Terrestrial Volunteer Monitoring

Program Review

Toronto and Region Conservation Authority

March 2015

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Report Prepared by: Theresa McKenzie, Terrestrial Volunteer Coordinator
Reviewed by: Scott Jarvie, Associate Director, Enviromental Monitoring & Data Management

1.0 Introduction

The TRCA Terrestrial Volunteer Monitoring (TVM Program, or TVMP) has been in operation since 2002, with 2003 being the first complete year of data collection. During 2013, a report entitled *Terrestrial Biodiversity in the Toronto region 2003 - 2012* (TRCA 2013) was prepared, for publication on the website in early 2014. This milestone presents an ideal opportunity to review the TVM program, how well it is meeting its objectives, to summarize accomplishments, to document remaining or emerging challenges and to make recommendations for the future. This report documents the results of this review.

In recent years, there has been interest from a variety of organizations in beginning to monitor nature reserves, parks, restoration sites or other local sites for which they have responsibility. In addition, some Conservation Authorities without a long-term terrestrial monitoring program are considering instituting one. Such organizations may find this program review useful as they consider their own options for monitoring.

2.0 TVM Program purpose and objectives

In addition to the scientific objectives for a monitoring program, the TVMP was established to meet additional objectives relating to public engagement, volunteer participation, field training for biology students and mentoring as outlined under the categories below:

2.1 Major objectives

a) to add a cost-effective terrestrial long-term monitoring element to the TRCA regional monitoring effort, which had previously covered only aquatic habitats
b) to provide scientifically robust data that could be used to evaluate terrestrial ecosystem condition in the region as a whole, as well as the major urbanization zones (originally urban and rural, later an urbanizing zone was also mapped)
c) to monitor selected indicators over the long-term to establish whether change/trends were occurring
d) to monitor indicators that would provide an ability to interpret the data in relation to potential cause(s) of differences and/or trends found; monitoring results would thereby provide recommendations relevant to the TRCA mandate
e) to provide empirical field data to monitor the results of implementation of the Terrestrial Natural Heritage Systems Strategy and to test the assumptions on which it was based
f) to provide an opportunity for volunteer participation in monitoring by members of the public having sufficient knowledge to form a basis for training in scientific protocols and species identification; ideal volunteer candidate groups were amateur naturalists, perhaps with established expertise in one area or species group (e.g. birds, wildflowers) who wanted to learn more, university students in biology or ecology

programs wishing to obtain field experience, and foreign-trained professionals with a similar need for local knowledge and experience

g) to pilot a volunteer monitoring program, and establish whether such a program could provide the desired results from a science perspective

h) to communicate the lessons learned and support the efforts of internal and external partners to meet their own monitoring objectives by capitalizing on the information coming out of the TVMP

3.0 Program design, indicators, and protocols

The TVM program design and protocols are described in detail in other documents, including the TVMP Volunteer Manual (2014), the Coordinator's Guide (2015) and program reports (TRCA 2006, TRCA 2008, TRCA 2012, TRCA 2013). The following, largely duplicated from the Coordinator's guide, summarizes:

3.1 Study area description

The area monitored encompasses the terrestrial and wetland natural cover in the nine watersheds of the TRCA jurisdiction. These include Etobicoke Creek, Mimico Creek, Humber River, Don River, Highland Creek, Rouge River, Petticoat Creek, Duffin's Creek and Carruther's Creek. Also included are the land areas of Frenchman's Bay, the Toronto Islands and the Lake Ontario waterfront within the jurisdictional boundaries.

The total area is approximately 250,000 hectares and includes the entire City of Toronto, significant portions of the regional municipalities of York, Durham, and Peel as well as a small area in Mono-Adjala township (Figure 1).

When the monitoring began, TRCA landscape analysis identified 66,000 hectares under natural cover. By 2007-2008, 61,900 hectares remained. Natural cover is not evenly distributed, with a disproportionate weighting towards the north (Figure 2). Within the City of Toronto, it exists primarily on floodplains and slopes associated with the river valleys, these lands having been preserved primarily for flood control purposes.

Physiographic features within the region include a portion of the Oak Ridges moraine, the morainal south slope, Peel plain, and the glacial Lake Iroquois shoreline. The Niagara escarpment passes through the northwestern corner of the jurisdiction where it meets the western boundary of the Oak Ridges moraine landform.

The Toronto region lies in an ecological transition zone between the Great Lakes-St. Lawrence forest in the north and the Carolinian forest in the south. Terrestrial natural cover is

primarily deciduous and mixed forest, interspersed with smaller tracts of wetland, meadow and Great Lakes shoreline habitats (TRCA, 2007a).

3.2 Sample size

Without the benefit of an *a priori* power analysis or existing data to support one, the sample size was set conservatively at the high end of what might be expected to support analysis, with a determination that 1% of the total area of terrestrial natural cover would be included in monitoring sites. Because the intent was to monitor a range of habitat types at each site, and volunteers would be collecting presence/absence data for a set of indicator species, the monitoring site size was set at 10 hectares, which meant a sample size of 66 sites. Originally, three were subjectively-selected control sites, including urban parkland, a residential subdivision, and an agricultural field. The latter two of these proved to be impractical to monitor under the TVM protocols, and they were dropped from the program. The urban park control (Queen's Park) remains.

3.3 Site selection process

The balance of the fixed 10 hectare site locations were selected by random placement of points within the mapped natural cover of the region. For each point location, ortho-rectified aerial photography was viewed with a Geographical Information System (GIS), running ArcView software. The user outlined a 10 hectare polygon containing the point. Subjectively, the priority was to include first forest, then wetland, followed by a watercourse and finally, meadow habitat, within the site boundary. This priority was based on the natural history of the area prior to European colonization, and meant to follow the distribution of habitat components at that time.

Once the fixed sites were outlined, lot-level property boundaries were added to the aerial photo view, and land ownership researched. While some properties were TRCA owned, many others had private or other levels of public ownership. Since site boundaries had been drawn on the basis of landscape level habitat types, deliberately not considering property boundaries, many sites included the properties of multiple landowners. All landowners were approached for permission to conduct long-term monitoring on their lands. Where such was not obtained, if possible, boundaries were adjusted to eliminate the property for which permission was not given. To minimize complexity at this point, priority was placed on incorporating abutting land for which permission had been obtained. At the completion of the site selection process, 55 sample sites, in addition to the urban park control site, comprised the final complement of 56 sites monitored under the program.

3.4 Native indicator species selection

Reports produced under the TVMP to date discuss the purpose, and value, in selecting a limited number of indicators for monitoring (TRCA 2006, TRCA 2008, TRCA 2013). For the purposes of the TVMP, the final complement of 50 native indicator species incorporates a robust set representing the habitats of interest, a variety of taxonomic groups, habitat required during all seasons, and a range of ecological requirements and sensitivities as determined under the Regional Species of Conservation Concern Ranking and Scoring protocol (2011).

Section 3.5 describes the Species of Conservation Concern scoring method. Developed by TRCA for the Toronto region, but widely applicable, this method provides a foundation on which all of the Authority's terrestrial species conservation and monitoring work, including the TVM program, depend. From the perspective of the TVM program, it supports both the biodiversity metric used and the interpretation of the monitoring results.

The final indicator species set was selected to optimize the information content that could be obtained through the interpretation of presence/absence data and species richness.

3.5 TRCA Species of Conservation Concern ranking and scoring

Effective 1998, TRCA adopted the designation of terrestrial Species of Conservation Concern for the region. Using regional distribution data, native flora and fauna were assigned to one of three rank categories: regional concern, urban concern, or not of concern. Subsequently, an objective scoring method was developed and applied, to provide explanatory detail to the ranks, and to allow for standardized updates to be carried out as additional, or more current, data became available. Under the method, vascular plants and vertebrate animals native to the Toronto region are scored on a set of ecological sensitivity, habitat requirement and abundance criteria by TRCA biologists. The criteria scores are summed to provide a total score, which is then used to assign the local rank of conservation concern (TRCA 2011). The method is designed both to enhance our ability to recognize species of regional concern before they have become rare, and to better understand what characteristics of individual species affect their sensitivity or risk of being lost from natural cover in the region. The ranks indicate the degree to which various species are in need of protection and the score detail informs conservation action in order to enhance the prospects for success.

A similar ranking and scoring method is applied to native vegetation communities (TRCA 2011). It will not be discussed further here, since vegetation communities are not monitored under the TVMP.

Flora are scored using four criteria: local occurrence, population trend, habitat dependence, and sensitivity to impacts associated with development. Fauna are scored on seven criteria:

local occurrence, local population trend, continent-wide or range-wide population trend, habitat dependence, sensitivity to development, area-sensitivity, and patch isolation sensitivity. Appendix B lists the scores and ranks for the native indicator species monitored under the TVMP protocols.

Initial application of the scoring method resulted in the recognition and designation of five local conservation concern ranks, referred to as L ranks. Species ranked L1 through L3 are the *Species of Conservation Concern* (SOCC) for the Toronto region, analogous to the earlier "regional concern" rank. Those ranked L4 are considered species of concern in the urban and urbanizing zones, and those ranked L5 are not of concern at either the regional or the urban scale.

The method also records native species that are known to have been extirpated from the region with an LX designation, and non-native (introduced) species with an L+. Species in these groups are not scored.

Species scores are periodically updated as, and when, new data becomes available. For example, a change in local occurrence as determined through TRCA's biological inventory work will trigger a re-evaluation for the affected species, as will published research that expands knowledge of a species requirements, or updates continental or range level abundance or distribution data. Additional information on the rationale and methodology can be found in the document entitled *Vegetation community and species ranking and scoring method* (TRCA 2011).

3.6 Native species monitoring protocol

The monitoring protocol is outlined in the TVM Volunteer Manual (TRCA 2014). The rationale for the method and additional relevant information for the purposes of the program coordinator are discussed here.

The native species selection process included discussions among TRCA biologists to consider:

- the ease with which trained volunteers would be able to find and accurately identify selected species, given their presence on the site
- the ideal time of year and time of day to conduct searches
- the potential for misidentification resulting from the presence of a look-alike or sound-alike species, and
- the optimal observation method to be employed for each selected species

The results of these discussions can been seen in the complement of indicators selected, the timing of visits for each species, the identifying characteristics that must be verified and checked off on the data sheets to confirm a correct identification, and the method(s) of observation for each species. Examples of the latter include visual observation of an

individual, recognition of a mating call or bird song, playback of bird songs or calls to elicit a response from a territorial individual, and/or visual observation and identification of tracks or trails. The volunteer manual includes all of the data sheets. The winter #1 sheet is appended to this document as a sample (Appendix A).

For some species, all of that species' observation characteristics must be checked on the data sheet for the record to be counted as a positive observation of the species, without verification. For other species, only one, or two, of three characteristics are required. The template documenting this is included in the Quality Assurance (QA) tool in Microsoft Access, and is used in the QA process to flag species observations requiring verification. It is attached as Appendix C to this report for reference.

The identification characteristics for each species were carefully selected to minimize the likelihood of a trained volunteer making an incorrect identification. Often, they assist the volunteer in focusing on individual characteristics that rule out a specific, potentially confusing, species. An example of this is having the volunteer verify that a presumed porcupine has neither a "mask" on the face, nor bands on the tail, thus minimizing the potential for recording a raccoon as a porcupine. Training sessions explicitly discuss this, so that volunteers are consciously aware of potential misidentifications themselves and focused on preventing them.

Confidence in the results and published reports from a program that relies upon volunteers to collect the data is enhanced by:

- the requirement for candidates to have some level of relevant knowledge on which the training can build prior to being accepted into the program
- the requirement for training prior to monitoring for each season
- the provision of support materials including an instruction manual, aerial photo and Ecological Land Classification coded maps, a colour field guide, and DVD with audio files
- the protocol method, which is designed to minimize the risk of recording an absence for a species that is present, as well as the risk of misidentifications
- the application of the automated quality assurance protocol, followed by the staff verification process
- the ability to flag data with questionable validity and revisit it as more information becomes available
- the long-term commitment requested of volunteers

3.7 Invasive plant indicator species

Invasive species monitoring was not a component of the TVMP at the program's inception in 2002. Within five years however, it became evident that many sites were invaded by exotic

invasive plants. At the same time, a greater focus was being placed on the issue of invasive species regionally, within Ontario, and across North America. The five-year program review determined that regional scale monitoring of invasive plants was needed, and that it was feasible to implement a protocol that would use trained TVMP volunteers to assess the severity of invasion by a limited number of invasive plants. Eight high-priority invasive species were selected in consultation with staff botanists, and a protocol developed for implementation beginning 2009 (TRCA 2012).

4.0 Data collection results

Originally, while it was agreed that a site monitoring frequency of every second year was sufficient to provide information on ecosystem condition, it was also agreed that such a schedule would be impractical from the volunteer engagement perspective, and thus an annual schedule of survey visits was established. Since data are compiled to calculate species richness scores by site and time period, data gaps due to missed surveys are problematic. The solution employed for the 10-year report was to compile annual data into two-year periods for analysis. A single native indicator species richness score was calculated for each site for each two-year period.

Data collection improved for individual sites and thus the program as a whole over the first 9 years, dropped slightly in the tenth year, remained at 80% until 2014, when it fell again (table 1). During the first few years, increases were due both to the fact that the program became more well-known, such that the pool of potential volunteers grew, and to staff efforts to ensure that full data collection and data entry happened. With recognition of the necessity to do so, reminders were sent to volunteers in a variety of forms to encourage full compliance with the protocol collection schedule. Many follow-ups were carried out to encourage complete data entry. A systemic reason for the 2014 drop has not been established, although it has become evident that students in all fields are now being strongly encouraged to volunteer. A recruit who is unable to find a volunteer program in their chosen field may apply for the TVM program instead. Such a volunteer tends not to fulfill the commitment long-term. A data gap is likely to occur while a replacement is recruited.

The data entry situation improved considerably following the 2005-2006 development and implementation of an online database for direct entry by volunteers upon completion of visits. This eliminated the need to physically receive paper data sheets from volunteers and enter them, and also provided a data summary reporting mechanism that allowed the coordinator to track the status of data collection throughout the year.

Table 1: Data collection results by year

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
% complete	24%	41%	43%	52%	63%	76%	79%	80%	85%	80%	80%	80%	74%

5.0 Data quality assurance

Section 3 of this report, in particular the discussion of the native indicator species identification protocol in Section 3.6, reviews aspects of quality assurance. The 2006 progress report (TRCA 2006) describes the quality assurance process including the automated data validation and manual data verification processes in detail. Key to the process is the automated validation tool, which compares data records to a set of templates in order to flag data that violates survey visit protocols, such as date or time of day of survey, as well as species observations for which one or more required characteristics are not recorded. The coordinator reviews flagged data during the verification process, and has the ability to accept, reject or allow data to remain flagged. Data that are accepted or rejected will not appear in subsequent flagged data reviews, while data remaining flagged may or may not be accepted or rejected at a later review, if there is additional information available to inform such a decision.

At the end of 2012 there were 154 species observations either rejected or remaining flagged, equivalent to 2.3% of the 6787 species presence records. Of these, 86 flagged records originated from a single site for which a large number of species were recorded over time although the typical habitat for them was missing. The questionable identification status for multiple species observations led to uncertainty with respect to the observer's ability to identify other species, resulting in all observations for that site being flagged. The site was removed from the data analyses for the 10-year report.

6.0 Data compilation, analysis and interpretation

Species observations are compiled into species richness scores by site/time period. The time period selected will depend upon data gaps and the best option for garnering the most useful data. Annual periods are not necessary and will result in fewer sites with full data. For the 10-year report, two-year periods were selected.

The species richness score incorporates the Flora and Fauna Regional Species of Conservation Concern (SOCC) ranking, by weighting presence according to the SOCC total score in the calculation of TVM native indicator species richness.

TVM native indicator species richness score is the sum of the SOCC total scores for all indicators recorded as present during the period in question, divided by the sum of SOCC total scores for all native indicators, multiplied by 100, per the equation below. SR scores, therefore, are in the range 0 - 100. They are referred to as scores, not percentages.

Equation:

$$\text{SR score} = \frac{\Sigma \text{ SOCC total scores for all species found on site X in time period T}}{\Sigma \text{ SOCC total scores for all native indicator species}} \text{ X } 100$$

In addition to reporting SR scores for the full indicator species set, subgroups or guilds can be analyzed using the appropriate sub-scores calculated in a similar way.

The SOCC total scores are revised occasionally by the terrestrial staff biologists. For the 10-year report, the most recently available scores were used when data analysis began. By the time it was complete, there had been single point revisions to two or three species. Since the effect would be negligible to the TVM SR scores, they were not adjusted.

Lichens have not been scored and ranked. At this point the presence of any lichen indicator is scored using the minimum total score recorded by any native indicator that has been scored, i.e. eight points.

The previous 5-year report used a different method for reporting species richness and for incorporating the information content from the SOCC scoring and ranking (TRCA 2008). The newer method described above, as used in 2013, is more informative, easier to apply and more easily communicated.

Analysis and statistics

Analysis to date has primarily investigated differences between urbanization zones, temporal trends (with none evident), and has modelled landscape-level characteristics as explanatory variables. The methods used in the most recent report (TRCA 2013) are a good starting point for future analysis.

When communicating results, it is important to note that the TVM SR scores are most useful in a relative sense and not an absolute one, although very low scores support an interpretation that can make a very strong point with respect to the impacts related to urbanization, and their result on biodiversity. There is no objective way to establish what score represents a maximum, indicative of a "pristine' condition. It would not be expected that any site contained habitat for all of the indicator species, and so a score approaching 100 would not be realistic, even for an "unimpacted" site.

7.0 Reporting

The schedule of reports is as follows:

- annual - summary report incorporated as a section in the Environmental Monitoring and Data Management Progress Report; a template is followed, and the draft is generally due during January for the previous calendar year
- periodic (five-year schedule) biodiversity in the Toronto region report; compiles the data, analyzes, interprets and makes recommendations; this is the primary ongoing report from the program; the next report will be prepared for publication in 2018, comprising results to 2017
- invasive species reporting; schedule to be determined; the first report covering 2009 - 2011 data was produced in 2012
- ad hoc reports as appropriate; if data compilation shows a change or trend may be occurring, that should be reported

7.1 TVM Reports published to date

Terrestrial biodiversity in the Toronto region 2003 - 2012: a decade of monitoring under the Terrestrial Volunteer Monitoring Program. December 2013.

Severity of invasion by invasive plant indicators at Terrestrial Volunteer Monitoring Program sites 2009 - 2011. June 2012.

Toronto and Region Terrestrial Volunteer Monitoring Program Monitoring Results 2002 - 2007.
June 2008.

Terrestrial Volunteer Monitoring Program, Progress Report. December 2006.

8.0 Scientific results and utility of the information

As demonstrated by the published reports, the presence/absence data collected on the indicator species monitored under the program have proven to be informative with respect to the terrestrial ecosystem condition of the region and its urbanization zones, judged on the basis of indicator species richness. Similarly, the quantitative scores for severity of invasion by the invasive plant indicators is informative with respect to differences between urbanization zones and the distribution of invasions. The data reported for the 2009 - 2011 period provide a baseline against which future invasion scores may be compared.

8.1 Experimental error

As is the case for any data collection project, there may be errors in the data. It is possible that a species was missed, and therefore recorded as absent on one or more visits on one or more sites on which it was actually present. It is also possible that one or more species were incorrectly identified and thus recorded as present when in fact absent, from one or more sites. Some species are more difficult to find than others. Some are more difficult to identify. Some volunteers are more familiar with some species than are others. The protocols are designed to minimize the potential for error, especially for differential error between sites or groups of sites that could introduce a systematic bias. The number of indicators monitored, and the frequency of surveys, combined with the data quality assurances processes together minimize both the error rate and the impact on the species richness score, should there be an error with respect to a species. Data exploration to investigate the possibility of systematic bias has found no evidence of any, and confidence in the overall data quality is high.

8.2 Utility of the methods and data for other groups

The methods have proved to be robust in fulfillment of the program objectives. Further, the long-term dataset of native indicator species richness scores, and severity of invasion scores, with means for the region as a whole and the urbanization zones, provide benchmarks that may be of use to other groups having a need to institute terrestrial monitoring in Southern Ontario.

As discussed in the *Terrestrial Biodiversity in the Toronto region 2003 - 2012* report (TRCA 2013), others could follow either the complete survey protocol, or segments of that protocol to monitor a site of interest. The resulting indicator species richness scores could be tracked to judge change over time, and compared to the appropriate urbanization zone means to interpret condition relative to those zones. Some general examples are:

- tracking success of restoration projects, before and after the restoration work and/or over the long-term
- monitoring a local site such as a conservation area, land trust property, park or reserve; tracking how its ability to support and/or sustain native biodiversity compares to the average, minimum or maximum for the urbanization zone in which it is located; such information will be valuable in evaluating the success of a management plan
- golf course monitoring; with adaptation it may be possible to benchmark using TVM data, by tracking how many of the native indicator species persist on the property over

time; the volunteer manual and the published reports provide some basic information on actions that could be undertaken to enhance the score

9.0 Program enhancement

The TVM program is meant to be dynamic and responsive to the information needs of the organization and its partners, while maintaining standardized protocols. The addition of the invasive species monitoring component is an example of an enhancement that resulted from a new, identified need. During the first few years of the program, protocols underwent minor revisions as a result of lessons learned. These were designed to enhance data accuracy. The primary example is the addition of mink trail identification as a valid observation characteristic for that species, designed to improve the recording of mink where they were in fact present on a site. It necessitated not only the addition of an appropriate characteristic to the data sheet, but also the inclusion of training on mammal track and trail identification in the winter season training presentation.

The importance of maintaining standard protocols over the long term means that changes should not be made unless the benefit of doing so outweighs the potential cost. Modifications should be documented, and explicitly considered when data analysis and interpretation occurs. Using the example above, an increase in recorded presence of mink beginning in 2009, is interpreted as success in the new protocol's ability to find and record mink, when present. Should there be a change in the frequency of mink reported over time with 2009 used as the baseline year, the interpretation will be different.

Any revision to the program requires a consideration of both the pros and the cons of making a change. Since the program aims to track temporal change, this is particularly true with respect to any modification that may affect the "before" to "after" comparability of results Any revision must be documented, including a description of the change, the rationale for making it, and the date implemented. Following are the significant revisions made to date:

- effective December 2008 minor enhancements to the volunteer manual were made; these included the addition of some new photos, minor rewording of some species identification characteristics to make them clearer, and the addition of the "Native Species Indicators; Indications" table
- effective winter 2009 a species observation tertiary characteristic was added for mink and porcupine that permitted the recording of tracks; winter training was modified to include a section on track and trail identification, how to distinguish mink and porcupine tracks from other animal tracks that might be observed, photos of trails and tracks and training on how to properly measure and photograph trails for verification; the volunteer manual was similarly enhanced

- effective July 2009 the invasive plant species surveys were implemented, and six of the previously monitored native plant indicators were removed from the protocols; all volunteers were required to attend the training, the training presentation was expanded to cover the new protocols, the length of the summer #3 and summer #4 surveys were increased from 1-1/2 hours to 2 hours, and the manual was modified to include the invasive indicators
- effective June 2012, the section of the manual covering safety was updated to include the Workplace Hazard Assessment document, and training covering this information was included in all site assignment program orientation training from that point forward
- effective August 2014 a general update of the manual was completed to incorporate information resulting from the reports, the most current L rank scores for indicators, and more current TRCA corporate information

There is a risk that at some point one or more site locations will need to be changed. If a property is sold, a new landowner may not continue providing permission to monitor. Properties may become developed. A protocol to follow in these cases has not been developed. This should be done. It could be argued that, in the first case, an alternate location within a specific radius should be randomly selected if possible, whereas in the second case the site should continue to be monitored according to the protocols as long as possible. By doing so, the effect of the habitat loss will be taken into account during temporal analysis.

10.0 Accomplishments and challenges

10.1 Summary of accomplishments since program launch

- long-term operation with growth in participation and data collection
- development of website and online data entry database
- protocol enhancements, training enhancements
- new invasive plant protocol
- development of scoring methodology for native indicator species richness and severity of invasion
- data analysis and reports
- presentations made at Latornell conferences, Ontario Forestry Association annual meeting, Terrestrial Invasive Plant Species conference, Southern Ontario CAs Terrestrial Monitoring group meetings, Regional Monitoring Forum
- internal presentations to the TRCA Development and Planning division's SWOT (Strengths, weaknesses, opportunities and threats) team, the stewardship group, Humber Alliance, and Etobicoke-Mimico Coalition
- newsletter/newspaper articles and contributions to articles

- volunteer engagement and positive feedback
- mentoring and proven value of program in enhancing career goal achievement for participants; several who have advanced to employment in the conservation field have cited the experience gained in the TVM program as helpful in this respect

10.2 Remaining or emerging challenges

- need better method of tracking volunteer hours for reporting purposes
- QA/QC tool needs programming each time it is run; it is not clear whether this is a bug, a feature of the programming, or solely related to the MS Access software product updates/revisions that occur over time; a 2015 project is planned to revise the database structure
- the FrontPage web editing software is obsolete; a new tool is required
- program website would benefit from updating to offer more current content and attractive images
- internal (TRCA) familiarity with the program and understanding of its value could still be better, although it has increased significantly with the increased communications since publication of the 10-year report
- the increasing incidence of black-legged ticks and tick-borne disease in Ontario presents an emerging challenge for field workers, including volunteers
- the challenging and deteriorating local job market for students graduating from biology programs results in many leaving the area for work; more volunteer participants now resign with little warning and prior to completion of the 3-year term, due to a need to pursue career opportunities elsewhere; the sudden nature of their departure may result in lost data

11.0 Recommendations

- replace FrontPage
- update the trcavolunteerdata.ca website in conjunction with the above
- implement other programming bug fixes, updates to the online database and to the QA/AC tool
- modify TRCA volunteer application process for automatic notification to employer e-mail address when an application is entered online
- enhance TVM volunteer online database with the addition of a data entry table to which volunteers can log in and enter their volunteer hours
- obtain additional photos and videos to strengthen communications products and training
- review available videos for possible inclusion in training presentations (e.g. pileated woodpecker video)

- consider whether there is value in, and it is corporately practical to, implement a program Facebook page
- integrate the TVM program's species richness scoring approach to the monitoring data analysis for TRCA restoration projects
- continue to share program information, data and reports with external partners and other interested parties; during 2015, share data and methods with Parks Canada, as they develop their approach to monitoring of the Rouge Urban National Park
- review the volunteer role, and the needs of current volunteers to determine whether modifications to the program to better serve them are warranted; one possibility would be to develop a part-time employment option for students, wherein they could monitor multiple sites year-round while attending university; new Canadians working in other fields while attempting to become established in the field of ecology might also benefit; the resulting improvement in reliability of data collection, particularly on more remote sites, would benefit TRCA

12.0 Conclusion

The TVMP has proven to be a valuable component of the RWMP. Subject to the ongoing availability of committed volunteers, and continuing agreement by participating landowners it should continue well into the future. Enhancements over time have increased the value of the program, the benefit of participation by volunteers, as well as the quantity and quality of data generated.

Significant changes to the program are not warranted or recommended at this time. Changes to further streamline and improve the database and web content to reflect evolving technology will be implemented. The key risk to the program is the continued availability of stable funding over the long-term. Opportunities to generate new funding support will be pursued, to reduce this risk.

Appendix A - sample data sheet

Winter Visit # 1 Data Sheet

Observer name: _____ Date (month/day/year): _____

Site # : _____ Temperature: _____ (˚C)

Start Time (use 24 hr clock): _____ % Cloud Cover: _____

End Time (use 24 hr clock): _____ Precipitation: _____

	✓
mink (*Mustela vison*)	
Primary: one foot long and skinny with furry tail ……..	☐
Secondary: black/brown in colour (small white spot under chin often visible)	☐
Tertiary: tracks are in 2-2 bounding pattern; near water; to 4" wide per pair; pairs between 11" and 38" apart; trail may contain slides up to 4" wide ……	☐
porcupine (*Erethizon dorsatum*)	
Primary: black, dark grey or dark brown …….....	☐
Secondary: no mask on face or bands on tail …….....	☐
Tertiary: trail in snow is 5 to 9" wide, showing body drag all along its length, may contain urine trails; porcupine sign includes **fresh** stripping of bark from trees (add comment describing observation if this characteristic is checked; digital photo with scale if possible) ……	☐
ruffed grouse *(Bonasa umbellus)*	
Primary: when flushed – brown bird with loud wing flutter …….....	☐
Secondary: tracks chicken sized - raised hind toe often not seen in track	☐
Tertiary: chicken-sized bird ……	☐
eastern hemlock (*Tsuga canadensis*)	
Primary: single, flat needles on a small stalk in a flat arrangement on branch	☐
Secondary: needles very short with pale stripes on back …….....	☐
white pine (*Pinus strobus*)	
Primary: soft needles in clusters of five …….....	☐
Secondary: cones open loosely, elongated (8-20cm) and woody …….....	☐
white cedar *(Thuja occidentalis)*	
Primary: evergreen tree with flat scaly leaves, not needles …….....	☐
Secondary: tiny brown cones in clusters …….....	☐

Comments:

TRCA TVM INDICATOR FAUNA 2012 SCORES & RANKS		LO	PT n	PT t	HD	AS	PI	SD	AP	Total Score	L Rank
Common Name	Scientific Name										
		0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-1		
American toad	*Anaxyrus americanus*	0	3	2	1	4	0	4	0	14	L4
American woodcock	*Scolopax minor*	0	2	3	3	2	2	4	0	16	L3
bobolink	*Dolichonyx oryzivorus*	0	3	3	3	1	1	5	1	17	L3
bullfrog	*Lithobates catesbeiana*	3	3	2	2	4	2	5	1	22	L2
eastern chipmunk	*Tamias striatus*	0	2	2	2	3	1	3	0	13	L4
eastern meadowlark	*Sturnella magna*	0	2	2	2	3	1	3	0	13	L4
eastern screech-owl	*Megascops asio*	0	2	2	1	2	3	3	0	13	L4
eastern wood-pewee	*Contopus virens*	0	4	2	2	1	1	3	0	13	L4
green heron	*Butorides virescens*	0	3	2	2	1	2	4	0	14	L4
green frog	*Lithobates clamitans*	0	2	2	1	3	1	4	0	13	L4
grey treefrog	*Hyla versicolor*	0	3	3	3	4	2	5	1	21	L2
mink	*Mustela vison*	1	2	2	3	3	0	3	0	14	L4
northern leopard frog	*Lithobates pipiens*	0	3	2	1	4	2	5	1	18	L3
northern spring peeper	*Pseudacris c. crucifer*	1	2	3	3	3	2	5	1	20	L2
ovenbird	*Seiurus aurocapillus*	0	2	3	4	2	4	4	0	19	L3
pileated woodpecker	*Dryocopus pileatus*	0	2	2	4	1	3	3	0	15	L3
porcupine	*Erethizon dorsatum*	3	2	3	3	4	2	4	0	21	L2
ruffed grouse	*Bonasa umbellus*	1	3	3	3	2	2	5	1	20	L2
savannah sparrow	*Passerculus sandwichensis*	0	3	2	1	1	1	4	0	12	L4
scarlet tanager	*Piranga olivacea*	0	2	2	4	1	3	4	0	16	L3

western chorus frog	*Pseudacris triseriata*	3	3	3	2	4	3	5	1	24	**L2**
swamp sparrow	*Melospiza georgiana*	0	1	2	1	2	1	5	1	13	**L4**
Virginia rail	*Rallus limicola*	0	2	2	2	3	3	4	0	16	**L3**
wood duck	*Aix sponsa*	0	2	1	3	2	2	4	0	14	**L4**
wood frog	*Lithobates sylvatica*	0	2	3	3	4	3	5	1	21	**L2**

TRCA TVM INDICATOR FLORA 2012 SCORES & RANKS		LO	PT n	HD	SD					Total Score	L Rank
Common Name	Scientific name										
		0-5	0-5	0-5	0-5						
marsh marigold	Caltha palustris	2	4	3	4					13	L4
Jack-in-the-pulpit	Arisaema triphyllum	1	3	2	3					9	L5
narrow-leaved spring beauty	Claytonia virginica	2	4	4	5					15	L3
white trillium	Trillium grandiflorum	1	3	4	5					13	L4
foam-flower	Tiarella cordifolia	1	3	3	4					11	L4
star-flower	Trientalis borealis	1	4	4	5					14	L3
Michigan lily	Lilium michiganense	1	4	3	5					13	L4
turtlehead	Chelone glabra	2	3	4	5					14	L3
swamp milkweed	Asclepias incarnata ssp. incarnata	2	3	4	4					13	L4
spotted Joe-Pye weed	Eutrochium m. maculatum	2	2	3	3					10	L5
barber-pole bulrush	Scirpus microcarpus	1	2	4	3					10	L5
white oak	Quercus alba	2	5	4	5					16	L3
riverbank wild rye	Elymus riparius	2	2	4	4					12	L4
Christmas fern	Polystichum acrostichoides	1	3	5	4					13	L4
zig-zag goldenrod	Solidago flexicaulis	2	1	3	2					8	L5
winterberry	Ilex verticillata	2	4	4	5					15	L3
eastern hemlock	Tsuga canadensis	1	4	3	5					13	L4
white pine	Pinus strobus	1	4	3	4					12	L4
white cedar	Thuja occidentalis	1	4	1	5					11	L4

TRCA TVM INDICATOR Lichens *		* Lichens have not been assessed under the TRCA ranking and scoring protocol. For the purposes of the TVM Total SR score calculation they were arbitrarily assigned 8 points, equal to the minimum score achieved by any indicator species that has been assessed.	Total Score *	L Rank
Common Name	**Scientific name**			
mealy rosette	*Physcia millegrana*		8*	NA
candleflame	*Candelaria concolor*		8*	NA
hooded sunburst	*Xanthoria fallax*		8*	NA
hammered shield	*Parmelia sulcata*		8*	NA
rough-speckled shield	*Punctelia rudecta*		8*	NA
common greenshield	*Flavoparmelia caperata*		8*	NA

Appendix C: Quality assurance template. Any survey visit outside the specified date and time ranges is flagged for review. Any species observation that does not include the asterisked characteristics is flagged for further verification.

Terrestrial Volunteer Database Data Validity Checks - valid times of day updated July 7/10

Visit	Valid Date Range		Valid Start Time	Species	Required Characteristics			
	From	To	(24 hr clock)		Primary		Secondary	Tertiary
Winter #1	28-Dec	5-Mar	> 5:00, < 11:30	Mink	*		*	
				Porcupine	*		*	
				Ruffed Grouse	*	or	*	
				E. Hemlock	*			
				W. Pine	*			
				W. Cedar	*			
Winter #2	28-Feb	5-Apr	> 18:00	E. Screech Owl	*			
Spring #1	1-Apr	30-Apr	> 19:00	Am. Woodcock	*			
				Wood Frog	*			
				Spring Peeper	*			
				Chorus Frog	*			
				N. Leopard Frog	*			
				Am. Toad	*			
Spring #2	1-Apr	30-Apr	> 19:00	Am. Woodcock	*			
				Wood Frog	*			
				Spring Peeper	*			
				Chorus Frog	*			
				N. Leopard Frog	*			
				Am. Toad	*			
Spring #3	1-May	31-May	> 5:00, < 11:30	Wood Duck	*		*	
				Pil. Woodpecker	*		*	
				Marsh marigold	*		*	*
				Jack-in-the-pulp	*		*	
				Narrow-leaved spring beauty	*		*	*
				White Trillium	*		*	
				Foam flower	*		*	*
				Star flower	*		*	*
Summer #1	1-Jun	25-Jun	> 19:00	E. Wood Peewee	*			
				Ovenbird	*			
				Scarlet Tanager	*		*	
				Swamp Sparrow	*			
				Green Heron	*		*	
				Virginia Rail	*			
				Bobolink	*		*	*

				E. Meadowlark	*		*	*
				Savannah Sparrow	*		*	
				Green Frog	*			
				Bull Frog	*			
				Grey Treefrog	*			
Summer #2	2-Jun	5-Jul	> 19:00	E. Wood Peewee	*			
				Ovenbird	*			
				Scarlet Tanager	*		*	
				Swamp Sparrow	*			
				Green Heron	*		*	
				Virginia Rail	*			
				Bobolink	*		*	*
				E. Meadowlark	*		*	*
				Savannah Sparrow	*		*	
				Green Frog	*			
				Bull Frog	*			
				Grey Treefrog	*			
Summer #3	1-Jul	31-Jul	> 5:00	Michigan Lily	*		*	*
				Turtlehead	*		*	*
				Swamp Milkweed	*		*	*
				Spotted Joe Pye Weed	*		*	*
				Barber-pole bulrush	*		*	*
				White Oak	*		*	*
				Riverbank Wild Rye	*		*	
Summer #4	1-Aug	31-Aug	> 5:00	Michigan Lily	*		*	*
				Turtlehead	*		*	*
				Swamp Milkweed	*		*	*
				Spotted Joe Pye Weed	*		*	*
				Barber-pole bulrush	*		*	*
				White Oak	*		*	*
				Riverbank Wild Rye	*		*	
Fall #1	28-Sep	5-Nov	> 5:00	E. Chipmunk	*			
				Christmas Fern	*		*	
				Winterberry	*		*	*
				Zigzag Goldenrod	*		*	
				Mealy Rosette	*		*	*
				Candleflame	*		*	*
				Hooded Sunburst	*		*	*
				Rough Speckl. Shield	*		*	*
				Common Greenshield	*		*	*
				Hammered Shield	*		*	*

Data outside these parameters will be flagged for review, and a message displayed per listed message descriptions below. Coordinator will either accept, reject or leave data flagged data.

Flagged data messages:

Flagged visit	Date not valid for visit #
	Start time not valid for visit #
Flagged species observation.	Species observation criteria incomplete