



# Plethodontid Monitoring Protocol

## Terrestrial Long-term Fixed Plot Monitoring Program

*Regional Watershed Monitoring and Reporting*

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## 1.0 INTRODUCTION

There are several species of plethodontid salamanders across Canada but only one species is known to be found in the Toronto and Region Conservation Authority's (TRCA) jurisdiction – *Plethodon cinereus* (eastern red-backed salamander). There are historical reports of *Eurycea bislineata* (two-lined salamander) found within the region but there have been no sightings in recent years.



Figure 1: *Plethodon cinereus* (eastern red-backed salamander)

Plethodontid salamanders can be used as an indication of overall forest health due to their life history traits. They require mature deciduous or mixed forests that have damp soils, downed woody debris and good leaf litter in order to complete their life cycles. This group of salamanders is termed “lungless” as they breathe through their skin which makes them sensitive to stressors that impact soil quality and temperature as well as air quality. They generally have stable populations under appropriate habitat conditions and therefore are a good organism to study in a long-term monitoring program (Zorn, 2008).

## 2.0 STUDY DESIGN

Ensuring a sample size that is appropriate to detect region wide trends is the primary objective of the monitoring program. However, with additional funds and resources it will also be desirable to increase the sample size in order to have the ability to look at differences between three land-use zones (urban, urbanizing and rural).

### *Primary objective(s):*

- To determine if the abundance and distribution of eastern red-backed salamanders in the TRCA jurisdiction is changing  $\pm 15\%$  over a 5 year period.

An *a priori* power analysis was conducted in 2008 (Zorn 2008) to determine the appropriate number of monitoring plots needed to achieve sufficient power. In 2015, a further power analysis (retrospective) was conducted to ensure the appropriate number of plots are monitored for assessing temporal trends in red-backed salamander abundance. The sample sizes used in this power analysis were based on assuming 2014 as the baseline year and using only data from visits 2-5. The baseline year was chosen to be 2014 because this was the first year all the cover boards were the same type and therefore changes in count between years should be due to real factors instead of changing cover board type at different sites in different years. Only visits 2-5 were used to calculate average salamander abundance in 2014 because in 2015 the number of visits changed from 5 to 4. This allows the analysis to be consistent in survey effort while still using the data from 2014 as the baseline year.



Power was sufficient (>82%) for tracking regional temporal trends in average salamander abundance at long-term monitoring plots. This means that a decline of 20% over 5 years can be detected with sufficient power. Full details of the 2015 power analysis can be found in TRCA (2015b).

### 3.0 EQUIPMENT & MATERIALS

Different materials and equipment are needed depending on whether the plot is being set-up for the very first time or if visited for seasonal monitoring (Table 1).

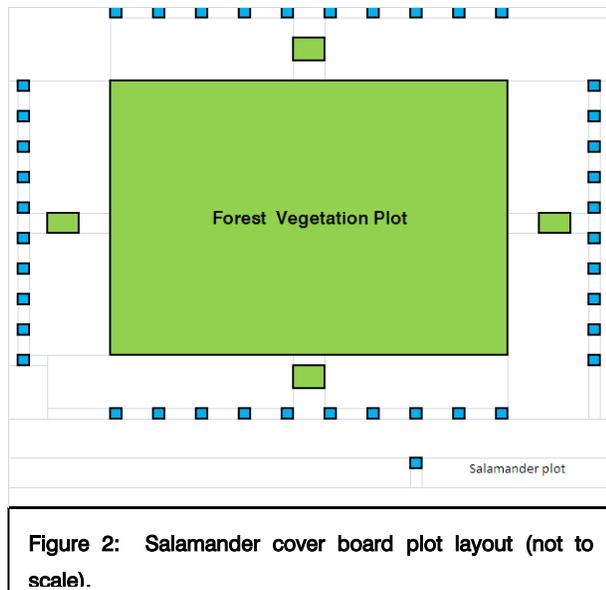
**Table 1.** List of required equipment and materials for plot set-up and seasonal monitoring.

Set-up Equipment	Seasonal Monitoring and Maintenance Equipment
<ul style="list-style-type: none"> <li>• Map showing plot locations</li> <li>• Flagging tape</li> <li>• Hand held GPS unit</li> <li>• 30 m measuring tape</li> <li>• 40 area cover boards (ACBs)</li> <li>• Data sheets and pencils</li> <li>• Stapler and staples</li> <li>• Writable tags</li> <li>• Camera</li> </ul>	<ul style="list-style-type: none"> <li>• Data sheets and pencils</li> <li>• Stapler and staples</li> <li>• Writable tags</li> <li>• Map showing plot location and UTM coordinates</li> <li>• Kelway Soil Tester</li> <li>• Thermometer</li> <li>• GPS unit (to navigate to the site)</li> <li>• Camera</li> <li>• 3 replacement cover boards (if needed)</li> <li>• Bug repellent</li> </ul>

### 4.0 PLOT SET-UP METHODOLOGY

Where possible, plethodontid monitoring is combined with the set-up and monitoring of fixed forest vegetation plots. As such 40 Area Cover Boards (ACBs) are placed around the perimeter of the 20 m x 20 m vegetation plots. With this design, 10 boards are placed 1 m from the edge of the vegetation plot along each of the four sides (Figure 2). In some instances the vegetation plots are not in appropriate plethodontid habitat so the boards were either placed in nearby habitat in the same general area or in some circumstances new site locations had to be found. The configuration for the placement of the cover boards varied from site to site based on site conditions and habitat availability.





A two-step process is involved when new site locations have to be found. First a desk-top exercise is undertaken using ArcView GIS software in order to determine where in the TRCA jurisdiction appropriate habitat maybe located by referring to vegetation type mapping. A search for mature tableland deciduous and mixed forest located on TRCA owned property were the main criteria for positive selection of a given site. This initial step is then followed up with a field search to determine if plethodontid salamanders are present. Searches are conducted with 2 biologists turning over logs and rocks for a set period of 20 minutes. If no animals are found the site is not used in the monitoring program but the results are documented. If animals are found a monitoring plot is set-up in the area.

Area cover boards are made from rough cut pine and are approximately 30.5 cm x 25 cm x 2.5 cm. The ACBs are placed by clearing all leaves and twigs on the ground to ensure that the board has direct contact with the soil. Once the board is in place leaves and small branches are placed over top of the board to cover it. In order to prevent the cover boards from being tampered with, plots ideally were set up away from trails. Due to plethodontid territoriality behaviour, a 5 m distance was maintained between individual boards regardless of the placement configuration. Each board is labeled with a writable tag and given a unique numerical value between 1 to 40 and the agency name (TRCA). Tags are stapled to the corner of the board (Figure 3).



**Figure 3: Artificial cover board design**

Over time the cover boards rot and are no longer appropriate for long-term monitoring as they deteriorate. These boards are replaced with “new” boards that have been weathered (stored outside for at least one year). The replacement of any boards is documented on the data sheets.



## 5.0 DATA COLLECTION METHODOLOGY

The EMAN monitoring protocol for Plethodontid salamanders is as followed:

Zorn, P., Blazeski, V. and Craig, B. 2004. Joint EMAN / Parks Canada National Monitoring Protocol for Plethodontid Salamanders.

Cover boards are checked once a week for 5 weeks in the spring each year. In 2014, data were analyzed to determine the effect of removing the first visit on the number of salamanders counted. Data showed no impact of only conducting visits once a week for 4 weeks on salamander counts so only 4 visits were conducted starting in 2015. Air temperatures are above 5°C and checks ideally should not follow a night of frost. In addition, no monitoring is conducted during high winds or thunderstorms as a safety precaution for surveyors. Monitoring is done between sunrise and noon by a staff biologist and field assistant. The biologist and assistant are fully trained in the identification and handling procedures of all resident salamanders.

After arriving at the site the data sheet is filled in with the plot name, observer names, date, time, Beaufort wind and sky codes (Tables 2 and 3), air temperature at breast height and ground level, and if there had been precipitation in the past 24 hours. Soil moisture and pH measurements are taken at two locations within the plot that appear to be representative of the conditions found throughout. This is most often recorded at board 1 and the board diagonally across the grid from board 1. Surveyors should ensure that the previous year's data sheet is checked to determine the exact location of readings. Soil moisture and pH measurements are taken using a Kelway Soil Tester which requires the instrument to be gently pushed into the soil to cover the metal plates (approximately 6 cm). Put the probe in and allow it to stabilize for 5 minutes before reading pH. For soil moisture (done after pH), hold the button down for 2 minutes and then take the reading. Repeat this process at the other board. See Appendix A for a sample data collection sheet.

**Table 2.** Beaufort wind codes (taken from Zorn *et al.* 2004)

Beaufort Scale	Approximate Wind Speed (km/h)	Description	Visual Cues
0	1	Calm	Smoke rises vertically
1	3	Light	Smoke drifts
2	8	Light breeze	Leaves rustle
3	16	Gentle breeze	Lighter branches sway
4	24	Moderate breeze	Dust rises, branches move
5	34	Fresh breeze	Small trees sway
6	45	Strong breeze	Larger branches move



**Table 3.** Beaufort sky codes (taken from Zorn *et al.* 2004)

Sky Code	Description
0	Clear (no cloud at any level)
1	Partly cloudy (scattered or broken)
2	Continuous layer(s) of cloud
3	Sandstorm, dust storm, or blowing snow
4	Fog, thick dust or haze
5	Drizzle
6	Rain
7	Snow, or snow and rain mixed
8	Shower(s)
9	Thunderstorm

Each cover board is then checked starting at board number 1 and following in numerical order to board number 40. When animals are found under the cover boards they are carefully moved to the side before the board is replaced. In order to handle the salamanders, no chemicals such as bug spray or sun screen can be on the surveyor's hands. Salamanders can then be placed back at the edge of the board so that they can go back under once it is back in position. The species found are documented along with the number of individuals. Disturbances are noted that are associated with each board (substrate, board, or ants) along with an indication of the degree of disturbance. After boards have been checked they should be moderately camouflaged using sticks and/or leaves to discourage vandalism but still visible to a technician who would know the approximate direction and spacing between boards. If it's the last site visit, boards should be more highly camouflaged.

## 6.0 DATA MANAGEMENT AND ANALYSIS

### *Data Management*

At the end of each field season all the data collected is entered into a corporate TRCA access database and all field collection forms are stored into a corporate filing system.

### *Data Analysis for the 2015 Terrestrial Long-term Monitoring Program Report (TRCA 2015a)*

Salamander data can be retrieved from the TRCA Natural Heritage Monitoring database using the query function and selecting the Plethodontid button then selecting red-backed salamander at all sites (excluding special projects) for all years.

No spatial or temporal analyses were conducted in TRCA (2015a) because of several methodological inconsistencies since the start of the program which make analyzing spatial or temporal trends invalid. In order to run these analyses in the future, average salamander abundance should be used. This can be calculated for each site in each year as follows. Sum the total number of salamanders found under all the boards per site visit. Take the average of the four site visits during a specific year.



## 7.0 REFERENCES

- TRCA. 2015a. Terrestrial Long Term Monitoring: Spatial and Temporal Trends 2008-2014.
- TRCA. 2015b. A Retrospective Power Analysis for the Terrestrial Long Term Monitoring Program.
- Zorn, Paul. 2008. A *Priori* Power Analysis for Toronto and Region Conservation Authority's Regional Watershed Monitoring Program. Report prepared for TRCA. Ottawa, ON
- Zorn, P., Blazeski, V. and Craig, B. 2004. Joint EMAN / Parks Canada National Monitoring Protocol for Plethodontid Salamanders.



# APPENDICES



APPENDIX A: Plethodontid salamander field data sheet

**FIXED PLOT MONITORING – PLETHODONTID DATA SHEET**

<b>Plot Name:</b>			<b>Observer Name:</b>						
<b>Date:</b>		<b>Time:</b>		<b>Precip in Last 24 hrs:</b>			<b>Yes</b>	<b>No</b>	
<b>Air Temp:</b>		<b>Ground Temp:</b>		<b>Beaufort Sky Code:</b>		<b>Beaufort Wind Code:</b>			
<b>pH location 1:</b>		<b>Soil moisture location 1:</b>		<b>pH location 2:</b>		<b>Soil moisture location 2:</b>			
ACB Number	Species	Count	ACB Age	ACB Disturbance					
				Ants		Substrate		Board	
				Active non-red		Slight		Animal	
				Active red		Significant		Human	
								Board no longer viable	
				Active non-red		Slight		Animal	
				Active red		Significant		Human	
								Board no longer viable	
				Active non-red		Slight		Animal	
				Active red		Significant		Human	
								Board no longer viable	
				Active non-red		Slight		Animal	

