

**Ecological Monitoring in the Annapolis Valley:
DND Granville Ferry Rifle Range and McGill Lake Wilderness Area**

Forest Biodiversity Monitoring Final Report

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Finally, many thanks to all the CARP staff who participated in the hours of fieldwork associated with establishing long-term monitoring quadrats.

Executive Summary

Two study areas were surveyed in the summer/fall 2004: the Department of National Defence (DND) Granville Rifle Range, and the McGill Lake Wilderness Area. The data collected at these two sites consists of baseline data and is the first of several surveys that will be part of CARP's long-term biodiversity monitoring program. All the data and analyses included in this report provide a base against which future surveys will be compared.

Five 20 X 20m quadrats were surveyed within the DND Granville Rifle Range property boundaries. On the basis of abundance, basal area, relative density, relative dominance and Importance Value Index, Sugar Maple, *Acer saccharum*, was the most important species in the stand. It was followed closely by White Spruce, *Picea glauca*, in all of the above parameters, mainly due to its high abundance in a single quadrat at the base of the mountain. Eleven species, typical of the Acadian mixed forest, were surveyed in total. The majority of stems were in the smallest diameter at breast height (DBH) size class, however DBH measurements as high as 50.6cm were recorded. The average for the stand was 15.22cm. Most of the stems were alive and standing. A regeneration survey, consisting of 25 subplots, revealed that most seedlings were Sugar Maple.

A plant survey on the property found no plant species protected in Nova Scotia under either federal or provincial Endangered Species Acts. It did however find several species of interest, including Purple Trillium, *Trillium erectum*, Large Round-Leaved Orchid, *Plantanthera orbiculata*, American Spikenard, *Aralia racemosa*, the rare sedge *Carex laxiflora* and fern species of the genus *Botrychium*. The rare habitat known locally as the "ice caves" was also found within property boundaries.

Four 20 X 20m quadrats were established in the mature Pine forest of the McGill Lake Wilderness Area. On the basis of abundance, basal area, relative density, relative dominance and Important Value Index, White Pine, *Pinus strobus*, strongly dominated the stand. It was also found to be among the most common seedlings recorded during the regeneration survey. A total of eight species, representing four families were recorded, which are typical of the Acadian coniferous forest. The average DBH for the stand was 25.04 cm, ranging from 4.0cm to 54.9cm. The greatest number of stems fell within the smallest DBH size class and most were alive standing. Finally, four soil decay rate subplots were established at McGill Lake. The sixteen wooden tongue depressors will be re-surveyed in one year and soil decay rates calculated.

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Introduction

The slopes of Nova Scotia's Annapolis Valley are covered with a rich temperate forest of mixed deciduous and coniferous trees. Its annual cycle of spring growth and colourful autumn decline is an integral part of the Valley ecosystem and can serve as a valuable indicator of ecosystem health. The continuous monitoring of forests using permanent quadrats provides a means to track the long-term health of these vital ecosystems.

The Clean Annapolis River Project (CARP) is a charitable, non-governmental organization created in 1990 to *work with communities and organizations to foster the conservation, restoration, and sustainable use of the freshwater and marine ecosystems of the Annapolis Watershed*. Since the early 1990's, CARP has been conducting numerous ecological monitoring activities, mostly focused on aquatic environments. In the summer of 2004, CARP established a total of ten long-term monitoring quadrats with the aim of collecting baseline data on forest health and diversity in the Annapolis River Watershed. The goal is to assess the long-term health of the various forest types in the watershed by monitoring changes in terrestrial biodiversity and to use this information as an early warning system for environmental change. This report will provide an overview of the monitoring activities in the two 2004 study areas: Department of National Defence Granville Ferry Rifle Range, and the McGill Lake Wilderness Area. Monitoring results for both sites, including data on trees, regeneration, rare and endangered species, and soil decay rates, will be presented.

Study Areas

Department of National Defence (DND) Granville Ferry Rifle Range

The Granville Ferry Rifle Range, located in Granville Ferry, Nova Scotia, is owned and operated by the Department of National Defence 14 Wing Greenwood. The property occupies 1,279 hectares and extends on both slopes of the North Mountain, in the communities of Granville Ferry on the Valley side and Hillsburn on the Bay of Fundy side. At the base of the mountain's south-facing slope, and the edge of the property, are several military training facilities and various small dirt roads. However, access to the property is restricted and much of the area is only accessible by small hiking and ATV trails. Since DND purchased the greater part of the property near the time of the second World War, there has been limited disturbance in the forest in over 50 years.

14 Wing Greenwood has been working toward completing a biodiversity inventory, in order to sustainably manage the property as well as meet their obligations under the Species at Risk Act. Given these responsibilities as well as the relative unimpacted nature of the property, the Granville Ferry Rifle Range was an ideal location for the establishment of long-term biodiversity quadrats. The site selection method was stratified by forest type along the slope of the mountain, and quadrat coordinates randomly selected within each forest category. Five quadrats were established within the property boundaries. Due to a dense canopy, the two hand-held GPS units used by the survey team malfunctioned. This error, combined with grown up boundary lines that were difficult to detect, resulted in the sixth quadrat, intended for the DND property, to be established a few hundred meters outside the north-western boundary (Figure 1). A sixth quadrat will be surveyed within the property during the summer of 2005. Twenty-five regeneration subplots were also surveyed. In addition to these quadrats and subplots, a botanical survey was conducted on the property in order to identify any rare and endangered flora and sensitive habitats. A summary of the findings of that survey is presented in the results section below.

Plant Survey - 2004
 Department of National Defence
 Granville Ferry, NS

Monitoring Quadrants

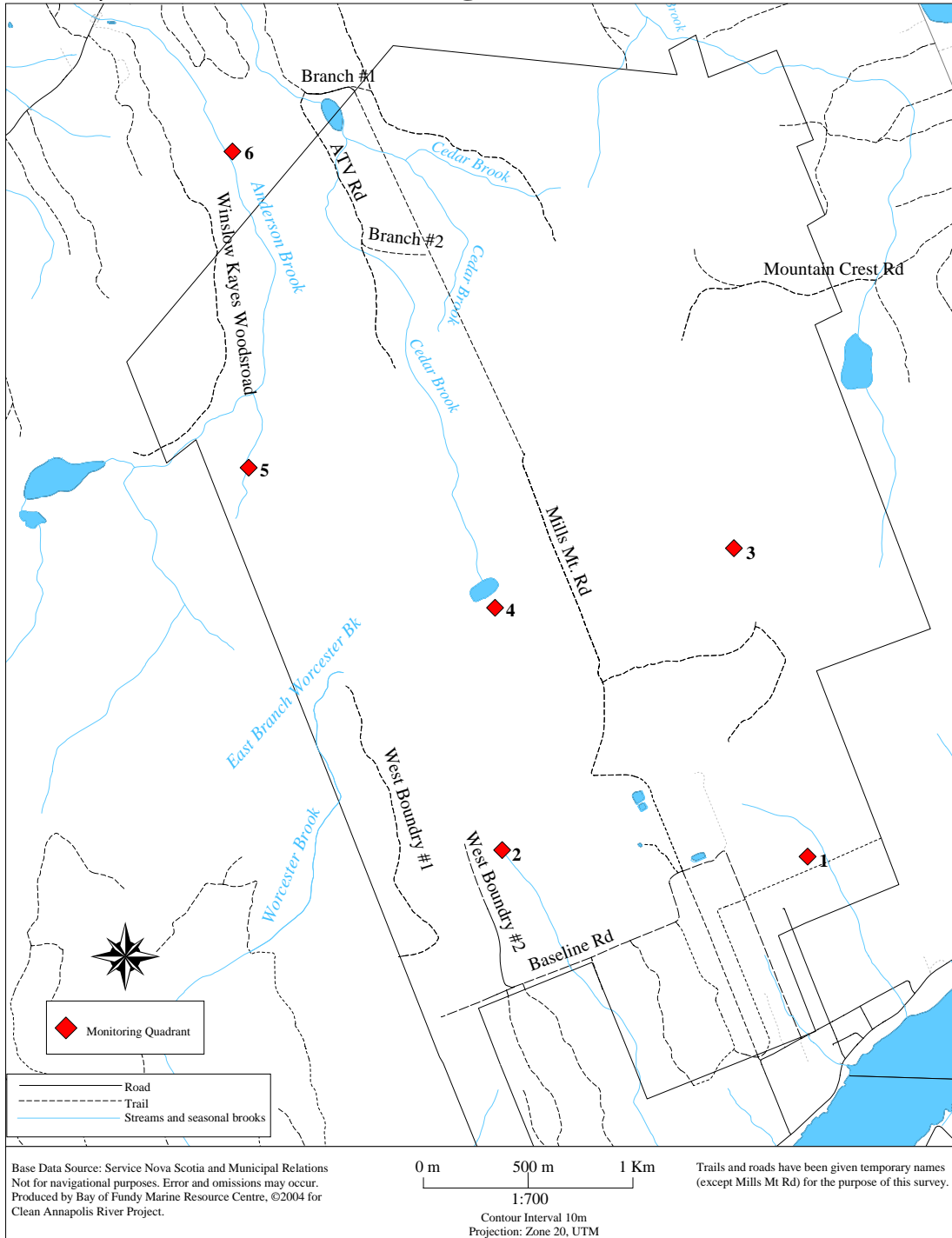


Figure 1: Map of DND Granville Rifle Range Showing Biodiversity Quadrats

McGill Lake Wilderness Area

The Wilderness Area of McGill Lake is located on the Annapolis Valley's South Mountain, and protects 180 hectares of various wetland and forest types. It is part of a greater provincial network, comprised of 31 sites in total, which represent the typical landscapes of Nova Scotia. McGill Lake is located near the community of Albany Cross, close to the southern boundary of the Annapolis River Watershed. Protected habitats include dry and wet bogs, moss-shrub and treed bogs, as well as fens (DOEL, 2004). Also protected are various forest types, mainly hardwood communities of maple-oak-birch, and mature pine forests. Due to its protected status and its mature forest community, this area was ideal for the establishment of long-term biodiversity quadrats.

In collaboration with the Nova Scotia Department of Environment and Labour, the coordinates of one quadrat were randomly selected within the forest type in question: the mature pine-spruce-fir/maple-birch community. The remaining quadrats were placed adjacent to the first one, to form a 40 X 40m square (Figure 2). In addition to the 4 forest quadrats, 20 regeneration subplots and 4 soil decay rate subplots were established.

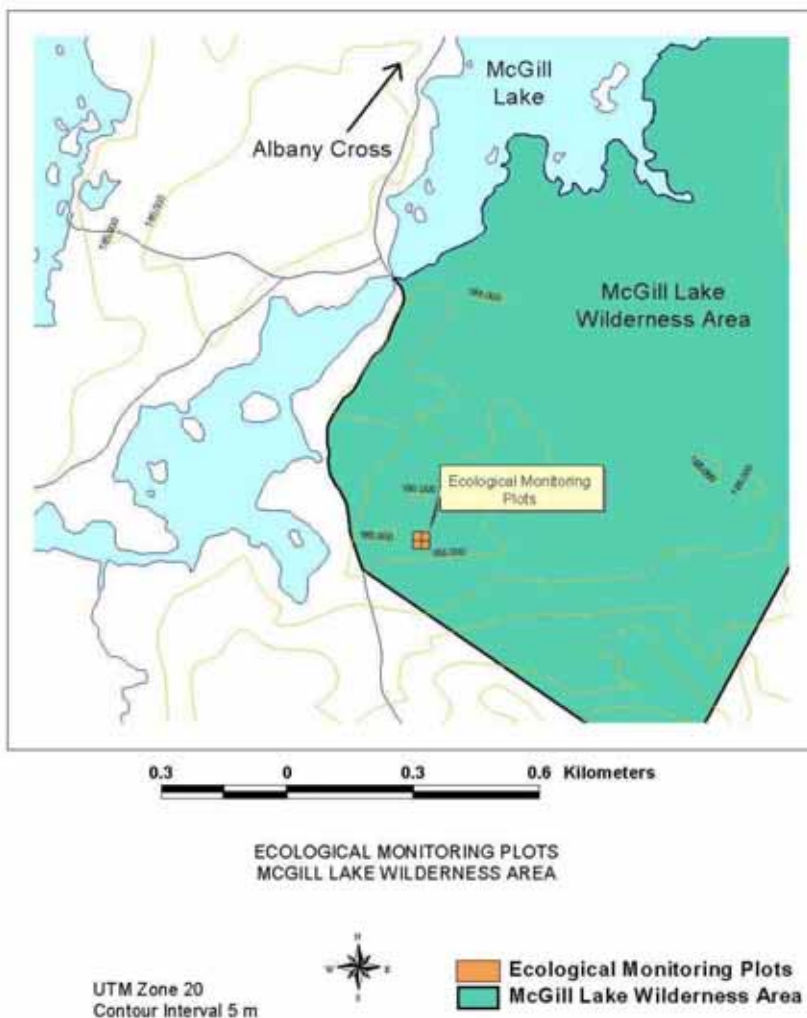


Figure 2: Map of McGill Lake Wilderness Area Showing the Biodiversity Quadrats

Monitoring Results

The biodiversity quadrat protocols used for each of the study areas were those found in the EMAN Terrestrial Vegetation Monitoring Protocol (Roberts-Pichette and Gillespie, 1999). To measure regeneration and saplings, the protocol developed by the Canadian Forest Service was used (EMAN, 2004). Finally, the protocol used for the soil decay rates established at McGill Lake Wilderness Area was developed by the Pacific Forestry Centre, of the Canadian Forest Service (EMAN, 2004).

Tree data collected at both study sites was entered into the Biomon software. Maps showing the relative size and distribution of each tree were produced for each quadrat, which were in turn ground-truthed. See Appendix A and Appendix F for the maps at DND Granville Rifle Range and McGill Lake Wilderness Area, respectively. Regeneration and soil decay rate data was entered into a Microsoft Excel file for storage and later analysis. Definitions and equations of the various indices used to analyse the data are included in the glossary.

For the purpose of this report, the five quadrats on the DND Granville property have been analysed together as one stand, and the four quadrats at McGill Lake as a second stand. The data collected from quadrat O6, located outside the western boundary of the DND Granville property, is not included in the analysis. See Appendix I for more information.

DND Granville Ferry Riffle Range

Trees

Eleven species were identified in total (Table 1). Present were both hardwoods (Maple-Birch-Beech-Ash) and softwoods (Fir-Spruce-Hemlock), typical of the North Mountain Ridge Natural Landscape (DOEL, 2002). The forest community changed with the elevation, from the lowland on the Valley side, up the steep slope to the upland and back down the gradual slope on the Bay of Fundy side. The base of the mountain is characterized mainly by softwood stands, while the upland region is mostly covered with hardwoods.

Table 1: Names and Abundances of Trees Recorded at DND Granville Rifle Range (Quadrats 01-05)

Scientific Name	Family Name	Species Code	Common Name	Number of Trees in Stand	% of Trees in Stand
<i>Abies balsamea</i>	<i>Pinaceae</i>	ABIBAL	Balsam Fir	28	9.96
<i>Acer rubrum</i>	<i>Aceraceae</i>	ACERUB	Red Maple	11	3.91
<i>Acer saccharum</i>	<i>Aceraceae</i>	ACESAC	Sugar Maple	66	23.49
<i>Betula alleghaniensis</i>	<i>Betulaceae</i>	BETALL	Yellow Birch	42	14.95
<i>Betula papyifera</i>	<i>Betulaceae</i>	BETPAP	White Birch	16	5.69
<i>Fagus grandifolia</i>	<i>Fagaceae</i>	FAGGRA	American Beech	23	8.19
<i>Fraxinus americana</i>	<i>Oleaceae</i>	FRAAME	White Ash	7	2.49
<i>Picea glauca</i>	<i>Pinaceae</i>	PICGLA	White Spruce	62	22.06
<i>Picea rubens</i>	<i>Pinaceae</i>	PICRUB	Red Spruce	25	8.90
<i>Tsuga canadensis</i>	<i>Pinaceae</i>	TSUCAN	Eastern Hemlock	1	0.36

The trees identified on the DND stand are characteristic of the Acadian mix wood forest, which typically has species at both their Northern limit (i.e.: Hemlock, Pine) and Southern limit (i.e.: Balsam Fir). It is a transition forest between the Boreal forest to the North and deciduous forests of the South.

Table 2 provides a summary of some basic statistics from the stand (quadrats 01-05). Dead fallen trees were not tagged in this initial survey, as it represents baseline data. Tagged dead trees that have fallen will be recorded in subsequent years. 83% of the total stems were live and had an average DBH of 15.22cm. The total basal area of live standing trees was slightly over 29 m²/ha. Stand height was measured at each quadrat and ranged from approximately 11 to 17 meters. The average height of the stand was 13 meters.

Table 2: Census Statistics from DND Granville Rifle Range (2004)

Statistics	2004 Census
Area of stand (m ²)	2000
Families represented	5
Species represented	10
Unknown species	1*
Live stems	322
Standing	309
Leaning	5
Fallen	0
Broken	8
Dead Stems	66
Standing	42
Leaning	6
Fallen	N/A
Broken	18
Total number of stems (live)**	322
Total number of trees (live)	281
Average DBH (cm)	15.22
Total basal area of live standing stems (m ² /ha)	29.275

* One dead tree could not be identified

** Some trees have multiple stems

Figure 3 compares the percentage of stems in each status category. The most abundant category by far is the alive standing status, to which 79% of stems belong. The second largest category is that of dead standing stems, followed by dead broken stems. There were very few alive leaning or broken stems, nor were there many dead leaning stems. Dead stems were sometimes difficult to identify, and on one occasion, identification was not possible.

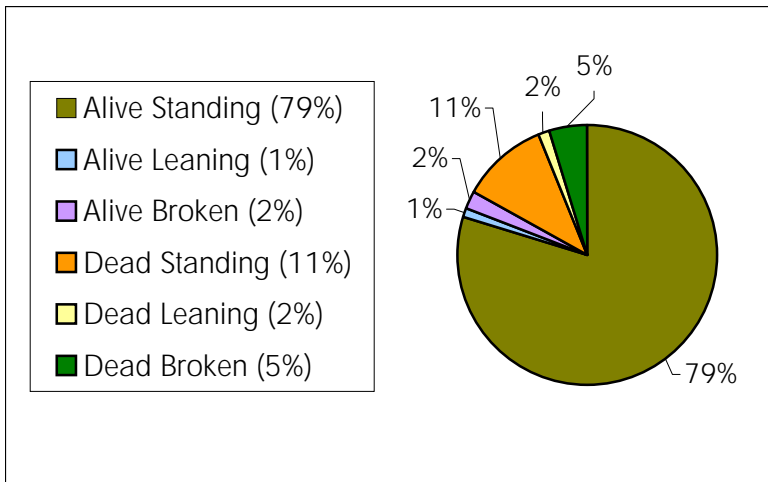


Figure 3: A Comparison of the Ratio of Stems by Condition, DND Granville Rifle Range

The abundance of each species in the stand is shown in Figure 4. The most commonly found species was Sugar Maple (*Acer saccharum*), with 66 trees in total throughout the stand, followed closely by White Spruce (*Picea glauca*). Yellow Birch (*Betula alleghaniensis*), Balsam Fir (*Abies balsamea*) and Red Spruce (*Picea rubens*) were fairly abundant in the stand with 42, 28 and 25 live trees, respectively.

The high abundance of White Spruce (*Picea Glauca*) in the stand, although atypical of the Acadian Forest, has become increasingly common through its invasion of abandoned farmland. Of the 62 standing White Spruce trees counted, 60 occurred in quadrat 01, which is located at the base of the mountain. Quadrat 01 is a relatively uniform quadrat in terms of tree species, size and condition. 100% of live stems were White Spruce, of which 98% were alive standing and 74% were between the 9-19cm DBH size class. This area was most likely farmland several years ago, which would explain why it is presently dominated by this early successional Spruce species.

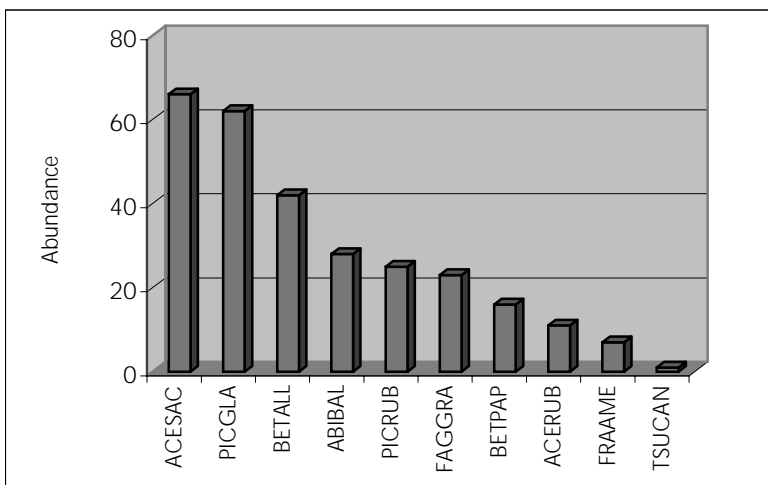


Figure 4: Abundance of Each Species, DND Granville Rifle Range

Basal area is a common and useful parameter that can provide information on several stand characteristics, including volume, biomass, density as well as competition. On the DND stand, the two most abundant species, *Acer saccharum* and *Picea Glauca* also have the greatest basal area (Figure 5). *Picea rubens*, *Fraxinus americana*, and *Acer rubrum*, are the next most important species in terms of basal area. Although these three species are not ranked very high in terms of abundance, they occupy a significant basal area, indicating that they are greater in size. Similarly, the third most abundant species, *Betula alleghaniensis*, ranks only sixth in terms of basal area.

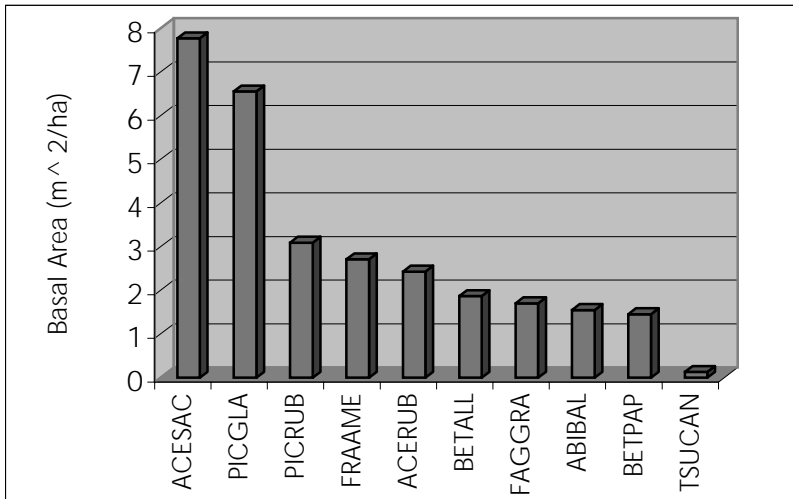


Figure 5: Basal Area Occupied by Each Species in DND Granville Rifle Range

Figure 6 shows the distribution of stems among the different DBH size classes. 115 (35.7%) stems were in the first (smallest) class. Most of the remaining stems ranged from 9.01cm to 24.0 cm. Only 24 stems were greater than 24.0cm DBH. The high occurrence of smaller trees indicates that there is new recruitment of saplings into the larger population.

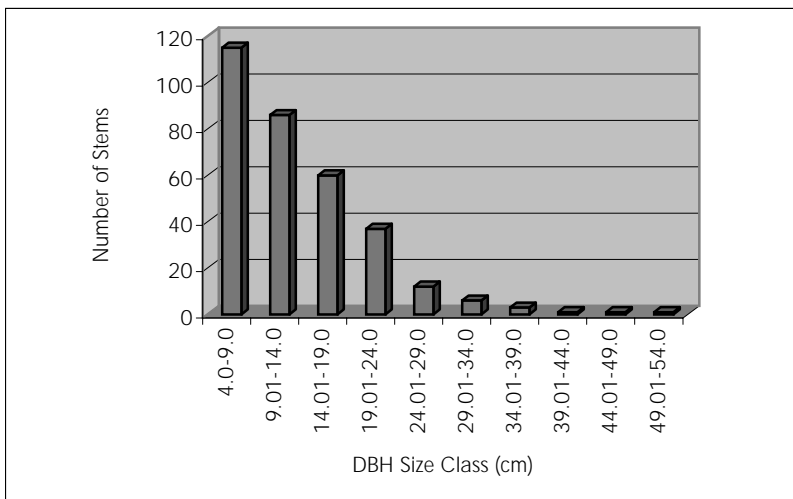


Figure 6: Size Class Distribution of Stems, DND Granville Rifle Range

Of all the species, *Acer saccharum* had a slightly greater relative density, relative dominance, and relative frequency, making it the most important species in the stand (IVI = 60.75) (Table 3). However, it is followed closely by *Picea glauca* and to a lesser extent by *Picea rubens*. See the glossary for definitions and equations of these parameters.

Table 3: Relative Density, Relative Dominance, Relative Frequency, and Importance Value Index for Trees in DND Granville Rifle Range

Species	Relative Density	Relative Dominance	Relative Frequency	Importance Value Index (IVI)
<i>Acer saccharum</i>	23.49	26.54	10.71	60.75
<i>Picea glauca</i>	22.06	22.39	7.14	51.59
<i>Picea rubens</i>	8.90	10.58	14.29	33.76
<i>Betula alleghaniensis</i>	14.95	6.39	7.14	28.48
<i>Fagus grandifolia</i>	8.19	5.82	14.29	28.29
<i>Abies balsamea</i>	9.96	5.29	10.71	25.97
<i>Betula papyifera</i>	5.69	4.98	14.29	24.95
<i>Acer rubrum</i>	3.91	8.30	10.71	22.93
<i>Fraxinus americana</i>	2.49	9.26	7.14	18.90
<i>Tsuga canadensis</i>	0.36	0.46	3.57	4.39

A species accumulation curve was prepared to determine whether more quadrats will be needed to accurately capture the biodiversity of the area (Figure 7). The species accumulation curve estimates the “break point”, where a 10% increase in area monitored yields less than 10% new species (Roberts-Pichette and Gillespie, 1999). Beyond the break point, additional monitoring effort would not yield a significant increase in the number of species identified. The recommended minimum number of quadrats is three over the break point. Figure 7 shows that the five quadrats established on the DND property meet that minimum criterion, and that any additional quadrats would not significantly increase the number of species identified. Therefore, the establishment of additional monitoring quadrats on the DND Granville Rifle Range would not significantly increase the understanding of tree species abundance and diversity.

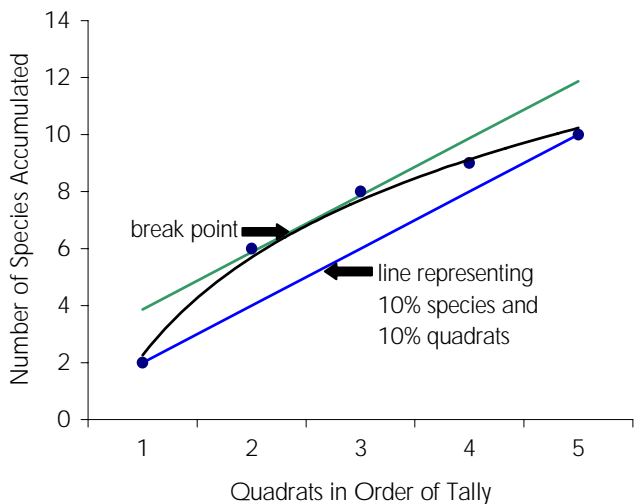


Figure 7: Species Accumulation Curve, DND Granville Rifle Range

Regeneration

Evaluating the ability of a forest to regenerate and replace dead and dying trees is an important part in assessing the health of that forest. Twenty-five 2 X 2m regeneration subplots were surveyed in and around the monitoring quadrats on the DND Rifle Range. Sugar Maple (*Acer saccharum*) was the most commonly found seedling/sapling in the stand, followed by Balsam Fir (*Abies balsamea*), and Red Spruce (*Picea rubens*). Five subplots surveyed had no regeneration growing within the 4m² area. Most of the seedlings were in the 16-35cm category, with very few in the taller categories (76-200cm). Eight saplings (> 200cm height) were measured in total. See Appendix B for the complete regeneration data collected at DND Rifle Range.

Rare and Endangered Flora and Fauna – DND Granville Property

On August 27, 2004, a search of the Atlantic Canada Conservation Data Centre database was conducted (ACCDC, August 2004). The search, which included the DND property as well as a five kilometer buffer zone, provided information on rare flora and fauna that have been recorded in that area. The buffer zone was added in order to conceal the exact location of rare species for their protection. The search results for flora showed that a 5km buffer around the study area contains a relatively moderate number of rare taxa records: 37 records of 30 taxa from 9 sources (Data Density: 0.22 rec/km²). It is reasonable to assume on ecological grounds that these rare flora taxa are likely to occur nearer to the site than shown.

In addition, the 5 km buffer around the study area contains 10 records of 9 rare vertebrate fauna, and 7 records of 6 rare invertebrate fauna. Wood Turtles (*Glyptemys insculpta*) are present in watersheds in the study area, and utilise both the upper and lower elevations. Also, Peregrine Falcons (*Falco peregrinus*) are present in the study area (i.e.: within a 20 km foraging radius of one or more nesting sites).

Botanical Survey

In addition to the ACCDC Rare and Endangered Flora and Fauna search, a botanical survey was conducted to determine if any rare or endangered flora exists on the DND property. A plant list and distribution chart was compiled and can be found in Appendix E. Botanist Gini Proulx, accompanied by several volunteer field assistants, explored the property between mid-August and mid-October, 2004, and compiled all the data in this section.

Early in the project, it was determined that the property was unlikely to contain habitats that would harbour any plants protected in Nova Scotia under either provincial or federal Endangered Species legislation. Maps and aerial photos were used to preview existing habitats; then a list was prepared of 33 rare plants that MIGHT be found in these habitats. This list was used for guidance in the field. Plants included in the survey were ferns, flowering plants, shrubs, trees and vines. The study did not include grasses, sedges, rushes, mosses, liverworts or fungi. Six main habitat types on the property were examined: road, brook, steep slope, upland, lowland and wetland. Appendix C provides more information on the habitat types surveyed and the areas searched.

The survey **did not** detect any plant species protected in Nova Scotia under either provincial or federal Endangered Species legislation; however, some species of interest were found that are worthy of mention, including some that should be reassessed during the flowering season (spring/summer) to verify identification.

The most significant botanical discoveries were found in the Worcester Brook watershed, which contains most of the habitats known to occur in the entire study area. Worcester Brook flows in a southerly direction at the base of the south facing slope and is located just inside the western boundary (See Figure 1). Many smaller brooks, trickles and seeps,

some passing underground, occur on the rocky slope and eventually enter Worcester Brook through a ravine at the lower level.

Lists of species protected under our Endangered Species legislation are very precise and relatively short; however, degrees of plant rarity and how that rareness is measured and expressed differ over time and between authorities. In order to provide an accurate account of the status of species, three current ranking systems are used. Information is provided in Appendix D on two of the Nova Scotia ranking systems cited in this report. The species of interest that were found during the survey are discussed in further detail below.

- Purple Trillium, *Trillium erectum* – This flowering plant was found scattered along the Worcester Brook ravine. Purple Trillium was considered **rare** (Pronych and Wilson, 1993) a decade ago; however, recent assessments consider it uncommon (**S3**) (ACCDC, 2004), but secure (**Green**) (DNR, 2001). Although abundant in some sites in Nova Scotia, Purple Trillium may be considered rare because it is restricted to a small area of the province, i.e. Annapolis Valley and east to Pictou County.



Figure 8: Purple Trillium, *Trillium erectum*

Source: Nova Scotia Museum

- Large Round-leaved Orchid (*Plantanthera orbiculata*) – Solitary specimens of this orchid were found in three widely separated locations in the Upland habitat. Further investigation of these plants is recommended during the flowering period (August) to determine if they are the variety *macrophylla*. *Plantanthera orbiculata* Variety *macrophylla* is ranked **yellow** (DNR, 2001), indicating that the variety may require some protection while the typical *Plantanthera orbiculata* is considered uncommon (**S3**) (ACCDC, 2004) and secure (**Green**) (DNR, 2001).
- *Carex laxiflora* – This **rare** sedge (Pronych and Wilson, 1993) was discovered by botanists Ruth Newell and Heather Stewart on the steep slope northeast of Worcester Brook. (UTM 20T 0298000 4959601 NAD83). *Carex laxiflora* is known only from Annapolis, Kings and Hants counties. According to Roland and Smith (1969), the first authentic record for this plant east of southern Maine was reported by Fernald in 1922 on the “North Mt., Granville”.
- American Spikenard, *Aralia racemosa* – The occurrence of this plant in the Worcester Brook area is of interest. Usually found as solitary plants, an abundance of luxurious specimens appear here at the western edge of its range.
- Yellow Violet, *Viola pubescens* – This tentatively identified violet, if confirmed, would significantly extend westward its known range in Nova Scotia. These violets were found growing in a low area of rich soil about 100 metres east southeast of the point where Worcester Brook exits the property to the south (UTM 20T 0297900 4959561 NAD83). For a positive identification, a check of these plants during their flowering season (Apr/May) is recommended.

- *Botrychium* – At least three fern species of this genus were found in the deciduous uplands and Worcester Brook ravine. They are **uncommon** to **scattered** in N.S. according to Roland/Zinck (1998) and of **S3** status according to the ACCDC (2004).

Magnificent Eastern Hemlocks, *Tsuga canadensis*, were encountered, especially in the Worcester Brook ravine. Very large Sugar Maple, *Acer saccharum*, Yellow Birch, *Betula alleghaniensis*, and American Beech, *Fagus grandifolia*, were found scattered on the steep slopes and were common in the upland sections. The diameter at breast height (DBH) of two trees was measured at 1.2 meters above ground level. A Sugar Maple measured 79 cm DBH and a Yellow Birch was over 64 cm DBH. Eastern White Cedar, *Thuja occidentalis*, which is considered provincially **rare** in Nova Scotia by Pronych and Wilson (1993), occurs in the extreme lower section of the Cedar Brook watershed in the village of Hillsburn. Because this watershed occupies a considerable portion of the DND property, it was expected that this species would be found there. However, Cedar was not found within the DND property.

Two alien shrubs were found on the DND property. First, European Alder-buckthorn, *Rhamnus frangula*, also commonly known as Glossy Buckthorn, is well established in the eastern lowland. Fruiting trees, (3 to 4 m) were common in the block of old pastureland directly east of the firing range. Smaller *Rhamnus frangula* trees were found scattered throughout the survey site. This introduced ornamental shrub has become a common weed in Nova Scotia (White *et al.*, 1993). Second, a small Privet shrub of the *Ligustrum* genus was found in the same eastern lowland area with the Buckthorn. Larger (2 to 3m) fruiting Privets were located in the upland area in at least 2 locations. It was not possible to identify the species at this time of year, so it is not known if there is any invasive potential. Both of these shrubs have been planted as hedges in Nova Scotia for generations.

Many of the spring and summer flowering plants could not be identified during this late summer/fall study. A return in May and June (possibly combined with an avian survey) would provide a more representative plant list when added to the current species list. Bryophytes (liverworts and mosses) grow in abundance in the shaded, rocky streams. A botanist field assistant, who noted some interesting species, suggested that a bryophyte study in the pristine area of Worcester Brook should be productive.

Although not officially part of the survey, a list of birds sighted or heard through casual observations is provided in Table 4. Some sightings were of fall migrants, but most could probably be considered residents. Boreal Chickadees, *Poecile hudsonicus*, were seen. This bird has a **S3** ranking on the Atlantic Canada Conservation Data Centre List (ACCDC, 2004). It is uncommon throughout its range in the province, or found only in a restricted range, even if abundant at some locations.

Table 4: Birds Sighted or Heard at DND Granville Rifle Range

Scientific Name	Common Name
<i>Bombycilla cedrorum</i>	Cedar Waxwing
<i>Bonasa umbellus</i>	Ruffed Grouse
<i>Buteo jamaicensis</i>	Red-tailed Hawk
<i>Carduelis pinus</i>	Pine Siskin
<i>Catharus guttatus</i>	Hermit Thrush
<i>Catharus ustulatus</i>	Swainson's Thrush

Scientific Name	Common Name
<i>Colaptes auratus</i>	Northern Flicker
<i>Corvus corax</i>	Common Raven
<i>Cyanocitta cristata</i>	Blue Jay
<i>Dryocopus pileatus</i>	Pileated Woodpecker
<i>Mniotilta varia</i>	Black and White Warbler
<i>Picoides villosus</i>	Hairy Woodpecker
<i>Poecile atricapillus</i>	Black-capped Chickadee
<i>Poecile hudsonicus</i>	Boreal Chickadee
<i>Regulus satrapa</i>	Golden-crowned Kinglet
<i>Sitta canadensis</i>	Red-breasted Nuthatch
<i>Strix varia</i>	Barred Owl
<i>Turdus migratorius</i>	American Robin
<i>Vireo olivaceus</i>	Red-eyed Vireo
<i>Vireo solitarius</i>	Solitary Vireo

In August, a healthy population of American Toads, *Bufo americanus*, was noted in the Mills Mt. Rd./Cedar Brook area. A number of frog species (unidentified) seemed very active in Cedar Brook in August, as well. Tree Frogs were encountered on at least three occasions.

The property boundary lines have grown up with small trees in most sections. As well, the red paint on tree blazes has weathered making it difficult, sometimes, to know where the lines are located. Most signs encountered were in good shape. The Mills Mt. Rd access point is not signed, but a metal DND sign was found nearby in a well-used beaver run leading to the beaver pond on Cedar Brook. Moderate ATV use was noted on the following roads where they extend within DND property: Mountain Crest Rd., the ATV Rd. (including Branches #1 and # 2) and Winslow Kaye’s woods road. Deep ruts were noted near a rock outcrop on the Mountain Crest Rd. Some roads were given temporary names for the purpose of this survey.

An unusual natural phenomenon, known locally as the “Ice Caves”, exists on DND property near the western boundary. According to local history, winter ice lasts well into summer in these shaded, rocky crevices. The melting ice creates colder than usual seeps and streams during the growing season. Through on-site investigation and interviews with a former DND employee, it was established that the “caves” were, indeed, located on DND property at the base of a steep slope immediately northeast of the western boundary. Although so far, no rare plants were found in or near the “caves” that were checked, the “Ice Caves” in their own right, constitute a significant natural rarity. In fact, the site was a popular tourist attraction in the 1920-1930 era.

Visits to the “caves” during the survey were too late to find any remaining ice. On 23 Aug, cold air appeared to be entering the cavities underground through the jumbled boulders that formed the walls. None of the cavities checked exceeded a metre or two in depth or width. It appears that ground water percolates down the mountain, travelling underground through fragmented rocks. (This is evidenced by the myriad seeps and small brooks on the steep slope northeast of Worcester Brook.) When the groundwater resurfaces, it washes soil from between the rocks enlarging the cavities, but leaving a root-entangled sod canopy overhead. During the winter, this emerging water freezes within spaces between rocks lodged near the surface. A thick layer of ice accumulates. Heavy rock, a protective cover of sod

and the cool air pouring in from underground combine with deep shade to provide the conditions needed to maintain the ice mass into early summer. According to local reports, ice remains in some deep cavities between boulders at the base of the mountain until June or early July. One interview indicated that there was one cave large enough to enter (but considered too dangerous). The size of this cave varied over time as rock debris built up or washed away and a falling tree eventually covered the entrance. Figure 9 shows the approximate location of the “ice caves” as well as the approximate location of some species of interest.

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Significant Species

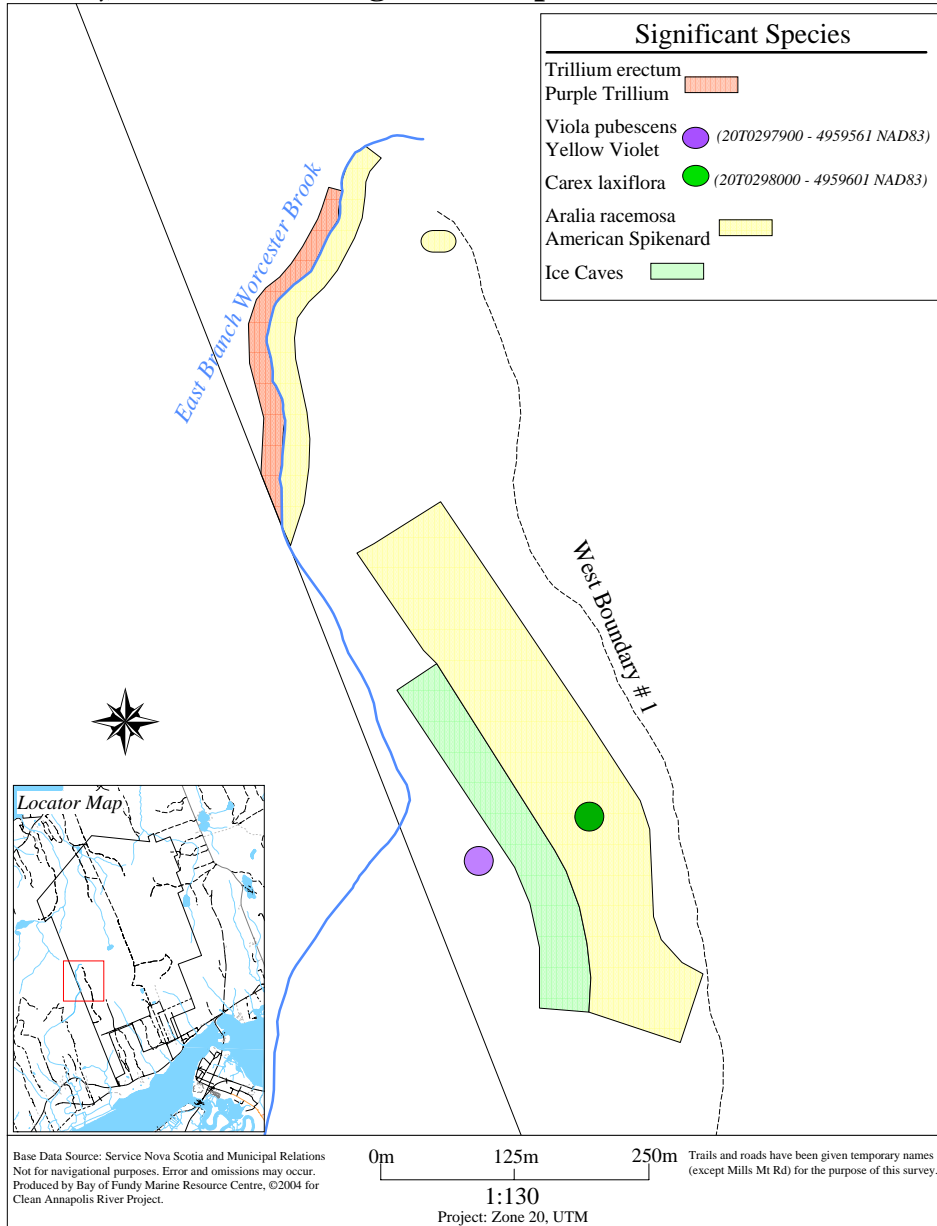


Figure 9: Significant Plants and Ice Caves, DND Granville Rifle Range

McGill Lake Wilderness Area

Trees

Eight species of trees were recorded in the McGill Lake Wilderness Area stand (Table 5). The forest type of the area consists of an Acadian coniferous forest that is primarily dominated by large White Pine (*Pinus strobus*). These exist in spruce-fir-pine/maple-birch association in the upland plain of the South Mountain Rolling Plain Natural Area (DOEL, 2002). The high occurrence of large *Pinus strobus*, a late successional tree, suggests that the stand is relatively mature.

Table 5: Names and Abundances of Trees Recorded at McGill Lake Wilderness Area (Quadrats 01-04)

Scientific Name	Family Name	Species Code	Common Name	# of Trees in Stand	% of Trees in Stand
<i>Abies balsamea</i>	<i>Pinaceae</i>	ABIBAL	Balsam Fir	7	6.73
<i>Acer rubrum</i>	<i>Aceraceae</i>	ACERUB	Red Maple	20	19.23
<i>Betula papyifera</i>	<i>Betulaceae</i>	BETPAP	White Birch	8	7.69
<i>Betula populifolia</i>	<i>Betulaceae</i>	BETPOP	Grey Birch	10	9.62
<i>Picea rubens</i>	<i>Pinaceae</i>	PICRUB	Red Spruce	13	12.5
<i>Pinus resinosa</i>	<i>Pinaceae</i>	PINRES	Red Pine	7	6.73
<i>Pinus strobus</i>	<i>Pinaceae</i>	PINSTR	White Pine	38	36.54
<i>Quercus rubra</i>	<i>Fagaceae</i>	QUERUB	Red Oak	1	0.96

Table 6 shows basic stand statistics at McGill Lake. Of the 140 total stems, 113 were live and 27 were dead. Future surveys will allow the calculation of tree mortality, which could not be done with baseline data. The average DBH was 25.04cm, and the total basal area of live standing trees was 27.81m²/ha. Stand height was measured in the four quadrats, and ranged from 19m to 21m. The average height for the stand was approximately 20m.

Table 6: Census Statistics from McGill Lake Wilderness Area (2004)

Statistics	2004 Census
Area of stand (m ²)	1600
Families represented	4
Species represented	8
Unknown species	0
Live stems	113
Standing	111
Leaning	2
Fallen	0
Broken	0
Dead Stems	27
Standing	21
Leaning	4
Fallen	N/A
Broken	2

Statistics	2004 Census
Total number of stems (live)*	113
Total number of trees (live)	104
Average DBH (cm)	25.04
Total basal area of live standing trees (m ² /ha)	27.81

*Some trees may have multiple stems.

Figure 10 shows the percentage of stems by condition. The majority of stems were alive standing (80%), while 15% of stems were dead standing. The remaining 5% of stems were alive leaning, dead leaning, or dead broken.

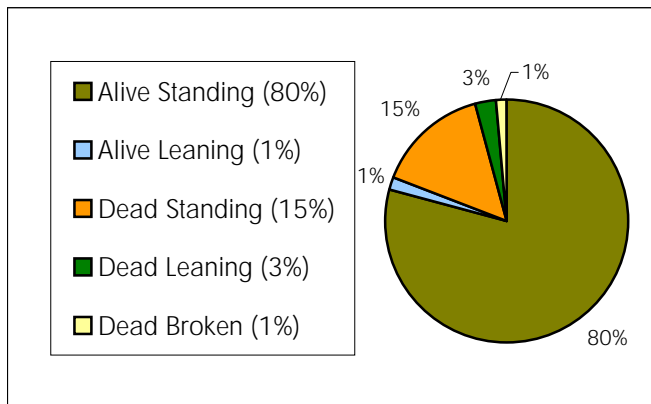


Figure 10: A Comparison of the Ratio of Stems by Condition, McGill Lake Wilderness Area

White Pine (*Pinus strobus*) was by far the most abundant species (38 trees), with almost double the abundance of the second most common Red Maple (*Acer rubrum*) (20 trees). Red Spruce (*Picea rubens*), Grey Birch (*Betula populifolia*) and White Birch (*Betula papyifera*) were relatively common throughout the stand, with abundances of 13, 10 and 8, respectively. Only 1 Red Oak (*Quercus rubra*) was recorded. Figure 11 compares the abundances of each species.

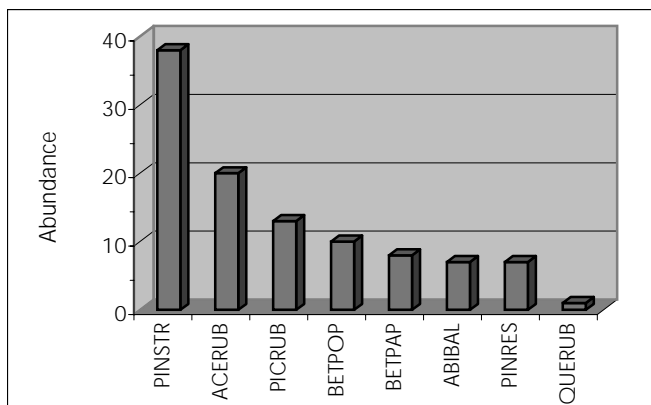


Figure 11: Abundance of Each Species, McGill Lake Wilderness Area

The stand basal area is plotted by species in Figure 12. *Pinus strobus* clearly occupies the greatest area, with almost 4 times the area of the second most dominant. Although Red Pine (*Pinus resinosa*) was only seventh in terms of abundance, it is ranked second in terms of basal area. This demonstrates the considerable size of most trees of this species in the stand. In fact, the two biggest trees surveyed in terms of DBH were *Pinus resinosa* and measured 54.5cm and 54.9cm. The single *Q. rubra* surveyed occupied a greater basal area than the ten *B. populifolia* measured.

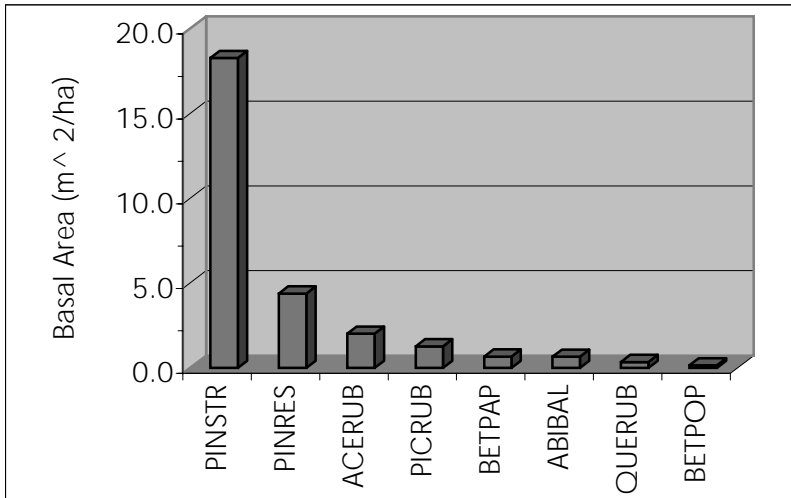


Figure 12: Basal Area Occupied by Each Species in McGill Lake Wilderness Area

The number of stems generally decreased with increasing size classes. The most common size class was the smallest (4.0-9.0cm), indicating new recruitment of saplings in the stand. There was a slight increase in the 29.01-39.0cm category, which was made up almost completely of White and Red Pine. In fact, all stems greater than 30.0cm were either *P. strobus* or *P. resinosa*.

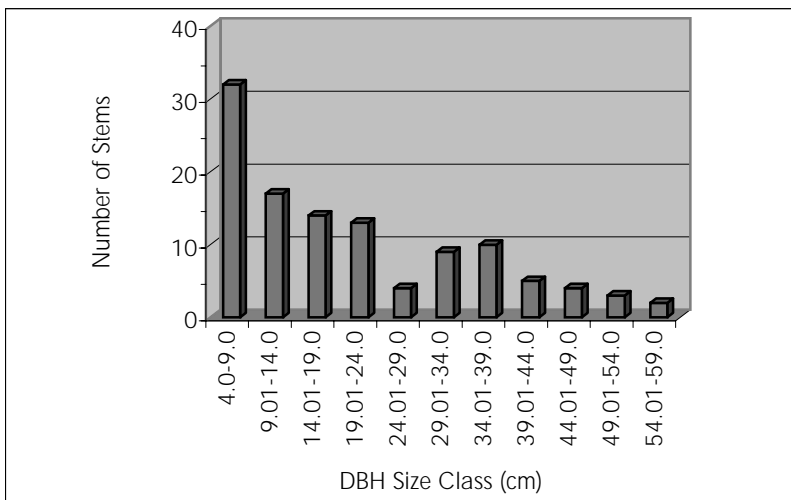


Figure 13: Size Class Distribution of Stems, McGill Lake Wilderness Area

The dominance of *Pinus strobus* in the McGill Lake stand becomes even more apparent in Table 7. Its combined relative density, dominance and frequency give it an importance value index far greater than any other species in the stand. Its dominance is promoted by the well-drained nature of the terrain (DOEL, 2002). Next in importance is *Acer rubrum*, which had significant relative density and frequency throughout the stand.

Table 7: Relative Density, Relative Dominance, Relative Frequency, and Importance Value Index for Trees in McGill Lake Wilderness Area

Species	Relative Density	Relative Dominance	Relative Frequency	Importance Value Index
<i>Pinus strobus</i>	36.54	65.71	17.39	119.64
<i>Acer rubrum</i>	19.23	7.28	17.39	43.90
<i>Pinus resinosa</i>	6.73	15.79	13.04	35.56
<i>Abies balsamea</i>	6.73	2.38	17.39	26.50
<i>Picea rubens</i>	12.50	4.60	8.70	25.80
<i>Betula papyifera</i>	7.69	2.43	13.04	23.17
<i>Betula populifolia</i>	9.62	0.54	8.70	18.85
<i>Quercus rubra</i>	0.96	1.27	4.35	6.58

Regeneration

Twenty regeneration subplots were established in and around the 20 X 20m quadrats at McGill Lake Wilderness Area. Red Spruce (*Picea rubens*) was the most commonly found seedling/sapling within the subplots, followed by White Pine (*Pinus strobus*) and Red Maple (*Acer rubrum*). Seedlings were largely in the smaller height categories (16-55cm) with fewer in the taller categories. No saplings (> 200cm) were recorded and only one subplot had no regeneration. See Appendix G for the complete regeneration data collected at McGill Lake.

Soil Decay Rates

Measuring the decay rates of soil can provide information on some basic soil properties such as respiration and productivity (EMAN, 2004). When vegetation dies and begins to decompose it releases carbon dioxide into the atmosphere. As temperature increases with global climate change, decomposition rates may also increase, thereby increasing the amount of carbon dioxide released into the atmosphere. A basic understanding of decay rates can allow scientists to track some of the effects climate change may have on our forests and may help in the better understanding of some fundamental ecological processes.

Four subplots were established at the McGill Lake Study Area for a total of sixteen pre-weighed wooden tongue depressors installed for decay rate analysis. These will be allowed to decompose for one year, at which time, CARP will collect and re-weigh them to determine decay rate. The table in Appendix H shows the preliminary data on decay rates; however, any further analysis can only be done in one year's time. It is expected that repeated soil decomposition monitoring will occur at this site, with additional sites being established in the watershed.

Summary

Forest monitoring on the DND Granville Rifle Range showed Sugar Maple, *Acer saccharum*, to be the dominant species in this Acadian mixed forest. Although it dominated in several of the parameters measured, it was followed closely by White Spruce, *Picea glauca*. White Spruce was highly abundant in a single quadrat at the base of the North Mountain, most likely due to invasion from abandoned pastureland.

Although the botanical survey found no plant species protected under provincial or federal Endangered Species legislation, several species of interest were recorded. Of note, Purple Trillium, *Trillium erectum*, was found scattered along the Worcester Brook watershed. Uncommon species of orchids, sedges, violets and ferns were also found within the DND Granville property boundary. A unique habitat known as the "ice caves" was also explored.

Baseline data collected at the McGill Lake Wilderness Area revealed an Acadian coniferous forest highly dominated by White Pine, *Pinus strobus*. It was by far the most abundant tree and occupied a greater basal area than any other species in the stand. Preliminary data on regeneration and soil decay rates was also collected.

This report presents the baseline data against which future re-inventories will be compared. In order to truly monitor ecological change in forests, surveys must be done repeatedly over the long term. The use of permanent monitoring quadrats provides a means to assess the health of forest ecosystems as well as offer an early warning system for environmental change.

Glossary

Taken from Roberts-Pichette and Gillespie, 1999.

Abundance: total number of individuals of each species in the total area of the sample.

Basal Area: cross-section area of tree stems.

Density: average number of individuals of a species on a unit area basis

$$D = \frac{\text{number of individuals in the sample}}{\text{total area of sample (m}^2\text{)}}$$

Dominance: area a species occupies in a stand on a unit area basis

$$\text{Dom} = \frac{\text{basal area of individual species in the sample (m}^2\text{)}}{\text{total area of the sample (m}^2\text{)}}$$

Frequency: distribution of a species through a stand, i.e. percentage of plots in the sample area in which a given species occurs

$$F = \frac{\text{number of plots in which a species occurs}}{\text{total number of plots in sample}} \times 100$$

Importance Value Index: an index made up of Relative Density, Relative Dominance and Relative Frequency that profiles the structural role of a species in a stand. It is useful for making comparisons among stands in reference to species composition and stand structure.

$$\text{IVI} = \text{Relative Density} + \text{Relative Dominance} + \text{Relative Frequency}$$

Relative Density: density of one species relative to all species

$$\text{RD} = \frac{\text{number of individuals of a species in a sample}}{\text{total number of individuals of all species in the sample}} \times 100$$

Relative Dominance: area a species occupies in a stand as a percentage of the total area occupied by all species

$$\text{Rdom} = \frac{\text{basal area of a species (m}^2\text{)}}{\text{total basal area of all species (m}^2\text{)}} \times 100$$

Relative Frequency: distribution of one species relative to all species

$$\text{RF} = \frac{\text{frequency of a species in a sample}}{\text{total frequency of all species in the sample}} \times 100$$

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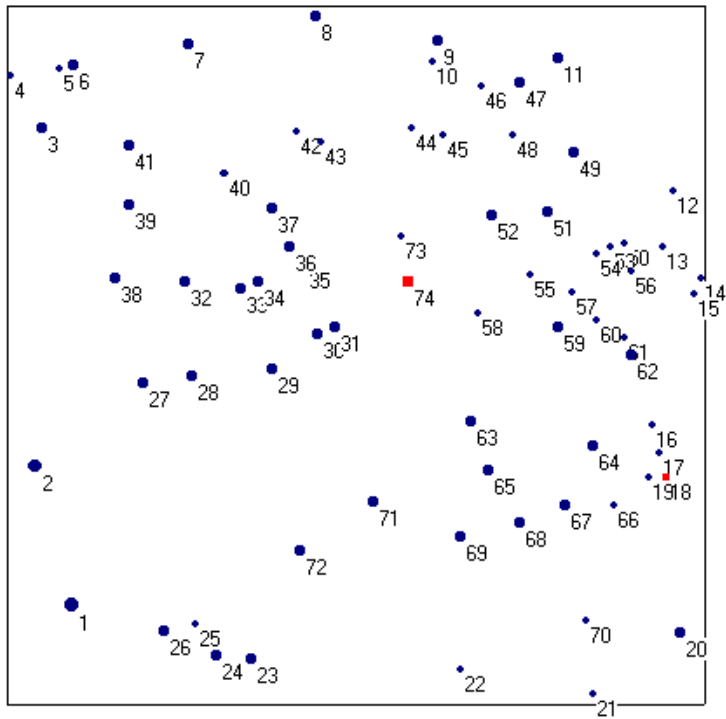
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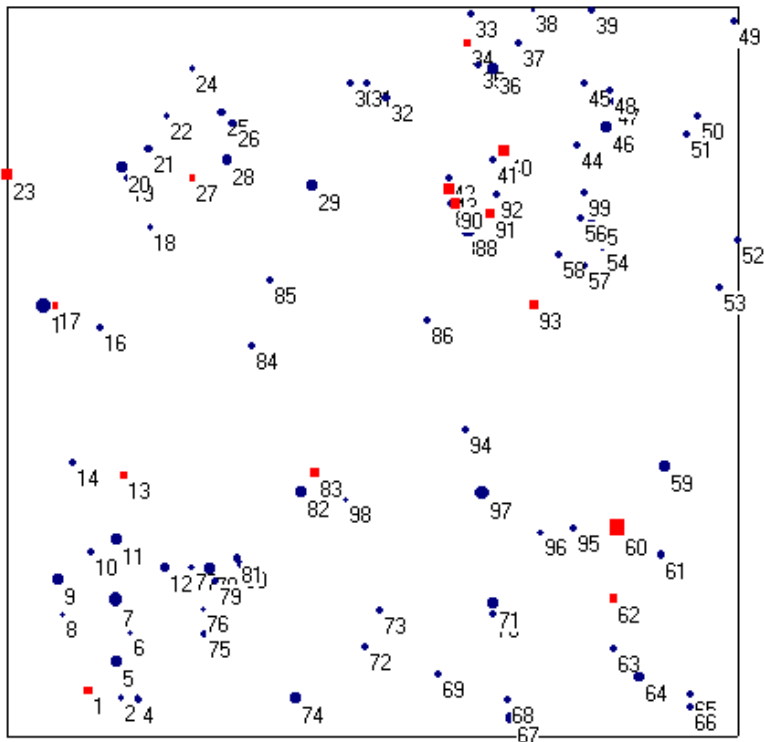
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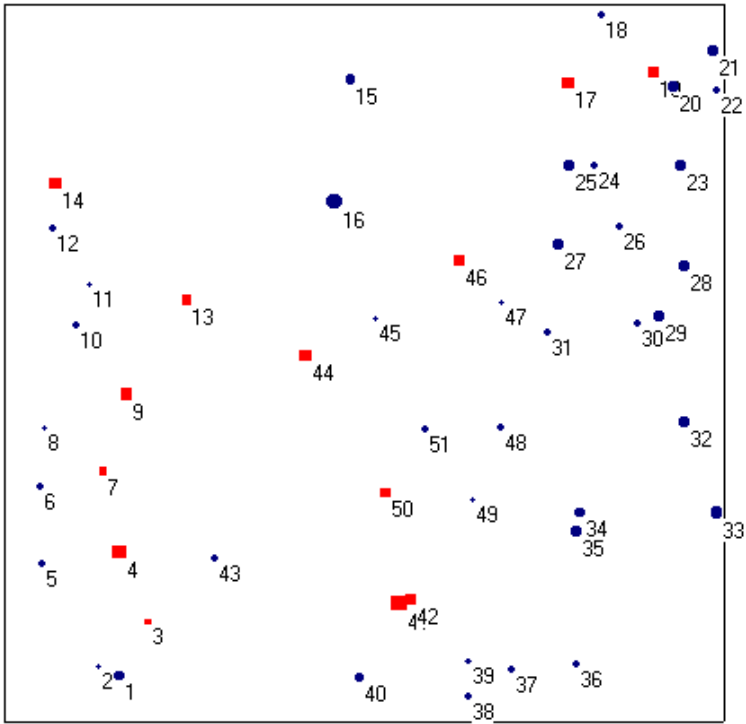
Appendix A – DND Granville Rifle Range Tree Maps



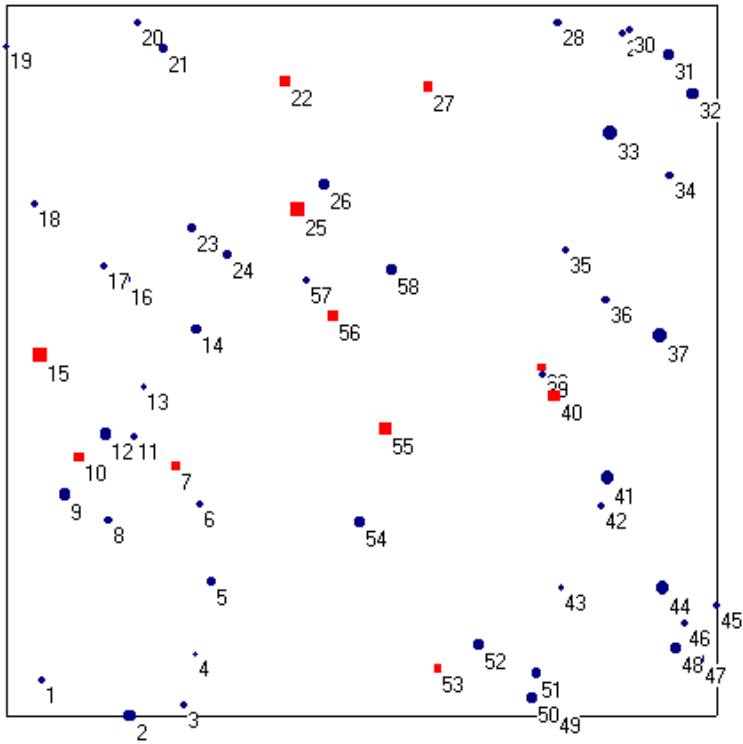
Map 1: Relative tree size and distribution, Quadrat 01, DND Granville Rifle Range.



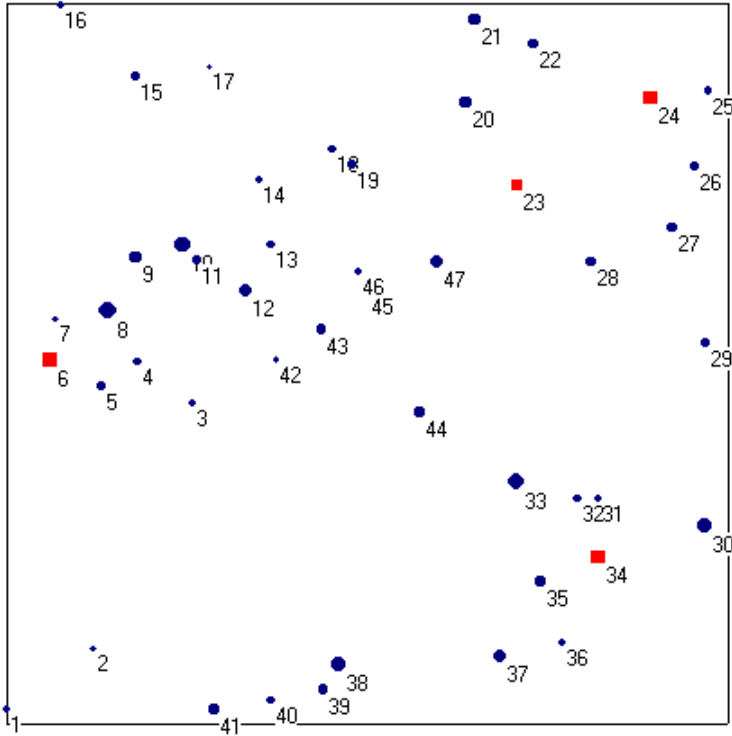
Map 2: Relative tree size and distribution, Quadrat 02, DND Granville Rifle Range.



Map 3: Relative Tree Size and Distribution, Quadrat O3, DND Granville Rifle Range.



Map 4: Relative Tree Size and Distribution, Quadrat O4, DND Granville Rifle Range.



Map 5: Relative Tree Size and Distribution, Quadrat 05, DND Granville Rifle Range.

Appendix B – Regeneration Subplot Data at DND Granville Rifle Range

Date (d/m/y)	Quadrat	Northing	Easting	Subplot	Species*	Total No.	16-35cm	36-55cm	56-75cm	76-95cm	96-200cm	> 200cm
23/08/04	1	4959329	300073	1		0						
23/08/04	1			2	ALNRUG	3						3
23/08/04	1			3	ABIBAL	2	2					
23/08/04	1			4	ACERUB	2	1	1				
23/08/04	1			4	ABIBAL	2	2					
23/08/04	1			5	ACERUB	1				1		
23/08/04	1			5	ABIBAL	4	4					
19/08/04	2	4959361	298610	1	BETALL	3						3
19/08/04	2			2	ABIBAL	1						1
19/08/04	2			3		0						
19/08/04	2			4	BETALL	1						1
19/08/04	2			5		0						
20/08/04	3	4960810	299720	1	ABIBAL	5	5					
20/08/04	3			1	PICRUB	2		1	1			
20/08/04	3			2	ABIBAL	2	2					
20/08/04	3			3	ABIBAL	1	1					
20/08/04	3			4	PICRUB	2		1	1			
20/08/04	3			5	ABIBAL	2	2					
27/08/04	4	4960524	298576	1	ACESAC	2	2					
27/08/04	4			2	ABIBAL	3	3					
27/08/04	4			2	ACEPEN	1	1					
27/08/04	4			3	PICRUB	1	1					
27/08/04	4			3	ACERUB	2	2					
27/08/04	4			4	ACESAC	14	14					
27/08/04	4			4	ABIBAL	1	1					
27/08/04	4			4	FAGGRA	1			1			
27/08/04	4			5	ACEPEN	1		1				
27/08/04	4			5	ACESAC	1	1					
27/08/04	4			5	ABIBAL	1	1					
27/08/04	4			5	PICRUB	1	1					
24/08/04	5	4961196	297396	1	ACESAC	2	2					
24/08/04	5			2	ACESAC	1	1					
24/08/04	5			2	ACEPEN	1	1					
24/08/04	5			3	ACEPEN	8	7	1				
24/08/04	5			3	ACESAC	5	5					
24/08/04	5			3	ABIBAL	1	1					
24/08/04	5			4	ACESAC	3		2			1	
24/08/04	5			5	FAGGRA	1	1					

* ABIBAL - Balsam Fir, ACEPEN - Striped Maple, ACERUB - Red Maple, ACESAC, Sugar Maple, ALNRUG - Speckled Alder, BETALL, Yellow Birch, FAGGRA - Beech, FAGGRA - Beech, PICRUB - Red Spruce

Road: Includes Mills Mt. Road, West Boundary Rd. #1, West Boundary Rd. #2, Mountain Crest Rd., Winslow Kaye's Woods Rd., ATV Rd. (including Branches #1 and #2) and Baseline Rd. The common factors affecting plant species in these roadways are disturbed and compacted soils. Beyond these similarities, the roads vary from maintained gravel roads accessible by car (Baseline), to woods roads with recent ATV traffic (Mountain Crest, ATV Rd. and Winslow Kaye's), to well-defined woods roads without recent human disturbance, but with natural disturbances such as windfalls and washouts from spring run-off. Road habitats surveyed included the roadway and an approximate 3 meter border on either side. For clarity, some unnamed roads are given temporary names.

Brook: Includes Cedar Brook, Worcester Brook and Anderson Brook. Waterfalls were encountered in the steep Worcester Brook ravine and on Anderson Brook. Evidence of a high volume spring run-off was noted throughout. Brook habitats surveyed included the brook bed, banks and an approximate 3 metre border on either side.

Steep Slope: Includes a boulder talus slope on the East Branch of Worcester Brook and the southwest-facing slope just inside the mid-point of the western boundary. The latter slope consists of a small percentage of cliff face and stabilized boulder talus. Thin soils over fragmented basalt support predominately coniferous mixed woods. Groundwater percolates quickly downhill through the jumbled underlying rocks giving rise to myriad little streams and seeps along the face of the slope. Where conditions are favorable, "ice caves" form here.

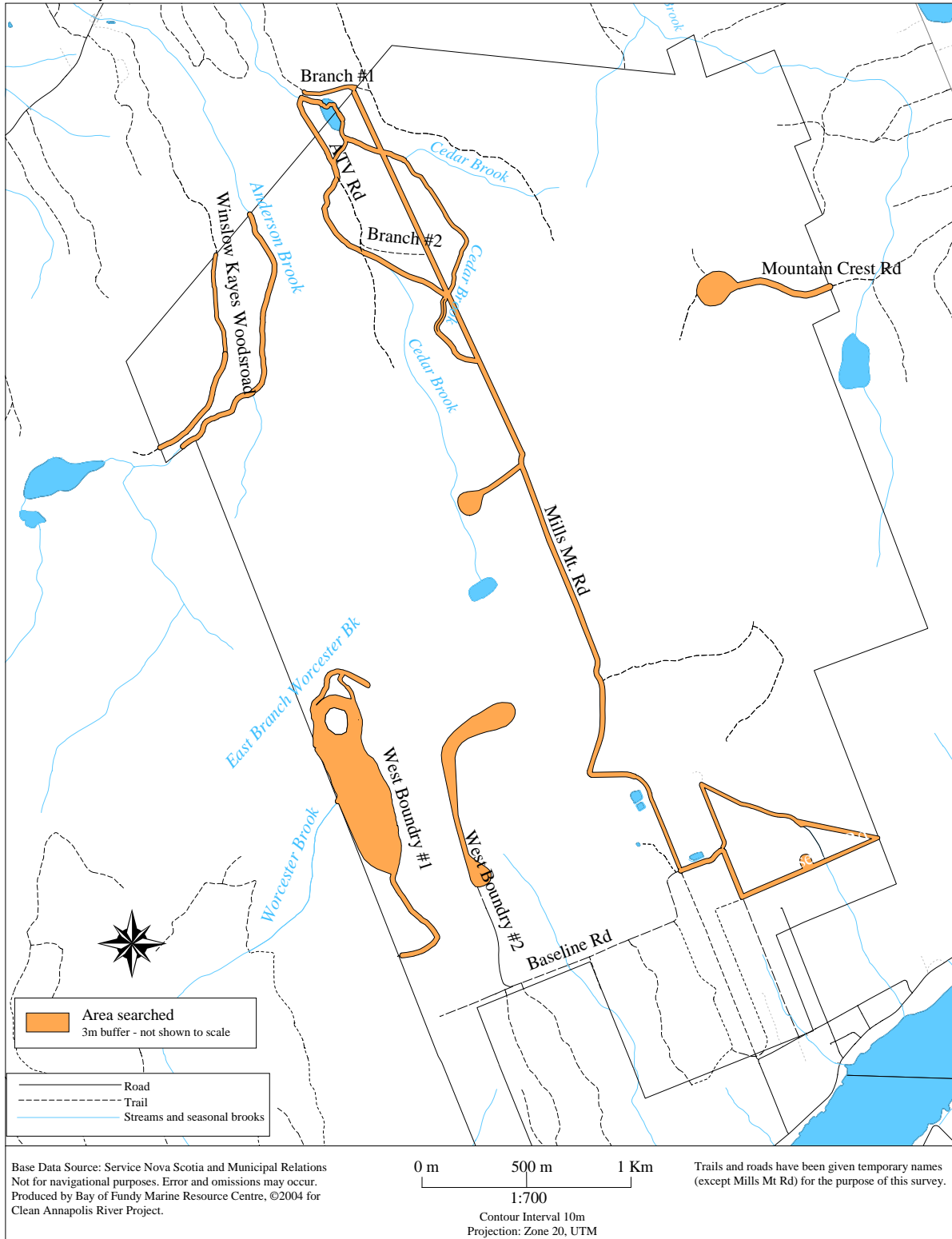
Upland: Includes the long slope from the crest of the mountain toward the Fundy shore. Here, a climax hardwood forest with a rich hardwoods flora covers the largest portion of the property. Huge tree specimens were encountered: Eastern Hemlock, Red Spruce, and White Pine scattered among the predominant Sugar Maple, Yellow Birch and American Beech.

Lowland: Includes southern section of property between the Baseline Rd. and the foot of the mountain. Conifers predominate in a mixed forest cover (probably on old pastureland). Includes general areas adjacent to CARP Biodiversity Quadrats 1 and 2.

Wetland: Includes a Red Maple swamp (partly flooded by a beaver dam) where Cedar Brook exits DND property in the north. A wet depression in thick woods north of Anderson Brook is included here.

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Areas Searched



Appendix D – Nova Scotia Species Ranking Systems

1) Atlantic Canada Conservation Data Centre

S1	Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.
S2	Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.
S3	Uncommon throughout its range in the province, or found only in a restricted range, even if abundant in at some locations. (21 to 100 occurrences).
S4	Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the Element is of long-term concern (e.g. watch list). (100 + occurrences).
S5	Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially ineradicable under present conditions.
S#S#	Numeric range rank: A range between two consecutive numeric ranks. Denotes uncertainty about the exact rarity of the Element (e.g., S1S2).
SH	Historical: Element occurred historically throughout its range in the province (with expectation that it may be rediscovered), perhaps having not been verified in the past 20 - 70 years (depending on the species), and suspected to be still extant.
SU	Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information.
SX	Extinct/Extirpated: Element is believed to be extirpated within the province.
S?	Unranked: Element is not yet ranked.
SA	Accidental: Accidental or casual in the province (i.e., infrequent and far outside usual range). Includes species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range; a few of these species may even have bred on the one or two occasions they were recorded.
SE	Exotic: An exotic established in the province (e.g., Purple Loosestrife or Coltsfoot); may be native in nearby regions.
SE#	Exotic numeric: An exotic established in the province that has been assigned a numeric rank.
SP	Potential: Potential that Element occurs in the province, but no occurrences reported.
SR	Reported: Element reported in the province but without persuasive documentation, which would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
SRF	Reported falsely: Element erroneously reported in the province and the error has persisted in the literature.
SZ	Not of practical conservation concern in the province, because there are no definable occurrences, although the species is native and appears regularly. An NZ rank will generally be used for long distance migrants whose occurrences during their migration

2) Nova Scotia Department of Natural Resources – General Status Ranks of Wild Species in Nova Scotia

BLUE (Extirpated/Extinct) - Species that are no longer thought to be present in the province or in Canada, or that are believed to be extinct. Extirpated species have been eliminated from a given geographic area but may occur in other areas. Extinct species are extirpated worldwide (i.e. they no longer exist anywhere). Species listed by COSEWIC as extinct or nationally extirpated automatically receive an Extirpated/Extinct general status rank. This rank applies at the national level and in whichever province or territory the species formerly existed. Nationally Extirpated/Extinct species are not considered part of Nova Scotia's species richness.

RED (At Risk or Maybe at Risk) - Species for which a formal detailed risk assessment has been completed (COSEWIC assessment or a provincial equivalent) and that have been determined to be at risk of extirpation or extinction. Species that maybe at risk of immediate extirpation or extinction and are therefore candidates for interim conservation action and detailed risk assessment by COSEWIC or the Province.

YELLOW (Sensitive) - Species that are not believed to be at risk of immediate extirpation or extinction, but which may require special attention or protection to prevent them from becoming at risk.

GREEN (Secure) - Species that are not believed to be at risk, or sensitive. This category includes some species that have declined in numbers but remain relatively widespread or abundant.

UNDETERMINED - Species for which insufficient data, information, or knowledge is available to reliably evaluate their status.

NOT ASSESSED - Species that are known or are believed to be present regularly, but have not yet been assessed.

EXOTIC - Species that have been moved beyond their natural range as a result of human activity. In this report, exotic species have been purposefully excluded from all other categories.

ACCIDENTAL - Species occurring infrequently and unpredictably, outside their usual range. Because they so rarely occur in Canada, Accidental species are not considered a part of the province's species richness.

Appendix E – Plant List and Distribution Chart, DND Granville Rifle Range

Note: Unless otherwise noted, Roland/Zinck (1998) is the source of scientific and common names. **Habitat Legend:** Rd = Road, Brk = Brook, SSlope = Steep Slope, Up = Upland, Low = Lowland, Wet = Wetland. (See Appendix C)

Trees, Shrubs and Vines							
Scientific Name	Common Name	Rd	Brk	SSlope	Up	Low	Wet
<i>Abies balsamea</i>	Balsam-fir	X	X	X	X	X	X
<i>Acer pensylvanicum</i>	Striped Maple	X	X	X	X	X	
<i>Acer platanoides</i>	Norway Maple					X	
<i>Acer rubrum</i>	Red Maple	X	X			X	X
<i>Acer saccharum</i>	Sugar Maple	X	X	X	X		
<i>Acer spicatum</i>	Mountain maple		X	X		X	X
<i>Alnus incana</i>	Speckled Alder	X				X	X
<i>Alnus viridis</i>	Downy Alder	X					
<i>Berberis thunbergii</i>	Japanese Barberry			X	X		
<i>Betula alleghaniensis</i>	Yellow birch	X	X	X	X	X	X
<i>Betula populifolia</i>	Grey Birch					X	
<i>Clematis virginiana</i>	Virgin's Bower	X			X	X	
<i>Comptonia peregrina</i>	Sweetfern					X	
<i>Crataegus monogyna</i>	English Hawthorn					X	
<i>Daphne mezereum</i>	Daphne	X	X	X	X	X	
<i>Epigaea repens</i>	Mayflower	X	X		X	X	
<i>Fagus grandifolia</i>	American Beech	X	X	X	X	X	
<i>Fraxinus americana</i>	White Ash	X	X	X	X	X	X
<i>Hamamelis virginiana</i>	Witch-hazel		X				
<i>Ilex verticillata</i>	Canada Holly	X	X			X	X
<i>Kalmia angustifolia</i>	Sheep Laurel	X	X		X		
<i>Larix laricina</i>	Hackmatack					X	
<i>Ligustrum sp.</i>	Privet sp.				X	X	
<i>Lonicera canadensis</i>	American fly-honeysuckle	X	X			X	
<i>Myrica gale</i>	Sweet Gale						X
<i>Myrica pensylvanica</i>	Bayberry	X	X			X	X
<i>Picea glauca</i>	White Spruce	X	X	X	X	X	X
<i>Picea rubens</i>	Red spruce	X	X	X	X	X	X
<i>Pinus strobus</i>	White Pine				X	X	

Scientific Name	Common Name	Rd	Brk	SSlope	Up	Low	Wet
<i>Populus grandidentata</i>	Large-toothed Aspen			X		X	
<i>Populus tremuloides</i>	Trembling Aspen					X	
<i>Prunus serotina</i>	Black Cherry					X	
<i>Prunus sp.</i>	Cherry sp.				X		
<i>Prunus virginiana</i>	Choke-cherry					X	
<i>Quercus robur</i>	English Oak					X	
<i>Rhamnus cathartica</i>	Common Buckthorn					X	
<i>Rhamnus frangula</i>	European Alder-buckthorn	X	X	X	X	X	
<i>Ribes glandulosum</i>	Skunk Currant			X			
<i>Ribes lacustre</i>	Bristly Black Currant			X			
<i>Rosa micrantha</i>	Rose					X	
<i>Rosa sp.</i>	Rose sp.					X	
<i>Rubus pubescens</i>	Dwarf Raspberry	X	X			X	X
<i>Rubus sp.</i>	Raspberry			X		X	
<i>Rubus sp.</i>	Blackberry	X		X		X	X
<i>Sambucus racemosa</i>	Red-berried Elder		X	X		X	
<i>Solanum dulcamara</i>	Bittersweet			X			
<i>Sorbus americana</i>	Mountain-ash	X	X				
<i>Spiraea alba</i>	Meadow-sweet						X
<i>Taxus canadensis</i>	Yew		X				
<i>Tsuga canadensis</i>	Hemlock	X	X	X	X	X	X
<i>Viburnum alnifolium</i>	Hobble-bush	X	X				
<i>Viburnum nudum</i>	Witherod	X	X				
<i>Viburnum opulus</i>	Highbush-cranberry	X				X	
Herbaceous Flowering Plants							
<i>Achillea millefolium</i>	Yarrow	X		X			
<i>Actaea alba</i>	White Baneberry	X	X		X		
<i>Actaea rubra</i>	Red Baneberry	X					
<i>Agrimonia gryposepala</i>	Agrimony	X					
<i>Agrimonia sp.</i>	Agrimony sp.	X				X	
<i>Anaphalis margaritacea</i>	Pearly Everlasting	X					
<i>Antennaria neglecta var. canadensis</i>	Pussytoes	X		X			

Scientific Name	Common Name	Rd	Brk	SSlope	Up	Low	Wet
<i>Aralia nudicaulis</i>	Wild Sarsaparilla	X	X	X	X	X	X
<i>Aralia racemosa</i>	American Spikenard		X	X	X		
<i>Arctium minus</i>	Common Burdock		X				
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit		X				
<i>Aster acuminatus</i>	Wood Aster	X	X		X	X	
<i>Aster lateriflorus</i>	Calico Aster * (Newcomb, 1977)	X	X				
<i>Bidens sp.</i>	Beggar's-ticks	X					
<i>Callitriche palustris</i>	Water-starwort		X				
<i>Cardamine pratensis</i>	Cuckoo Flower		X				
<i>Centaurea nigra</i>	Knapweed	X					
<i>Chrysosplenium americanum</i>	Golden Saxifrage	X	X				
<i>Cicuta maculata</i>	Water-hemlock	X					
<i>Circaea alpina</i>	Small Enchanter's Nightshade		X				X
<i>Cirsium arvense</i>	Canada Thistle					X	
<i>Clintonia borealis</i>	Clintonia-lily		X		X	X	
<i>Coptis trifolia</i>	Gold-thread	X	X			X	X
<i>Corallorhiza maculata</i>	Spotted Coral-root		X	X			
<i>Corallorhiza trifida</i>	Early Coral-root		X				
<i>Cornus canadensis</i>	Bunchberry	X	X				
<i>Cypripedium acaule</i>	Pink Lady's-slipper	X	X				
<i>Daucus carota</i>	Wild Carrot	X					
<i>Epifagus virginiana</i>	Beech-drops	X		X	X		
<i>Epipactis helleborine</i>	Helleborine	X	X	X	X	X	X
<i>Eupatorium perfoliatum</i>	Boneset	X					
<i>Euthamia graminifolia</i>	Narrow-leaved Goldenrod	X				X	
<i>Fragaria sp.</i>	Strawberry	X	X				
<i>Galium sp.</i>	Bedstraw sp.		X			X	X
<i>Galium triflorum</i>	Sweet-scented Bedstraw		X	X	X		
<i>Gaultheria hispidula</i>	Creeping Snowberry		X	X			
<i>Gaultheria procumbens</i>	Teaberry	X	X		X		
<i>Geranium robertianum</i>	Herb-Robert		X	X		X	
<i>Goodyera tessellata</i>	Checkered Rattlesnake Plantain				X		
<i>Hieracium murorum</i>	Golden Lungwort	X	X	X			

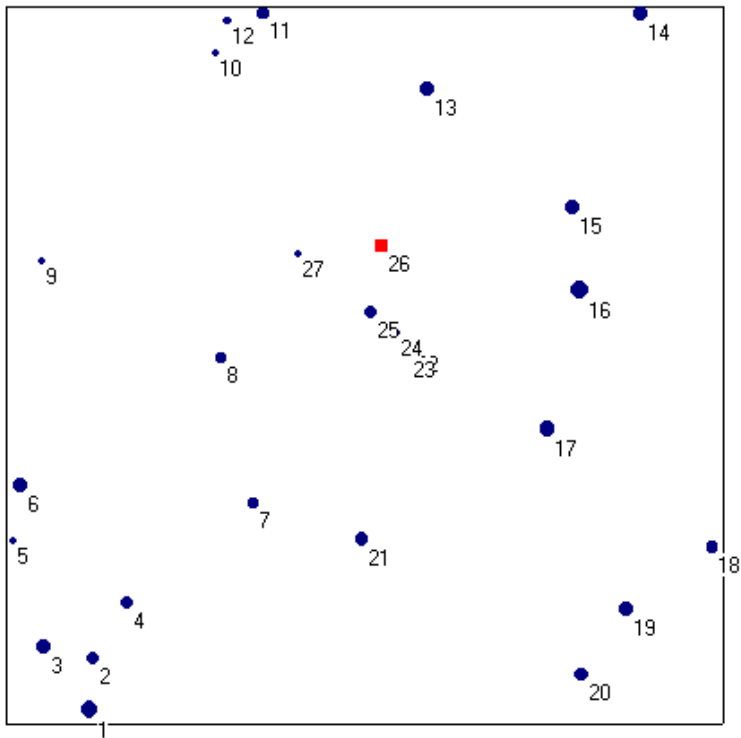
Scientific Name	Common Name	Rd	Brk	SSlope	Up	Low	Wet
<i>Hieracium paniculatum</i>	Panicled Hawkweed* (Newcomb,1977)	X					
<i>Hieracium sp.</i>	Hawkweed sp.					X	
<i>Hydrocotyle americana</i>	Pennywort	X	X				X
<i>Impatiens capensis</i>	Jewelweed	X	X	X		X	X
<i>Iris versicolor</i>	Blue Flag	X	X				
<i>Linnaea borealis</i>	Twinflower		X		X	X	
<i>Lobelia inflata</i>	Indian Tobacco	X					
<i>Lycopus sp.</i>	Bugle-weed	X	X				
<i>Lycopus uniflorus</i>	Bugle-weed	X	X				X
<i>Lysimachia nummularia</i>	Moneywort	X					
<i>Lysimachia terrestris</i>	Loosestrife	X					
<i>Maianthemum canadense</i>	Wild Lily-of-the-valley	X	X	X	X	X	
<i>Medeola virginiana</i>	Indian Cucumber-root		X	X	X		
<i>Mentha arvensis</i>	Field Mint	X	X			X	
<i>Mitchella repens</i>	Partridge-berry	X	X		X	X	
<i>Mitella nuda</i>	Mitrewort		X				
<i>Monotropa hypopithys</i>	Pine-sap			X	X		
<i>Monotropa uniflora</i>	Indian Pipe		X		X		
<i>Myosotis sp.</i>	Forget-me-not	X					
<i>Oenothera biennis</i>	Evening-primrose	X					
<i>Osmorhiza claytonii</i>	Hairy Sweet Cicely	X		X	X		
<i>Oxalis acetosella</i>	Wood-sorrel		X		X	X	X
<i>Oxalis stricta</i>	Yellow Wood-sorrel		X				
<i>Platanthera clavellata</i>	Northern Club-spur Orchid	X					
<i>Platanthera hyperborea</i>	Northern Green Bog-orchid	X					X
<i>Platanthera orbiculata</i>	Large Round-leaved Orchid				X		
<i>Platanthera psycodes</i>	Small Purple Fringed Orchid	X	X				
<i>Polygonatum pubescens</i>	Solomon's Seal		X				
<i>Polygonum cilinode</i>	Fringed Bindweed* (Newcomb, 1977)			X			
<i>Polygonum sagittatum</i>	Tear-thumb	X				X	
<i>Prenanthes altissima</i>	Tall White Lettuce		X	X			
<i>Prenanthes sp.</i>	Lions-paw* (Roland & Smith, 1969)		X				X
<i>Prunella vulgaris</i>	Heal-all	X	X	X		X	X

Scientific Name	Common Name	Rd	Brk	SSlope	Up	Low	Wet
<i>Pyrola elliptica</i>	Shinleaf		X				
<i>Pyrola secunda</i>	One-sided Wintergreen	X					
<i>Pyrola sp.</i>	Wintergreen sp.		X	X	X		
<i>Ranunculus recurvatus</i>	Hooked Crowfoot* (Newcomb 1977)	X	X				
<i>Ranunculus repens</i>	Creeping Buttercup	X	X			X	X
<i>Rudbeckia hirta</i>	Black-eyed Susan	X					
<i>Satureja vulgaris</i>	Basil	X		X			
<i>Scutellaria lateriflora</i>	Skullcap		X	X		X	X
<i>Solidago flexicaulis</i>	Wood-goldenrod	X	X	X			
<i>Solidago puberula</i>	Rough Goldenrod					X	
<i>Solidago sp.</i>	Goldenrod	X				X	
<i>Spiranthes sp.</i>	Ladies'-tresses	X					
<i>Stellaria borealis</i>	Northern Stitchwort		X				
<i>Streptopus amplexifolius</i>	White Twisted Stalk		X				
<i>Streptopus roseus</i>	Rosy Twisted Stalk	X	X		X		X
<i>Thalictrum pubescens</i>	Meadow-rue	X	X				
<i>Trientalis borealis</i>	Starflower		X		X	X	
<i>Trifolium pratense</i>	Red Clover	X					
<i>Trillium erectum</i>	Purple Trillium		X				
<i>Trillium sp.</i>	Trillium sp.	X	X				
<i>Tussilago farfara</i>	Coltsfoot	X	X			X	
<i>Typha latifolia</i>	Broad-leaved Cat-tail					X	
<i>Vaccinium macrocarpon</i>	Large Cranberry	X					
<i>Vaccinium sp.</i>	Blueberry	X	X		X	X	
<i>Verbascum thapsus</i>	Common Mullein		X	X			
<i>Veronica officinalis</i>	Common Speedwell	X		X	X	X	
<i>Veronica serpyllifolia</i>	Thyme-leaved Speedwell		X				
<i>Viola pubescens</i> ? <i>syn. Viola eriocarpa</i>	Yellow Violet ?					X	
<i>Viola sp.</i>	Violet species	X	X		X	X	X

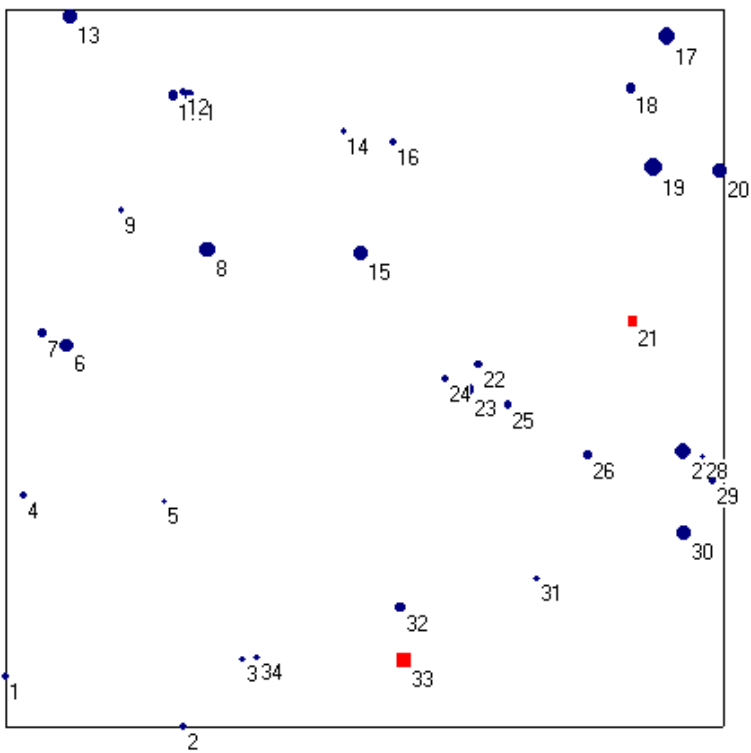
Sedges and a grass identified by R. Newell and H. Stewart in the Worcester Brook area include: *Carex laxiflora*, *Carex rosea*, and *Cinna latifolia*.

Ferns and Related Families							
Scientific Name	Common Name	Rd	Brk	SSlope	Up	Low	Wet
<i>Athyrium filix-femina</i>	Northern Lady Fern			X			
<i>Botrychium dissectum</i>	Grape-fern	X			X		
<i>Botrychium multifidum</i>	Grape-fern	X			X		
<i>Botrychium virginianum</i>	Rattlesnake Fern		X				
<i>Denndaedtia punctilobula</i>	Hay-scented Fern	X	X		X		
<i>Diphasiastrum complanatum</i>	Running Pine* (Cobbs, 1963)	X			X		
<i>Diphasiastrum digitatum</i>	Crowfoot Club-moss or Running Pine				X		
<i>Diphasiastrum tristachyum</i>	Ground-cedar	X			X		
<i>Dryopteris intermedia</i>	Evergreen Wood Fern	X	X	X	X	X	
<i>Dryopteris marginalis</i>	Marginal Wood Fern		X	X			
<i>Dryopteris sp.</i>	Wood Fern sp.	X	X	X	X	X	
<i>Equisetum sp.</i>	Horsetail sp.		X			X	
<i>Equisetum sylvaticum</i>	Wood-horsetail	X	X				
<i>Gymnocarpium dryopteris</i>	Common Oak Fern	X	X	X	X		
<i>Huperzia lucidula</i>	Shining Fir-moss	X	X		X	X	
<i>Lycopodium annotinum</i>	Bristly Club-moss				X		
<i>Lycopodium clavatum</i>	Staghorn Club-moss* (Cobb, 1963)	X	X		X		
<i>Lycopodium obscurum</i>	Ground-pine or Tree Club-moss	X					
<i>Onoclea sensibilis</i>	Sensitive Fern	X	X		X	X	X
<i>Osmunda cinnamomea</i>	Cinnamon Fern	X	X		X		X
<i>Osmunda claytoniana</i>	Interrupted Fern	X	X		X	X	
<i>Osmunda regalis</i>	Royal Fern		X				
<i>Phegopteris connectilis</i>	Northern Beech Fern	X	X	X	X	X	X
<i>Polypodium virginianum</i>	Rock Polypody		X	X			
<i>Polystichum acrostichoides</i>	Christmas Fern	X	X	X	X	X	
<i>Pteridium aquilinum</i>	Bracken	X			X	X	
<i>Thelypteris noveboracensis</i>	New York Fern	X	X				
<i>Thelypteris palustris</i>	Marsh-fern						X

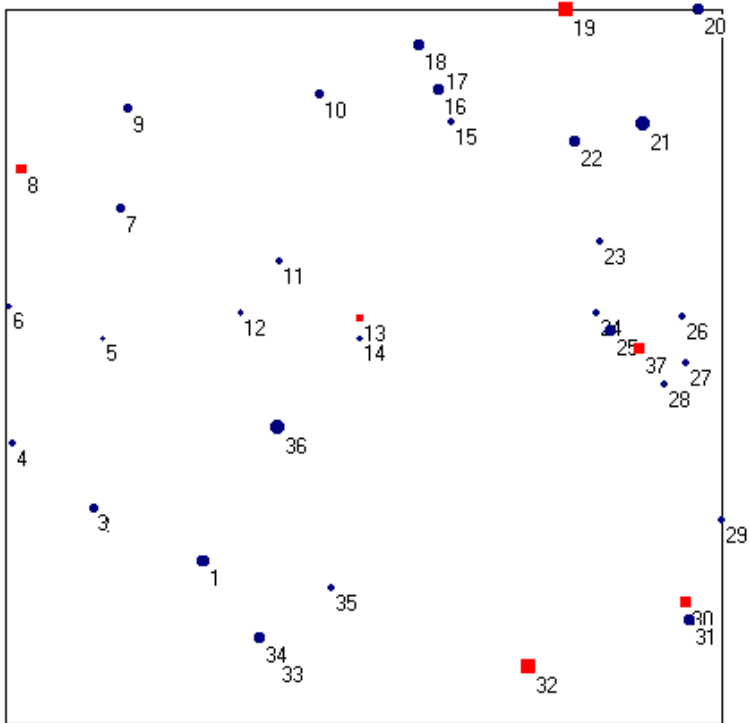
Appendix F – McGill Lake Wilderness Area Tree Maps



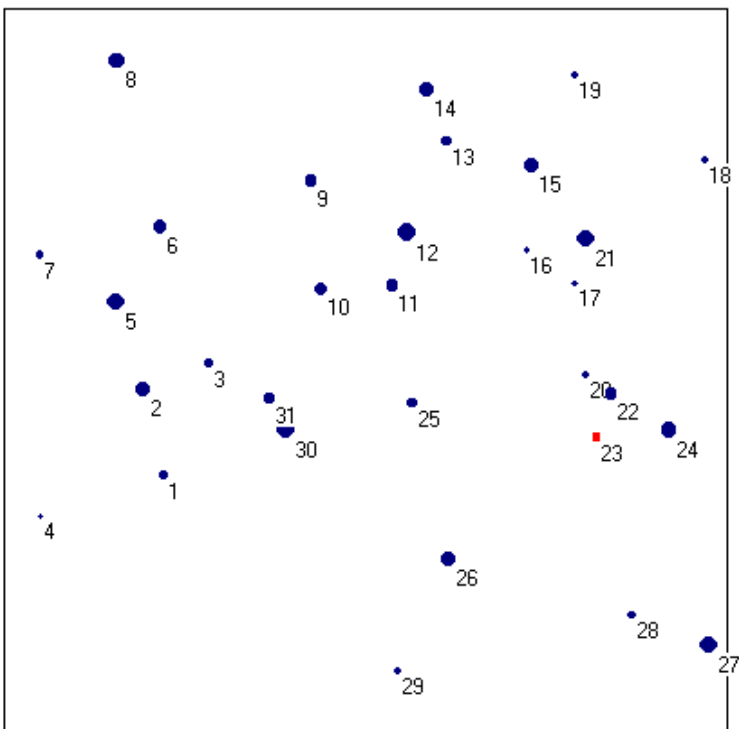
Map 6: Relative Tree Size and Distribution, Quadrat 01, McGill Lake Wilderness Area.



Map 7: Relative Tree Size and Distribution, Quadrat 02, McGill Lake Wilderness Area.



Map 8: Relative Tree Size and Distribution, Quadrat O3, McGill Lake Wilderness Area.



Map 9: Relative Tree Size and Distribution, Quadrat O4, McGill Lake Wilderness Area.

Appendix G – Regeneration Subplot Data at McGill Lake Wilderness Area

Date (d/m/y)	Quadrat	Northing	Easting	Subplot	Species*	Total No.	16-35cm	36-55cm	56-75cm	76-95cm	96-200cm	> 200cm
25/08/04	1	4947704	340070	1	QUERUB	7	5			1	1	
25/08/04	1			1	ACERUB	3	1	2				
25/08/04	1			2	ACERUB	3	1	1			1	
25/08/04	1			3	QUERUB	1	1					
25/08/04	1			4	PICRUB	7	1	6				
25/08/04	1			5	ABIBAL	1	1					
25/08/04	1			5	PINSTR	1	1					
25/08/04	1			5	ACERUB	4		4				
25/08/04	2	4947687	340063	1	QUERUB	2	2					
25/08/04	2			1	PINSTR	1					1	
25/08/04	2			2	ABIBAL	5	4	1				
25/08/04	2			2	PINSTR	9	8	1				
25/08/04	2			3		0						
25/08/04	2			4	ACERUB	3	1		1		1	
25/08/04	2			4	PINSTR	1	1					
25/08/04	2			5	PINSTR	1	1					
26/08/04	3	4947696	340053	1	PINSTR	12	12					
26/08/04	3			1	ABIBAL	7	4	3				
26/08/04	3			1	PICRUB	1	1					
26/08/04	3			1	QUERUB	1	1					
26/08/04	3			2	PICRUB	12	9	2	1			
26/08/04	3			2	ACERUB	1	1					
26/08/04	3			3	ABIBAL	4	4					
26/08/04	3			4	PICRUB	21	5	4	5	1	4	
26/08/04	3			4	QUERUB	1	1					
26/08/04	3			5	PINSTR	9	6	3				
26/08/04	3			5	BETPAP	1				1		
26/08/04	4	4947712	340042	1	QUERUB	2		2				
26/08/04	4			1	ACERUB	4	2	2				
26/08/04	4			2	PICRUB	16	4	8	3			
26/08/04	4			2	ACERUB	1	1					
26/08/04	4			3	ACERUB	3	3					
26/08/04	4			4	PICRUB	3	2			1		
26/08/04	4			4	QUERUB	1		1				
26/08/04	4			5	PICRUB	22	10	10	1		1	

* ABIBAL - Balsam Fir, ACERUB - Red Maple, BETPAP - White Birch, PICRUB - Red Spruce, PINSTR - White Pine, QUERUB - Red Oak

Appendix H – Preliminary Soil Decay Rate Data at McGill Lake Wilderness Area

Quadrat No.	Stick No.	Pre-weight (g)	Location (along axis, or in plot)	Date Laid (d/m/y)
1	1A	2.7402	North of regen subplot 2	26/08/04
1	1B	2.4470	North of regen subplot 2	26/08/04
1	1C	2.7660	North of regen subplot 2	26/08/04
1	1D	2.3289	North of regen subplot 2	26/08/04
1	2A	2.6589	North of regen subplot 3	26/08/04
1	2B	2.3982	North of regen subplot 3	26/08/04
1	2C	2.5728	North of regen subplot 3	26/08/04
1	2D	2.4410	North of regen subplot 3	26/08/04
1	3A	2.7521	North of regen subplot 4	26/08/04
1	3B	2.6134	North of regen subplot 4	26/08/04
1	3C	2.5775	North of regen subplot 4	26/08/04
1	3D	2.4101	North of regen subplot 4	26/08/04
1	4A	2.1120	North of regen subplot 1	26/08/04
1	4B	2.3104	North of regen subplot 1	26/08/04
1	4C	2.7075	North of regen subplot 1	26/08/04
1	4D	3.1863	North of regen subplot 1	26/08/04

Appendix I – Data collected at Quadrat 06, Granville Ferry

Due to a dense canopy, the two hand-held GPS units used by the survey team malfunctioned. This error combined with grown up boundary lines that were difficult to detect, resulted in the sixth biodiversity quadrat, intended for the DND property, to be established a few hundred meters outside the north-western boundary line (UTM: 4962713N 0297318E). Data collected at this site was not included in the report's analysis. Since the location of the quadrat is in close proximity to the DND property and the habitat is essentially the same, some information is included here as an appendix.

69 live trees (79 stems) were tagged on quadrat 06. 18 dead trees (20 stems) were also tagged. The most abundant species was Red Spruce (*Picea rubens*), followed by Red Maple (*Acer rubrum*). Three Eastern Hemlock (*Tsuga canadensis*) trees were recorded. One new species, Grey Birch (*Betula populifolia*) was encountered that had not yet been recorded on the DND property.

Picea rubens was the most abundant seedling observed in the regeneration survey. They were almost exclusively of the smallest height class (16-35cm). No saplings (> 200cm) were recorded.

A tree map was also produced for the quadrat, showing the relative size and distribution of trees.

Quadrat 6

