# MONITORING FOREST ECOSYSTEMS OF THE BRUCE PENINSULA

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BRUCE PENINSULA BIOSPHERE ASSOCIATION
2004

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The knowledge, expertise and cooperation of several individuals made the continuation of this valuable monitoring program possible. Thanks to the support of these people, this report will provide baseline data to achieve a better understanding of the forest ecosystems in the Municipality of the Northern Bruce Peninsula, an integral part of the Niagara Escarpment Biosphere Reserve.

I would like to express my sincere thanks to…

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| | | |
|---|---|---|
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# SECTION ONE

## Terrestrial Vegetation Biodiversity

## INTRODUCTION

For the past three years the Bruce Peninsula Biosphere Association has been establishing a long-term monitoring program in an effort to assess the integrity of the forest health within the Northern Bruce Peninsula. The development of this long-term ecological monitoring program will aid in the maintenance of existing ecosystems by detecting early warning signs of any potential ecological problems, either natural or anthropogenic, and providing the information required to develop management plans to sustain the ecosystems (Liipere, 2002). The Bruce Peninsula Biosphere Association has based their monitoring program on several protocols established by the Ecological Monitoring and Assessment Network (EMAN). These EMAN protocols examine key characteristics of forest health with a standardized approach to allow ecosystem assessments not only locally but regionally and nationally. This report is a continuation of the long-term monitoring program and, as such, provides further information regarding the established forest plots and a comparison between the three consecutive years (Liipere 2002, Boyle 2003).

## METHODS

### Location and design

Sixteen forest plots within the Northern Bruce Peninsula (Figure 1) were examined using the following EMAN protocols: Tree Condition, Regeneration/Sapling Survey, and Downed Woody Debris (Roberts-Pichette & Gillespie, 1999). These forest plots were originally established in 2002 (15 plots) and 2003 (1 plot) following the guidelines provided by EMAN. A 20 x 20 m plot was established to examine Tree Condition on those trees with a diameter at breast height (dbh) greater than 10 cm (Figure 2). To evaluate Tree Condition, trees are grouped into dominant, co-dominant, intermediate, or suppressed, which essentially is based on the amount of sunlight the tree canopy is exposed to and is referred to as crown class. The state of the crown is then considered by assessing the incidence of branch mortality (healthy, light-moderate decline, severe decline, or dead). Stem defects such as decay fungus, animal damage or cankers are recorded.

The Regeneration/Sapling Survey is evaluated with four 2 x 2 m regen. plots located outside of the 20 x 20 m plot, with an additional regeneration plot located in the center of the 20 x 20 m plot. Seedlings between 16 and 200 cm in height are identified and recorded, saplings greater than 200 cm in height and less than 10 cm dbh are tallied.

Downed woody debris (DWD) is measured along the perimeter, beginning in the southwest corner until a distance of 45.14 m is reached. Only those logs or stumps greater than 7.5 cm in diameter, at the point where the line intersects the log or stump, are considered. Each log or stump is then given a value between 1 and 5 depending on its current state of decomposition.

For further information regarding the collection of data for these parameters refer to the most recent versions of the EMAN protocols available at http://www.eman-rese.ca/eman/ecotools/protocols/terrestrial/, as well as those in Appendix 1 of Liipere 2002. Also, for a complete history, description, and UTM coordinates for the 16 forest plots refer to Liipere 2002 and Boyle 2003.

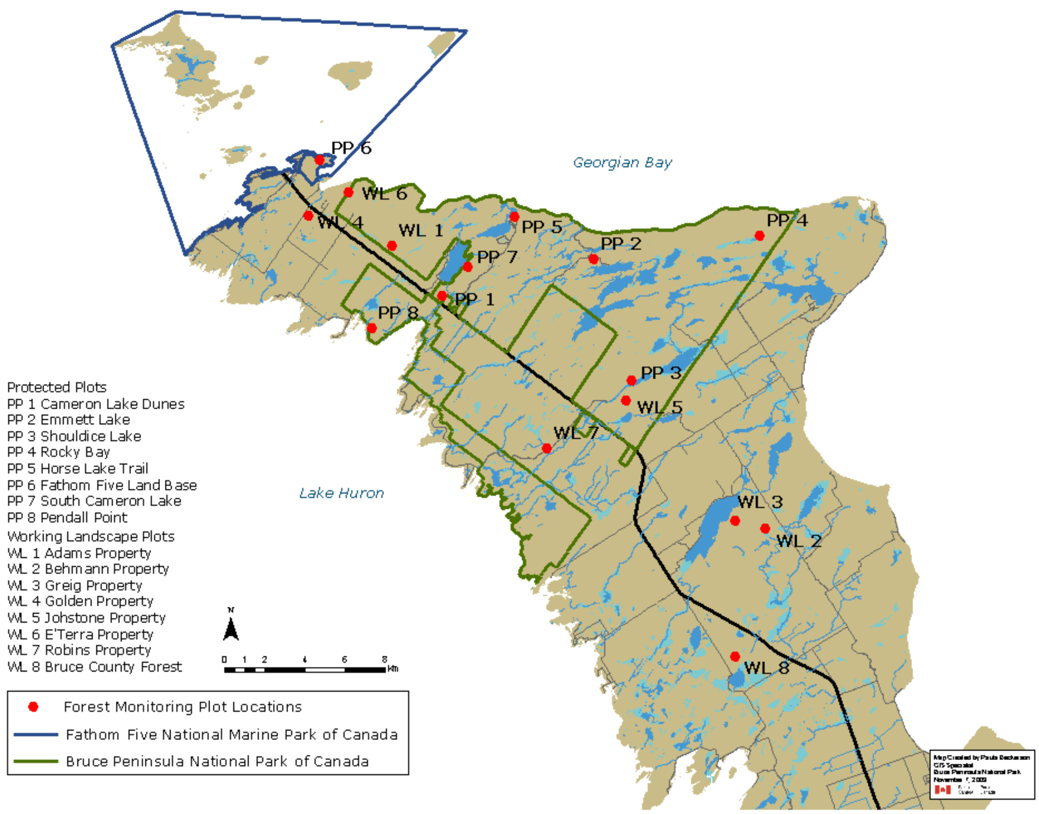


**Figure 1:** Location of the sixteen Bruce Peninsula Biosphere Association forest monitoring plots in the Northern Bruce Peninsula, Ontario, Canada. Eight of the plots are located in the protected area (PP) of the National Park and eight are in the working landscape (WL).

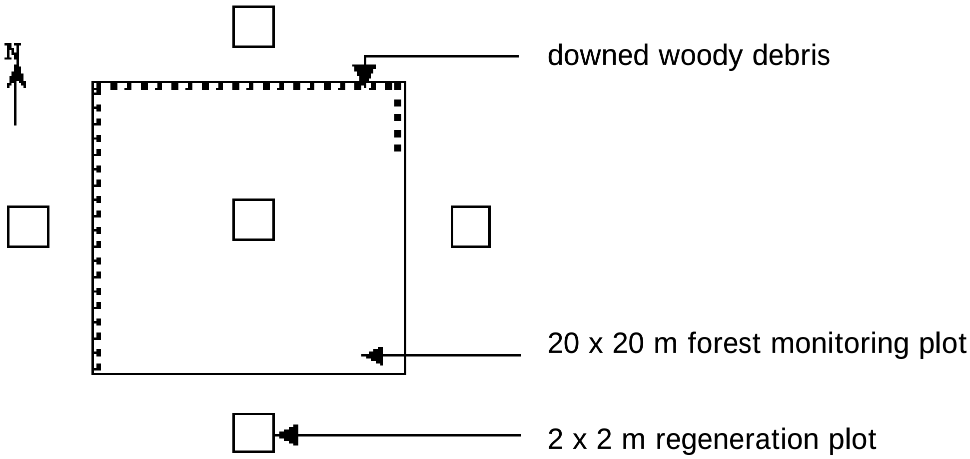


**Figure 2:** Forest monitoring plot design as described by the Ecological Monitoring and Assessment Network (EMAN).

## Mapping

In 2002, plot maps were created for each forest plot based on physical data collected from the site. These maps are created using the computer program BIOMON and illustrate the location of each tree in the plot with a dot relative to the dbh. If a tree has fallen the tree is depicted with a line. This year the map for the Robins Property (WL7) and South Cameron Lake (PP7) plots were found to be inaccurate and as such were corrected.

## Data analysis

For the tree condition protocol, data from dominant and co-dominant trees were isolated to observe trends over time in forest health. If a forest stand is stressed it should be quickly noted from a negative trend in either crown rating or the occurrence of stem defects since these factors are not common in healthy dominant and co-dominant trees (Zorn, personal comm.). Trees that are considered intermediate or suppressed receive less sunlight and consequently often exhibit a high incidence of stem defects or severe dieback in healthy forests (Zorn, personal comm.). A threshold of 10% over 2 consecutive years has been set in place for both crown rating and the presence of the decay fungus stem defect (Zorn, personal comm.).

To compare crown rating among forest plots, the mean proportion of dominant and co-dominant trees within the severe decline category from 2002, 2003, and 2004 are plotted in a bar chart (Figure 3). The percentage of these trees is then separated by year and grouped into hardwood or cedar/poplar forest plots (Figures 4 & 5).

Of the 9 stem defects observed in this study decay fungus is the stem defect of interest because it is a symptom of disease, whereas all other defects can be a result of weather damage (Zorn, personal comm.). To compare among forest plots, the mean proportion of dominant and co-dominant trees exhibiting decay fungus in 2002, 2003 and 2004 are plotted in a bar chart (Figure 6). The percentage of these trees is then separated by year and grouped into hardwood or cedar/poplar forest plots (Figures 7 & 8).

To assess forest stand recruitment, the mean number of dominant seedlings (those seedlings representing greater than 25% of the total number of seedlings within a forest plot) are plotted in a bar chart and compared among forest plots (Figure 9) (Zorn, personal comm.). A further comparison is provided by separating the total number of dominant seedlings by year and by forest plot (Figures 10 & 11). To date, a threshold has not been set (Zorn, personal comm.).

Downed woody debris was simply compared to the previous years data to account for any potential loss of class 1 debris. Since DWD in class 1 is often sought after for campfires a decrease in this class could harm ecological processes as DWD plays a vital role in nutrient cycling, soil erosion and provides habitat for various animals (Zorn, personal comm.). A threshold of 0 is currently in place for the removal of DWD from an ecosystem (Zorn, personal comm.).

## RESULTS

### Crown rating

Of the 8 hardwood plots, only 3 plots (Emmett Lake – PP2; Rocky Bay – PP4; Behmann Property – WL2) contain trees within the severe decline category. Rocky Bay (PP4), located in a protected area, has crossed the 10% threshold when comparing the mean proportion of dominant and co-dominant trees from 2002, 2003 and 2004 in the severe decline category

(Figure 3). However, this only occurred in 2002 and the percentage of these trees in subsequent years has fallen below 10% (Figure 4).

All of the cedar/poplar plots contain trees within the severe decline category (Figure 3). Two of these plots (Horse Lake Trail – PP5; Fathom Five Landbase – PP6), located in a protected area, have surpassed the 10% threshold. Horse Lake Trail (PP5) has fluctuated slightly since 2002, but Fathom Five Landbase (PP6) has just crossed the threshold this year (Figure 5). Three of the working landscape cedar/poplar plots (Golden Property – WL4; Johnstone Property – WL5; E'Terra Property – WL6) have surpassed the 10% threshold. The Golden Property (WL4) surpassed it this year, the Johnstone Property (WL5) appears to be undergoing a decreasing trend, and the E'Terra Property (WL6) is only borderline at this point. Overall, only Horse Lake Trail (PP5) has stayed above the threshold for 2 consecutive years (Figure 5).

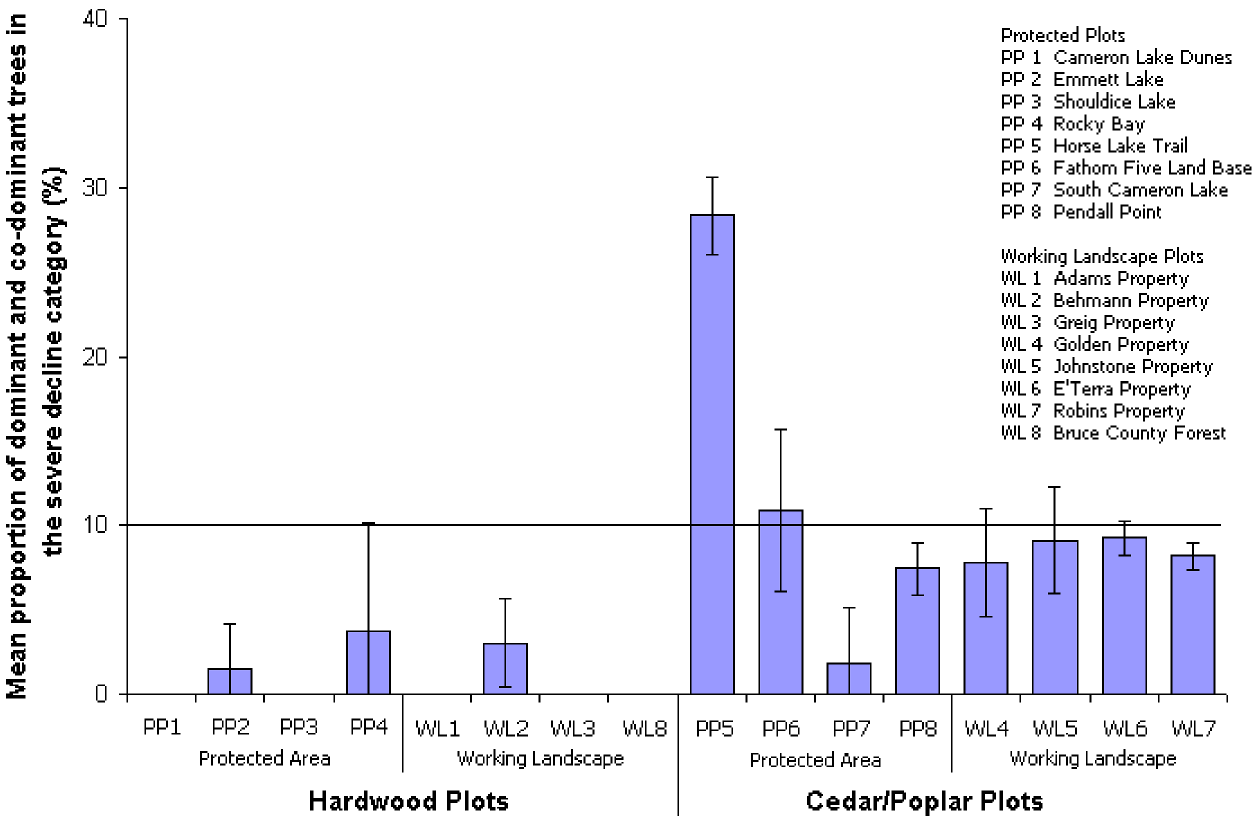


**Figure 3:** Dominant and co-dominant trees in the severe decline crown rating category, as observed in 16 forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the mean proportion of these trees for 2002, 2003, and 2004, ± the standard deviation. The solid line illustrates the monitoring threshold of 10% that provides an early warning sign if surpassed for two consecutive years.

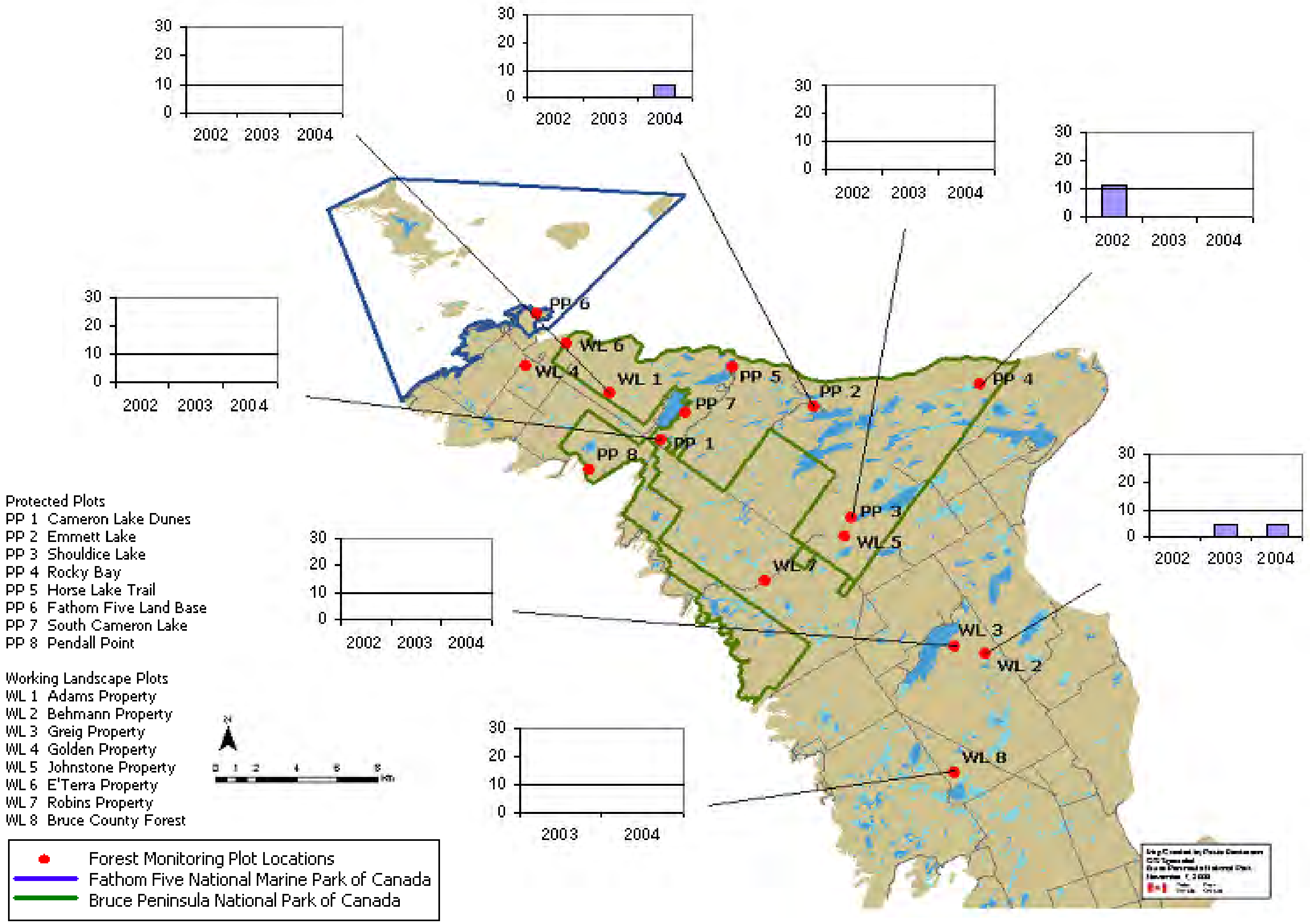


**Figure 4:** Dominant and co-dominant trees in the severe decline crown rating category for 2002, 2003 and 2004, as observed in 8 hardwood forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the percentage of these trees and the solid line illustrates the monitoring threshold of 10% that provides an early warning sign if surpassed for two consecutive years.

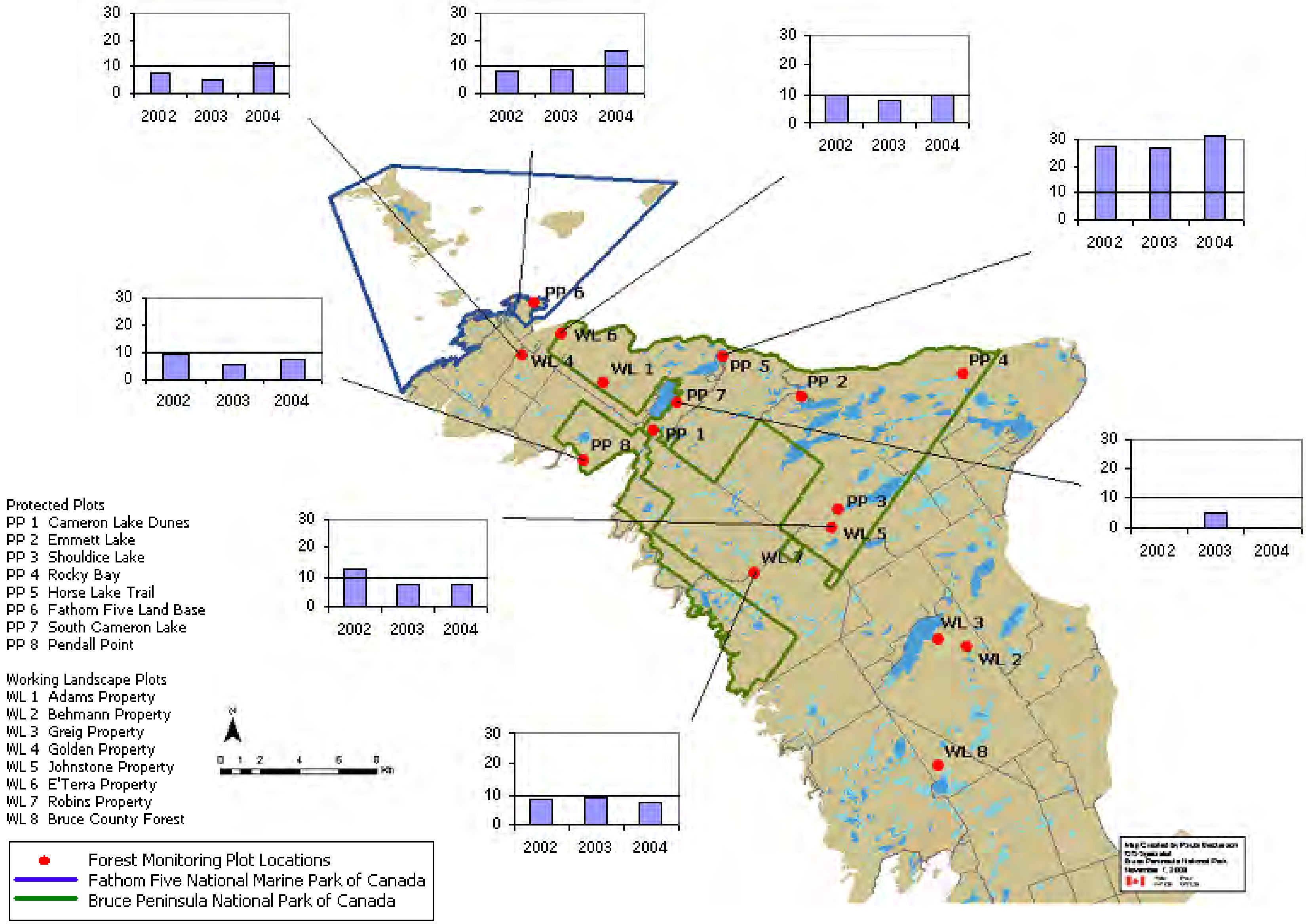


**Figure 5:** Dominant and co-dominant trees in the severe decline crown rating category for 2002, 2003 and 2004, as observed in 8 cedar/poplar forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the percentage of these trees and the solid line illustrates the monitoring threshold of 10% that provides an early warning sign if surpassed for two consecutive years.

## Stem defects

Decay fungus was present in 4 of the 16 forest plots, one working landscape hardwood plot (Behmann Property – WL2) and 3 cedar/poplar plots, 2 of which were located in the working landscape (Johnstone Property – WL5; Robins Property – WL7) and 1 in a protected area (Horse Lake Trail – PP5) (Figures 6, 7 & 8). In all cases, the mean proportion of dominant and co-dominant trees with decay fungus was well below the 10% threshold.

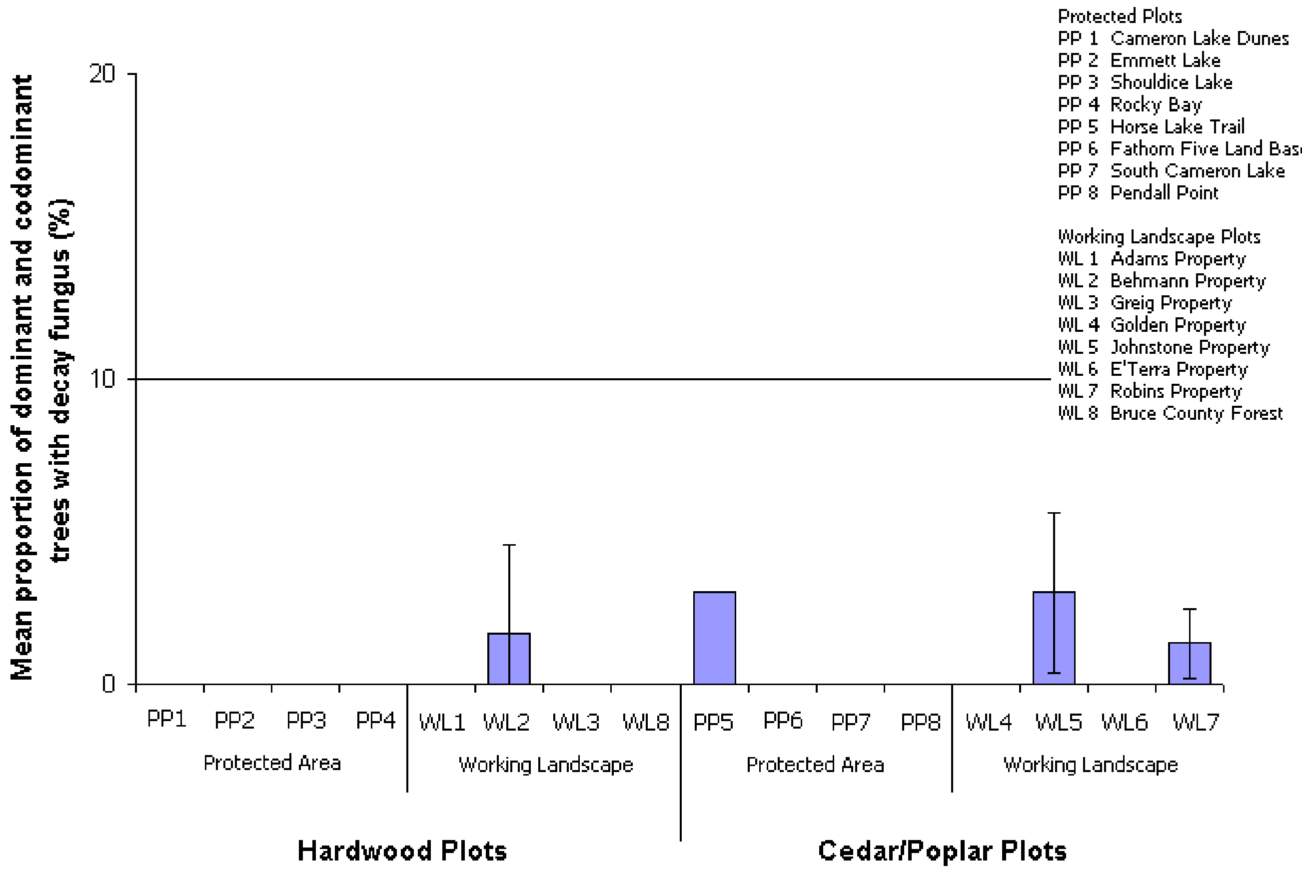


**Figure 6:** Dominant and co-dominant trees with the decay fungus stem defect, as observed in 16 forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the mean proportion of these trees for 2002, 2003, and 2004, ± the standard deviation. The solid line illustrates the monitoring threshold of 10% that provides an early warning sign if surpassed for two consecutive years.

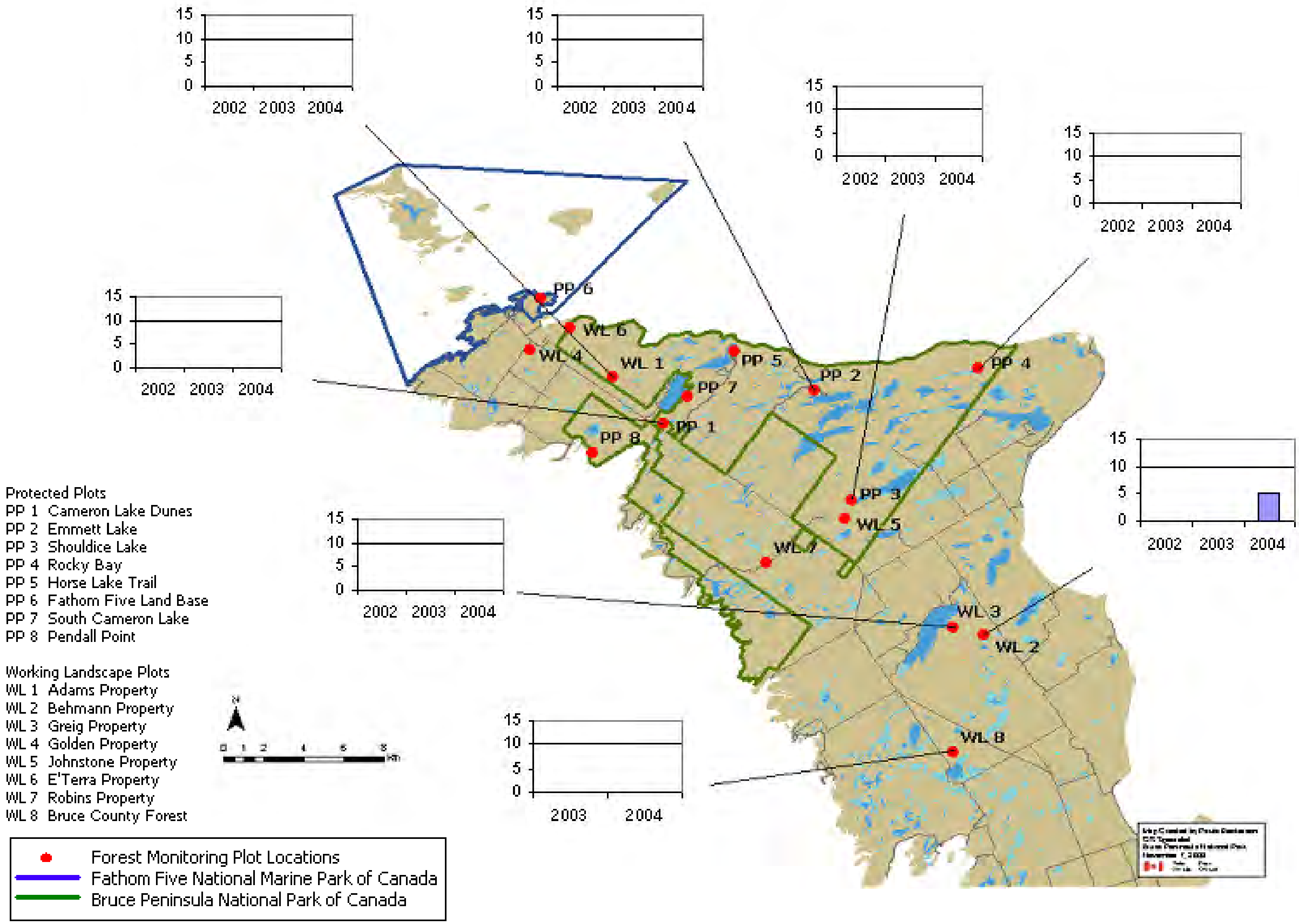


**Figure 7:** Dominant and co-dominant trees with the decay fungus stem defect for 2002, 2003 and 2004, as observed in 8 hardwood forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the percentage of these trees and the solid line illustrates the monitoring threshold of 10% that provides an early warning sign if surpassed for two consecutive years.

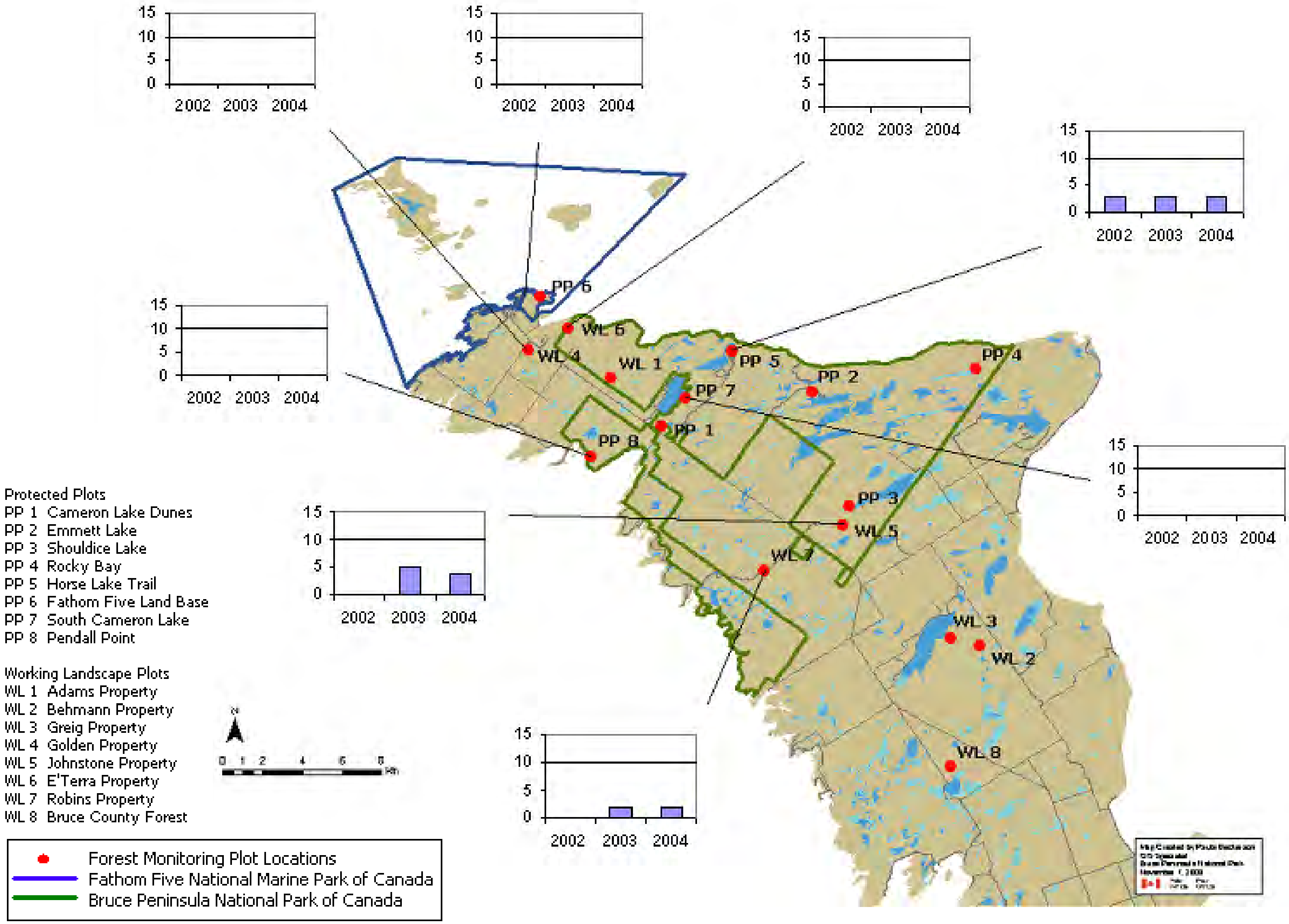


**Figure 8:** Dominant and co-dominant trees with the decay fungus stem defect for 2002, 2003 and 2004, as observed in 8 cedar/poplar forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the percentage of these trees and the solid line illustrates the monitoring threshold of 10% that provides an early warning sign if surpassed for two consecutive years.

## Regeneration and sapling survey

From the survey for 2002, 2003 and 2004, there were 3 species found in the hardwood plots (sugar maple, white ash and balsam fir) and 3 species in the cedar/poplar plots (balsam fir, white ash, and eastern white cedar) (Figure 9). Sugar maple was present in 6 of the 8 hardwood plots, where white ash was in 3 of 8 and balsam fir was in one. Balsam fir was present in all but one of the cedar/poplar plots, while white ash and eastern white cedar were each found in 1 of 8 plots. No regeneration was evident at the Horse Lake Trail (PP5) forest plot. When comparing the total number of seedlings from the current study to the previous years data, birch was a dominant seedling on a working landscape hardwood plot (Behmann Property – WL2) in 2002 (Figure 10) and a protected cedar/poplar plot (Horse Lake Trail – PP5) in 2002 and 2003 (Figure 11).

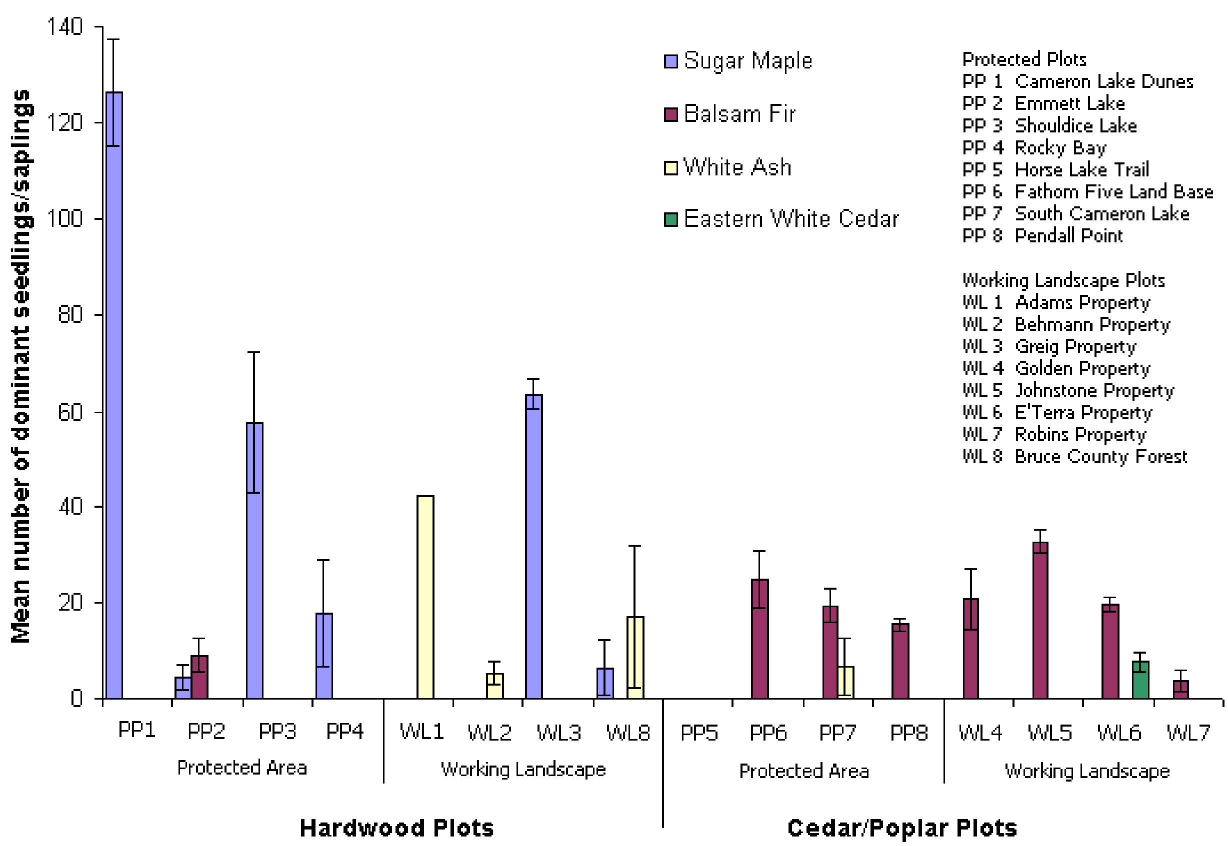


**Figure 9:** Dominant seedlings as observed in 16 forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the mean number of dominant seedlings for 2002, 2003, and 2004, ± the standard deviation.

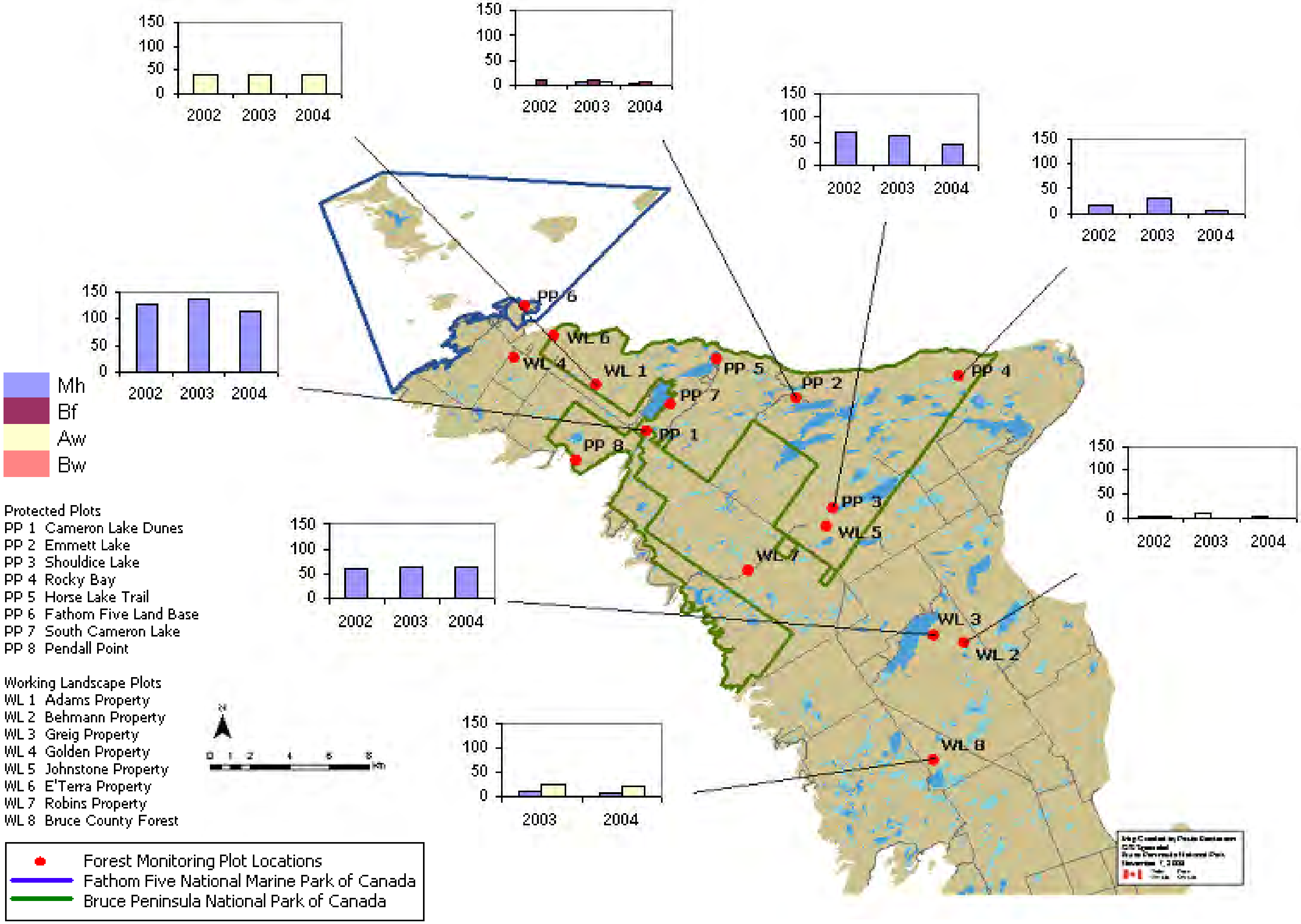


**Figure 10:** Dominant seedlings in 2002, 2003 and 2004, as observed in 8 hardwood forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the total number of dominant seedlings.

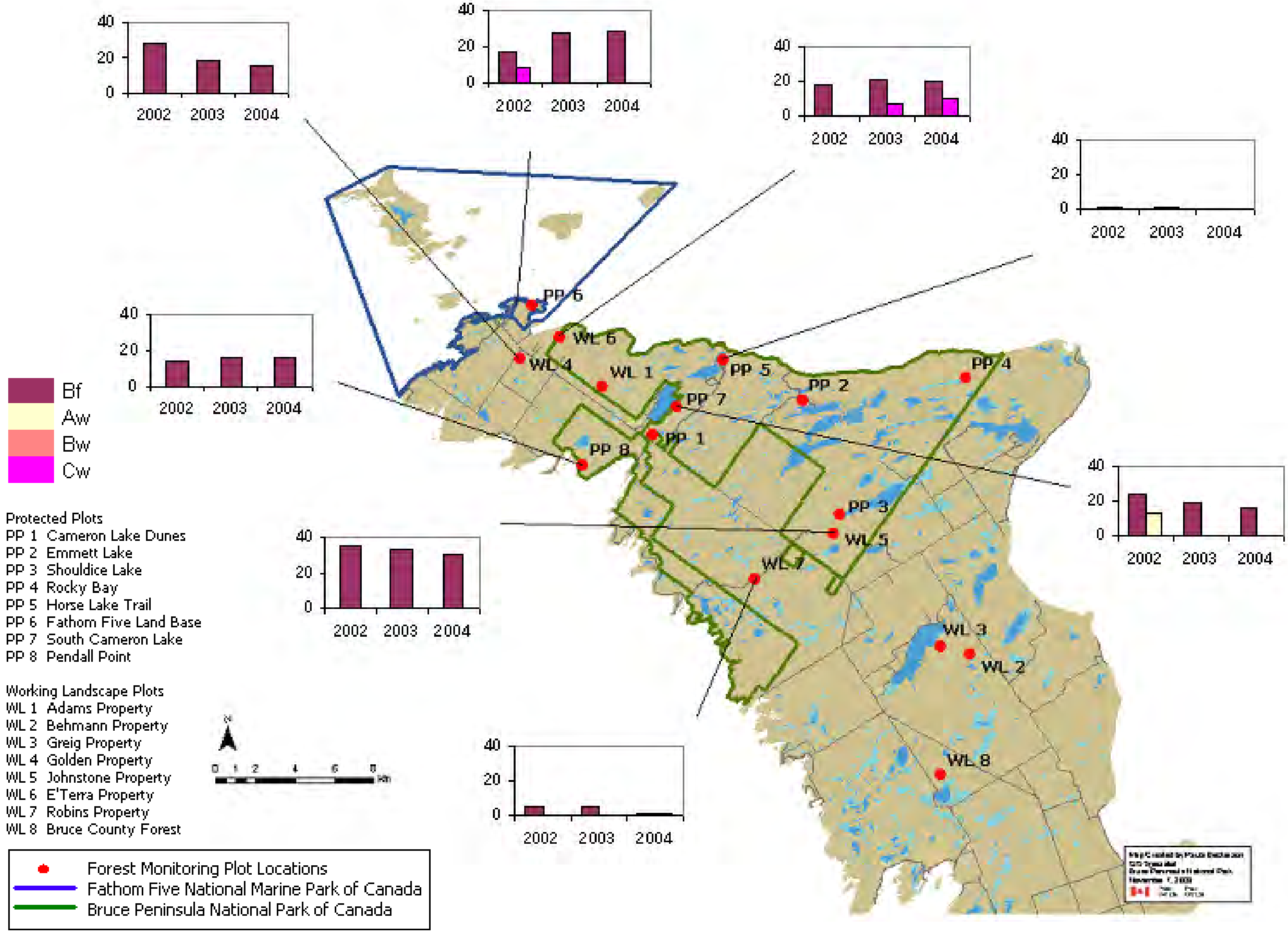


**Figure 11:** Dominant seedlings in 2002, 2003 and 2004, as observed in 8 cedar/poplar forest plots located in the Northern Bruce Peninsula, Ontario, Canada. Bars represent the total number of dominant seedlings.

## Downed woody debris

All DWD that was categorized as decomposition class 1 in 2003 was located in this study. Generally, class 1 DWD represents those logs or stumps that are intact, still have their original color and have not yet softened (Roberts-Pichette & Gillespie, 1999). As DWD decomposes over time, the decomposition class increases. Class 2 DWD has started to soften while retaining it's original color and may sag in places if it is supported by another object. The bark is absent from class 3 DWD and the original color has faded. Class 4 and 5 DWD is flat on the ground and has a blocky or powdery texture, respectively (Roberts-Pichette & Gillespie, 1999). In this study, any DWD that appeared to be missing was due to an increase in decomposition class.

## Mapping

Some plotting errors were identified and corrected. Four trees (9, 12, 21, and 31) were relocated within the plot map for the South Cameron Lake (PP7) plot (Figure 12). For the Robins Property plot (WL7), 7 trees (7, 29, 30, 31, 35, 48, and 57) were repositioned on the plot map (Figure 13). These changes were made in Microsoft Paint due to the difficulty in accessing the computer program BIOMON. To access the original plot maps from 2002, refer to Liipere 2002.

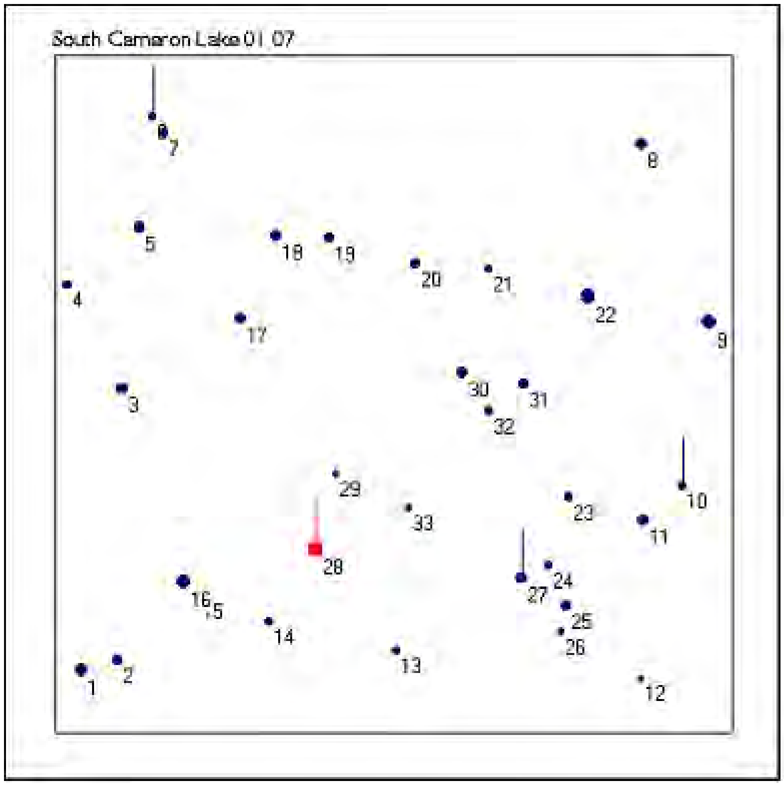


**Figure 12:** South Cameron Lake (PP7) revised plot map.

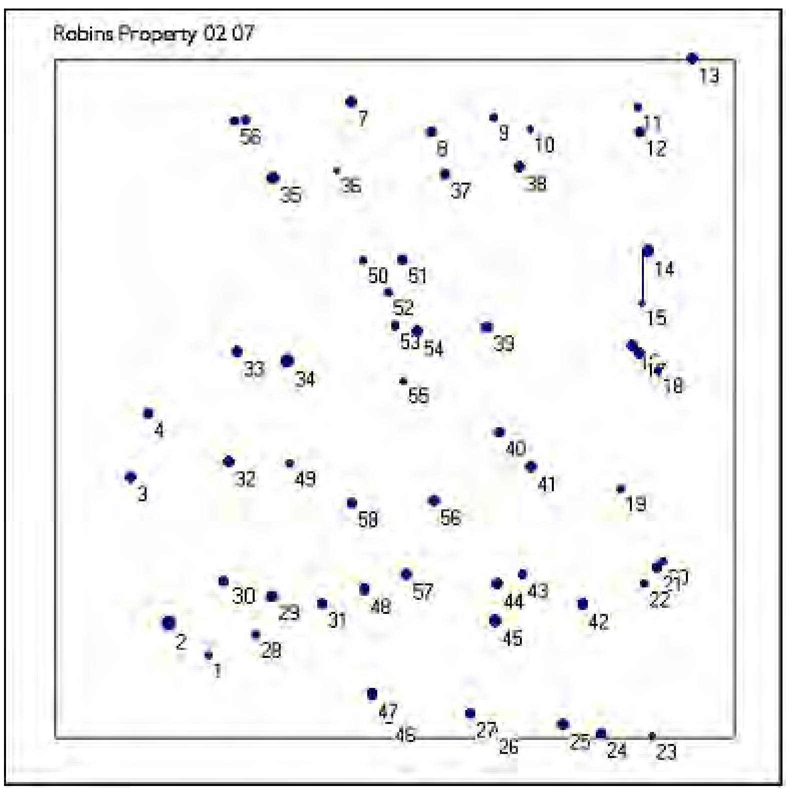


**Figure 13:** Robins Property (WL7) revised plot map.

## DISCUSSION

The data collected this year represents the third year of long-term monitoring and further establishes trends in forest health within the Northern Bruce Peninsula. At this point, all forest plots are below the given thresholds for the measures of interest, except for Horse Lake Trail (PP5). However, Horse Lake Trail (PP5) has only surpassed the threshold for crown rating and has remained fairly consistent since 2002.

Several corrections have been made to the data set since last year. In the 2003 data set a few dead trees were classified as dominant or co-dominant as opposed to non-applicable. When isolating the data from the dominant and co-dominant trees, only live trees should be considered. Consequently, a few dead trees were included in the crown rating and stem defect comparisons in 2003. Also, for crown rating and stem defects, the 2003 means were calculated using the total number of trees in each plot as opposed to the total number of dominant and co-dominant trees. Thus, all means for crown rating and stem defects have been recalculated and are slightly higher in this report when compared to Boyle (2003). Also, the manner in which the y-axis is labelled has changed. For the map illustrating the percentage of trees in the severe decline category for hardwood plots, the small graphs were not matched with the appropriate plot number in the 2003 report. For regeneration, a few of the bars representing the mean number of dominant seedlings in 2003 were coloured incorrectly. Lastly, the figure caption on page 18 of the 2003 report reads 'total number', while actually representing a mean.

Some issues that need to be addressed in the upcoming year include, checking and possibly replacing the nails used to attach the identification tags to the trees and verifying the tree species in a few plots, which have been red-flagged in the database. In regards to labelling trees, the nails should not be set all of the way into the stem because over time they become overgrown. Also, please note that dbh was measured this year but this is only required on a five year cycle.

For future endeavours in this monitoring program, a GPS unit in which permanent maps to plot locations could be stored would be a great asset. If possible, a permanent way to outline the 20 x 20 m forest plots would allow the DWD to be easily located in subsequent monitoring years. Also, calipers for measuring tree diameter would produce more accurate results.

# SECTION TWO

## Salamander Abundance

## INTRODUCTION

Plethodontid salamanders are used as an indicator species of forest health through a joint effort by EMAN and Parks Canada (Zorn & Blazeski, 2002). Of the plethodontid salamanders, those species found in forested areas and lacking an aquatic larval stage are the salamanders of interest. These salamanders are lungless, causing them to be particularly sensitive to any changes in air or water quality as they are dependent on soil moisture for respiration (Zorn & Blazeski, 2002). This characteristic, in addition to their long life span of 20 years or more, high annual survival rates, and small home ranges, make them ideal species for indicators of ecosystem health (Zorn & Blazeski, 2002).

To monitor plethodontid salamanders, artificial cover boards (ACOs) are commonly used to provide a standardized sampling unit, which is safe for animal use and can be easily checked (Zorn & Blazeski, 2002). Last year, ACOs were distributed in several existing forest monitoring plots in the Northern Bruce Peninsula, and left to weather for one year (Boyle 2003). This study represents the initial monitoring year for plethodontid salamanders in this area.

## METHODS

### Location and design

In 2003, artificial cover boards (ACOs) were installed in 8 of the forest monitoring plots, 4 located in protected areas (Cameron Lake Dunes – PP1, Emmett Lake – PP2, South Cameron Lake – PP7, and Pendall Point – PP8) and 4 in the working landscape (Harmony Acres – WL1, Behmann Property – WL2, Johnstone Property – WL5, and Robins Property – WL7). In each area, 2 plots are located in hardwood stands and 2 plots are in cedar/poplar stands. Each forest monitoring plot contains 40 ACOs, which outline the plot at a distance of 10 m from the plot perimeter, each separated by 5 m (Figure 14).

Artificial cover boards were checked on a weekly basis beginning on May 12, 2004 and ending on July 1, 2004. Those ACOs located in protected areas were monitored for 8 consecutive weeks, while those ACOs in the working landscape were only monitored for 3 consecutive weeks due to time constraints. To maintain consistency, ACOs should be monitored for 8 consecutive weeks each spring, ideally starting immediately after snow melt.

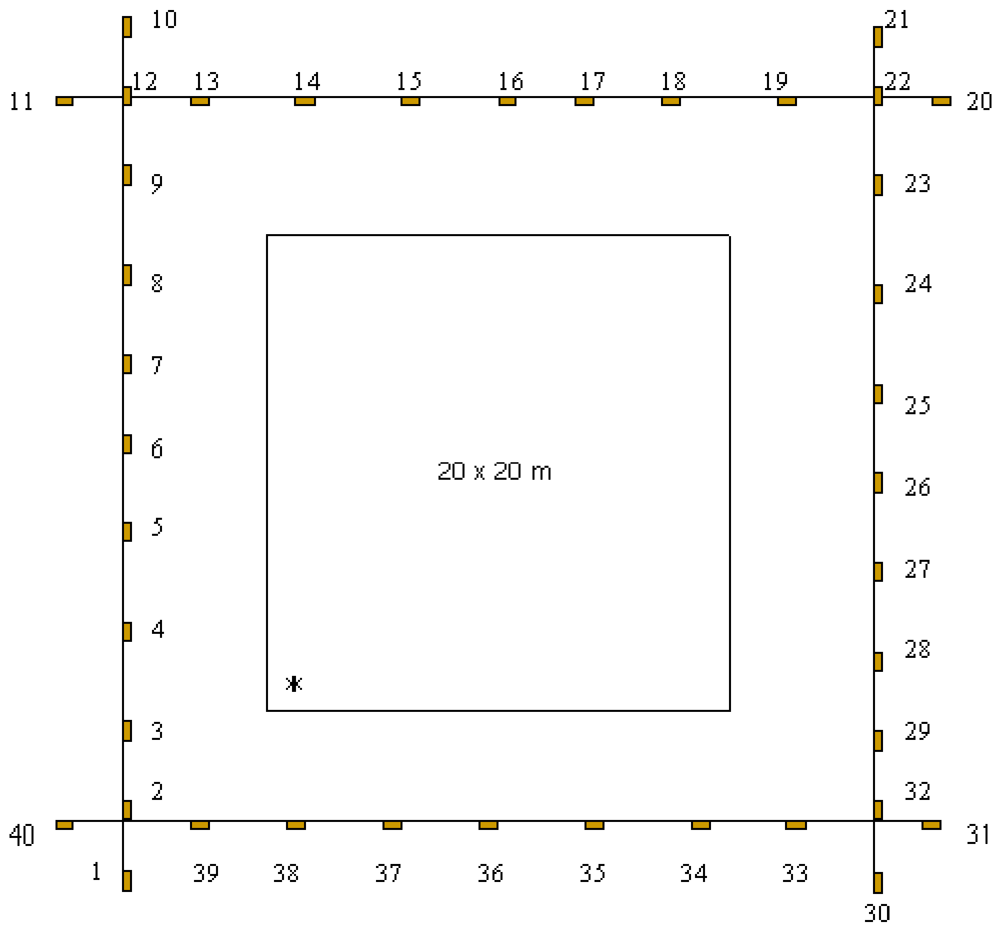


**Figure 14:** Arrangement of artificial cover boards (ACOs) surrounding a forest monitoring plot. The asterisk represents the southwest corner of the forest monitoring plot. The numbers represent the ACO number.

Each sampling session was conducted in the morning because it is potentially cooler and wetter than the afternoon (Zorn & Blazeski, 2002). Sampling began in the southwest corner at ACO 1 and followed a clockwise pattern ending at ACO 40. All mandatory variables such as, plot location, salamander count and species, ground and air temperature, precipitation in the last 24 hours, etc. were recorded. Most of the additional preferred variables were also recorded, including, soil moisture, soil pH, snout-vent length, vent-tail length, weight, age, age class and sex of the salamander. Salamanders were measured by placing them in a small plastic dish, flattening them with a sponge, and tracing their snout-vent and vent-tail lengths with a dry-erase marker. The sex of the salamander was also obtained at this time. Salamanders were then placed in a plastic bag to obtain a weight measurement.

When handling the salamanders, they were kept moist at all times. The plastic container and sponge used to measure the salamander, as well as the plastic bag to obtain a weight, were all thoroughly moistened with distilled water. Care was also taken to ensure that salamanders were not crushed, by releasing them next to the ACO once the ACO was placed back on the ground. Also, salamanders absorb anything they come into contact with, so it is important to ensure that hands are free of lotions or sprays, but moistened with distilled water.

For further information regarding the use of plethodontid salamanders as indicator species, as well as the collection of data and required variables, refer to the Joint EMAN/Parks Canada National Monitoring Protocol for Plethodontid Salamanders (Zorn & Blazeski, 2002).

### Data analysis

A bar chart illustrating the total number of redback salamanders observed this spring is provided. The abundance of other species observed was not included in the bar chart because only 1 of each of 3 species (red-spotted newt, blue-spotted salamander, and yellow spotted salamander) was observed.

## RESULTS

The redback salamander represented 99.3% of the salamander abundance. A quick glance at the bar chart (Figure 15) would give the impression that redback salamanders are more abundant in the protected areas, however, different sampling periods were used for the protected area as opposed to the working landscape. Trends may not be evident until 5 years of consistent monitoring data has been collected.

For the 3 other species that were observed, the red-spotted newt was found on the Robins Property cedar/poplar plot (WL7), the blue-spotted salamander was found on the South Cameron Lake cedar/poplar plot (PP7), and the yellow spotted salamander was located on the Emmett Lake hardwood plot (PP2).

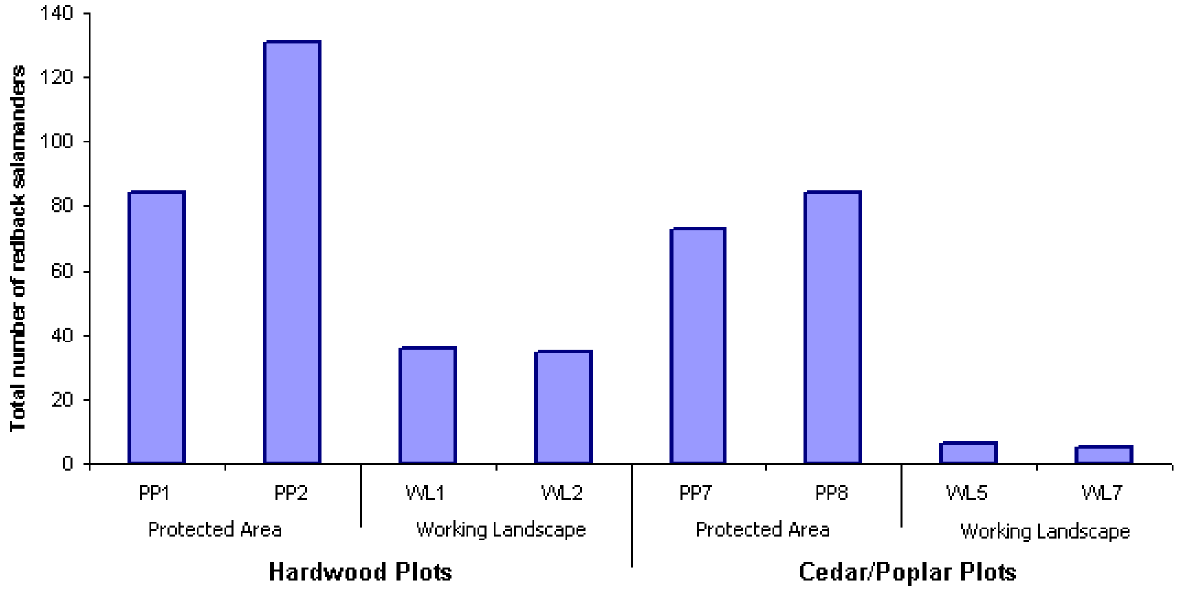


**Figure 15:** Total number of redback salamanders as observed in 8 forest monitoring plots. Those plots located in protected areas (PP) were monitored for 8 consecutive weeks and those plots located in the working landscape (WL) were monitored for 3 consecutive weeks.

## DISCUSSION

This being the first monitoring year, the data provides a snapshot of salamander abundance in the Northern Bruce Peninsula. The most abundant species is the redback salamander, representing 99.3% of the population, with a total of 454 redback salamanders observed.

The sampling frame, beginning in early May and ending at the end of June was successful. Sampling later than this may not be as fruitful because as the soil moisture decreases in the summer months, salamanders will burrow to deeper layers of the soil (Zorn & Blazeski 2002). Also, it is important to make sure that all sites are checked at the same frequency, within the same sampling frame.

Current sampling techniques could be improved with the help of a more accurate scale, revised data sheets, and a kestrel. The scale used this year would take on moisture and give inaccurate readings. Data sheet A could be merged with data sheet B because most information recorded on data sheet A can be discerned from data sheet B. Finally, a kestrel would ensure consistent air temperature readings among the data. Various thermometers were used this year due to a shortage of kestrels.

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Zorn, P. Regional conservation biologist, Parks Canada, Ontario Service Centre. Personal communication through e-mail.

## APPENDIX

## WORKING LANDSCAPE FOREST MONITORING PLOTS

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**Golden Property (WL4)**
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**Johnstone Property (WL5) ***
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Dyers Bay, ON
(519) 795-7424

**E'Terra Property (WL6)**
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**Robins Property (WL7) ***
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**Bruce County Forest (WL8)**
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* forest monitoring plots with artificial cover boards (ACOs) for salamander monitoring