Redington Wind Farm

Redington Pond Range, Maine

Section 7: Wildlife and Fisheries

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1.0 Introduction

The purpose of this section is to describe and characterize the existing landscape and ecological setting of the project area, assess the potential effects of the proposed project, describe impact avoidance and minimization strategies, and propose potential mitigation and monitoring options for the project. This section has been prepared using a variety of data sources that include a series of comprehensive field surveys conducted over a 10 year period, published literature, and State records.

Ecological investigations of the proposed Redington Wind Farm began in 1993 with preliminary investigations of the dominant land uses and habitats in the areas around Redington Mountain and Black Nubble. A fall raptor migration survey was also conducted. Additional, more detailed field investigations ensued in 1994 and 2002 on Redington Mountain, in 2000 and 2003 along the proposed transmission line system, and from 2001 to 2002 on Black Nubble. Additionally, some site-specific field investigations occurred in 2004 and 2005 along proposed road and transmission line alignments and a bat detector survey was conducted in late summer and fall of 2005.

The affected project area is fairly limited and includes only those areas with Redington Wind Farm project elements. This includes a narrow ridgetop band across the summits of the Redington Mountain and Black Nubble parcels, transmission line corridors, and road alignments (Figure 7-1). Most of these project components are very finite features on the landscape, occurring as very narrow, linear features. As such, a relatively small acreage of land is ultimately affected. Additionally, a variety of sensitive natural features, such as streams and permanent water bodies (e.g., beaver flowages), have been avoided to the extent practicable during the project design. The result is a fairly limited number of regulated ecological resources that occur immediately within the project area. However, where appropriate, diverse wildlife species that could pass through the project area at various times have been identified and their affected habitats described.

This permit application section has been formatted to describe each of the major ecological resources in the vicinity of the project area. It begins with a brief description of the ecological setting of the project area, including important regional landscape characteristics that dictate the composition of plant and animal communities in the area. Natural plant communities occurring within the project area are then described, followed by descriptions of each of the major vertebrate wildlife groups, including fish, reptiles and amphibians, birds, and mammals. Following that is a description of potential impacts of the project on the protected natural resources. Finally, a section detailing potential impact avoidance, minimization, and mitigation strategies is included. Discussion of how the project fulfills the requirements set forth by the Maine Land Use Regulatory Committee (LURC, Chapter 10.25, E.2.a) is included within each major section and at the conclusion of the document.

2.0 Ecological Setting of Project area

The project area is situated largely within Redington Township and Carrabassett Valley in Franklin County, Maine. The entire region is generally undeveloped and dominated by a working industrial forest and mountainous landscape (Figure 7-2). Elevations in the general vicinity of the project area range from approximately 2,200 feet at Nash Stream to 4,010 feet at the Redington Mountain summit. Other, larger peaks in the region include Sugarloaf (4,250 ft), Crocker Mountain (4,228 ft), Bigelow Mountain (4,145 ft), and Spaulding Mountain (4,010 ft). The project area is within the Western Mountain Biophysical Region of Maine, which is characterized by cool summers, low annual precipitation, and high snowfall. Average maximum July temperature is the lowest in Maine (75º F) except for the Eastern Coastal region. Average minimum winter temperature (-1º F) is comparable to that of northern Maine. Typical lower and middle elevation soils are somewhat deep and poorly drained coarse loamy soils. Upper elevation (>2,500 ft) soils are generally well drained, cold, and acidic. Shallow saddleback soils occur on ridgetops (McMahon 1990).

Photo 1. Hillside clearcuts in Carrabassett Valley Township

A combination of forest communities occur in the area. Stands of balsam fir[1] dominate elevations above 2,500 feet, while stands of birch, maple, and American beech are more dominant along lower elevation slopes and valleys. Two events in recent decades—the outbreak of spruce budworm in the 1970s and subsequent industrial timber harvesting activities—have greatly influenced regional forest characteristics. All but the upper mountain regions have been influenced by past and

[1] Scientific names to all plants mentioned in the text are provided in Appendix A and scientific names to all animals mentioned are provided in the species-habitat matrix in Appendix B.

current timber harvesting activities (Photo 1), while even higher elevations were affected by the spruce budworm. Both measures have ultimately affected the composition of the forest, particularly by reducing the amount of spruce in lower elevation stands and converting large areas of mixed forest to younger and more uniform fir stands (Photo 2).

Photo 2. Areas of mixed forest converted to young softwood forest east of Redington Mountain (note remnant dead hardwoods above dense softwood regeneration).

The principal waterways draining the vicinity of the project area are Nash Stream, Stony Brook, and the South Branch of the Carrabassett River (Figure 7-2). Nash Stream flows from the project area, northward, to the South Branch of the Dead River, approximately eight miles north of the Black Nubble summit. Branches of Nash Stream reach elevations of about 2,635 feet from east of the Black Nubble summit and about 2,800 feet west of it, where several small ponds outlet to the West Branch of Nash Stream. Stony Brook reaches elevations of approximately 2,900 feet on the north slope of Crocker Mountain and flows northward to Stratton Brook, which, in turn, flows into Flagstaff Lake. The proposed 115 kV transmission line corridor crosses Stony Brook and its tributaries. The South Branch of the Carrabassett River flows from Caribou Pond, just east of Redington Mountain, north and east, around Sugarloaf Mountain before turning southward.

3.0 Natural Communities and Wetlands

Natural community surveys were conducted within the project area in 1994, 2000, and 2003. Surveys included investigations of terrestrial and wetland habitats and were conducted on Redington Mountain (1994), Black Nubble (2001), and the proposed 115 kV transmission line corridor (2000). Other field surveys conducted in 1993, 1995, and 2003 included the collection of additional information on the natural communities in the project area.

3.1 Methods

A natural community is an assemblage of interacting plants and animals and their common environment, recurring across the landscape, in which the effects of recent human intervention are minimal (Gawler 2001). Natural communities, therefore, serve as convenient categories to characterize site ecosystems and to identify predictable wildlife assemblages. Natural communities are most easily and commonly identified by their unique combination of dominant plants.

Natural communities were classified according to Maine Natural Areas Program's (MNAP) most recent classification system (Gawler and Cutko 2004). Some parts of the project area clearly did not meet the above definition of a natural community due to recent timber harvesting activities. These areas were subsequently classified as regenerating forest stands. Furthermore, areas that were originally classified using an older MNAP classification system (this included Redington Mountain and the proposed transmission line) were re-classified, as needed, according to any changes in community classification criteria.

Additionally, natural community classifications tend to be very broad compared to other habitat classification conventions. For example, several different types of wetlands, as classified using the United States Fish and Wildlife Service classification (Cowardin *et al.* 1979), may be included within one MNAP natural community. Consequently, wetlands in the project area, while technically being variations within other types of natural communities, are specifically addressed in subsection 3.2.7 of this report.

Surveys on Redington Mountain were originally conducted over approximately 16 person-days in September and October 1993. The following year, additional resource studies were conducted (e.g., wetland mapping, rare plant surveys, small mammal trapping, breeding bird surveys) and included continued collection of habitat and natural community related data. An additional round of field surveys were conducted in June of 2002 and included 6 person-days of field effort. Natural community surveys were originally conducted on Black Nubble in September and October 2001 and totaled 20 person-days. Field surveys conducted in 2002 accounted for nearly 30 additional person-days spent in the project area.

For Redington Mountain and Black Nubble, aerial photographs were used to locate each ridgeline and preliminarily identify the natural communities. Subsequent field surveys included traveling along each ridgeline to identify, map, and characterize natural communities and other natural resources on a qualitative basis, including wetlands. Notes on the dominant plants, tree heights, hydrology, signs of wildlife use, and physical characteristics were recorded (Photo 3). Photos were also taken to document typical habitat characteristics and to illustrate important natural community features. Some habitat boundaries and other more notable features were surveyed using a global positioning system (GPS) receiver. Wetlands were identified, characterized, and located using GPS.

Photo 3. Natural community surveys were conducted along both ridgelines.

Photo 4. Natural community surveys along the proposed 115 kV transmission line corridor were conducted largely in clearcuts and areas of heavy selection harvest, as these plant communities dominated the lower elevations.

As with the ridgetop work, natural communities and protected natural resources along the proposed 115 kV transmission line alignment, including freshwater wetlands, streams, and brooks, were identified, photographed, and qualitatively assessed (Photo 4). Dominant plant species and hydrologic conditions were recorded for each wetland and for each major upland natural community type encountered along the proposed right-of-way. Wildlife observations were also recorded. Field surveys were conducted during approximately 9 person-days in September 2000 and 4 person-days in November 2003.

3.2 Natural Community Descriptions

The occurrence and composition of natural communities in the project area are largely driven by topography, and are very typical of the western Maine mountain region. Wetland habitats are essentially limited to valley bottoms and occasional isolated basins. Perennial streams are limited to the lowest slopes and valley bottoms, while intermittent streams occur on side slopes throughout mid-elevation areas. Side slopes of valleys and lower slopes of mountains are dominated by northern hardwood species, including American beech, yellow birch, and sugar maple. As elevation increases, the

Photo 5. The distribution of natural communities is largely driven by elevation and exposure, as seen here on the northeast slope of Black Nubble. Note predominance of hardwood and mixed forests at low and mid-elevations and softwood forests at the highest elevations.

incidence of red spruce, and then balsam fir, increases. Most higher elevations are vegetated with a predominantly coniferous forest dominated by balsam fir and scattered red spruce, with the hardwood canopy component being largely limited to heartleaved paper birch and mountain ash (Photo 5).

Photo 6. Clearcut above 3,000 ft on the northeast slope of Black Nubble.

The plant communities are also highly altered in some areas, largely in the form of active and past timber harvesting activities. Old and recent clearcuts and shelterwood cuts are common throughout the project area, leaving large open areas with relatively sparse canopies. Clearcuts and selection cuts are generally common below 2,700 feet. However, numerous cuts do occur as far up as 3,200 feet in elevation along some of the slopes of Black Nubble (Photo 6) and 3,500 feet on Redington Mountain.

Following is a description of the natural communities observed in the project area. It is divided into two categories: *Terrestrial Communities* and *Wetlands and Streams*.

3.2.1 Terrestrial Communities

Four natural community types typical of western Maine occurred in the vicinity of the ridgetop project areas of Redington Mountain and Black Nubble: Beech-Birch-Maple Forest, Spruce-Northern Hardwood Forest, Spruce-Fir-Wood Sorrel-Feathermoss Forest, and Fir-Heartleaved Birch Subalpine Forest (Figures 7-3 and 7-4). All four of these communities occur within the Spruce-Fir-Northern Hardwoods Forest Ecosystem of Maine (Gawler and Cutko 2004).

Regenerating conifer and mixed forest stands, resulting from past and ongoing clearcut activities, are very common along the sideslopes of the mountains, between lower elevation beech-birch-maple forest and higher elevation fir-heartleaved birch subalpine forest.

Beech-birch-maple forests were dominant at lower elevations and, as elevation increased, the percentage of softwood occurrence increased due to physical conditions of the environment and forest harvest practices. Spruce-northern hardwood forests served as transitional forests between beech-birch-maple forests and the higher subalpine communities.

3.2.2 Beech-Birch-Maple Forest

This forest type was originally included under a broader classification called Northern Hardwood Forest (MNAP 1991). Beech-birch-maple forests are most common at elevations below 2,300 feet around the bases of the mountains, on the lower valley side slopes, and on higher, protected slopes. This hardwood forest type also occurs as strips in smaller depressions and stream valleys between 2,300 feet to 2,700 feet, but was not very common at higher elevations (Figure 7-4). It is one of the more common forested natural communities associated with the proposed transmission line corridor, though harvesting activities have significantly altered the plant species composition in most areas.

Photo 7. Beech-birch-maple forests typically have an open understory with a uniform, low herbaceous layer. Shrub development varies from sparse to dense stands of hobblebush.

Dominant canopy trees in this community include sugar maple, red maple, American beech, and yellow birch. Striped maple is a dominant sub-canopy and shrub species. Hobblebush, mountain maple, and red-berried elder are also common shrubs. The herb layer is typically dominated by partridgeberry, evergreen wood fern, bracken fern, bluebead lily, common wood-sorrel, and whorled aster (Photo 7). As elevation increases, balsam fir becomes a more common component of this community type.

Many of the beech-birch-maple forest stands of the project area have been affected by harvesting activities. Where harvesting has occurred, these usually shaded forests contain relatively open canopies that in turn tend to support species not commonly associated with mature hardwood forests, including wild red raspberry and a wide array of herbaceous species (Photo 8).

Photo 8. Heavy selection cut in a beech-birch-maple forest. Note dense raspberry thickets (light green and tan patches) throughout the understory.

3.2.3 Spruce-Northern Hardwood Forest

Spruce-northern hardwood forest is the transitional natural community between the lower elevation beech-birch-maple forests and higher elevation softwood-dominated communities. It is assumed that many of the regenerating conifer areas at elevations mainly below 2,700 feet were once spruce-northern hardwood forests. It is currently more common surrounding Black Nubble than Redington Mountain due to lower elevations and slightly less disturbance (Figure 7-3). Where this community type is still intact, the canopy is a mixture between hardwood (birch, beech, and maple) and softwood (mainly spruce) species with a variety of shrub and herb species (Photo 9).

Photo 9. Spruce-northern hardwood forest on a mid- to upper-elevation slope. At its highest elevations, the hardwood component of this community is often dominated by yellow birch, as seen here.

3.2.4 Spruce-Fir-Mountain Sorrel-Feathermoss Forest

This is a very common natural community in Maine. It occurs on the side slopes of both Redington Mountain and Black Nubble but does not typically reach the ridgetops. It occurs at elevations to approximately 2,800 feet on the south facing ridgeline of Black Nubble and up to 3,200 feet around Redington Mountain (Figures 7-3 and 7-4). These forests typically have a closed canopy with red spruce being dominant and balsam fir being common. The understory is sparse and contains conifer litter, mosses, and occasional northern forest herbs such as common wood-sorrel, bluebead lily, and goldthread (Photo 10). These forests usually occur on very acidic soils (Gawler and Cutko 2004). This community was formerly included within a much broader classification, Subalpine Spruce-Fir Forest, in the 1991 MNAP classification (MNAP 1991).

Photo 10. Spruce-fir-mountain sorrel-feathermoss forest. Note the lack of understory shrubs and low live branches. Herb layer is mostly wood-sorrel and goldthread, with occasional wood fern.

3.2.5 Fir-Heartleaved Birch Subalpine Forest

This community is the dominant forest type on the peak and ridgeline areas above 2,700 feet (Figures 7-3 and 7-4). It also was formerly included in the broader 1991 Subalpine Spruce-Fir Forest classification (MNAP 1991). However, since it is a more unique example of high elevation forests within Maine, it has since been identified as a separate community type. This community has an S3 state ranking and is considered rare with roughly 20 – 100 occurrences statewide (Gawler and Cutko 2004). In western Maine, however, it is relatively common (Figure 7-2). The S3 ranking, therefore, is more of an indication of the relative rarity within Maine of the ecological conditions that foster the development of this community, namely high elevations and a cold climate. These conditions promote the development of this forest community and limit the existence of most other northern forest plant species.

Fir-heartleaved birch subalpine forests occur throughout the project area and is the only community documented at the peak and highest ridgelines of Redington Mountain and Black Nubble. Parts of some lower ridgelines and slopes also contain a great deal of this community as well, although clearcutting has limited its lowest extent, where it would naturally grade into other types of spruce and fir dominated forests and spruce-northern hardwood forests. Balsam fir and heartleaved paper birch are the common canopy species, although red spruce and mountain ash also commonly occur. Canopy heights of this forest type increase as elevation decreases. At the summit of both mountains, the canopy height is generally less than 25 feet tall and significant signs of wind stress (i.e., stunting, wind flagged trees, blowdowns) occur, and the ground layer is often covered by a low-uniform layer of mosses (Photo 11). On lower ridgeline areas and more protected lower slopes, wind damage is less severe and tree heights average 40 to 50 feet.

Photo 11. Fir-heartleaved birch subalpine forest at peak of Black Nubble.

Soils in this community are typically very shallow, often characterized by a very thin layer of coarse-grained sand and fine gravel, overlain by a moss layer from which the canopy trees grow. Tree blowdowns are common and show the prevalence of coarse, rocky materials immediately below the thin soil (Photo 12).

Photo 12. Typical wind blown tree. Note the shallow root system of the tree itself and the coarse, rocky soil immediately below it.

This forest and other similar spruce communities experienced outbreaks of spruce budworm disease in the late 1970s. The result of this was widespread mortality of mature trees that today has created an abundance of hard and soft snags, downed woody debris, and an extremely thick development of balsam fir regeneration (Photo 13). Much of the regeneration is currently 6 to 15 feet in height, depending on site exposure, elevation, and original degree of mortality.

Photo 13. Area of historic budworm-induced tree mortality. Note the abundance of standing and downed timber and dense regeneration.

Understory development varies in this community, depending on canopy characteristics. Where the canopy is broken, such as within blowdowns, herbs, shrubs, and regenerating canopy trees are often very dense and dominant plants include balsam fir, mountain ash, heartleaved paper birch, red raspberry, evergreen wood fern, and wild sarsaparilla. Other areas with senescing large trees have an abundance of natural canopy openings, resulting in a large amount of filtered sunlight on the ground. These areas tend to have a well-developed herbaceous layer of wood fern and whorled aster along with seedlings of the canopy trees (Photo 14). Where the canopy is complete, understory development is sparse and often limited only to carpets of forest mosses, particularly red-stemmed moss and hairy-cap moss, with occasional goldthread, bunchberry, and wood-sorrel.

Photo 14. Left: Tall fir-heartleaved birch community with an abundance of natural canopy openings. Note the well-developed herbaceous layer. Right: Similar community with a dense canopy and very little ground cover.

Fir waves are an unusual expression of this community (Gawler 2001) and were observed in the project area. Fir waves are more common on the upper slopes of Redington Mountain than on Black Nubble, where only small areas of canopy loss occur immediately northwest of the summit. However, fir waves on nearby Crocker Mountain (Photo 15) are much more typical than any of those observed on the project area ridgelines. On the ground, fir waves often resemble blowdown areas in that a large number of wind-thrown and standing dead trees occur, which then allows for the development of dense herbaceous and shrub layers (Photo 16).

Photo 15. Fir waves on the southwest face of Crocker Mountain. These are generally much less developed on Redington Mountain (the northwest ridge of Redington is visible in mid-field of this photo) and nearly non-existent on Black Nubble.

Photo 16. Typical conditions in a fir wave area. Note standing and fallen timber and dense regeneration.

3.2.6 Regenerating Forest Stands

Regenerating forest stands occur throughout the project area, on the mid and low elevation slopes (Figures 7-3 and 7-4). These are typically clearcuts and heavy selection cuts that are being actively managed to promote softwood growth (Photo 17). Most areas are well to over stocked with fir and scattered spruce regeneration ranging from 3 to 15 feet in height, though very recent clearcuts frequently have little vegetation at all (Photo 18). A large proportion of the clearcuts surrounding Black Nubble appear to be less than 10 years old and occur most commonly below 3,000 feet in elevation. These young forest stands east of Redington Mountain appear approximately 10 to12 years old while those on the west and north side of Redington Mountain are 1 to 5 years old.

Photo 17. Left: Clearcut east of Redington Mountain. Redington Mountain is in the mid-ground immediately left of the large clearcut. (The southern peak of Redington Mountain is located at the top of the snowy slope on the left. The slope with obvious fir waves beyond the clearcut is the southern side of Crocker Mountain). Right: Clearcut high on the northeast slope of Black Nubble. Regeneration is primarily red spruce and balsam fir and raspberries are locally common.

Photo 18. Three shots of different industrial harvesting practices with different ages and stocking levels. Left: recent clearcut. Middle: 6- to 9-year-old clearcut with moderate stocking. Right: 10- to 12-year-old former shelterwood harvest with dense stocking.

Some harvested areas are heavy shelterwood cuts, where much of the forest canopy is removed but residual trees are initially left to enhance regeneration efforts and later killed. These cuts typically occur at lower elevations, where hardwoods are generally more common. Consequently, the understory often consists of hardwood regeneration; particularly stump sprouts of the canopy species (Photo 19). These types of cuts were very common along the proposed 115 kV transmission line corridor.

Photo 19. Heavy selection cut east of Nash Stream, along the proposed 115 kV transmission line corridor.

3.2.7 Wetlands and Streams

This section provides a summary of the general wetland resources in the vicinity of the project area. It is not intended to provided detailed descriptions of wetlands impacted by the proposed development. Wetland impacts are provided in subsection 9.0 of this report.

Wetlands and streams are generally limited natural resources in the vicinity of the project area. This is largely due to the mountainous topography of the region. They occur in valley bottoms and isolated depressions and beaver flowages can be common in valley bottoms. Side slope groundwater discharge does create sloping wet woods in discrete areas. These areas, however, are generally very intermittent and typically develop into small intermittent stream channels that flow down side slopes in the project area. Once these intermittent channels have formed, they often consist of a simple, narrow scoured channel with a mineral bottom and often do not have wetlands associated with them.

Ridgetop project areas of Black Nubble and Redington Mountain contain very few wetland resources while the proposed transmission line corridor, which occurs at lower elevations, crosses a variety of wetlands and streams (Figures 7-3 through 7-5). Three forested wetlands are located on the Redington Mountain ridgeline, at the saddle of the ridgeline (Figure 7-3). These are dominated by balsam fir and black spruce. Canopy characteristics differ between these wetlands. Those with a closed canopy have very little herbaceous vegetation besides mosses (Photo 20) while those that are open have more developed ground cover. The herb layer in this latter type largely consists of a mat of sphagnum moss, with goldthread, sedges, and grasses (Photo 21).

Photo 20. Forested wetland atop Redington Mountain. Herbaceous layer is largely mosses and sedge species.

Photo 21. Forested wetland atop Redington Mountain. This wetland contains a relatively open, fir-dominated canopy with a thick mat of Sphagnum mosses and mixed sedge species. Standing water is seasonally present.

Forested wetlands are the predominant wetland type in the vicinity of the Black Nubble ridgelines as well (Woodlot Alternatives, Inc. 2001). These wetlands largely occur as small seeps and basin depressions and are limited to the southwestern ridgeline. Canopies consist mainly of balsam fir with some mountain ash and red maple. Typically, the understory contains balsam fir, hobblebush, red spruce, red maple, and speckled alder. Common herbs include evergreen wood fern, mountain wood fern, wood-sorrel, whorled aster, wool grass, bunchberry, soft rush, short-tailed rush, sensitive fern, and three-seeded sedge. The moss *Sphagnum girgensohnii* is common in most of these wetlands and forms carpets that remain moist throughout the summer and early fall.

In contrast to the two ridgelines, more than 30 wetlands were identified within or near the proposed transmission line corridor alignments investigated since 2000. These wetlands typically include isolated basins or hillside seeps associated with perennial and intermittent stream channels. The majority of wetlands consist of low shelves along small stream channels, floodplains along Stony Brook and Nash Stream, and groundwater discharge sites along side slopes. These wetlands are almost exclusively forested wetlands in varying states of succession (Cowardin *et al.* 1979), as many occurred in areas that had been harvested. Other wetland types include scrub-shrub wetlands dominated by speckled alder and are limited to streamside floodplains along Nash Stream.

Typically, forested wetland communities include a mixed canopy dominated by red maple, yellow birch, and balsam fir. The understory consists of tree saplings and shrubs such as witch hazel, hobblebush, mountain maple, and fly honeysuckle. Commonly occurring wetland herbs include evergreen and mountain wood ferns, lady fern, long beech fern, wood-sorrel, dwarf raspberry, drooping sedge, rough sedge, and whorled aster. Wetland hydrology in the forested systems is largely driven by groundwater discharge that effectively saturates the typically shallow soils in this area. Most wetlands identified were saturated to the surface during the September 2000 field investigations.

Scrub-shrub wetlands along the proposed 115 kV transmission line exist as inclusions within larger forested wetlands, or as independent communities along streams where soils and periodic flooding prevent substantial tree growth. Scrub-shrub communities are dominated by speckled alder with red-berried elder and common red raspberry. Commonly occurring herbs include sensitive fern, ostrich fern, common horsetail, and tall meadow rue.

Although generally limited within the Redington Mountain and Black Nubble study sites, intermittent streams are the most common surface water features observed in these two areas. Intermittent streams are often not continual and frequently stop where water flows underground and re-emerges further downhill. Most channels are narrow and unvegetated, although some mosses and late season herbaceous species (wetland and upland species) sometimes occur in the rocky, scoured channels of these features. They do not occur on any ridgetop habitats of Redington Mountain or Black Nubble but instead are observed on the mid-slopes leading up to the ridgelines.

The proposed transmission line corridor contains significantly more streams and wetlands than the ridgeline project areas. Most of the streams observed are intermittent. Many of these have narrow forested floodplain wetlands associated with them, although many consist of a simple, narrow channel (frequently as little 1-ft wide) carved into the hillside slopes (Photo 22). Stony

Photo 22. Example of small intermittent flowage within right-of-way.

Brook and a tributary to it represent two perennial streams crossing the proposed right-of-way, near its northern end (Figure 7-5). Nash Stream is the largest perennial stream encountered and several branches of Nash Stream are located at the lowest elevations, in the valley bottoms east of Black Nubble.

4.0 Fish and Fisheries

Year-round fish habitat in the vicinity of the project area is limited to several perennial streams located in the valleys and low areas surrounding the project area. Most of the streams located in the project area itself are small intermittent stream drainages that form the headwaters of the larger perennial streams located in the valley bottoms. These stream habitats were assessed regarding suitability for fish and fisheries. Field surveys focused on habitat, but included incidental observations made during surveys.

4.1 Methods

4.1.1 Habitat Assessment and Agency Consultation

Topographic maps and aerial photos were used to identify stream channels and other bodies of water that could potentially provide fish habitat in the project area. As part of the habitat assessment and community characterization, the Maine Department of Inland Fisheries and Wildlife (MDIFW) was contacted to identify any significant fisheries resources or fisheries habitat in the project area.

4.1.2 Field Surveys

Field surveys were conducted to confirm the conditions of streams and drainages providing potential fish habitat. All streams encountered in field surveys were described, mapped, and qualitatively assessed for suitability as fish habitat.

4.2 Fish Community Characterization

The immediate project area consists primarily of ridgeline habitats and lacks perennial stream habitat. However, the West Branch of Nash Stream begins southwest of the summit of Black Nubble. The main branch of Nash Stream begins as several tributaries that flow between Redington Mountain and Black Nubble. Other mapped streams in the vicinity of the project area include Stony Brook, which is slightly smaller than Nash Stream and is located northwest of Crocker Mountain, and the South Branch of the Carrabassett River, located to the east of Redington Mountain (Figure 7-6). All of these streams likely support populations of other species, particularly small species such as dace, minnows, and shiners.

MDIFW has indicated that Nash Stream supports a wild brook trout (*Salvelinus fontinalis*) fishery (see Appendix C). Although MDIFW cited only Nash Stream as supporting a wild brook trout fishery, it is likely that Stony Brook and the South Branch of Carrabassett Valley also support brook trout. Brook trout depend on cold, clear water for successful spawning and typically spawn in sandy or gravelly substrates within cold streams. MDIFW expressed concern that activities associated with the transmission corridor could endanger the integrity of the stream habitat and emphasized the need for a vegetated buffer surrounding the riparian zone. The proposed route of the transmission corridor has since been relocated so as to avoid the Nash Stream corridor, as discussed in subsections 9.3 and 9.4 of this report.

Field surveys confirmed that perennial streams were located only in the valley bottoms in the vicinity of the project area. Intermittent streams are present in the project area itself, but do not constitute suitable year-round fish habitat. However, these streams form the headwaters of the larger perennial streams found in the lower valleys and provide inherent value by seasonally supplying clean water to the larger perennial streams and may be used for short periods of time when flowing. These streams tend to have relatively steep gradients and rocky substrates and probably provide temporary fish habitat. While surveys targeting fish were not conducted, one small brook trout was observed on the eastern slopes of Redington Mountain in 1994. The fish was swimming in a flooded skidder rut (within a clearcut area) that drained into an unnamed tributary flowing into Caribou Pond, which eventually drained into the South Branch of the Carrabassett River.

4.3 Summary and Conclusions

MDIFW indicated that Nash Stream supports a wild brook trout fishery. Additional streams that could support brook trout include Stoney Brook and the South Branch of the Carrabassett River, including Caribou Pond. These streams are headwater streams and are essentially undeveloped in the vicinity of the project area. Therefore, they provide important habitat for trout and a variety of other fishes that could include minnows, shiners, and dace.

This project is expected to have no direct or indirect impacts on fish species or their habitat. Whereas initial project designs included several crossings of Nash Stream by a 115 kV transmission line, as well as a substation that would impact the wetland bordering the stream, these features have been relocated away from the stream and associated wetlands. Although the current design does include limited vegetation clearing within wetlands bordering perennial streams associated with road and transmission line crossings, the project will result in no undue adverse impact on fisheries resources on a local or regional scale.

5.0 Reptiles and Amphibians

The principal goal of reptile and amphibian field investigations was to characterize the existing reptile and amphibian populations in the project area in order to address potential impacts on these animals associated with the development of the Redington Wind Farm. This was accomplished by identifying the dominant natural communities in the project area, assessing the quality of those habitats, and conducting surveys to document the presence of these species within the project area.

To characterize the community, a literature review of local species distribution and habitat requirements was conducted along with the collection of field data. Field data collected as part of any targeted search were used in conjunction with incidental observations of these species made during the course of other field investigations.

5.1 General Community Description

In general, Redington Mountain and Black Nubble provide limited opportunities for most reptile and amphibian populations. This is largely due to the cold climate and dominant habitats in which the project area occurs. As mentioned above, the Redington Wind Farm project has been designed to avoid many of the areas that would provide the best habitat for these species. Only the most common, hardy snakes occur in the project area, with the eastern garter snake being the most frequent. Due to the lack of aquatic habitat, no turtles occur within the project area.

Significantly more amphibians occur within the project area. The northern redback salamander is one of the most common vertebrates in the northeast. It is one of only two amphibian species in the area that does not require water for egg laying. As such, populations of this species are not dependant on the distribution of aquatic habitats, resulting in the common occurrence in a wide variety of habitat types and ecological settings. The northern dusky salamander also lays terrestrial eggs, but these must be very close to aquatic habitat, as the larvae are fully aquatic once they move to water during the first few days of life. This behavior limits the distribution of northern dusky salamanders to areas near suitable larval stream habitat, which is largely only along the proposed transmission lines. The only other common salamander species in the project area are two lined salamanders, which use streams for nesting and larval maturation.

Frogs and toads are much more mobile than salamanders. Consequently, many more species occur farther from aquatic breeding habitats. Both wood frogs and American toads occur along the project area summit ridgelines. Both species breed in temporary water bodies such as vernal pools but may also use deep skidder ruts and ditches of logging roads. Other species prefer to use more permanent water bodies, such as beaver flowages. These species, therefore, are more common at lower elevations where preferred habitats are located.

5.2 Methods

5.2.1 Species-Habitat Association

To establish both a list of species expected to occur in the project area and an evaluation of the likelihood that a species would be found in a particular habitat, a species-habitat matrix was generated for the project area. Vegetation community types were first identified by aerial photo interpretation and visits to the project area. Local and regional references were then used to establish a list of species that could potentially be found in the project area (DeGraaf and Yamasaki 2001, Hunter *et al.* 1999, Ernst *et al*. 1994, Petranka 1998). The resulting species-habitat matrix (Appendix B Table 1) includes only those species expected to occur in the "footprint" of the project area, where wind turbines, roads, and transmission lines are to be located. The project area was also evaluated in order to assess the possible presence of any rare or endangered reptile and amphibian species.

5.2.2 Incidental Observations

Reptile and amphibian presence was documented during field surveys in 1994, 2000, 2001, and 2002. These surveys largely included incidental observations made during the course of other field investigations or simply while traveling through the project area. However, some limited targeted surveys were conducted and included searches under logs and rocks and within streams. These surveys provided an opportunity to confirm the presence of reptiles and amphibians and to assess the likelihood that certain species would be found in the project area. All species observed were recorded, as were notes regarding the habitat and condition of the individuals. Although survey times and methods differed between Redington Mountain and Black Nubble, reptile and amphibian populations were expected to be comparable between the sites, due to the proximity of the sites to one another and the similarity of habitat types between the sites.

5.3 Results

The species-habitat matrix (Appendix B Table 1) identifies 3 species of reptiles and 10 species of amphibians that could reasonably be expected to occur in the project development area. This represents those areas for which wind turbines, roads, and transmission lines have been proposed. During the design of the project, some high value ecological resources, such as major rivers, ponds, and beaver flowages, were purposely avoided. Consequently, many species of reptiles and amphibians that occur regionally in these types of habitat were not listed. Included are the turtles and some of the more common frogs that use permanent water.

The three reptiles expected to occur in the project area are all snakes: eastern garter snake, northern ringneck snake, and northern redbelly snake. Only the eastern garter snake was observed during field surveys. This species was observed at a high elevation on Black Nubble as well as along the proposed 115 kV transmission line near Stony Brook.

Seven of the 10 species of amphibians expected to occur in the project area (American toad, wood frog, green frog, pickerel frog, northern redback salamander, northern dusky salamander, and northern two-lined salamander) were observed during field investigations. The wood frog, American toad, and northern redback salamander were observed on the ridgelines of Black Nubble and Redington Mountain, as well as at lower elevations along the proposed transmission lines. Northern two-lined salamander larvae were observed in Nash Stream at several locations and a northern dusky salamander was observed in an un-named stream near Black Nubble. Finally, a single green frog and a single pickerel frog were observed outside of the formal project area, near wetland habitats on the lower slopes of Black Nubble. While the project area is not located adjacent to any suspected breeding or overwintering sites for green and pickerel frogs, some project features, such as roadways, are within the terrestrial dispersal range of these species.

5.4 Summary and Conclusions

Amphibian and reptile populations are expected to be limited within the higher elevations of the project area. Only a very few species are expected to occur along the ridgelines of Black Nubble and Redington Mountain. Instead, these populations are expected to be centered around the intermittent and perennial stream habitat that is more commonly available at lower elevations and stream valleys.

The current project design has resulted in avoidance and minimization of impacts on wetland habitats, which would be the most critical habitats to amphibians within the project area. Reptile species in the project area are limited to three common snake species, which have generalist habitat requirements. Impacts on amphibians and reptiles will be limited to the construction of road and transmission line corridors, and will not constitute undue adverse impacts.

6.0 Birds

The bird community in the project area was investigated periodically over 5 years during 1993 to 2003. The principal goal was to characterize the existing bird populations in the project area in order to address potential impacts on these animals associated with the development of the Redington Wind Farm. This was accomplished by identifying the dominant natural communities in the project area, assessing the quality of those habitats, and conducting surveys to document the presence of these species within the project area. Some targeted field surveys were conducted to accomplish this task, including breeding bird surveys, spring and fall hawk migration counts, golden eagle surveys, and a series of various songbird migration surveys. These targeted surveys were conducted in various capacities in 1993, 1994, and again in 2002.

To characterize the community, a literature review of local species distribution and habitat requirements was conducted along with the collection of field data. Field data collected as part of any targeted search were used in conjunction with incidental observations of these species made during the course of other field investigations.

6.1 General Community Description

Coniferous forests dominate the ridgelines and higher elevations in the project area, whereas deciduous beech-birch-maple forests occupy the lower valleys. A majority of the lower elevation areas have been harvested historically and are in various states of successional development. Due to the harsh climate of the upper elevations and the wider range of habitats occurring at lower elevations, the bird community at lower elevations is richer than that at higher elevations. However, the unique habitat characteristics of the upper elevations provide habitat for a number of species adapted specifically to those high elevation habitats in Maine.

6.1.1 Game Birds and Waterfowl

Because the project area lacks significant sources of permanent aquatic habitat, waterfowl were not included in the species-habitat matrix. It is possible that various species of waterfowl could migrate through or over the region, but it is unlikely that they would inhabit the project area for any length of time, even during migration. The ruffed grouse and spruce grouse, on the other hand, are quite common in the project area. The spruce grouse is generally not common in Maine, but is locally common in the project area and in higher elevation habitats in the forested western mountains of Maine. American woodcock are present in the project area, particularly in regenerating, lower elevation forests.

6.1.2 Raptors and Owls

While the species within this group have various feeding strategies, they all depend largely upon small mammals and songbirds for food. Regenerating softwood stands provide important foraging habitat for some of these species, due to the open canopy and higher density of prey sources. These species typically prefer to nest in relatively undisturbed forest habitats, with nest sites most likely occurring in areas with a high, dense, mature forest canopy. The breeding population of raptors and owls in the upper elevations of the project area is likely fairly small as the overall densities are relatively low for these species on a unit area basis.

6.1.3 Forest Birds and Songbirds

Forest birds and songbirds are by far the most common types of birds in the project area. The upper elevation ridgelines are inhabited by a number of species preferring softwood habitats. Some of the more common species include black-capped chickadee, boreal chickadee, golden-crowned kinglet, red-breasted nuthatches, Swainson’s thrush, winter wren, blackpoll warbler, yellow-rumped warbler, and dark-eyed junco. Other less common species include gray jay, Bicknell’s thrush, and yellow-bellied flycatcher.

Habitats lower on the mountainsides and in the valley bottoms provide a more structurally diverse set of habitats and, consequently, support more avian species. White-throated sparrows are perhaps the most common species in early successional forest stands, as well as in higher elevation blowdowns. Yellow warblers, common yellowthroats, song sparrows, and Lincoln’s sparrows can also be very common in young stands while American redstarts, Canada warblers, and chestnut-sided warblers are common in slightly older areas. Lower elevation forested areas provide habitat for many more species. Species commonly occurring in these hardwood and mixed forest areas include hermit thrush, eastern wood pewee, least flycatcher, blue-headed vireo, red-eyed vireo, white-breasted nuthatch, Nashville warbler, Tennessee warbler, northern parula, black-and-white warbler, black-throated blue warbler, black-throated green warbler, and ovenbird.

Woodpeckers are more common at lower elevations, where larger trees are available for nesting. However, some species commonly occur at the higher elevations in the project area. Downy and hairy woodpeckers are particularly common and black-backed woodpeckers are routinely observed. Northern flickers are also common, but largely occur at lower elevations. Many were frequently observed foraging along the abundant logging roads and skidder trails.

6.1.4 Migratory Birds

Many species, such as gulls and waterfowl, may pass through the project area, but because the project area lacks appropriate habitat for these species, their occurrence at any particular time or within any particular habitat is difficult to predict. However, it is likely that a large number of species pass through, or over, the project area during migration periods. Therefore, a separate list of those species reasonably expected to occur in the vicinity of the project area during spring or fall migration was created and includes nearly 50 species (Appendix B Table 2).

6.2 Methods

6.2.1 Species – Habitat Matrix

A species-habitat association was generated to identify species that are probable residents of the project area and to identify the various seasonal habitats in which resident species are most likely to occur. Habitat types within the project area were evaluated and categorized during community surveys conducted in 1993, 1994, 2000, 2001, and 2003. The species list was generated by compiling all species observations made in the project area during field investigations, professional experience, and by reviewing species distributions as described in local and regional literature (DeGraaf and Yamasaki 2001). The species and habitat lists were then plotted on a matrix, and the most likely species-habitat associations were indicated by cross-referencing species with their habitat requirements and the available habitats in the project area. Species were classified as breeding residents, winter residents, or year-round residents. Migratory birds were not included on this matrix because their habitat use, temporal presence, and reliability of occurrence are too unpredictable. However, a list of additional species that could reasonably be expected to pass through the project area during migration was prepared (Appendix B Table 2).

6.2.2 Incidental Observations

The presence of birds in the project area was documented during field investigations in 1993 and 1994 and from 2000 to 2003. Many field investigations were detailed studies for a variety of taxonomic groups but provided the opportunity for observations of the bird community in the project area. These observations were typically made by simply identifying the species observed and recording notes on the general location, habitat, and observed activity (e.g., feeding, cavity excavation, nesting). This information was used to refine the species-habitat matrix and to verify the occurrence of species within the project area.

6.2.3 Breeding Bird Surveys

Breeding bird surveys were conducted on Redington Mountain in 1994 and 2002 and on Black Nubble in 2002. The surveys were conducted on the ridgelines in the vicinity of the proposed wind turbines, with survey points positioned to ensure adequate coverage of the ridgeline project areas. The purpose of these surveys was to document the species breeding in the project area and to detect any species that may not have been included in the species-habitat matrix that was prepared for the area. Surveys in both years utilized point counts, a standard method for documenting breeding bird assemblages in forested habitats (Ralph *et al*. 1993).

In 1994, 20 survey points were established on Redington Mountain (Figure 7-7). In 2002, a separate set of 20 points were established that sampled a larger portion of the Redington Mountain ridgeline (Figure 7-7) and 9 points were established on Black Nubble (Figure 7-8). The location of survey points was determined prior to field surveys using aerial photographs and topographical maps. Survey points were spaced approximately 500 feet apart in 1994 and 700 feet apart in 2002. When conducting the surveys, the points were located using GPS so that they could be accurately mapped and relocated.

In both years, counts were conducted for 10 minutes during the early morning hours (between 4:30 and 8:30 AM) and under suitable weather conditions (no rain or a slight drizzle and no or very light winds). All birds seen or heard during the counts were identified. Bird observations were plotted onto a map of the area and divided into three distance categories (<50m, 50 to 100m, >100m). Observations were also divided into time intervals of 1 to 3 minutes, 3 to 5 minutes, and 5 to 10 minutes.

The method used in 2002 also incorporated field protocol developed by the Vermont Institute of Natural Science (VINS) for their Mountain Birdwatch Program (Rimmer *et al*. 1996). The protocol was developed, in part, to document the occurrence and regional distribution of Bicknell's thrush, a regionally uncommon species that utilizes only high elevations in New England. This method involves documenting the occurrence of Bicknell's thrush at the survey points or while traveling between survey points. If, after the last point on a route is surveyed, no Bicknell's thrushes were observed during the survey or while traveling between points, then a taped recording of the Bicknell's thrush's call was played for one minute, followed by a two-minute listening period at each of the survey points. If the playback method failed to elicit any response from a Bicknell's thrush, then the survey was repeated within a 2-week period.

Point count surveys were conducted three times at each point on Redington Mountain during the nesting season in 1994. In 2002, surveys were planned for two survey periods. Weather conditions did not permit the second survey period to take place, so surveys were conducted only once in 2002.

Data were assembled in spreadsheets for the purposes of analysis. Data for the entire 10-minute sample period were used during data analysis. For the 1994 Redington Mountain data, average abundance of each species was calculated for each survey point. The relative frequency of observation for each species was calculated as the percentage of survey points at which each species was observed. This was calculated separately for 1994 and 2002 data from Redington Mountain and separately for 2002 Black Nubble data.

6.2.4 Golden Eagle Surveys

Although common in the western U.S., the golden eagle is one of the rarest breeding birds east of the Mississippi River. Only one breeding pair of golden eagles has been documented in Maine since 1984 (Todd 1989). In July 2005, MDIFW confirmed a sighting of two adult Golden Eagles approximately 40 miles south of the potential Redington development project; however, no resident population was confirmed. (C. Todd, MDIFW, pers. comm.). Maine considers the species to be endangered, but golden eagles are not federally listed due to stable western populations. Targeted field surveys for golden eagles were undertaken in 1994. The survey consisted of aerial and ground surveys of potential nest sites in the region. Surveys were completed in close coordination with MDIFW staff. These surveys are described in greater detail in subsection 8.0 of this report.

6.2.5 Hawk Migration Surveys

Hawk migration surveys were conducted in the fall of 1993 and again in the spring and fall of 1994. A total of 39 person-days were spent conducting these surveys: 14 during the fall of 1993; 17 during the spring of 1994; and 8 during the fall of 1994. Two sites on Redington Mountain and two sites on Sugarloaf Mountain were surveyed in 1993, while three sites on Redington Mountain and one on South Crocker Mountain were surveyed in 1994. Additionally, surveys conducted for golden eagles included incidental observations from Bigelow Mountain, Black Nubble, and Old Turk Mountain in Byron, Maine.

Surveys used standard methods used by the Hawk Migration Association of North America, as follows. Surveys were conducted from one hour after sunrise, when possible, until late afternoon. Observers recorded species, time of observation, direction of flight, and flight path. Age and sex were also recorded, when possible. Flight heights were estimated using existing meteorological towers and powerlines for reference, when available. Weather data were collected hourly, including wind direction, wind speed, temperature, cloud cover, and precipitation. Surveys were generally conducted on days following the passage of a cold front accompanied by high pressure cells as this combination of meteorological conditions is typically followed by clear skies, northwest winds, and low temperatures and provides optimal conditions for migrating raptors (Kerlinger 1989).

6.2.6 Nocturnal Songbird Migration Surveys

The vast majority of North American landbirds migrate at night (Kerlinger 1995), making the study of songbird migration difficult. Their presence in the air at night raises concern over their potential collision with wind turbines, or any other tall structure. Consequently, a variety of surveys were conducted to characterize the nighttime movement of songbirds through and over the project area during migration periods. The surveys used a variety of techniques for this. Each major technique is described below.

6.2.6.1 1994 Ceilometer and Moonwatching Surveys

Ceilometer and moonwatching surveys were conducted in the spring and fall of 1994 to document the passage of nocturnally migrating songbirds through the project area. This work was undertaken as a comparison study, with one survey point located at the peak of Redington Mountain and one in coastal Maine, at Wolf Neck Woods State Park in Freeport. During this survey, bird migration was monitored by directing a ceilometer (1,000,000 candlepower Coleman spot-flood spotlight) vertically into the sky (Gauthreaux 1969). One observer lay supine next to the light beam and directed a spotting telescope vertically within the beam. Birds passing through the light beam were observed as streaks of light crossing the field of view. The time and direction of each bird observed passing through the beam was recorded.

A second observer viewed the light beam laterally, from 100 to 200 feet away. Low flying birds, generally those flying below 500 feet, were readily seen by the second observer by eye as they passed through the light beam. Birds seen by observer one and not by observer two were classified as flying above 500 feet, while those seen by both observers were estimated as flying either below 200 feet or between 200 and 500 feet by the second observer. Observations typically began at 8 – 10 PM and continued until 1 – 3 AM, depending on weather conditions and migration traffic rates.

On clear nights with a full or nearly full moon, ceilometer observations were not possible due to the moonlight washing out the light created by the light beam. Consequently, moonwatching was used to monitor migration on those nights (Lowery 1951); the face of the moon was watched using a spotting telescope and all birds seen flying across the face of the moon were recorded. As with the ceilometer technique, the time and direction of flight of each bird was recorded.

Surveys were conducted on 6 nights from May 23 to June 4, 1994, and 6 nights from August 30 to October 10, 1994. As mentioned above, surveys on Redington Mountain were conducted simultaneously with surveys in coastal Maine in order to place into perspective the migration traffic rates observed in the project area through a direct comparison of migration intensity.

Data were summarized by night for those nights that both surveys were conducted. The summary included the conversion of raw data observations to hourly passage rates, based on the number of minutes sampled during each hour of observation. The general flight direction of migrants was also summarized.

6.2.6.2 2002 Radar Surveys

Marine Surveillance Radar

Field Protocol

Nocturnal bird migration surveys were conducted just north of Black Nubble in the Fall of 2002 and at a site between Black Nubble and Redington in the Spring of 2004. A Furuno X-band marine surveillance with an 8-foot slotted wave guide antenna was used throughout the observation period.

For the Fall 2002 survey, the radar was located in an open logging yard midway up the northern ridgeline of Black Nubble (Photo 23). This topography allowed for a nearly clear view in all directions with fairly limited ground clutter. For the Spring 2004 survey, the radar was located in the saddle between the southeast end of the Black Nubble development area and the southern end of Redington Mountain (Figure 7-9).

Ground clutter is the reception of radar waves that are reflected from nearby vegetation or hillsides and appears as green blotches on the radar screen (Photo 24). Consequently, sites that were chosen for the radar included characteristics that allowed surrounding vegetation to mask out features that could cause ground clutter but still provide a good view of the surrounding sky for the radar. In addition to the careful strategic placement of the radar unit, a sheet metal screen 1-foot wide by 8-feet long was attached to the lower edge of the waveguide antenna (Cooper 1991). A bracket underneath the screen allowed it to be angled upward in front of the lower portion of the antenna and was adjusted to further reduce ground clutter (Photo 25).

Photo 23. Black Nubble radar site.

Photo 24. View of radar screen at Black Nubble site.

Photo 25. Angled bracket being installed on radar antenna.

Radar surveys occurred on 20 nights from September 18 to October 31, 2002, and on 15 nights from May 6 to May 30, 2004. Radar surveys were conducted on nights with suitable bird migration weather patterns (i.e., relatively clear skies with limited precipitation). Nocturnal songbird migration activity typically begins 45 minutes after sunset and usually peaks during the first four hours of the night (Able 1970; Gauthreaux 1971; Richardson 1971, 1972). Consequently, radar operation typically began approximately 30 minutes after sunset and continued until several hours before sunrise.

The radar was operated with a maximum range of 0.5 nautical miles (3,038 ft). Finally, the 30-second echo trail setting was enabled during radar surveys. This function maintains a track of each target on the display screen for a 30-second time period, enabling an analysis of an individual flight direction. While the radar was in operation, the display screen was recorded to provide a permanent record of the migration observations.

Data Analysis

Radar data was summarized by hour, by night, and for the entire season to obtain passage rate estimates (number of targets passing through the radar range per hour) and flight directions. In general, 3 to 6 one-minute samples of the recorded radar display were used for each hour of the night for which data was available. A total of 712 one-minute samples were analyzed across the 20-night Fall 2002 survey period and 370 one-minute samples were analyzed across the 15-night Spring 2004 survey period.

The data analysis was accomplished by converting the analog video recordings to digital video clips, playing the clips and tracing each target using a computer graphics software package, and then using an engineering analysis package to re-trace each target and output a spreadsheet file with the number and direction of all targets in the one-minute samples. Analysis software designed specifically to analyze directional data (Oriana2© Kovach Computing Services) was then used to analyze the data sets to determine mean flight directions.

NEXRAD Weather Station Radar

The Fall 2002 radar surveys at Black Nubble were initiated several weeks into the migration season on September 18, 2003. Consequently, NEXRAD weather data from August 14 to October 31 was collected to compare general trends throughout the entire migration season in order to assess how much of the season may have been missed due to the late start. NEXRAD radar provides a different type of data than the marine surveillance radar used at Black Nubble. It is a long range Doppler radar that produces reflectivity data on objects (and precipitation) in the sky, as well as data on the velocity of those objects (Photo 26). It does not individually track birds, as the marine surveillance radar does. However, it does detect birds in the air over a large area and has been used extensively to interpret large-scale bird migration patterns (Gauthreaux and Belser 1998).

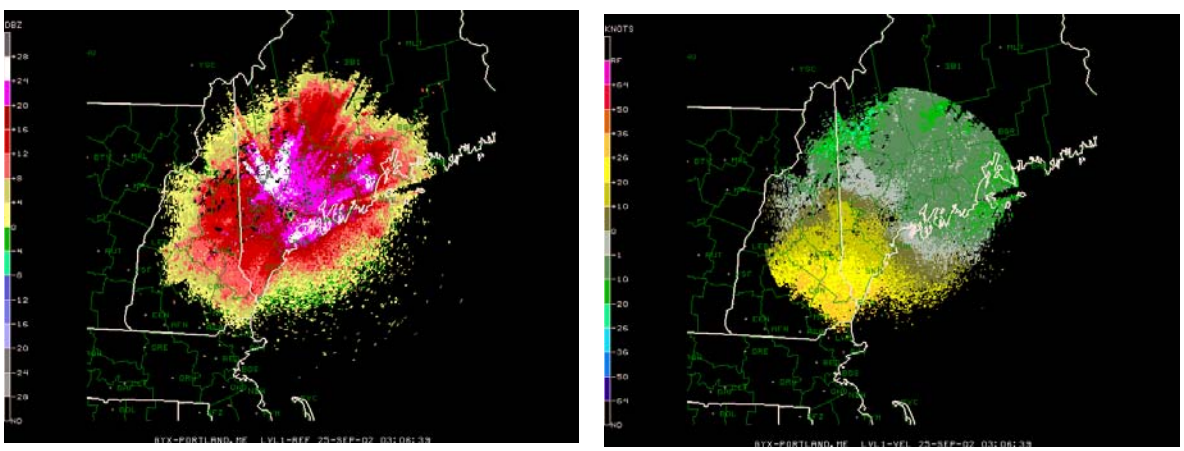


Photo 26. NEXRAD radar images. Left image is a reflectivity image showing a very broad area in which the radar is detecting small airborne targets. Right image shows velocity data for those same targets. Green indicates target velocity toward the radar while yellow indicates velocity away from the radar. This image shows a night of heavy migration with the general trend in movement being to the southwest.

NEXRAD weather radar data originating from the National Weather Service (NWS) station in Gray, Maine, was obtained from the NWS data archive server and analyzed using methods published by Gauthreaux and Belser (1998). Hourly samples of both reflectivity and velocity were compiled and compared with winds aloft data. Each night was qualitatively categorized as 1) no migration (very little activity or nights with rain), 2) light migration, or 3) heavy migration. These determinations were based on the color-coded strength of the radar reflectance data, the development of the radar images with respect to sunset, the direction and speed recorded on the velocity plots, and ambient winds aloft data that was separately obtained from the NWS. Once all nights had been analyzed and categorized, the number of nights with migration activity before the start of on-site surveys at Black Nubble (August 14 to September 17) was compared with the number of nights with activity after the surveys were started.

6.2.6.3 Acoustical Monitoring

Acoustical monitoring was conducted in an effort to identify the species of birds migrating through the project area from September 18 to October 31, 2002. This work was initiated at the request of MDIFW over their concerns of potential impacts on Bicknell's thrush and other potential species of concern that may move through the project area. Acoustical monitoring stations included a sensitive microphone, an amplifier, and a VCR with an 8-hour recording tape (Photos 27 and 28). The VCR did not record any video signals but did record audio signals. Stations were set up to begin taping at sunset and to continue for 8 hours, essentially recording calls for the entire night.

Photo 27. Acoustical monitoring stations with microphone and solar panel array.

Acoustical monitoring stations were constructed in accordance with methods developed by William Evans of Old Bird, Inc. Four monitoring stations were established. Two stations were in the project area: one near the radar site at Black Nubble and the other in a clearing near the peak of Black Nubble (Figure 7-9). Two other stations were established for comparison purposes in lower elevation areas outside of the western Maine region: one station in Jay, representing the western Maine foothills, and the other in Yarmouth representing coastal Maine.

Photo 28. Acoustical monitoring stations on Black Nubble, with solar power array, batteries and instrumentation. Microphone is situated to far right in photograph.

After the migration season ended, each of the video tapes were post-processed by playing the tape into a computer audio input line and simultaneously running two analysis software programs—tseepo and thrusho. These programs, developed by Old Bird, Inc., each monitored the audio input for call notes within each of their respective frequency ranges. Upon detection of a call note, the programs downloaded a sound file onto the computer hard drive. All call notes downloaded were then viewed using a third program—GlassOFire—that visually depicts the downloaded files as spectrographs on the computer screen. These spectrographs were viewed to identify call notes and false detection sounds such as wind, rustling leaves, crickets, and electrical static. When possible, call notes were identified to species using a reference library obtained from Old Bird, Inc. However, not all species can be individually identified and in some cases, call notes were categorized into groups of species with very similar calls. Call identifications were verified with Dr. Bill Evans at Old Bird, Inc.

6.3 Results

6.3.1 Species – Habitat Matrix

Based upon available literature regarding habitats in the project area and bird life histories, 99 species were identified as potential resident species. These species are presented on the species-habitat matrix located in Appendix B Table 1. The matrix specifically identifies which species are expected to use the habitats that have been documented in the project area and the timing of that use. Species confirmed as occurring in the project area have been identified on the matrix. This includes 62 of the 99 species. The remaining species are considered to likely occur but simply were not seen during field investigations. Additionally, a list of species expected to migrate in or through the project area was prepared and is presented in Appendix B Table 2.

6.3.2 Breeding Bird Survey Results

A total of 27 species were observed in the project area during the breeding bird surveys in 1994 and 2002 (Table 7-1). Data indicated differences in the number and percent frequency (percent of plots at which a species was observed) of birds observed between the sites, as well as the number and percent frequency of birds observed between years at Redington Mountain. Twenty-one species were observed during the 1994 surveys on Redington Mountain while only 18 were observed in 2002. However, the 2002 surveys documented five species that were not observed in 1994. Conversely, the 1994 surveys documented eight species that were not observed during the 2002 surveys. The 2002 surveys at Redington Mountain did confirm nesting activity of one species—yellow-bellied flycatcher, with the nest of this species observed in the root system of a wind thrown tree near the southern meteorological tower. The surveys on Black Nubble documented fewer species than on Redington Mountain. Only 13 species were observed at the 9 survey points, 2 of which were not observed during the breeding bird surveys on Redington Mountain.

Table 7-1. Breeding Bird Survey Results						
Species	1994 Redington Surveys*		2002 Redington Surveys		2002 Black Nubble Surveys	
	#	% freq	#	% freq	#	% freq
Blackpoll Warbler	36	100%	29	90%	11	89%
Winter Wren	21	95%	7	35%	8	78%
Swainson's Thrush	19	95%	17	55%	9	78%
Bicknell's Thrush	18	80%	5	25%	2**	11%
White-throated Sparrow	13	75%	4	15%	8	78%
Dark-eyed Junco	12	70%	12	45%	6	56%
Yellow-rumped Warbler	9	60%	27	70%	15	89%
Boreal Chickadee	9	60%	10	45%	2	22%
Least Flycatcher	6	50%	1	5%		
Ruby-crowned Kinglet	5	50%				
Golden-crowned Kinglet	2	25%	1	5%	3	22%
Nashville Warbler	2	30%				
Magnolia Warbler	2	25%			1	11%
Gray Jay	2	25%				
unidentified	1	10%	1	5%		
American Goldfinch	1	5%				
Cedar Waxwing	1	10%				
Red-breasted Nuthatch	1	10%	1	5%		
Spruce Grouse	1	5%				
Blackburnian Warbler	1	5%	1	5%		
Blue-headed Vireo	1	5%				
Yellow-bellied Flycatcher			5	20%	2	22%
Black-capped chickadee			1	5%		
Common Raven			1	5%		
Purple Finch			1	5%		
Spruce Grouse			1	5%		
American Robin					1	11%
Downy Woodpecker					1	11%
Species Richness	**21**		**18**		**13**	
Numbers presented are the cumulative number of individuals observed on all plots for each site in each year. 1994 surveys on Redington Mountain were conducted three times at 20 survey points while 2002 surveys were conducted one time at 20 points on Redington Mountain and at 9 points on Black Nubble.						
*1994 Redington data uses the mean number of birds observed during three survey events at each point and is therefore the sum of those means.						
** The report of Bicknell's Thrush on Black Nubble is uncertain, the two birds were observed during playback surveys but could not be definitively identified.						

A suite of 7 species were commonly observed during the surveys and typically occurred at 50 percent or more of the survey plots. This suite includes those species that are indicative of higher elevation conifer forests in northwestern Maine. Blackpoll warblers were particularly abundant and were observed at approximately 90 percent of the survey points during all of the survey periods. The other common species included winter wren, Swainson's thrush, Bicknell's thrush, white-throated sparrow, dark-eyed junco, and yellow-rumped warbler.

Interestingly, these results area similar to those documented in Kibby, Skinner, and Merrill Strip Townships during the Kenetech Windpower, Inc. surveys in 1992 (U.S. Windpower 1993). Six of the most common species documented during that survey were the same as at Redington Mountain and Black Nubble. However, that project area did not include Bicknell's thrush as one of the seven most common species. Instead, the red-eyed vireo was commonly observed. This latter difference is likely due to the fact that many of the survey points for that survey were placed on lower elevation ridgeline dominated by northern hardwood forest communities.

6.3.3 Hawk Migration Survey Results

A total of 52 hawk observations were recorded during fall 1993 surveys. Comparatively, a total of 92 hawk observations were recorded during spring 1994 surveys. In the fall of 1994, 18 hawk observations were made during a lighter field effort than that of the previous 2 survey periods. Table 7-2 provides summary results from the hawk migration surveys. Surveys were conducted across seven mountaintops in the vicinity of the project area, with most surveys concentrated on Redington Mountain. A total of 10 species were collectively observed across all mountaintops, with the sharp-shinned hawk, red-tailed hawk, American kestrel, and broad-winged hawk being the most common.

Table 7-2. 1993-1994 Hawk Migration Survey Results from the Project area and Surrounding Vicinity

Species	**Fall 1993**			**Spring 1994**							**Fall 1994**	
Survey Location	**Redington Mountain**	**Sugarloaf Mountain**	**Fall 1993 Total**	**Redington Mountain**	**Crocker Mountain**	**Old Turk Mountain**	**Black Nubble**	**Bigelow Mountain**	**Mount Abram**	**Spring 1994 Total**	**Redington Mountain**	**Overall 1994 Total**
Turkey vulture		2	2							0		0
Osprey			0	4		1				1		5
Northern harrier			0	1				1		1	1	3
Sharp-shinned hawk	4	20	24	14		3		2		19	2	21
Cooper's hawk		1	1					1	3	4		4
Broad-winged hawk	3	3	6	11		1				12		12
Red-tailed hawk		12	12	10	1	5		2		18	4	22
Rough-legged hawk		1	1							0		
American kestrel		4	4	9		2	1			12		12
Merlin		1	1	1						1	1	2
Unidentified *Accipiter*			0	2		3				5	4	9
Unidentified *Buteo*			0	1		4		2	1	8	4	12
Unidentified Falcon			0	1						1		1
Unidentified Raptor		1	1	3		2				5	2	7
Common raven			0		1			10	10	21		21
Total	7	45	**52**	57	1	21	1	8	4	**92**	**18**	**110**

Note: Additionally, 2 turkey vultures and 2 American kestrels were observed along Route 17 during the Old Turk Mountain golden eagle survey.

A total of 8 species were represented from the 52 hawk observations in the fall of 1993. Twenty-four were sharp-shinned hawks, 12 were red-tailed hawks, and the remaining observations were scattered among broad-winged hawks (6), American kestrels (4), turkey vultures (2), Cooper's hawk (1), rough-legged hawk (1), and merlin (1). One raptor was unidentified.

A total of 8 species were represented from the 92 hawk observations in the spring of 1994. As in 1993, the sharp-shinned hawk had the highest number of observations at 19. This was followed by the red-tailed hawk (18), broad-winged hawk (12), American kestrel (12), osprey (5), Cooper's hawk (4), Northern harrier (2), and merlin (1). Additionally, there were five unidentified *Accipiters*, eight unidentified *Buteos*, one unidentified falcon, and five unidentified raptors.

Eighteen hawks were observed during fall 1994 surveys. Of the 18 observations, 10 were grouped by genus or were unidentifiable. Of the remaining eight, red-tailed hawks were most common, with four observations. Two sharp-shinned hawks were observed and one of each the Northern harrier and merlin were also identified.

Table 7-3 illustrates 1994 fall hawk migration observation totals from a number of sites in the northeast. HMANA hawk migration research conducted in fall of 1994 on Kibby Mountain, Maine, documented 195 hawk observations while only 18 observations were documented at Redington Mountain that fall.

Table 7-3. Fall 1994 Raptor Count Data from Northeastern Sites, as Recorded by the HMANA, and the Redington Wind Farm Project Area

Site	Total Count	Site Classification
Mount Wachusett, Massachusetts	9959	Inland Mountain
Mount Agamenticus, Maine	6019	Coastal Mountain
Brownell Mountain, Vermont	468	Inland Mountain
Kibby Mountain, Maine	195	Inland Mountain
Redington Mountain, Maine	18	Inland Mountain

Regionally, sites in western Maine reported far fewer hawk migration traffic rates than in areas further south. For example, 6,019 raptors were observed at Mount Agamenticus in southern coastal Maine and 9,959 raptors were observed at Mount Wachusett in central Massachusetts in the fall of 1994, indicating an overall higher traffic activity of migrating hawks in these more southern, less mountainous areas.

6.3.4 Songbird Migration Survey Results

6.3.4.1 Ceilometer and Moonwatching Surveys

Ceilometer surveys were attempted on 12 nights in 1994 (6 in the spring and 6 in the fall). Despite efforts to match approaching weather fronts, weather conditions on Redington Mountain were typically harsher than at the coastal study site and included fog, rain, and snow while conditions on the coast were clear. Consequently, only two nights during the spring surveys produced two sets of data for comparison while all six nights in the fall produced comparable data. Table 7-4 summarizes the effort spent recording nocturnal migration data at each site for each season and for each method of bird detection.

Table 7-4. 1994 Nocturnal Migration Survey Effort Summary

Summary of Effort by Season			
Site	**Spring**	**Fall**	**Total**
Redington	17.25	30	47.25
Freeport	20	33.5	53.5
Total hours by season	**37.25**	**63.5**	**100.75**
Summary of Effort by Method			
Site	**Ceilometer**	**Moonwatching**	**Total**
Redington	24.25	23	47.25
Freeport	20	33.5	53.5
Total hours by method	**44.25**	**56.5**	**100.75**

A total of 642 birds were observed during ceilometer and moonwatching surveys (Table 7-5). More than six times as many birds were observed at the coastal survey site (555) than at Redington Mountain (87). At Redington Mountain, 52 birds were observed in spring and 35 in fall. Surveys at the coastal site documented 267 birds observed in spring and 288 in fall. Similarly, passage rates were very different between the sites, with 4 to 7 times as many birds per hour (BPH) in Freeport than at Redington Mountain.

Table 7-5. Ceilometer and Moonwatching Survey Results

Results	Redington Mountain			Freeport			Overall Total
	Spring	Fall	Total	Spring	Fall	Total	
Migration Intensity Data							
Number of Birds Observed	52	35	87	267	288	555	642
Hourly Passage Rate (BPH)	3	1.2	1.8	13.4	8.6	10.4	6.4
Flight Height Data							
Percent below 200 feet	35%			15%			18%
Percent 200 – 500 feet	12%			31%			28%
Percent above 500 feet	53%			54%			54%

Kenetech Windpower, Inc. conducted a similar study in 1994 in Kibby Township, approximately 25 miles north-northwest of Redington Mountain (Northrop, Devine & Tarbell, Inc. 1995a,b). Using ceilometer and moonwatching techniques, the Kenetech study documented 42 birds during the spring migration period and 115 in the fall. Spring passage rates were similar to those observed at Redington Mountain, with an average of 2.2 BPH. The fall passage rate, however, was 3.7 BPH, which is higher than what was observed at Redington Mountain.

Passage rates from both of these studies, including data from the coastal Maine site, are significantly less than passage rates collected at sites in the southern United States but approach passage rates observed during other northern studies in the midwest and New England (Table 7-6). For example, Able and Gauthreaux (1975) documented nightly passage rates from 18 to 130 BPH in spring (2-year average = 56.7 BPH) and 16 to 503 BPH in fall (2 year average = 131.9 BPH) near Athens, Georgia. Other studies in the southeast have documented maximum passage rates of over 800 BPH and average seasonal rates from 100 to 265 BPH (Gauthreaux 1969, Able and Gauthreaux 1975). Passage rates from a study conducted in North Dakota were closer to those observed from the studies conducted in Maine, as were results from a study near Searsburg, Vermont (Avery *et al*. 1976, Curry and Kerlinger 2002). This similarity is likely due to the more northern latitude of the Maine and North Dakota sites, with these more northern sites being crossed by a smaller proportion of the North American continental bird population.

Table 7-6. Comparison of Ceilometer and Moonwatching Results

Location	Observed Passage Rates (range and average in BPH)			Citation
	Spring	***Fall***	***Overall***	
Athens, Georgia	18-130, ave=56.7	16-503, ave=131.9	108.0	1
Lake Charles, Louisiana	--	22-812, ave=264.3	264.3	1
Georgia and Louisiana	9-106, ave=29	7-225, ave=94.8	77.7	2
southeast North Dakota	0.9-18.4, ave=5.3	1.1-23.4, ave=4.9	5.1	3
Freeport, Maine	6.3-31, ave=13.4	2.6-13.5, ave=8.6	10.4	4
Redington Mountain, Maine	2-4, ave=3	0-2, ave=1.2	1.8	4
Kibby Township, Maine	0-5.2, ave=2.2	0-11.2, ave=3.7	3.1	5
Searsburg, Vermont	0-14, ave=2.9	0-10, ave=2.9	1.9	6

1 = Able and Gauthreaux 1975
2 = Gauthreaux 1969
3 = Avery *et al.* 1976
4 = this study
5 = Northrop, Devine & Tarbell, 1995a,b
6 = Curry and Kerlinger 2002 (data from two years have been grouped)

Flight height data were summarized by site for both seasons combined (Table 7-5). Variation existed in the percentage of birds flying less than 200 feet from the ground and those flying between 200 and 500 feet. Proportionally more birds were observed flying less than 200 feet from the ground at Redington Mountain than at the coastal site. However, more than half of all birds observed during ceilometer and moonwatching surveys were estimated as flying above 500 feet from the ground. Estimates from both sites were similar, with 53 percent observed above 500 feet at Redington Mountain and 54 percent at the coastal site. Similar flight height estimates were made during the Kenetech Windpower, Inc. ceilometer surveys. That study found 52 percent of the observed migrants were flying below 200 feet while 48 percent were flying above 200 feet (Northrop, Devine & Tarbell, Inc. 1995a,b).

Qualitative ceilometer and moonwatching observations of the flight direction of birds observed at the two sites were similar. In general, birds at both sites flew to the northeast in spring and the southwest in fall. Variation that was observed in spring, however, included flights from northeast to northwest at Redington Mountain and flights from northeast to east at the coastal site. Fall survey variation included flights from southwest to south at Redington Mountain and flights from southwest to southeast at the coastal site.

6.3.4.2 Radar Surveys

Marine Surveillance Radar – Fall 2002

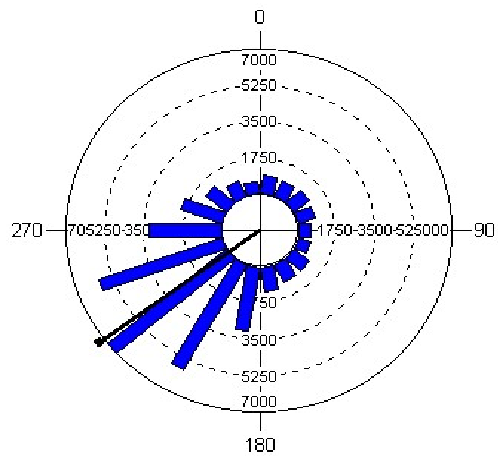
Radar surveys were conducted for approximately 136.5 hours on 21 nights from September 18 to October 29, 2002. A total of 712 one-minute samples were used during the post processing and data analysis aspects of the study. A total of 37,173 targets were identified within those samples. Hourly passage rates (number of targets per kilometer of front per hour of observation (t/km/hr)) observed within the detection range of the radar per hour varied from 160 targets per hour to 9,768 targets per hour, with a seasonal average of 2,830 targets per hour (Table 7-7).

The mean flight direction of all targets analyzed was southwest, at 234° (Figure 7-10). In fact, approximately 70 percent of all of the 37,173 targets were flying in directions between south and southwest, with the remainder of the target flights largely uniformly distributed in other directions. However, significant night-to-night variation in flight direction was observed (Table 7-7, Figure 7-11).

Table 7-7. Summary of Fall 2002 Radar Surveys

Night of	Passage Rate	Nightly Flight Direction	Flight Toward Black Nubble		Flight Not Toward Black Nubble	
			Number	Percent	Number	Percent
9/18/2002	1262	69.7	86	5.1%	1585	94.9%
9/19/2002	879	19.1	24	1.8%	1308	98.2%
9/23/2002	2609	233.0	229	6.3%	3379	93.7%
9/24/2002	2358	222.8	242	9.2%	2390	90.8%
9/25/2002	1996	34.0	160	3.4%	4524	96.6%
9/26/2002	1407	6.7	43	2.8%	1506	97.2%
9/29/2002	773	210.8	86	9.8%	792	90.2%
10/1/2002	1177	110.1	75	4.1%	1758	95.9%
10/3/2002	2848	253.9	57	1.6%	3494	98.4%
10/8/2002	2943	236.1	26	1.5%	1712	98.5%
10/11/2002	1082	259.3	39	2.8%	1371	97.2%
10/14/2002	2192	224.1	129	5.9%	2062	94.1%
10/15/2002	1303	254.3	12	0.7%	1673	99.3%
10/17/2002	1004	193.9	59	12.8%	402	87.2%
10/21/2002	1390	229.2	67	3.9%	1632	96.1%
10/22/2002	1598	210.7	193	11.5%	1483	88.5%
10/23/2002	803	226.3	57	5.4%	997	94.6%
10/24/2002	978	234.3	43	3.7%	1112	96.3%
10/27/2002	567	199.1	85	20.7%	326	79.3%
10/28/2002	845	213.5	65	7.6%	790	92.4%
10/29/2002	896	232.5	25	2.3%	1049	97.7%
Full Season	1472	233.6	1802	**4.9%**	35345	**95.1%**

Figure 7-10
Fall 2002 Mean Flight Direction



Range rings indicate number of targets. Outer ring (7,000 targets) equals approximately 19% of targets observed.

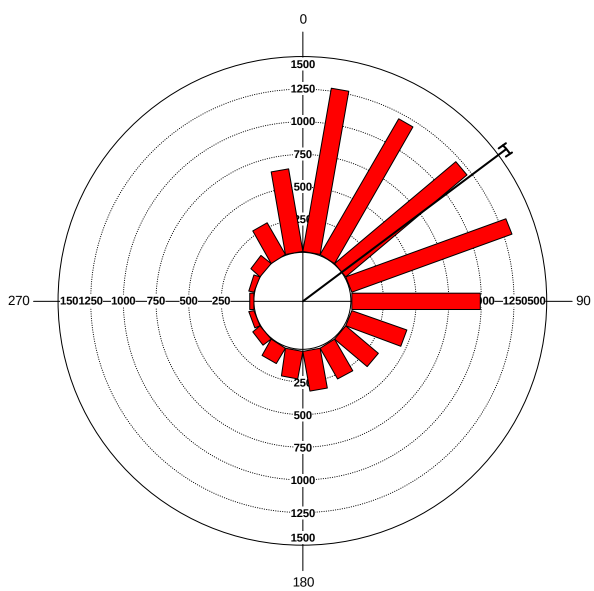
Marine Surveillance Radar – Spring 2004

Spring 2004 radar surveys were conducted for approximately 133 hours on 15 nights from May 6 to May 29. A total of 370 one-minute samples were used during the post processing and data analysis aspects of the study. A total of 8,999 targets were identified within those samples. Nightly passage rates observed within the detection range of the radar per hour) varied from 105 to 1,751 to t/km/hr, with a seasonal average of 808 t/km/hr (Table 7-8).

The mean flight direction of all targets analyzed was northeast, at 53° (Figure 7-12). As with the Fall 2002 survey data, significant night-to-night variation in flight direction was observed. Figure 7-13 provides a visual depiction of the target flight directions observed on each of the 21 nights surveyed.

Table 7-8. Summary of Spring 2004 Radar Survey		
Night of	**Passage Rate**	**Nightly Flight Direction**
5/6/2004	604	49
5/7/2004	136	161
5/8/2004	666	38
5/9/2004	1172	62
5/10/2004	1104	60
5/11/2004	988	59
5/12/2004	783	31
5/13/2004	1198	50
5/14/2004	1676	42
5/15/2004	717	154
5/16/2004	753	48
5/25/2004	169	355
5/27/2004	1751	44
5/28/2004	292	146
5/29/2004	105	167
Entire Season	808	53

Figure 7-12
Spring 2004 – Entire Season



Range rings indicate number of targets. Outer ring (1,500 targets) equals approximately 17% of targets observed.

Overall Radar Survey Assessment

Few other studies are available that provide exactly comparable data. The Kenetech Windpower, Inc. study in 1994 used identical methods and equipment as were used at Black Nubble (Northrop, Devine & Tarbell, Inc. 1995a,b). That data is provided for comparison in Table 7-9. Differences between spring and fall passage rates would be expected, as bird populations would be anticipated to be greater in the fall, right after the breeding season. Variations in the passage rates between the two studies could be due to differences in local, regional, and continental bird populations between the two survey years; in the amount and timing of sampling effort; in the range and detection settings functions of the sampling equipment, or in the use of the areas by migrating birds.

Table 7-9. Summary of Spring and Fall Radar Surveys

Site/Season	Passage Rate*			Flight Direction
	Mean	Min	Max	
Redington				
Fall 2002	1472	567	2943	234°
Spring 2004	808	105	1751	53°
Kenetech				
Spring 1994	99	n/a	n/a	34° to 53°
Fall 1994	638	56	2116	200°
* Targets/km/hr				

Beyond this comparison, no other studies provide similar data. These data sets provide passage rates much higher than typically encountered in most radar studies being conducted in the northeast with publicly available data. Passage rates provided in these two studies depict movement of all airborne targets. Marine surveillance radars, particularly 25 kw units, have the ability to detect insects and occasional nights of high insect density are typically observed. Adjustments for removing insect data were not developed at the time of the 2004 analysis to the same degree as methods currently used for contemporary (2005) studies. Considering how great insect density can occasionally be, the inclusion of those targets increases passage rates, making these two studies only comparable to each other.

Despite the composition of the targets, peaks in nightly traffic rates likely correspond to periods of heavy migration associated with the passage of fronts and the resulting development of optimal migration conditions (clear with moderate to strong north winds during the fall and southerly winds in the spring). Bird migration has been demonstrated by a number of researchers to be tied to weather patterns in this way, with the largest migration events occurring fairly soon after the passage of fronts (Nisbet and Drury 1967; Able 1972, 1973; Richardson 1974; Gauthreaux 1978; Williams *et al.* 2001). Correlations between passage rates at Black Nubble and weather patterns were not tested. However, Northrop, Devine & Tarbell, Inc. (1995b) found that nearly 60 percent of the variation in migration traffic rates was attributable to weather patterns and 3 to 6 times as much migration occurred the day of or the day after a cold front compared to 2 or more days after.

In general, the early part of the Fall 2002 migration season experienced much greater variability in the nightly flight directions of birds. Five of the first nine nights surveyed documented the majority of targets flying in northerly or easterly directions. Reverse migrations such as this are not uncommon and have been documented in North America and Europe to be related, in part, to unsuitable wind direction (Richardson 1978). Conversely, all of the last 12 nights experienced flight directions only to the southwest or west-southwest. These observations appear to indicate that weather patterns were more suitable for nocturnal songbird migration during that time period, birds were more prepared and more readily initiating migratory movements, or, more likely, a combination of these factors. Considerably less variation in flight direction was observed during the Spring 2004 survey.

As mentioned above, weather patterns have been found to influence nightly migration patterns. Additionally, nocturnally migrating songbirds are typically described as flying uniformly across the landscape in something termed as broad-front migration (Lowery and Newman 1966; Able 1972; Richardson 1971, 1972; Williams *et al*. 1977). However, local topographic characteristics may also affect the direction of bird movements. The majority of targets observed at Black Nubble were flying in a southwesterly direction rather than flying directly south, where Black Nubble is located. Only 4.9 percent of the 37,173 targets were observed flying between 170° and 190°, which is generally the direction to the peak of Black Nubble from the radar site (Table 7-8, Figure 7-10).

There was an apparent lack of birds flying directly towards Black Nubble during the Fall 2002 survey period (Figure 7-10, Table 7-7)[2]. This could be due to birds flying low enough to see the silhouette of the mountain and steering southwest to fly over the adjacent, lower elevation areas. Considering that migrating songbirds typically fly less than 1,600 feet to 2,500 feet above the ground (Able 1970, Gauthreaux 1991) it is very likely that the birds were changing their course to avoid the peak (3,700 ft), which was approximately 1,800 feet higher than the radar location. Additionally, visual nighttime observations of the landscape around the radar station from the ground documented the very obvious location of Black Nubble as a high ridgeline seen in silhouette against the night sky.

The Spring 2004 survey generally documented similar flight characteristics, with few targets flying directly towards the nearest mountaintops of Black Nubble and Redington Mountain. There was a greater dispersal of flight directions, in general, but that dispersal was into the relatively wide basin of the headwaters of Nash Stream, just north of the saddle constriction between Black Nubble and Redington Mountain. Many targets were observed flying toward Crocker Mountain, which was further from the radar site. The limited range of the radar, however, did not allow for the documentation of movement patterns of targets near Crocker Mountain.

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[2] A similar analysis for the Spring 2004 survey data was not conducted, as the radar site was confined between the two project area ridgelines.

Figure 7-14 shows the results of the bird migration flight direction analysis with respect to regional topography. It is likely that several major features direct bird movements through the region during migration. In the fall, the mountain landmasses northwest, west, and south of Flagstaff Lake probably act as visual cues to migrating birds, particularly those flying low enough to see the silhouette of the ridgelines. Consequently, the valleys of the North Branch Dead River, South Branch Dead River, and Flagstaff Lake represent significant low-lying topographic features that migrating birds fly over at night while they alter their flights in response to the higher elevation ridgelines. In the spring, the high ridgelines of Saddleback Mountain, Mount Abraham, Spaulding Mountain, Sugarloaf Mountain, and Bigelow Mountain may act similarly to divert movements of lower flying migrants around high elevations and either over lower mountains and ridges or within the larger valleys such as Carrabassett River and Orbeton Stream valleys.

Some published research supports the idea that some birds may use topographic cues while migrating at night. Bingman *et al*. (1982) found that the Hudson River acted as a leading line for nocturnally-migrating songbirds under most wind conditions. At Hawk Mountain, Pennsylvania, Sielman *et al.* (1981) found that birds on the upwind side of a ridge were moving along the ridge, birds at the crest were moving along and over it, and few birds were observed at low altitude on the downwind side of the ridge. Similar radar observations were seen during the Kenetech Windpower, Inc. radar studies as at Black Nubble. During that study, targets flew west and southwest, flying parallel to the topography of the mountain range and stream valley being surveyed (Northrop, Devine & Tarbell, Inc. 1995b, personal observations of researchers at both study sites).

Another study, conducted in the Franconia Notch area of New Hampshire, used ceilometers, a small marine surveillance radar, and daytime observations to study the flight patterns of migrating birds in a mountainous area of New England (Williams *et al*. 2001). They found that birds observed north of the Franconia Range tended to fly southwesterly, parallel to the face of the range, while those observed flying over the mountain tops were flying southerly. Additionally, one survey point within a pass in the mountain range documented birds moving south-southeastward, down the pass, while those documented at points outside the pass continued southwest, parallel to the range. This indicates, as was observed in the Black Nubble study, that most birds fly low enough to see the outlines of ridges and mountaintops and may deliberately fly along or around these features, rather than gain altitude to pass over them. Birds observed flying south over the mountaintops may already be high enough that they do not need to increase altitude and, therefore, do not change course.

NEXRAD Weather Data

A total of 55 nights of NEXRAD weather data were available from August 14 to October 29 for analysis of broad scale migration during fall of 2002. Of these, a total of 20 nights did not document bird migration activity due to inclement weather or no to very little reflectivity and velocity data. Consequently, there were 35 nights where some degree of bird migration activity was documented (i.e., light or heavy), with 29 nights reporting heavy migrations. Appendix D provides a summary table of all 25 nights for which NEXRAD data was available and examples of NEXRAD radar reflectivity and velocity images for nights with no, light, or heavy migration activity.

For NEXRAD data interpretation purposes, bird migration is discernable from most precipitation, unless the weather system is a large, slow moving front that remains over the weather observation station in excess of six to eight hours. However, bird activity was detected on some nights when rain occurred only periodically. On those nights, radar reflectivity patterns indicative of migrating birds were observed forming and then dissolving during those periods between rain events. Nights exhibiting these conditions were given a classification of light migration activity.

Radar observations were initiated near Black Nubble on September 18, 2002, and it was determined that the fall migration season for 2002 was already underway. The first signs of bird migration observed from the NEXRAD data analysis, however, indicated light bird migration on August 22, 2002. A total of nine bird migration events were documented prior to the start of the radar observations near Black Nubble, eight of which were classified as nights of heavy migration (Table 7-10). A total of 26 nights of bird migration, 22 of which were classified as nights of heavy migration, were documented to have occurred between September 18 and October 29, 2002. This represents 74 percent of the total observed bird migration. Consequently, it is estimated that data generated from radar migration surveys at Black Nubble represent approximately three-quarters of the migrant bird population that passed through the area during the fall of 2002.

Table 7-10. NEXRAD Summary Data

Criteria	Number of Nights		
	Before 9/18	**After 9/18**	**Total**
No Migration	13	7	20
Light Migration	1	4	6
Heavy Migration	8	22	29
Total	22	33	55

6.3.4.3 Acoustic Surveys

Acoustic surveys took place at the Black Nubble radar site and summit from September 25 to October 29, 2002. The survey equipment stationed in Jay, Maine, did not produce usable data and was eliminated from the study. The survey equipment stationed in Yarmouth, Maine, was installed October 17 and was operational until October 29.

The microphone stations documented a total of 37 call notes. Ten species were reliably documented during data analysis and one set of call notes was distinguished to one of two species. Several other call notes were identified to belong to groups of species that are hard to individually identify. A summary of the results of these surveys is presented in Table 7-11 and examples of some of the call note spectrograms are presented in

Figure 7-15. More calls were recorded at the radar site (24) than at the summit of Black Nubble (10). Only three calls were recorded at the Yarmouth monitoring station. However, as noted above, that station was only operated for a 12-day period. For that period when all three stations were operational (October 17 – 29), the Yarmouth station recorded three call notes while the other two only recorded one each.

Of the species that were individually identified, most are common to the project area during the nesting season or to the region during migration. Included are the Canada goose, yellow-rumped warbler, black-throated blue warbler, common yellowthroat, white-throated sparrow, song sparrow, and dark-eyed junco. Also, one note was either a brown creeper or a golden-crowned kinglet, both of which are also common to the area. One less common species that was reliably identified was a white-crowned sparrow, a species that only occurs in the project area during migration. A fox sparrow call note was also recorded. This is another less common species, breeding only in far northern Maine and being more common in the remainder of the State only during migration. Two savannah sparrow call notes were recorded in late October at the Yarmouth recording station.

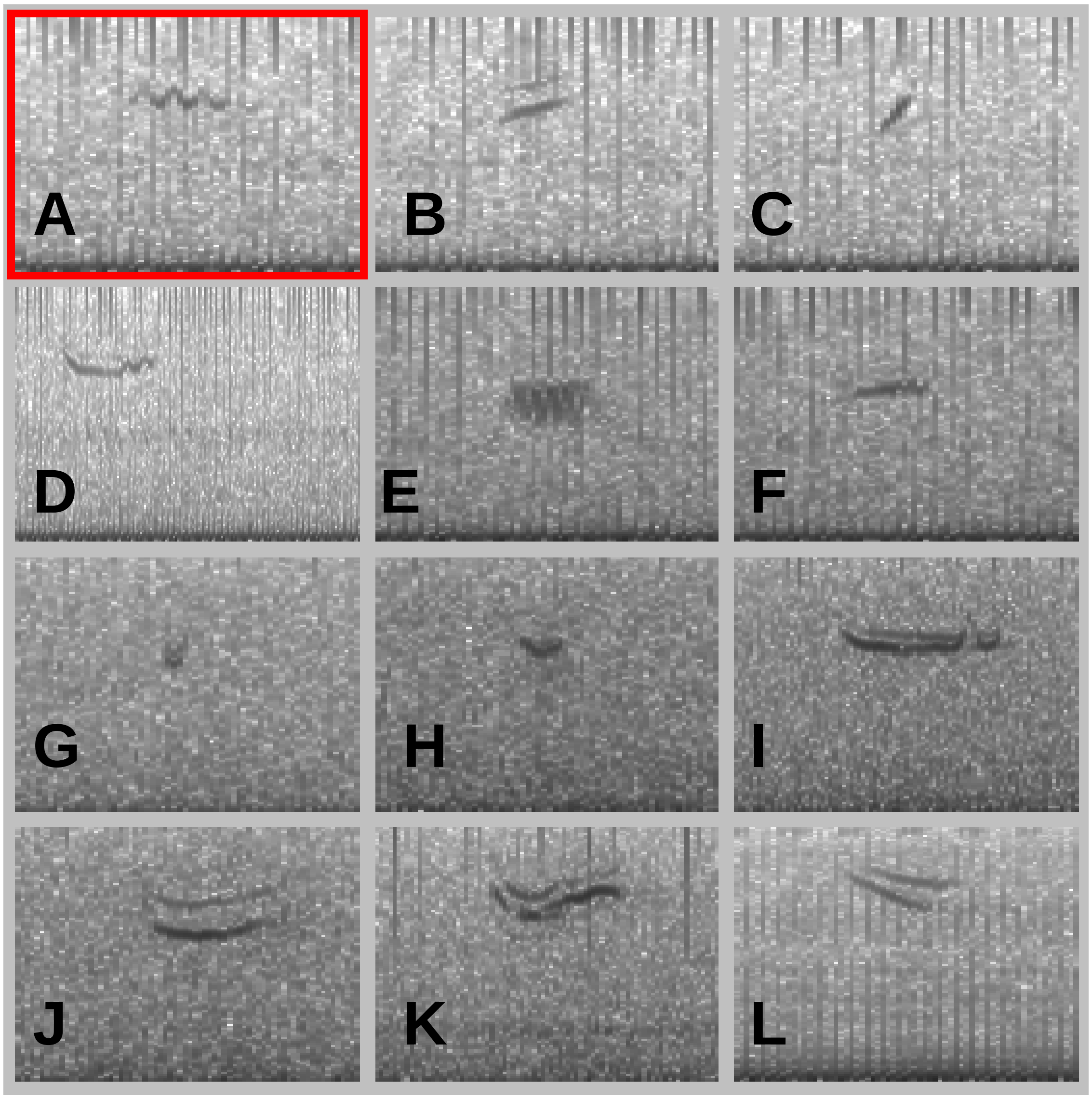
Some call notes could only be identified to a suite, or complex, of species whose call notes sound similar and call spectrographs appear similar. Species within each of these complexes are identified on Table 7-11. Almost all of those species are also common in the vicinity of the project area.

Table 7-11. Summary of Acoustical Monitoring Surveys

Location	Night of	Time of call	Species and Notes
Black Nubble Radar Site	09/25-9/26	9:08 PM	Not classifiable
	09/25-9/26	9:32 PM	Zeep complex
	10/1-10/2	7:03 PM	Zeep complex
	10/1-10/2	7:39 PM	Zeep complex
	10/1-10/2	8:08 PM	Double banded upsweep
	10/1-10/2	8:55 PM	Not classifiable
	10/1-10/2	9:43 PM	Double banded upsweep

Table 7-11. Summary of Acoustical Monitoring Surveys (continued)			
Location	**Night of**	**Time of call**	**Species and Notes**
	10/1-10/2	10:05 PM	Black-throated blue warbler
	10/1-10/2	11:10 PM	White-throated sparrow
	10/1-10/2	11:10 PM	White-throated sparrow, same individual as above
	10/1-10/2	12:14 AM	Common yellowthroat
	10/1-10/2	12:15 AM	Common yellowthroat, same individual as above
	10/1-10/2	12:59 AM	Common yellowthroat
	10/1-10/2	1:49 AM	Yellow-rumped warbler
	10/1-10/2	1:49 AM	Yellow-rumped warbler, same individual as above
	10/1-10/2	2:25 AM	Not classifiable
	10/3-10/4	11:41 PM	Possibly a white-crowned sparrow
	10/8-10/9	12:47 AM	White-crowned sparrow
	10/8-10/9	1:57 AM	Song sparrow
	10/11-10/12	11:36 PM	Probably a dark-eyed junco
	10/14-10/15	1:56 AM	Brown creeper or Golden-crowned kinglet
	10/14-10/15	1:56 AM	Brown creeper or Golden-crowned kinglet, same individual as above
	10/15-10/16	12:44 AM	Canada goose
	10/28-10/29	9:37 PM	Not classifiable
Black Nubble Summit	10/8-10/9	8:07 PM	White-throated sparrow
	10/8-10/9	8:35 PM	Song sparrow
	10/8-10/9	8:53 PM	Single banded upsweep
	10/8-10/9	9:37 PM	Single banded upsweep
	10/8-10/9	12:24 AM	White-throated sparrow
	10/8-10/9	1:30 AM	White-throated sparrow
	10/14-10/15	10:02 PM	Song sparrow
	10/14-10/15	12:58 AM	White-crowned sparrow
	10/14-10/15	1:58 AM	Fox sparrow
	10/17-10/18	11:44 AM	Song sparrow
Yarmouth, Maine	10/21-10/22	8:37 PM	Savannah sparrow
	10/23-10/24	12:50 AM	Savannah sparrow
	10/27-10/28	9:20 PM	Possibly a dark-eyed junco
Zeep complex: includes blackpoll warbler, yellow warbler, blackburnian warbler, and magnolia warbler			
Double-banded upsweep: includes Tennessee warbler, Nashville warbler, black-throated green warbler, orange-crowned warbler, mourning warbler, yellow-rumped warbler, vesper sparrow, and white-crowned sparrow			
Single-banded upsweep: includes white-crowned sparrow and yellow-rumped warbler			

Figure 7-15 Spectrograms of Recorded Bird Calls.



A – 'zeep' complex
B – double-banded upsweep complex
C – black-throated blue warbler
D – white-throated sparrow
E – common yellowthroat
F – yellow-rumped warbler
G – possible dark-eyed junco
H – brown creeper or red-breasted nuthatch
I – white-crowned sparrow
J – song sparrow
K – fox sparrow
L – savannah sparrow

All calls depicted were recorded at the radar site with the exception of K (Black Nubble summit) and L (Yarmouth, Maine).

6.4 Summary and Conclusions

Compilation of the species-habitat matrix suggested that the bird community is the most diverse of the wildlife assemblages in the project area, with 99 potentially occurring breeding or wintering species and an additional 47 species that could be reasonably expected to migrate through or over the area. While fewer species are expected to occur along the project area ridgelines than at lower elevations, a more unique suite of species likely occurs at the summits and ridgelines of Black Nubble and Redington Mountain than in lower elevation sites. Included within this suite are spruce grouse, black-backed woodpeckers, gray jays, boreal chickadees, Bicknell’s thrushes, and blackpoll warblers.

In Maine, these species typically specialize either in high-elevation spruce forests of western Maine or cold, spruce-dominated wetlands in eastern and northern Maine. The lower elevation portions of the project area consist of habitats that are more common in Maine, such as northern hardwood forests, mixed forests, and early successional habitats. Consequently, species that use these habitats are also much more common in Maine.

Results of ceilometer and acoustical surveys, as well as raptor and breeding bird surveys, suggest that bird species assemblages on Black Nubble and Redington Mountain are similar to those found in similar locations in Maine, and that passage rates of migrating raptors are similar or even slightly lower than those observed in similar nearby locations. These surveys also revealed far lower migration activity within the project area than at a reference site on the coast of Maine.

Breeding bird surveys along the ridgelines of Black Nubble and Redington Mountain documented 27 species. Many of these species were common higher elevation species of western Maine, with the most common ones observed being similar to those found during other high elevation surveys in the region.

Radar surveys demonstrated flight patterns in the area may be affected to some extent by local topography. The fall data showed that a small proportion of the targets tracked by the radar were flying towards the direction of the nearest proposed wind turbines on Black Nubble. The majority of bird targets were flying towards the southwest, which was parallel to the northern slope of the mountain range. Spring data showed a wider dispersal of flight directions. That dispersal, however, was into a relatively wide basin formed by the headwaters of Nash Stream, just north of the saddle in the ridgeline between Black Nubble and Redington Mountain.

The radar surveys suggest that birds may be flying low enough to observe topographic features and alter their flight direction to fly along or around high elevations, rather than gain altitude to pass over ridgelines. This same observation has been documented by other researchers in New England. The observations of birds in the ceilometer beam on Redington Mountain and recorded with a microphone located at the peak of Black Nubble, however, indicate that some birds do fly high enough to pass over these higher elevations.

Potential impacts on birds associated with the project include habitat disturbance and collision mortality. Habitat disturbance will be very limited, relative to the amount of available habitat in the region. The risk of avian collision mortality is difficult to predict, although results of radar sampling and raptor surveys suggest that migrating birds may avoid the project area, presumably due to the topography of the site. While a small amount of avian collision mortality is likely inevitable for a project such as this, the project is not expected to result in undue adverse impact on bird species. The issue of collision mortality is discussed further in subsection 9.5 of this report, and potential impacts on specific rare bird species are discussed in subsection 8.2 of this report.

7.0 Mammals

The mammal community in the project area was periodically investigated over five years from 1994 to 2005. The principal goal was to characterize the existing mammal populations in the project area in order to address potential impacts on these animals associated with the development of the Redington Wind Farm. As with other species groups, this was accomplished by identifying the dominant natural communities in the project area, assessing the quality of those habitats, and conducting surveys to document the presence of these species within the project area. Some targeted field surveys were conducted to accomplish this task, including small mammal trapping, surveys for potential deer yards, and consultation with natural resource agencies, particularly regional biologists from MDIFW.

To characterize the community, a literature review of local species distribution and habitat requirements was conducted along with the collection of field data. Field data collected as part of any targeted searches were used in conjunction with incidental observations of these species made during the course of other field investigations.

7.1 General Community Description

The mammal community in the project area is fairly diverse. Like other wildlife populations, the project area ridgelines are inhabited by the fewest species due to a lower diversity of available habitat, harsh climate, and more limited food resources. Seasonal variation in the use of the upper ridgelines probably also occurs, with many of the more mobile species moving to lower areas protected from wind and snowpack during winter.

Small mammals constitute the largest group of mammals in the project area. Each of these species has a specific habitat preference and range; however, these smaller, typically more abundant species are present throughout the project area and the transmission line corridor. Southern red-backed voles and red squirrels are the most obvious small mammals along the project area ridgelines. A more diverse assemblage of these species uses habitats at lower elevations. Clearcut and selection cut areas provide habitat for deer mice, meadow voles, and eastern chipmunks, while more mature mixed and hardwood forests provide more suitable habitat for gray squirrel, northern flying squirrel, and woodland jumping mice. Streamside areas are important for several species of shrew, as are areas of dense forest cover that maintains cool, shaded forest floor conditions. This occurs in the stream valleys at low elevations, along permanent and intermittent drainages at mid- elevations, and along the project area ridgelines. One rare small mammal, northern bog lemming, is known to occur in the project area and is discussed below and in subsection 8.0 of this report.

Of the bat species that potentially occur in the project area, the little brown bat and the northern long-eared bat are likely the most common (DeGraaf and Yamasaki 2001). From 1996-1997, the little brown bat and long-eared bat were the two most common species encountered during mist net surveys within Acadia National Park (ANP) and adjacent sites in eastern Maine (Zimmerman and Glanz 2000). From 1992-1993, Krusic *et al.* (1996) also captured the northern long-eared bat and little brown bat more frequently than other species during mist net surveys in the White Mountain National Forest (WMNF); however, general capture numbers were lower in the WMNF when compared to ANP. These two species share similar habitat preferences: feeding in clearings and near ponds and streams and roosting in cavities within dead hardwood trees.

The remaining five bat species also feed over ponds and streams and occasionally over roads or trails through forests. As a group, bats are more commonly found near wetlands and in habitats containing large numbers of insects during their nighttime feeding. In the project area, habitats along the lower elevation transmission line corridor provide the most suitable feeding habitat for bats, due to its higher density of wetlands, more open forest community, and milder roosting conditions. Beaver flowages found along the perennial streams in the vicinity of the project area also provide important habitat for foraging bats. Conversely, the project area ridgelines do not provide optimal habitat for these species. In general, tree sizes along the ridgelines and upper slopes are too small to provide suitable summer roosting sites and the cool, windy conditions do not foster the development of readily accessible, dense prey populations. Field surveys for bats are described in subsection 8.3.4 of this report.

Other northern forest mammals common to the project area include the snowshoe hare, several of the mustelids (weasels), bobcat, fox, and coyote. Species occurring at higher elevations include snowshoe hare and pine marten, as well as occasional red fox and coyote. Additional species become more common at lower elevations. Ermine and long-tailed weasel habitat is particularly abundant in clearcuts and heavy selection cuts, where small mammal densities are typically high and an abundance of low cover and brush piles occurs. Streams and wetlands at lower elevations provide habitat for additional species, particularly beaver but also mink, skunks, and raccoons.

Several large mammals are common in the project area. The most obvious is the moose, which occurs at all elevations and habitats. White-tailed deer also occur, though their presence at higher elevations is less common. Black bear use the project area ridgelines, as evidence of their presence was observed near the peak of Black Nubble. However, the disturbed forests in the vicinity of the project area (where timber has been harvested) provides more important feeding habitat for black bears, which have been shown to feed in transmission line corridors and railroad right-of-ways in New Hampshire (Meddleton and Litvaitis 1990 *in* DeGraaf and Yamasaki 2001). Slash piles that remain in the harvested areas also provide potential bear den sites.

Canada lynx, a federally listed threatened species and a state-listed Special Concern species, is also known to occur in the region. The range of the Canada lynx is slightly north of the project area, but because the project area is part of a large contiguously forested region and contains appropriate habitat, the lynx could potentially occur in the project area. MDIFW also indicated, in 2001 and 2003, that they had received several reliable lynx reports in the previous ten years (M. Caron, MDIFW, pers. comm.). It is discussed in more detail in subsection 8.0 of this report.

7.2 Methods

7.2.1 Species-Habitat Matrix

The objective of this mammal community characterization was to identify mammals that could be expected to occur in the project area and to identify the habitats that they would utilize. Aerial photography, topographic maps, and reconnaissance-level site visits were first used to generate a list of habitat types present in the project area. Regional and local literature was then used to generate a list of species that could potentially occur in the vicinity of the project area (DeGraaf and Yamasaki 2001, Whitaker and Hamilton 1998). Only those species likely to be found in the habitat types found in the project area were included. A species-habitat matrix was then constructed that identifies those species expected to occur and their seasonal habitat use of the available habitats. As part of this effort, MDIFW was contacted to request records of rare, threatened, or endangered mammal species in the project area, or any significant wildlife habitats for mammals, such as deer wintering areas.

7.2.2 Incidental Observations

The presence of mammals in the project area was documented during field investigations in 1993 and 1994 and from 2000 to 2003. Many field investigations were detailed studies for a variety of taxonomic groups but provided the opportunity for observations of the mammal community in the project area. These observations were typically made by simply identifying the species observed and recording notes on the general location, habitat, and observed activity. This information was used to refine the species-habitat matrix and verify the occurrence of species within the project area.

7.2.3 Small Mammal Trapping

Small mammal trapping was conducted during the late summer and early fall and focused on areas above 2,700 feet along the ridgelines, streams, and damp areas supporting sphagnum moss. Trapping was conducted largely in fir-heartleaved birch subalpine forests and spruce-fir-mountain sorrel-feathermoss forests, as these habitats dominate the upper elevations of the project area and are more suitable for some of the rarer species of small mammals in Maine (Figures 7-16 and 7-17). Traps were positioned in a variety of microhabitats, located near natural crevices and woody debris, and along observed small mammal runs. Traps were arranged in clusters and baited with peanut butter. Traps were typically placed in groups of 5 to 50, to saturate suitable small mammal microhabitats, and were set to capture animals for 1 to 2 nights.

Trapping efforts occurred on Redington Mountain for a total of 1,620 trap nights (TN) between August 31 and September 2, 1994, and on Black Nubble for a total of 950 TN between September 4 – 7 and October 16 – 17, 2001. Snap traps were the primary means of trapping, although pitfall traps were also used on Redington Mountain (120 TN of the 1,620 total).

7.2.4 Deer and Moose Wintering Habitat Surveys

MDIFW has specific procedures for locating and mapping deer wintering areas. The first step consists of an aerial survey of known sites and additional sites that appear to have suitable habitat characteristics during years with appropriate winter conditions. If, during the flight, suitable habitat conditions and deer use are documented, a follow-up ground survey of the area is conducted to document the level of use by wintering deer (MDIFW survey procedure, 12/22/93).

Prior to conducting surveys, existing LURC maps of deer wintering areas in the project area and within the five surrounding townships were reviewed. This larger area included

Coplin Plantation, Redington Township, Mount Abram Township, Carrabassett Valley, and the northwest corner of Kingfield. The MDIFW was also contacted to identify any known or potential deer wintering habitat in the area. In addition to contacting the MDIFW, foresters and land managers from both the International Paper Company and Scott Paper Company were contacted as to any preliminary or documented evidence of deer wintering habitat on their respective properties.

Based on this information, a flight path was proposed that would first cover known deer wintering areas in Coplin Plantation and then would focus on the access roads to the project area and the high elevation regions of Redington Mountain. This flight path was reviewed by MDIFW prior to the survey and flown in April 1994. Biologists experienced in conducting aerial surveys for deer wintering areas flew over the site at an altitude of approximately 500 feet, following the prescribed flight plan. All areas of potential winter deer activity were noted on USGS 7.5' topographic maps.

7.2.5 Canada Lynx Snow Tracking Surveys

Through consultation with MDIFW, the need to conduct Canada lynx surveys in the vicinity of the project area was identified. MDIFW offered to conduct those surveys and did so in 1994 and 1995. Surveys were conducted by snowmobile and on snowshoes and generally entailed traveling through accessible areas and inspecting all animal tracks observed. MDIFW completed a similar ecoregional snow track survey during the winter of 2005, with no documented occurrence of lynx sign in the entire western Maine survey area (C. Hulsey, MDIFW, pers. comm.).

7.3 Results

7.3.1 Species-Habitat Matrix

Based upon available literature on species distribution and habitat preferences, 46 mammal species were identified as being potential residents of the project area. These included 7 bat species, 22 small mammal species, 12 medium-sized species, 4 large predators, and 2 large herbivores. These species are identified, along with their seasonal habitat requirements in the species-habitat matrix located in Appendix B Table 1.

Although only 19 of the 46 potentially occurring mammal species were observed during field surveys, additional species are expected to occur within the study area. This is due largely to the fact that field surveys focused on the project area ridgelines, where thick vegetation made observation difficult, and where fewer species are expected to occur, because of the harsher climatic conditions and smaller food supply. Also, several of the mammal species expected to occur in the study area are secretive or require very specific survey techniques to observe.

A total of five small mammal species were documented on Redington Mountain in 1994 (Table 7-12). Three species, one of which was not found on Redington, were documented on Black Nubble in 2001 (Table 7-12). The most common species caught on both mountains was the southern red-backed vole, which comprised 98 percent of the captures on Black Nubble and 86 percent of the captures on Redington Mountain. Four species of shrew were documented on the project area ridgelines—three on Redington Mountain and two on Black Nubble—although only a small number of individuals were captured. Interestingly, no deer mice or meadow voles were observed on the project area ridgelines. These two species are typically fairly common and are as common, regionally, as southern red-backed voles. It is anticipated that these species are very common in lower elevation habitats associated with the proposed transmission lines, particularly regenerating harvested areas. However, their numbers are expected to be low within the ridgeline habitats in the project area, where the climate is harsher and food resources scarcer.

Table 7-12. Small Mammal Trapping Results

Species	Redington Mountain		Black Nubble	
	# Captured	Captures per 100 TN	# Captured	Captures per 100 TN
Masked shrew	2	0.12	2	0.21
Smoky shrew	3	0.19	--	--
Pygmy shrew	2	0.12	--	--
Northern short-tailed shrew	--	--	1	0.11
Southern red-backed vole	55	3.4	128	13.5
Northern bog lemming	1	< 0.1	--	--
Totals	64	3.95	131	13.68

7.3.2 Deer and Moose Wintering Habitat

Moose and deer are common in the project area. Moose are common at all elevations while deer are probably less common at the high elevations of the project area ridgelines. Moose winter in the vicinity of the project area ridgelines, side slopes, and valleys, as evidenced by shed antlers observed in several locations around Black Nubble and on the northern slope of Redington Mountain. Shed antlers were observed most frequently in clearcuts, heavy selection cuts, or along the periphery of these areas. Additionally, large accumulations of scat, presumably from concentrated and sustained winter use, were occasionally observed in these areas as well as in full-canopied spruce and fir stands along the edges of harvested areas on Black Nubble and Redington Mountain.

According to information provided by LURC, MDIFW, and local paper company officials, no mapped deer wintering areas exist within or immediately near the project area. Of the five towns reviewed, only Carrabassett Valley contains Significant Wildlife Habitat mapped by the MDIFW. Based on flight data from MDIFW aerial surveys flown in 1993 and 1994, the only areas of winter deer activity in the expanded project vicinity are along the Dead River in Coplin Plantation and in Kingfield.

No deer activity was observed during surveys of the project vicinity in March of 1994. Additionally, no evidence of concentrated deer wintering activity was observed in the area during the April 1994 aerial survey. Based on this lack of evidence of wintering deer in the project area, no targeted ground surveys were conducted. Subsequent wildlife and habitat surveys of the project area from 1994 to 2003 verified a limited amount of use of the site by white tailed deer at upper and mid elevations, with an increased incidence of deer sign at lower elevations.

7.3.3 Canada Lynx Snow Tracking Surveys

The MDIFW did not document any Canada lynx tracks during their surveys in the vicinity of the project area during their 1994 and 1995 surveys. However, some more recent, reliable observations of lynx have been received by MDIFW within 15 miles of the project since that work in 1994 and 1995 (M. Caron, MDIFW, pers. comm.). MDIFW completed a similar ecoregional snow track survey during the winter of 2005, with no documented occurrence of lynx sign in the MDIFW Region in which the project area occurs (C. Hulsey, MDIFW, pers. comm.).

7.4 Summary and Conclusions

Mammal species that are typically found in the higher elevation habitats in northwestern Maine, such as moose, red squirrels, showshoe hare, and several species of small mammals, were common in the project area. The project area also provides habitat for several rare species, including the northern bog lemming, yellow-nosed vole, and Canada lynx, which have either been observed in the project area, or are suspected to occur in the region. Based upon the documentation of northern bog lemming in the ridgeline habitat, the proposed turbine layout has been altered such that no turbines are located within the preferred northern bog lemming habitat or within a 250 foot buffer zone around this habitat. Potential impacts on the northern bog lemming and other rare species are discussed further in subsection 8.3 of this report. In general, the upper elevation ridgelines of the project area provide habitat for fewer species and receive less use than lower elevations, due to the harsher climate and smaller food supply within the higher elevation habitat.

Bats are anticipated to concentrate habitat use near open and edge areas (e.g., clearcuts, yarding areas, roads and trails) and water bodies (ponds, stream corridors, marshes, etc.) that are preferred habitats occurring at lower elevations in the project area. Due to the harsh climate and scarcity of suitable feeding and roosting trees on the ridgelines of Redington Mountain and Black Nubble, the bat community near the proposed turbines is expected to be small, with a low species diversity. Acoustic bat surveys were conducted in the late summer and fall of 2005 near the summit of Black Nubble. The results of that work and an assessment of potential impact of the project to bats are discussed further in subsection 8.3 of this report.

This project is not expected to cause undue adverse impact on mammal species. Although the northern bog lemming is likely one of the most vulnerable species, due to its low mobility and special habitat requirements, the project footprint has been adjusted so as to minimize the likelihood of impact to this species. The construction of access roads and transmission lines will result in inevitable short term impacts, but these roads will not sustain high traffic volumes and will therefore have minor long term impacts on mammal species. Bats are the least understood mammal species in the project area, and are susceptible to collision mortality, but Redington Mountain and Black Nubble are not located within habitat of the Indiana Bat, and do not have characteristics that would be expected to increase the risk of collision mortality.

8.0 Rare, Threatened, and Endangered Species

Much of the project area consists primarily of high elevation spruce and fir-dominated forests. Forested mountaintop communities generally have a limited distribution in Maine and often support an assemblage of species that is distinct from more common lower elevation forests. Also, because high elevation forests are typically less altered by human development and timber harvesting operations, these forest communities provide habitat for species whose ranges have been limited by human activities occurring on lower elevation landscapes. This section of the report summarizes what is known about the distribution and life history of rare, threatened, and endangered species that may occur in the project area or for which specific field investigations were conducted.

8.1 Reptiles and Amphibians

8.1.1 Spring Salamander – Special Concern Species

The northern spring salamander is a species of Special Concern in Maine. Spring salamanders are primarily aquatic and typically overwinter in damp burrows near streams (Hunter *et al.* 1999). These salamanders have no lungs and must absorb oxygen through their skin and membranes in their throat (Markowsky 1999). They are large salamanders and have a small surface area, relative to their mass, through which to absorb oxygen. This restricts northern spring salamanders to cold (<12º C) water bodies with a high degree of dissolved oxygen. Northern spring salamanders are typically found only in undisturbed areas, as they are especially susceptible to stream degradation.

However, no spring salamanders were found during searches in Nash Stream, Stony Brook, and larger tributaries to these streams. The extent of industrial timber harvesting may have had some influence on local populations over time. Additionally, most of the perennial stream habitat observed in the vicinity of the project area occurs low in the valleys, with most of the upper headwater streams being temporary. This further reduces the availability of suitable habitats for this species.

8.1.2 Northern Leopard Frog – Special Concern Species

Northern leopard frogs inhabit wet meadows and grassy areas in the summer, and overwinter in permanent bodies of water such as streams and ponds that do not freeze completely (Hunter *et al.* 1999). Leopard frogs breed in shallow water bodies with emergent vegetation, such as ponds and shallow pools in gentle streams. Because these habitats are not found in the ridgeline portions of the project area, leopard frogs are expected to be found exclusively at lower elevations, such as near the transmission line corridor, where they would likely be using aquatic habitats such as permanent streams and beaver flowages for breeding and overwintering. The proposed transmission line does cross several perennial streams but has been located away from large, open water bodies like beaver flowages. Therefore, no undue adverse impacts are predicted for this species.

8.2 Birds

8.2.1 Golden Eagle – Maine Endangered Species

Although common in the western U.S., the golden eagle is one of the rarest breeding birds east of the Mississippi River and only one breeding pair of golden eagles has been documented in Maine since 1984 (Todd 1989). Maine considers the species to be endangered, but golden eagles are not federally listed due to stable western populations. Golden eagles typically inhabit mountainous areas and have been found nesting on cliffs associated with undisturbed coniferous forests in Maine (Boone and Krohn 1996 as cited in DeGraaf and Yamasaki 2001). In 1993, the MDIFW identified Black Nubble and three nearby mountain peaks (Bigelow Mountain, Old Turk Mountain, and Mount

Abraham) as potential golden eagle nesting sites and recommended surveys be conducted in these locations specifically for golden eagles.

An initial aerial survey for golden eagle nest sites was flown over the four mountains mentioned above on April 5, 1994, in conjunction with an aerial deer wintering area survey. Ground-based surveys using binoculars and spotting scopes were also conducted on Bigelow Mountain on April 8 (5.5 hours), Old Turk Mountain on April 8 and 20 (20.75 hours), Mount Abraham on April 14 and 15 (17.25 hours), and Black Nubble on April 15 and 21 (17.5 hours). MDIFW also surveyed an additional undisclosed location. These surveys did not reveal the presence of any golden eagles or golden eagle nesting sites. In addition, no golden eagles were observed during any of the hawk migration surveys that were conducted in and near the project area in the fall of 1993, spring of 1994, and fall of 1994.

8.2.2 Cooper's Hawk – Special Concern Species

Cooper's hawks are considered rare and localized breeders in New England and nest in a variety of habitats, including coniferous, deciduous, and mixed forests. They are tolerant of fragmentation and will occur in relatively small forest stands. They feed on birds and small mammals and typically feed in more open habitats near wooded areas (DeGraaf and Yamasaki 2001).

The stunted coniferous forests on the ridgelines of Redington Pond Range and Black Nubble do not provide ideal nesting habitat for Cooper's hawks, so their presence in the project area is expected to be incidental at most. Lower elevation forest stands may provide suitable habitat, particularly those that are older and provide suitable nesting sites. They could also use some of the cleared areas at lower elevations for feeding habitats. Five Cooper's hawks were observed in the vicinity of the project area. All observations, however, occurred during hawk migration surveys and included one sighting at Sugarloaf Mountain in the fall of 1993, one sighting at Bigelow Mountain in the spring of 1994, and 3 sightings at Mount Abram in the spring of 1994. No evidence of Cooper's hawks nesting in the vicinity of the project area was documented.

8.2.3 Three-toed Woodpecker – Special Concern Species

Three-toed woodpeckers feed on insects in dead or decaying wood, and inhabit coniferous forests, especially those that have been recently burned or logged, provided that sufficient dead trees remain (DeGraaf and Yamasaki 2001). The high elevation ridgelines in the project area do provide suitable habitat conditions for this species and black-backed woodpeckers, a species with similar habitat requirements, were observed in the project area. No three-toed woodpeckers were observed during bird surveys in the project area, although the presence of clearcuts near the project area and blowdowns on the mountain slopes and ridgelines could provide a suitable food supply for the species.

8.2.4 Olive-sided Flycatcher – Special Concern Species

Olive-sided flycatchers inhabit montane coniferous forests with tall, standing dead trees and open northern wetland systems such as bogs and fens (DeGraaf and Yamasaki 2001). They prefer open habitats with an abundance of individual standing trees for feeding perches and have been noted to benefit from openings within conifer forests. Olive-sided flycatchers feed on flying insects, and could utilize cut over areas for feeding habitat. No olive-sided flycatchers were observed during Breeding Bird Surveys along the project area ridgelines. However, an individual was observed near a wetland system at a lower elevation in a regenerating clearcut east of Redington Mountain during a field survey in 2002.

8.2.5 Bicknell's Thrush – Special Concern Species

Bicknell's thrushes have been identified as one of the least common passerines in eastern North America (Pashley *et al.* 2000, Rosenberg and Hodgman 2000). Although little empirical population evidence exists for the Bicknell's thrush, its habitat and range have been declining due to habitat loss and degradation (Atwood *et al.* 1996). Bicknell's thrushes inhabit high-elevation ridgeline spruce/fir communities, and depend upon the thick stunted vegetation of these habitats for nesting (Atwood *et al.* 1996, Rimmer *et al.* 1996, DeGraaf and Yamasaki 2001). They have also been shown to inhabit early successional clearcuts at low and high elevations in Canada (Ouellet 1993, Nixon *et al.* 2001).

Black Nubble and Redington Mountain are both encompassed within a large continuous landmass area over 21,000 acres in size that occurs above 2,700 feet in elevation. This represents an abundance of suitable habitat conditions for this species within the region. Consequently, it is a locally common species in the region. Field surveys confirmed the presence of Bicknell's thrushes on Redington Mountain and indicated that their presence on Black Nubble was possible, but less likely. Bicknell's thrushes were observed during 34 of 60 survey samples (57%) on Redington Mountain in 1994. However, because those surveys were conducted at 20 points that were each surveyed 3 times, it is anticipated that those 55 observations represented 18 individuals. In 2002, a total of 5 individuals were observed at 5 out of 20 sampled locations (25%), and an additional 6 individuals were observed outside of the survey samples. Surveys of nine sample locations on Black Nubble in 2002 did not confirm the presence of Bicknell's thrushes, but two unidentified thrushes were observed in thick stunted balsam fir/spruce thickets near the summit survey point and were presumed to be Bicknell's thrush.

The project will result in disturbance of a total of 135.76 acres above 2,700 feet. This includes impacts associated with turbine pads (13.14 acres), transmission lines (10.23 acres), and access roads (112.39 acres). However, the project would be limited to ridgeline habitats and would affect only a small portion of the viable habitat that exists on both peaks. No specific information occurs regarding interactions between Bicknell's thrushes and wind power facilities. However, preliminary data from surveys conducted by the Vermont Institute of Science within a ski area suggests that the species is relatively tolerant of disturbance, and may actually select cleared areas, which mimic naturally disturbed areas (Rimmer *et al.* 2004).

Because the transmission lines and turbine openings along ridgelines will result in tree clearing similar to that found in a clearcut, Bicknell's thrushes will likely be able to inhabit these areas following disturbance. Observations at the existing meteorological measurement towers on Redington Mountain corroborate the finding that high elevation openings in the forest do not necessarily restrict habitat use by Bicknell's thrush. Bicknell's thrushes were repeatedly observed perching and calling at both active meteorological towers on Redington Mountain as well as at other openings previously created for meteorological towers and near edges of natural canopy openings (e.g, blowdowns). Based on observations of breeding bird habits at an existing New England wind power facility, it is anticipated that the Bicknell's thrush population in the study area will habituate to the wind turbines following construction.

Although all bird species could be impacted by collision mortality from an operating wind farm, none of the rare, threatened, or endangered bird species likely to inhabit the project area are particularly vulnerable to collision. Collision mortality is discussed further in subsection 9.6 of this report. Also, disturbances above 2,700 feet, which provide unique habitat for the Bicknell's thrush, will affect only a very small portion of available habitat. Consequently, this project is not expected to result in undue adverse impacts for rare, threatened, or endangered bird species in the project area, either as the result of habitat loss or collision mortality.

8.3 Mammals

8.3.1 Long-tailed Shrew – Special Concern Species

The long-tailed shrew inhabits cool coniferous forests with an abundance of moss-covered rocks and logs as well as wooded talus slopes (DeGraaf and Yamasaki 2001).

This habitat type is abundant in and around the project area, and the project will affect only a small percentage of available habitat for the long-tailed shrew. The range of this species is tied to high elevation areas in the Appalachian Mountain Range. Although suitable habitat for this species does occur in and around the project area, none were caught during 1994 and 2001 trapping surveys.

8.3.2 Yellow-nosed Vole – Special Concern Species

The yellow-nosed vole inhabits coniferous and mixed forests at higher elevations, favoring cool, damp moss-covered rocks and talus slopes (DeGraaf and Yamasaki 2001). They are restricted to northern and western Maine, northern New Hampshire, and the higher elevations of Vermont, westward to the Adirondacks and southward, down the Appalachians to Tennessee. MDIFW records indicated that yellow-nosed voles do occur in the region and the presence of suitable habitat throughout the high elevation areas of the project area and vicinity indicate that it is possible that it occurs. None were caught, however, during trapping efforts in 1994 and 2001. As is the case for the long-tailed shrew, abundant suitable habitat for this species occurs within and around the study area, and only a small percentage of this habitat will be impacted by the project. Undue adverse impacts are expected for neither species.

8.3.3 Northern Bog Lemming – Maine Threatened Species

Small mammal trapping conducted on the ridgeline of Redington Mountain in 1994 documented the presence of a northern bog lemming, a state-listed Threatened species.

Photo 29. Wooded wetland habitat in which bog lemming are located.

Prior to this observation, only seven documented observations existed in the northeastern U.S. (Clough and Albright 1987). Previous observations in Maine had been made in the alpine zone of Mt. Katahdin, and in a lower elevation spruce forest in western Baxter State Park. Since 1994, two observations of northern bog lemmings have also been made in northern Maine (C. Todd, MDIFW, pers. comm.). The identity of the bog lemming collected on Redington Mountain was verified by mammalogists at the American Museum of Natural History in Washington, D.C. It was captured in a low, forested wetland located near the saddle of the Redington Mountain ridgeline, in the vicinity of the existing southern meteorological tower. The wetland was dominated by 15 to 25-foot tall black spruce, red spruce, and balsam fir along its periphery with smaller, 3 to 6-foot tall trees at its center. The ground layer was dominated by sphagnum mosses (primarily *Sphagnum girgensohnii, compactum, russowii, capillifolium,* and *rubrum*) with occasional herbaceous species such as three-seeded sedge, goldthread, and bunchberry (Photo 29).

Relatively little is known about the biology and ecology of the northern bog lemming (DeGraaf and Yamasaki 2001, Whitaker and Hamilton 1998). It largely occurs in high-elevation habitats like those found in the project area, though it is found at lower elevation further northward, and has been found in a variety of habitats, including alpine meadows, Krummholz spruce-fir forests, and forested areas containing sphagnum mosses (Whitaker and Hamilton 1998, Clough and Albright 1987). The rarity of this species may be due, in part, to a lack of survey effort for the species, as the relative inaccessibility of these types of habitat has likely limited past attempts to document this species. Due in part to the sensitivity of rare species populations, no additional investigations have been conducted to document this population. It is anticipated that this species could inhabit other similar areas along the ridgeline that it was found on, namely another open-canopied forested wetland located within the saddle portion of the Redington Mountain ridgeline.

Based on the documentation of the northern bog lemming on Redington Mountain, suitable wetland habitats were identified and mapped, and a 250 foot buffer zone was implemented around these wetlands as a first level of protection (Figure 7-18). Turbine 7 was originally proposed to be located adjacent to one of these wetlands, and the ridgetop access road was designed to cross between this wetland and the other forested wetland on the ridge suspected of providing habitat for bog lemmings, turbine . To reduce potential impact on the species, turbine 7 was relocated westward, outside of the 250-foot buffer zone. The ridgetop access road for turbine 7 was also re-aligned, so that the section of road between turbines 6 and 8 is now located west of the wetlands. Although this alignment includes approximately 400 feet of road within the 250-foot buffer zone, this is significantly less than the original road alignment, which included over 1,000 feet of road in the buffer located between the wetlands with suitable lemming habitat. A protection plan has been prepared for this area to protect, to the extent possible, the lemming habitat on Redington Mountain. Details of that plan are provided in subsection 10.0 of this report.

Due to the sensitivity of the northern bog lemming, the project plan has been adjusted to minimize potential impact on the species to the greatest extent practicable. Relocation of turbine 7 and the associated access road has greatly reduced the potential for the project to impact the species. Based on these design modifications, and the small overall footprint of the project within the preferred habitat of the northern bog lemming, this project is not expected to have undue adverse impact on the species.

8.3.4 Bats – Special Concern Species

Based on normal geographical distributions, seven species of bats could be expected to occur in the vicinity of the Redington Wind Farm. These species are the little brown bat, northern long-eared bat, eastern pipistrelle, eastern red bat, hoary bat, silver-haired bat, and big brown bat. Little specific information is currently known about population levels and distributions of these species in the Northeast and all seven species are consequently listed as Species of Special Concern in Maine. Initial field surveys and subsequent discussions that occurred between 1994 and 2003 with MDIFW staff did not identify concern with potential impacts to bats at the Redington Wind Farm. This general lack of concern was based on the sub-alpine and high elevation habitat conditions of the site, the lack of known bat hibernacula in the region, and the suspected low populations of bats in the region.

Wind projects have been cited as a potential threat to migrating bats for a number of years, especially since a study at the Mountaineer Wind Energy Facility in Tucker County, West Virginia, documented 475 dead bats between April 20 and November 9, 2003 (Johnson and Strickland 2004). Subsequent fieldwork in 2004 at the Mountaineer site and nearby Meyersdale Wind Facility has revealed even higher rates of bat collision mortality with operating wind turbines (Arnett 2005). These studies have raised numerous concerns regarding the potential for collision mortality associated with wind turbines to impact bat populations (Williams 2003). The concerns lie primarily with wind farms in the eastern U.S., where documented bat fatality rates have been considerably higher (bats per turbine per year) than at western wind farms (Williams 2003, Arnett 2005).

Researchers currently have limited understanding of the specific factors influencing rates of bat collision mortality, although evidence from the timing of fatalities documented at existing wind facilities and other structures suggests that migrating bats are at the highest risk (Johnson and Strickland 2004, Johnson *et al*. 2003, Whitaker and Hamilton 1998). A number of plausible hypotheses explaining the high rates of bat mortality have been presented by bat researchers, but none of these have been adequately tested or proven.

In response to these concerns, MDIFW requested bat surveys be conducted in the Redington Wind Farm Project area at a pre-application meeting on August 22, 2005. Acoustic monitoring surveys were initiated on the summit of Black Nubble on August 26 and continued through November 2, 2005.

Acoustic Bat Monitoring

Acoustic bat monitoring was conducted near the summit of Black Nubble (1,055 m or 3,460 ft elevation) to assess bat activity along one of the project area ridgelines. These surveys consisted of passive acoustic monitoring during the fall months, which are expected to have the highest levels of bat activity in this region due to bat swarming and migration behaviors. Anabat II (Titley Electronics Pty Ltd) bat detectors were used for the duration of this study. Anabat detectors are frequency-division detectors, dividing the frequency of ultrasonic calls made by bats (a factor of 16 was used in this study[3]) so that they are audible to humans. These detectors are able to detect all bat species known to occur in New England using this setting. Data from the Anabat detectors were logged onto compact flash media using a CF ZCAIM (Titley Electronics Pty Ltd) and downloaded to a computer for analysis.

The acoustic surveys were designed primarily to document the occurrence and detection rates of bats near the ground and at heights near the low end of the blade-swept area of the proposed turbines. To do this, two detectors were suspended from the guy wires of the Black Nubble met tower, at heights of approximately 10 m (30 ft) and 20m (65 ft). Detectors were programmed to operate from 6:00 pm to 8:00 am each night. One detector was deployed continuously August 26 to November 2, 2005. A second detector was operated at the site from September 13 to September 21, 2005.

Data Analysis

Data files were downloaded from the CF ZCAIM in the field, and potential call files were extracted from data files using CFCread© software, with default settings in place. This software screens all data recorded by the bat detector and extracts call files based on the

[3] The frequency division setting literally divides ultrasonic calls detected by the detector by the division setting in order to produce signals at frequencies audible to the human ear.

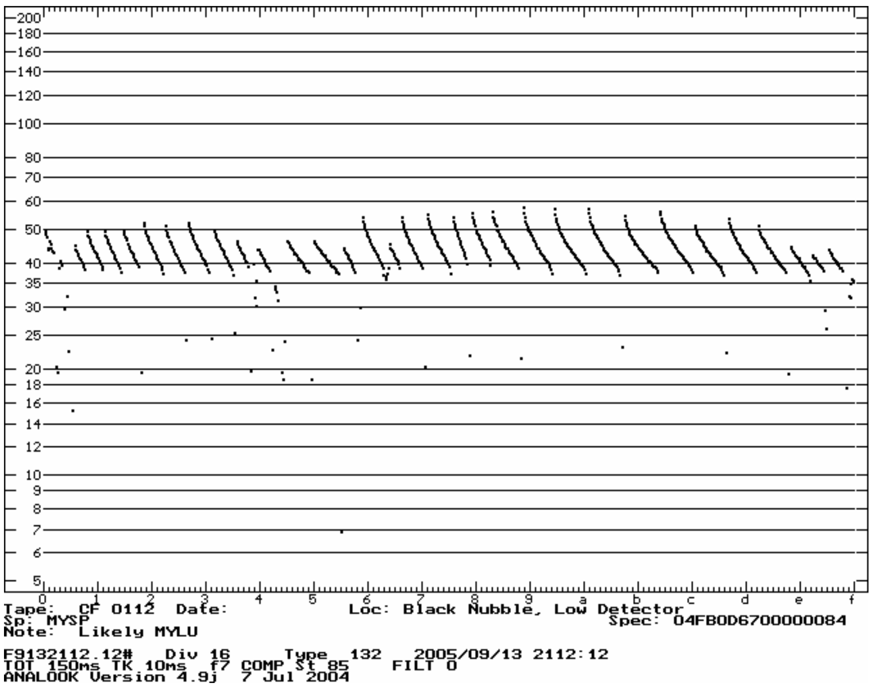
number of pulses recorded within a certain time period. Every potential call file was visually inspected, with any distinct grouping of recognizable calls or call fragments being considered a bat call sequence. Call sequences were identified based on visual comparison of call sequences with reference libraries of known calls collected by Chris Corben, Lynn Robbins, and the University of Maine Mammalogy Department using the Anabat system. Calls created by bats are easily distinguished from occasional noise created by surrounding features, such as wind in the met tower and trees.

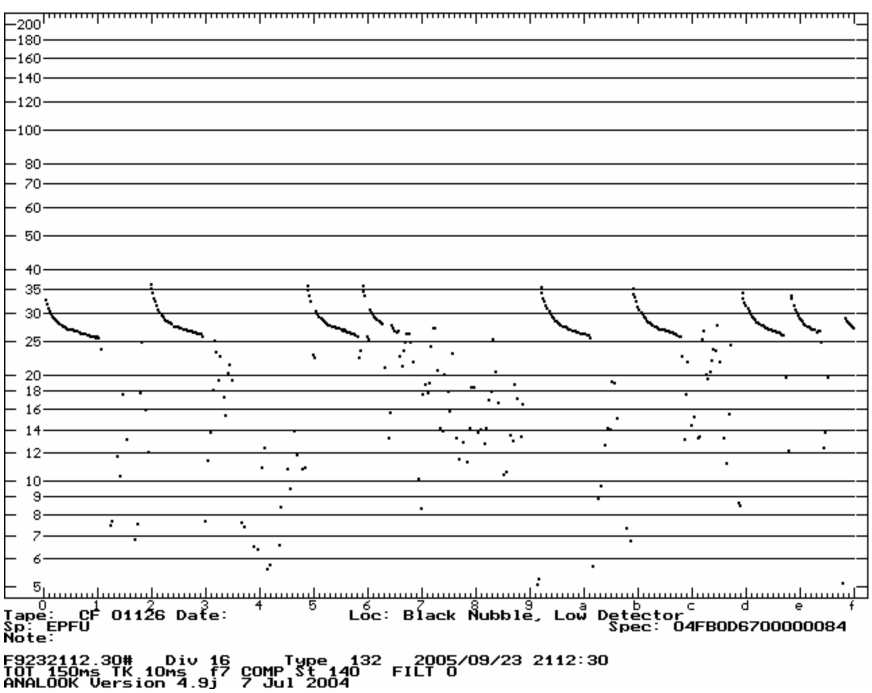
Qualitative visual comparison of recorded call sequences of sufficient length to reference libraries of bat calls allows for relatively accurate identification of bat species (O'Farrell *et al*. 1999, O'Farrell and Gannon 1999). However, the accuracy of this method depends upon experience of the reviewer and the relevance of reference call files used. Because reference calls used in the Redington analysis were developed by other researchers, most of which were of western origin, a conservative approach to identifying the species that created each recorded call was used. Poor quality recordings or brief fragments were labeled simply as unknown, except in cases where there was reasonable assurance that the fragment was exclusively within the *myotid* frequency range. *Myotids* were not identified to species, due to the similarity of calls between species within this genus. Figure 7-19 contains representative examples of call files recorded by the detectors.

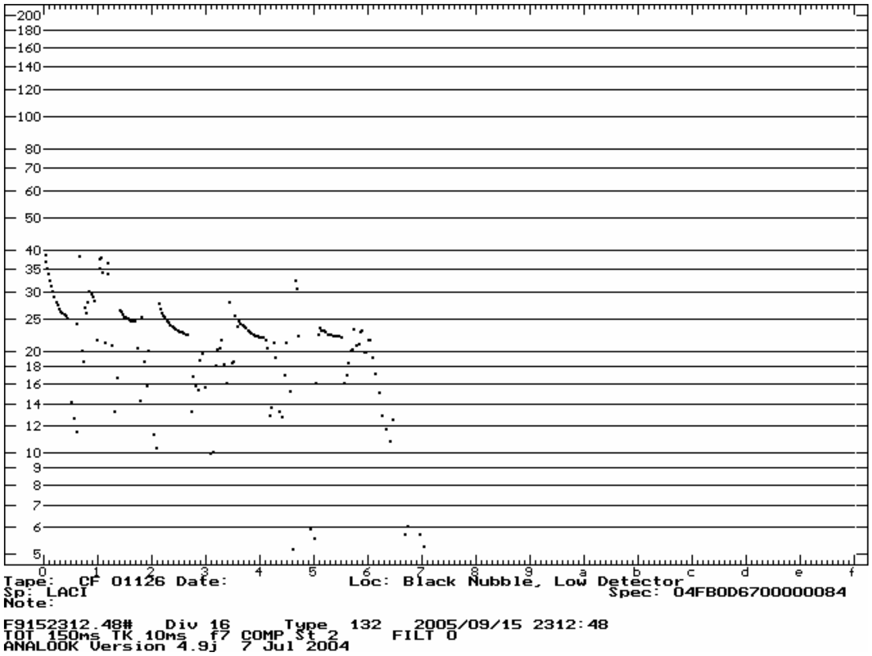
Once all of the call files were identified, nightly tallies of detected calls by species were compiled for each detector. A mean detection rate for the survey period was also. Detection rates indicate only the number of calls detected and do not necessarily reflect the number of individual bats in an area.

Figure 7-19
Representative calls of each species identified during acoustic bat monitoring at Black Nubble during fall 2005.

(EPFU = big brown bat, LACI = hoary bat, MYSP = *Myotis* sp., MYLU = little brown bat, UNKN = unknown.)



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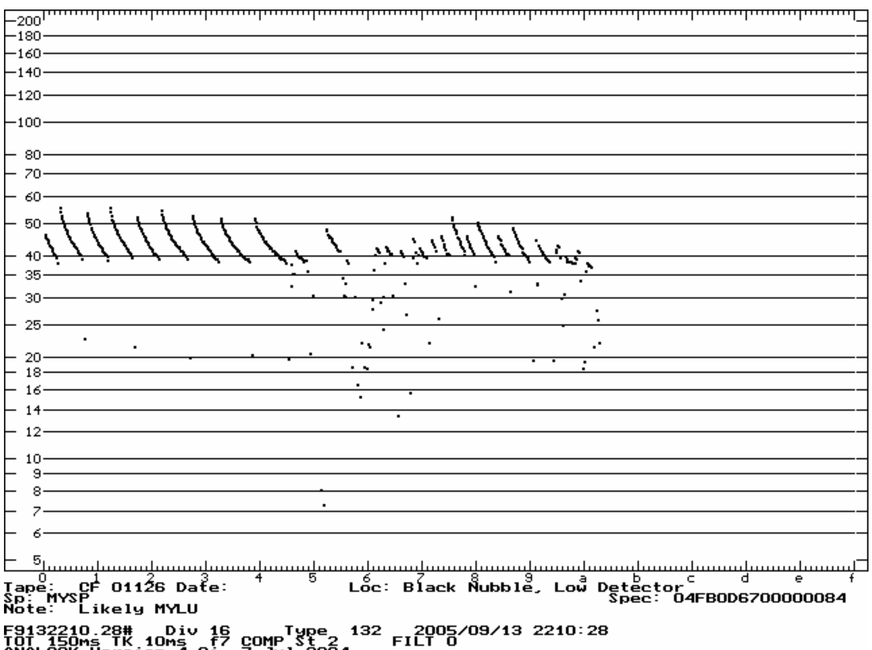
0 1 2 3 4 5 6 7 8 9 a b c d e f
Tape: CF 01126 Date: Loc: Black Nubble, Low Detector
Sp: LACI Spec: 04FB0D6700000084
Note:
F9152312.48# Div 16 Type 132 2005/09/15 2312:48
TOT 150ms TK 10ms f7 COMP St 2 FILT 0
ANALOOK Version 4.9j 7 Jul 2004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0 1 2 3 4 5 6 7 8 9 a b c d e f
Tape: CF 01126 Date: Loc: Black Nubble, Low Detector
Sp: MYSP Spec: 04FB0D6700000084
Note: Likely MYLU
F9132210.28# Div 16 Type 132 2005/09/13 2210:28
TOT 150ms TK 10ms f7 COMP St 2 FILT 0
ANALOOK Version 4.9j 7 Jul 2004

Acoustic Bat Monitoring Results and Discussion

Acoustic monitoring surveys began on August 26 and continued through November 2. In total, 70 detector-nights of sampling were recorded (Table 7-13). A total of 287 bat call sequences were recorded, all by the lower detector. Of this total, 265 call sequences (93%) were recorded on the nights of September 13 and September 19 (Figure 7-20). All of these calls were recorded by the low detector while none were recorded by the upper detector, which was deployed and operating during that time period. With the exception of these 2 nights, the highest passage rate was 9 bat call sequences recorded on the night of September 14.

The mean detection rate for the entire survey period was 4.2 calls/detector-night. The range of detection rate between the two detectors was from 0 calls/detector-night at the high detector to 4.6 calls/detector-night at the low detector. No bats were detected on 59 (84%) of the 70 detector-nights sampled. At the high detector no bats were detected on any of the eight nights that it was recording, even though the low detector recorded bats on six of those same eight nights. At the low detector bats were detected on only ten of the 62 nights it was recording data.

Table 7-13. Summary table for the results of fall bat surveys at Black Nubble

Date (night of)	# Detectors	Detector Location	Survey Time	# Call Sequences, High Detector	# Call Sequences, Low Detector	Total # Call Sequences
8/26/05	1	Low	19:00-07:00	--	1	1
8/27/05	1	Low	19:00-07:00	--	0	0
8/28/05	1	Low	19:00-07:00	--	1	1
8/29/05	1	Low	19:00-07:00	--	0	0
8/30/05	1	Low	19:00-07:00	--	0	0
8/31/05	1	Low	19:00-07:00	--	0	0

(continued)

Table 7-13. Summary table for the results of fall bat surveys at Black Nubble (continued)

Date (night of)	# Detectors	Detector Location	Survey Time	# Call Sequences, High Detector	# Call Sequences, Low Detector	Total # Call Sequences
9/1/05	1	Low	19:00-07:00	--	0	0
9/2/05	1	Low	19:00-07:00	--	0	0
9/3/05	1	Low	19:00-07:00	--	0	0
9/4/05	1	Low	19:00-07:00	--	0	0
9/5/05	1	Low	19:00-07:00	--	0	0
9/6/05	1	Low	19:00-07:00	--	0	0
9/7/05	1	Low	19:00-07:00	--	0	0
9/8/05	1	Low	19:00-07:00	--	0	0
9/9/05	0	system power down	--	--	--	--
9/10/05	0	system power down	--	--	--	--
9/11/05	0	system power down	--	--	--	--
9/12/05	0	system power down	--	--	--	--
9/13/05	2	High, Low	19:00-07:00	0	142	142
9/14/05	2	High, Low	19:00-07:00	0	9	9
9/15/05	2	High, Low	19:00-07:00	0	5	5
9/16/05	2	High, Low	19:00-07:00	0	2	2
9/17/05	2	High, Low	19:00-07:00	0	1	1
9/18/05	2	High, Low	19:00-07:00	0	0	0
9/19/05	2	High, Low	19:00-07:00	0	123	123
9/20/05	2	High, Low	19:00-07:00	0	0	0
9/21/05	1	Low	19:00-07:00	--	1	1
9/22/05	1	Low	19:00-07:00	--	0	0

(continued)

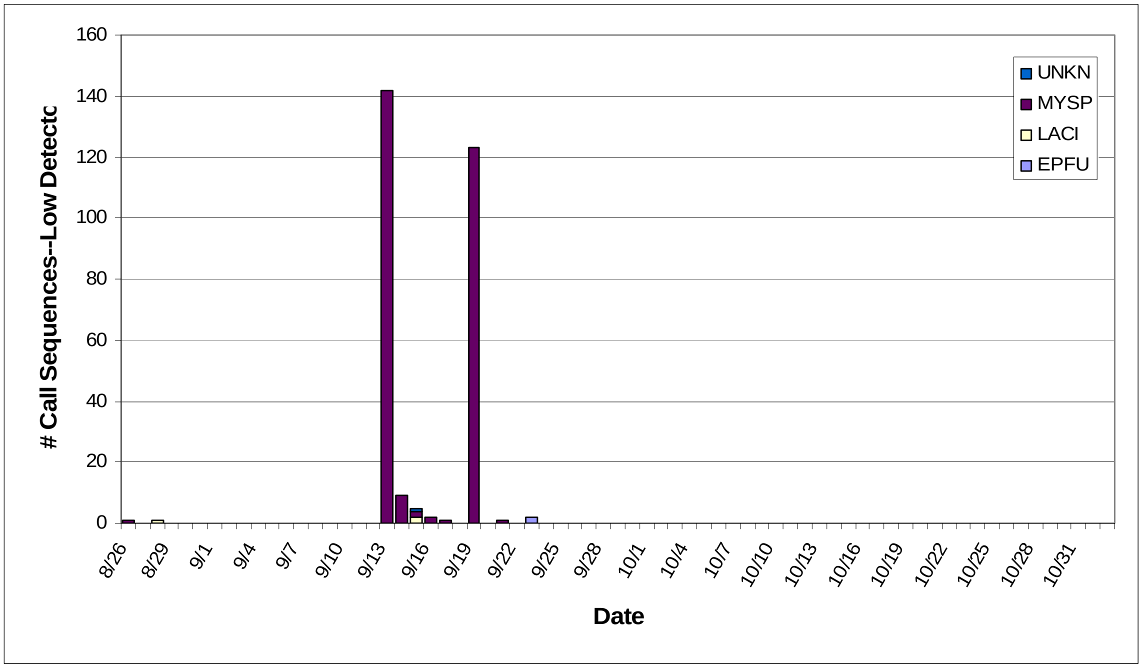
Table 7-13. Summary table for the results of fall bat surveys at Black Nubble (continued)

Date (night of)	# Detectors	Detector Location	Survey Time	# Call Sequences, High Detector	# Call Sequences, Low Detector	Total # Call Sequences
9/23/05	1	Low	19:00-07:00	--	2	2
9/24/05	1	Low	19:00-07:00	--	0	0
9/25/05	1	Low	19:00-07:00	--	0	0
9/26/05	1	Low	19:00-07:00	--	0	0
9/27/05	1	Low	19:00-07:00	--	0	0
9/28/05	1	Low	19:00-07:00	--	0	0
9/29/05	1	Low	19:00-07:00	--	0	0
9/30/05	1	Low	19:00-07:00	--	0	0
10/1/05	1	Low	19:00-07:00	--	0	0
10/2/05	0	system power down	--	--	--	--
10/3/05	0	system power down	--	--	--	--
10/4/05	0	system power down	--	--	--	--
10/5/05	1	Low	19:00-07:00	--	0	0
10/6/05	1	Low	19:00-07:00	--	0	0
10/7/05	1	Low	19:00-07:00	--	0	0
10/8/05	1	Low	19:00-07:00	--	0	0
10/9/05	1	Low	19:00-07:00	--	0	0
10/10/05	1	Low	19:00-07:00	--	0	0
10/11/05	1	Low	19:00-07:00	--	0	0
10/12/05	1	Low	19:00-07:00	--	0	0
10/13/05	1	Low	19:00-07:00	--	0	0
10/14/05	1	Low	19:00-07:00	--	0	0

(continued)

Table 7-13. Summary table for the results of fall bat surveys at Black Nubble (continued)						
Date (night of)	**# Detectors**	**Detector Location**	**Survey Time**	**# Call Sequences, High Detector**	**# Call Sequences, Low Detector**	**Total # Call Sequences**
10/15/05	1	Low	19:00-07:00	--	0	0
10/16/05	1	Low	19:00-07:00	--	0	0
10/17/05	1	Low	19:00-07:00	--	0	0
10/18/05	1	Low	19:00-07:00	--	0	0
10/19/05	1	Low	19:00-07:00	--	0	0
10/20/05	1	Low	19:00-07:00	--	0	0
10/21/05	1	Low	19:00-07:00	--	0	0
10/22/05	1	Low	19:00-07:00	--	0	0
10/23/05	1	Low	19:00-07:00	--	0	0
10/24/05	1	Low	19:00-07:00	--	0	0
10/25/05	1	Low	19:00-07:00	--	0	0
10/26/05	1	Low	19:00-07:00	--	0	0
10/27/05	1	Low	19:00-07:00	--	0	0
10/28/05	1	Low	19:00-07:00	--	0	0
10/29/05	1	Low	19:00-07:00	--	0	0
10/30/05	1	Low	19:00-07:00	--	0	0
10/31/05	1	Low	19:00-07:00	--	0	0
11/1/05	1	Low	19:00-07:00	--	0	0
11/2/05	1	Low	19:00-07:00	--	0	0
Total	***70***	***Calls/detector-night***		***0***	***4.6***	***4.2***

Figure 7-20
Nightly passage rates (recorded by the lower detector) at Black Nubble during fall 2005 surveys.



EPFU = big brown bat, LACI = hoary bat, MYSP = *Myotis* sp., UNKN = unknown.

Timing of calls for the two nights with passage rates of over 100 call sequences per night indicates bats were flying repeatedly past the detector between 9:00 pm and midnight on September 13, and between 7:45 pm and 8:30 pm on September 19. While acoustic data cannot be used to estimate the numbers of individual bats detected, the fact that calls were clustered together in a relatively small amount of time suggests they were produced by a small number of bats, or even a single individual, flying past the detector repeatedly. For example, a total of 123 calls were recorded on the night of September 19 during just 45 minutes.

At least three bat species were identified from the recorded call sequences. Nearly all (98.3%) of the call sequences recorded at Black Nubble were identified as *myotids*, and are likely those of the little brown bat, a species expected to be common in the area. Although definitive differentiation between the *myotids* is not possible using acoustic surveys alone, all of the recorded call sequences identified as *myotids* were nearly identical and most closely resembled the calls of the little brown bat (See Figure 7-19 for representative examples of call files detected at Black Nubble). In addition to *myotids*, three sequences were identified as hoary bats, two as big brown bats, and one remained unidentified (Figure 7-19).

The detector survey documented high variability in activity levels between nights. This variability is likely influenced by the overall level of sampling effort but can also indicate an overall low but variable abundance of bats in the study area. Even on those nights when many calls were recorded, the clustered timing and similar appearance of the numerous calls detected on September 13 and 19 suggest that a small number of bats generated a large number of passes by repeatedly flying past the detector.

Based on characteristics of the habitat at the Redington Wind Farm, and the relatively harsh conditions found on this site, bat populations are generally expected to be low in the area. No bats were observed during extensive night field work during 2002 radar sampling on the site, and little suitable feeding habitat exists along the forested ridgelines, besides sub-alpine spruce and fire forest. Further, the general frequency of high wind conditions at this elevation likely influences the relative availability of insect prey. Habitats along cleared forest edges outside of the sub-alpine zone would likely be the most suitable habitat for bats along the ridgeline. The generally low number of bats recorded during the detector survey is consistent with this. While bats are present in the area, their presence is likely in low numbers and during brief migratory movements.

8.3.5 Canada Lynx – Federal Threatened Species, Maine Special Concern Species

The Canada lynx was added to the list of federally threatened species in 2000 (Department of the Interior 2000). Although once ranging from Maine to New York, the current distribution of lynx in the northeastern U.S. is thought to exist primarily in northwestern Maine, and the extreme northern portions of New Hampshire and Vermont (Department of the Interior 2000). Because the project area is located in one of the larger forested regions in the western mountains of Maine, it is possible that lynx could be found in the project area, although surveys in 1994 and 1995 by MDIFW did not document any lynx tracks in the vicinity of the project area (S. Richie, MDIFW, pers. comm.). The MDIFW has since received several reliable observations of lynx in Redington, Mt. Abram, and Carrabassett Townships in the past 10 years (M. Caron, MDIFW, pers. comm.). However, ecoregional snow track surveys conducted by MIFW during the winter of 2005 showed no evidence of Canada Lynx near the proposed Redington wind development project.

Lynx specialize in hunting snowshoe hare, which makes up the majority of the food source for the species. Consequently, lynx tend to be limited to northern boreal forests with a sufficient snowshoe hare population. Lynx typically den in dense conifer regrowth, beneath downed logs, windfalls, and horizontal tangles that provide adequate cover. Lynx dens have been found in Maine by MIFW every denning season since 1999. Dens are typically located in a red spruce/regenerating hardwood stand that contained large amounts of dead wood (Department of the Interior 2000). While no lynx were observed during fieldwork in the project area, the area does contain suitable lynx habitat, and also supports a population of snowshoe hare, which were observed frequently during fieldwork. Lynx typically occur at low population densities and often have very large home ranges (Department of the Interior 2000) and it is possible that lynx could remain undetected in the project area, especially because most field surveys were conducted in summer months, when lynx would be more difficult to observe. Because Lynx are highly mobile, and because the project will occupy only a very small percentage of suitable habitat in the region, this project will have no undue adverse impact on Lynx.

8.4 Summary and Conclusions

The project area consists of a high elevation habitat type that is limited in terms of its overall distribution in Maine and New England. However, the habitat is locally common within the western Maine region. In fact, the two project area ridgelines are located within a contiguous landmass of approximately 21,000 acres that occurs above 2,700 feet in elevation. Additionally, a large number of other, smaller landmasses of similarly high elevation also occur in the region.

The conditions within the project area and throughout much of these locally common high elevation areas create habitats that are suitable for several rare species, including the Bicknell's thrush and northern bog lemming. These species are restricted to high elevation areas or the habitats that occur at those elevations. Also, because the project area is within a large, somewhat contiguously forested area, species with large home ranges and habitat requirements, such as the Canada lynx, may occasionally be present in the project area.

A total of 17 species listed as either threatened, endangered, or special concern in Maine could potentially occur in the project area. The presence of seven of these species (Cooper's Hawk, olive-sided flycatcher, Bicknell's thrush, northern bog lemming, little brown bat (probably although possibly the long-eared bat), big brown bat, and hoary bat) was documented during field surveys in the vicinity project area. However, the likelihood of potential impact on each these 17 species has been considered, as described above, and no undue adverse impacts are expected.

9.0 Impact Assessment

On a regional and local scale, wind farm projects pose the capability of creating two types of impact on natural resources, direct and indirect, and existing wind farms in other parts of the country have documented various types of impacts. Potential direct impacts on wildlife associated with the Redington Wind Farm include direct habitat and natural community loss, habitat fragmentation, and mortality. Potential indirect impacts include habitat alterations, introduction of non-native flora and fauna, and disturbance effects from the wind farm facility (turbine sound emission, tower lighting, transmission line electrical charge, transmission line edge effect).

The following is a list of Redington Wind Farm project features that could affect wildlife:

- approximately 12.5 miles of new access and summit roads that extend beyond existing logging and haul roads (the details of proposed new roads are provided in Section 1 of the application),
- 30 approximately 0.5 acre mountain summit openings for wind turbines and foundations,
- a 7.5 mile 115 kV transmission line within an approximately 150-foot right-of-way extending from the Nash Stream substation to the existing CMP Bigelow substation in Carrabasset Valley (65 ft H-frame poles),
- a 2.6 mile 34.5 kV exit transmission line within an approximately 50 – 75-foot right-of-way extending from the Redington Mountain summit to the Nash Stream substation (45 ft single poles),
- a 1.2 mile 34.5 kV exit transmission line within an approximately 50 – 75-foot right-of-way extending from the Black Nubble Mountain summit to the Nash Stream substation (45 ft single poles),
- Buried collector system (loop, single, or multiple string) between turbines on each summit (26,100 ft – 14,600 ft on Redington and 29,500 ft – 18,200 ft on Black Nubble),
- A 34.5/115 kV Nash Stream substation,

- maintenance facility adjacent to an existing road (the location of the 2002 radar shack), and
- construction staging areas along existing and proposed roads.

Approximately 307.13 acres of land will be impacted by the proposed project (Table 7-14). For the most part, habitat loss will occur in the turbine footprint area, from new road construction, and from the construction of utility facilities such as the substation and operations building. This amounts to approximately 115.53 acres lost from the new road construction and 13.14 acres from clearing for turbine footings. Of the 307.13 total acres to be impacted, only 135.76 acres above 2,700 feet are to be impacted. This includes approximately 112.39 acres of new roads, 10.23 acres of transmission lines, and 13.14 acres of turbine pads.

Table 7-14. Anticipated acreage impacts for new roads, turbine clearings, and transmission line corridors

Project Feature	Acreage
Mountaintop Roads	92.2
New Access Roads (includes wide-outs)	23.33
Turbine Pads	13.14
Existing Road Widening	9.6
115 kV Transmission Line, Substation, and Transmission Line Access Road	129.5
34.5kV Transmission Line	35
Stump Dumps	4
TOTAL PROJECT	307.13

9.1 Roads

Impacts from roads will include direct loss in habitat. Approximately 115.53 acres of habitat loss will occur from the construction of new roads, which will total 12.5 miles (5.4 miles on Redington, 6.2 miles on Black Nubble, 0.8 miles of transmission line access, 0.1 miles to new substation). Direct impacts from road construction have been minimized to the extent practicable. The existing network of active and inactive logging roads in the area have been used as much as possible for access to the project area ridgelines. Existing roads used for the project will be upgraded to pass the large trucks needed for construction but upgrading activities pose much less of an impact than construction of new roads. In general, most existing roads will simply need re-grading. Some culvert and bridge replacements will be made as well (see Section 1 of the Application for road construction details). In some areas, vegetation clearing will be needed along the roads so that the large turbine parts can pass by. In all areas where wetlands occur on one side of an existing road but not on the other and where road widening or vegetation is needed, those activities will be undertaken on the non-wetland side of the road. A total of 12 miles of existing roads will be enhanced through widening or vegetation clearing, resulting in a total of 9.6 acres of disturbance.

New roads have been designed based on adaptive approach of initial design, field survey, and design re-alignment. The field surveys focused on identifying wetlands, streams, and other features that could constrain road construction such as very steep slopes. On Redington Mountain, two potential routes to the ridgeline were assessed: one from the North and one from the West. The western route was eventually chosen because it contained fewer wetlands and, additionally, it avoided the need for an extensive crossing structure along the northern route.

Indirect effects of roads could be barriers or filters to wildlife movement, increased predation, and the introduction of exotic or competitive species. Some species are known to be hesitant to cross roadways. The gravel surface and limited use of the proposed roads, however, will lessen any barrier or filter effects of the proposed roads to wildlife. Increased predation can occur through the use of road corridors by predators. These include avian predators, such as hawks and owls, and mammalian predators, such as fox and coyote.

Construction of new roads could lead to the introduction or spread of exotic plant species or competing wildlife. In general, the relatively harsh climate of the project area will lessen this likelihood. Additionally, the existing roads in the project area provide insight into what the shoulders of new roads will look like. Existing roads are vegetated largely with native species such as raspberries and common sedges and grasses and it is anticipated that any new roads will become colonized with similar plant communities. To eliminate the opportunity for these undesirable species introductions, newly cleared areas (absent road surfaces and turbine footprints) will be broadcast spread with a layer of wood chips generated during the clearing of trees and other woody vegetation. The application of locally chipped mulch will limit the opportunity for non-native and invasive plant species to colonize disturbed areas and provide a suitable medium for indigenous shrub and tree regeneration.

9.2 Turbines

Each turbine will sit in a small opening in the forest along each ridgeline. These clearings will be just large enough to contain the turbine foundation, a small concrete pad for a ground-mounted transformer, and any additional space needed as a lay-down area for construction of the turbine. That additional space is required to swing turbine blades into alignment for attachment to the turbine itself. To the extent practicable, turbine openings have been minimized in size. This has been done by using the proposed new roadway for as much lay-down space as possible. The result is an average turbine opening of just under 0.5 acres and a total area of approximately 13.14 acres.

The turbine foundations and the pads for the transformers are a direct loss of habitat, though this is quite small and contiguous with the turbine access road. The remainder of the turbine opening represents an indirect impact in the form of habitat conversion. The lay-down area will be cleared of trees and some grading may be required around the turbine foundation. Upon completion of construction, that area will be allowed to re-vegetate. It is anticipated that these areas will re-vegetate as the existing meteorological tower clearings have grown in. The existing meteorological tower openings presently contain native vegetation indicative of regionally common, high-elevation early successional forest openings, including red raspberry and balsam fir.

The existing wildlife community in the project area is currently adapted to such variation in plant community structure along the ridgelines in the form of blowdowns. Species commonly observed in and near ridgetop blowdowns and the meteorological tower clearings in project area include Swainson's thrush, Bicknell's thrush, yellow-bellied flycatchers, boreal chickadees, yellow-rumped warblers, blackpoll warblers, white-throated sparrows, and dark-eyed juncos. Consequently, it is anticipated that the turbine openings themselves will not result in an undue adverse impact on local wildlife.

9.3 Transmission Lines

Two 34.5 kV transmission lines for the project will extend from the ridgetop areas to the proposed Nash Stream substation. These will be approximately 75 feet wide and consist of 45-foot power poles. The 115 kV transmission line will be the H-frame, 3 conductor transmission line commonly seen across the state. The corridor width for the 115 kV line will be approximately 150 feet except where it occurs along the existing Boralex transmission line (see Figure 7-5 Sheet 1), where it will include a 75-foot widening of that corridor. Transmission line corridors will be allowed to revegetate to shrubs and low trees. Unlike the turbine clearings, shrubs and low trees will be allowed to grow to a height of approximately 15 feet, resulting in a habitat that resembles four to eight year-old clearcuts. The 34.5 kV transmission lines account for approximately 35 acres while the 115 kV transmission line accounts for 129.5 acres. These are indirect impacts because the habitat in these areas will be converted to shrub-dominated habitat and not completely lost as wildlife habitat.

In areas that have not been recently logged, impacts will be similar to what is currently common in the area from forest harvesting practices, conversion to early successional forests. These areas are expected to become dominated by shrubs and a variety of broad and narrow-leaved herbaceous vegetation, as is typical of transmission lines. However, the proposed transmission line corridors already contain shrub-dominated habitat, as forested harvesting is quite common along the lower one-half of both of the proposed 34 kV lines and along approximately two-thirds of the 115 kV line. Consequently, impact in these areas will occur largely from the maintenance of the existing early successional plant communities.

The transmission line corridors were designed to avoid wetlands to the best extent possible. Wetland avoidance has resulted in an avoidance of nearly 12 acres of impact. Subsection 9.4 describes wetland impacts associated with the project.

The transmission lines will also cross many streams and brooks, the most notable being Nash Stream and Stony Brook. The location and alignment of streams was an important design consideration of the transmission lines (see Section 1 of the application for transmission line design and construction standards). For the 34.5 kV lines, routes were chosen that ran parallel to and away from streams coming down project area ridgeline. Lower in the valley, both 34.5 kV lines must cross Nash Stream (Black Nubble route) and one of its major tributaries (Redington route). For both of these lines, sites were chosen where there was very little floodplain wetland associated with the stream and where the stream channel was located in a narrow, deep valley. This type of topography will allow for pole placements well above the stream so less canopy clearing over the stream will be needed. This will help to provide continued shade to the stream, maintaining water quality.

The 115 kV line was originally located in the Nash Stream floodplain. That alignment would have had significant impacts on wetland resources associated with Nash Stream and was subsequently re-aligned upslope. The only major stream now crossed by the 115 kV line is Stony Brook. It was originally planned to cross Stony Brook along the town boundary. However, Stony Brook runs parallel to the town boundary in this area for approximately 1,500 feet. Consequently, the 115 kV line was moved northward to run alongside the existing Boralex transmission line (Figure 7-5 Sheet 1). This has resulted in a decrease in the width of canopy clearing over Stony Brook needed for the new line.

Additionally, the new line will cross the brook at a perpendicular angle to reduce impacts associated with the loss of shading.

The most obvious effect of transmission line construction will be the creation of permanent shrub-dominated habitat. This type of habitat is common in the vicinity of the project area, as a result of active forest harvesting practices and it is anticipated that the transmission line will be colonized by local wildlife typical of young clearcut areas. Because forest harvesting is so common in the area, the borders of the transmission lines will blend with the surrounding habitats. Consequently, impacts associated with a hard habitat edge (such as avoidance to cross) will be lessened.

9.4 Wetland Impacts

Wetland resources in the Redington Wind Farm project area have been described in subsection 3.2.7 of this report. To the extent practicable, project features have been designed to avoid and minimize impacts to known wetland resources. Approximately 9.43 acres of wetlands will be impacted during construction of the Redington Wind Farm (Table 7-15). Very little of this, however, includes the loss of wetland habitat. Nearly all of this impact will be in the form of vegetation clearing for the project transmission lines (Figure 7-21). Standards for transmission line construction activities are provided in Section 1 of the application. Within this report, direct wetland impacts refer to loss of wetland habitat, through filling, whereas indirect wetland impacts refer to alteration of wetland vegetation, which will not result in a reduction of wetland area.

Table 7-15. Summary of Wetland Impacts (acres)

Project Feature	Town				Total Impact	*Indirect Impact**
	Coplin PLT	Redington TWP	Carrabassett Valley	Wyman		
Roads	0.06	0.21	0.17	0.00	**0.44**	***0.13***
Turbine sites	0.00	0.00	0.00	0.00	**0.00**	***0.00***
Black Nubble 34.5 kV line	0.00	0.33	0.00	0.00	**0.33**	***0.33***
Redington 34.5 kV line	0.00	0.58	0.00	0.00	**0.58**	***0.58***
115 kV line	0.00	3.48	4.41	0.19	**8.08**	***8.08***

* Indirect impacts include areas of cleared vegetation and are included within the reported Total Impact column.

Wetland impacts from roads include a total of approximately 0.44 acres of direct and indirect impacts. This includes 0.31 acres (13,500 ft^2) of fill and 0.13 acres (5,663 ft^2) of vegetation clearing. Vegetation clearing, which is necessary to allow transport of turbine-related equipment, will be a one-time event, after which vegetation will be allowed to return to its former state.

Wetland impacts associated with the road design were limited to the extent practicable by routing new roads around wetlands and limiting road widening or improvements in areas near wetlands. In the former case, most known wetlands were avoided. Wetlands impacted by new roads will largely include narrow floodplains along streams. In the latter case, road improvements have focused on limiting work within wetlands. For example, in areas where road widening is needed and wetlands occur only on one side of the road, road expansion will occur into the area of non-wetland.

The proposed transmission lines include more wetland habitat than other project features. Approximately 9 acres of wetland are crossed by the transmission lines. Wetland impacts have been minimized through a number of modifications to the proposed lines and facilities. Initially, the 115 kV line was proposed along the Nash Stream floodplain (Woodlot 2000). This alignment would have resulted in several crossings over the stream and approximately 9.5 acres of wetland vegetation clearing along Nash Stream. That same alignment would also have crossed Stony Brook at a shallow angle and in an area where its floodplain is rather wide, which would have included approximately six acres of wetland vegetation clearing. Consequently, the proposed line was moved northward and co-located with the existing Boralex transmission line. The result of these two changes alone is a reduction in potential wetland impact of more than 10 acres.

Other examples of minimizing wetland impacts include moving the location of the proposed Nash Stream substation and smaller changes in transmission line alignments to cross streams at right angles or in areas with less floodplain wetland. Like the 115 kV line, the substation originally located near Nash Stream and would have included approximately 0.3 acres of direct wetland impact (loss). It was subsequently moved twice. The first time it was moved eastward, to the top of a slope above the stream. A wetland north of that location, however, would have necessitated building a permanent road through the wetland. Consequently, the substation was moved north of that wetland so no direct wetland impact would occur (Figure 7-5 Sheet 3). The result of all of the above-mentioned impact minimization strategies is a decrease of over 11.5 acres of impact to wetland resources.

Of the total 9.43 acres of wetland impacted by this project, only 0.17 acres of impact (7,615.55 ft^2) will need to be permitted by LURC. Indirect impacts associated with vegetation clearing for transmission lines account for 8.99 acres of wetland impact, which will not require a permit. Similarly, the 0.13 acres of indirect wetland impacts associated with one-time vegetation clearing along roads will not require a permit. Of the remaining 0.31 acres, which are direct impacts, 0.14 acres are associated with road crossings of minor flowing waters, which are allowed without a permit subject to the standard that best management practices are observed (LURC, Chapter 10.23, N.3.b(14)). Because the project will be in compliance with this standard, these impacts will not require a permit, leaving only 0.17 acres of direct impacts to be permitted by LURC.

9.5 Habitat Fragmentation

Habitat fragmentation is the division of habitat into smaller and smaller patches that become more and more isolated from each other and from larger forested areas. These smaller patches are believed to be of lower quality, consequently providing less suitable habitat for native wildlife populations.

Both project area ridgelines are above 2,700 feet in elevation and located at the northwestern edge of a very large and contiguous 21,000-acre landmass occurring above 2,700 feet in elevation (Figure 7-2). While the entire land mass is not contiguously forested, subalpine forested habitats are dominant, with areas of exposed bedrock, shrub-dominated alpine communities, ski trails, and limited harvested areas also occurring. Lower elevations surrounding this land mass are dominated by active and regular industrial forest management activities, although these activities have extended as far up as 3,500 feet in elevation in the vicinity of Redington Mountain and 3,200 feet near Black Nubble.

Changes associated with the Redington Wind Farm include the conversion of some forested, mountaintop habitats to narrow roads or clearings for wind turbines and power transmission lines (Table 7-14). This conversion, however, may not pose a significant restriction to wildlife utilizing these habitats. First, only a very small acreage of land will be altered for the project (Table 7-14). A total of approximately 64.4 acres of land within the proposed D-PD subdistrict will be cleared for roads or turbine clearings of shrub-dominated habitat. This represents only 6.4% of the 1,004 total acres of mountaintop leased area and an even smaller proportion of the 21,000 acre high elevation land mass (0.3%) in which the project is located.

Second, narrow clearings for the access roads represent the only major direct habitat loss associated with the project. The access roads will be maintained as drivable roads for the duration of the Redington Wind Farm operations. As such, they provide no little or no wildlife value for most wildlife, although extensive use is expected by some species that will find it easier to move about on the mountain. For the most part, however, clearings made for wind turbines and the 34.5 kV transmission line corridors will re-vegetate to conditions that resemble the regenerating clearcuts and blowdowns that are already common in the region.

It is also fully anticipated that local wildlife populations will adapt and respond to this conversion of habitat types much as they already do to the natural occurrence of blowdowns and forest management activities in the area. As an example, several of the species that use the high elevation forests in the study area, including black-backed woodpeckers, yellow-bellied flycatcher, winter wren, and Bicknell's thrush, were all observed foraging, calling, or nesting along the edge of meteorological tower clearings on Redington Mountain and Black Nubble. Meteorological tower clearings are slightly greater than one acre in size, which is approximately twice the size of openings planned for wind turbines. This phenomenon was also observed at lower elevations along clearcut edges, clearly indicating these bird species are adapted to the variable habitat conditions present in the project area.

Finally, an important aspect of habitat fragmentation is the separation of individual forest fragments from each other and from much larger forest reserves. The linear nature of the Redington Wind Farm project features will not contribute to creating forest fragments. Neither will it isolate small fragments of forests on the landscape. Roads will generally be 30 feet wide and will represent narrow breaks in the forest canopy, which is already common in the project area. Clearings for wind turbines will be very small openings, approximately 1/3 to 1/2 acre in size, located along the road and, except for the turbine foundation and a crane pad, allowed to revegetate to low shrubs and herbaceous cover. Transmission lines are primarily proposed at low elevations and will be maintained as shrub-dominated habitats within a landscape that already contains a high occurrence of young forest and clearcuts.

9.6 Potential Wildlife Collision Impacts

Because wind turbines are large and extend above the forest canopy potential exists for wildlife collisions to occur. Bird collisions with tall structures, such as buildings and communications towers, have been well documented, though few empirical studies documenting the magnitude or criteria needed for collisions to occur exist. What is known is that the larger reported collision events generally occur with taller structures and during periods of inclement weather.

Wildlife collisions with wind turbines first emerged as a concern in the western United States, when large numbers of raptor fatalities were reported at wind power facilities in California. Although most studies of the potential wildlife impacts of wind power facilities have focused on collisions of birds with turbines, bats are also vulnerable to collisions with wind turbines. In fact, the most recent evidence suggests that bat mortality at wind power developments in the east is more common than bird mortality, as studies that are presently occurring are reporting bat mortality but little to no bird mortality.

West (2001) provided a summary of avian collisions with wind turbines, which is often calculated as the number of fatalities/turbine/year. Only one study was conducted in the eastern United States (in Pennsylvania) and fatality rates varied from 0 to 4.5 fatalities/turbine/year with most of the reported rates being less than 2 fatalities/turbine/year. Subsequent work has generally provided similar results with respect to avian fatalities at existing wind farms.

When first studied in 1991 and 1992, reported bat mortality at wind facilities was very low (1-2 fatalities per site per year), but more recent studies have documented mortality rates at wind facilities similar to and even exceeding those of birds (California Energy Commission 2002, Keeley *et al.* 2001). More recent studies documenting mortality at eastern wind power developments have found collision rates of nearly one bat per turbine per day during a swarming period survey (Arnett 2005) and an annual estimate at 46.2 fatalities/turbine/year, which far exceeds any reported fatality rates for avian species (Johnson 2004). The predominant bat species found during most surveys include the tree-roosting species (hoary, red, and silver-haired bats) as well as big brown bats and eastern pipistrelles. No protected species have yet to be found during any mortality studies, despite several projects being located near known hibernacula of several federally-protected species, and very few bats of the Genus *Myotis* have been found.

It is anticipated that the greatest risk of avian and bat collisions with wind turbines will occur during the migration season. In addition, greater risk of bat collisions may occur just prior to fall migration. In this region, bats typically swarm in late summer (July or August), during which time breeding occurs, and the majority of reported bat mortality has occurred during this period.

Radar surveys conducted in the fall of 2002 and the spring of 2004 were conducted to document bird and bat migration in the vicinity of the project area. No studies have been published that report the results of radar surveys conducted in conjunction with mortality surveys at existing wind power facilities. The lack of this type of information limits the ability of the radar survey data collected at Redington Wind Farm to predict the number of bird or bat fatalities at proposed wind developments. However, that data does allow a qualitative assessment of bird or bat movements with respect to the proposed project.

The details of the radar surveys at Redington Wind Farm are provided in subsection 6.3.4.2 of this report. In general, direct comparison of that data with other available surveys is limited. Movement characteristics of targets observed during the surveys indicate that birds and bats may be directing their migratory movements away from the upper ridgelines of mountains in the vicinity of the project. Some research suggests that bird migration may be affected by landscape features, such as coastlines, large river valleys, and some northeastern mountain ranges. This has been documented for diurnally-migrating birds, such as raptors, but is not as well established for nocturnally migrating birds (Sielman *et al.* 1981, Bingman *et al.* 1982, Bruderer and Jenni 1990, Richardson 1998, Fortin *et al.* 1999, Williams *et al.* 2001, Diehl *et al.* 2003, Woodlot Alternatives, Inc. unpublished data).

The flight directions of targets documented in the project area were generally in directions away from the peaks and high ridges of Black Nubble and Redington Mountain. This was observed during both seasons of survey. What is unknown is how high those radar targets were flying. The altitude at which nocturnal migrants fly has been one of the least understood aspects of bird migration. During nighttime flights Bellrose (1971) found the majority of birds were between 500 and 1,500 feet above the ground level but on some nights the majority of birds observed were from 1,500 to 2,500 feet above the ground. Radar studies have largely confirmed those visual observations, with the majority of nocturnal bird migration appearing to occur less than 1,650 to 2,300 feet above the ground (Able 1970, Alerstam 1990, Gauthreaux 1991, Cooper and Ritchie 1995).

Studies that included altitude data from other proposed wind facilities in the Northeast are consistent with this as well. Cooper *et al.* (2004b) documented mean nightly flight altitudes at Mount Storm, West Virginia, between 700 and 2,500 feet, with a seasonal mean of 1,350 feet. In western New York, Cooper *et al.* (2004a) documented a mean flight altitude of 1,750 feet with a small percentage (4%) of targets flying less than 400 feet above the ground. This distribution of flight heights has also been observed at over a dozen sites throughout New York and Vermont (Woodlot Alternatives, Inc. unpublished data).

These published flight heights may help to explain flight directions observed during the radar surveys at Redington Mountain. Due to the difficult terrain, the radar system was not deployed on the ridgelines. Rather, it was located at an elevation of 1,900 feet north of Black Nubble during the Fall 2002 survey and at 2,700 feet in the saddle between Black Nubble and Redington Mountain during the Spring 2004 survey. These radar locations are 1,000-2,000 feet below the peaks of the two project area ridgelines. Given the likelihood that the majority of bird migration occurs less than 2,000 feet above the ground, then many birds passing through the project area would be flying below the project area ridgelines.

It is anticipated that many individuals, upon seeing the silhouette of the project area ridgelines, divert their movements to pass over valleys, along valley side slopes, and over low ridgelines rather than use energy to gain further altitude. This would significantly reduce the risk of collision with wind turbines. This is not to say that no birds pass over the ridgelines. Acoustic monitoring near the peak of Black Nubble documented birds passing over the ridge. The number of recorded calls, however, was less than half as many as were recorded from the radar site north of the summit. While insufficient data currently exist to estimate potential avian and bat fatality rates, qualitative assessment based on radar surveys suggest that birds and bats may be avoiding the high ridgetop areas during night migration by directing movements over lower elevation areas. If this is occurring, the relative magnitude of potential fatalities is expected to be low compared to fatality rates reported in the literature.

The high elevation ridgeline habitats in the study area are not favorable bat habitat, due to their dense stunted tree canopy, their cold climatic conditions, and the lack of wetlands and other suitable feeding habitat. Consequently, tree-roosting species, the species that have been found most during fatality studies, are not expected to be abundant along those ridgelines during the breeding and summer swarming season. During migration, it is also not anticipated that bats will concentrate specifically over the ridgelines so potential impacts during those time periods are expected to be low, relative to what has been found at existing wind farms. Additionally, bat fatality studies have been conducted at projects at more southern locales, where continental bat populations are larger. The location of the project area at the northern limit of most bats species' ranges significantly reduces the relative risk of potential bat fatalities by limiting the total number of bats that are likely to pass by the project area. The relatively low detection rate documented during the 2005 bat detector survey is generally consistent with this.

9.7 Other Potential Impacts

9.7.1 Turbine Sound Emission

As a result of the Redington Wind Farm, a significant increase in the amount of sound emission is not expected, given the relatively slow RPM of the turbines and aerodynamic braking design. The mechanical sounds associated with turbine revolutions are generally low and non-invasive. Emissions will only be audible in the immediate vicinity of the mountain summits and summit access roads. It is unclear how this constant sound emission will affect locally occurring wildlife species. However, observations at existing wind power developments in the northeast indicate that local wildlife readily habituate to the wind turbines (Woodlot Alternatives, Inc. unpublished data).

10.0 Impact Mitigation and Monitoring Plan

The impacts of the Redington Wind Farm on local and regional wildlife are expected to be relatively benign. This is due in large part to the relatively low density of the project features on the landscape and its placement in a landscape dominated by active forest harvesting. Additionally, the project has been designed to avoid or minimize impact on resources such as wetlands and streams. Despite this, some direct and indirect impacts will occur. Based on these impacts, several conceptual mitigation and monitoring plans have been developed. The goals of the plans vary but in general are designed to protect habitats and further investigate the impact of the Redington Wind Farm on local wildlife populations. These plans are detailed below.

10.1 Avian Habituation Study

Based on observations of bird activity at another New England mountain-top wind power development, the local breeding bird community is not expected to be unduly impacted by construction of the Redington Wind Farm. Short-term disturbances will likely occur during construction but, following this, the bird community is expected to habituate to the project.

An avian habituation study is proposed to characterize the bird community dynamics before and after construction of the project. Three transects will be established, one on each of the two project area ridgelines and one on an adjacent ridgeline with similar habitat. Breeding bird point counts will be conducted at regular intervals along each transect. Transects will be surveyed during the year before construction (or coincident with construction if time does not allow for this), one year after construction, three years after construction, and 5 years after construction. Data will be compared between years and between the developed and undeveloped ridges. Final details of the avian habituation study will be developed during the final development and design phase of the project.

10.2 Pre- and Post-Construction Radar and Visual Study

A radar and visual study of bird migration will be conducted from the project area ridgelines. Earlier studies did not survey bird migration from the project area ridgelines due to the difficulty in access these areas. Reliable access to the ridgelines, however, will be available fairly rapidly after receipt of a project development permit. This access will be used to place a radar system at a suitable location on one of the project area ridgelines.

The radar system will be used to characterize bird movements over the project on a sample of nights during the spring and fall migration periods. Passage rates, flight direction, and flight height will be documented with the radar. On a sample of those nights, a thermal imaging camera will be used to characterize low level flights of radar targets. This will be repeated following construction of the project. Of particular use will be the thermal imaging data of low level flights over the ridgeline before and after construction. Final details of the radar and visual surveys will be developed during the final development and design phase of the project.

10.3 Northern Bog Lemming Habitat Management Plan

A habitat management plan will be developed for the Redington Mountain ridgeline. The goal of the plan will be to maintain habitat conditions in the wetlands known and suspected to provide habitat for northern bog lemmings. The plan will identify a protection zone around these wetlands within which impacts from the proposed development have been minimized.

Specific measures to maintain habitat conditions will be identified in the plan and include use of bark mulch for roadside erosion control. This technique is beneficial in that it restricts the need for planting of grasses typically used to control runoff and consequently limits the potential introduction of competing small mammal species and predators in the high elevation areas. It also limits opportunities for the spread of exotic plants along the proposed ridgetop access road. Methods and a schedule for these activities, as well as monitoring of habitat conditions and the lemming population will be identified in the plan. The full details of the plan will be developed in consultation with MDIFW biologists during the final development and design phase of the project.

11.0 Conclusions

Like any wind energy facility, the potential for collision mortality certainly exists at the Redington Wind Farm. However, data from radar and raptor surveys suggest that the topography of the region causes many birds to fly to either side of the site, rather than over the ridgelines, which reach elevations of nearly 3,700 feet. Due to the harsh conditions and limited feeding resources along these ridgelines, bats are also expected to avoid the upper elevation ridgelines during migration, and resident bat populations are expected to be small, and have low diversity. Although accurately predicting the likelihood that the proposed facility would cause bird or bat collision mortality is not possible, the topography, climate, and habitat of the site and the surrounding area would, if anything, discourage migrating birds and bats from flying over the ridgelines. Acoustic bat surveys conducted in fall 2005 documented a low occurrence near the peak of Black Nubble, which generally corroborates this conclusion.

The data presented in this report were collected during a period of more than 10 years, over which time numerous changes were made to the proposed development plan. These changes have minimized the potential impacts of the project on wildlife, wildlife habitat, and wetlands. Like any large scale development, this project will have inevitable impacts on the landscape. However, alterations in the design plan have eliminated over 11.5 acres of wetland impacts, including impacts on ecologically significant stream resources, and have resulted in creation of buffer zones around particularly sensitive ridgeline habitats. The result of this process has been that the potential for the project to impact wildlife and habitats within the project area has been greatly reduced. While the project area does include unique habitats and species adapted to these habitats, the project will affect only a small area relative to the amount of available habitat that will remain unaltered, providing adequate habitat for displaced wildlife. As it is proposed, the project is expected to have no undue adverse impact on local wildlife and fisheries and their preferred habitats, as regulated under Natural Features by the LURC (LURC Chapter 10.25,E,2,a).

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Appendix A

Scientific Names to All Plants Mentioned in the Text

American beech (*Fagus grandifolia*)

balsam fir (*Abies balsamea*)

black spruce (*Picea mariana*)

bluebead lily (*Clintonia borealis*)

bracken fern (*Pteridium aquilinum*)

bunchberry (*Cornus canadensis*)

common horsetail (*Equisetum arvense*)

common wood-sorrel (*Oxalis montana*)

drooping sedge (*Carex crinita*)

dwarf raspberry (*Rubus pubescens*)

evergreen wood fern (*Dryopteris intermedia*)

fly honeysuckle (*Lonicera canadensis*)

goldthread (*Coptis trifolia*)

hairy-cap moss (*Polytrichum* spp.)

heartleaved paper birch (*Betula papyrifera* var. *cordifolia*)

hobblebush (*Viburnum lantanoides*)

lady fern (*Athyrium filix-femina*)

long beech fern (*Phegopteris connectilis*)

mountain ash (*Sorbus americana*)

mountain maple (*Acer spicatum*)

mountain wood fern (*Dryopteris campyloptera*)

ostrich fern (*Matteuccia struthiopteris*)

partridgeberry (*Mitchella repens*)

red maple (*Acer rubrum*)

red spruce (*Picea rubens*)

red raspberry (*Rubus idaeus*)

red-berried elder (*Sambucus racemosa* ssp. *pubens*)

red-stemmed moss (*Pleurozium schreberi*)

rough sedge (*Carex scabrata*)

sensitive fern (*Onoclea sensibilis*)

short-tailed rush (*Juncus brevicaudatus*)

soft rush (*Juncus effusus*)

speckled alder (*Alnus incana*)

sphagnum moss (*Sphagnum* spp.)

striped maple (*Acer pensylvanicum*)

sugar maple (*Acer saccharum*)

tall meadow rue (*Thalictrum pubescens*)

three-seeded sedge (*Carex trisperma*)

whorled aster (*Oclemena acuminata*).

wild sarsaparilla (*Aralia nudicaulis*)

witch hazel (*Hamamelis virginiana*)

wool grass (*Scirpus cyperinus*)

yellow birch (*Betula alleghaniensis*)

Appendix B

Species-Habitat Matrix
Table of Potential Migrant Bird Species

Appendix B Table 1. Species-Habitat Matrix

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
		Y	*Thamnophis sirtalis*	Eastern garter snake		Y	Y	Y	Y	Y	Y	Y	Y
			Storeria occipitomaculata	Northern redbelly snake	Woodland debris—bark and rotting wood.	Y	Y	Y	Y	Y			
			Diadophis punctatus	Northern ringneck snake	Mesic areas with abundant cover.	Y	Y	Y	Y		Y		
					Total # reptile species using habitat type (out of 3 species):	3	3	3	3	2	2	1	1
		Y	*Desmognathus fuscus*	Northern dusky salamander	Permanent forested seeps, springs, headwater streams.		Y	Y	Y		Y		Y
		Y	*Eurycea bislineata*	Northern two-lined salamander	Well-shaded streams for breeding.		Y	Y	Y		Y		Y
SC			*Gyrinophilus porphyriticus*	Northern spring salamander	Woodland headwater streams; high gradient seeps or springs.			Y	Y		Y		Y
		Y	*Plethodon cinereus*	Northern redback salamander	Logs, stumps, rocks, etc.	Y	Y	Y	Y		Y		
			Notophthalmus viridescens	Eastern newt	Water bodies with aquatic vegetation (adults); juveniles (efts) are terrestrial.	Y	Y	Y	Y				Y
		Y	*Bufo americanus*	Eastern American toad	Shallow, still water for breeding.	Y	Y	Y	Y	Y	Y	Y	Y
		Y	*Rana clamitans*	Green frog	Margins of riverine or lacustrine habitats for breeding.	Y	Y	B					Y

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
SC			*Rana pipiens*	Northern leopard frog	Shallow pools of standing water adjacent to wet meadows.	Y	Y	B		B			Y
		Y	*Rana palustris*	Pickerel frog	Shallow, clear water of bogs, woodland streams, and lake margins.	Y	Y	B	B				Y
		Y	*Rana sylvatica*	Wood frog	Vernal pools in forest habitat.	Y	Y	Y	Y		Y	Y	
			Total # amphibian species using habitat type (out of 10 species):			7	9	10	8	2	6	2	8
		Y	*Cathartes aura*	Turkey vulture	Forest clearings and fields; large branch stubs of dead trees for roosting.				B	B			
		Y	*Accipiter striatus*	Sharp-shinned hawk	Extensive undisturbed open mixed woodlands.		B	B	B	B	B	B	
SC		Y	*Accipiter cooperii*	Cooper's hawk	Mature deciduous or coniferous woodlands.		B	B	B	B	B	B	
		Y	*Accipiter gentilis*	Northern goshawk	Extensive mature mixed woodlands.		Y	Y	Y	B	B	B	
		Y	*Buteo jamaicensis*	Red-tailed hawk	Mature forests for nesting; nonforest openings for foraging.		B	B	B	B	B	B	
		Y	*Buteo platypterus*	Broad-winged hawk	Extensive woodlands with roads or clearings.			B	B	B	B	B	
		Y	*Falco sparverius*	American kestrel	Cavity trees >30 cm; open flat terrain.			B	B	B	B	B	
		Y	*Buteo lagopus*	Rough-legged hawk	May overwinter in area.					W			

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
E			*Aquila chrysaetos*	Golden eagle	Cliffs for nesting; wide expanses of open land.					B	B	B	
		Y	*Falco columbarius*	Merlin	Natural cavities or old woodpecker holes in open woodlands.				B	B	B	B	
		Y	*Bonasa umbellus*	Ruffed grouse	Fallen logs amidst dense saplings.		Y	Y	Y	Y	Y	Y	
		Y	*Dendrogapus canadensis*	Spruce grouse	Coniferous forest.	Y	Y	Y	Y	Y	Y	Y	
		Y	*Scolopax minor*	American woodcock	Fertile moist soils containing earthworms; small clearings and dense swales.	B	B			B			
			Bubo virginianus	Great Horned owl	Large abandoned hawk nests, large cavity trees.		Y	Y	Y	Y	Y	Y	
			Strix varia	Barred owl	Cool, damp lowlands; cavity trees with min. dbh of 20”.		Y	Y	Y	Y	Y		
		Y	*Aegolius acadicus*	Northern saw-whet owl	Cavity trees with minimum dbh of 12”.		Y	Y	Y		Y		
		Y	*Archilochus colubris*	Ruby-throated hummingbird	Nectar-bearing flowers.		B	B	B	B			
			Sphyrapicus varius	Yellow-bellied sapsucker	Trees with min. dbh of 10”, especially aspens containing sound decayed wood.		B	B	B		B		
		Y	*Picoides pubescens*	Downy woodpecker	Trees, limbs with decay column (min. dbh 6”).		Y	Y	Y	Y	Y		
		Y	*Picoides villosus*	Hairy woodpecker	Trees, limbs with decay column (min. dbh 10”).		Y	Y	Y		Y	Y	

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
SC			*Picoides tridactylus*	Three-toed woodpecker	Spruce and fir trees (min dbh 12") with column of decayed wood.				Y	Y	Y	Y	
		Y	*Picoides arcticus*	Black-backed woodpecker	Spruce and fir trees (min dbh 10") with column of decayed wood.				Y	Y	Y	Y	
		Y	*Colaptes auratus*	Northern flicker	Open areas, forest edges; trees with columns of dead wood.	B	B	B	B	B			
		Y	*Dryocopus pileatus*	Pileated woodpecker	Mature forest; trees with decay at least 20" dbh.		Y	Y	Y		Y		
SC		Y	*Contopus borealis*	Olive-sided flycatcher	Tall perch adjacent to low, wet coniferous thicket, bog.		B		B	B	B		
		Y	*Contopus virens*	Eastern wood-pewee	Forest edge or open woods.		B	B					
		Y	*Empidonax flaviventris*	Yellow-bellied flycatcher	Low, wet, coniferous woods.		B		B	B	B	B	
			Empidonax alnorum	Alder flycatcher	Dense woody regeneration, low shrubs; thickets and clearings.	B	B						
		Y	*Empidonax minimus*	Least flycatcher	Open, deciduous or mixed forest; forest edges.	B	B	B	B				
		Y	*Myiarchus crinitus*	Great-crested flycatcher	Mature deciduous forest; cavity trees on forest edges.			B	B	B			
			Tyrannus tyrannus	Eastern kingbird	Clearings, fields, orchards; perches for aerial foraging.	B				B			
		Y	*Vireo solitarius*	Blue-headed vireo	Mixed or predominantly coniferous woodland.			B	B	B	B	B	

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
			Vireo gilvus	Warbling vireo	Scattered deciduous trees in open areas; often adjacent to water.		B	B					
			Vireo philadelphicus	Philadelphia vireo	Hardwood forest edges; early successional forests.	B	B	B					
		Y	*Vireo olivaceus*	Red-eyed vireo	Closed deciduous forest canopy.		B	B	B				
		Y	*Vireo flavifrons*	Yellow-throated vireo	Mature deciduous forests.			B	B				
		Y	*Perisoreus canadensis*	Gray jay	Coniferous forests.				Y	Y	Y	Y	
		Y	*Cyanocitta cristata*	Blue jay			B	B	B	B	B		
		Y	*Corvus brachyrhynchos*	American crow	Open areas for foraging.		Y	Y	Y	Y	Y		
		Y	*Corvus corax*	Common raven	Cliffs, more common in winter				Y	Y	Y	Y	
			Tachycineta bicolor	Tree swallow	Cavity trees (min dbh 10”); old woodpecker cavities, near open areas.	B	B			B			
		Y	*Parus atricapillus*	Black-capped chickadee	Cavity trees or dead stubs in small woodlands, clearings or open woodlands.		Y	Y	Y	Y	Y	Y	
		Y	*Parus hudsonicus*	Boreal chickadee	Softwood snags, stubs.		Y	Y	Y	Y	Y	Y	
		Y	*Sitta canadensis*	Red-breasted nuthatch	Cavity trees in mixed or coniferous woods (min. dbh 12”).		Y	Y	Y	Y	Y	Y	

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
			Sitta carolinensis	White-breasted nuthatch	Cavity trees in hardwoods and mixed woods (min dbh 12”).		Y	Y	Y				
			Certhia americans	Brown creeper	Woodland trees with sloughing or loose bark.		B	B	B	B	B		
		Y	*Troglodytes troglodytes*	Winter wren	Moist, mixed or coniferous woodlands with down logs; low woody vegetation.	B	B	B	B	B	B	B	
		Y	*Regulus calendula*	Ruby-crowned kinglet	Conifer stands, more common in Adirondacks	B			B	B	B	B	
		Y	*Regulus satrapa*	Golden-crowned kinglet	Dense conifer thickets or stands, esp. spruce.	B			B	B	B	B	
			Sialia sialis	Eastern bluebird	Low cavity trees or nest boxes; open country.					B			
SC		Y	*Catharus bicknellii*	Bicknell’s thrush	Stunted coniferous forest at high elevations.						B	B	
		Y	*Catharus ustulatus*	Swainson’s thrush	Coniferous or mixed forests.	B		B	B	B	B	B	
		Y	*Catharus guttatus*	Hermit thrush	Coniferous or mixed woodlands with dense undergrowth.		B	B	B	B	B		
		Y	*Hylocichla mustelina*	Wood thrush	Cool, moist mature deciduous or mixed forest.		B	B	B				
		Y	*Turdus migratorius*	American robin		B	B	B	B	B	B		
		Y	*Dumetella carolinensis*	Gray catbird	Low, dense shrubby vegetation in open country or forest understory.	B				B			

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
			Toxostoma rufum	Brown thrasher	Hardwood forest-field ecotone.					B			
			Bombycilla cedrorum	Cedar waxwing	Open country, shrubs, trees, thickets with persistent fruits (winter).	B	B			B			
			Vermivora chrysoptera	Tennessee warbler	Brushy, semiopen country.		B	B	B	B	B		
		Y	*Dendroica ruficapilla*	Nashville warbler	Scattered trees interspersed with brush, thickets		B	B	B	B	B		
			Parula americana	Northern parula	Presence of bearded lichen (*Unsnea*).		B	B	B	B	B	B	
			Dendroica petechia	Yellow warbler	Small scattered trees or dense shrubs; commonly near water.	B				B			
			Dendroica pensylvanica	Chestnut-sided warbler	Early successional deciduous stands; dense hardwood regeneration (3 to 10 ft).	B		B		B			
		Y	*Dendroica magnolia*	Magnolia warbler	Young stands of spruce-fir or hemlock.				B	B	B		
		Y	*Dendroica tigrina*	Cape May warbler	Spruce-fir forests.				B		B	B	
		Y	*Dendroica caerulescens*	Black-throated blue warbler	Hardwood/mixed wood stands well-developed understory; mountain laurel.			B	B				
		Y	*Dendroica coronata*	Yellow-rumped warbler	Coniferous trees (summer), bayberry thickets (winter)				B	B	B	B	
		Y	*Dendroica virens*	Black-throated green warbler	Mixedwood/coniferous stands.			B	B		B		

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
		Y	*Dendroica fusca*	Blackburnian warbler	Coniferous forest, mixed woodlands.				B		B	B	
			Dendroica castanea	Bay-breasted warbler	Dense coniferous stands, especially of spruce and fir.				B		B	B	
		Y	*Dendroica striata*	Blackpoll warbler	Stunted spruce, especially at higher elevations.						B	B	
		Y	*Miniotilta varia*	Black-and-white warbler	Deciduous/mixed wood stands.			B	B	B	B	B	
		Y	*Setophaga ruticilla*	American redstart	Open deciduous/mixed wood stands with a dense shrub/midstory understory.	B	B	B		B			
		Y	*Seiurus aurocapillus*	Ovenbird	Open, mature mesic or dry forest.			B	B				
			Seiurus noveboracensis	Northern waterthrush	Cool, shaded, wet ground with shallow ponds.	B	B						
			Oporornis philadelphia	Mourning warbler	Larger openings of hardwood regeneration; dense shrubs.	B				B			
			Geothlypis trichas	Common yellowthroat	Dense hardwood regeneration, shrub layer.	B				B			
			Wislonia pusilla	Wilson’s warbler	Cold shrub swamps, bogs; thickets.	B				B			
			Wilsonia canadensis	Canada warbler	Dense deciduous or ericaceous understory		B	B	B				
			Piranga olivacea	Scarlet tanager	Hardwood/mixedwood forest canopy.			B					

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
			Pipilo erythrophthalmus	Eastern towhee	Dense, brushy understory; well-drained soils.					B			
		Y	*Spizella arborea*	American tree sparrow	Open country; brushy cover; weedy fields (winter).		W			W			
			Spizellia passerina	Chipping sparrow	Clearings with bare ground; coniferous or thorny shrubs.					B			
			Passerculus sandwichensis	Savannah sparrow	Old fields.					B			
		Y	*Melospiza melodia*	Song sparrow	Brushy cover, hardwood regeneration; conspicuous song perches.	B	B			B			
			Melospiza lincoinii	Lincoln’s sparrow	Brushy thickets along field edges or drainways; wet grass or sedge meadows.	B				B			
			Melospiza georgiana	Swamp sparrow	Brushy wetlands with emergent vegetation.	B							
		Y	*Zonotrichia albicollis*	White-throated sparrow				B	B	B	B	B	
		Y	*Junco hyemalis*	Dark-eyed junco	Woods roads, cut banks; uprooted trees.				B	B	B	B	
			Pheucticus ludovicianus	Rose-breasted grosbeak	Forest edges, dense hardwood thickets and saplings stands; brushy fields.	B	B	B	B	B			
			Agelaius phoeniceus	Red-winged blackbird	Emergent vegetation adjacent to open fields.	B				B			
			Molothrus ater	Brown-headed cowbird	Open grassy habitat.	B		B	B				

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
			Pinicola enucleator	Pine grosbeak	Conifer forests				W	W	W	W	
		Y	*Carpodacus purpureus*	Purple finch	Coniferous trees.				B		B	B	
		Y	*Loxia curvirostra*	Red crossbill	Conifer forests			Y	Y	Y	Y	Y	
			Loxia leucoptera	White-winged crossbill	Conifer forests				Y	Y	Y	Y	
		Y	*Carduelis pinus*	Pine siskin	Conifer forests, feeders				B	B	B		
		Y	*Carduelis tristis*	American goldfinch	Open, weedy fields with scattered small trees.	Y				Y			
			Coccothraustes vespertinus	Evening grosbeak	Spruce and fir forest		B		B		B		
Total # bird species using habitat type (out of 99 species):						29	47	52	67	71	56	39	0
		Y	*Sorex cinereus*	Masked shrew	Damp woodlands, ground cover.	Y	Y	Y	Y	Y	Y	Y	
			Sorex palustris	Water shrew	Herbaceous cover, cold-water wetlands and streams	Y	Y			Y	Y		Y
		Y	*Sorex fumeus*	Smoky shrew	Loose, damp leaf litter.	Y	Y	Y	Y	Y	Y	Y	
SC			*Sorex dispar*	Long-tailed shrew	Rocky, wooded sites.	Y	Y	Y	Y	Y	Y	Y	

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
		Y	*Microsorex hoyi*	Pygmy shrew	Moist leaf mold near water	Y	Y	Y	Y	Y	Y	Y	
		Y	*Blarina brevicauda*	Northern short-tailed shrew	Low vegetation, damp, loose leaf litter.	Y	Y	Y	Y	Y	Y	Y	
			Parascalops breweri	Hairy-tailed mole	Loose, moist, well-drained soil.		Y	Y	Y	Y			
			Condylura cristata	Star-nosed mole	Wet muck and humus	Y	Y	Y					
SC		Y	*Myotis lucifugus*	Little brown myotis	Forest openings for feeding, females: dark, warm sites for maternity colonies.	B	B	B	B	B	B		B
SC			*Myotis septentrionalis*	Northern long-eared bat	Large cavity trees for roosting. Caves, mine shafts for hibernating.	B	B	B	B	B	B		B
SC			*Lasionycteris noctivagans*	Silver-haired bat	Dead trees with loose bark or cavities, streams.	B	B	B	B	B	B		B
SC			*Pipistrellus subflavus*	Eastern pipistrelle	Warm, draft-free, damp sites for hibernation, open woods.	B	B	B	B	B			B
SC		Y	*Eptesicus fuscus*	Big brown bat	Cold, dry areas of caves or buildings for hibernation.	B	B	B	B	B	B		B
SC			*Lasiurus borealis*	Red bat	Deciduous trees on forest edges for roosting.	B	B	B	B	B	B		B
SC		Y	*Lasiurus cinereus*	Hoary bat	Edges of coniferous and mixed forests; ponds, streams, and trails for foraging.	B	B	B	B	B	B		B
		Y	*Lepus americanus*	Snowshoe hare	Dense brush or softwood cover.	Y	Y	Y	Y	Y	Y	Y	

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
		Y	*Tamias striatus*	Eastern chipmunk	Forest edge or shrub cover, elevated perches, logs.			Y	Y	Y	Y		
		Y	*Tamiasciurus hudsonicus*	Red squirrel	Woodlands with mature trees, conifers preferred.		Y	Y	Y	Y	Y	Y	
		Y	*Sciurus carolinensis*	Gray squirrel	Tall trees for dens or leafnests.		Y	Y	Y				
			Glaucomys sabrinus	Northern flying squirrel	Mature trees, cavities for winter dens; arboreal lichens.		Y	Y	Y	Y	Y		
			Castor canadensis	Beaver	Woodland streams, rivers.	Y	Y						Y
			Peromyscus maniculatus	Deer mouse	Northern hardwoods or northern coniferous forest.	Y	Y	Y	Y	Y	Y	Y	
			Peromyscus leucopus	White-footed mouse	Down logs, rotting stumps, cavities.	Y	Y	Y	Y	Y			
		Y	*Clethrionomys gapperi*	Southern red-backed vole	Springs, brooks, seeps, bogs; debris or slash cover.	Y	Y	Y	Y	Y	Y	Y	
			Microtus pennsylvanicus	Meadow vole	Herbaceous vegetation, loose organic soils.	Y				Y			
SC			*Microtus chrotorrhinus*	Yellow-nosed vole	Cool, moist rocky woods, herbaceous ground cover and flowing water.			Y	Y	Y	Y	Y	
T		Y	*Synaptomys borealis*	Northern bog lemming	Moist to wet loose soils; decaying leaf litter or herbaceous ground cover.	Y	Y	Y	Y	Y	Y	Y	
			Synaptomys cooperi	Southern bog lemming	Damp soil and moist duff layer.	Y	Y	Y	Y	Y	Y		

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
			Zapus hudsonius	Meadow jumping mouse	Herbaceous groundcover, loose soils.	Y				Y			
			Napaeozapus insignis	Woodland jumping mouse	Moist cool woodland, Loose soils, herbaceous cover.		Y	Y	Y	Y			
			Erithizon dorsatum	Porcupine	Rock ledges or den trees.		Y	Y	Y		Y		
		Y	*Canis latrans*	Coyote	Well-drained secluded den sites.		Y	Y	Y	Y	Y	Y	
		Y	*Vulpes vulpes*	Red fox	Well-drained den sites. Tends to hunt more open or semiopen habitats.	Y	Y		Y				
			Urocyon cinereoargenteus	Gray fox	Hollow logs or rock crevices for dens.	Y	Y	Y	Y	Y	Y		
		Y	*Ursus americanus*	Black bear	Fallen trees, hollow logs, rock ledges, slash piles.	Y	Y	Y	Y	Y	Y		Y
			Procyon lotor	Raccoon	Hollow den trees.	Y	Y	Y	Y	Y			
		Y	*Martes americana*	Marten	Mixed forest stands.			Y	Y	Y	Y	Y	
			Martes pennanti	Fisher	Hollow trees, logs.	Y	Y	Y	Y	Y	Y	Y	
			Mustela erminea	Ermine	Dense brush cover, slash.		Y	Y	Y	Y	Y		
			Mustela frenata	Long-tailed weasel	Areas of abundant prey. Previously excavated den sites. Wooded edges.	Y	Y	Y	Y	Y	Y	Y	

State Listing	Federal Listing	Observed?	Species	Common Name	Special Habitat Needs & Comments	Palustrine Scrub-Shrub Wetland	Palustrine Forested Wetland	Beech-Birch-Maple Forest	Spruce-Northern Hardwood Forest	Regenerating Softwood	Spruce-Fir-Sorrel-Feathermoss Forest	Fir-Heartleaved Birch Subalpine Forest	Palustrine, Perennial Stream
			Mustela vison	Mink	Hollow logs, natural cavities, under tree roots, riparian habitat.	Y	Y	Y	Y	Y	Y		Y
			Mephitis mephitis	Striped skunk	Well-drained soils for burrows; den sites. Open uplands; around human habitation.			Y	Y	Y	Y		
SC	T		*Lynx canadensis*	Canada lynx	Dense softwood regeneration; secluded den sites.			Y	Y	Y	Y	Y	
			Lynx rufus	Bobcat	Rock ledges, under windfalls or in hollow logs.			Y	Y	Y	Y	Y	
		Y	*Odocoileus virginianus*	White-tailed deer	Softwood yarding cover.	Y	Y	Y	Y	Y	Y		
		Y	*Alces alces*	Moose	Wetlands (in summer).	Y	Y	Y	Y	Y	Y	Y	Y
Total # mammal species using habitat type (out of 46 species):						32	38	41	41	41	35	18	12
Total # species using habitat type (out of 158 total species):						**71**	**97**	**106**	**119**	**116**	**99**	**60**	**21**

Habitat Use Codes: B = breeding season, Y = year-round, W = winter

State/Federal Status Codes: E = endangered, T = Threatened, SC = Special Concern

Appendix B Table 2. Potential Migrant Bird Species

Common Name	Species
American bittern	*Botaurus lentiginosus*
Great blue heron	*Ardea herodias*
Canada goose	*Branta canadensis*
Wood duck	*Aix sponsa*
American black duck	*Anas rubripes*
Mallard	*Anas platyrhynchos*
Blue-winged teal	*Anas discors*
Green-winged teal	*Anas crecca*
Ring-necked duck	*Aythya collaris*
Common goldeneye	*Bucephala clangula*
Hooded merganser	*Lophodytes cucullatus*
Osprey	*Pandion haliaetus*
Bald eagle	*Haliaeetus leucocephalus*
Northern harrier	*Circus cyaneus*
Peregrine falcon	*Falco peregrinus*
Killdeer	*Charadrius vociferus*
Spotted sandpiper	*Actitis macularia*
Common snipe	*Gallinago gallinago*
Herring gull	*Larus argentatus*
Mourning dove	*Zenaida macroura*
Black-billed cuckoo	*Coccyzus erythrophthalmus*
Common nighthawk	*Chordeiles minor*
Chimney swift	*Chaetura pelagica*
Belted kingfisher	*Ceryle alcyon*
Eastern phoebe	*Sayornis phoebe*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bank swallow	*Riparia riparia*
Cliff swallow	*Hirundo pyrrhonota*
Barn swallow	*Hirundo rustica*
Veery	*Catharus fuscescens*
European starling	*Sturnus vulgaris*
Orange-crowned warbler	*Vermivora celata*
Prairie warbler	*Dendroica warbler*
Fox sparrow	*Passerella iliaca*

Common Name	Species
Field sparrow	*Spizella pusilla*
Vesper sparrow	*Pooecetes gramineus*
White-crowned sparrow	*Zonotrichia leucophrys*
Lapland longspur	*Calcarius lapponicus*
Snow bunting	*Plectrophenax nivalis*
Indigo bunting	*Passerina cyanea*
Bobolink	*Dolichonyx oryzivorus*
Eastern meadowlark	*Sturnella magna*
Rusty blackbird	*Euphagus carolinus*
Common grackle	*Quiscalus quiscula*
House finch	*Carpodacus mexicanus*
Common redpoll	*Carduelis flammea*
Hoary redpoll	*Carduelis hornemanni*

Appendix C

Maine Department of Inland Fisheries and Wildlife Letter

STATE OF MAINE
DEPARTMENT OF
INLAND FISHERIES & WILDLIFE
284 STATE STREET
41 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0041

ANGUS S. KING, JR.
GOVERNOR

LEE PERRY
COMMISSIONER

689 Farmington Road
Strong, ME 04983
October 16, 2000

Jonathan Milne
Woodlot Alternatives, Inc.
122 Main St. No. 3
Topsham, ME 04086

Re: Significant Fisheries Resources, right-of-way corridor, Carrabassett Valley/Redington Twps.

Dear Mr. Milne:

The map enclosed with your letter to Charles Hulsey indicates that the proposed corridor runs along Nash Stream for some distance. Nash Stream supports a wild brook trout fishery. To protect habitat and to maintain cool water temperatures and flow regimes, it is important to maintain a vegetated buffer along the riparian zone. LURC P-SL zoning standards should be considered the minimum amount of protection for this steeply-graded stream; additional protection in the form of wider buffer zones would be appreciated.

Sincerely,

Forrest Bonney
Regional Fishery Biologist

Appendix D

Fall 2002 NEXRAD Radar Summary

Fall 2002 NEXRAD radar summary							
Date	**Migration Activity**			**Date**	**Migration Activity**		
Night of:	None	Light	Heavy	Night of:	None	Light	Heavy
14-Aug-02	x			23-Sep-02			x
15-Aug-02	x			24-Sep-02			x
16-Aug-02	x			25-Sep-02			x
18-Aug-02	x			26-Sep-02	x		
20-Aug-02	x			27-Sep-02	x		
21-Aug-02	x			28-Sep-02			x
22-Aug-02		x		29-Sep-02			x
25-Aug-02	x			30-Sep-02	x		
26-Aug-02	x			1-Oct-02		x	
27-Aug-02	x			8-Oct-02			x
29-Aug-02	x			9-Oct-02		x	
30-Aug-02			x	11-Oct-02			x
1-Sep-02	x			12-Oct-02			x
2-Sep-02	x			13-Oct-02	x		
4-Sep-02			x	14-Oct-02			x
5-Sep-02			x	15-Oct-02			x
9-Sep-02			x	16-Oct-02	x		
11-Sep-02	x			17-Oct-02			x
12-Sep-02			x	18-Oct-02			x
13-Sep-02			x	19-Oct-02	x		
16-Sep-02			x	20-Oct-02			x
17-Sep-02			x	21-Oct-02			x
Initiation of Black Nubble Surveys				22-Oct-02			x
18-Sep-02			x	23-Oct-02			x
19-Sep-02			x	24-Oct-02			x
20-Sep-02		x		25-Oct-02			x
21-Sep-02			x	26-Oct-02		x	
22-Sep-02	x			29-Oct-02			x
Summary:	Number of nights with no migration activity: 20 Number of nights with light migration activity: 6 Number of nights with heavy migration activity: 29						