



**Vermont
Spruce Grouse Recovery Plan
February 2012**



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We wish to acknowledge Frank Oatman's and Sally Laughlin's pioneering interest and support for the conservation of spruce grouse in Vermont. Beginning in the late 1970s, Frank and Sally were both ardent supporters and promoters of the need to maintain and hopefully recover this species. Thanks to Rich Chipman and Jason Boulanger, both who conducted literature review which contributed to this plan, to Julie Alexander for translating portions of the Anticosti papers from French to English, and to Tony Smith for the cartography. Thanks also to the many reviewers of this plan, including Vermont's Bird Scientific Advisory Committee, and especially to Chris Rimmer, Keith Weaver, and Department staff for their thoughtful comments on earlier drafts of this plan.

EXECUTIVE SUMMARY

Spruce grouse (*Falci pennis canadensis*, formerly *Dendragapus canadensis*) inhabit the boreal forests of North America. Although considered common in Canada, Alaska and Maine, in Vermont the species is near the southern edge of its range. Historical accounts indicate the species was present in the northeastern counties of Orleans and Essex (Thompson 1853, Cutting 1884). Currently, a breeding spruce grouse population is restricted to a 62 km² (25 mi²) area of spruce-fir forest in northern Essex County (Royar and Alexander 1987). This breeding habitat is principally owned by the U.S. Fish and Wildlife Service (Nulhegan Basin Division of the Silvio O. Conte Refuge, hereinafter "Refuge") and the State of Vermont, Fish and Wildlife Department (Wenlock Wildlife Management Area).

It is believed that between 150 and 300 adult birds occur in this population, and periodic surveys between 1991 and 2003 suggested a stable population. Subsequent surveys, however, indicate a reduced population, at least along the original transect routes. Although the future of this population would seem secure given the interests of the two public owners in conserving biodiversity (assuming that vegetation management will continue to maintain and improve habitat and that disturbance from the potential increase in recreationists to this area can be controlled) a stochastic event such as a widespread fire or disease (forest or avian) outbreak could severely impact the population.

Full recovery of spruce grouse in Vermont will require the establishment of 2 additional sub-populations, most likely on the State Lands located in the southern Essex County towns of Victory and Granby, and in the northern Essex County town of Norton. Restoration of spruce grouse into Victory Basin began in 2008, with 24 birds captured in Maine by Vermont Fish and Wildlife Department (VFWD) staff and 15 obtained from a Quebec contractor. In 2009 and 2010, an additional 95 birds were translocated from Maine and Quebec, bringing the 3-year total to 134 grouse.

Spruce grouse in Vermont may be downlisted to State-threatened status if, on average for 5 years, there are at least 2 self-sustaining sub-populations, each with at least 30 nesting females, and with occasional dispersal between populations. Delisting (removing from the Vermont Endangered and Threatened Species List) will be recommended if, on average for 5 years, there are at least 3 self-sustaining sub-populations, each with at least 30 nesting females, and with occasional dispersal between populations.

NATURAL HISTORY AND ECOLOGY

Taxonomy and Distribution

The spruce grouse is a member of the Family Tetraonidae. Two, and possibly three, subspecies exist. The most widespread subspecies is *F.c. canadensis*, which occurs in Vermont and is commonly called the Canada spruce grouse. This subspecies also occurs from Nova Scotia and Maine west to Michigan and southern Ontario (Johnsgard 1973). A second subspecies, *F.c. franklinii*, occurs in the Rocky Mountain region. A third subspecies, *F.c. isleibi*, is tentatively identified in southeast Alaska (Williamson et. al, 2008).

Species Description

Spruce grouse are heavy-bodied birds with short, rounded wings and a short beak. Both sexes have feathering that extends to the base of their toes which is an adaptation for walking on snow (Johnsgard 1973). Adult spruce grouse are usually 38-43 cm (15-17 inches) long (Peterson 1980). The average weight of males is 570 g (20 oz); females average 430 g (15 oz) (Johnsgard 1973).

The body of a male spruce grouse is finely barred in gray and black. The throat and breast patch are black and sharply outlined by white stripes that begin at the eye and extend downward towards the upper breast. Female spruce grouse are mostly brown with thick barring of black and gray on the head and undersides. Both sexes have short tails with a chestnut or rusty colored terminal band, and a comb of red skin above each eye which can be seen at close range (Peterson 1980).

Ruffed grouse (*Bonasa umbellus*), commonly known as partridge, coexist with spruce grouse in Vermont. Spruce grouse, especially females, could easily be mistaken for ruffed grouse at first glance. In general, ruffed grouse are slightly larger and lighter in color than spruce grouse. In addition, ruffed grouse have a tuft of raised feathers on the crown, and a much larger tail “fan” when erected in display mode.

Home Range and Patch Size

The seasonal home range size of spruce grouse varies by sex and age, with females and broods requiring the largest area. Herzog and Boag (1978) found summer brood ranges to average 29 ha (72 ac), and Ellison (1973) reported brood ranges of about 50 ha (124 ac). Spring male ranges averaged 1 ha (2.5 acres) (Herzog and Boag 1978).

Individuals in some spruce grouse populations are considered migratory. Herzog and Keppie (1980) found movements of up to 9.5 km (5.9 mi) between discrete summer and winter range and Keppie subsequently recorded one dispersal/migration of 25 km (15.5 mi) (D. Keppie, pers. comm.). In winter, spruce grouse are dispersed throughout the forest with overlapping home ranges (Ellison 1973).

The mean habitat patch size occupied by insular populations of spruce grouse in New York was 157 ha (388 acres) and the minimum patch size occupied was 20 ha (49 acres) (Fritz 1985); however, the percentage of patch occupancy declined sharply when patch size was less than 100 ha (250 acres) (Fritz 1979).

Food Habits

Spruce grouse food habits change throughout the year and may result in seasonal shifts in habitat utilization. Boag and Schroeder (1992) stated that “Foraging in conifers occurs mainly at midcrown level, perhaps because needles there are nutritionally better, branches provide sturdy support, and the grouse can see approaching avian predators but still remain partially concealed”. Larch and spruce needles were found to be the dominate food items during the spring breeding season in New York (Gradoni 1982). Females during egg-laying feed heavily on trailing arbutus (*Epigaea repens*) flowers and spore capsules of hair-cap mosses (*Polytrichum spp.*) (Naylor and Bendell 1989, Keppie 1995). During the summer months, spruce grouse feed mainly on berries, insects and vegetation growing on the forest floor (Allan 1985). The growing tips, leaves, flowers and fruits of blueberries (*Vaccinium spp.*) are a major component of the diet (Boag and Schroeder 1992). Fruits and leaves of bunchberry (*Cornus canadensis*) and fungi are important in the diet of chicks (Keppie 1995, DeFranceschi and Borg 1991).

Larch needles are favored in late summer and fall until unavailable (Crichton 1963; Gradoni 1982; Allan 1985). Larch may provide a transition food from the more varied summer diet to a conifer dominated winter diet. Larch comprises 15-20% of stand composition on most spruce grouse habitats in New York (R. Chambers, pers. comm.).

Spruce grouse shift to an arboreal feeding pattern in winter and their diet consists almost exclusively of conifer needles (Keppie 1977). Gradoni (1982) found that spruce grouse in the Adirondacks of New York eat predominately balsam fir needles with smaller amounts of black spruce (*Picea mariana*) during winter. In New Brunswick, spruce may be a favored food item over fir (D. Keppie, pers. comm.).

Reproduction and Survival

Spruce grouse usually breed at one year of age. Males occupy breeding territories in the spring and begin their courtship display which consists of “flutter flights” to and from low perches and the ground and strutting about with red eye combs inflated and tail feathers fanned. Males are polygynous and females are monogamous (Boag and Schroeder 1992).

Females select a nest site outside of the male’s territory. The nest is a rounded depression in the substrate lined with dead conifer needles, leaves and feathers and is usually located under branches and/or thickets (Redmond et al. 1982). Egg laying begins approximately 17 days after the ground becomes 50% snow-free (Keppie and Towers 1990).

Females deposit a clutch averaging 5.6 eggs, and incubation averages 21-23 days, with the female leaving the nest only for defecation and short feeding periods (Keppie 1982).

Broods leave the nest within one day of hatching. Average brood size shortly after leaving the nest varies from 3.3-5.0 chicks (Robinson 1980). Number of young surviving to late August was found to be 1.7/female in Michigan (Robinson 1980) and 2.0 in New Brunswick (Keppie 1982) but only 0.64 in small and patchy habitats on Mount Desert Island, Maine (Whitcomb et.al.1996).

Spruce grouse may live for at least 13 years of age (Boag and Schroeder 1992) but are more likely to be killed by a predator before reaching their fifth year (Gliddi 1994). Annual survival rates were found to be 44% for males and 49% for females in New Brunswick (Keppie 1987) and 38% and 23% in Michigan (Robinson 1980).

HABITAT REQUIREMENTS AND STATUS

General Habitat Requirements

The spruce grouse is a bird of the boreal forest. Highest grouse densities (40-80 adults in summer/100 ha or 1-2/ac) are found in young dense jack pine (*Pinus banksiana*) stands, where live branches occur from 4-8 meters (13-26 ft) above ground (Szuba and Bendell 1983; Keppie 1995). Jack pine forests do not occur in Vermont, however, spruce-fir forests of similar structure provide suitable habitat throughout much of spruce grouse range. Keppie (1987) documented breeding densities of 9.8 - 21.9 adults/100 ha (0.25-0.55/ac) in a New Brunswick spruce-fir pine forest. Spruce (*Picea spp.*) is preferred over fir (*Abies balsamea*) because it develops and maintains better vertical stratification. A shrub layer of *Vaccinium spp.* or regenerating spruce-fir in low densities enhances habitat for spruce grouse (Robinson 1969). Larch (*Larix laricina*) in the overstory may provide a preferred fall food resource. Forest openings are important to female spruce grouse and their broods, as they provide greater abundance of accessible food resources for chicks than the dense forest (Allan 1985).

Cover Requirements

The key cover characteristics for spruce grouse include tree and shrub species density and composition, canopy closure, tree height and vertical stratification (Keppie, pers. comm.). In general, spruce grouse require softwood habitat with live branches close to the ground, and “apparently prefer relatively young successional stands” (Boag and Schroeder 1992). Jack pine forests in the East show declining grouse densities after trees attain heights of 10-12m, (33-39 ft) or about 30-45 years of age; however, spruce forests can retain value longer because of persistent low live branches (Keppie 1995).

Spruce-fir forests of the Northeast reach appropriate vertical complexity for spruce grouse at 20 to 50 years of age. Habitat becomes less suitable for spruce grouse in conifer stands where tree height is greater than 15m (49 ft) and the live crown is less than 50% of the total height of the tree (Keppie, pers. comm.). Allan (1985) reports spruce grouse in Maine generally selected trees 8-9m (26-29 ft) in height, and the average height at which birds were found within these trees varied between 2 and 5m (7-16 ft), depending on the season of the year. Allan (1985) also found red spruce (*Picea rubens*) to be the dominant tree species at spruce grouse locations in Maine in all seasons except autumn. During autumn, spruce grouse occupied habitats with higher proportions of balsam fir and larch.

An understory layer of low to moderate density appears to be favored by spruce grouse. In New Brunswick, northern Michigan and central Ontario blueberries as well as trailing arbutus prevail among low vegetation where spruce grouse are found (Robinson 1969, Keppie, pers. comm.). A dense shrub layer however, is apparently poor spruce grouse habitat, and Keppie (1995) theorized that “these shrubs, when dense and > 40 cm tall seem to preclude movement and (or), perhaps more important, reduce the bird’s detection of predators.”

VERMONT POPULATION STATUS AND DISTRIBUTION

Distribution and Status

Historically, spruce grouse were found in Orleans and Essex Counties in northeastern Vermont (Thompson 1853, Cutting 1884). The present Vermont breeding spruce grouse population is found in the Nulhegan Basin between the Wenlock Wildlife Management Area in Ferdinand and the so-called “Yellow Bogs” area in Lewis (Royer and Alexander 1987). The extensive Nulhegan Basin, approximately 62 km² (24 mi²) in size, is a soft plutonic basin and glacial outwash plain.

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Vast swamps of pure black spruce or mixed spruce, balsam fir and larch dominate the vegetative cover of these lowland boreal forests. Scattered alder (*Alnus rugosa*) swamps and small open bogs are also present (Thompson 1989).

The largest landowners of grouse habitat in the Nulhegan Basin are the U.S. Fish and Wildlife Service (USFWS), The Conservation Fund (TCF), and the Vermont Fish and Wildlife Department (VFWD). In 1999, the USFWS acquired 10,500 ha (26,000 ac) from Champion International Corporation (CIC) to create the Nulhegan Division of the Silvio O. Conte National Wildlife Refuge. This refuge includes approximately three-fourths of Vermont's current spruce grouse habitat. TCF purchased 1,650 ha (4,090 ac) surrounding McConnell Pond from International Paper Corporation in 1994. This tract of land is located in the northwest part of the Nulhegan Basin. Only a small portion of spruce grouse habitat is located on this parcel.

At the southern edge of the Nulhegan Basin lies the Wenlock Wildlife Management Area (WMA) which consists of 805 ha (1,993 ac) owned and managed by VFWD. This WMA, of which 41% is comprised of upland and lowland softwood forests, is managed for both white-tailed deer (*Odocoileus virginianus*) wintering habitat and spruce grouse (Alexander and Horton 1986). CIC and the State of Vermont had jointly written and implemented a long range management plan for a 5,354 ha (13,261 ac) portion of the Nulhegan Deer Wintering Area which called for an equal distribution of age classes (0-60 years) for all merchantable softwood stands and protection of wetland habitats. This plan, in addition to providing suitable deer habitat, was also designed to provide sustained spruce grouse habitat. Approximately 95% of the occupied spruce grouse habitat in the Nulhegan Basin occurs on conserved land.

There may be a small breeding population of spruce grouse in Norton between and including the Bill Sladyk WMA and the Black Turn Brook State Forest, the latter parcel which is owned by the Vermont Department of Forests, Parks and Recreation (VDFPR). The area between these two State parcels is owned by a private timberland company. There have been sightings of birds reported in this area (Royer 1986) and in 1994 a ruffed grouse hunter accidentally shot a female spruce grouse. Breeding season surveys conducted in this area in 1985 and 1986, however, failed to confirm the presence of a breeding population (Royer and Alexander 1987), and birds seen here may represent dispersals from the Nulhegan Basin population.

Spruce grouse droppings have been collected from Granby Bog in Granby and Ferdinand Bog in Ferdinand (Royer and Alexander 1987). In August of 1989 a male was observed near U.S. Route 2 in Concord (M. DesMeules, pers. comm.) and birds were seen on Monadnock Mountain in Lemington in 1996 and 2001. It is likely that these sightings represent dispersing birds only and not established sub-populations.

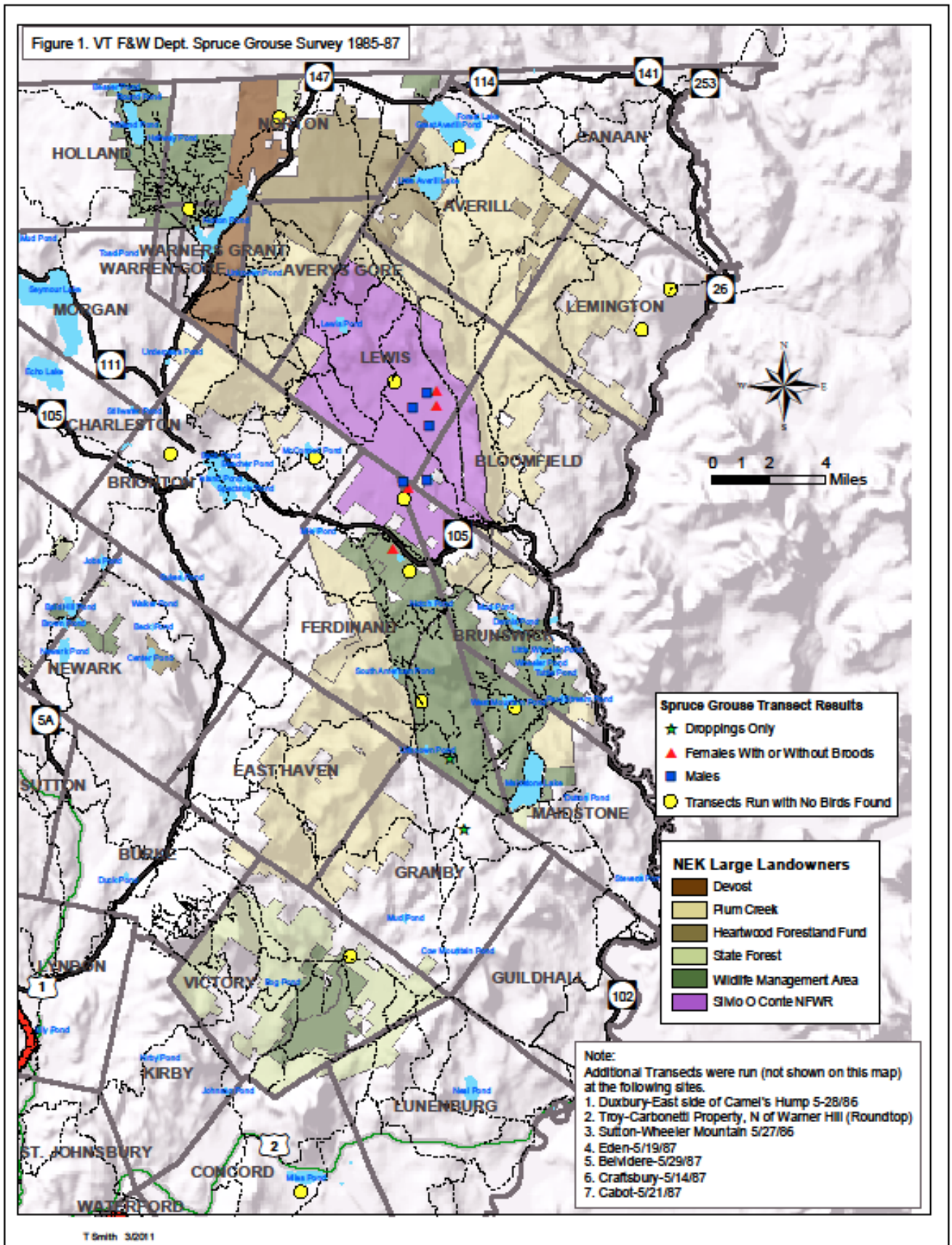
The only historical records of spruce grouse occurring outside of the Northeast Kingdom come from Camel's Hump in Duxbury and Richmond. Corps of Engineers' wildlife biologist Judith Johnson observed a spruce grouse on the east side of the mountain in 1978, and Dr. Hub Vogelmann, (formerly Botany Department Chair, University of Vermont) also remembers seeing birds on the Hump in the 1970s. Suspect droppings collected on 11/01/2003 along the Dean Trail on Camel's Hump State Forest are currently awaiting DNA analysis by Dr. William Kilpatrick (University of Vermont, Department of Biology).

In 1985, the spruce grouse was recognized as a "species of special concern" by the Vermont Endangered Species Committee's Scientific Advisory Group on Birds. At this time, little was known about Vermont spruce grouse, except that they were not in abundance. Information from Christmas Bird Counts and the Vermont Breeding Bird Atlas Project (Laughlin and Kibbe 1985) supported the contention that the species was restricted to a small area and was low in numbers.

In 1987, the Scientific Advisory Group on Birds proposed to the State's Endangered Species Committee that the spruce grouse be listed as endangered. In 1988, with the recommendation of the Endangered Species Committee, the spruce grouse was listed as an endangered species in Vermont.

Research and Management

From 1985 to 1987, VFWD conducted annual surveys to locate new areas occupied by spruce grouse (Royer and Alexander 1987). This study failed to find any actual birds outside of the Nulhegan Basin, although droppings were found in Granby and Ferdinand Bogs (Figure 1). In 1988, the Department made a shift to census blocks of habitat where the spruce grouse were already present, concentrating efforts in Wenlock WMA and Yellow Bogs. Survey participants walked transects and played audio tapes of aggressive female spruce grouse in order to elicit responses from males and, less frequently, females. Responding birds were live-captured using telescoping poles with monofilament nooses and banded

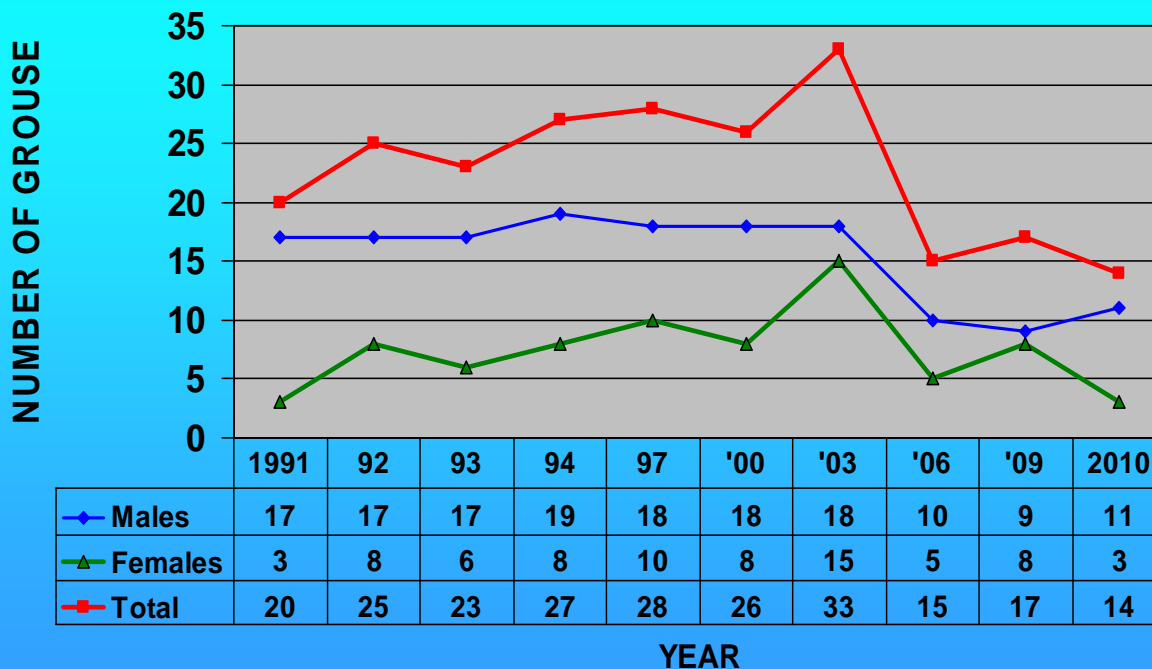


for identification purposes. Thirty-one birds were banded, including 17 males in an intensively surveyed 600 ha (2.3 mi²) unit in Yellow Bogs. By assuming a 1:1 sex ratio as reported by Ellison (1974) and extrapolating to a total of 1820 ha (7 mi²) of suitable habitat where other birds were banded, the breeding population of spruce grouse in the Nulhegan Basin was estimated to be at least 105 birds (Pence et al. 1990).

In 1990, VFWD initiated an annual spruce grouse trend survey to monitor breeding populations in the Nulhegan Basin. Five permanent transects were established on CIC lands and a sixth at Wenlock WMA, designed mainly to detect presence of males (see Appendix 1 for survey methods). In 1994 VFWD decided to conduct the survey every third year. The number of birds detected remained steady at around 26 birds per year until 2006, when only 15 were detected. Habitat maturation, widespread blowdown, and paludification had degraded large areas of habitat along the permanent transect routes, and some adjustments to transects were made for the 2009 survey. Nonetheless, only 17 birds were detected in 2009, so VFWD decided to conduct a survey again in 2010, with more adjustments made to avoid additional areas of blowdown and include now 30-year old clearcuts, some of which had been pre-commercially thinned and showed promise in potentially holding birds.

The 2010 survey detected only 14 birds, and three of the survey routes in traditional areas detected zero birds. Traditional routes at Wenlock WMA and Mollie Beattie Bog continue to turn up good numbers of birds, and new transect sections located in the 30-year old clearcuts were successful in detecting birds. It is possible that the spruce grouse population in the Nulhegan Basin remains relatively stable and has shifted into new habitats over the past two decades, but it is also possible that the population has truly experienced a decline (Figure 2). Future surveys should continue to explore younger habitats that have regenerated since the 1980s.

Figure 2: Nulhegan Basin Spruce Grouse Trend Survey Results 1991 - 2010



In 1993, Model Habitat Management Guidelines for Spruce Grouse (Alexander and Chipman 1993) were written to be applied to existing spruce grouse range in Vermont. These guidelines were also recommended for Vermont habitats which may become the site of any future spruce grouse reintroduction, and have since been promoted nationally (Williamson et al 2008). A summary of the habitat management recommendations excerpted from the Model Guidelines is shown in Appendix 2.

The VFWD annually maintains hunter warning signs (Appendix 3) that differentiate spruce grouse from ruffed grouse. These signs are distributed along roads throughout the known breeding area in the Nulhegan Basin on USFWS and VFWD lands, and more recently at the reintroduction sites in Victory Basin. Similar warning signs were first posted in 1988, after which the effectiveness of these signs was investigated via surveys of hunters on the Nulhegan Basin. Of all hunter survey respondents (n=112) 88% saw a sign designating the area as spruce grouse territory. Fifty-four percent of respondents indicated they still would have known spruce grouse were in the area if signs did not exist, and 65% said they could differentiate a ruffed grouse from a spruce grouse (Pence et al. 1990).

Finally, VFWD implements other educational efforts aimed at reducing accidental spruce grouse losses via notices in its “Guide to Hunting, Fishing and Trapping Laws” and press releases have been issued just prior to the September opening of Vermont’s small game hunting season (Appendix 4).

Vermont Reintroduction Initiative

Spruce grouse have been successfully introduced to Newfoundland in 1964 (Tuck 1968) and Anticosti Island, Quebec in 1985-86 (LeMay and Ferron, 1987). The VFWD has long recognized Victory Basin in Victory (Figure 2) as suitable habitat for reintroduction of spruce grouse (Alexander 1983). This basin is the second largest boreal basin in the state, and 10 km² are owned by VFWD, as part of the Victory Basin Wildlife Management Area (VBWMA). The VDFPR owns an additional 6 km² of suitable spruce grouse habitat in the town of Victory, located both east and west of the VBWMA, within the Victory State Forest (VSF). The last official record of spruce grouse in Victory is a mounted male at the Fairbanks Museum and Planetarium, St. Johnsbury. The collection date of this specimen is unknown, but presumed to be circa 1891 (S. Amos, pers. comm.).

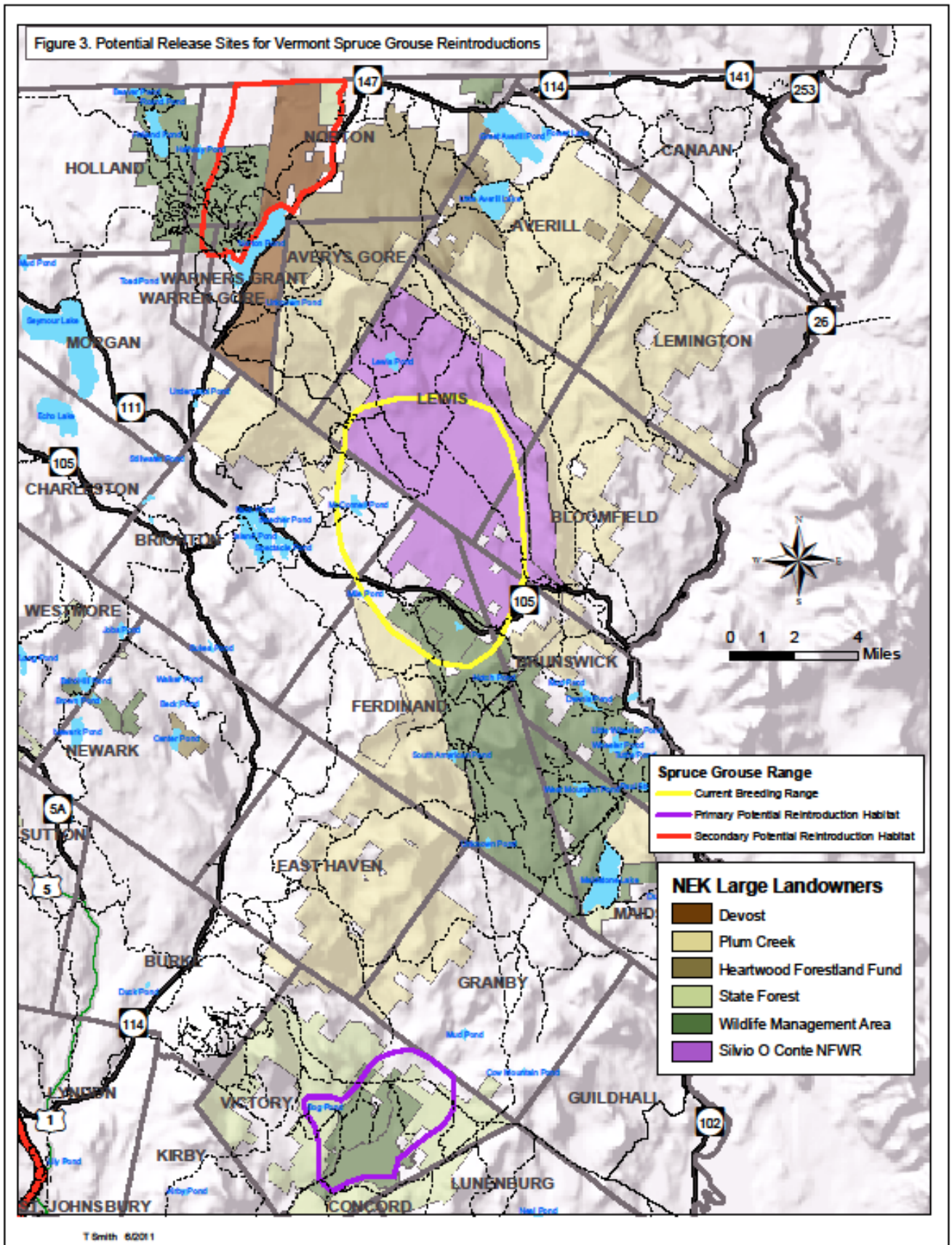
Victory Basin was selected as a reintroduction site because of its abundance of suitable habitat and large acreage of State ownership. The VFWD and VDFPR manage softwood stands on their lands in Victory Basin to provide contiguous functional winter shelter for white-tailed deer, including a distribution of vegetative age classes that will ensure replacement shelter for overmature stands. This management plan dovetails well with the habitat needs of spruce grouse.

If a sub-population is successfully established at Victory, it is possible that occasional dispersal to and from the Nulhegan Basin population might occur. Due to topography and presence of coniferous cover along riparian zones, the likely southerly dispersal route from the Wenlock WMA would be down Paul Stream through Ferdinand Basin to the southern tip of Ferdinand, and then up Granby Stream, through Granby Bog to the terminus of one of its tributaries near Nurse, Spruce, or Sable Mountains. From there dispersing grouse would have to travel a final distance of 5 km, along smaller drainages between the aforementioned hills, to reach Victory Basin. The entire dispersal distance would be approximately 25 km, which has been known to occur (D. Keppie, pers. comm.).

Evidence that spruce grouse have occasionally dispersed along this route include the droppings found in Granby and Ferdinand Bogs during the 1986 survey, and a male seen on the edge of Ferdinand Bog in 1985 by the Vermont State Naturalist (C. Johnson, pers. comm.).

A notable drawback of selecting VBWMA as a priority reintroduction site is the popularity of the area to “bird hunters”. Although ruffed grouse and woodcock hunters generally confine their hunting activity to the alder, aspen, and old field habitats present, and generally avoid the coniferous stands, accidental shootings are likely to occur. A vigorous information and signing effort was implemented in 2008 to help reduce accidental shootings.

A second potential release site is the Coaticook River Basin in Norton, Vermont (Fig. 3.). This area includes 24 km² of potential habitat, portions of which are located on the Bill Sladyk WMA to the south and the Black Turn Brook State Forest which abuts the Canadian border. The majority of this basin, lying between the two State parcels, is currently owned by the Devost Leasing, Inc., and is protected from development by a conservation and public access easement held by the State. Spruce grouse have occasionally been seen in this area in recent decades, most likely the results of dispersals from the Nulhegan Basin.



The Newfoundland and Anticosti Island introductions succeeded with total releases of 134 and 343 birds, respectively. The Anticosti introduction was accomplished with 5 individual release sites. Three sites were subsequently censused for evidence of success or failure. These sites and their respective stocking numbers were Petite Lac Long (127 birds), Chemin Ste-Marie (54) and Stang Paul (36) (LeMay and Ferron, 1987). Stocking densities were approximately 63 (Petite Lac Long), 90 (Chemin Ste-Marie) and 60 birds/km² (Etang Paul). The latter site proved unsuccessful, which was attributed to inadequate habitat as there was virtually no understory due to extreme overbrowsing by white-tailed deer (J. Ferron, pers. comm.).

LeMay and Ferron (1987) developed a population model based on the literature and their own findings. Beginning with 100 birds (40 adults and 60 chicks) introduced in the spring and early summer, their model predicts a surviving fall population of 68 grouse. After winter mortality, the population was reduced to 60, with an equal sex ratio of 30 males and 30 females. With 30 breeding females, the modeled population grew to 90 by the following year; this model therefore showed a population rate-of-increase of 1.50 for birds introduced to Anticosti. Budgetary constraints prevented further studies to investigate whether or for how long this rate was sustained, but it is known that spruce grouse are now common throughout the 7,941 km² island. Although red fox are present on the island, the red squirrel, a significant predator on spruce grouse eggs, does not occur. A similar high rate-of-increase, therefore, may not be achievable in the presence of red squirrels.

J. Ferron (pers. comm.) recommends a reintroduction stocking density of 20 birds/km², with a minimum of 60 birds, for one release site. He further recommends capturing and transporting birds in mid- to late summer, when capture of hens and their entire broods is easily accomplished. Although Vermont's Nulhegan Basin spruce grouse might possibly withstand the summertime removal of 60 birds, it might also prove excessively damaging to the population. Clearly, such a risk was unwarranted, and a source of birds for reintroduction was sought from the closest population that could safely provide 60 birds. In 2008, 24 birds were captured in Maine by VFWD staff and 15 more were obtained from Quebec contractor Laurier Breton (retired Senior Wildlife Technician with the Quebec Ministry of Natural Resources) and translocated to VBWMA. An additional 95 birds were translocated from Maine and Quebec in 2009 and 2010, bringing the 3-year total to 134 grouse (38 adult males, 44 adult females, and 52 chicks).

Limited springtime breeding season surveys were conducted in Victory in 2009 and 2010. Four adults (3 males and 1 female) were detected in 2009, and 2 males were detected in 2010 (including one which had been translocated as a chick from Maine in August, 2008). Limited chick surveys were also conducted in July of 2009 and 2010 with no chicks detected. Hens with chicks were reported, however, by 2 separate observers in early summer, 2009.

Although all aforementioned jurisdictions are home to the same subspecies of spruce grouse found in Vermont, it is possible that Vermont's population has become genetically isolated from all other populations. Dobzhansky (1970) advised against the mixing of isolated stocks to establish a population because it may reduce genetic fitness by loss of closely-linked or co adapted genes. Conversely, Meffe (1987) pointed out that edge of range populations (such as Vermont's) may have lower genetic variance than do those near the center, and that the individuals from centrally located populations may display a higher fitness in character such as growth rate, survivorship, fecundity, etc.

THREATS AND LIMITING FACTORS

Habitat Loss and Encroachment

Two main causes of historic spruce grouse decline are habitat loss and human encroachment. As colonial settlements expanded from southern Vermont into northeastern Vermont forests, spruce fir forests were cleared and the relatively tame spruce grouse was undoubtedly taken for human consumption whenever the opportunity arose. As industrial timber companies were formed, vast areas of virgin spruce fir forest were cut, and 19th century loggers may have taken spruce grouse to supplement their daily fare. By 1980 spruce grouse apparently remained only in the 62 km² Nulhegan Basin, which at the time was experiencing heavy cutting of its mostly mature forests. Today much of Essex County forests are publicly owned or subject to conservation easements held by the State and/or private conservation organizations. As a result, conservation and sustained forestry goals across much of Essex County forestland will likely maintain, if not increase, available spruce grouse habitat. Increasing human development, however, will no doubt continue to encroach on some peripheral habitats, and the forecast increases in outdoor recreationists to Essex County could disrupt breeding activities and/or increase susceptibility to predation or adverse weather conditions (especially if pets accompany their owners on excursions through grouse habitats).

Predation

Predation is likely the most common cause of spruce grouse mortality (Boag and Schroeder 1992) although no predator is known to depend on spruce grouse as a large part of its diet (Robinson 1980). A major predator of spruce grouse eggs is the red squirrel (*Tamiasciurus hudsonicus*) (Boag et al 1984, Naylor and Bendell 1987). Other potential predators in Vermont are the northern goshawk (*Accipiter gentilis*), barred owl (*Strix varia*), northern raven (*Corvus corax*), red fox (*Vulpes vulpes*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), black bear (*Ursus americanus*), striped skunk (*Mephitis mephitis*), fisher (*Martes americana*) and ermine (*Mustela erminea*). On Mount Desert Island, 7 of 19 radio transmitter-carrying adult females (37%) were predated between April and late August (Whitcomb et.al.1996). Predators identified were a red-tailed hawk (*Buteo jamaicensis*), red fox and an unidentified raptor. A study in Ontario of 67 spruce grouse nests found 55% were depredated by red squirrels, red fox, black bear and striped skunk (D'Eon 1997).

Weather

Though harsh weather conditions may rarely kill adult spruce grouse directly, they may lower vitality, making grouse more susceptible to other forces such as predation and disease (Gliddi 1994). To keep warm in winter, spruce grouse burrow into the snow, creating a cavity for insulation. A snow depth of at least 4-5 inches is needed for this “snow roosting” (Kueber 1973). Lack of sufficient snow depth or the development of a hard crust may place added stress on wintering grouse. Cold and wet weather conditions in the spring may also lead to elevated loss of eggs or newborn chicks, and although to our knowledge there is no empirical evidence of such effects, Robinson (1980) did find a close relationship between chick survival and June temperatures.

Disease

Spruce grouse have been known to harbor many parasites, but none are known to cause serious mortality (Boag and Schroeder 1992). Robinson (1980) found no difference in survival rates between grouse with or without parasites. Some diseases however, such as *Aspergillus fumigatus*, a fungus which can infect lung tissue, may cause death in the winter months (Boag and Schroeder 1992). Herzog in 1979 found renal gout to be the cause of death of 4 radio-marked grouse during periods of heavy rain (Gregg et. al 2004).

Climate Change

Long-term change in average temperatures and climate, linked to global warming, can impact natural communities and wildlife habitats and is recognized as a contemporary threat to many wildlife species in Vermont (Kart et al. 2005). Vermont has warmed 1.6° F from 1885 to 1999 and is predicted to warm by another 6 - 10° F by 2090 (NERAG 2001). Such a warming trend could affect the southern range of cold-adapted trees, such as spruce and fir, and their range will likely retreat northward (NHWAP 2005). Such a change could seriously affect habitat suitability for spruce grouse throughout its current range in Vermont.

Accidental Shooting

Another potential limiting factor, especially in small patches that might hold dispersing grouse, is accidental shootings by ruffed grouse hunters. A grouse hunter, conditioned to shoot quickly at a flushing grouse, could easily mistake a flushed spruce grouse for a ruffed grouse. A few accidental shootings were documented during the 1980's in Essex County, including a group of eight grouse shot at Wenlock WMA by hare hunters in 1982, and one hen shot by a ruffed grouse hunter near Gaudette Brook in Norton in 1994. The continuation of educational efforts aimed at grouse hunters in Essex County should help prevent this source of mortality from actually limiting the population.

GOALS, OBJECTIVES, AND STRATEGIES FOR RECOVERY

Recovery Goal

The goal of this recovery plan is to increase the total population of spruce grouse in Vermont so their future is secure and they may be removed from the State's threatened and endangered species list.

Recovery Objectives

1. **Downlisting Objective:** Downlist the spruce grouse in Vermont to State-threatened status if, on average for 5 years, there are at least 2 self-sustaining sub-populations, each with at least 30 nesting females, and with occasional dispersal between populations.

2. **Delisting Objective:** Delist (i.e., remove from the Vermont Endangered and Threatened Species List) the spruce grouse in Vermont if, on average for 5 years, there are at least 3 self-sustaining sub-populations, each with at least 30 nesting females, and with occasional dispersal between populations.

Justification for Objectives

Historically, spruce grouse were much more widespread, and presumably secure, throughout northeastern Vermont. Currently, they are restricted to a single, albeit large boreal basin. Although maintenance of coniferous forest types in the basin is all but guaranteed due to its being in public ownership, viability of the spruce grouse population could be seriously compromised by a catastrophic weather, fire, insect or disease event. Additionally, negative impacts from increased recreational use of this basin may prove difficult to control. Management of habitat on public lands should provide sustained spruce grouse habitat, and recreational impacts should be assessed when possible.

Establishment of a second sub-population in Victory Basin would reduce the likelihood of serious impact to the overall population from the aforementioned causes. The goal of 30 adult females was selected based on the growth model developed by Lemay and Ferron (1987). Furthermore, genetic exchange with New Hampshire spruce grouse may be enhanced with establishment of another population within similar dispersal distance of the Connecticut River. Population viability would be enhanced beyond that for Threatened Species status with the establishment of a third sub-population which would present another potential route for genetic exchange with northern New Hampshire.

RECOVERY ACTIONS

Note: Recommended priority for actions across all categories are indicated in brackets as higher [H], medium [M] or lower [L].

Monitoring

1. Continue the triennial breeding season census on the 6 established transects within the Nulhegan Basin, utilizing the established methodology (Appendix 7.1). A long-term agreement to allow monitoring on the Refuge by VFWD staff should be obtained, and monitoring assistance from the Refuge Manager/staff solicited. [M]
2. Continue the annual breeding season and chick censuses within the Victory Basin for at least 5 years to assess degree of breeding activity and population establishment. If and when reintroduction is judged to have been successful, monitoring could be scaled back to triennial surveys. [H]
3. Incidental reports of spruce grouse outside the Nulhegan Basin should be recorded and mapped. Breeding season censuses should be considered if multiple reports indicate the possible existence of a sub-population in new areas. [L]
4. Accidental take and threats to habitat (e.g. spruce budworm outbreaks, effects of climate change on boreal forests) should be documented and monitored. [M]

Habitat Management

1. Spruce grouse are one of two featured species in the Wenlock WMA plan, and habitat conditions have improved as management activities have been implemented. Model habitat management guidelines for spruce grouse (Appendix 7.2) should continue to be incorporated into future updates of the Wenlock WMA Long Range Plan. Cooperation from the USFWS and The Conservation Fund should also be solicited to incorporate model guidelines for spruce grouse habitat into long-range plans for management of spruce grouse habitat on the Conte Refuge and McConnell

Vermont Spruce Grouse Recovery Plan

Pond tract. VFWD and VDFPR district staff should offer assistance in planning, layout and implementation of the habitat guidelines. [M]

2. Model habitat management guidelines for spruce grouse should also be incorporated into management plans of lands suitable for potential reintroduction sites. Within Victory Basin, this will require a continuation of the management coordination already in place for the lowland coniferous forests on VBWMA and VSF. Within the Coaticook Basin, potential habitat should be mapped on the Bill Sladyk WMA, Black Turn Brook SF, and the private land which connects these parcels. A management agreement with the latter private landowner should be sought before reintroduction is attempted in this area. [M]
3. Potential dispersal corridors between Wenlock WMA and Victory Basin should be identified and managed to provide contiguous coniferous or mixed forest cover where possible. Much of the main corridor would lie on the West Mountain WMA where riparian corridors will likely be managed to provide contiguous cover as a general management practice. Cooperation with other important landowners, namely Plum Creek Timber Company and LIADSA Investments II, LLC should also be sought. [L]

Outreach and Education

1. The general public and ruffed grouse hunters in particular should continue to be informed about the status and habitat needs of spruce grouse in Vermont. A fact sheet was developed to assist this effort, and annual press releases (see Appendix 4) should continue to be distributed just prior to the fall small game season. [M]
2. Department staff conducted outreach with local stakeholder groups who were apt to be the most interested in and/or affected by the Victory Basin reintroduction program (e.g. Northeast Kingdom Chapter of the Ruffed Grouse Society and Northeast Kingdom Audubon). Staff also attended selectboard meetings in the involved towns. These efforts should be repeated prior to any further reintroduction efforts. [H]
2. Notices pertaining to spruce grouse and their distribution in Vermont should continue to be included in Vermont's Annual Guide to Hunting, Fishing & Trapping. [H]
3. Warning signs should continue to be maintained at conspicuous locations in the Nulhegan and Victory Basins, and at any future reintroduction sites (see Appendix 3). [H]
4. District Game Wardens should maintain additional enforcement presence in spruce grouse habitats, especially on opening weekend of grouse season, when possible. [M]

Species Management

1. A minimum of 60 (preferably 150) spruce grouse (20% adult males, 20% adult females and 60% juveniles per Lemay and Ferron, 1987) should be captured in mid-to late summer and released at each reintroduction site (e.g., Victory Basin). All released birds should be leg banded with individual color combinations and 1 aluminum, numbered band, in order to obtain dispersal, survival or mortality information from sightings and/or returns. Warning signs should be erected throughout the release site to minimize potential accidental losses. [H]
2. If reintroduction of Victory Basin is successful (i.e., ≥ 30 nesting females annually) step 1 should be repeated for the Coaticook River Basin, assuming permission and habitat management agreements from the larger private landowners is obtained. [M]
3. Feather and scat samples have been collected from native Vermont birds and birds introduced from Maine and Quebec. Genetic analysis of the Vermont birds has begun, and should be repeated with the introduced birds in order to compare genomes and document differences, if any. If differences are found, tissue samples should be collected in the future to investigate dispersal and genetic exchange between subpopulations.

Partnerships/Funding

1. Current efforts to monitor spruce grouse, manage their habitat, and minimize accidental shootings have been adequately staffed and funded by VFWD with the aid of USFWS State Wildlife Grants. Valuable staffing assistance has also been provided by the Nulhegan Basin Division of the Conte Refuge. Any additional restoration efforts, including capture

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efforts in nearby states and/or provinces, genome testing, and additional enforcement presence, may require funding from sources other than VFWD's general operating budget, such as Pittman-Robertson funds or additional State Wildlife Grants. Partnerships and/or funding assistance should be sought from other public and private conservation organizations, if necessary. [M]

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APPENDICES

APPENDIX 1: NULHEGAN BASIN SPRUCE GROUSE SURVEY PROCEDURES - 2010

Survey date is May 04. In the event of rain and/or high winds, the alternate date is May 05.

All participants should meet at 4:45 a.m. at the USFWS Refuge Dormitory in Brunswick (with the exception of the Wenlock route surveyor, who may go directly to Wenlock at 5:00 a.m.).

All participants should bring with them a field notebook, pencil and a compass with the declination set at zero. A small pair of binoculars may also help in sexing birds that remain partially concealed in a tree top.

A transect map, GPS unit, digital player or cassette tape recorder with two tapes of a female spruce grouse calling, and spare batteries will be provided when we meet at the Refuge Dorm.

Use the GPS unit to navigate to your starting point and to conduct your route. You may find it helpful to also use a compass and follow the magnetic compass bearings (declination set to zero) shown on your transect map, or follow roads, trails, edges of clearcuts, type changes, streams or ponds as shown on your transect map. **Record the starting and ending times** at your first and last stops.

PLAY THE TAPE ONLY AT EACH STOP along the transect. Volume should be high but not distorted (generally on a setting of 8 if the recorder's volume scale is 0-10). Be on the watch for spruce grouse flying in.

Stop at 100 yard intervals. At each interval set down or hang up the recorder and **move away 50 feet** to listen and **watch for 3 minutes**.

Return to tape player and **shut it off for 30 seconds while listening** for a male 'flutter flight' or female response call. Then proceed to the next stop and repeat cycle.

Keep track of the number of stops traveled in a field notebook and enter 0's for no birds heard or seen or X's for stops skipped due to beaver flooding, recent windthrow, etc.

IF YOU HEAR OR SEE A BIRD turn the player down to a more natural volume and leave it on the ground in an open area. Obtain a GPS location for the bird and record the stop number and time in your notebook. Spend a few minutes if necessary to verify sex and check for additional birds. Then, turn off the player and proceed to the next stop (100 yards). Repeat the cycle. Note: If you first locate a bird 'ahead' of a stop, you should skip a stop to avoid 'dragging the bird along'.

Count and note locations of any **Gray Jays** or **Black-backed Woodpeckers** seen.

APPENDIX 2: HABITAT MANAGEMENT GUIDELINES¹

These model habitat guidelines were written to be applied to existing spruce grouse range in Vermont. These guidelines should also be applied to Vermont habitats which become the site of any future spruce grouse reintroduction. To be considered as a possible reintroduction site, the area or "patch size" of suitable habitat should be at least 100 ha (250 acres) (Fritz 1979). The overriding consideration in spruce grouse habitat management is the maintenance of nearly contiguous tree cover interspersed with openings.

The following guidelines are recommended:

1. Manage habitat in 50 ha. (124 acres) units, to accommodate the upper range of home range size for females with broods.
2. Even-age or all-age management systems may be used, however, 37% to 50% of all trees within the habitat management unit (HMU) should be in age classes between 20-50 years at all times.
3. Whether the management is described as even-age or all-age, the area of regeneration in each HMU is calculated using the following formula:

$$\frac{\text{CUTTING INTERVAL}}{\text{ROTATION AGE}} = \text{AMOUNT OF AREA REGENERATED}$$

Example: In a stand with a 60 year rotation, and a treatment scheduled every 15 years, $15/60 = 0.25$ (25%) of the HMU should be regenerated during each treatment (Adapted from Reay et al. 1990).

4. Rotation age should range from 60 years for predominately fir stands to 80 years for predominately spruce stands. Cutting intervals should be 10-15 years, resulting in the creation of 4-8 age classes.
5. Softwood regeneration is a critical goal. Clearcut only when softwood regeneration is adequate. Otherwise employ shelterwood techniques to obtain necessary softwood regeneration. Spruce regeneration is preferred over fir.
6. Silvicultural treatment should occur during snow-free periods if scarification is necessary to establish softwood regeneration. However, cutting should not occur during spruce grouse courtship and breeding seasons (mid-April to mid-July).
7. If even-age management is employed, regeneration cuts should be no larger than 12.5 ha (31 acres), as larger cuts would result in the inability to provide equal distribution of at least 4 age classes over time within the HMU. Smaller regeneration cuts of 0.4-1 ha (1-2.5 acres) are preferred as they allow for more thorough utilization of openings by hens with broods.

Employing true all-age stand management (periodic single-tree or group selection cuts from all diameter classes) across an entire HMU may not provide optimum spruce grouse habitat. While continuous forest cover with adequate vertical stratification should be provided by all-age management, sparse canopy brood openings will be lacking. To prevent this habitat deficiency, at least 20% of each HMU should receive even-age regeneration treatments [defined as an area at least 0.4 ha (one acre) in size with a residual basal area $\leq 6.8\text{m}^2/\text{ha}$ (30 sq. ft./acre) following the final regeneration cut].

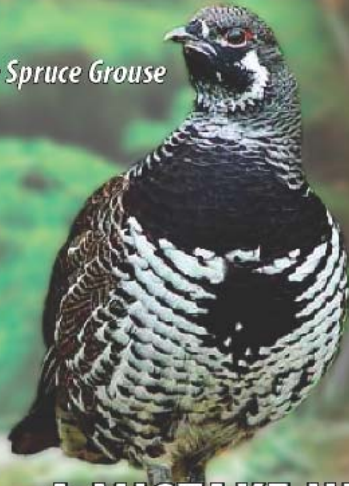
8. Hardwood composition should be kept below 10% of the composition of the HMU. Tree species to encourage during management activities include black, red, and white spruce, balsam fir, and larch.
9. Larch should be maintained at 10-20% of stand composition where it occurs.
10. Pre-commercial thinnings are acceptable only up to age 30.

¹ Excerpted from Alexander and Chipman 1993.

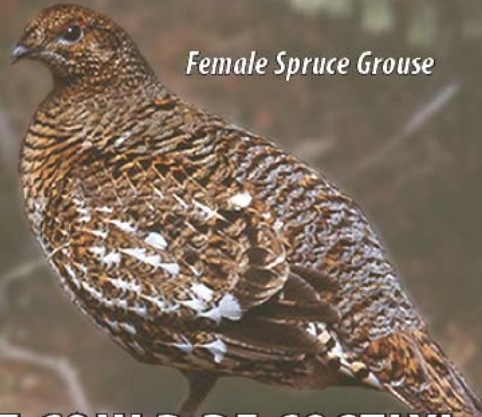
APPENDIX 3 : WARNING SIGNS FOR RUFFED GROUSE HUNTERS

Attention Hunters SPRUCE GROUSE AREA

Male Spruce Grouse



Female Spruce Grouse



A MISTAKE HERE COULD BE COSTLY!

**VT FISH & WILDLIFE RECOMMENDS NOT HUNTING
RUFFED GROUSE (PARTRIDGE) IN THIS AREA.**

Ruffed grouse are similar in appearance and size to the **STATE ENDANGERED SPRUCE GROUSE** which also lives in this area.

The **SPRUCE GROUSE** is protected by Vermont Endangered Species Law. Persons may be arrested and fined \$1,000 for killing, harassing, or negatively disturbing them.

Thanks For Your Help!
www.vtfishandwildlife.com

*Ruffed Grouse
males and females
look alike*



APPENDIX 4: SAMPLE PRESS RELEASE

Appendix 7.4. Sample Press Release



NEWS

Vermont Fish & Wildlife Department
Agency of Natural Resources
103 South Main Street
Waterbury, VT 05671-0501

Telephone (802) 241-3700
FAX (802) 241-3295
Email jhall@fpr.nwr.state.vt.us

October, 1999

Media Contacts: Cedric Alexander, 802-751-0105 or Steve Parren, 802-241-3717

HUNTERS, KNOW YOUR GROUSE

Plan on hunting in the Nulhegan River or Coaticook River watersheds? Hunters should be aware that there are two species of grouse living in those areas--the common ruffed grouse and the endangered spruce grouse.

Similar in size and coloration, these species may be hard to tell apart in the woods. According to Vermont Fish and Wildlife Department biologist Cedric Alexander, "At this time of year ruffed grouse may be feeding in aspen stands and alder flowages within the boreal forest. Spruce grouse are feeding primarily on larch (tamarack) and fir needles."

Spruce grouse have no crest on the head, and males are generally darker in color than ruffed grouse. When flushed, the spruce grouse will usually stay nearby and alight on a tree branch. Their lack of fear of people has earned them the nickname "fool hen."

Spruce grouse in Vermont are now limited to a comparatively small area of the boreal forest. Alexander notes, "Based on the Fish and Wildlife Department's periodic censuses, the spruce grouse population in Vermont is considered stable with at least 150 individuals."

The endangered status of these birds in the state results primarily from their small population size, which is isolated from all other populations. Isolated members of a species no longer have access to a larger gene pool. Research has shown that this can reduce the chance that such a population will survive.

Signs alerting hunters to the presence of spruce grouse have been posted in most areas frequented by this species. Some of these areas are on lands that were formerly owned by Champion International Corporation and are now owned by the State of Vermont or the U.S. Fish and Wildlife Service. These areas are open to hunting and are posted with regard to the spruce grouse, just as in the past. If you are hunting ruffed grouse in the Northeast Kingdom, be sure you know the difference between the two species.