Terrestrial Volunteer Monitoring Program

Progress Report

December 2006

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1.0 INTRODUCTION

This document reports on the development, implementation and progress of the Toronto and Region Conservation Authority's Terrestrial Volunteer Monitoring Program. Established in 2002, the program is currently in it's fifth year of monitoring a series of fixed sites distributed throughout the watersheds of the Toronto Region (Map 1). Logistical results with respect to administering the volunteer program as well as data collection and monitoring results are included for the period 2002 through 2006.

1.1 Background

A plan for a Regional Watershed Monitoring Network was developed in 2000 to address identified needs for better information on the current state, changes over time and stressors on aquatic and terrestrial ecosystems in the Toronto region. Since that time the Toronto and Region Conservation Authority (TRCA) has moved forward to implement several of the high priority biomonitoring components of the plan, in particular those required to fulfill the needs of the Toronto Remedial Action Plan (RAP), as well as the individual watershed and waterfront councils and alliances. The reader is referred to *Development of a Regional Watershed Monitoring Network* (2000) and workshop proceedings *Toward a Watershed Monitoring Framework for the Toronto Regio*n (1999) for more detailed information on the discussion around monitoring needs and the original Regional Watershed Monitoring Network concept.

Terrestrial ecosystem monitoring needs and recommendations described in the *Terrestrial Natural Heritage Monitoring Discussion Paper* (2000) informed the subsequent development and implementation of three sets of terrestrial ecosystem evaluation and monitoring procedures. In the first, staff analyze remote sensing data in order to quantify natural cover within the jurisdiction and characterize it at a coarse landscape level of habitat type classification (forest, successional, wetland, meadow, beach/bluff). The second comprises systematic biological inventories of vegetation communities as well as flora and fauna. Over time, all natural cover in the TRCA jurisdiction will be inventoried, allowing for mapping of vegetation communities and species of concern. Complementing these two elements is the Terrestrial Volunteer Monitoring Program, designed to provide a level of detail finer than the remote sensing, yet coarse enough to be practical for implementation across the entire region, on a continuous basis. This element also meets the Watershed Network goal of providing opportunities for the public to be involved in monitoring in a meaningful way.

Concurrent with the Terrestrial Monitoring Program development and implementation has been the development of the TRCA's Terrestrial Natural Heritage System Strategy (THNSS) for the region. The Terrestrial Volunteer Monitoring Program elements were designed to inform decision making and target setting relative to strategy implementation. Readers are referred to the *Terrestrial Natural Heritage Systems Strategy (Draft 2006)* document for more detailed information on the strategy and its implementation.

2.0 THE TERRESTRIAL VOLUNTEER MONITORING PROGRAM

Designed to supplement remote sensing and systematic biological inventory data collection, the Terrestrial Volunteer Monitoring Program (TVMP) has three main objectives:

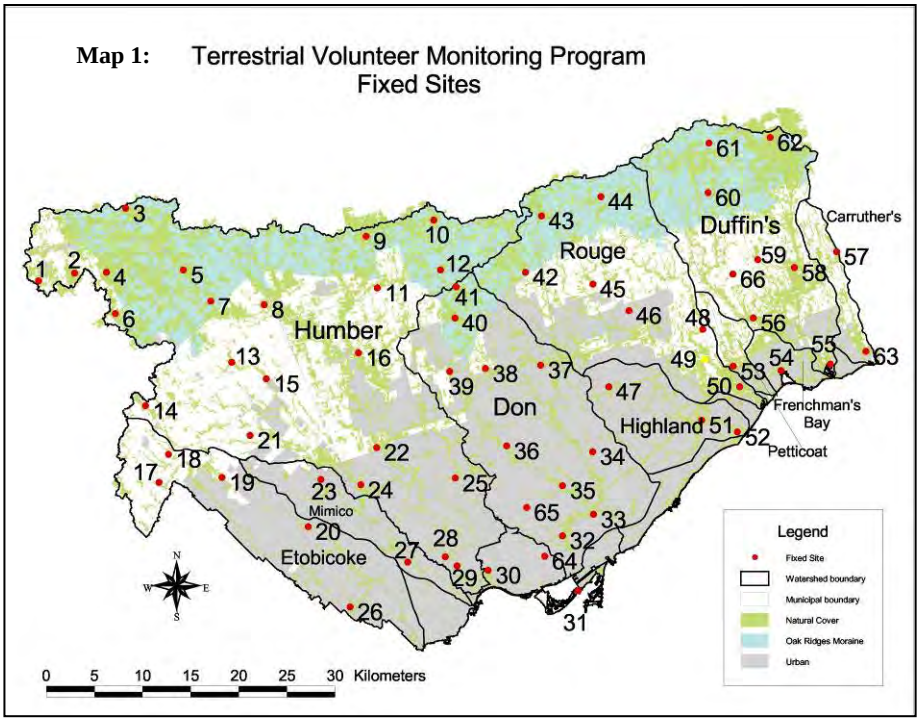
1. to monitor selected terrestrial fixed sites over the long term to assist in the evaluation and reporting of terrestrial ecosystem health in the TRCA jurisdiction;

2. to collect terrestrial ecosystem monitoring data that are spatially distributed across the TRCA jurisdiction, representative of the full range of habitat types existing in the Toronto region, and encompass both privately owned and public lands; and,
3. to involve citizen scientists in a long term conservation program that will provide a learning opportunity, build their connection with nature, and allow them to participate in the collection of meaningful data that will be utilized to inform decision making

The TVM program involves surveying for the presence of a selected set of 56 indicator fauna, flora and lichen species on 66 ten hectare fixed sites located in natural cover areas on both public and private lands distributed throughout the Toronto region (Map 1). Citizens living in the watersheds are recruited to volunteer their time for these surveys, and landowners are asked to participate by allowing surveys to occur on their land. In a few cases, private landowners have also acted as the volunteer surveyors for sites located on their properties.

Volunteer monitoring data are collected during all four seasons every year. The intent is to use data from the volunteer sites as representative of natural cover in the broader region, and as a monitoring tool, to record general trends of regional terrestrial ecosystem health over time. In the short term, the data also assist in confirming other observations of species response to land use across the region.

Volunteers conduct seasonal surveys amounting to 16 hours per year, distributed over 10 visits. In return, the TRCA facilitates a forum for training and discussion of natural history and conservation within local watersheds, and coordinates field trips focusing on indicator species and habitats. The volunteer data set is managed and analyzed by the TRCA and presented back to the volunteers and public. Currently this is done in the form of a published report. Future plans include the development of an online tool to facilitate the sharing of data and information with partnering organizations as well as the public. In addition to collecting the monitoring data, a major goal of the program is to maintain a long-term partnership between volunteers, TRCA, and landowners of properties with sites.



2.1 Program Protocol

As a citizen science based project, the Terrestrial Volunteer Monitoring Program was designed to allow for a high level of confidence in the validity of the data collected. Key elements include:

- required seasonal training for all volunteers, specific to the species surveyed for that season;
- species selected, in part, for the ease with which volunteers could find and identify them
- a set of characteristics for each species (primary, secondary, tertiary) to be checked off on data sheets (Appendix A) as volunteers record each observation, which were designed to eliminate the erroneous recording of similar looking or sounding species; and,
- standardized observation protocols, visual and audio aids.

Further, an automated data validation matrix within the database flags data records that require additional verification by staff, and a data verification protocol standardizes how such verification takes place.

The survey protocol sets out the specific month, time of day and length of time for each survey to ensure comparability between sites, equality of effort and best likelihood of observing the target species in critical habitat for the survey.

A safety protocol is also followed that covers the provision of West Nile virus information to new volunteers, mandates that volunteers are always accompanied by a partner, that they take no risks while doing the surveys and that they inform the coordinator of any issues or concerns. Reflective vests are available for loan to volunteers who park at roadside and/or walk along roads while conducting surveys or travelling to or from the site. Dashboard car signs are also provided to inform landowners and others of the reason for the presence of an unfamiliar vehicle on properties.

2.2 Site Selection

The nine watersheds of the Toronto region encompass a total area of 250,000 hectares, and landscape level analysis (aerial photo interpretation) of 2002 ortho-photography shows approximately 63,350 hectares of this area being under natural cover. The 66 fixed sites therefore currently include one site for every 1006 hectares of natural cover, plus 3 control sites to provide coverage of urban parkland, suburban residential and agricultural land. This sample size is intended to support statistical analysis of site results as being representative of the region.

The 63 non-control sample sites were initially distributed among watersheds according to watershed area, with a minimum of 2 sites allocated to each. Next, specific site locations were chosen randomly within available natural cover of at least 10 hectares in size. Where possible, boundaries were established to include some forest, wetland and meadow habitat within each site. No preference was made with respect to public versus private lands to avoid the potential for biasing results, and to support regional representation, although the subsequent inability to obtain universal approval from private landowners has prohibited data collection on some sites and may necessitate selecting alternate locations for some of these. Final adjustments to boundaries were made as needed to enhance the safety of volunteers, i.e. by eliminating unreasonably rugged terrain and potentially dangerous river crossings.

2.3 Indicators of Ecosystem Health

The complexity of natural ecosystems makes the task of measuring their current state of health and viability, and monitoring changes over time, equally complex. The selection of a set of indicators of ecosystem health is a method used to simplify the monitoring process. Such indicators must be measurable and the set collectively adequate to provide a good representation of overall system health.

Many different physical (abiotic) and biological (biotic) factors or characteristics of a specific site could potentially be included in such a set of indicators and measured in order to compare different sites, watersheds and/or regions (spatial comparisons). Monitoring a set of indicators over time likewise provides the ability to observe and analyze trends (temporal comparisons).

Selecting species native to the region and monitoring their presence/absence with respect to fixed sites that are representative of the region, can provide a good indicator of overall ecosystem health since the continued presence (survival and reproduction) of each species can only occur where and when the underlying needs of that species are met. Thus the presence or absence of locally native individual species, whose life history and habitat requirements are well understood, can provide information regarding a range of characteristics of specific sites. This is the approach utilized for the TVM program.

A change in the composition of species present in one site/region over another, or one time period over another would reflect a change in habitat and/or other characteristics of the ecosystem. An observed trend could potentially raise a "red flag" or mark an improvement in specific areas or the region overall. An observed change in the species composition of a site, area, or region would indicate a need or opportunity for analysis and interpretation.

2.4 Indicator Species Selection

Practical considerations dictate that a subset of the total species existing in the region be chosen as indicator species for monitoring. Selection criteria include such factors as habitat requirements, degree of specialization on specific habitats, and sensitivities in several areas. For the Terrestrial Volunteer Monitoring Program, an existing ranking and scoring system for species of conservation concern in the Toronto region was used as a guide. The local conservation concern ranks run from L1 (highest level of concern) through L5 (lowest level of concern). The ranking process scores each species along a gradient for each of several component criteria such as sensitivity to development, mobility, area sensitivity, population trend and degree of generality or specificity in habitat requirements, to generate an overall L-rank (Appendix B). A local conservation level of concern rank has been established for all terrestrial vascular plants and vertebrate fauna within the Toronto region. Ranks have not been established at this point for the lichens. For further detail on the L-ranking process and the component criteria used in the scoring process, the reader is referred to the TRCA Terrestrial Natural Heritage Program document entitled *Vegetation Community and Species Ranking and Scoring Method (2006).*

Species were chosen across the spectrum of conservation concern, range of habitat type requirements and to include representatives of amphibian, bird and mammal fauna, flora and lichens. Final selections between equally valuable indicator species were sometimes made based on the ease with which non-biologists could learn to find and identify them correctly. In one case, two look-alike

species of flora were both included to ensure that volunteers were effectively trained to distinguish between them and focused on the distinctions while conducting their surveys.

The table in Appendix C highlights some key ecological requirements and sensitivities related to human impact of the species monitored under the Terrestrial Volunteer Monitoring Program, along with benefits derived from, or notable tolerances with respect to human activity. This background is helpful in interpreting presence and absence data for the various species in rural, urban and urbanizing landscapes.

2.5 Annual Training and Data Collection

Volunteer training is provided in four meetings, one per season, held every year. New volunteers are required to attend the applicable season's training prior to surveying for that season. Continuing volunteers are encouraged to attend refresher training every year.

The survey timing for each indicator species was determined to best establish that habitat conditions within a site are providing for key survival and/or reproductive needs of each observed species, combined with the best practical opportunity for observing it. The following are some examples to illustrate:

- Wood frogs are surveyed on two separate evenings in April, during their breeding season, at which time the males are calling to attract mates and can be identified by their vocalizations.

- Porcupines are known to range over a much wider area of habitat throughout the summertime (≈100 ha.) than they do in winter (≈10 ha.), and they are difficult to see when grazing high in trees that are in full foliage. The TVM program therefore monitors for porcupine in the winter when they are found in their more restricted but critical winter habitat, are easier to see even when high in trees, and when tracks and torn hemlock branches on the snow are often available clues to guide the observer to the animal's location.

- Several migratory songbirds are surveyed on two evenings in June by playing recorded calls to elicit a response from a territorial male, thereby providing evidence that the species is using the site as breeding habitat.

- Flora species are surveyed at the optimum time for observers to find and confidently identify them, generally when they are blooming.

For all species where there is a variable timeframe for optimum viewing year to year, surveys take place during two separate visits, timed to enhance the likelihood of successfully observing the species if present on the site.

Table 1 summarizes the species surveyed by common name and the annual survey schedule, while Appendix B provides the complete indicator species list by both scientific and common name, along with the local species of conservation concern scoring and rank (L-rank) for each.

Table 1: **Annual Data Collection Schedule for Volunteer Monitored Fixed Sites**

		Indicator	
Season	Month	Fauna/Trails	Flora/Lichens
Winter	January or February (one visit)	▪ Porcupine ▪ Mink ▪ Ruffed Grouse	▪ Eastern Hemlock ▪ White Pine ▪ Eastern White Cedar
	March (one visit)	▪ Eastern Screech Owl	
Spring	April (two visits)	▪ American Woodcock ▪ Spring Peeper ▪ Wood Frog ▪ Western Chorus Frog ▪ Northern Leopard Frog ▪ American Toad	
	May (one visit)	▪ Pileated Woodpecker ▪ Wood Duck	▪ Marsh Marigold ▪ White Trillium ▪ Jack-in-the-pulpit ▪ Narrow-leaved Spring Beauty ▪ Foam Flower ▪ Star Flower
Summer	June (two visits)	▪ Eastern Wood Peewee ▪ Ovenbird ▪ Scarlet Tanager ▪ Swamp Sparrow ▪ Virginia Rail ▪ Green Heron ▪ Bobolink ▪ Savannah Sparrow ▪ Eastern Meadowlark ▪ Green Frog ▪ Grey Treefrog ▪ Bullfrog	
	July & August (one visit each month)		▪ Michigan Lily ▪ Riverbank Wild Rye ▪ Turtlehead ▪ Black-eyed Susan ▪ Swamp Milkweed ▪ Spotted Joe-pye Weed ▪ Barber-pole Bulrush ▪ Greater Burreed ▪ Big Bluestem ▪ Spreading Dogbane ▪ Common Arrowhead ▪ Fireweed ▪ White Oak
Fall	October (one or two visits)*	▪ Eastern Chipmunk ▪ Trail Mapping*	▪ Christmas Fern ▪ Winterberry ▪ Zigzag Goldenrod ▪ Mealy rosette lichen ▪ Candleflame lichen ▪ Hooded Sunburst lichen ▪ Rough Speckled Shield lichen ▪ Common Greenshield lichen ▪ Hammered Shield lichen

* Trail mapping may be done on the same visit as the species survey for fall or may be completed another day, depending upon the density of trails on the site and volunteer preference

2.6 Data Management

Data are recorded on paper data sheets in the field. Until recently these were photocopied (or scanned) by the volunteer and submitted to the Terrestrial Volunteer Coordinator. A sample data sheet is provided in Appendix A.

During 2005-2006 an online web-based data entry system was developed and implemented. Volunteers have individual user names and passwords, and can log-in to enter and review data for their assigned site. They are encouraged to enter their data immediately upon returning from a site visit while details and comments are fresh in their minds. Hard copies are still requested from volunteers and spot checked for data entry accuracy. Should issues arise, complete audits of paper to data will be effected.

Data are stored in a relational database, currently an MS Access format. Re-entry of all previously collected survey data, as necessitated by the configuration of the new online system, has been completed.

2.6.1 Data Validation Process

Quality assurance (QA) of data is an important consideration for any data collection project. In this instance, there is the additional element of volunteer observers carrying out the collection without on-site technical assistance. As a result, an automated data validation matrix has been developed that initially flags survey visits which contain variances from the visit protocol, and species observations that are incomplete with respect to required characteristics observed. Subsequently, by utilizing the habitat characteristics, watershed, location, and proximity to urban influence of each site, along with each species requirements and sensitivities, the matrix validates every positive species observation for its degree of "reasonableness". Observations that would benefit from further verification are flagged for the Coordinator who initiates a verification process.

The standardization and automation of several steps in the process are unique elements providing the ability to easily validate data, capture incidences of species in new or unexpected locations and communicate that information. Verification of data while affected volunteers are still involved and available for inclusion in the process enhances the ability to make a final determination and reduce the number of records in question. The result is a degree of confidence in processed data that would otherwise be difficult to achieve.

2.7 Program Coordination

At the outset of the volunteer program, site selection, program development, training and recruitment was carried out by a team of terrestrial biologists. As participation grew, it became clear that a dedicated resource was required to recruit, train and supervise volunteers, manage the data, continue program development and reporting, as well as provide effective communication and a consistent contact point for volunteers and landowners. The Terrestrial Volunteer Coordinator position was created to fulfill these requirements.

2.8 Program Evolution

While a long term monitoring program will naturally evolve over time, it is desirable to maintain the base data collection protocol as consistent as possible to ensure comparability of results. This project

was launched in early 2002, following the completion of several pilot projects that monitored frogs in Toronto region watersheds (Don, 1997; Don & Humber, 1998; Don, Humber & Rouge; 1999). Recruiting began, training was conducted and a number of sites were monitored that year. With experience, areas for improvement were identified with respect to the training, data sheet design, and recruitment in particular. There were no major flaws detected in the species identification protocols and aids, but in one case it was determined that a different season would be better for observation of a species, and in others, that additional characteristics were needed to assist volunteers in making positive identifications. Appropriate changes were made to the protocols and data sheets. The minor nature of the changes combined with the data validation process' ability to flag data issues allows verified data from 2002 to be included in the analysis, at least for those sites that were consistently monitored that year. This measurement will continue to be tracked as indicative of training and recruitment effectiveness, with the objective being to reduce the percentage of flagged data over time.

2.9 Funding

As a component of the TRCA Regional Watershed Monitoring Network, this program is funded primarily through the TRCA capital budget with funding provided by the City of Toronto and regional municipalities of York, Peel, and Durham. Additional funding for the establishment of the overall Terrestrial Natural Heritage program including the terrestrial monitoring was obtained through the first five years from the organizations listed in table 2, and the TD Friends of the Environment Fund provided support for the purchase of safety vests for use by volunteers while accessing sites and surveying at roadside. At present, a funding inquiry is being distributed to organizations that may be interested in partnering in this program going forward. Such funding will be needed to ensure that ongoing program enhancement, reporting, data sharing and appreciation events continue.

Citizen's Environment Watch (CEW) and the Ecological Monitoring and Assessment Network (EMAN) contributed to protocol development, and permission to use the species photographs and sound recordings for the program was kindly provided at minimal cost by the copyright holders. For a complete list of partners and contributors, see section 8.0.

Table 2**: Terrestrial Natural Heritage Program Funding Organizations**

Funding Organizations
The George Cedric Metcalf Charitable Foundation
The Richard Ivey Foundation
The R. Samuel McLaughlin Foundation
The Schad Foundation
The Salamander Foundation
Greater Toronto Airports Authority
Unilever Canada
J. P. Bickell Foundation
The Helen McCrea Peacock Foundation, managed by The Toronto Community Foundation

3.0 TVM PROGRAM ACCOMPLISHMENTS AND CHALLENGES

The TVMP program is making a valuable contribution to monitoring the terrestrial ecosystem in the Toronto region, has built a large base of volunteer and landowner support, and has to date resulted in significant "lessons learned" with respect to the implementation of a citizen science program. Highlights of both accomplishments and challenges which may be informative for participants, potential users of program data and others considering developing monitoring programs are covered in the following sections.

3.1 Online Database, Volunteer/Landowner Information Management System

During 2005 and 2006 a new database was developed in conjunction with a website for online data entry. The monitoring data has all been converted to the new system, and processed through data validation. The volunteer and landowner information management modules are still under development, to be completed in early 2007. These new tools will improve the ability to maintain the currency of volunteer information and communicate more efficiently with landowners, providing ongoing site reports to satisfy requests that have been made. Prior to this report, there has been no dissemination of information to interested landowners since early 2003, although this is a goal of the program.

3.2 Volunteer Participation, Commitment and Effort

When the program was first launched in the spring of 2002, it began with 14 of 66 sites being monitored, each by a pair of volunteers. By the end of that year, site coverage had increased to 34. Over time, additional sites have been added and volunteers have left the program and been replaced. Since participation is dynamic, recruitment is an ongoing process. When a site is assigned, one individual is designated the primary volunteer. This person attends training and is responsible for protocol adherence, data collection and data submission. Usually the primary volunteer recruits their own field partner to accompany them on visits. In a few cases, the program has matched individuals who both wished to participate but did not have an available partner to make the survey visits with them.

Volunteers joining the program are asked to commit themselves for at least 3 years. This is done in an effort to get a good return on the training investment, to minimize the amount of time spent recruiting and setting up site assignments versus more value-added work with ongoing volunteers, and to enhance the average level of experience and knowledge of the volunteer group, which should result in a higher quality of data collection. However the request is made with an understanding of the fact that situations change and not all volunteers who make the commitment up-front will be able to complete the term. In 2005 there were 8 pairs of volunteers who had been with the program 3 years. By mid-2006 there were 9 pairs with this length of service, 5 of whom had been a part of the program from the outset. The contribution of long term volunteers is invaluable and feedback from this group has been instrumental in ongoing program development.

In some cases volunteers have remained for a very short period of time. A greater emphasis is now placed on clearly communicating the level and kind of effort involved to potential volunteers at the outset and to recruiting with a view to ensuring that the commitment is a match for the requirement. Additional positions for "floater" volunteer teams and "on-call" field partners were added in 2004. This was done to both provide opportunities for volunteers who could commit only for shorter terms,

and to meet an identified back-up need. The floater volunteers attend training and then fill-in for primary volunteers who are unable to conduct a scheduled visit, while on-call field partners accompany a primary volunteer whose regular partner cannot make a visit.

The reported time invested by program volunteers is an estimate as travel times to sites vary widely, many volunteers participate in training beyond the minimum requirement, and some have volunteered to visit sites with other new volunteers and/or act as floaters or on-call partners in addition to completing their own surveys. Three of the primary volunteers are each involved in monitoring two sites.

There have been over 250 volunteer participants involved with the program since its inception. Table 3 summarizes training participation and visits completed by volunteers over the period March 2002 through October 2006. For 2002 through 2004, the total number of volunteers participating within the given year is a rough estimate. Since 2005, better record keeping on start and end dates for primary volunteers allows better accuracy. The numbers in this table reflect the large investment in time spent training relative to conducting surveys. This investment is necessary to ensure quality data collection results, as well as to provide the educational benefit participants are looking for. The added expense in time allows for economy in dollars and a successful volunteer program.

The trend to a higher proportion of expected visits completed each year is a reflection of improvements in recruiting and communication with volunteers, as well as the addition of the floater and on call volunteer elements. Efforts to increase the proportion of expected visits completed will continue.

Table 3**: Volunteer Participation in the Terrestrial Monitoring Program**

	2002*	**2003**	**2004**	**2005**	**2006****
# sites surveyed	34	42	41	48	45
# expected survey visits per site (to protocol)	9*	11	11	11	11
Total # site visits, all sites (expected)	306	462	451	528	495
Total # site visits, all sites (actual)**	144	240	260	322	359
% visits completed	47%	52%	58%	61%	73%
Total # volunteer participants	≈70	≈110	≈100	129	112
Total # of training & field trip attendances	86	145	154	208	141
Estimated total training person hours	344	580	690	832	564
Estimated total site visit person hours	446	744	806	998	1113
Estimated total volunteer person hours	790	1324	1496	1830	1677

* Since the program began in March 2002, the 2 winter protocol visits did not apply that year.

** Site visit counts include trail mapping visits

The greatest ongoing challenge with participation is the fact that a volunteer who must leave the program may not notify the coordinator promptly, resulting in missed visits. The length of time spent by the coordinator collecting data sheets in the past meant that this situation might not be caught until several months had passed, and multiple seasons missed. A new data summary report now informs

the coordinator of missing data and the potential that a visit has been missed, allowing for earlier follow up to be initiated.

A volunteer may be unable to complete a visit at other times for a variety of reasons, a situation that is possible to allow for within the programme if sufficient notice is given, but without at least two weeks notice it is difficult to contact, provide site information to and get confirmation from a replacement that they can complete the survey.

Another challenge is the coordination effort involved in getting materials on loan returned when a volunteer resigns. Most make a special trip to deliver the monitoring kit due to its size, but some have difficulty with scheduling and/or focusing on the importance of doing this once they have made a decision to leave the program.

3.3 Volunteer Recruitment and Motivation

Since the inception of the program, the volunteer recruitment process has evolved to facilitate successful site assignment of volunteers who are interested in and committed to the program, and are able to obtain value from their participation in it. A volunteer position job description is used, along with a program description that clearly outlines what participation entails. Potential volunteers first register by completing a questionnaire that covers not only the requirements of the program, but also what their reasons are for wanting to join. Once a joint decision is made for the volunteer to enter the program and a site that meets the needs of the individual becomes available, a site assignment meeting is arranged. At this meeting, the coordinator provides protocol, data recording/data entry and safety training, maps and an aerial photo of the site, landowner information and contacts if needed, the program manual, a fauna calls CD and a hand magnification lens. All materials are on loan and must be returned should the volunteer resign from the program. This session is also used to provide information and links to any other aspects of the work or projects of the TRCA about which the volunteer has questions.

Some of the reasons volunteers report as having motivated them to join the program include:

- opportunity to participate in collecting scientific data of value in supporting future decision making on environmental protection in their communities,
- enjoyment of the time spent outdoors in natural areas,
- learning more about the watershed in which they live, the species monitored, habitats, TRCA programs, ecology, etc.,
- networking with other volunteers and TRCA staff,
- gaining academic credit through volunteering and
- establishing a record of reliability and competence that can be referenced in employment applications

Educational field trips, exclusively for TVMP volunteers, are scheduled according to interests and season. These are led by an experienced staff biologist and build volunteers' experience and knowledge in areas such as using fauna calls for bird indicator species, recognizing frog calls, using habitat clues and fauna signs when searching for a species, and lichen identification, as well as discussion of associated species, life cycles and ecological needs. These are very well attended and valued by volunteers.

Because the program is long term, involves considerable training and builds field experience, a job-seeking volunteer who has established a record of reliable participation will find it a valuable addition to their resume and is welcome to offer the coordinator as a job reference, whether applying at TRCA or elsewhere. This, along with the networking opportunity associated with the program, is particularly valuable to participants who are new to Canada and working on building their Canadian experience and references. In addition, individuals participating on watershed councils, and members of other community based environmental groups have found participation in the program to be a good way to broaden their field experience.

Appreciation of volunteers is demonstrated in many ways, not the least being the value that is placed on the data they collect. Ongoing communication supports their efforts, and their input is requested on program development, what they'd like to see in reports, and what events or field trips they would like. As a part of the public consultation process on the Terrestrial Natural Heritage System Strategy, a presentation of the draft strategy was made to this group and their suggestions solicited. Some volunteers are involved in local community groups working on environmental protection or monitoring of some type. Via the coordinator, they are able to access professional answers to questions or species identifications to help them with their efforts, whether a part of the TVM program or other initiatives. As the program gains depth, it is foreseen that opportunities will arise for more formal sharing of information.

The TRCA occasionally invites volunteers from all of its volunteer programs to a volunteer appreciation reception. Additionally, a celebration of the TVM program was held in November 2006. This social and appreciation event recognized both the terrestrial monitoring volunteers and volunteer landowner participants in the program. TRCA terrestrial natural heritage staff and management joined the coordinator in thanking the volunteers and landowners.

3.4 Volunteer Feedback and Data Collection Survey Comments

Feedback from volunteers is requested and appreciated. In particular it is solicited during training sessions and at the debriefing of volunteers as they exit the program. Volunteers are encouraged to include comments regarding their experiences on data sheets and many do so.

In general, feedback on the program is very positive. Comments often relate to the fact that participation is enjoyable as well as educational and offers a greater degree of responsibility for results and variety of experiences than many other volunteer opportunities in the environmental field do.

While new volunteers often find lichen identification to be the most challenging aspect of the program, several volunteers have developed an enduring interest in this fascinating group of organisms as a result of their participation, and have pursued additional field courses and other learning opportunities since being introduced to them.

Particular experiences, such as playing recorded bird calls and getting a response, often feature in the comments made by volunteer surveyors, with the first experience of hearing the eastern screech owl being a highlight often mentioned by those who have encountered it. Others include hearing the courtship flights of an American woodcock, or the startlingly loud territorial song of a little Virginia rail hidden from view in a cattail marsh. Both experiences are new to most volunteers. Following are examples of data sheet comments recorded by several of the volunteers:

“We were out for only 5 min. tonight (7:15 pm) and the little guy (eastern screech owl) turned up to sing to us - at first we weren't sure what we were hearing, it sounded like an injured cat, then, he sang the other hooting part, and flew in closer to us! WOW! It was magical! The only thing that was unnerving to me was the sense that we were 'tricking' him with the tape - so we only played it a couple of times, confirmed the sighting and left him in peace. What a great experience!”

" We hadn't walked far into the forest when we stopped to play the tape the first time. In the silence I heard something unidentifiable…..I played it again and we heard the owl in the distance clearly. It called again and sounded closer…it alighted on a tree to our left. What a perfect night to observe it. The city lights reflected off the clouds and we had a backlit view of this little owl as it sang again and again, both the whinney and the trill…."

" The scarlet tanager hung around high in the trees above us for at least 20 minutes before deigning to be seen, but "chick-burring" away the whole while, while we swatted mosquitoes and peered upwards in vain. Finally he dipped down to get a peek at us and we got a visual, which made the intervening mosquito bites worthwhile!"

"We were amazed to count 10 porcupines in total, 5 of them on the site, 5 outside the boundaries, but nearby, along with several porcupine trails in the snow, which made finding the animals themselves not very difficult. This was our first winter visit and the sightings made our day."

" I had another experience with an eastern screech owl in my neighbourhood. … at 11:34 pm I heard the trilling call of an owl, so loud I heard it inside my house! I went outside and narrowed down the location…Had it not been for this program I would have had no idea about the identity of this bird in my neighbourhood."

3.5 Data Collection

There have been over 1,300 site visits, equivalent to approximately 450 person days of effort, and just over 10,500 species observation records recorded by the TVMP program volunteers throughout the region during the period March 2002 through October 2006, a significant beginning toward a database that will continue to grow and support analysis of trends and spatial analysis of ecosystem health.

The *Terrestrial Natural Heritage Monitoring Discussion Paper* (2000) had suggested that the purposes of ecological monitoring might be served through the monitoring of fixed sites for the presence or absence of indicator species on a bi-annual schedule, or even every three years. However the need to train and schedule volunteers made this less practical than continuous monitoring scheduled throughout the year, every year, and so the program was implemented with seasonal visits annually. Because of volunteer turnover, the time lag in finding replacements, and missed visits by volunteers, the data set is not complete every year for each of the sites monitored. The end result is a hybrid between annual data and bi- or tri-annual data collection. Over time, this should not negatively impact the potential for analysis of trends, and spatial analysis will be supported as long as a sufficient number of well distributed sites are monitored in the time period considered. Upon completion of the fifth program year in the spring of 2007, the first statistical analysis of data will be undertaken. With respect to the analysis of temporal (chronological) trends it is expected that ten years of data will be needed to carry out statistically valid analysis. In the meantime, data on species presence/absence at the site level are compared with staff data where volunteer and staff sites overlap, individual site reports inform landowners of the species observed at their properties, and species mapping shows where individual species have been found, the numbers of indicator species found on monitored sites

and where spatial differences in species or L-rank groups have been observed. Analysis looks at the degree of supporting or non-supporting evidence that volunteer observations provide with respect to predictions made by other Terrestrial Natural Heritage program elements, such as landscape level analysis, the species of concern L-ranking process, and the Terrestrial Natural Heritage System Strategy computer modelling exercises.

3.6 Landowner Participation, Communication and Recognition

Of the 66 original planned sites, 27 were on privately owned land, the balance in public ownership, with 7 of the latter located on TRCA owned properties. In many cases the site crosses property lines with between 2 and 5 landowners participating for a single site.

Of the 27 privately owned sites, approval to survey was not successfully obtained for 15 sites. Adjustments to site boundaries were made for 7 of these to place them only on the properties for which approval was received. However this was not feasible for 8 others and they have not been surveyed to date. As it becomes possible to do so, communication with landowners will be initiated again in the hope of obtaining approval, and if it is not forthcoming, the sites will be moved to other locations. For publicly owned lands, approval was obtained for all. In one case, where approval for tenanted properties included a commitment on the part of TRCA to advise tenants annually of the surveys, an inability to obtain updated tenant contact information from the landowner has restricted surveys on a site.

Following the 2002 surveys, participating landowners were sent a copy of the species atlas which recorded species found on sites throughout the jurisdiction. The current report and atlas will be available to all participants along with a new site level report for sites on private land. The site report describes the site, it's habitat types, summarizes the survey visits made to date, and lists the species observed. It compares the site to others with respect to the number of species found and offers some basic interpretation of the observations (Appendix F). This report will be produced annually in future in response to the requests for more frequent updates made by several participants. The volunteer and landowner appreciation event is used to recognize our participating landowners and provide a forum for them to have questions answered and learn more about the program and it's results, other TRCA programs, and meet the volunteers and TRCA staff.

4.0 RESULTS

Species observation results have been summarized and mapped to show comparisons between urban and rural zones in the region, and comparisons with staff data, where staff surveyed sites overlap volunteer sites, have been tabulated. In addition, quality assurance and training effectiveness is being measured through the number of data records flagged and the number subsequently verified each year, with a goal to improvement over time, and these results are included.

4.1 Species Maps and Summaries

Appendix D is an atlas prepared from the site observations made during the period of March 2002 through October 2006. It begins with an introductory map showing the distribution of sites surveyed during this period along with the distribution of natural and urban cover, as well as the boundaries of the nine watersheds of the Toronto area, the Oak Ridges Moraine and the regional municipalities. This is followed by a set indicating where each species was observed on maps with natural cover, watershed boundaries and the urban zone shown. An additional map shows observations for L1 and L2 species

as a group for the region, and another illustrates the number of species found on each site, for those sites with surveys completed for every season.

For selected sites where both staff data and volunteer data have been collected, comparisons of the species found from the volunteer indicator species list were made. Some examples are shown in Appendix E. It is important to remember that the protocols followed are dissimilar in many respects, meaning that differences in the lists could be a result of any of these differences and/or skill level in finding and identifying the species, and should not be interpreted on the basis of skill level alone. In fact, the type of survey carried out by staff varies site by site since the purpose of the survey was determined by the plan/requirement for the larger habitat patch being surveyed, and not specifically to survey for species on the volunteer program indicator species list.

Additionally, site level reports as described earlier are in preparation for each site located on private land that has been surveyed to date. A sample is provided in Appendix F.

4.2 Data Validation

All data have been processed through the automated two-stage quality assurance (QA) process. The follow-up process using additional information such as staff observations from the same area, observations made multiple years by multiple surveyors, explanatory comments made by observers and samples or photos provided for verification has allowed a large proportion of the flagged data to be verified. Data observations that fail stage 1 quality assurance, or remain flagged at that stage are not included in mapped results, since they have not progressed to the point of being considered a positive species observation according to the protocol. Observations that have passed stage 1 but are flagged in stage 2 are currently included in the mapping. They require investigation and will be addressed prior to publication of the technical report following completion of the fifth year of data collection. Tables 4 and 5 summarize the number of records initially flagged by stage 1 and stage 2 QA along with the number remaining flagged following initial verification.

Table 4**: Stage one data validation results**

		Data flagged by QA			Data failed QA or remaining flagged			
# Species Survey Visits *	**# Species Observations with at least one char. checked**	**Visit Protocol**	**Species Char. Incomplete**	**% Sp. Char. Inc.**	**Visit Protocol**	**Species Char. Incomplete**	**% Sp. Char. Inc.**	**Year**
127	304	5	96	32%	1	19	6%	2002
220	379	17	43	11%	2	14	4%	2003
239	447	10	60	13%	0	21	5%	2004
289	551	17	59	11%	0	13	2%	2005
321	508	17	30	6%	1	25**	5%**	2006

* Visit number counts do not include trail mapping visits

** The verification process for 2006 is not complete. These numbers may decrease.

Table 5: **Stage two data validation results**

No. Positive Species Observations	No. Records Flagged	% of Records Flagged	No. Requiring Further Investigation	% Requiring Further Investigation	Year
285	186	65%	21	7%	2002
365	179	49%	28	8%	2003
426	192	45%	15	8%	2004
538	276	51%	41	15%	2005
483	243	50%	40	16%	2006

The higher numbers of records requiring further investigation following stage 1 validation for 2006 and stage 2 validation for both 2005 and 2006 relate to the fact that verification often includes requesting samples, photos or additional information, and this follow-up by volunteers will occur during subsequent scheduled visits to the site. Over time, should some records be successfully verified, these numbers would decrease.

The large proportion of records flagged in stage 2 validation is a result of the conservative design of the automated matrix screening process. To ensure high quality results, it was initially set to require manual verification of a large proportion of positive species observations. The demonstrated ease with which so many of these could be verified allows for fine tuning of the matrix going forward, with confidence that a greater number of records can be successfully screened by a modified matrix.

As volunteers gain experience and knowledge, they are often able to address the validity of their earlier observations. They are encouraged to report occurrences where their own increasing knowledge causes them to realize that a positive species identification made in a previous year was in error. When this happens, the coordinator updates the database to remove the species presence observation and enters an explanatory comment. This is not a frequent occurrence. To date there have been three instances.

It is important to note that the volunteers as a whole demonstrate a very high degree of concern with respect to the accuracy of their identifications, will request additional information or help when in doubt, and are very receptive to obtaining and providing samples or photos when asked. Additionally, an often expressed concern is the possibility that they might be missing a species that is in fact present. Some initially believe that they should be able to find everything on the indicator species list, and believe that they are missing species only through inexperience. Training addresses the fact that the number and variety of species on the indicator list makes it highly unlikely in fact that a site would support all, that protocols are designed to enhance the likelihood of finding species if present, and that if missed one year, a species that is present is likely to be found in a subsequent year. It emphasizes the importance of determining both what is, and what is not, on a site. The point is made that an absence observation is of equal value to a presence observation in the analysis of monitoring results, particularly once repeated observations of the same result increase confidence in interpreting it as actual absence of the species.

Maps with flagged data included have been circulated to biology staff and feedback obtained on observation points that they would flag based on experience, with the result being used to test and fine tune the data validation matrix.

Following the verification of observations that can be verified through the volunteer team's efforts, the remaining set of flagged data will be provided to the staff biological team to consider whether, and for which records, to attempt on-site verification during field inventory work.

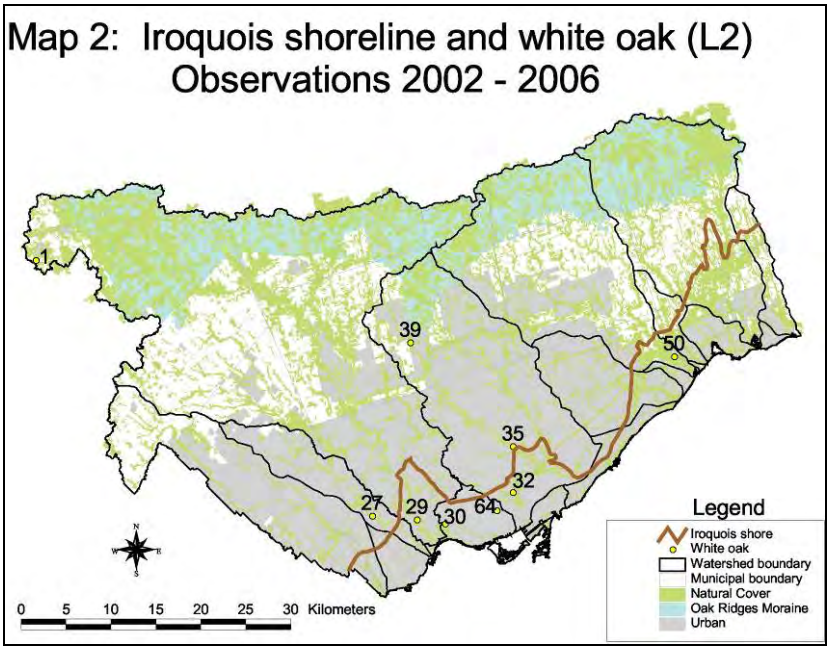
4.3 Interpretation

Ecological interpretation presented in this report is preliminary since the statistical significance of results has not been tested at this point. Conclusions regarding ecosystem health in the Toronto region and evidence with respect to predictions, based on statistically significant data, will be documented in the five year technical program report to be completed during 2007.

The 55 sites surveyed to date are well distributed and appear to be sufficient to provide for spatial interpretation of data results. However, the fact that 10 of these sites have not been surveyed for some seasonal visits must be taken into account in analysis. In particular, these sites are not included in comparisons of the total number of species found or comparisons between sites for the affected species. Further, a map of these 10 sites indicates a cluster in the northeast. This is taken into consideration for regional analysis for affected species. Upcoming recruitment will focus on eliminating gaps such as these.

L1 and L2 species were mainly found in the northern, less urban part of the jurisdiction, with the exception of white oak. These data are consistent with and support the L ranking method used.

In the case of white oak, it was reported from eight sites, of which six are located in the sandy soils along the old Lake Iroquois shoreline, a physiographic region that is located between the moraine and the current Lake Ontario shoreline, and meanders through the City of Toronto (Map 2). Staff records indicate a similar distribution of older relict trees, dating from prior to urbanization. White oak are not successfully regenerating in the Toronto region. Both of the other two volunteer records were flagged. The Don watershed site 39 has been surveyed by staff. While white oak (*Quercus alba*) was not observed there by staff, bur oak (*Quercus macrocarpa*) was recorded, suggesting that the volunteer record may be a misidentification. The verification process will establish whether this is the case. In the Humber watershed, site 1 has not been surveyed by staff to date. Verification efforts for the flagged record here however will again determine if white oak does in fact exist on the site.



The scarlet tanager (L3) is an area dependent species requiring large blocks of mature forest for breeding habitat. Observations of this species during the two June visits were mainly restricted to areas where such blocks exist, primarily in the northern part of the jurisdiction along the Oak Ridges Moraine. Two exceptions appear in the volunteer data, one in the Glendon forest (Lower West Don subwatershed, site 35), and the other in the Upper Etobicoke subwatershed (site 17). There is a possibility that these records were of later than average migrants, rather than birds on breeding territory. The Upper Etobicoke site was surveyed for scarlet tanager on two evenings in each of June 2003, 2005, and 2006, with a positive observation made only the first June visit in 2005 (June 12/05), which would tend to support the observation being of a migrant. The Glendon site was surveyed for scarlet tanager June 2003, 2004 and 2006. It was not recorded in 2003 or 2004, and was observed June 12/06, but not June 24/06, again lending support to the likelihood of the observation being of a migrating bird. The recently completed Ontario Breeding Birds Atlas project (OBBA) used a threshold migrant date of 31st May for scarlet tanager, while the TRCA fauna survey uses a later threshold of June 10th. The two volunteer reports satisfy the date requirement for a breeding evidence report for both of these thresholds. The OBBA and TRCA both require a second observation within the same season in order to upgrade a "possible" breeding record to a "probable" breeding record, and neither of the two noted volunteer records meet this requirement. It will be interesting to monitor whether any further reports occur at these sites, and perhaps worthwhile surveying the sites even later in the season to establish whether the species is present at that time.

Data such as this, if it is determined to be statistically significant, may be used to revise estimates of the migration timing windows for affected species. Tracking changes in migration windows and early/late breeding dates over time can be used to monitor climate change.

The eastern screech owl, an L4 species, was found at multiple sites within the urban zone, a result that again supports the L-rank prediction. In fact, a higher proportion of urban sites (11 of 19, or 58%) reported screech owl than did rural sites (9 of 28, or 32%), an initially surprising result. This may be due to an absence of great horned owl in urban zone habitat patches, resulting in reduced competitive pressure on the screech owl, which staff report as being unlikely to be found where the great horned

owl is present. Another hypothesis could be that the reduced total amount of suitable habitat available for this species in the urban zone has resulted in a higher population density and consequently a higher probability of observing it in any given deciduous forest patch than would be the case in the rural zone with its larger forest area. Population surveys would need to be carried out in both zones to determine if this was a reasonable conclusion. Certainly it appears that screech owl is not as sensitive to some of the negative matrix influences associated with urbanization as are some of the other woodland species (e.g. ovenbird, ruffed grouse and scarlet tanager).

Other L4 and L5 ranked species which, while differing widely in the number of sites reporting them, were observed fairly equally in both the urban and rural zones of the jurisdiction include common arrowhead, riverbank wild rye, zigzag goldenrod, swamp milkweed, spotted Joe-pye weed, marsh marigold, barber-pole bulrush, spreading dogbane, black-eyed Susan, foam flower, jack-in-the pulpit, white pine, eastern hemlock, eastern white cedar, eastern wood peewee, swamp sparrow, savannah sparrow and eastern chipmunk. The observed distributions of these species according to the volunteer data set, with no apparent reduced occurrence in the urban zone, are as predicted by the L ranks assigned to them.

The American toad, an L4, was found at a much higher proportion of rural sites than urban (10 of 14 or 71%). Should this result be established as statistically significant, further investigation may be of value in determining the reason and whether there is a change occurring with respect to the status of this species in the region. Considered to be one of the most resilient of amphibians, any reduction in urban populations should be of considerable concern.

The white trillium, an L3, was reported from both more sites in total and more sites in the urban zone than either Jack-in-the-pulpit or foam flower, both having an L4 rank. While white trillium is as vulnerable to trampling and collecting as the others are, perhaps the public is better educated with respect to the importance of leaving this plant undisturbed than they are for the other two, and this may be protective. While it is also possible that the higher number of observations of this species relates to a greater familiarity with it and greater ease in spotting its more showy flower, volunteers are trained to search thoroughly for all of the species throughout the site being surveyed, which should reduce the influence of this effect.

The common greenshield and rough speckled shield lichens, both described by the Environmental Monitoring and Assessment Network as being less tolerant of air pollution than the other four lichen species (Brodo & Craig, 2005) were reported on fewer sites in the region than the other species. Both were also found more frequently in the rural zone than urban, with the difference in distribution being most striking for the rough speckled shield lichen, with two thirds of records on rural sites.

In addition to ecological interpretation, the results for a few species suggest a need for review and enhancement of the survey protocol. One such species is the mink. Found on just two of 51 sites reporting, it is possible that the difficulty in observing this animal, even in appropriate habitat, may be impacting the result. An increase in reports of the species may occur if volunteers are trained to recognize, measure and record mink tracks as positive observations of this species. This would involve changing the protocol and would mean that mink data collected after the change was not comparable to mink data collected prior to it. For winter 2007 visits, training is being provided on the identification of mink tracks, and both sightings of mink and records of tracks supported by scaled photos and/or track measurements will be collected. At that point a determination will be made as to whether a protocol change is indicated. Similarly, birds for which a call is not played, such as bobolink, eastern meadowlark and green heron are more difficult to observe. Efforts will be

undertaken to determine to what degree such difficulty may be impacting observation results and, if indicated, modifications implemented to reduce the difficulty in recording an observation. For meadow species such as bobolink, this might mean ensuring that each pair of volunteers has binoculars to scan the meadows. Training could also add call recognition for species for which fauna calls are not played, in order to enhance the volunteers' ability to locate them and record visual observations.

If protocols are not followed, the accuracy of results is likely to be impacted. This may have occurred with respect to the spring #3 visit during which the wood duck, pileated woodpecker and ephemeral spring flora are surveyed. Volunteers are instructed to do the survey early in the morning before other people are out, as the wood duck will move away quickly on the approach of people. They are advised to look for the wood duck first, then the woodpecker and finally do the floral survey. This visit records a higher proportion of visit time not meeting protocol than any other as volunteers are going out after the required time. Although wood duck are difficult to observe in any case, this variance from protocol may have an impact. This point will be addressed in future training.

When comparisons of staff and volunteer data are appropriate, much of the data are in agreement. In most cases where staff observed an L1 through L3 ranked species on the site, volunteers also found it. In some cases, volunteers found L1 through L3 species that staff had not. Such cases are open to a variety of interpretations. Staff fauna surveys are rapid assessments of a larger area, searching for a longer list of species, whereas the volunteer fauna surveys are restricted to smaller areas with a smaller number of target species to search for, and the volunteer data set results from multiple survey visits made to the same sites. In some cases frog surveys have been carried out by staff, where in others they have not. There are also instances where a staff vegetation community and flora species of concern survey has been done, but a fauna survey has not, and vice versa. There are however two instances of flora species which were reported by a volunteer, yet not reported during a staff flora survey that was done at the appropriate time to observe the species. The first is winterberry, reported at four volunteer sites where it was not recorded by staff. It is unlikely that the flora biologists would have missed this species on multiple sites while doing full vegetation community and species of concern mapping, which may indicate a further training need on the identification of the species. The second is the narrow-leaved spring beauty (*Claytonia virginica*), for which there were two volunteer records on sites where it was not found by staff, while broad-leaved spring beauty (*Claytonia caroliniana*) was. Enhanced coverage of the distinctions between the two species will be added to spring training sessions to address the potential for misidentification .

In most cases, the volunteer data records that differ from staff data collected during surveys for the same species had already been flagged by the data validation system. The flag is a result of a variance between the species habitat requirement and the habitat on site, or a difference between predicted urban versus rural matrix or subwatershed species occurrence and the observation. The design of the validation matrix is supported by this result, and the flagged data will continue to be addressed through the verification process.

The overall program protocols appear to be working well in providing accurate observations, when comparisons with staff data are used as the test for accuracy.

5.0 CITIZEN SCIENCE IMPLICATIONS

In an environment of small science budgets, and high demand for quality results, the utilization of volunteers, especially for time-consuming environmental monitoring, is both attractive and concerning

to many organizations. It is attractive to believe that large scale projects can be effectively implemented at reasonable cost by training a number of volunteers with the inclination and background to carry out data collection activities, while using scarce science resources to conduct up-front design of the program, training, data management and analysis of results. On the other hand, it can be difficult to judge the quality of biological data collected by non-biologists.

While there are arguments for and against volunteers collecting science data, this program demonstrates through its development, implementation and evolution a methodology that can work well. In addition, experience from the program contributes to the identification of a set of key considerations which, if addressed appropriately, will provide for an effective monitoring program using volunteer citizen scientists. The following summarizes both elements of the program that were carefully planned relative to using volunteer surveyors and "lessons learned" that emerged with experience, the latter primarily related to volunteer recruitment, motivation and coordination. It is offered here in the hope that it may be helpful to others who wish to implement a similar project:

- Data needs and resulting program protocols must be clear before engaging in any data collection
- Program protocols must take into account the fact of volunteer data collectors at the design stage. With forethought, potential pitfalls can be avoided.
- Training of volunteers must be planned, effectively delivered with supporting aids as required, consistently offered and must be required for all volunteers. Testing should be considered.
- Materials, including visual and audio aids, need to be sufficient to the purpose and available on a loan basis to all volunteers.
- Recruiting is key. A volunteer position description should be developed and utilized during recruiting to ensure that needed abilities are provided. Resumes can be used just as they are in any recruiting process to assist in obtaining the best qualified candidates for the program in question.
- In order for volunteers to remain motivated, they must obtain clear benefits that meet their needs as a result of their participation. Surveying them at the recruiting stage to determine their reasons for wanting to join the program and the benefits they expect to achieve, will help to make a good match and ensure their ongoing satisfaction.
- In the case of a monitoring program, a long term commitment from volunteers is ideal. Asking for such a commitment up-front does not ensure it, but should help to lengthen the average stay of participants. Recruitment should also consider the likelihood of the volunteer remaining with the program. For example, some university students, while they may have good and recent knowledge related to the program, may move frequently and so may not be the best choice as a permanent volunteer assigned a specific fixed site for an extended term. It may be better to utilize their skills as backup volunteers who fill in on various sites when a more permanent volunteer needs a partner or cannot make a survey at the prescribed time.
- It is critical that a Volunteer Coordinator staff position be responsible for the program. Whether full or part time, the coordinator must be available to ensure ongoing program evolution, data management and reporting, and most importantly, volunteer recruitment/training and ongoing management. This person needs to be organized and an effective communicator with a customer service orientation towards volunteers and landowners. This position allows the organization to effectively leverage the cost of one paid staff to the delivery of effective results from many volunteers, while also building a positive image with the public. A poorly coordinated program runs the risk of producing the opposite effect.
- Data management should include an effective data validation methodology designed to flag variances from protocol adherence and potential data errors for verification.

- Budgeting for the program needs to provide for materials, coordination, training meetings, data management, report writing and publication, data sharing, and perhaps volunteer recognition events and awards.

6.0 CONCLUSION

The Terrestrial Volunteer Monitoring Program is a tremendous opportunity to build on and share our current ecological knowledge of the jurisdiction and at the same time collect and deliver important information to help report on the state of the watersheds. One example of this is the ability to validate ongoing staff findings in their broader (geographical) scope, since staff do not cover a representative segment of the jurisdiction each year. The TVMP also provides a connection to the public, through which the TRCA is able to meet and work with people living in the watersheds and facilitate a program whereby people (in some cases for the first time) are exposed to biology and biological monitoring. We hope to continue to build an opportunity for volunteers to gain skills in conservation and an understanding of our place as humans in the natural ecosystem of which we are a part.

The results to date indicate several areas where determining statistical significance to support interpretation and further use of the data is very desirable. This will be undertaken once data collection for winter 2007 and validation/ verification of all currently flagged data is complete.

Continuous improvement in the areas of training, communication and recruitment are and will be ongoing areas of focus, and will incorporate conclusions drawn from results to date as well as feedback from participants in the program and potential users of the monitoring data.

Maintaining the program over the long term will provide an invaluable addition to the TRCA data set . The support of landowners and participation of our volunteers to this end is appreciated and their contribution highly valued. Volunteer recruitment is ongoing. Potential recruits who believe the program to be a good match for their interests and who are available to attend training and conduct the surveys for a minimum three year term, are encouraged to contact the coordinator.

Future plans for the program include facilitating distribution and sharing of data and analysis to benefit the region and beyond. Agencies and other groups with an interest in the program are encouraged to contact the Terrestrial Volunteer Coordinator for additional information on the program, the data collected and future plans.

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City of Toronto
Region of Peel
Region of York
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Appendix A: Sample Data Sheet

Spring Data Sheet
Flora Species

Observer:
Site Number:

Date: Visit #1 .....
Visit #2 .....
Visit #3 .....

Survey Start Time:	#1	#2	#3
Survey End Time:	#1	#2	#3
Temperature (0C):	#1	#2	#3
% cloud cover:	#1	#2	#3
Precipitation:	#1	#2	#3

	#1 #2 #3
marsh marigold	
primary: waxy yellow flowers like large buttercups	☐☐☐
secondary: large roundish or kidney-shaped, shiny leaves	☐☐☐
tertiary: found in wetlands	☐☐☐
Jack-in-the-pulpit	
primary: flower stalk has over-arching hood, hood has purplish stripes	☐☐☐
secondary: leaves are three-parted (like a trillium)	☐☐☐
narrow-leaved spring beauty	
primary: low-growing plant with leaves strap-like or grass-like	☐☐☐
secondary: pink lines on white or pink petals	☐☐☐
tertiary: found in moist deciduous forests	☐☐☐
white trillium	
primary: leaves and flower parts in threes	☐☐☐
secondary: flowers white - or pale pink when aging	☐☐☐
foam-flower	
primary: hairy leaves, maple-leaf shape, at ground level only	☐☐☐
secondary: white flower clusters on leaf-less stalk	☐☐☐
tertiary: found in moist mixed forests and cedar swamps	☐☐☐
star-flower	
primary: small plant with one whorl of leaves	☐☐☐
secondary: small white flowers	☐☐☐
tertiary: found in coniferous or mixed forests - swampy or dry	☐☐☐

Comments:

Appendix B: Level of Conservation Concern (L Rank) Component Scoring for TVM Program Indicator Species

TRCA Flora Scores & Ranks							
		Local Occurrence	Population Trend	Habitat Dependence	Sensitivity to Development	Total Score	L Rank
Scientific name	Common Name	1-5	1-5	0-5	0-5	2-20	
Caltha palustris	Marsh marigold	2	4	3	4	13	**L4**
Arisaema triphyllum	Jack-in-the-pulpit	1	3	3	4	11	**L4**
Claytonia virginica	Narrow-leaved spring beauty	3	4	4	4	15	**L3**
Trillium grandiflorum	White trillium	1	4	4	5	14	**L3**
Tiarella cordifolia	Foam-flower	2	3	3	4	12	**L4**
Trientalis borealis ssp. borealis	Star-flower	2	4	4	5	15	**L3**
Lilium michiganense	Michigan or Turk's cap lily	3	4	3	5	15	**L3**
Chelone glabra	Turtlehead	3	3	4	4	14	**L3**
Asclepias incarnata ssp. incarnata	Swamp milkweed	2	3	4	3	12	**L4**
Eupatorium maculatum ssp. maculatum	Spotted Joe-Pye weed	1	2	3	3	9	**L5**
Scirpus microcarpus (S. rubrotinctus)	Barber-pole sedge or bulrush	2	2	4	3	11	**L4**
Sparganium eurycarpum	Giant or great bur-reed	3	4	5	4	16	**L3**
Sagittaria latifolia	Common arrowhead	2	2	5	4	13	**L4**
Rudbeckia hirta (R. serotina)	Black-eyed Susan	2	4	4	3	13	**L4**
Apocynum androsaemifolium	Spreading dogbane	5	3	2	3	13	**L4**
Epilobium angustifolium	Fire-weed	4	4	4	4	16	**L3**
Quercus alba	White oak	3	5	4	5	17	**L2**
Andropogon gerardii	Big bluestem	4	2	4	4	14	**L3**
Elymus riparius	Riverbank wild rye	2	2	5	2	11	**L4**
Polystichum acrostichoides	Christmas fern	2	3	5	5	15	**L3**
Solidago flexicaulis	Zig-zag goldenrod	1	1	3	2	7	**L5**
Ilex verticillata	Winterberry	3	4	4	5	16	**L3**
Tsuga canadensis	Eastern hemlock	+	4	3	5	12	**L4**
Pinus strobus	White pine	1	4	3	4	12	**L4**
Thuja occidentalis	White cedar	1	4	1	5	11	**L4**

TRCA Fauna Scores & Ranks											
Scientific name	Common Name	Abundance	National Population	Local Population	Habitat Dependence	Area Sensitivity	Mobility Restrictions	Sensitivity to Development	Additional Point	Total Score	L Rank
Bufo americanus	American toad	0	2	2	1	1	2	4	0	12	**L4**
Scolopax minor	American woodcock	0	2	3	2	3	2	4	0	16	**L3**
Dolichonyx oryzivorus	Bobolink	0	3	2	2	3	1	4	0	15	**L3**
Rana catesbeiana	Bullfrog	4	4	3	3	2	3	5	1	25	**L1**
Tamias striatus	Eastern chipmunk	1	2	2	1	2	2	3	0	13	**L4**
Sturnella magna	Eastern meadowlark	0	3	2	1	3	2	3	0	14	**L4**
Otus asio	Eastern screech-owl	1	2	2	3	1	2	3	0	14	**L4**
Contopus virens	Eastern wood pewee	0	4	2	1	2	2	2	0	13	**L4**
Butorides virescens	Green heron	2	2	2	2	2	2	3	0	15	**L3**
Rana clamitans	Green frog	0	2	2	1	1	2	4	0	12	**L4**
Hyla versicolor	Grey treefrog	2	2	3	2	3	3	5	1	21	**L2**
Mustela vison	Mink	3	2	2	1	3	2	4	0	17	**L3**
Rana pipiens	Northern leopard frog	0	3	2	2	1	2	5	1	16	**L3**
Hyla crucifer	Northern spring peeper	1	2	3	3	3	2	5	1	20	**L2**
Seiurus aurocapillus	Ovenbird	0	2	3	3	4	2	4	0	18	**L3**
Dryocopus pileatus	Pileated woodpecker	0	2	2	3	4	2	3	0	16	**L3**
Erethizon dorsatum	Porcupine	3	2	3	3	4	2	4	0	21	**L2**
Bonasa umbellus	Ruffed grouse	1	3	2	1	3	2	5	1	18	**L3**
Passerculus sandwichensis	Savannah sparrow	0	3	1	2	1	1	3	0	11	**L4**
Piranga	Scarlet	1	2	3	3	4	2	3	0	18	**L3**

olivacea	tanager										
Pseudacris triseriata	Striped chorus frog	3	2	3	2	2	5	5	2	24	**L2**
Melospiza georgiana	Swamp sparrow	0	1	2	2	1	2	5	1	14	**L4**
Rallus limicola	Virginia rail	1	2	2	2	2	3	4	0	16	**L3**
Aix sponsa	Wood duck	2	1	1	3	3	1	4	0	15	**L3**
Rana sylvatica	Wood frog	0	2	3	4	3	2	5	1	20	**L2**

Appendix C: Key ecological requirements and sensitivities, benefits and tolerances relative to human activity for TVMP indicator species

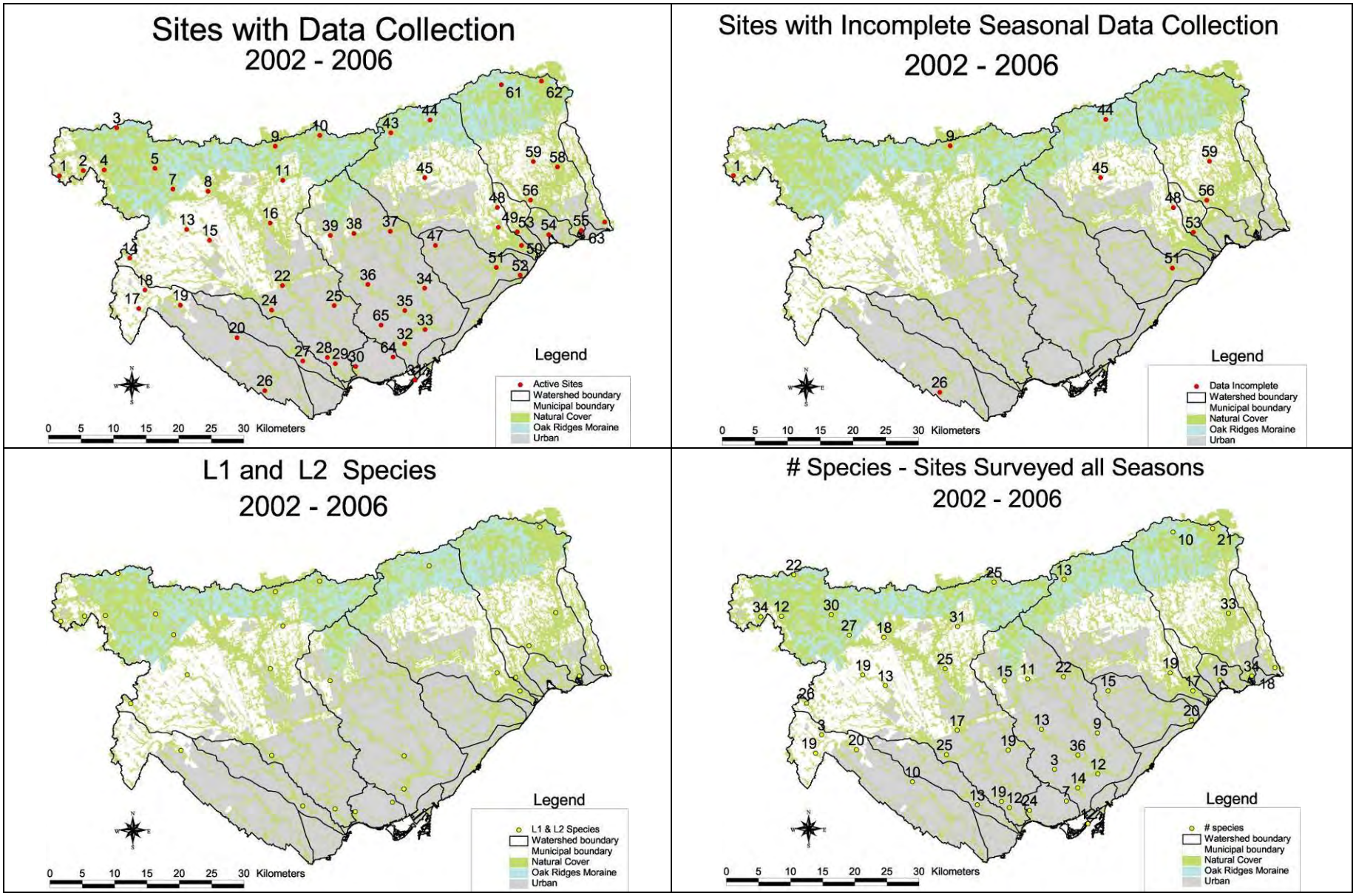
Indicator	L rank	Habitat requirements	Key sensitivities/survival issues related to human activity	Benefits/tolerances related to human activity
Mammals				
Eastern chipmunk	L4	• forest or woodland/parkland with sufficient supply of berries, nuts, mushrooms; ground burrower	• proliferation of roads within home range; free roaming pets; soil erosion or compaction (disturbance of burrow substrate)	• provision of nuts and seeds at garden bird feeders
Mink	L3	• wetland/riparian zones with natural cover and good supply of prey species	• removal of natural cover along streams, lakes and ponds; wetland reduction/removal; proliferation of roads within home range	• fish farms and garden ponds can supply feeding opportunities
Porcupine	L2	• large forest blocks - range over 100 ha. of forest, successional and meadow in summer, retracting to 10 ha. of forest in winter	• proliferation of roads within home range; reduction & fragmentation of forest and other natural cover; harassment by dogs and humans	• removal of natural predators such as Fishers
Amphibians				
Wood frog	L2	• forest with connectivity to breeding wetlands/ponds/vernal pools	• proliferation of roads within home range; separation of different habitat types or lack of either; contamination of breeding wetlands/ponds; free roaming pets	
Northern spring peeper	L2	• forest with connectivity to breeding wetlands/vernal pools	• proliferation of roads within home range; separation of different habitat types or lack of either; contamination of breeding wetlands/ponds; free roaming pets	
Striped chorus frog	L2	• undisturbed breeding wetlands/vernal pools; tends to remain in the vicinity of wetland breeding sites.	• contamination or loss of breeding wetlands/ponds; deterioration of habitat surrounding wetland; free roaming pets	
Northern leopard frog	L3	• meadows with connectivity to breeding wetlands/ponds	• proliferation of roads within home range; separation of different habitat types or lack of either: contamination of breeding wetlands/ponds; free roaming pets	
American toad	L4	• variety of habitat types but requires access to breeding wetlands/ponds	• proliferation of roads within home range; contamination or loss of breeding wetlands/ponds	
Green frog	L4	• ponds/wetlands with natural shoreline cover that do not freeze to the bottom	• reduction/elimination of wetlands/ponds; destruction of shoreline vegetation; free roaming pets	
Bullfrog	L1	• large ponds or lakes with natural shoreline cover	• contamination or loss of breeding wetlands/ponds; destruction of shoreline vegetation; free roaming pets	

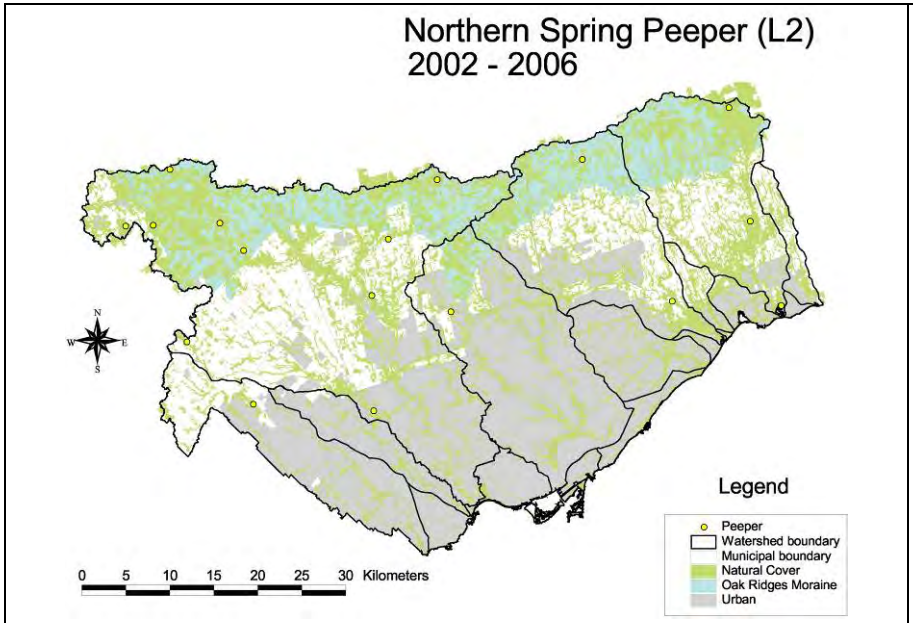
Grey treefrog	L2	• forest with connectivity to breeding wetlands/vernal pools	• proliferation of roads within home range; separation of different habitat types or lack of either, contamination of breeding wetlands/ponds	
Birds				
American woodcock	L3	• meadow associated with forest or successional habitat; ground nester in variety of habitats but requires some ground cover/understory	• meadow reduction/elimination; free roaming pets; disturbance and flushing by hikers/bikers	
Ruffed grouse	L3	• forest ground nester; needs undisturbed forest floor; large fallen logs for "drumming" platforms	• disturbance and flushing by hikers/bikers; free-roaming pets	
Eastern screech owl	L4	• cavity nester; mature deciduous forest/woodland/swamp.	• removal of dead standing and/or mature deciduous trees	• able to survive in urban/rural landscapes where mature trees exist; provision of nest boxes.
Wood duck	L3	• cavity nester, wetlands associated with forest, standing dead-wood,	• habitat destruction; fragmentation of habitat types	• provision of nest boxes
Pileated woodpecker	L3	• extensive mature forest (even a landscape with many fragments) with standing dead-wood.	• habitat destruction; removal of large, standing dead-wood	
Eastern wood peewee	L4	• forest breeder; preference for relatively open understory.	• removal of forest; excessive understory growth (e.g. buckthorn).	
Ovenbird	L3	• forest ground nester; intact natural litter layer.	• removal of forest; deterioration or clearance of natural litter layer; forest floor disturbance/trampling by hikers and bikers; free roaming pets	
Scarlet tanager	L3	• large tracts of mature mixed and deciduous forest	• forest reduction and fragmentation	
Swamp sparrow	L4	• wetland	• reduction of wetlands	
Green heron	L3	• forest/woodland breeding opportunities with plenty of wetland /swamp foraging in vicinity	• reduction/elimination of treed wetlands; reduction and contamination of wetland feeding opportunities	
Virginia rail	L3	• wetland; cattail marsh	• reduction/elimination/disturbance and contamination of wetlands; free roaming pets	
Bobolink	L3	• meadow; ground nester	• reduction/elimination of meadows; disturbance/trampling by hikers and bikers; free roaming pets; early hay harvesting	• provision of large tracts of suitable breeding habitat in agricultural landscape.
Eastern meadowlark	L4	• meadow; ground nester	• reduction/elimination of meadows; disturbance/trampling by hikers and bikers; free roaming pets	• provision of large tracts of suitable breeding habitat in agricultural landscape.

Savannah sparrow	L4	• meadow/successional	• reduction/elimination of meadows; disturbance/trampling by hikers and bikers; free roaming pets	• provision of large tracts of suitable breeding habitat in agricultural landscape and other open habitats.
Flora				
Marsh Marigold	L4	• marsh and swamp wetlands	• reduction/elimination of wetlands	
Jack-in-the-pulpit	L4	• forest floor	• reduction of forests; forest floor disturbance/trampling	
Narrow-leaved Spring Beauty	L3	• mature deciduous forest floor	• reduction of forests; forest floor disturbance/trampling; invasive species (e.g. garlic mustard)	
White Trillium	L3	• upland deciduous forest floor	• reduction of forests; forest floor disturbance/trampling; collection; invasive species	
Foam flower	L4	• moist/wet forest floor;	• reduction of forests; forest floor disturbance/trampling; invasive species	
Star flower	L3	• mature moist, rich forest floor	• reduction of forests; forest floor disturbance/trampling; invasive species	
Michigan Lily	L3	• moist/wet meadow, floodplain, along streams	• reduction/elimination of floodplain & riparian habitat; picking; introduced Asian lily beetle	
Turtlehead	L3	• wetland, wet meadow, streamside	• reduction of wetlands; removal of riparian vegetation; invasive species (e.g. Phragmites sp.)	
Swamp Milkweed	L4	• wetland, wet meadow, streamside	• reduction of wetlands; removal of riparian vegetation; invasive species	
Spotted Joe-pye Weed	L5	• wetland, wet meadow, streamside	• reduction of wetlands; removal of riparian vegetation;	
Barber-pole bulrush	L4	• marsh wetland, pond edges	• reduction of wetlands	
Greater bur-reed	L3	• shallow marsh wetland, pond edges	• reduction of wetlands; invasive species; high Canada geese populations	
Common arrowhead	L4	• wetland, wet stream/pond edges	• reduction of wetlands; removal of riparian vegetation; off-leash dogs; possibly water quality deterioration; high Canada geese populations	
Black-eyed Susan	L4	• dry sandy meadow	• reduction/elimination of meadows; invasive species (e.g. dog strangling vine)	
Spreading dogbane	L4	• meadow/forest openings & along open forest trails	• reduction/elimination of meadows; invasive species	• colonizes openings/trails
Fireweed	L3	• colonizer of disturbed ground; edges; forest floor following fire	• reduction/elimination of fire; invasive species	• colonizes disturbed edges such as along railway tracks

White Oak	L2	• upland forests; shade intolerant; germinates following fire	• historical clearing; reduction/elimination of fire; habitat conducive to regeneration/seed germination no longer available or seed source missing; high squirrel populations	• occasionally planted in urban and rural areas (but difficult to transplant)
Big Bluestem	L3	• dry savannah or prairie	• reduction/elimination of prairie/savannah	• can survive plantation in less than ideal habitat
Riverbank Wild Rye	L4	• stream edges	• removal of riparian vegetation; trampling	
Christmas fern	L3	• mature dry-fresh upland forest floor, typically mixed forest	• forest reduction/removal; trampling; invasive species	
Zig-zag Goldenrod	L5	• forest floor	• forest reduction/removal; trampling;	
Winterberry	L3	• thicket swamp wetland	• wetland reduction/removal; siltation; changes in hydrology	
Eastern hemlock	L4	• rich forests typically with a high water table or near streams	• forest reduction/removal; changes in hydrology and surface water (e.g. desiccation, sediment or other pollution)	
White pine	L4	• upland dry forest, plantations, meadows	• historical logging; continuing forest reduction/removal	
White cedar	L4	• wet/swampy coniferous forests, plantations, lowland forests, meadows	• forest reduction/removal; transplanting out of habitat for horticulture; invasive species; possibly climate change	• favoured in plantings
Lichens				
Candleflame	NA	• nutrient rich substrate; trees/wooden posts/dead trees in open areas	• tree removal (including dead trees)	• nutrient enriched agricultural landscapes; air pollution tolerant
Mealy rosette	NA	• trees in open areas	• tree removal (including dead trees)	• tolerant of air pollution
Common greenshield	NA	• deciduous forest trees; relatively clean air	• forest reduction/removal; air pollution	
Hammered shield	NA	• nutrient rich substrate; trees/wooden posts/dead trees in open areas	• tree removal (including dead trees)	• tolerant of air pollution
Hooded sunburst	NA	• nutrient rich substrate, trees in open areas	• tree removal (including dead trees)	• nutrient enriched agricultural landscapes; air pollution tolerant
Rough speckled shield	NA	• deciduous forest trees; relatively clean air	• forest reduction/removal; air pollution	

Appendix D: Indicator Species Atlas




Northern Spring Peeper (L2)
2002 - 2006
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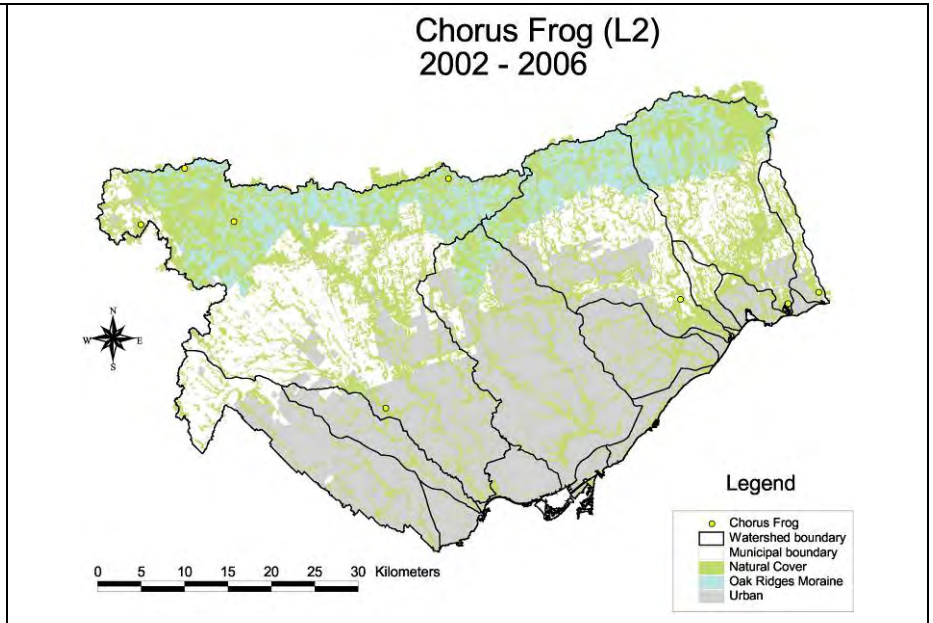
Peeper
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban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Chorus Frog
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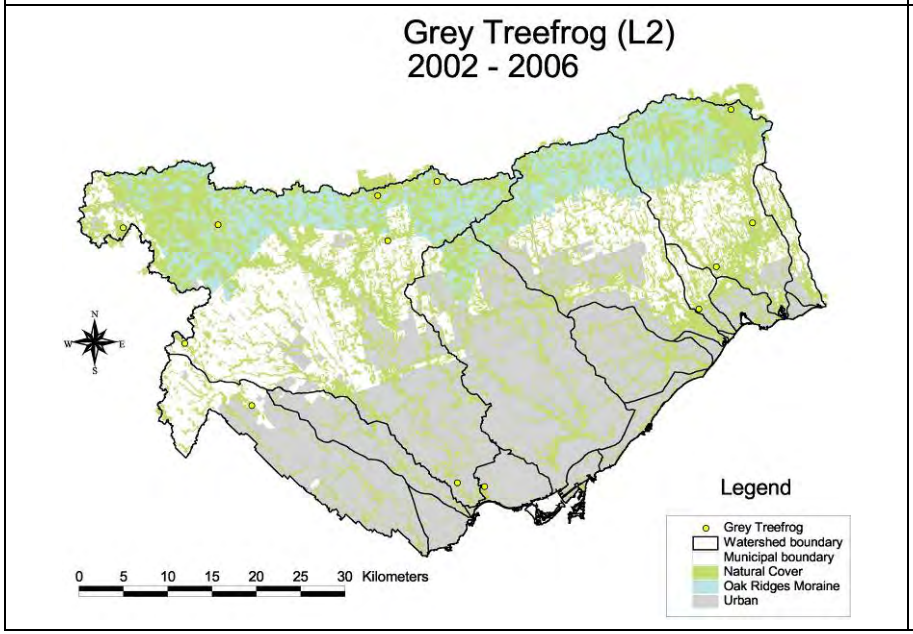
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Grey Treefrog (L2)
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Grey Treefrog
Watershed boundary
Municipal boundary
Natural Cover
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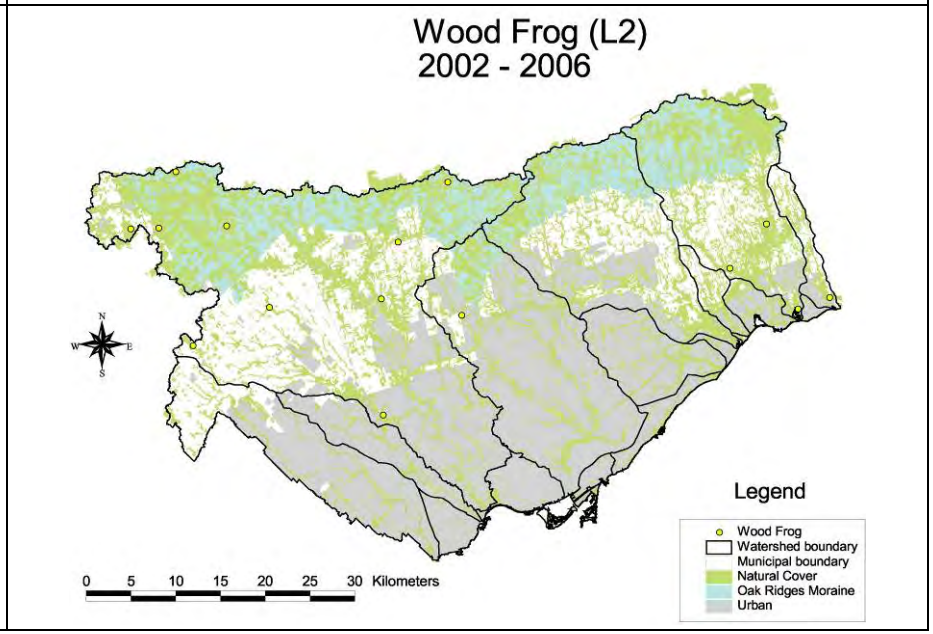
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Wood Frog
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
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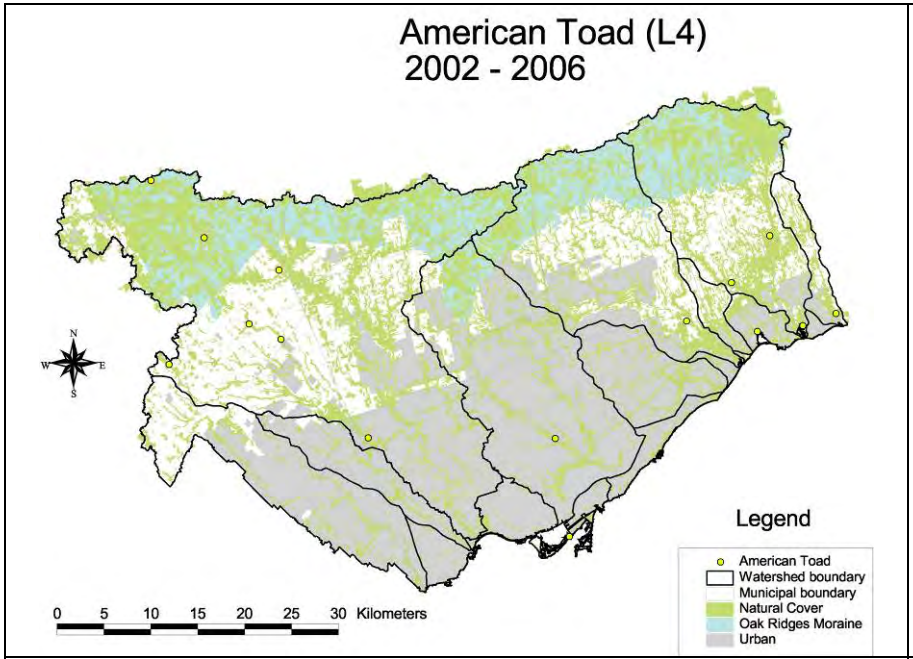
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Natural Cover
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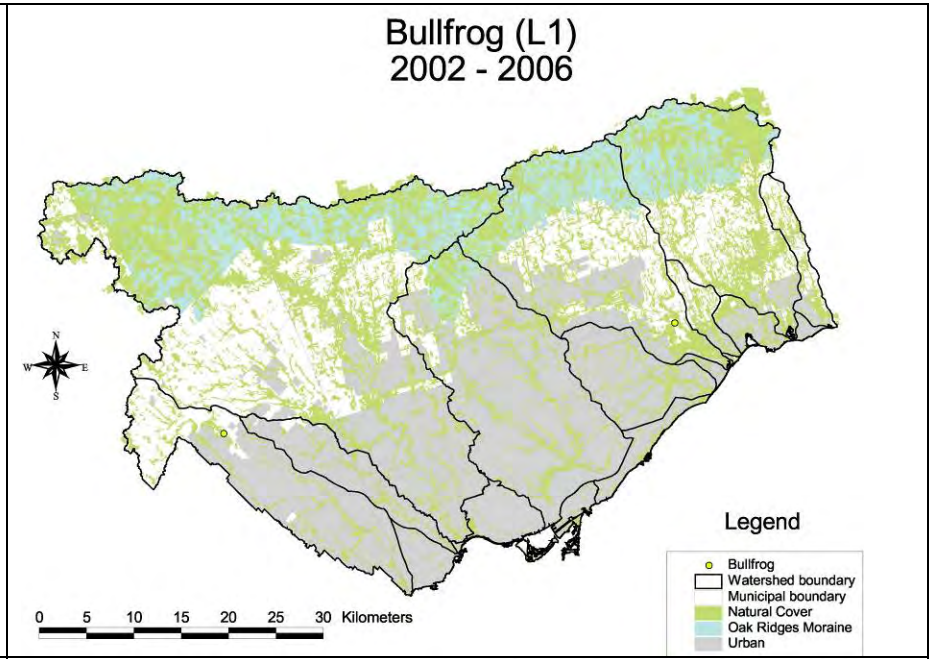
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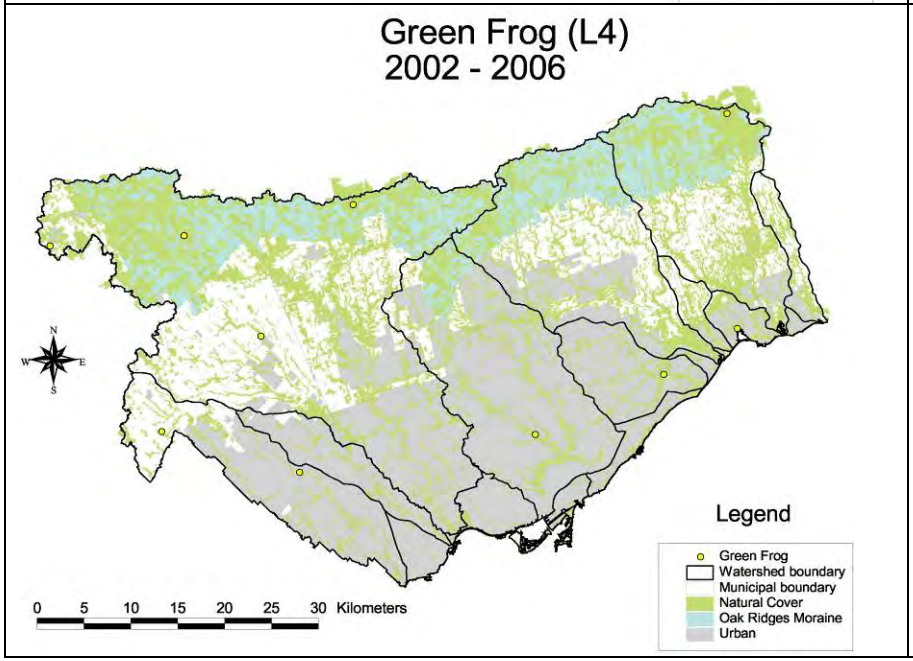
Natural Cover
Oak Ridges Moraine
Urban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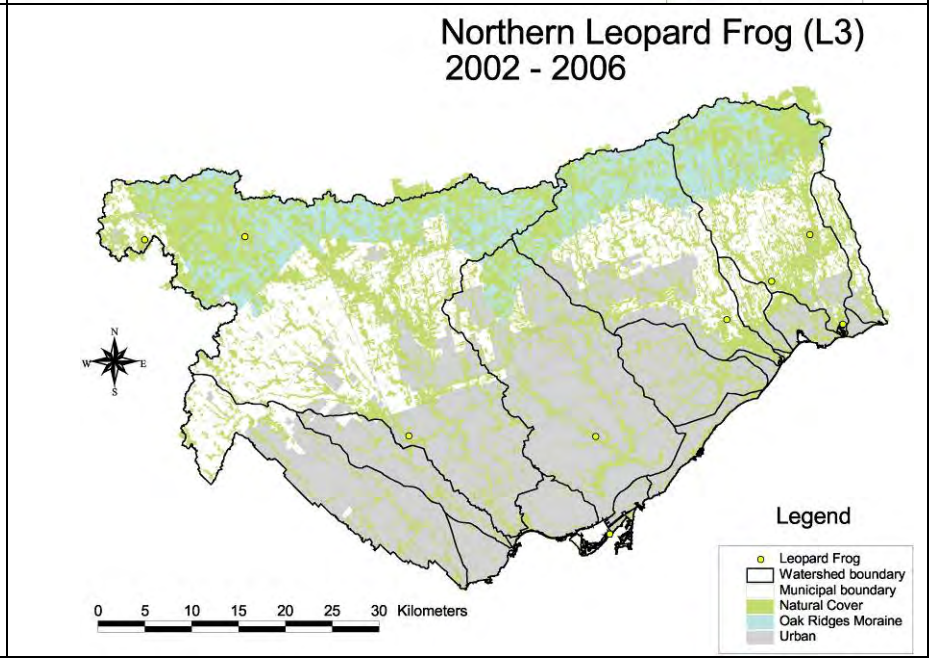
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban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Leopard Frog
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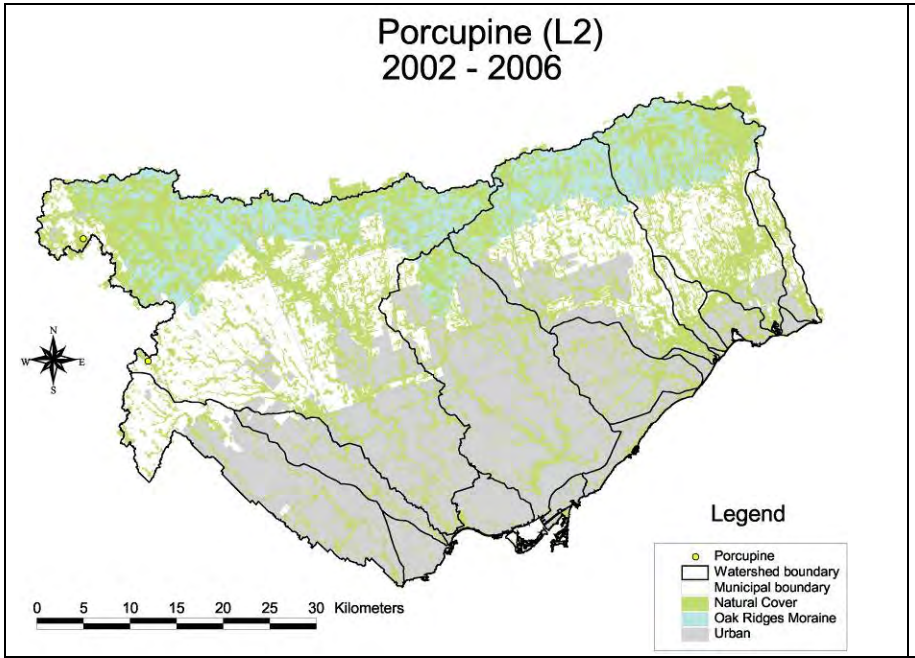
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban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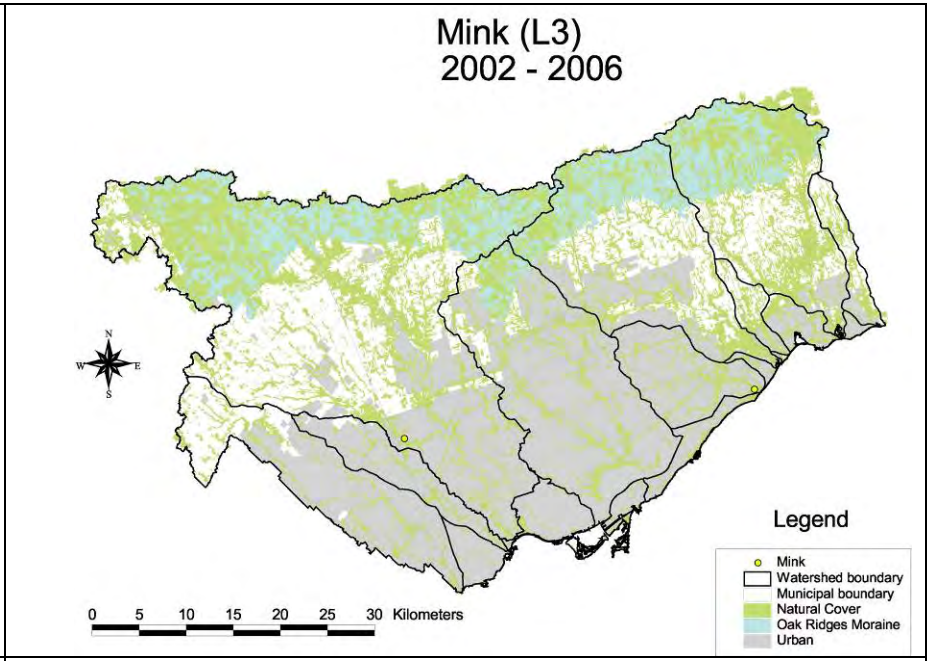
Porcupine
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban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Mink
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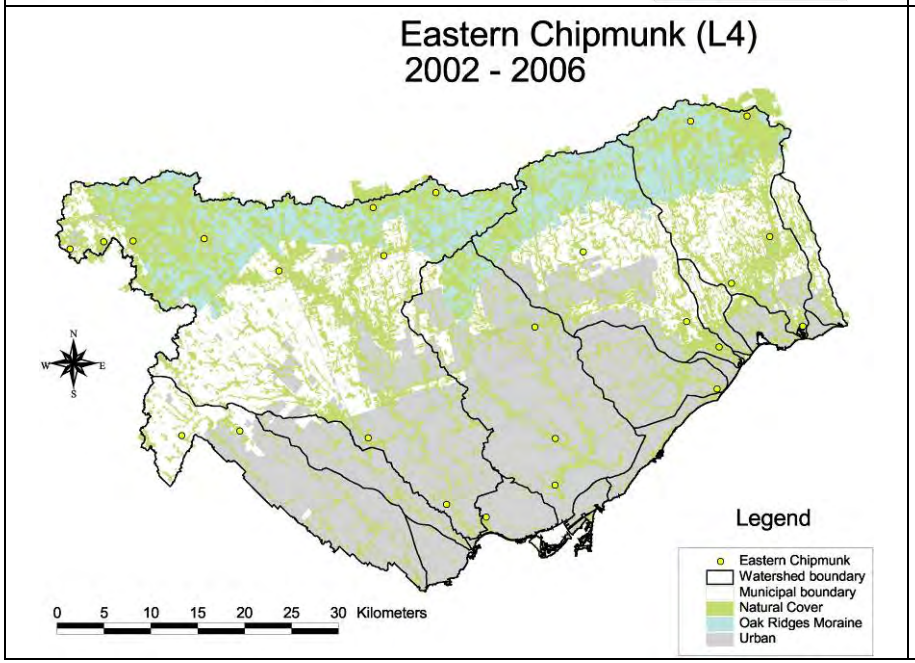
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Eastern Chipmunk (L4)
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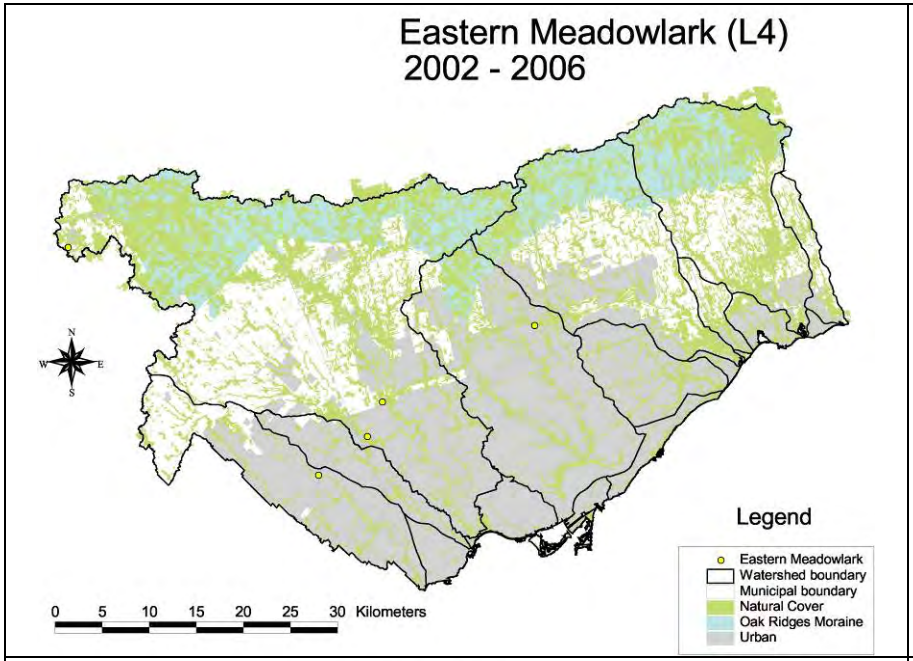
Eastern Chipmunk
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban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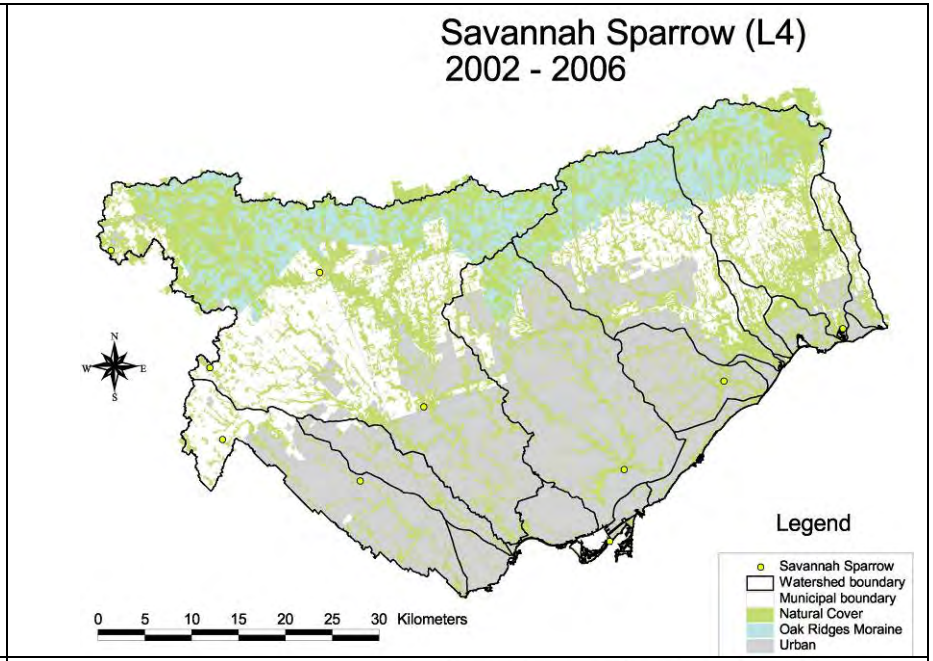
Eastern Meadowlark
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban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Savannah Sparrow
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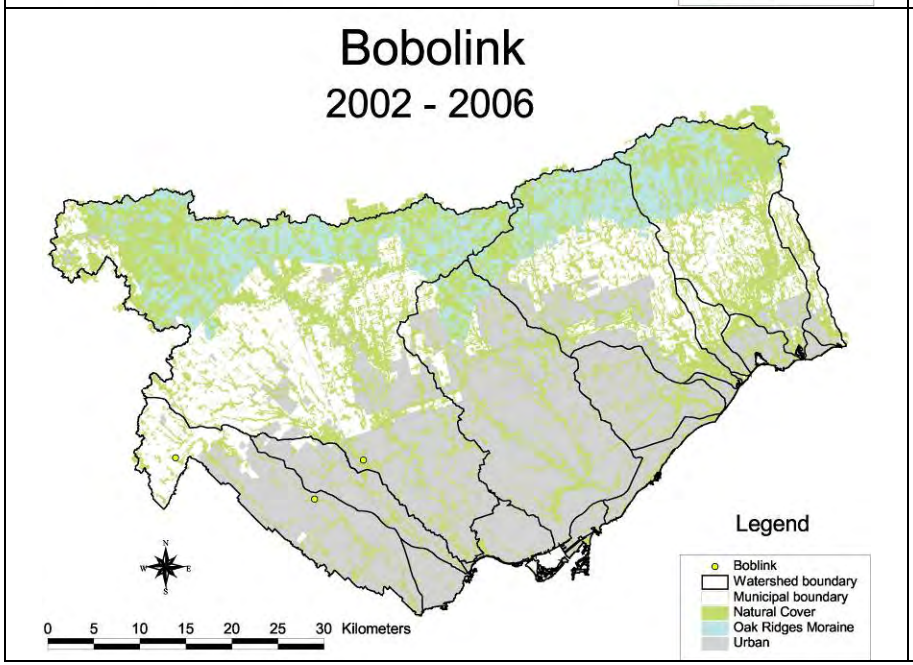
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Bobolink
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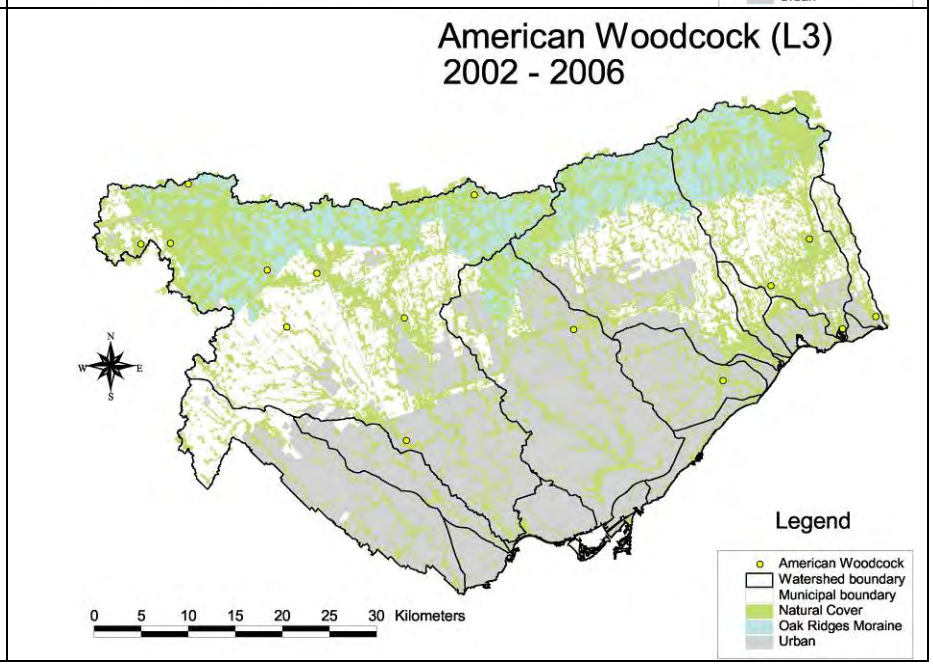
Boblink
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban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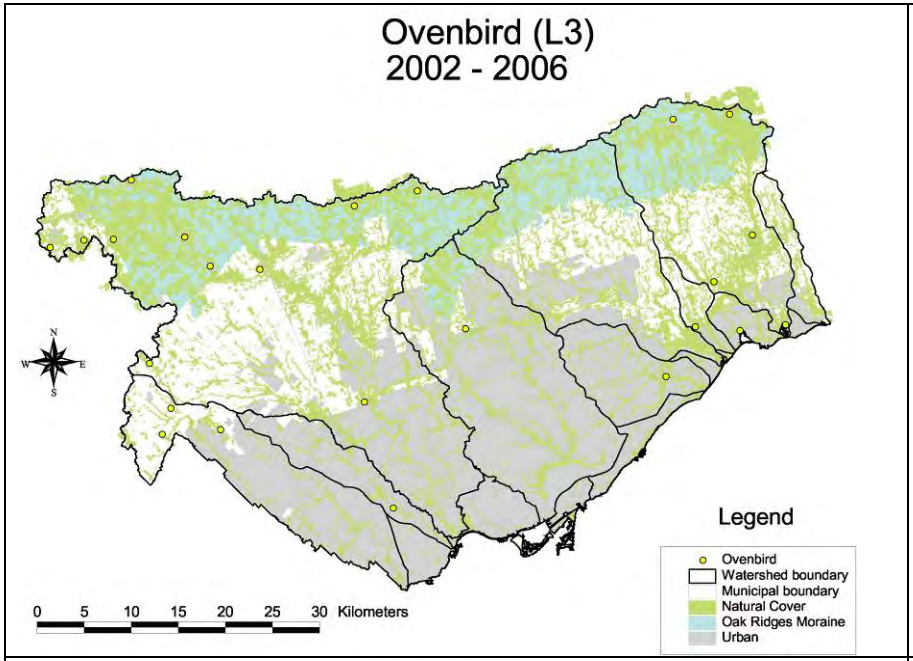
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Ovenbird (L3)
2002 - 2006
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Ovenbird
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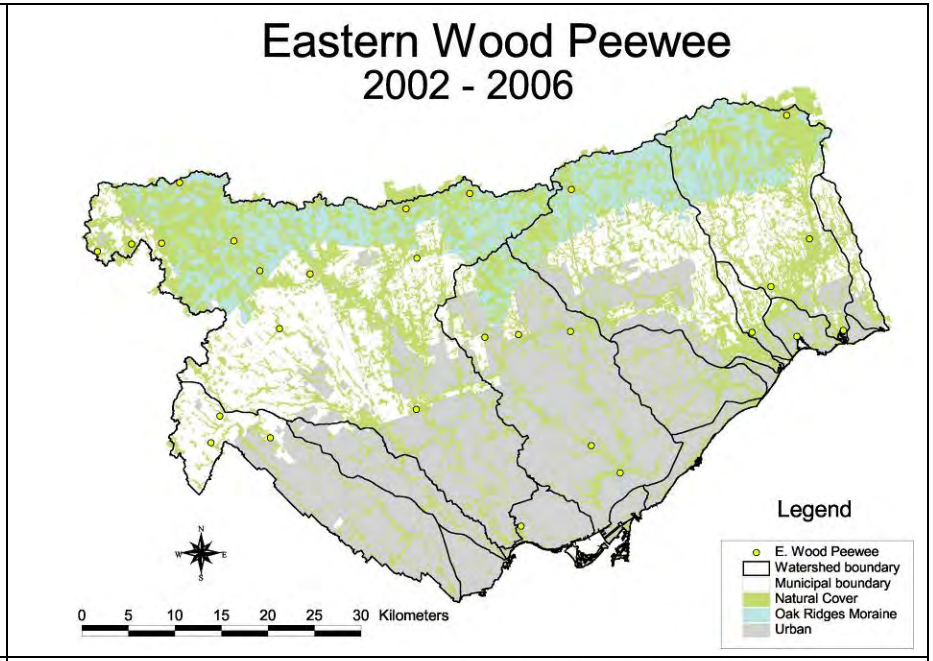
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban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2002 - 2006
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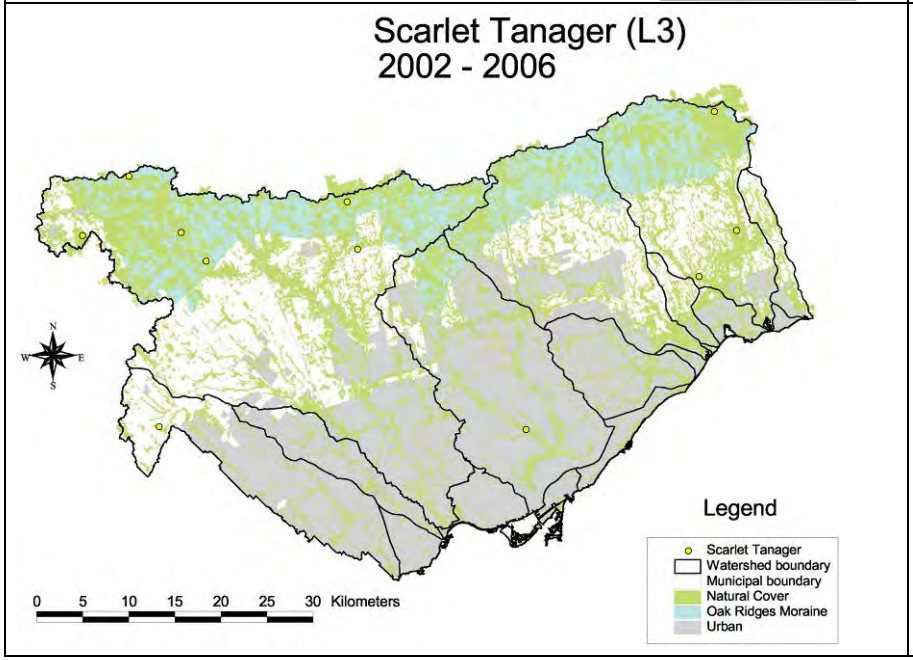
E. Wood Peewee
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Scarlet Tanager (L3)
2002 - 2006
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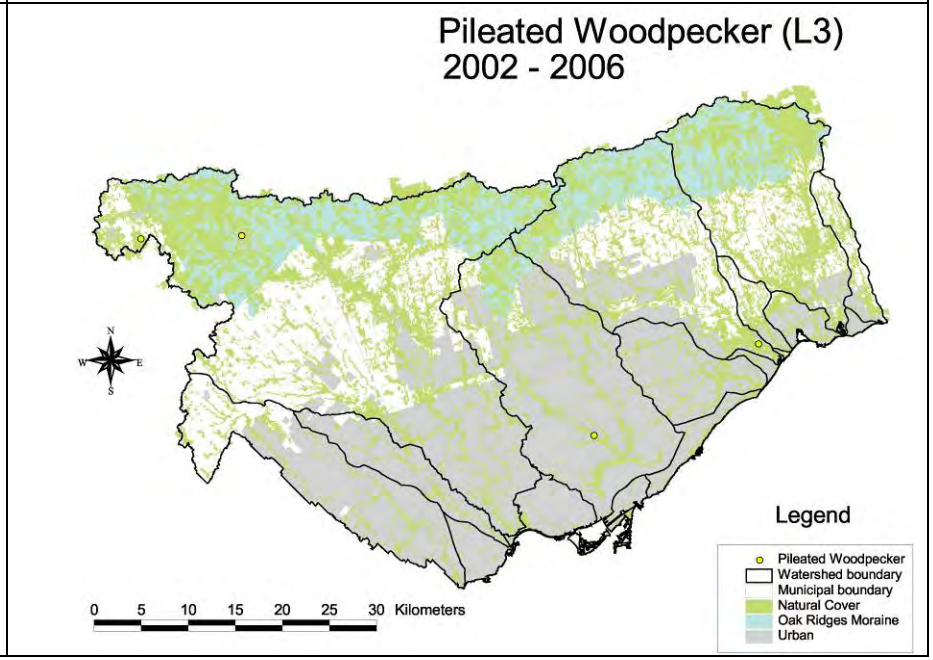
Scarlet Tanager
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Pileated Woodpecker (L3)
2002 - 2006
N
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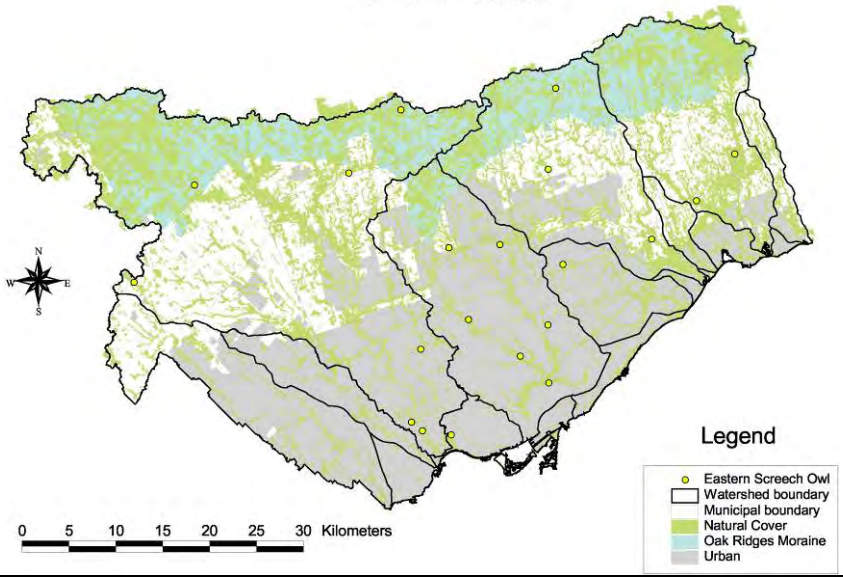
Legend
Pileated Woodpecker
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Eastern Screech Owl (L4)
2002 - 2006
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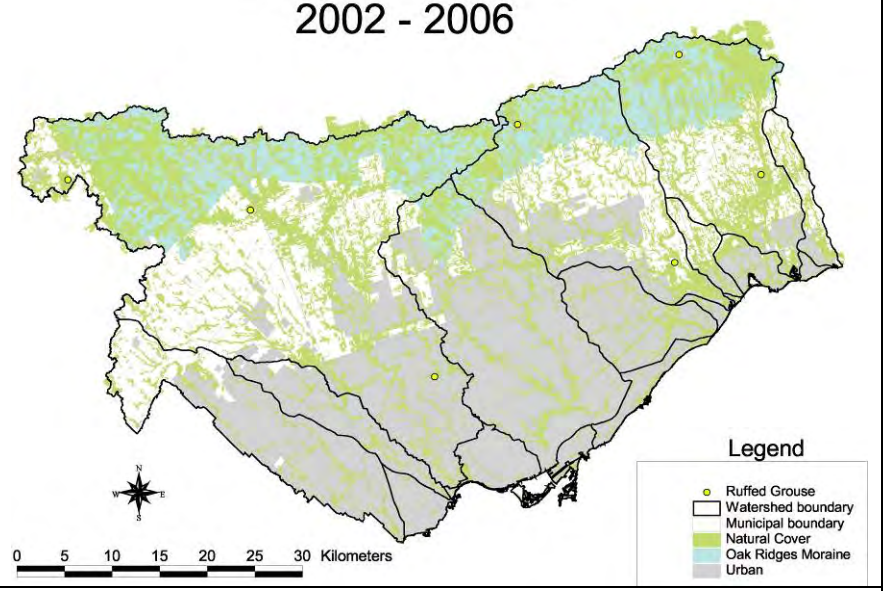
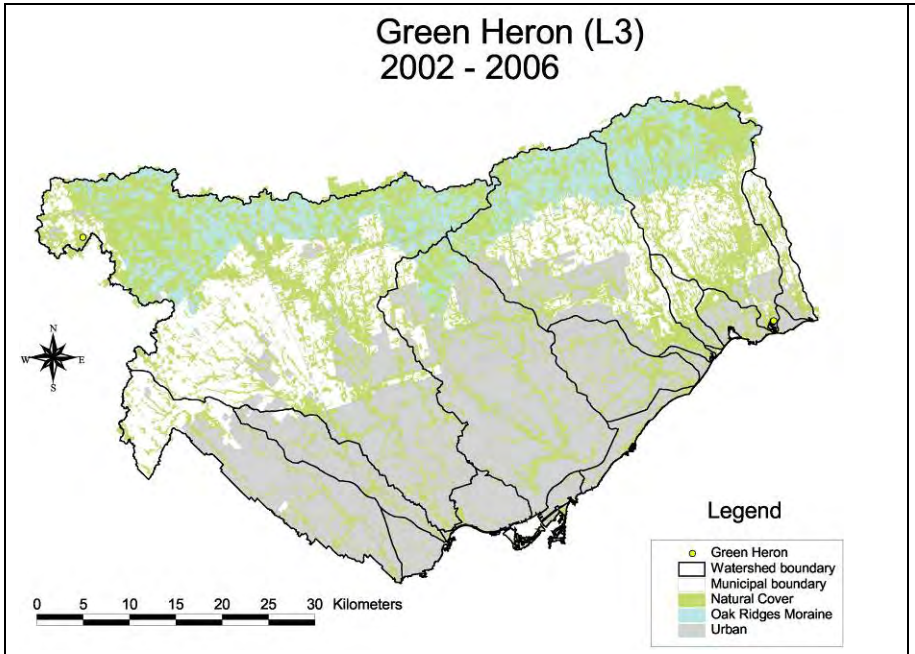
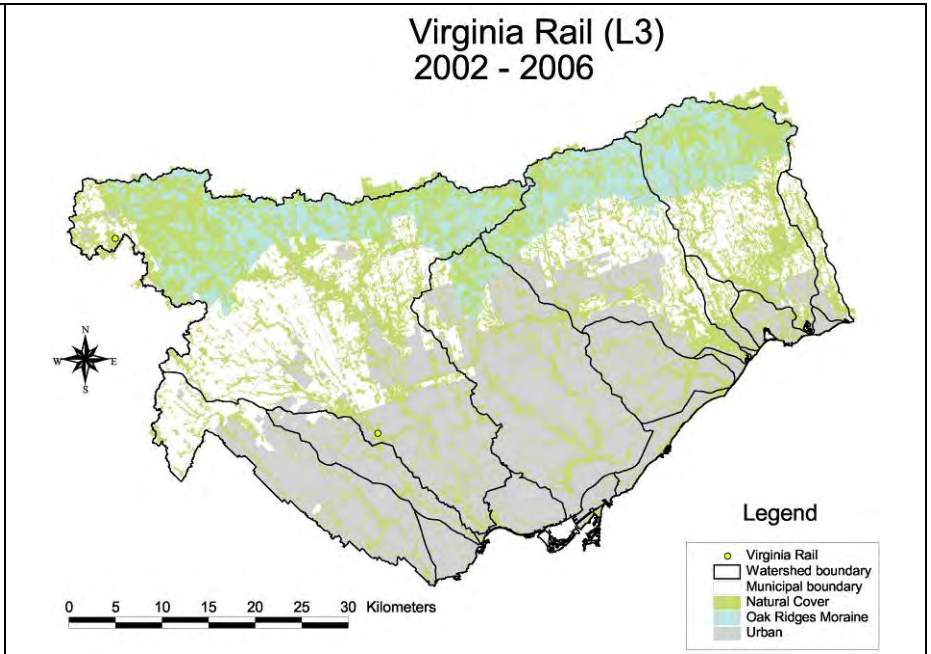
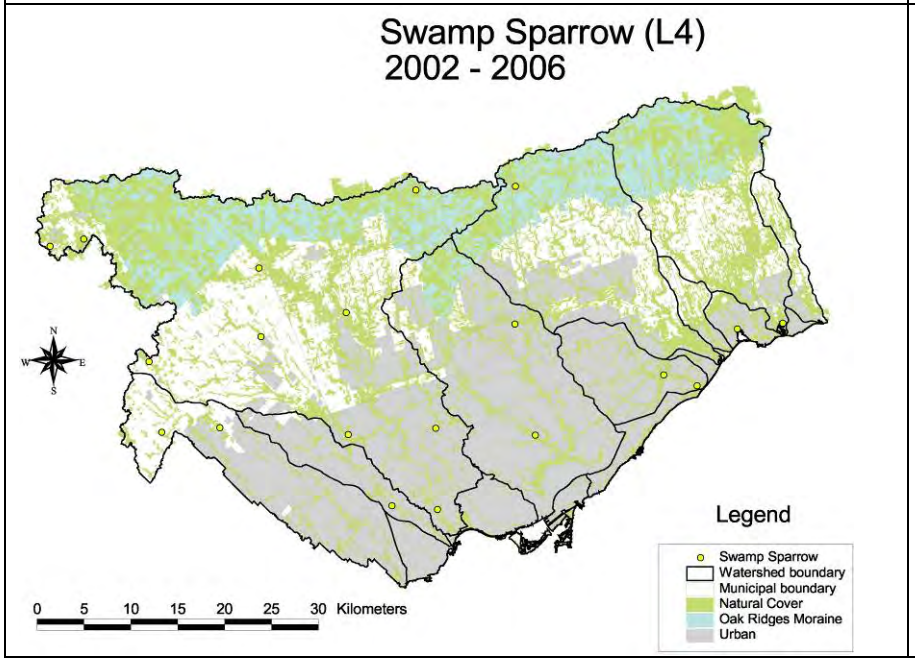
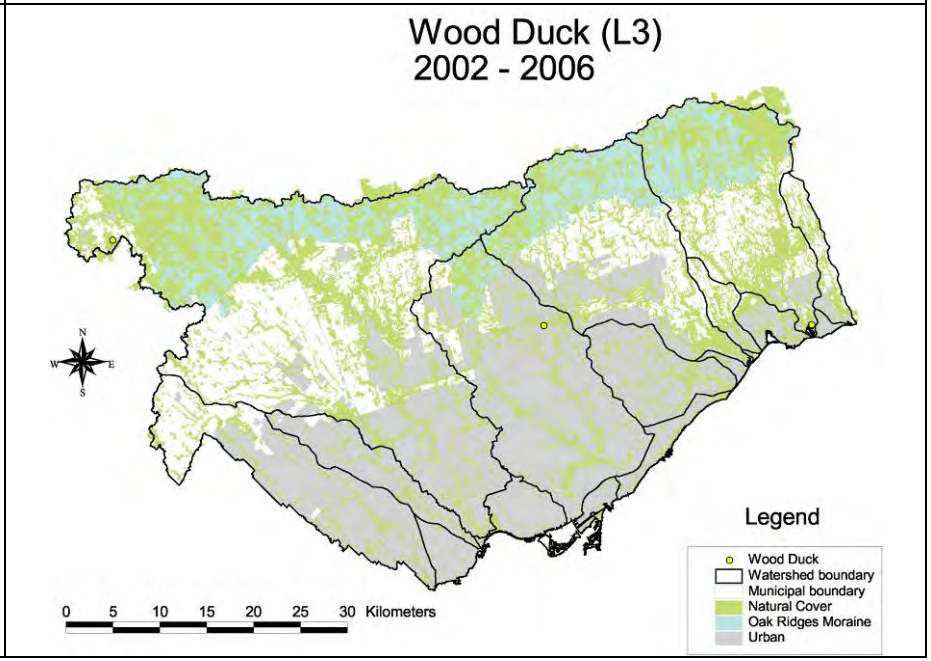
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Eastern Screech Owl
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

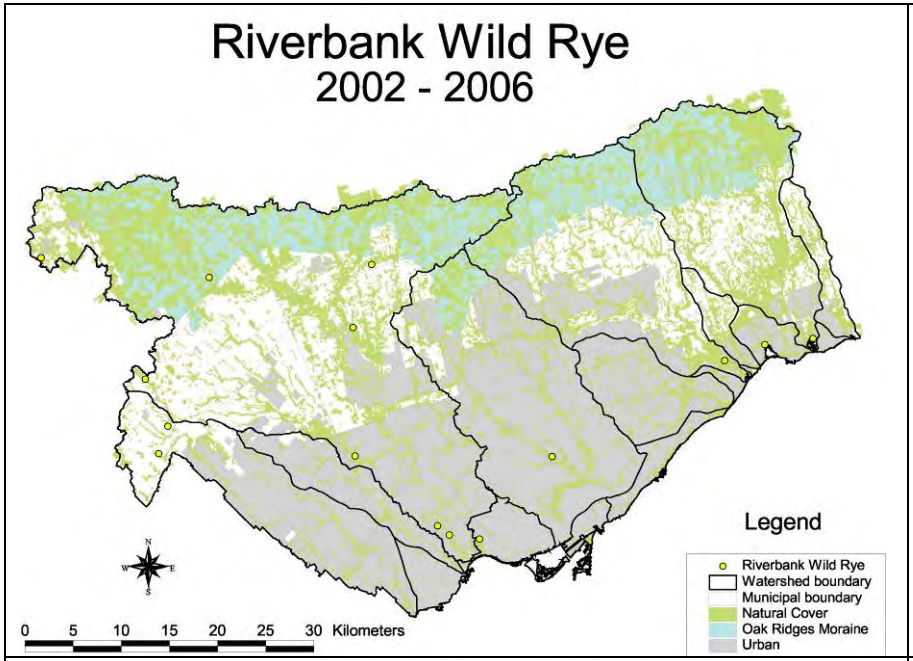

Ruffed Grouse (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Ruffed Grouse
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

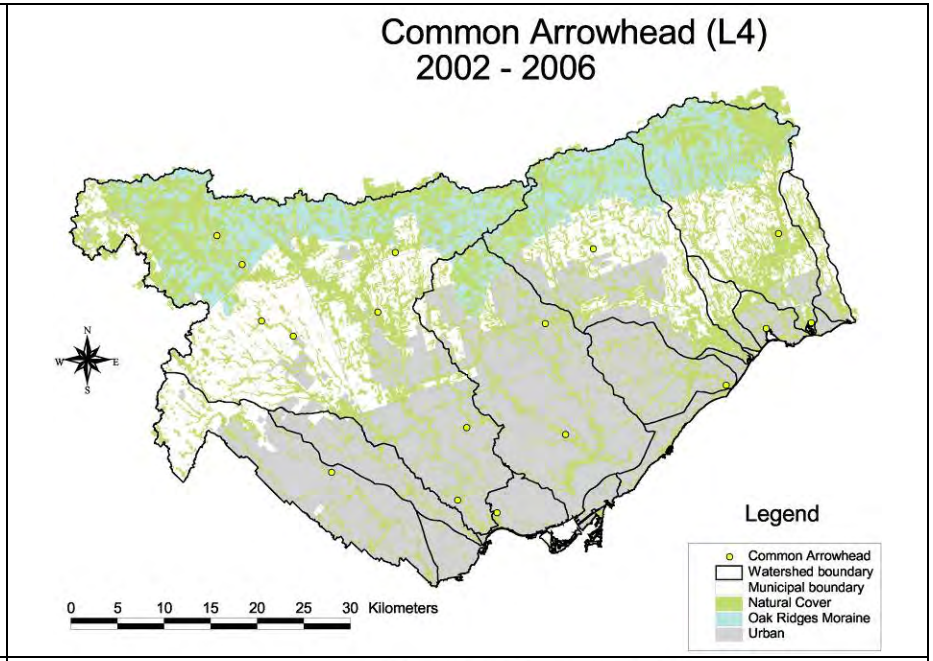

Green Heron (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Green Heron
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

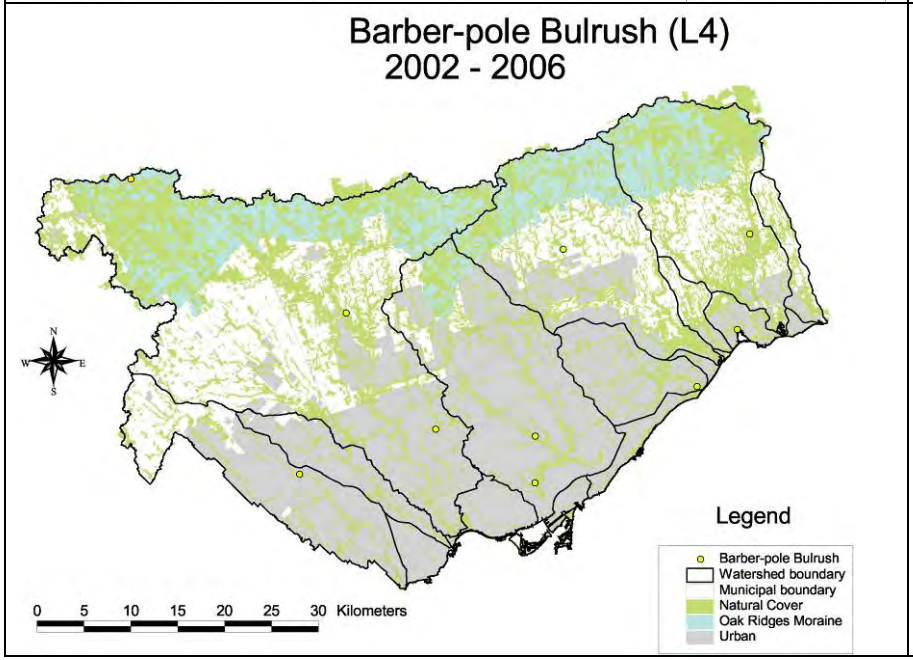

Virginia Rail (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Virginia Rail
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

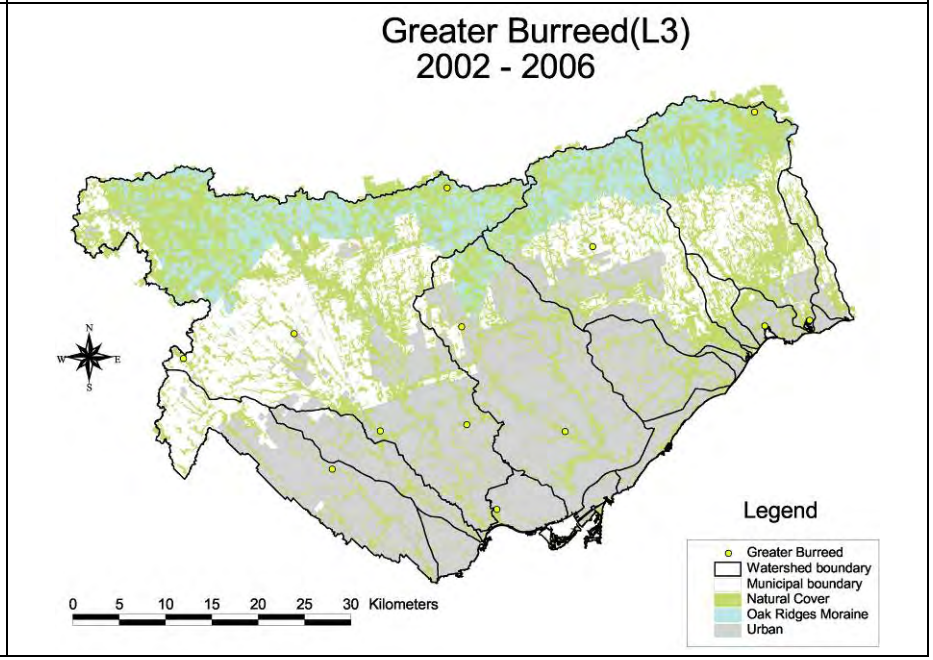

Swamp Sparrow (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Swamp Sparrow
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

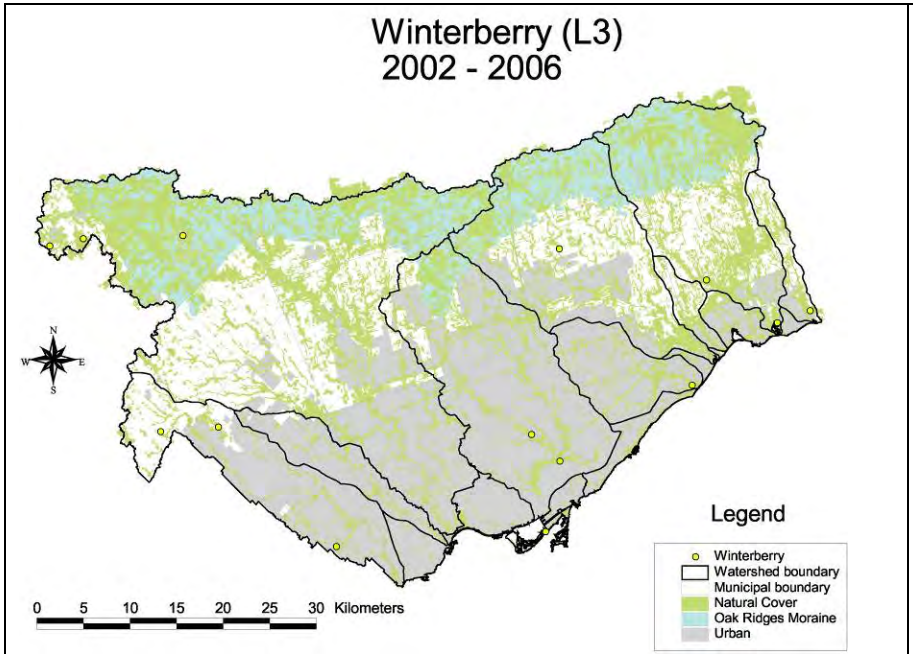

Wood Duck (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Wood Duck
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

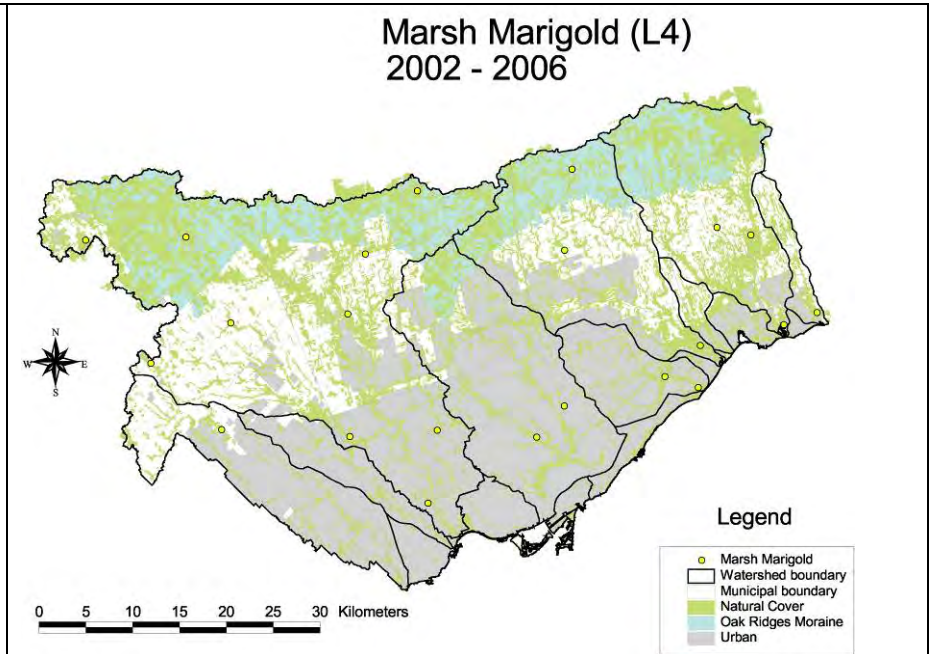

Riverbank Wild Rye
2002 - 2006
0 5 10 15 20 25 30 Kilometers
Legend
Riverbank Wild Rye
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

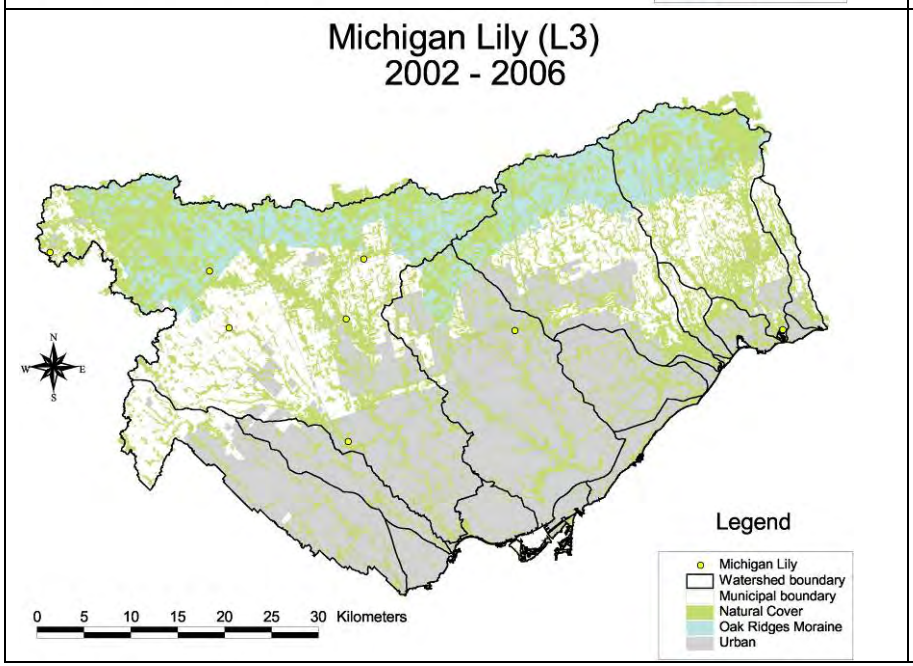

Common Arrowhead (L4)
2002 - 2006
0 5 10 15 20 25 30 Kilometers
Legend
Common Arrowhead
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

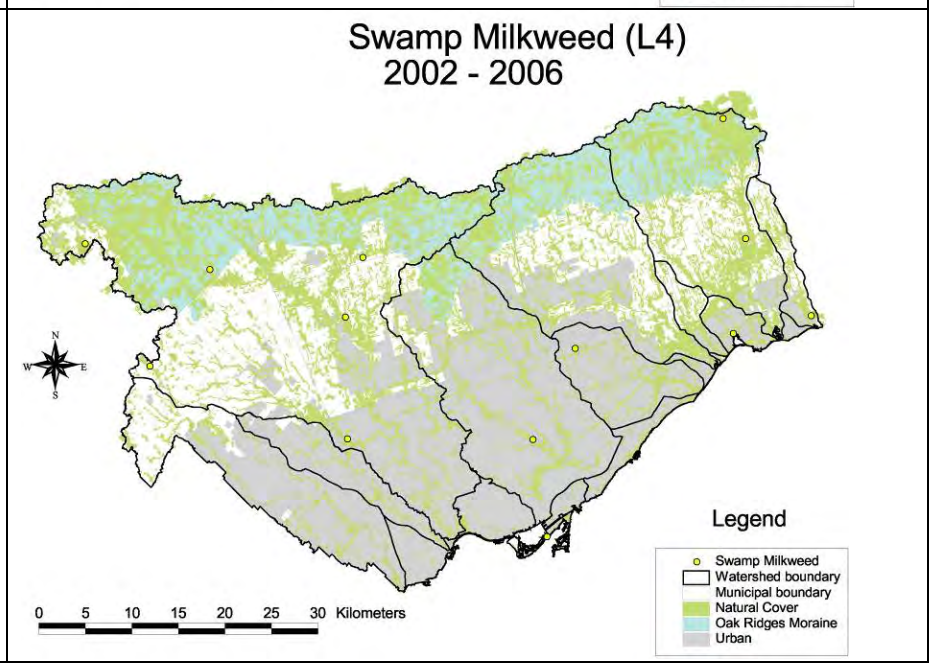

Barber-pole Bulrush (L4)
2002 - 2006
0 5 10 15 20 25 30 Kilometers
Legend
Barber-pole Bulrush
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

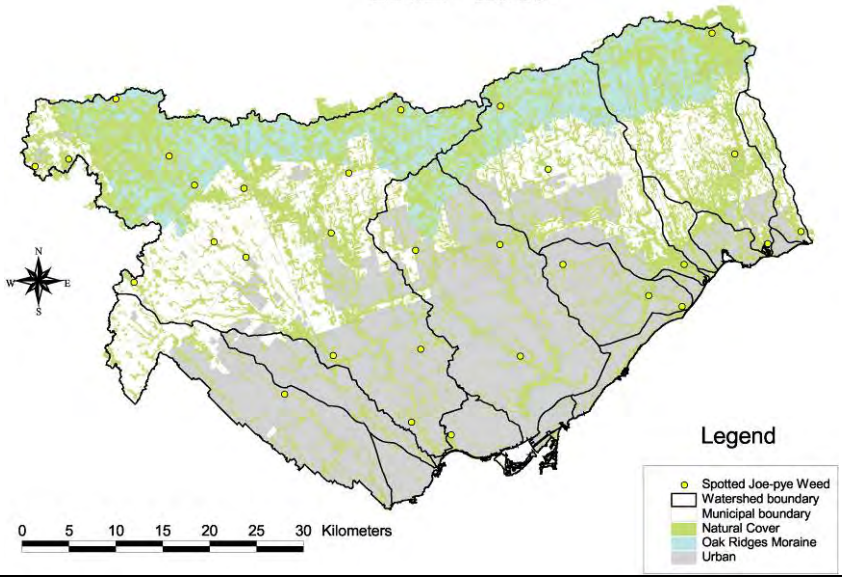

Greater Burreed(L3)
2002 - 2006
0 5 10 15 20 25 30 Kilometers
Legend
Greater Burreed
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

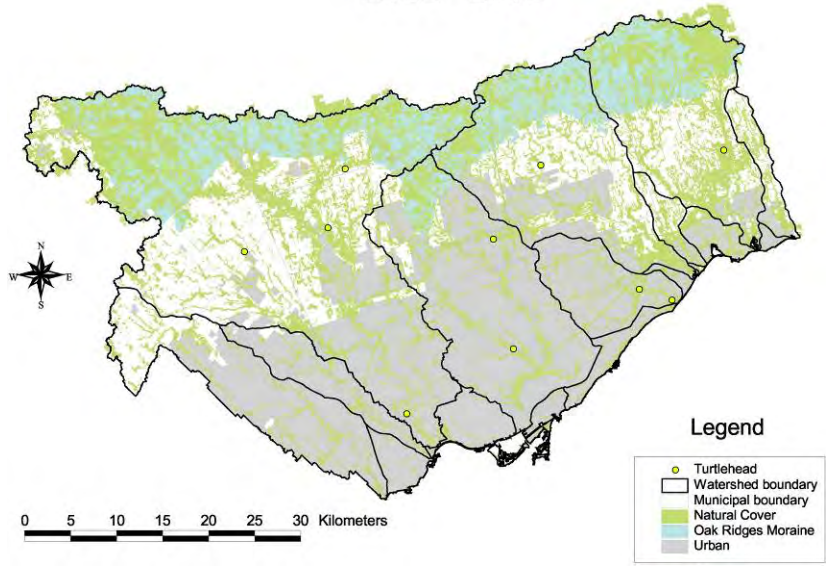

Winterberry (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Winterberry
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

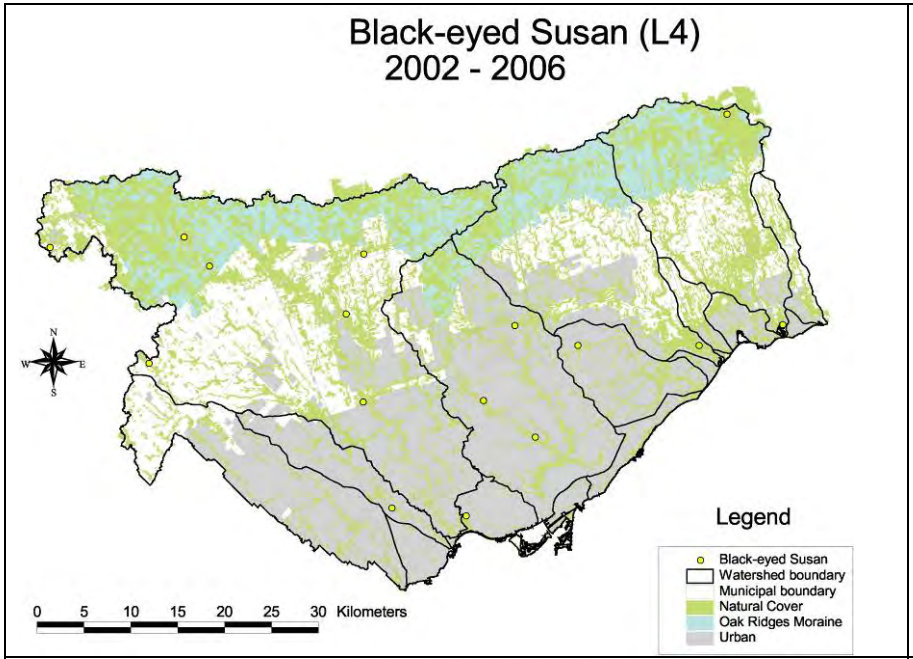

Marsh Marigold (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Marsh Marigold
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

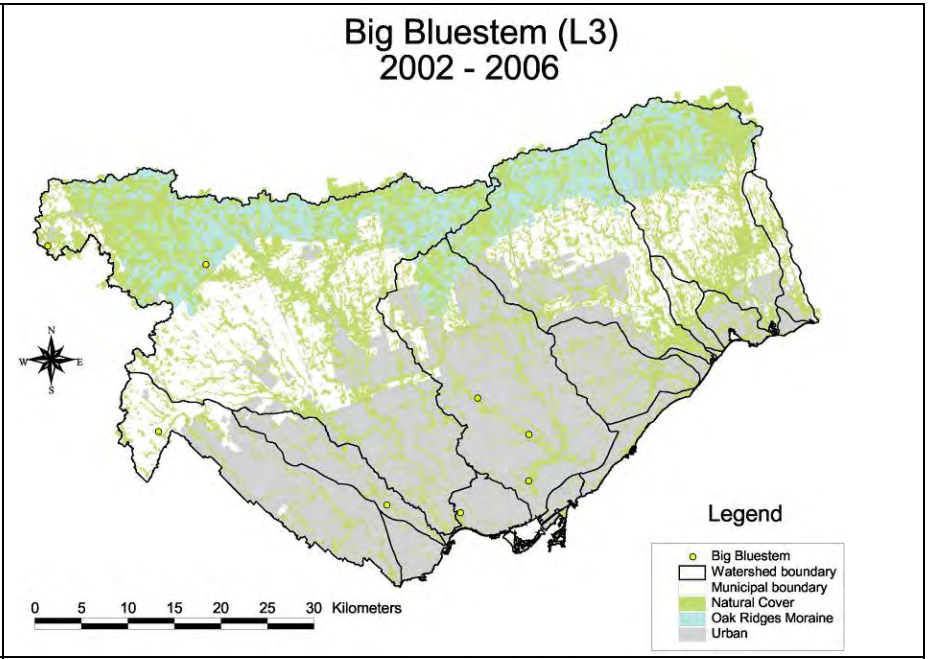

Michigan Lily (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Michigan Lily
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

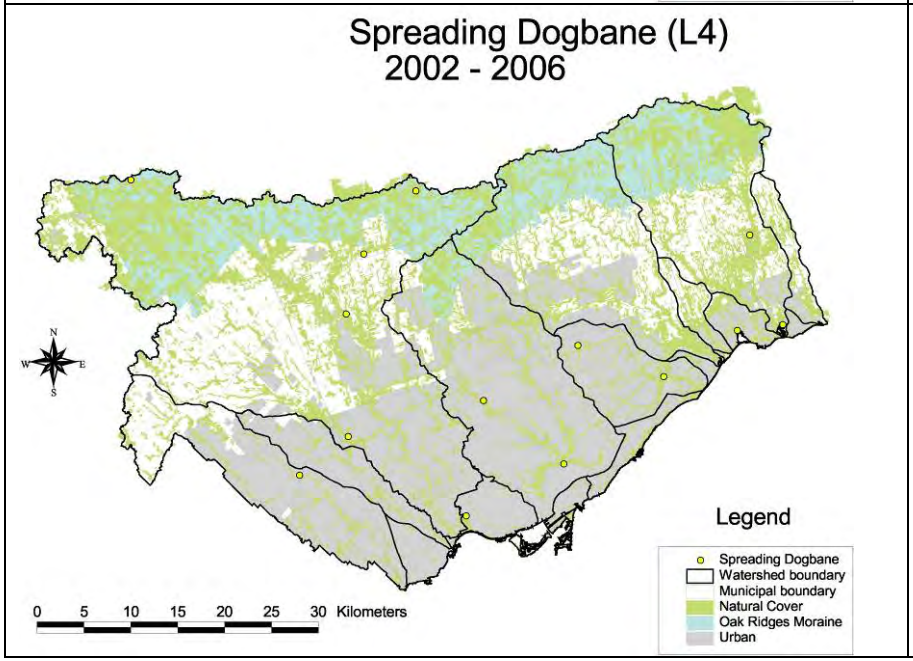

Swamp Milkweed (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Swamp Milkweed
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

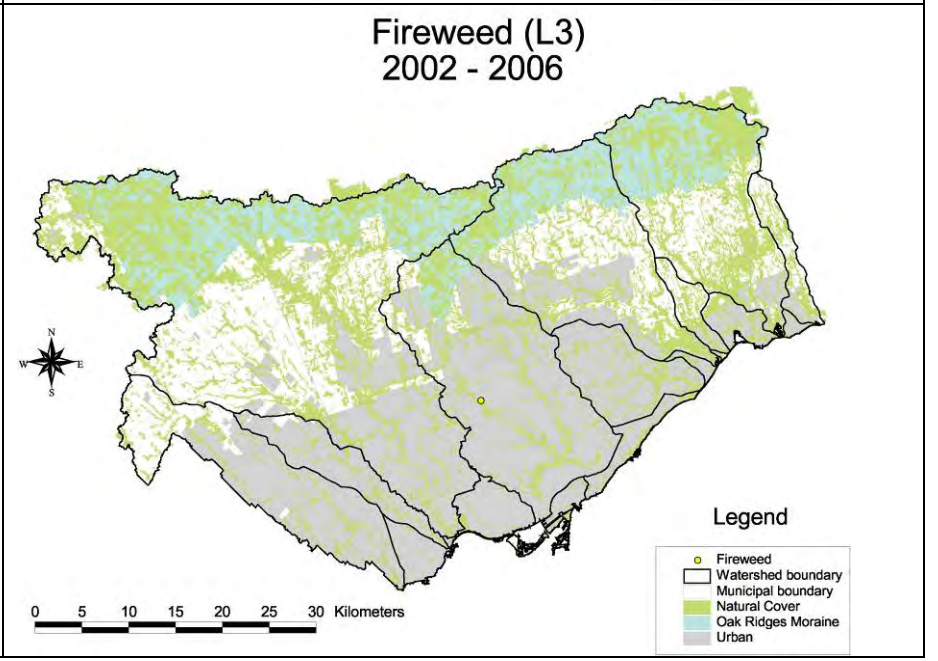

Spotted Joe-pye Weed (L5)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Spotted Joe-pye Weed
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

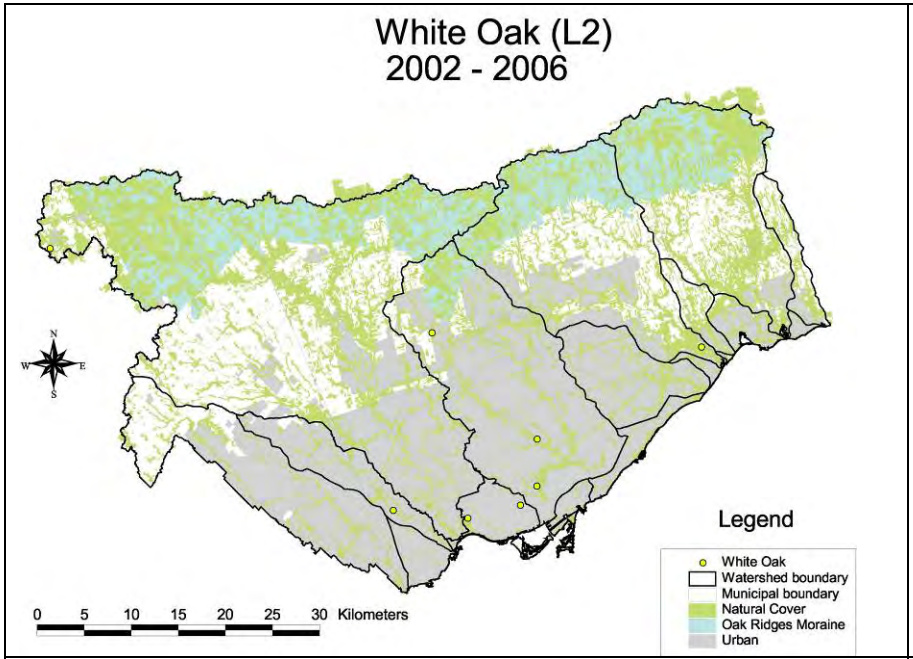

Turtlehead (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Turtlehead
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

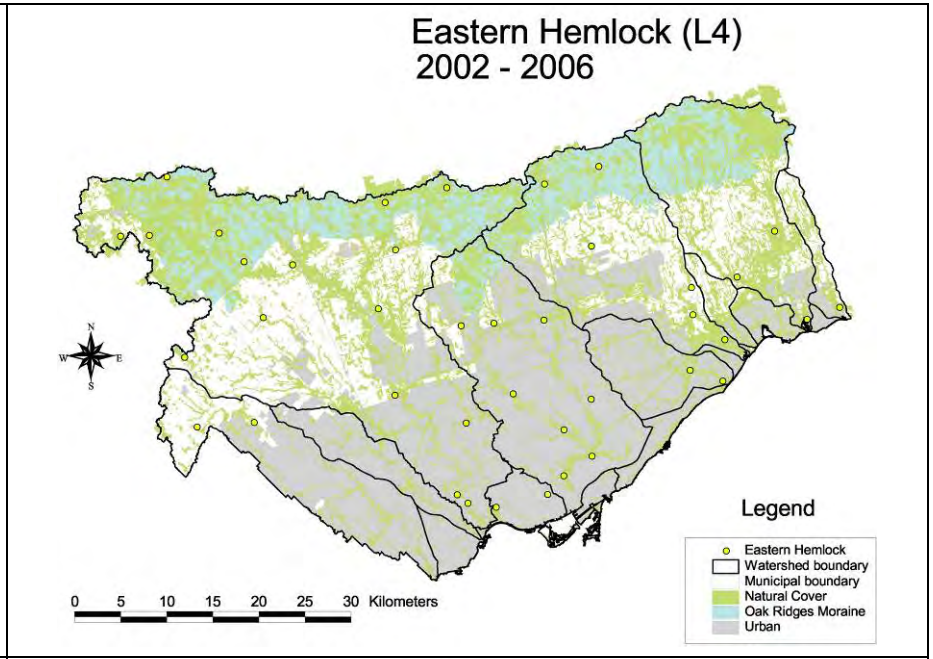

Black-eyed Susan (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Black-eyed Susan
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

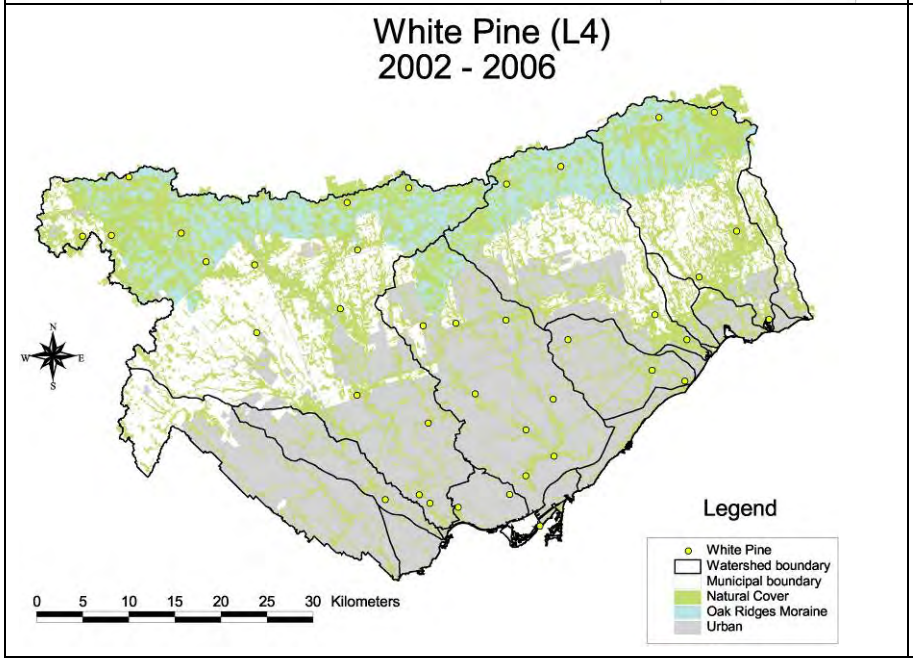

Big Bluestem (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Big Bluestem
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

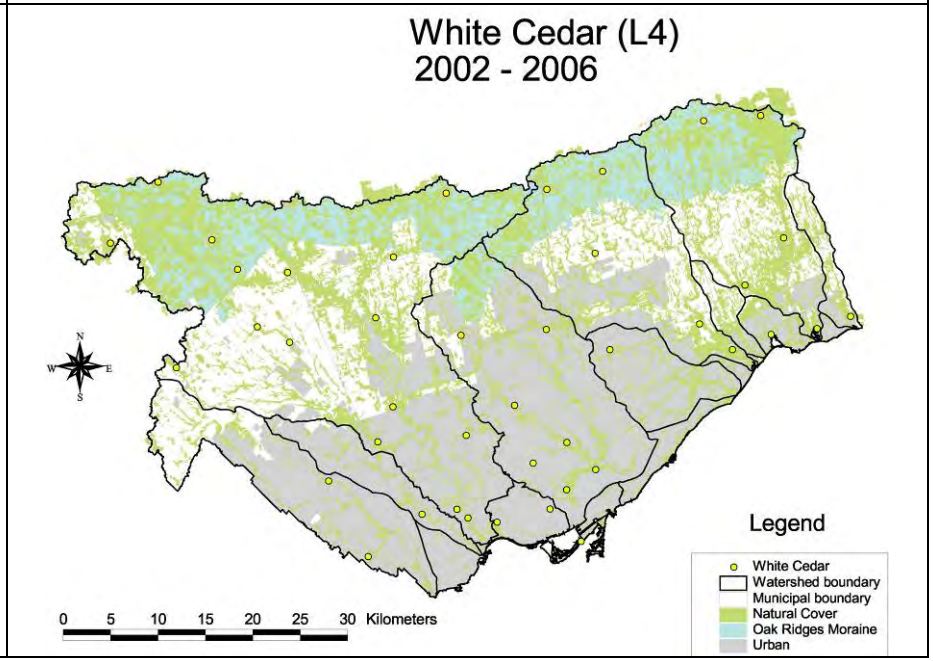

Spreading Dogbane (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Spreading Dogbane
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

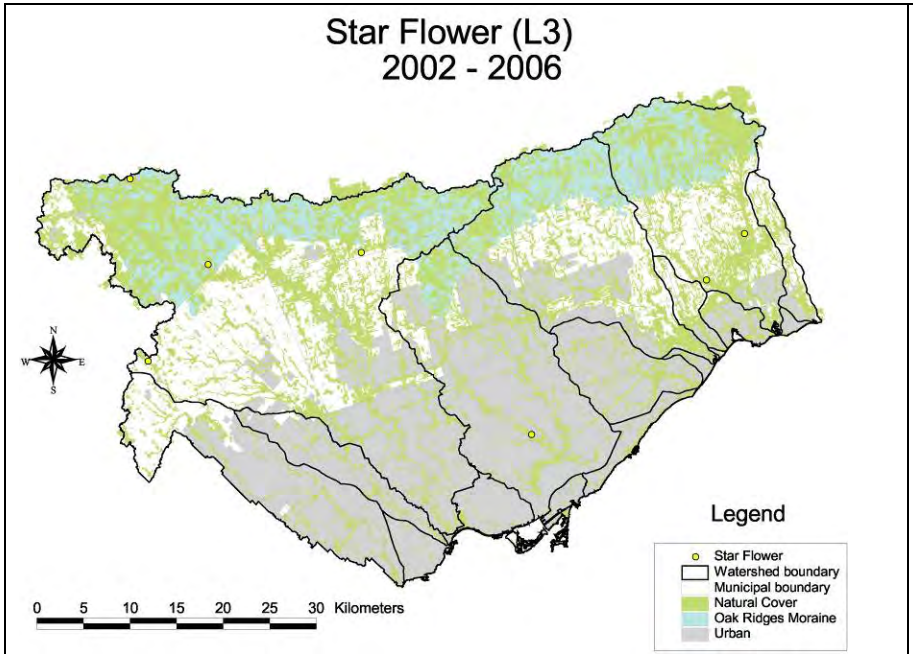

Fireweed (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Fireweed
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

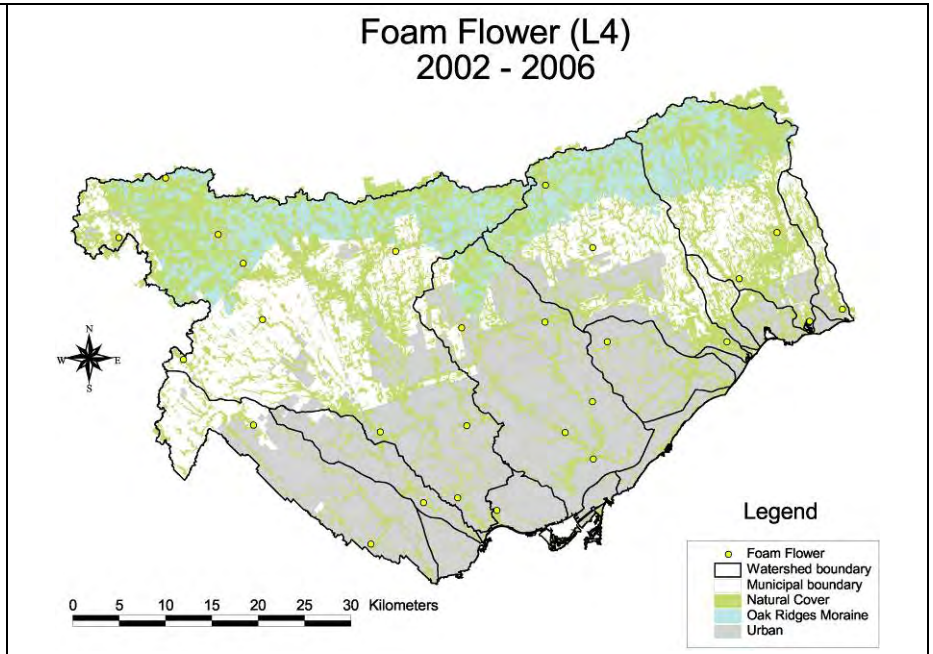

White Oak (L2)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
White Oak
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

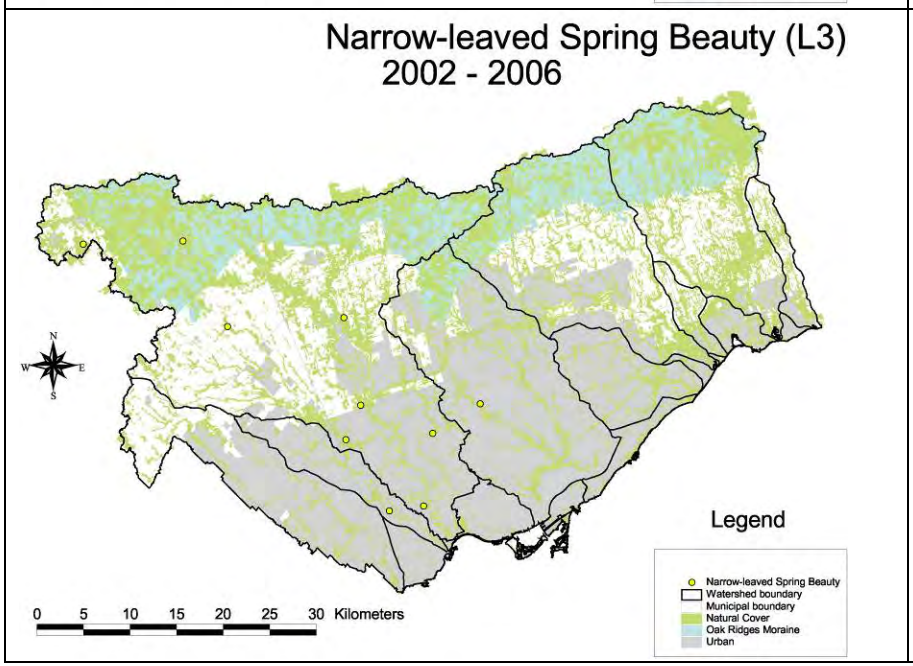

Eastern Hemlock (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Eastern Hemlock
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

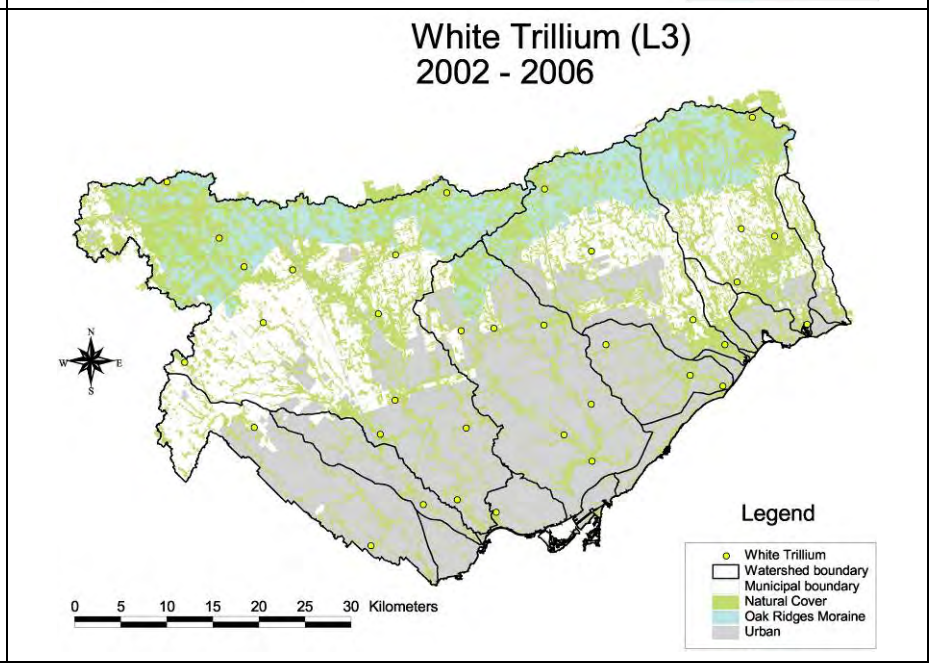

White Pine (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
White Pine
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

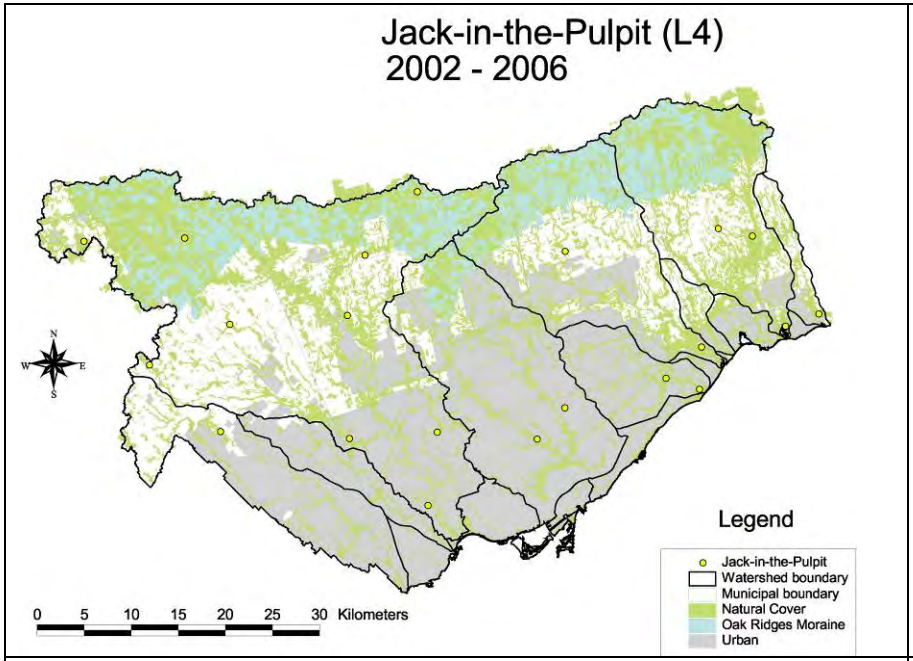

White Cedar (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
White Cedar
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

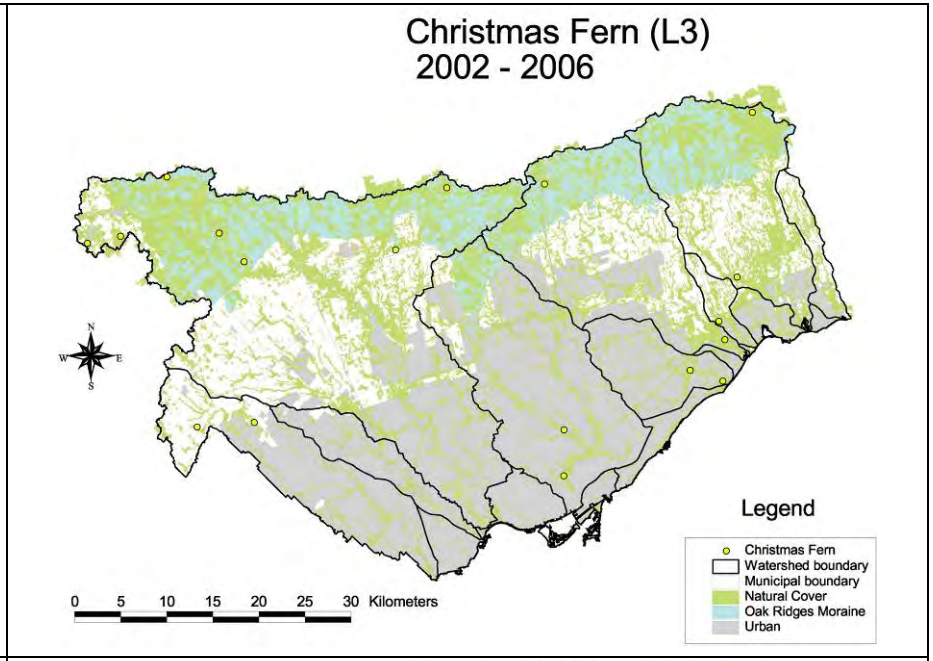

Star Flower (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Star Flower
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

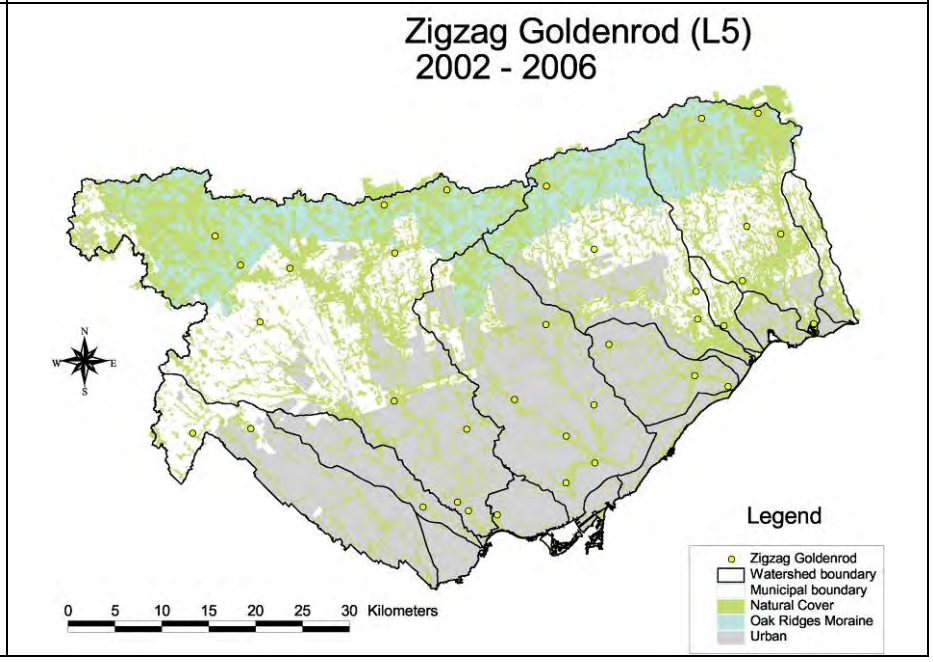

Foam Flower (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Foam Flower
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

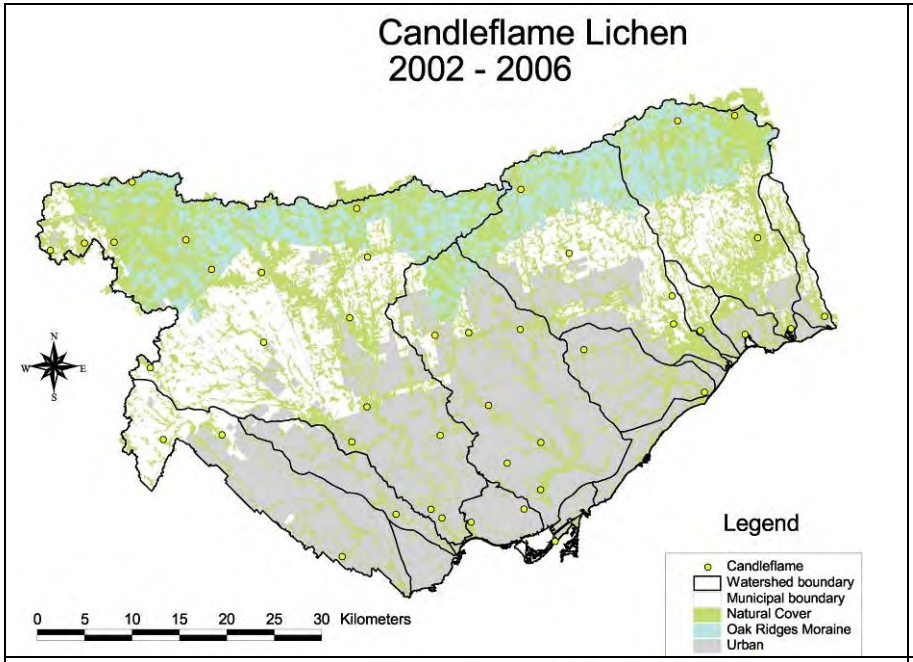

Narrow-leaved Spring Beauty (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Narrow-leaved Spring Beauty
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

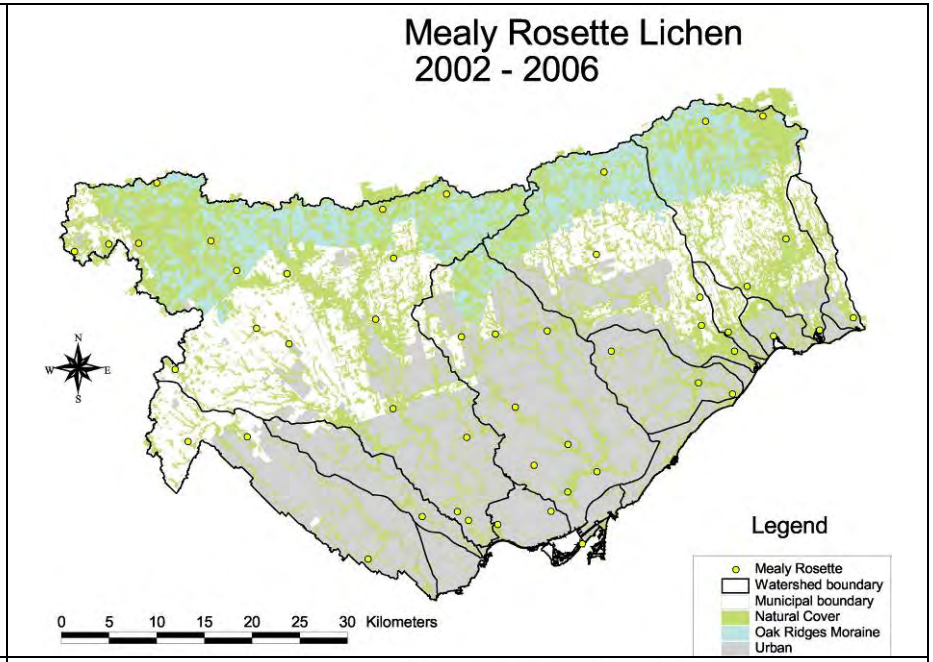

White Trillium (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
White Trillium
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

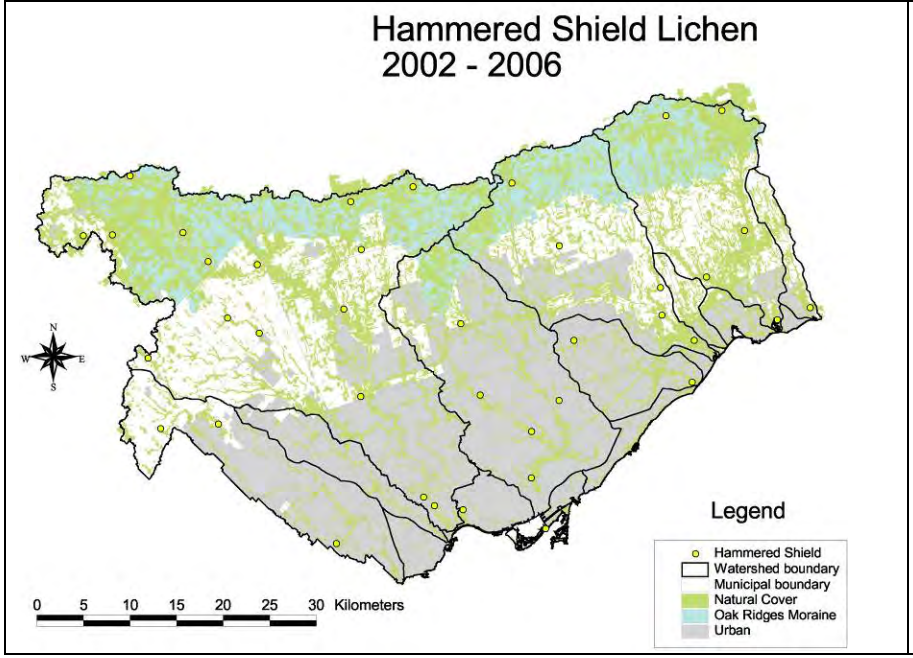

Jack-in-the-Pulpit (L4)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Jack-in-the-Pulpit
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

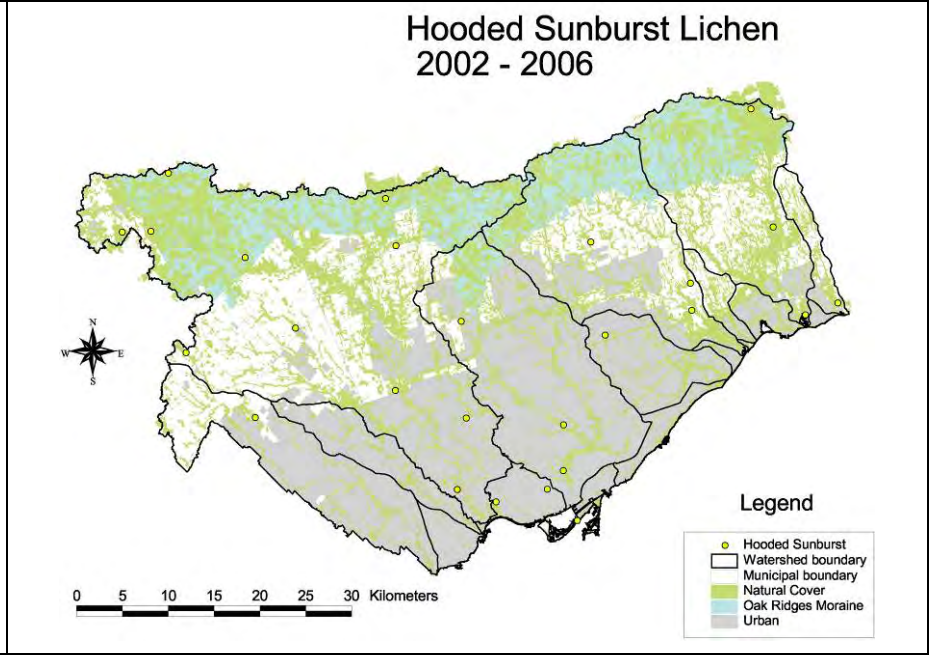

Christmas Fern (L3)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Christmas Fern
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

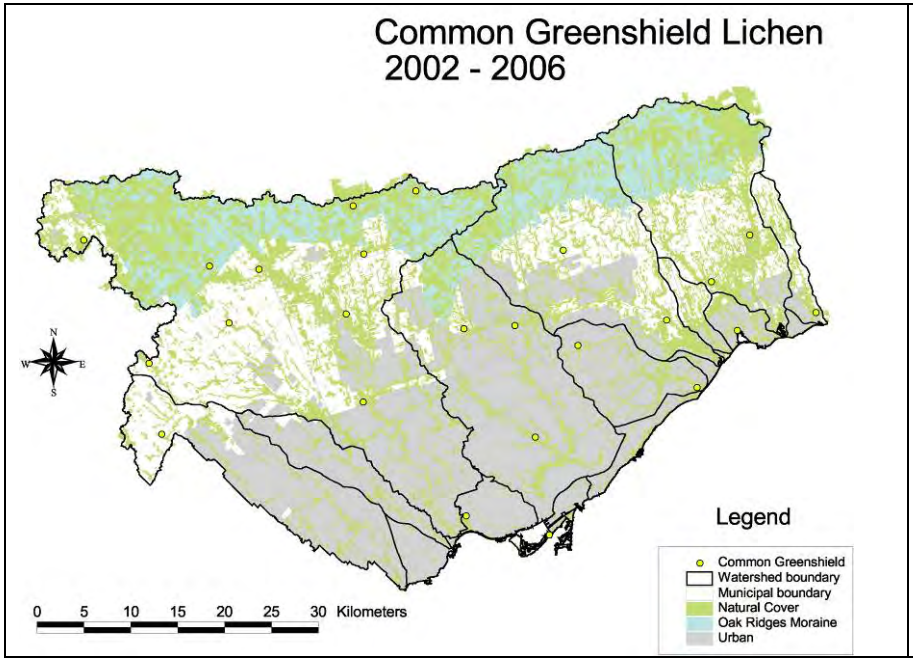

Zigzag Goldenrod (L5)
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Zigzag Goldenrod
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

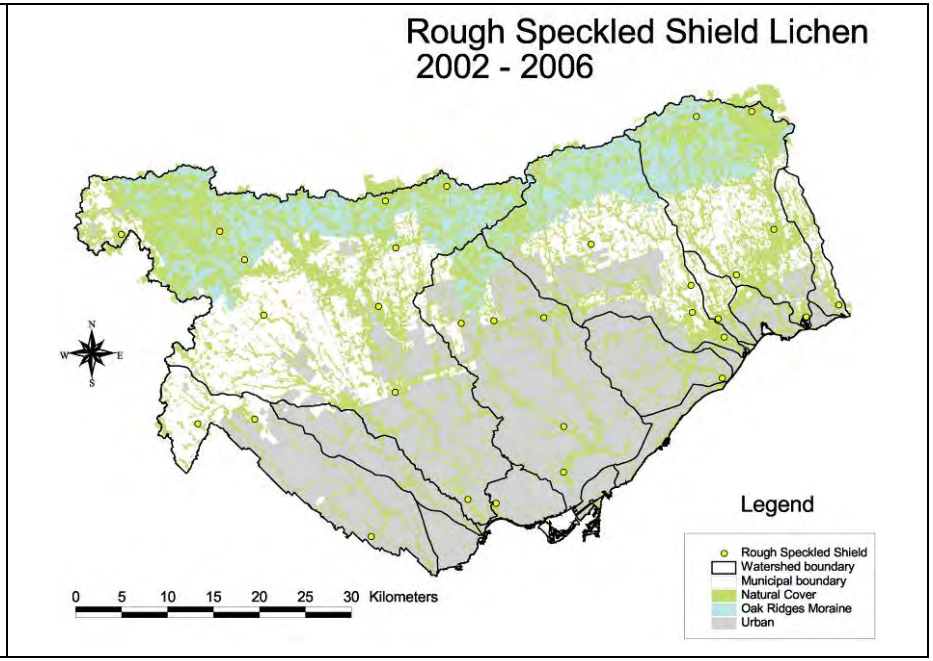

Candleflame Lichen
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Candleflame
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Mealy Rosette Lichen
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Mealy Rosette
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Hammered Shield Lichen
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Hammered Shield
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Hooded Sunburst Lichen
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Hooded Sunburst
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Common Greenshield Lichen
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Common Greenshield
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban


Rough Speckled Shield Lichen
2002 - 2006
N
W
E
S
0 5 10 15 20 25 30 Kilometers
Legend
Rough Speckled Shield
Watershed boundary
Municipal boundary
Natural Cover
Oak Ridges Moraine
Urban

Appendix E: Staff data compared to volunteer data for selected sites

Matches are shaded		Volunteer Observations			Staff Observations		
Species	Site	Year Observed by Volunteer			Year surveyed	Species Observed on Site	Species Observed in Vicinity
American Toad	3	2004			2001	Ovenbird	
American Woodcock	3	2004			2001	Ruffed grouse	
Barber-pole bulrush	3	2004			2001	Star Flower	
Candleflame	3		2005	2006	2001	White cedar	
Chorus Frog	3	2004		2006		White pine	
Christmas Fern	3		2005	2006			Eastern wood peewee
Eastern hemlock	3	2004		2006	2001		Scarlet tanager
Eastern wood-pewee	3	2004	2005	2006			
Foam-flower	3	2004		2006			
Green frog	3		2005				
Hammered shield	3		2005	2006			
Hooded Sunburst	3		2005	2006			
Mealy Rosette	3		2005	2006			
Ovenbird	3	2004	2005	2006			
Scarlet tanager	3	2004	2005	2006			
Spotted Joe Pye weed	3	2004	2005	2006			
Spreading dogbane	3		2005	2006			
Spring Peeper	3	2004		2006			
Star-flower	3	2004		2006			
White cedar	3	2004		2006			
White pine	3	2004		2006			
White Trillium	3	2004		2006			
Wood Frog	3	2004		2006			
American Toad	8	2002			2001	Eastern hemlock	
American Woodcock	8	2002			1998	Ovenbird	
Candleflame	8	2002			1998		American woodcock
Common Greenshield	8		2005		2001		Eastern wood peewee
Eastern Chipmunk	8		2005		1998		Grey treefrog

Eastern Hemlock	8		2003			2006	1998		Ruffed grouse
Eastern wood-pewee	8			2004					
Hammered shield	8	2002							
Mealy Rosette	8				2005				
Ovenbird	8					2006			
Ruffed grouse	8					2006			
Savannah Sparrow	8	2002							
Spotted Joe Pye weed	8	2002							
Swamp Sparrow	8					2006			
White cedar	8		2003			2006			
White pine	8		2003			2006			
White Trillium	8	2002			2005				
Zig-zag-goldenrod	8				2005				
American Toad	13			2004	2005		2001	Eastern hemlock	
American Woodcock	13			2004	2005		2001	Eastern wood peewee	
Common arrow-head	13			2004			2001	Foam flower	
Common Greenshield	13				2005		2001	White cedar	
Eastern Hemlock	13				2005	2006	2001		American woodcock
Eastern wood-pewee	13			2004	2005	2006	2001		Bobolink
Foam-flower	13			2004	2005	2006	2001		Green heron
Hammered shield	13				2005		2002		Spring peeper
Jack-in-the-pulpit	13				2005		2002		Western chorus frog
Marsh Marigold	13				2005		2001		Winterberry
Mealy Rosette	13				2005		2002		Wood frog
Michigan lily	13					2006			
Narrow-Leaved Spring Beauty	13					2006			
Rough Speckled Shield	13				2005				
Spotted Joe Pye weed	13			2004		2006			
White cedar	13				2005	2006			
White Trillium	13			2004	2005	2006			
Wood Frog	13			2004	2005				

Zig-zag-goldenrod	13				2005				
American Woodcock	16	2002	2003	2004	2005	2006	2002	American woodcock	
Barber-pole bulrush	16		2003	2004	2005			Broad-leaved Spring beauty	
Black-eyed Susan	16		2003	2004	2005		2002	Eastern hemlock	
Candleflame	16		2003				2003	Michigan lily	
Common arrow-head	16				2005		2002	White cedar	
Common Greenshield	16		2003				2002	White pine	
Eastern Hemlock	16		2003	2004	2005		2003		Bobolink
Hammered shield	16	2002	2003				2003		Eastern meadowlark
Jack-in-the-pulpit	16	2002	2003	2004	2005		2003		Eastern screech owl
Marsh Marigold	16	2002	2003	2004	2005		2003		Green heron
Mealy Rosette	16	2002	2003				2002, 2003		Spring peeper
Michigan lily	16	2002	2003	2004			2003		White trillium
Narrow-leaved spring beauty	16				2005		1999,2003		Wood frog
Riverbank wild rye	16		2003	2004					
Rough Speckled Shield	16	2002							
Spotted Joe Pye weed	16		2003	2004	2005				
Spreading dogbane	16	2002	2003	2004	2005				
Spring Peeper	16	2002	2003	2004	2005	2006			
Swamp milkweed	16		2003	2004					
Swamp Sparrow	16			2004					
Turtlehead	16			2004					
White cedar	16		2003	2004	2005				
White pine	16		2003	2004	2005				
White Trillium	16		2003		2005				
Wood Frog	16		2003		2005	2006			
Barber-pole bulrush	20					2006	2001	Common Arrowhead	
Bobolink	20					2006	2003		American Woodcock

Common arrow-head	20					2006	2003		Eastern meadowlark
Eastern meadowlark	20				2005		2003		Savannah sparrow
Greater bur-reed	20					2006			
Green frog	20				2005	2006			
Savannah Sparrow	20		2003		2005	2006			
Spotted Joe Pye weed	20				2005	2006			
Spreading dogbane	20				2005				
White cedar	20					2006			
Big blue-stem	27					2006	2002	Narrow leaved spring beauty	
Black-eyed Susan	27					2006	2002	Michigan lily	
Candleflame	27				2005				
Foam-flower	27		2003						
Mealy Rosette	27				2005				
Narrow-Leaved Spring Beauty	27		2003						
Ovenbird	27				2005				
Swamp Sparrow	27				2005	2006			
White cedar	27		2003			2006			
White oak	27				2005	2006			
White pine	27		2003			2006			
White Trillium	27		2003						
Zig-zag-goldenrod	27				2005				
Big blue-stem	30	2002	2003	2004	2005	2006	2000, 2001	Eastern wood peewee	
Black-eyed Susan	30	2002	2003	2004	2005	2006	2000	Eastern chipmunk	
Candleflame	30		2003	2004	2005	2006	1998	White Oak	Big bluestem
Common arrow-head	30			2004	2005	2006			
Common Greenshield	30		2003	2004	2005				
Eastern Chipmunk	30	2002	2003	2004		2006			
Eastern Hemlock	30		2003	2004	2005	2006			
Eastern screech owl	30			2004					
Eastern wood-pewee	30	2002			2005	2006			
Foam-flower	30	2002							

Greater bur-reed	30					2006			
Green frog	30				2005	2006			
Grey treefrog	30				2005				
Hammered shield	30		2003	2004	2005	2006			
Hooded Sunburst	30		2003	2004		2006			
Mealy Rosette	30	2002	2003	2004	2005				
Riverbank wild rye	30			2004	2005				
Rough Speckled Shield	30		2003			2006			
Spotted Joe Pye weed	30			2004	2005	2006			
Spreading dogbane	30	2002	2003						
White cedar	30		2003	2004	2005	2006			
White oak	30	2002	2003	2004	2005	2006			
White pine	30		2003	2004	2005	2006			
White Trillium	30	2002	2003	2004	2005				
Zig-zag-goldenrod	30	2002	2003	2004	2005	2006			
Eastern Hemlock	33					2006	2002	Eastern hemlock	
Eastern screech owl	33			2004			2002	White trillium	
Eastern wood-pewee	33					2006	2001	Eastern wood peewee	
Foam-flower	33					2006			
Mealy Rosette	33		2003			2006			
Savannah Sparrow	33		2003						
Spreading dogbane	33		2003						
White cedar	33			2004	2005	2006			
White pine	33			2004	2005	2006			
White Trillium	33	2002	2003			2006			
Winterberry	33					2006			
Zig-zag-goldenrod	33		2003	2004					
American Toad	35	2002	2003		2005		2004	Barber-pole bulrush	
Barber-pole bulrush	35					2006	2004	Christmas fern	
Big blue-stem	35		2003	2004	2005	2006	2000	Eastern chipmunk	
Black-eyed Susan	35		2003	2004	2005	2006	2004	Eastern screech owl	

Candleflame	35	2002		2004	2005	2006	2001	Eastern wood peewee	
Christmas Fern	35					2006	2004	Jack-in-the-pulpit	
Common arrow-head	35					2006	2004	Michigan lily	
Common Greenshield	35	2002		2004	2005		2004	Scarlet tanager	
Eastern Chipmunk	35			2004			2004	Star flower	
Eastern Hemlock	35		2003	2004	2005	2006	2004	Turtlehead	
Eastern screech owl	35		2003	2004	2005	2006	2004	White cedar	
Eastern wood-pewee	35		2003			2006	2004	White pine	
Foam-flower	35	2002	2003	2004	2005	2006	2004	White trillium	
Greater bur-reed	35					2006	2004		Eastern hemlock
Green frog	35		2003	2004		2006	2004		Marsh marigold
Hammered shield	35	2002		2004	2005	2006	2004		Michigan lily
Hooded Sunburst	35	2002		2004	2005	2006	2004		Riverbank wild rye
Jack-in-the-pulpit	35	2002		2004	2005		2004		Spreading dogbane
Marsh Marigold	35	2002		2004	2005		2004		White oak
Mealy Rosette	35	2002		2004	2005	2006			
Northern Leopard Frog	35			2004					
Pileated Woodpecker	35	2002	2003	2004	2005				
Riverbank wild rye	35		2003	2004	2005	2006			
Rough Speckled Shield	35	2002		2004	2005				
Scarlet tanager	35					2006			
Spotted Joe Pye weed	35		2003	2004	2005	2006			
Star-flower	35					2006			
Swamp milkweed	35		2003	2004	2005				
Swamp Sparrow	35		2003						
Turtlehead	35		2003			2006			
White cedar	35		2003	2004	2005	2006			
White oak	35		2003		2005	2006			
White pine	35		2003	2004	2005	2006			

White Trillium	35	2002	2003	2004	2005	2006			
Winterberry	35	2002		2004	2005				
Zig-zag-goldenrod	35	2002		2004	2005	2006			
Candleflame	38	2002					2003	Eastern chipmunk	
Common Greenshield	38	2002					1998	Eastern hemlock	
Eastern Hemlock	38		2003			2006	2003	Eastern screech owl	
Eastern screech owl	38		2003				2003	Eastern wood peewee	
Eastern wood-pewee	38				2005		1998	White pine	
Hammered shield	38	2002					1984	White trillium	
Mealy Rosette	38	2002			2005				
Ovenbird	38				2005				
Rough Speckled Shield	38	2002			2005				
White pine	38		2003			2006			
White Trillium	38	2002							
American Woodcock	51	2002					2001	Eastern chipmunk	
Christmas Fern	51			2004			2001	Eastern hemlock	
Eastern Hemlock	51				2005		2001	Eastern wood peewee	
Green frog	51	2002					2001	Swamp Sparrow	
Jack-in-the-pulpit	51	2002					2001	White pine	
Marsh Marigold	51	2002					2001		
Mealy Rosette	51			2004					
Ovenbird	51	2002							
Savannah Sparrow	51	2002							
Spotted Joe Pye weed	51	2002							
Spreading dogbane	51	2002							
Swamp Sparrow	51	2002							
Turtlehead	51	2002							
White pine	51				2005				
White Trillium	51	2002							
Zig-zag-goldenrod	51			2004					

Barber-pole bulrush	52			2004			2003	Christmas fern	
Candleflame	52		2003				2001	Eastern chipmunk	
Christmas Fern	52			2004			2003	Eastern hemlock	
Common arrow-head	52		2003	2004			2000	Eastern screech owl	
Common Greenshield	52			2004			1997	Green heron	
Eastern Chipmunk	52	2002					2003	White pine	
Eastern Hemlock	52		2003	2004	2005		2003	White trillium	
Hammered shield	52		2003				1997	Wood duck	
Jack-in-the-pulpit	52		2003	2004			2003		American toad
Marsh Marigold	52		2003	2004					
Mealy Rosette	52	2002	2003	2004					
Mink	52				2005				
Rough Speckled Shield	52	2002		2004					
Spotted Joe Pye weed	52		2003	2004					
Swamp Sparrow	52			2004					
Turtlehead	52			2004					
White pine	52		2003	2004	2005				
White Trillium	52		2003	2004					
Winterberry	52			2004					
Zig-zag-goldenrod	52		2003						
American Toad	54					2006	2005	American toad	
Barber-pole bulrush	54	2002					2005	Bobolink	
Candleflame	54	2002					2005	Green frog	
Common arrow-head	54	2002			2005	2006	2005	Swamp sparrow	
Common Greenshield	54	2002					2005	Common arrowhead	
Eastern wood-pewee	54				2005	2006	2005	Barber-pole bulrush	
Greater bur-reed	54	2002			2005		2005	Swamp milkweed	
Green frog	54					2006	2005	Greater bur-reed	
Mealy Rosette	54	2002					2005		Northern leopard frog

Ovenbird	54					2006	2005		White pine
Riverbank wild rye	54	2002					2005		Wood duck
Spreading dogbane	54	2002							
Swamp milkweed	54	2002							
Swamp Sparrow	54				2005	2006			
White cedar	54					2006			
American Toad	63		2003		2005				
American Woodcock	63		2003						
Candleflame	63	2002		2004					
Chorus Frog	63				2005				
Common Greenshield	63	2002							
Eastern Hemlock	63				2005				
Foam-flower	63		2003				2003	American toad	
Green frog	63	2002					2002,2003	American woodcock	
Hammered shield	63	2002		2004			2003	Barber-pole bulrush	
Hooded Sunburst	63			2004			2001,2003	Eastern chipmunk	
Jack-in-the-pulpit	63	2002	2003				2003	Eastern wood peewee	
Marsh Marigold	63	2002	2003				2003	Foam flower	
Mealy Rosette	63	2002		2004			2002	Green frog	
Rough Speckled Shield	63	2002		2004			2003	Swamp sparrow	
Spotted Joe Pye weed	63	2002					2003	White cedar	
Swamp milkweed	63	2002					2001,2002	Wood frog	
White cedar	63				2005		2003		Savannah sparrow
Winterberry	63	2002							
Wood Frog	63		2003		2005				

Regional Watershed Monitoring Program

The Regional Watershed Monitoring Program (RWMP) was established by the Toronto and Region Conservation Authority (TRCA) to evaluate the health of the Toronto region watersheds and track changes over time. The program was also designed to fulfill the monitoring and reporting needs of the Toronto Remedial Action Plan (RAP). The program aims to bring together like-minded agencies and organizations to collect, store, distribute and report on environmental monitoring data that supports decision making.

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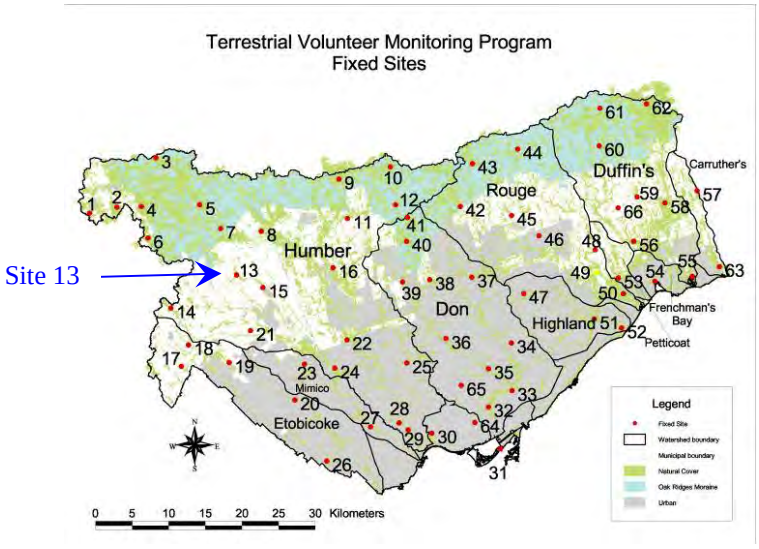
The program uses indicators to measure aquatic and terrestrial ecosystem health and change over time at the region, watershed and subwatershed levels (Tier One monitoring). The data will be used by network partners to identify areas of impact, and inform decisions regarding appropriate locations for more intensive monitoring (Tier Two) or environmental management activities such as habitat improvements or human impact reduction. Data from the terrestrial monitoring element will be used in action planning and evaluation of the Terrestrial Natural Heritage System Strategy implementation.

Volunteer monitored terrestrial sites are 10 hectares in size, and are distributed throughout the watersheds of the Toronto region.

Michigan Lily (L3)



General Site Description

This site is located in the Caledon area, on private property. The site crosses a property line and so is partially owned by two separate landowners. The site is forested with both deciduous and coniferous

components and has a tributary of the West Humber river running through it. It is surrounded by agricultural and rural residential land uses.

Site Characteristics

Each terrestrial site is characterized based on the general habitat types contained within it, it's proximity to urban development, and the watershed/subwatershed within which it is located. This information is used to group like sites for comparison and analysis of results.


Spring Peeper (L2)

Ownership	Private	
Rural/Urban	Rural	
Watershed	Humber	
Subwatershed	West Humber	
Habitat Type	**Present this site**	**Area (hectares)**
Forest	Yes	10
Meadow	No	
Wetland	No	
Successional	No	
Riparian	Yes	
Beach/Bluff	No	

Indicator Species

The monitoring program utilizes a set of 56 amphibian, bird, mammal, flora and lichen species as indicators of ecosystem health and records the presence or absence of these species each year. A greater number of the total set found would indicate a wider range of habitat types present and/or a healthier ecosystem. For species with known critical requirements and/or sensitivities, the presence or absence of said species can be used to infer the existence or lack of these needs and/or inhibitors (e.g. The Scarlet Tanager needs large forest area for breeding; The Ovenbird, as a ground nester, is sensitive to forest floor trampling and free roaming pets.) Such inferences can be verified through site visits and other means such as trail mapping where appropriate.

All species of fauna and vascular plants found within the Toronto region have been assigned a local species of conservation concern rank (L-rank) by TRCA biologists. This classification is helpful in prioritizing conservation actions related to species, and in communicating the local status of species to others. L1 is the highest level of concern or highest priority for conservation while L5 is assigned to species which are able to survive and perhaps even thrive in very urbanized habitats. L ranks have not been determined for lichens at this point.

The following tables summarize data collected on this site.

Years and Seasons Surveyed				
Year	Winter	Spring	Summer	Fall
2002				
2003				
2004		*	*	
2005	*	*		*
2006	*	*	*	*

Species Found	L rank	Year(s) Found
Fauna		
American Woodcock	L3	2004-2005
Eastern wood peewee	L4	2004-2006
American toad	L4	2004-2005
Wood frog	L2	2004-2005
Flora		
Marsh Marigold	L4	2005
Jack-in-the-pulpit	L4	2005
Narrow-leaved Spring Beauty	L3	2006
White Trillium	L3	2004-2006
Foam flower	L4	2004-2006
Michigan Lily	L3	2004-2006
Spotted Joe-pye Weed	L5	2004-2006
Common arrowhead	L4	2004
Zig-zag Goldenrod	L5	2005
Eastern hemlock	L4	2005-2006
White cedar	L4	2005-2006
Lichens		
Mealy Rosette	NA	2005
Common Greenshield	NA	2005
Hammered Shield	NA	2005
Rough speckled shield	NA	2004-2005


Common Greenshield Lichen

# indicator species found	19	
% of indicators found this site	34%	
% of indicators found (avg. for all sites)	31%	
% of indicators found (avg. for rural sites)	34%	
% of indicators found (avg. for rural sites with complete seasonal coverage)	39%	
% of indicators found (avg. for urban sites)	29%	

Summary

This site is average with respect to rural sites in the number of indicator species found. Being a totally forest block with riparian zones, it is not surprising that meadow and wetland species were not found. The fact that it supports the wood frog indicates reasonably high quality forest with wet areas/vernal pools available for breeding. The wood frog is an L2 ranked species (high level of conservation concern) so this is a positive aspect of the site.

Continuing data collection over time will provide the ability to observe changes as they occur, make comparisons with other locations and/or time periods, and use this information in conservation planning and implementation.

If you would like more information regarding this site, or the Terrestrial Monitoring Volunteer Program, please contact Theresa McKenzie at 416-661-6600 extension 5658 or email tmckenzie@trca.on.ca