Credit Valley Conservation

Lands Monitoring Program
Trail Counting Equipment
CVC Technical Report Series 2011-2

CVC
CREDIT VALLEY CONSERVATION

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ABSTRACT

Credit Valley Conservation's Lands Monitoring Program focuses on the collection and analysis of data on Authority owned and managed lands. Designed to function as an adaptable tool, the Lands Monitoring Program provides information through three program initiatives: the Property Inventory and Monitoring Program; the Environmental Inventory and Management Program and the Visitor Information Needs Program.

Automated counting equipment is used as a tool for data collection under the Visitor Information Needs component of the Lands Monitoring Program. As the management of this equipment and analysis of the data developed into a formalized process, the Automated Counter Program was established to organize the methods and processes associated with this project. The Automated Counter Program consists of a network of trail counting equipment that is used to monitor the spatial and temporal distribution of visitors between trail systems and across conservation areas. This information serves a variety of purposes and feeds into a number of land planning and management initiatives. This report provides information on the methodologies and procedures associated with the general management of trail counting equipment as part of CVC's Lands Monitoring Program.

1.0 . INTRODUCTION

In the rapidly urbanizing environment of southern Ontario, the protection and responsible management of natural areas is of increasing importance. Natural areas play a significant role in society by providing a broad range of functions such as; wildlife habitat, carbon storage, source water protection and opportunities for natural heritage appreciation and recreation. The term 'natural area' can refer to anything from a high traffic urban park, to a woodlot or sprawling wilderness reserve, and the degree of visitor activity may range significantly. Ongoing monitoring and management of these natural spaces is crucial to ensure that they, and the services they provide, are left intact for future generations.

Credit Valley Conservation owns and manages properties throughout the Credit River Watershed and is dedicated to the conservation, protection and responsible management of these natural areas. The Lands Monitoring Program (LMP), established in 2005, functions as an adaptive tool to assist with land planning and management initiatives. Born out of a strategic directive in CVC's Conservation Areas Strategy (1994), the LMP contributes to management goals through three key components; Visitor Information Needs Program, Property Inventory and Monitoring Program and Environmental Inventory and Management Program. All three programs have distinct methodologies, but collectively provide vital information to guide responsible decision making.

The Visitor Information Needs Program focuses on the interaction between human experience and the natural environment. The aim of this social-science based program is to gather information on, and gain a better understanding of, visitors to conservation areas. This is accomplished through a variety of initiatives that include visitor information surveys, postal code collection and demographic analysis, visitor observations and automated counter data. As specific types of data collection and analysis develop, they may be organized into sub-programs within the Visitor Information Needs Program. This allows methods and procedures to evolve and formalize, such as is the case with the Automated Counter Program.

The Automated Counter Program (ACP) provides quantitative information on the spatial and temporal distribution of visitors to CVC conservation areas. The ACP is made up of three distinct types of data collection; trail counter records, vehicle counter records and calibration observations. The ACP is designed to be flexible, and can cater to any number of specific monitoring questions such as, when are people visiting?; Where are the busiest access points?; and what activities are they pursuing? This data provides baseline visitor information and affords a better understanding of how CVC properties are being used.

Visitor monitoring is not a well-established research tradition and has often been relatively neglected compared with biophysical management needs (Cessford & Burns 2008). However, accurate and reliable information about visitor numbers is

essential for land planning and management decisions. Visitors have the capacity to influence the character of a natural area through various social and environmental factors. The activities they participate in, the places that they go and the issues that concern them most, play an important role in shaping a natural area.

Trail counters allow for a better understanding of how visitors use CVC conservation areas. The information they provide can influence management decisions regarding recreational planning, trail planning and development, mitigation of environmental degradation and general operations. CVC's ACP combines counting technology with observations to create a better understanding of how visitors use conservation areas.

This document is part of a series of technical reports that contains a review of methodologies associated with the Lands Monitoring Program. This report is comprised of information on the general management of trail counting equipment as part of the Automated Counter Program.

2.0. BACKGROUND

CVC owns 58 properties in the Credit River Watershed that are used by members of the public as well as partner groups, for appreciation and recreation purposes. Through media outlets and other means of communication, the public is invited to visit ten of these properties which are classified as core areas under the *Core 10 Conservation Areas System*. These properties offer a diverse range of activities and often have extensive trail systems. The focus of the Automated Counter Program is to provide baseline visitor information for these properties.

3.0. PURPOSE

The overall goal of the Automated Counter Program is to provide baseline information on how people are using natural areas so that CVC can better manage, protect and promote these properties. Depending on the needs of an agency, trail counting equipment can be a valuable tool that informs a number of specific objectives, an example of which is listed below.

- Rank sites and trails by level of usage
- Anticipate visitor numbers
- Monitor seasonal variations
- Support conservation area operations and schedules
- Determine after hours and off season usage (support increased enforcement)
- Share information with partner groups who are interested in visitor data
- Quantify the impact of a new or existing attraction

The main purpose of installing automated counting equipment is to gather information on how people use and interact with a specific property or location. The analysis of this information can be used to produce tangible outcomes as well as to solve key management challenges.

4.0. EQUIPMENT

The Automated Counter Program is defined by its equipment. In order to collect useful data, the trail counting equipment must be functioning at an optimal level. This is achieved through staff training and rigorous testing and maintenance schedules.

4.1. TRAFX RESEARCH LTD COUNTING SYSTEMS

CVC uses passive infrared counters manufactured by *TRAFx Research* in Alberta, Canada. The ACP was initiated in 2008 with a review of trail counting products currently on the market. The products and services offered by *TRAFx Research* were determined to be the best suited to CVC's needs due to their ease of use, competitive price and their excellent customer service.

The trail counters work by emitting an infrared beam that detects and counts the infrared signatures associated with warm, moving objects. This data is then downloaded using the portable dock and later uploaded to a computer using related software. The data is analyzed using an Access database, excel spreadsheet or *Datanet*, an online application available through *TRAFx Research*. Appendix A contains images of *TRAFx Research* counting equipment as well as a brief description and explanation of the various functions.

4.1.1. Equipment Settings

TRAFx Research trail counters can be configured to a variety of settings and modes. CVC tested the equipment under different situations and determined that the best mode settings were the recommended defaults. The two mode settings that can be altered are the collection period and the count delay.

4.1.1.2. Collection Period: The collection period refers to the unit of time in which data is collected. Trail counters have the ability to collect data by the day, hour or second. CVC trail counters collect hourly data which has a relatively fine level of granularity and can easily be converted into daily, weekly or monthly totals using simple database applications.

4.1.1.1. Delay: The delay refers to the delay period after an event. During the delay period, any events that would normally cause a trigger are ignored, for example slow moving individuals that are at risk for being counted twice. This reduces potential double counts of the same event. CVC uses the default delay

setting of 1.5 seconds as this setting was deemed the most appropriate for applications on CVC properties.

4.2. ADDITONAL EQUIPMENT

There are several additional tools and materials required to manage multiple trail counters. This equipment is largely dependant on the type of housing units that are employed, the number of counters and any ongoing issues such as vandalism and insect infestations. Table 1 provides a list of the tools and materials that are used for CVC's Automated Counter Program.

Table 1 - Equipment used for CVC's Automated Counter Program

Equipment	Field Kit - Required	Office-Required	Occasional Use	Description/Purpose
TRAFx 3G Dock	✔	✔		The battery powered dock is used to collect data from the trail counters located in the field. The information on the dock is then uploaded to the computer via a *TRAFx* software package.
Desiccant Packages	✔			Desiccant Packages (silica gel) absorb moisture from the trail counter case. They are yellow in colour but turn dark purple when 'moist', indicating that they should be changed. Desiccant packages should be replaced every collection period.
AA Batteries	✔			AA Batteries are kept in the field kit to replace expired counter batteries (3 required for each counter).
AAA Batteries	✔			AAA Batteries are kept in the field kit to replace expired dock batteries (3 required).
TRAFx Screwdriver	✔			Small screwdriver required to open the dock/counters to change batteries, reconnect wires, etc.
Robertson Screwdriver	✔			Multi-purpose screwdriver used to secure the lens to the housing unit.
Square head Screws	✔			Supplied by *TRAFx* to mount the lens on to a wooden housing unit.
Padlock Key	✔			All of CVC's trail counters are locked in housing units. All housing units should use the same locking system and key.
Multi-tool	✔			General purpose use.
Tamper Proof Screws			✔ (initial installation)	Secures fine wire mesh over the hole for the scope in order to prevent vandalism.
Bit for Tamper Proof Screws			✔ (initial installation)	Secures screws into place (A drill is also used, but is too heavy and used too infrequently to include in CVC's field kit)
Fine wire mesh (cut to 2"x2")			✔ (initial installation)	Fine wire mesh is used to make the scope hole inaccessible and to deter vandalism.
Compressed Air Canister			✔	Effective at clearing dirt and insects out of the housing units

Camera			✓	Useful for documenting vandalism and other activities in the area
Extra Lens	✓			To bring in the field in case a counter is damaged and the lens needs to be replaced
Alcohol Wipes	✓			Used to clean the counter's teeth once per year, or as build up occurs; ensures a secure connection between the counter and the dock.
Rubber Flap			✓ (initial installation)	Fastened on the outside of the post to protect the lock from winter elements. Please see Appendix B for illustration.
TRAFx CD		✓	✓ (in field for testing only)	Contains Trafx software used to test as well as download the data. A copy of this program may also be saved to the desktop.
Computer		✓	✓ (in field for testing only)	To organize, store and analyze all of the data collected.
Cable with two 9 Female Adaptations	✓ (in field for testing only)	✓		Used to connect the dock to the computer.
Trail Counter Log		✓		It is highly recommended that a log is used to record the counter's test results, maintenance requirements and any site-specific issues. An example of CVC's log can be found in Appendix C.
Lock Grease			✓	To be used seasonally - prevents locks from freezing

5.0. LOCATION

Trail Counters should be installed on properties where staff have a fairly good idea of how the property is being used. This data could be gathered through incidental notes, observations or by more formalized property condition or impact monitoring. It is also imperative that staff know the layout of the trail system as well as the various access locations. If this information is currently not available, then a site visit to 'scout' out the property should be the first step before selecting a location. General property knowledge is also important in order to determine if a trail counter is a suitable method for collecting the information desired.

CVC's ACP is adaptable, and a methodology for moving or relocating trail counters in the future is under development. Currently, there are no plans to relocate any of the trail counters.

5.1. SITE SELECTION

Once an appropriate site has been determined, the trail counter must be positioned correctly. The criteria for determining an appropriate location are discussed in Table 2.

Table 2 - Criteria for Site Selection

Criteria	Explanation
Trail Width	When two (or more) visitors are walking side by side on a trail, they are counted as one. Locations where the trail is narrow and passage occurs in single file are favoured.
Heavily Vegetated Areas	Areas with thick undergrowth should be avoided. When vegetation is heated by the sun and moves in the wind, it mimics a passing visitor and can result in false readings. In locations where undergrowth is inevitable, this issue can be resolved with regular maintenance.
Ease of Access	Data should be collected throughout the year, and safe access to remote locations in the winter months is an important consideration.
Distance	The trail counter should be located between one and three metres from the trail edge.
Known Usage	Property knowledge is an important consideration for not only selecting the location of the trail counter, but also determining if a trail counter is a suitable method for collecting the desired data.

In most instances, the position of the trail counter on the trail is set-up similar to Figure 1. This position takes into account the criteria listed in Table 2.

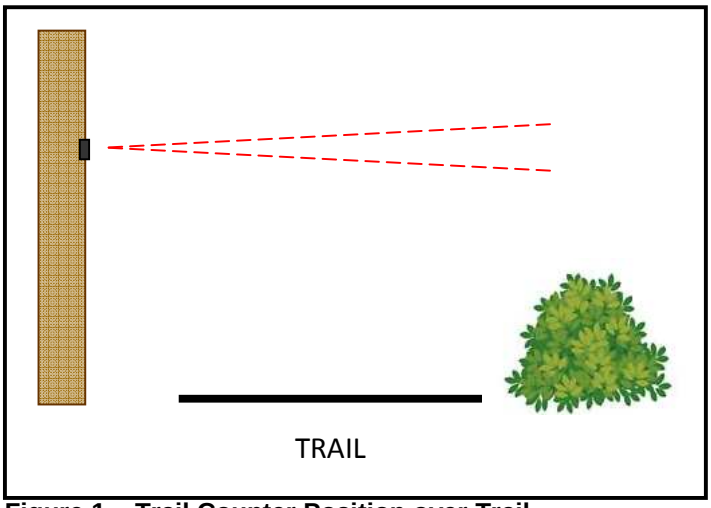


Figure 1 – Trail Counter Position over Trail

5.2. HOUSING UNITS

CVC uses different types of housing units to contain and protect trail counting equipment. The three models described in Table 3 have been installed at various conservation areas. The type of unit used depends on a variety of criteria including, but not limited to; topography, conservation area type (urban vs. rural), trail type and position available.

Table 3 - Trail Counter Housing Units

Different Types of Housing Units		
		
Post in Ground	Birdhouse Style	Modified Electrical Box
Advantages		
- Appropriate in most locations (CVC's most commonly used method) - Suitable for a variety of trails types - Blends into the environment easily - Can also be used as a sign post (or an existing sign post can be altered to house a counter) - The hollowed out post is protected with a locked metal plate, resulting in a very secure unit.	- Suitable in areas with surface bedrock or very wet soil (posts cannot be dug) - Easily moved - Should be built to deter vandalism (sturdy; thick wood)	- Very secure - Easily moved - Unobtrusive - Blends in well in urban settings
Disadvantages		
- Not suitable in areas with boardwalks, that have exposed bedrock or are very wet - The height of the post might differ depending on how deep the post's hole can be dug. - Not easily moved	- Suitable tree must be selected - Chain used to secure the box may rub off tree bark (Unit should not nailed to a tree) - May attract unwanted attention - May require more than one person to collect the data and reposition the box	- Needs to be placed in area with an existing structure (post, boardwalk, etc.)
Ideal Position		
- Adjacent to any trail	- Large tree in an area with high bedrock or where the soil is too wet for post installation	- On a boardwalk or existing fence post

6.0. EQUIPMENT MANAGEMENT

Equipment needs to be regularly visited and maintained to ensure that it is in good working order. Below is a table that describes how often specific tasks should be completed.

Table 4 - Frequency of Equipment Management

Monthly	- Assess location (Does everything look good? Is anything obstructing the lens?) - Collect the data - Change desiccant packages - Update the *Trail Counter Log* with any observations or issues - Organize files and upload data to the database - Analyze data (ensure everything is working properly)
Seasonally (4 times per year)	- Test the counters using the methodology provided in Appendix D
Annually	- Re-grease locks every winter - Clean the 'teeth' on the counter's computer system - Secure a new piece of rubber over the lock to protect from winter elements. - Complete a report on the annual findings
Every 5 Years	- Calibrate the counters using the most up-to-date methodology (provided in Technical Report xx)
Ongoing	- Clean out insect nests from inside the housing unit - Repair and record any vandalism - Batteries in the counters will require changing approximately every 3 years - Update Methodologies and Procedures

The overarching program used to facilitate trail counting equipment should also be periodically revisited and reviewed. This may include assessing trail counter locations and priorities. CVC's ACP is evolving and the overriding question of, *What are our visitor information needs?* is constantly being revisited.

6.1. DATA COLLECTION

Trail counters require ongoing maintenance to ensure that they are functioning properly. The data from CVC's trail counters are collected on a rotating schedule, approximately once every 3-4 weeks. This schedule allows staff sufficient time to carry out the tasks that should be included in each data collection period. These tasks are outlined in Table 5:

Table 5- Data Collection Tasks

Task	Description
Inspect Location and Equipment	• Inspect the location for any forms of vandalism or damage. Damage could include anything from wear and tear to nesting insects. • It is important to inspect the housing unit, the trail counter (particularly the scope) and the general area. • Record any findings (or lack of findings) in the *Trail Counter Log* (Appendix C)
Collect the Data *(It is important to read the manufacturer's guidelines when collecting data for the first time as failure to disconnect the dock properly*	• Connect the dock to the trail counter to download the data • The lights on the front of the dock will flash, indicating the progression of the download • Occasionally the dock will indicate a problem, either with

may result is lost data)	itself or with the trail counter (i.e. batteries require replacement). If the issue is unclear, refer to the manufacturer's manual for guidance
Replace Desiccant Packages	• Desiccant packages (silica gel packets) absorb moisture from the air and are key to keeping equipment functioning properly (moisture can quickly erode and damage electronic equipment) • Desiccant packages differ between manufacturers, but it is important to change them often (every 2 – 4 weeks, depending on location and climate)

Collecting trail counter data according to a planned schedule is essential for ensuring that all equipment is functioning properly. If a problem is identified, then steps can be taken to remediate the issue before large amounts of data are lost. Problem identification and solutions are discussed in section 6.3.

6.2. TESTING

Testing is crucial for ensuring that all equipment is working correctly. Testing is performed once per season (4 times per year). Test results, as well as any related issues and/or corrective measures, are recorded in the *Trail Counter Log* (Appendix C). Testing every season determines if there are any issues associated with different types of weather. Testing has revealed that trail counters perform less accurately on extremely hot, humid days because the infrared beam cannot detect the difference in body temperature of a passing visitor from the air temperature. Similarly, research suggests that infrared counters have difficulty detecting infrared signatures on extremely cold days when individuals are apt to layer heavy clothing. Although extreme temperature days are relatively rare, it is important to understand the limitations of the equipment.

According to *TRAFx Research*, trail counters can be expected to work at or above 95% accuracy. If a counter is working at a lower accuracy than 90%, a series of trouble-shooting techniques are carried out. The method for testing trail counter equipment can be found in Appendix D.

6.3. TROUBLESHOOTING

A myriad of issues and circumstances can cause trail counting equipment to malfunction. This includes everything from water damage and insect nests to vandalism. Issues are usually discovered through one of three ways; observation during the collection process, equipment testing or data analysis. Common issues and how to deal with them are described in Appendix E. For more complex issues it is advisable to refer to the manufacturer's manual.

6.4. VANDALISM

As most organizations and agencies that manage land for public use have come to realize, vandalism is not an uncommon occurrence. Even when trail counters are well concealed or protected, they tend to draw attention. The two most common types of vandalism that CVC has experienced are:

- The destruction of the protective grey lens through the use of sharp objects, and;
- The destruction of the housing unit and stealing or damaging the entire trail counter

The protocols that CVC uses for deterring vandalism and repairing units are discussed below.

6.4.1. Protecting the Lens

In order for the trail counting equipment to function properly, the infrared scope needs a clear view of the trail and should be placed approximately 40 – 60cm below eye level. Unfortunately, this makes an exposed scope an easy target for vandals.

The grey plastic lens protects the delicate (and costly) infrared scope (see Appendix A for illustration). When the lens is punctured, it creates the opportunity for moisture to enter and leads to deterioration of the infrared scope. If the lens is punctured, it requires immediate replacement. The trail counter should also be brought back to the office so that the infrared scope can be examined and dried out, if necessary. It is recommended that an extra lens be kept in the office for this reason.

In order to deter the lens from being vandalized, fine wire mesh netting should be fitted over the opening to the scope (see Appendix F). The wire mesh does not interfere with the equipment, and significantly reduces this type of vandalism.

6.4.2. Protecting the Entire Unit

CVC has experienced instances where vandals stole or attempted to destroy the trail counter. For various reasons, each of these instances was handled differently. When the counter is stolen, the following steps are recommended:

1. Upon notification of stolen or altered equipment, staff should visit the location and examine the situation. Often times, vandals may simply pull the counter out of the housing unit, perhaps trample or smash it, and leave it on the ground. Check the area and try to find the equipment.
2. If the equipment is found, bring it back to the office and dry it out using a hair dryer and/or by putting it in a bag of rice for a few days. Test the equipment. If the equipment is not working, contact the manufacturer to request suggestions or to purchase new equipment.

If the equipment is not found, then there are two options:

Table 6 - Options for Dealing with Stolen Trail Counters

Do Nothing	Post a Sign
This option is recommended in situations of extreme vandalism (housing unit was destroyed; perhaps other assets on the property were also damaged). Gather up the remains of the housing unit and bring it back to the office. If it is decided that a counter will be reinstalled in the area, try changing the location of the counter or create a more durable housing unit.	Post a sign on the housing unit describing what your agency does, what a trail counter is and why you would like it back. Attach a plastic bag to the housing unit as well and indicate that you would appreciate your equipment back. CVC staff successfully used this method in 2010.

It is important to record all instances of vandalism, including the location, equipment serial number and level of damage in the Trail Counter Log. This will allow staff to track trends and be aware of which trail counters may have issues in the future.

7.0. DATA MANAGEMENT

The consistent management of all trail counter data is essential for a well-functioning program. The management of information includes everything from a uniform naming convention of the trail counters themselves to the actual data files that are uploaded from the dock. Technical Report Series xx contains in-depth information on the data management procedures for CVC's ACP. This section provides an overview of some relevant topics for general organization.

7.1. STANDARDIZED NAMING CONVENTIONS

Utilizing a standardized naming convention for both the counting equipment and any associated data files is highly recommended. The name for each trail counter should be based on its geographical location (rather than a general or numerical naming system). For instance, a CVC unit located in Rattray Marsh Conservation Area at the Bexhill road access is labelled: RM – Bexhill. Standardized naming minimizes confusion for staff and ensures that data is consistently uploaded to the appropriate place.

A naming convention for Shuttlefiles that includes both the date and the location is suggested (**TRAFx Research* refers to data files specific to trail counters as Shuttlefiles). CVC collects trail counter data on a 3-4 week schedule where each location in the watershed is visited. Therefore the majority of Shuttlefiles contain information from all of the trail counter sites. Occasionally a specific counter may be visited out of sequence and consequently that Shuttlefile will contain only data from that specific location. CVC labels Shuttlefiles in the following manner:

- If the Shuttlefile contains data from all locations: July_21_2011_All_Counters
- If the Shuttlefile only contains information from a specific property: Sept_19_2011_IL-North_Dam.

The Shuttlefiles are stored in a shared CVC drive in file folders organized by year. The Technical Report on Data Management provides more detail on the management of Shuttlefiles.

8.0. DATA ANALYSIS

Trail counter data can be analyzed in countless ways. To ensure that the information is meaningful, however, staff need to revisit the key question(s) of the Program. CVC's trail counter data is analyzed through two separate, distinct approaches; quality assurance and quality control processes and calibration.

The data is first examined at the data level to ensure that it makes sense. If there are missing dates or observations that are not logical, they need to be investigated. Secondly, the data requires a high-level evaluation in order to determine exactly what it is revealing. Implementing a calibration program supports this second approach by ensuring the data's accuracy as well as providing rich detail on visitor demographics and behaviours. While clearly providing separate functions, the above methods for data analysis are both essential for valid, accurate results.

8.1. QUALITY ASSURANCE, QUALITY CONTROL

Ensuring that the data is accurate and valid requires a rigorous QA/QC process. For the most part, this process has been automated on CVC's trail counter database. A detailed account of these procedures is described in Technical Report Series xx. Table 7 below, lists a few of the common issues that the QA/QC processes identify and a brief description of how that issue is dealt with.

Table 7 - Common QA/QC Issues Associated with Trail Counter Data

QA/QC Issue	Identification	Possible Cause(s)	Management
Missing Data	Missing data can be described in one of two ways: 1. Tracks of data that are date and time stamped, but no counts were recorded 2. Missing data (no date and time stamps; no records) *(Note – TRAFx Trail Counters do not record data for the hour that the*	1. • Insect nest/debris was hindering counter • Wire connecting the counter to the scope became detached 2. • Trail counter was not properly launched • Shuttlefile was misplaced (human error) • Dock was not correctly disconnected from the	Missing data is a common problem that can be managed in a number of ways. At CVC, the missing data is acknowledged, and the reason or cause is stated in reports.

	dock was attached and the data was downloaded)	trail counter (human error)	
Outliers	An outlier can be described as an observation that is numerically distant from the rest of the dataset. Statistical analysis as well as general observation can be used to identify outlying data.	• Odd behaviour by humans or animals that may continuously trigger the counter • Faulty equipment • Poor positioning of the trail counter (it may be catching moving foliage) • Unknown factors	Although it depends on the cause of the outlying observation, it is usually deleted from the dataset. The observations before and after the outlier may be averaged and substituted.
Inconsistent Data	The identification of inconsistent data is subjective. It relates more to what is actually happening on a property than faulty data. For instance, if a relatively quiet property receives a high amount of visitation for 2 weeks in the fall, the event should be investigated.	The identification of this type of data is subjective. When staff are familiar with the data collected from a property, inconsistencies will become apparent.	It is recommended that staff record any events or circumstances that are out of the ordinary (i.e. trail maintenance days, etc). This data can later be matched up to determine if inconsistencies can be explained. If not, monitoring the property may help determine possible causes.

8.2. CALIBRATION

Many different factors can influence the accuracy of trail counter data and cause the equipment to systematically over or under count. These factors include everything from the counting equipment itself to the nature of the property, trail width and human behaviour. All of these factors play a role in the accuracy of the data. In order to understand how some of these factors affect the data, calibration is performed.

Calibration is a key element of the Automated Counter Program. In 2010, calibration involved staff recording observations of visitors while positioned beside a trail counter. A stop watch was used to record the exact time an individual passed by and this was later matched up to the times recorded by the trail counter. Staff also recorded general demographic information including activity, group size and approximate age. Calibration determines the level of error of a trail counter at a specific location, and determines what, if any, adjustment factor should be applied. An adjustment factor is a number that is applied to the raw data in order to produce more realistic results.

Calibration ensures that the counting equipment is working properly in real-life situations and provides enriched information about a site. Some of this enriched

information includes unusual occurrences that are discovered by staff in the field. One interesting example that occurs on CVC properties involves joggers, who while using a specific trail for their exercise regime, may run up and down a specific section of trail, passing a trail counter 5 or more times. Individuals that regularly pass a trail counter multiple times during one visit will skew results, and make the application of the adjustment factor essential. This type behaviour is impossible to speculate and would not be known if not for calibration.

Although calibration requires a considerable amount of staff time and resources, it is an integral element of the Automated Counter Program. The rationale, procedures and outcomes of CVC's calibration work are discussed in detail in the Technical Series Document xx.

9.0. RESULTS

Presented in this section are some examples of data that trail counting equipment can provide. The purpose of these samples is to illustrate some of the different means of displaying trail counter data. Data can be interpreted in numerous ways thereby providing baseline information, as well as information relevant to specific land management questions.

9.1. WEEKLY DATA

Graphs depicting weekly data totals are useful for highlighting weekly, seasonal and holiday trends and variations. Figure 2 is an example of a graph illustrating weekly totals. The graph clearly shows how visitation spikes in the fall, particularly around week 42, which was the 2010 Thanksgiving long weekend.

Illustrating weekly data also emphasizes any missing data, in the case of this dataset, weeks 22 and 23 (circled in red). For the ease of interpretation, any missing data should be highlighted and explained. For example, this missing data can be attributed to human error.

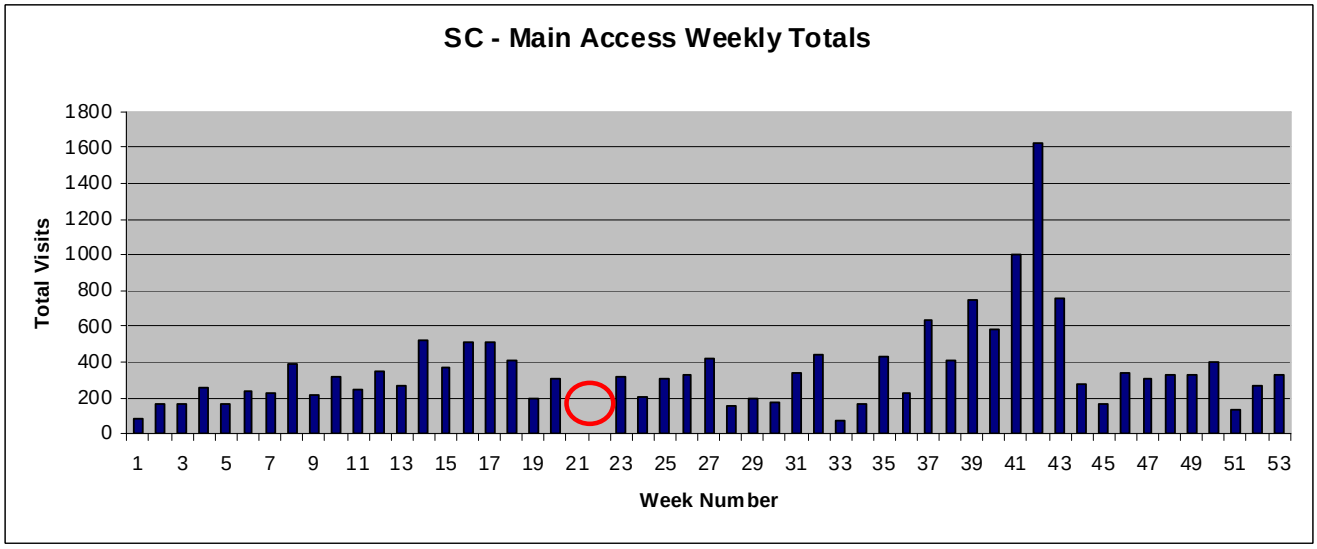


Figure 2 - Example of a Weekly Totals Graph

9.2. MONTHLY DATA

Similarly to weekly totals, monthly totals clearly portray the most popular times of year for visitors. This type of data can be displayed as both total visits per month as well as by percentage (Figures 3 and 4, below). The author must decide which graph is more relevant for the audience. In the majority of CVC reports, monthly trail counter data is displayed in total visits per month.

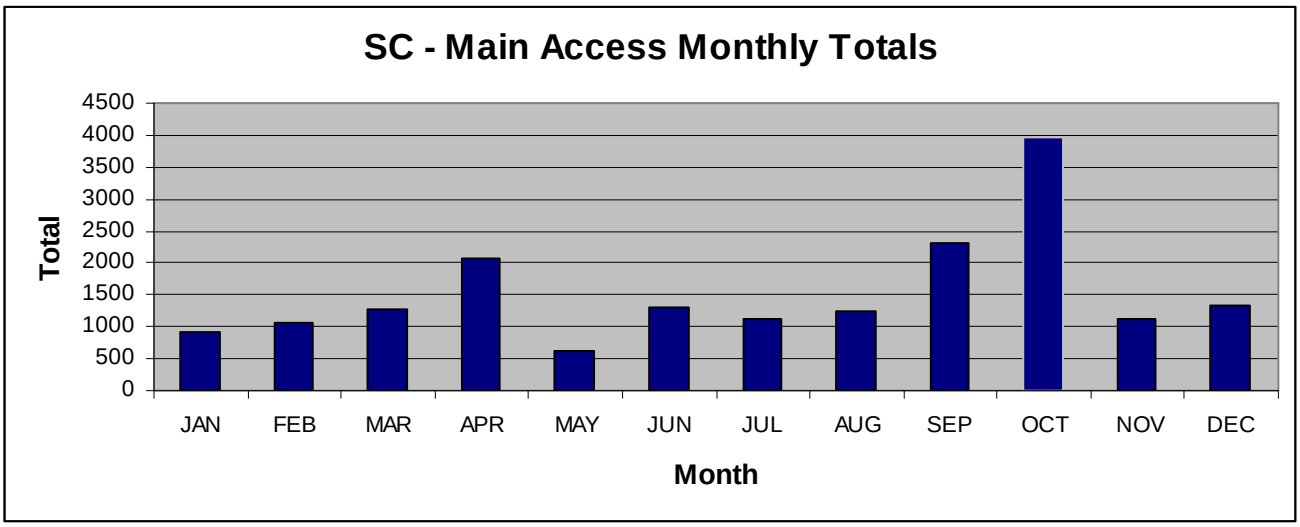


Figure 3 - Example of a Monthly Data Graph

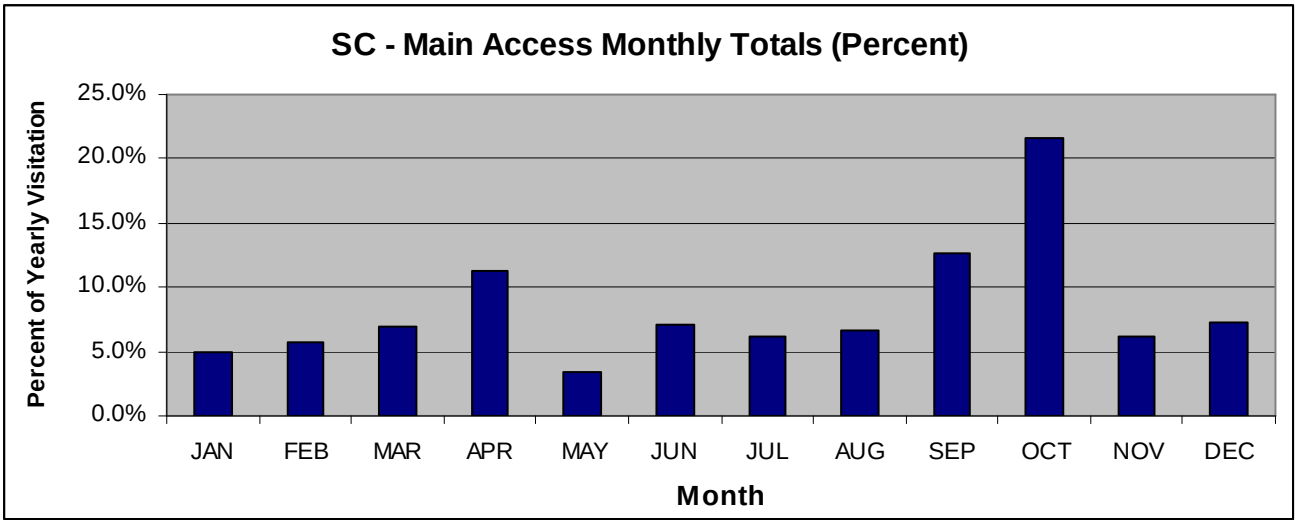


Figure 4 - Example of a Monthly Data Graph using Percentages

9.3. DAY OF WEEK

Analysis of visitor numbers by day of week can be very telling of the characteristics of a property. High weekend visitation (illustrated in the example graph, below), may be characteristic of 'destination' properties; properties that visitors seek out for a specific reason and plan their visit in advance. Properties that receive well distributed visitation throughout the week may be more apt to being visited by 'regulars'; those who live close by, visit more than once a week, or those who pass through the property as part of their commute (i.e. to get to and from school). Individuals are less likely to plan an 'outing' to these areas and instead drop by as part of their regular routine. Note that visitation on Mondays is often slightly higher that the rest of the weekdays due to public holidays.

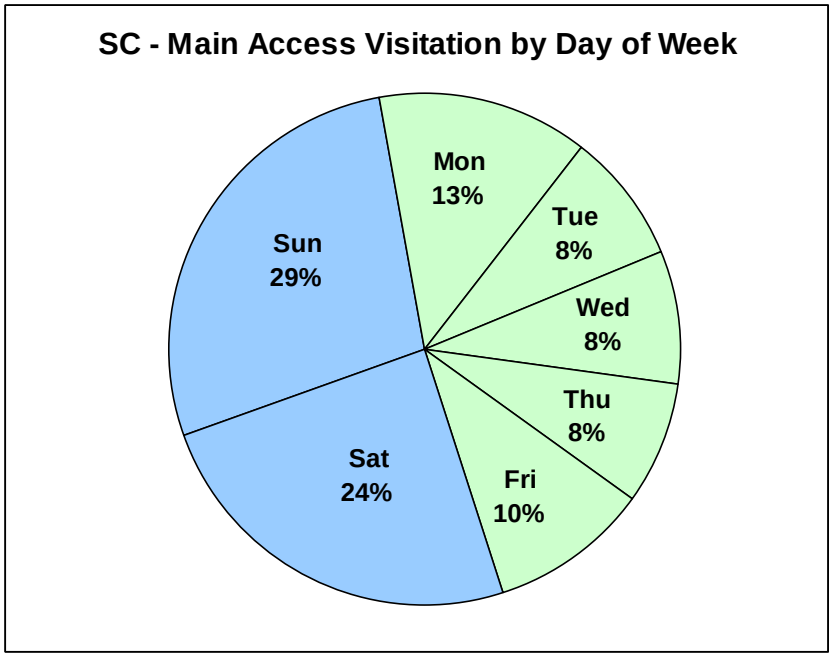


Figure 5 - Example of a Graph Depicting Days of the Week

9.4. Comparing Sites

Comparing visitor activity between sites, whether within a single property, or across several properties, provides important information regarding site popularity and visitor usage. Identifying relative site popularity directly feeds into land management initiatives such as trail planning, prioritization of maintenance issues, signage requirements and requirements for future monitoring. It may also spark discussions around the reasons why one site might be more popular than the next (is there more parking at one location? Is the signage more visible?).

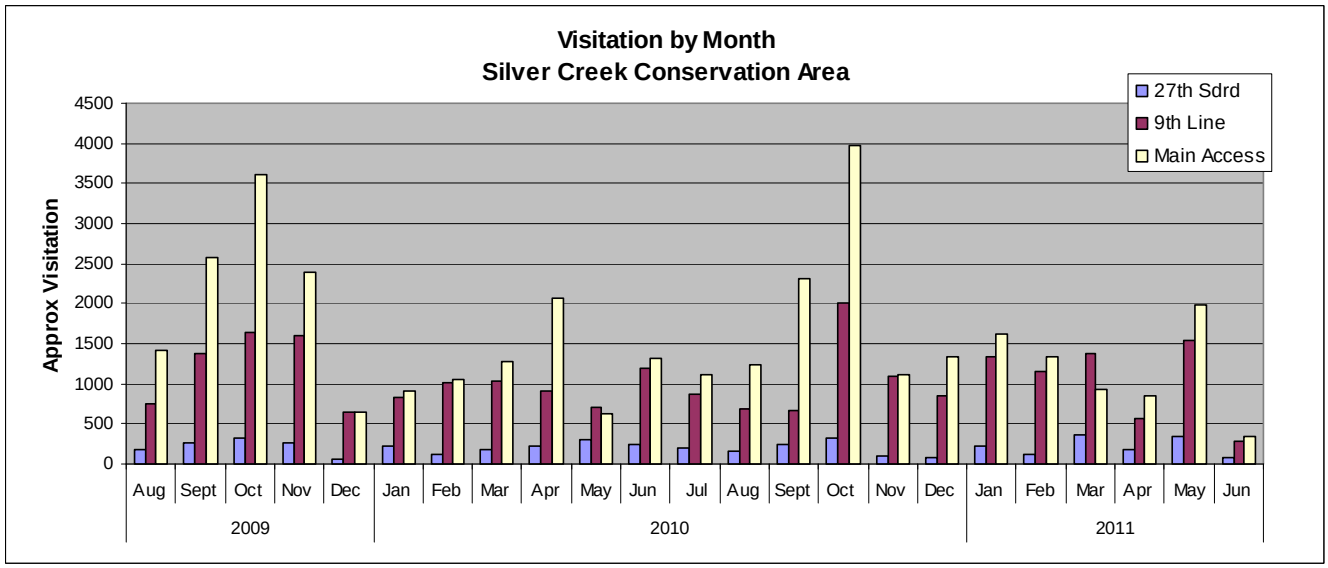


Figure 6 - Example of a Comparison Graph of Access Locations within a Single Property

Comparison graphs illustrate real spatial and geographical differences between access points at the same properties as well as across one or more properties. Depending on the purpose of a report, other effective comparison graphs may include:

- Changing yearly and monthly trends (Figure 6 below)
- Comparison between holiday and regular visitation at select sites
- Comparison of visitor activity before and after an event
- Comparison between different types of properties (i.e. passive vs. active use; urban vs. rural)

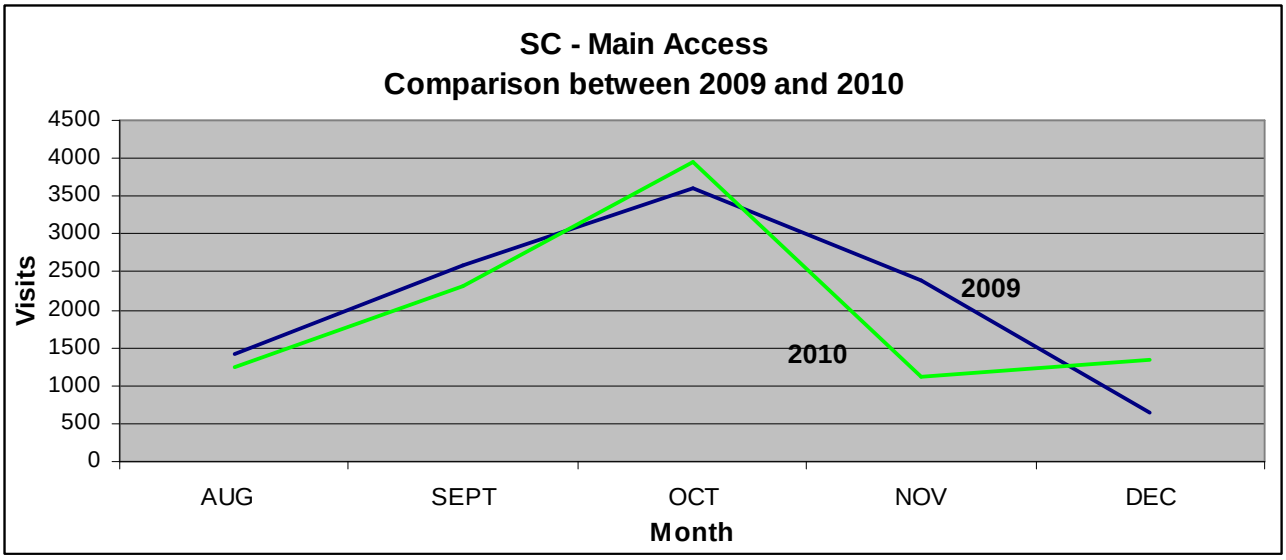


Figure 7 - Example of a Comparison Graph between Different Years

The topics listed above are examples of common approaches to analyzing and presenting trail counter data. Trail counter data can be interpreted and displayed in many different ways and the real challenge may be to simply scope the results and select the data that really answers the pressing research questions.

10.0. RECOMMENDATIONS

Automated Counter Programs may vary widely in scope and capacity and thus program specific recommendations are often not applicable. However, there are several high-level, overarching topics that are relevant to all agencies, organizations and individuals working with trail counters and trail counter data.

Organization is critical for any well-functioning program, especially where multiple individuals and a diverse range of equipment and data are involved. Scheduling collection periods and organizing data is essential for ensuring that equipment is operating properly and that the information is valid and reliable. Testing the counting units and keeping on top of equipment maintenance are also necessary elements of a successful program.

The ability to be flexible and creative is important when developing and maintaining an Automated Counter Program. Manuals and articles that explain how to select and employ counting equipment are readily available. Conversely, standards for the calibration, management and analysis of a trail counter program do not currently exist. Individual sites, agencies and research questions can be remarkably diverse and it is crucial that all staff involved with Automated Counting Programs are creative and focused in order to develop a program that will suit the needs and requirements of their organization.

Most importantly, it is essential that the fundamental research question remain as the underlying cause of the research. Staff need to remain aware of the questions that need to be answered and be attentive of whether the elements of the program can, and are, answering those questions.

As an Automated Counter Program grows and develops, new challenges and opportunities will arise. Those involved with the program need to be organized, flexible and acutely aware of what questions need to be answered. Communication is essential and any occasion to share information with interested parties should be strongly considered. A successful Automated Counting Program requires time, resources and a dedicated staff, but produces quality information and provides a deepened layer of understanding and appreciation of a property.

11.0. CONCLUSION

The focus of this report is on the automated counter work that takes place under CVC's Lands Monitoring Program. It contains the procedures and methodologies necessary to effectively implement and manage the Program. This document is dynamic, and methods may be altered, introduced or deleted based on how the Program grows and develops. This report, *Trail Counting Equipment CVC Technical Report 2011-2*, is part of a series of technical documents that concentrate on the procedures, processes and methodologies of CVC's Lands Monitoring Program.

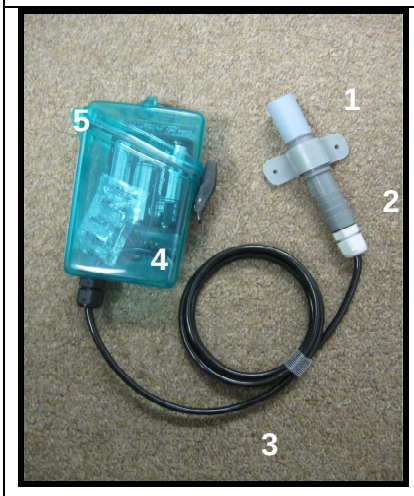
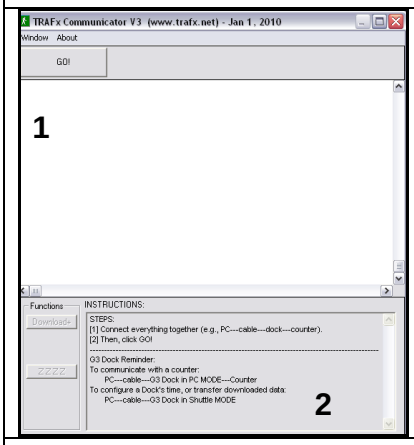
CVC's Lands Monitoring Program implements best practices for data collection and analysis through a variety of sub-programs, including the Automated Counter Program. This information assists with the development of management decisions regarding recreation strategies, trail planning and development, mitigation of environmental degradation and general operations. In essence, the Lands Monitoring Program is responsible for obtaining useful information about CVC properties. When applied, this useful information translates into knowledge which contributes to the solutions of key management problems and provides justification for difficult decisions.

The Credit River Watershed is located in a rapidly urbanizing area of Canada, and its current population is expected to increase to 1.5 million by 2020 (CVC 2009). Natural areas provide a variety of ecological functions such as sustaining biodiversity, providing habitat to species at risk and protecting drinking water supplies. Natural areas in close vicinity to urban centres contribute to local communities from a social and economical standpoint as well. These areas promote recreation, appreciation and education. It is important to manage natural areas so that they maintain their ecological integrity while ensuring that they remain accessible and contribute to the well-being of communities. Understanding how the public uses natural areas is critical for devising management plans and implementing programs that promote protection, conservation and appreciation.

APPENDIX A

TRAFx TRAIL COUNTING EQUIPMENT, COMPONENTS AND EXPLANTIONS

Table 1 - *TRAFx Research* Trail Counting Equipment

Infrared Trail Counter	
	1 Protective Plastic Lens
	2 Infrared Scope – detects motion and heat with an infrared sensor
	3 Black Wire Connecting Scope to Computer Board
	4 Computer Board – stores date, time and count records
	5 Plastic Waterproof Case (containing desiccant packet)
Trafx Communicator V3	
	1 Computer Interface. This software is necessary for downloading the data, testing and configuring the counting equipment.
	2 The software provides instructions for new users. It will also indicate any connection issues.
	*Note – the software application is shown here. The program is saved on a compact disc.
G3 Dock	
	1 Nine plug connection that attaches to cord; used to connect to the computer
	2 Indicator Lights. Will indicate any issues with the counter or with the dock as well as signal the progress of a download
	3 Teeth that connect to the trail counter

APPENDIX B

RUBBER FLAP INSTALLATION

The cold temperatures and heavy precipitation that persist throughout the winter months quickly degrade the lubricated elements of standard locks. This causes the locks to 'freeze-up' and makes opening them extremely difficult. To combat this issue, CVC staff secure a rubber flap over each lock on each housing unit.

A variety of materials can be used to protect the lock; CVC uses squares cut from rubber floor mats. The images below show the rubber flaps protecting the lock on a post-style housing unit.

Figures 1 – Rubber Flap protecting lock on a post-style housing unit

APPENDIX C

TRAIL COUNTER COLLECTION LOG – EXAMPLE

Trail Counter Name:										
Date/Staff Initial										
	Date	Initial	Date	Initial	Date	Initial	Date	Initial	Date	Initial
Checklist										
Scope Clear										
Data Collected										
Desiccant Pkgs										
Red Light Blinking										
Tested?										
Lock Greased?										
Comments Date										
Date										
Date										
Date										

APPENDIX D

TRAIL COUNTER TESTING PROCEDURE

Testing is essential to ensure that all trail counting equipment is working properly. Trail counters are tested once per season (4 times per year), and test results, as well as any related issues and corrective measures, are recorded in the Trail Counter Log. According to *Trafx*, trail counters can be expected to work at 95% accuracy. If a counter is working at an accuracy of less than 90%, a series of trouble-shooting techniques should be performed.

During testing, the trail counter is hooked up to a computer via the dock. The trail counter is configured so that each time a count is recorded; it appears on the computer screen. The manufacturer's reference manual outlines the exact process for setting up the trail counter in test mode.

TEST 1 is carried out for each counter. Depending on results, a second test (TEST 2) may be required. Figure 1, below, illustrates the where passing should occur on the trail in regards to testing.

Before TEST 1 confirm that:

- Three dots on scope are facing upward and to the right (1-2 o'clock)
- Scope opening is clear
- Batteries have sufficient power
- *Trafx* Communicator is in TEST mode

Table 2 - TEST 1 Procedure

Description	Reason
One person walks past the counter 10 times (5 times in each direction) in the centre of the trail	This is the simplest test, and if the counter is recording less than 9 out of 10 passes there may be an issue. It should be recorded if the counter is favouring one direction. Troubleshooting (Appendix xx) steps should be followed.
One person runs past the counter 5 times (centre of trail)	Occasionally runners are not recorded by the counter. This usually occurs on very hot days and/or when the runner is very quick. If the counter catches less than 4 out 5 passes, troubleshooting steps should be followed.
One person walks past the counter 5 times, passing on the inner edge of the trail (within 1m)*	Occasionally individuals walking unusually close to the trail are not caught by the counter. This may be caused by the position of the scope over the trail. Troubleshooting steps should be followed.
One person passes the counter 5 times walking on the outer edge of the trail (5m max., walking)*	Trail Counters only perceive people up to ~6m away. Depending on trail width, it is important to ensure that they are collecting at a distance of at least 5m. The position of the scope should be checked if it is missing people at this distance.
** Some trails are quite narrow and walking on the inner and outer edge of the trail may not be possible. In these instances, staff should pass the counter a total of 20 times walking and 5 times running.*	

APPENDIX D CONTINUED

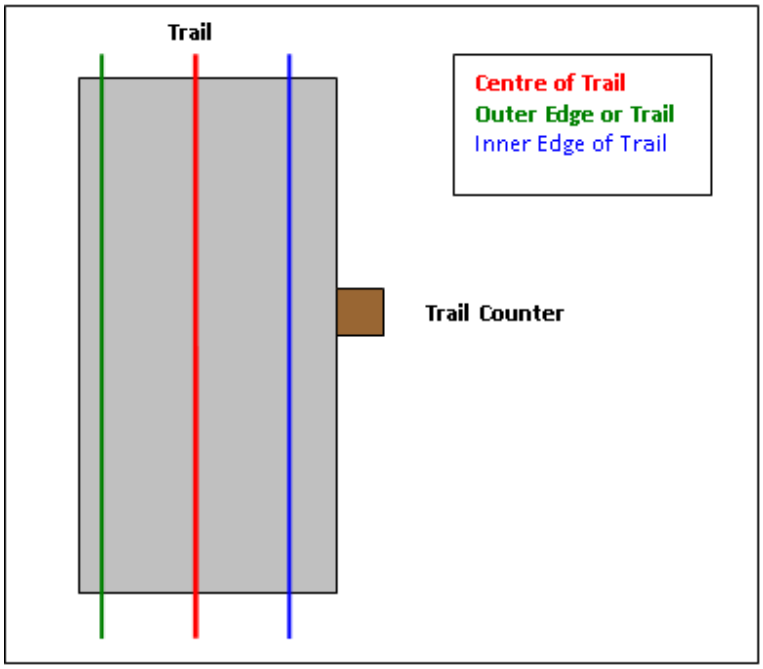


Figure 2 - Schematic of Trail Counter Testing Procedure

If the counter is not performing at **>90%** accuracy, determine where the errors are occurring and continue to 'Test 2'. This will support the identification of specific errors and assist with troubleshooting.

Before TEST 2 confirm that:
All wires are secure
Interior of the Trail Counter is free from moisture
The cord connecting the computer, dock and counter is secure
Read all 'pop-ups' from the *Trafx* Communicator CD

APPENDIX D CONTINUED

TEST 2

One person passes the counter 20 times (10 each way) in the centre of the trail (walking)
One person passes the counter 10 times walking on the inner edge of the trail (within 1m, walking)*
One person passes the counter 10 times walking on the outer edge of the trail (5m max., walking)*
One person passes the counter 10 times running by (centre of trail, running)

If the counter tests above 80% it may be re-installed, but the percentage, as well as any specific errors, must be noted. If the counter is testing at 80% or under, refer to the troubleshooting guidelines in Appendix D. If performing poorly after troubleshooting, the trail counter may have to be brought back to the office for further inspection.

APPENDIX E

TROUBLESHOOTING GUIDELINE

This section offers some guidelines for dealing with trail counter errors and malfunctions. Problems with counting equipment and discrepancies in the data are usually discovered in one of three ways; through observation during the collection process, through equipment testing or through analysis of the data. Some of the problems may be as simple as common oversights that occur during installation, while others may require consultation with the manufacturer. This section provides brief descriptions of common troubleshooting issues.

COMMON ISSUES

Many common issues can be identified and solved through regular checks while performing data collection. This section describes some common issues that cause equipment to malfunction.

Lens

The design of the lens makes it an ideal location for small insects to build nests. This obstructs the 'view' of the infrared beam and prevents it from working properly. It is also common to find the lens clogged by small twigs and debris. Through testing it was found that a black bag placed over the scope is useful for keeping the lens clear *if* it can be changed every two weeks. If the bag is changed less frequently, it quickly becomes dirty and may lead to less accurate counting. In order to help prevent small objects from hindering the infrared scope's ability to function, it is advisable to layer wire mesh over the opening to the scope (please see Appendix E). The infrared beam can 'see' past the mesh, and the mesh discourages small objects from being placed in the lens. Unfortunately, the mesh does not deter insects.

Position of the Scope

The situation of the scope is crucial for collecting good data. On *Trafx* trail counters, there is a black wire attached to the scope. On this wire there are three black 'dots'; see Figure 1. It is essential that these three dots be situated between 12 o'clock at 2 o'clock (when facing the counter from behind). This ensures the correct placement of the infrared beam. If the scope is situated at 12 o'clock and counting at less than 100% accuracy, try turning the scope slightly so that the dots are between 1 and 2 o'clock. This increases the sensitivity of the scope, which may be appropriate for some counters in specific situations.

APPENDIX E CONTINUED

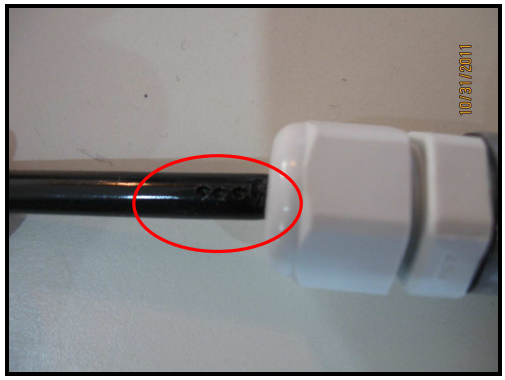


Figure 3 - Dots on Wire Correctly Position the Infrared Scope

Moisture

Moisture can cause a variety of issues with the counters. The desiccant packages should be changed at each scheduled collection period to ensure that the equipment stays dry. Moisture may affect the computer board by reducing overall accuracy, causing it to act erratically or cause overall system failure. If moisture makes its way inside the protective container and is noticed on the trail counter's computer board, it should be brought back to the office immediately and dried out with a hair dryer or sealed in a bag of rice for a few days. This issue is preventable if desiccant packages are changed often.

ADDITONAL TROUBLESHOOTING

Regular examination of the counting equipment and housing unit usually reveal most of the common problems that cause or lead to equipment malfunction. However, it is only through testing the equipment and/or analyzing the data, that other issues are identified.

Batteries

The dock will indicate if the battery voltage has declined or is non-existent, for example if the batteries have loosened in their plastic case. Although batteries in *Trafx* trail counters should only need to be replaced every 3 years, it is not uncommon for some to lose power before then. The best way to check the battery status is to attach the dock to the counter; the dock will indicate if there is an issue with the batteries. It is advisable to carry extra AA batteries in the field kit. It is worth noting, that even if a trail counter loses power, it will retain its data until the batteries are replaced.

Wiring

As illustrated in Figure 2, there are 3 small wires that connect the computer board to the battery box. If one or more of these wires loosens then it can effectively halt the equipment's system from working. While simple to re-attach using the *Trafx*

APPENDIX E CONTINUED

Screwdriver, it is important to identify this error early, as the trail counter has to be re-programmed with the correct date and time before it will function correctly again.

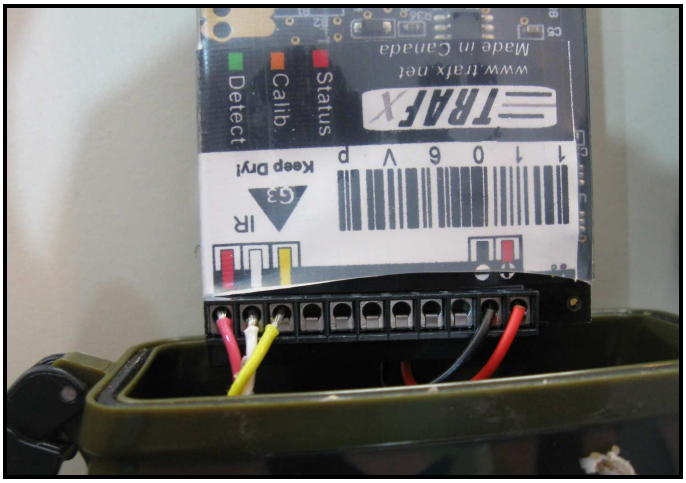


Figure 4 - Wires Connecting Different Components

Dock

There are multiple factors that influence the dock and can cause error. Largely issues arise if the batteries move or have been placed incorrectly. If the dock is not operating (i.e. lights are not visible, is not identified by TRAFx software), check the batteries to ensure they have not become loose. To prevent batteries from coming loose, take the back off of the dock and place a few layers of duct tape on the inside of the backing. This will create a tighter fit when it is screwed back on, and should discourage the batteries from loosening.

If there is a particular problem with a trail counter that cannot be identified, there could be an issue with dock. Consult either a reference manual or the manufacturer for more information.

Location

If the trail counter is consistently testing poorly then it is advisable to reassess the location and position of the trail counter. Determine if the height is appropriate; the trail counter should be between 1m and 1.3m off of the ground. Re-evaluate the width of the trail; the trail counters record at a maximum distance of 6m and therefore shouldn't be expected to reliably detect anything further than 5m away. Lastly, consider the position of the trail counter. If it is positioned on a diagonal on the trail, it may be function at strange angle. The location and situation of the trail counter is very important. If the staff dedicated to the management of an Automated Counter Program are not the same staff who install the housing unit and equipment, it is essential that the location is tested that the location, angles and distances are adequate.

APPENDIX E CONTINUED

Human Error

While the majority of the troubleshooting issues listed above are directly related to human error, there are a few additional issues that staff should be cognizant of. It is important to read the manual carefully and ensure that the counters are hooked up properly to the dock before downloading the data. If the dock and trail counter are not carefully aligned, an error may occur and data may be lost. CVC staff use a maintenance checklist, located in the Trail Counter Log Book, to encourage them to be aware of these common issues and help to prevent them.

It is important to keep all of the data that has been collected in one place, where it is uniformly labelled and organized. Data must be saved to a computer before being deleted from the dock. Organization is essential as it prevents data from being misplaced or lost.

ADVANCED TESTING

If the troubleshooting issues listed above have been investigated and no issue was discovered, advanced testing may be necessary. Bring the trail counter back to the office where it can be looked at more closely and tested in a controlled environment. The list of recommendations below may only be relevant in specific circumstances.

1. Test the trail counting unit in a controlled environment. For example, bring the unit inside, and test in quiet area. Be sure to avoid direct sunlight from hitting the scope. If the counter is testing well inside, there may be an issue with its location outdoors. Perhaps the housing unit is on a strange angle or its situation is not ideal.
2. Look closely at the protective plastic lens and determine if any damage has occurred. If so, water may have penetrated and impaired the infrared scope. If it appears that damage may have occurred, use pliers to remove the plastic lens and inspect the infrared scope. If damage to this piece of equipment has taken place, it is best to contact the manufacturer and replace it.
3. If everything appears to be in good working condition, but the unit is still not counting accurately, try swapping equipment pieces with another counter. Make sure that each counter is labelled and that the alternate counter is testing well. This will isolate which piece of equipment (either the infrared scope or computer system – or both) is malfunctioning. If replacement pieces are available on hand, then the solution may be easily resolved. If not, contact the manufacturer.

These troubleshooting tips have been employed by CVC Lands Monitoring Staff, for *Trafx* trail counters. Even if using similar equipment, it is best to consult with a current reference manual and/or the manufacturer.

APPENDIX F

PROTECTING THE LENS USING WIRE MESH

Layering thin wire mesh over the hole for the trail counter's lens reduces vandalism. Wire mesh prevents utensils such as pens or sticks and other materials, such as mud from gaining direct access to the lens and damaging it.

The trail counter's infrared beam can 'see' past the mesh and the mesh does not reduce or alter the performance of the trail counter. Figure 1, below, illustrates the application of the wire mesh using screws to secure it.

Figure 5 - Protective Wire Mesh Secured over Lens Hole

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