Yellowstone National Park for four summers, where over 2 million people visited during each summer in large part to view wildlife; and from conducting wildlife studies in the Nulhegan Basin of Vermont, where car loads of people hoping to see a moose could be seen every evening near Notch Pond Road; clearly demonstrate to me the wide interest and appeal of viewing and experiencing wildlife by the public. Vermont is presently at a crossroad where economic forces and development pressures are increasing. The potential for significant habitat destruction over the next few years is high and decisions made about development and habitat protection will impact the long-term viability of the black bear and other charismatic species in Vermont. The loss of these wildlife species from the Vermont landscape will greatly reduce the allure and appeal the currently draws visitors to Vermont.

The loss of black bears from southern Vermont will be a signal that Vermont has begun a trajectory of losses of wildlife habitat at a rate that impacts the long-term survival of populations of wildlife. This will be a sad event for the Vermont's citizenry for even though human development drastically impacted wildlife populations in the 1700 and 1800's these losses occurred because the impact on wildlife was not known or consciously considered. Future losses, however, will be the results of conscious decisions that the conservation of identifiable wildlife habitat that is critical to the survival of a population (and thus the long-term survival of that population) were not as important as the needs of a relatively few humans.

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