Visitor Impact Monitor and Trail Transect Study at St. Lawrence Islands National Park

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Abstract

For a three-year period the trail compaction and depth below bar was studied along 57 transects at St. Lawrence Islands National Park. Each transect experienced change, and overall there was an increase in cross-sectional area in 2001, and decrease in 2002. Mean cross-sectional area changed from 3,332 cm^2 in 2000 to 3,465 cm^2 in 2001 and then to 3,111 cm_2 in 2002. Average compaction changed from 1.64 kg/cm^3 in 2000, to 1.80 in 2001, and 1.85 in 2002, and was statistically significant between 2000 and 2002. Bare trail width changed from 0.95m in 2000 to 1.05m in 2001, and 0.97m in 2002. Initial results show that transects are relatively stable, but compaction, cross-section area and trail width in specific areas are increasing. This correlates with the large visitor numbers from 2000 to 2001, and the decrease in numbers in 2002. The non-significance in cross-sectional and trail width indicate that mitigation such as signage, trail treatments, and education help reduce deterioration. In addition to the quantitative data, qualitative surveys including a digital photographic record of all facilities and trails have been completed for four years as part of a discreet visitor impact monitor.

Introduction

St. Lawrence Islands National Park (SLINP) was established in 1904 and has enjoyed a long balance of recreation use, heritage importance, and conservation. Presently however, with a large increase in human development in surrounding areas, and with a greater number of park users than in the past, the mandate of Parks Canada has turned toward maintaining Ecological Integrity and environmentally sustainable use. The Parks Canada mandate (revised in 1994) states that its goal is:

> *"To fulfill national and international responsibilities in mandated areas of heritage recognition and conservation; and to commemorate, protect and present, both directly and indirectly, places which are significant examples of Canada's cultural and natural heritage in ways that encourage public understanding, appreciation and enjoyment of this heritage while ensuring long-term ecological integrity."* (Parks Canada, 1994)

Along with this mandate are Guiding Principles and Operational Policies that emphasize protecting Ecological Integrity (EI) and ensuring that EI remains paramount in the implementation of all aspects of park management.

As well as subscribing to the central aspects of maintaining EI in the National Parks, St. Lawrence Islands has established Limits of Acceptable Change within it's boundaries. St. Lawrence Islands currently exceeds its Limits of Acceptable Change in total trail area with 197 square meters of trail per hectare of park property, and as such, mitigation is required. With a goal of maintaining or improving the conditions of the micro-and macro-ecosystems, certain mitigation measures are taken to reduce human impact and allow the park to remain accountable to it's goals.

The Visitor Impact Study began in 1999 in order to keep a clear record of visitor impact on the islands and each of the facilities at SLINP. This is the first official study of this kind in the National Park System. Its goals are to discover, repair, and prevent further damage to the park. This visual impact monitoring involves an annual visual survey and digital photographic record of each island's facilities, trails, and sustained impacts. It also aims to discover trends in visitor impacts and direct public education efforts toward their prevention. Finally, it ensures long-term ecological integrity of Canada's cultural and natural heritage as emphasized in the purpose of Parks Canada. When establishing a Visitor Impact Monitoring (VIM) it is important to remember to ensure data collection is performed at about the same time each year; to look for trends such as social trails or illegal fire pits, and aim the public education efforts towards curbing these practices; and to do initial screenings of each facility to gather baseline data, and ensure that each representative type of facility is included in the study. It also is helpful to compare amount of damage to visitor statistics each year.

The trail transect study at SLINP was started in 1999 in order to determine the visitor impact on the hiking trails on the islands. The trail transects range from 2.7 m to 4.5 m long and covers a wide range of trail surface types including grassy, mowed, chipped, flat, steep, forest floor and rocky. The study was expanded in 2000 and 2001 with more transects added to cover a wider variety of trails and to establish control sites for later comparisons. In addition, all sites have been located with GPS to allow for positional consistency over the study period. Transects with only one marker had second markers added and those that have had to be discontinued for various reasons have been noted in the field recording sheets.

Trail transects have been widely used in studies on trail impact in the past across North America. David Cole (of the Aldo Leopold Research Station) was the first to bring them into wide use in the State Parks in the U.S. and has furthered trail erosion knowledge with work on trampling effects, effects of footwear, and mitigation results. This report will follow closely the study *Changes on Trails in the Selway-Bitterroot Wilderness, Montana, 1978-89* (Cole, 1991).

When trails and campsites have been compacted to the point of no longer allowing for root penetration and growth, they show signs of deterioration including bare patches, exposed roots, rocky surfaces, decreased vegetation, and pooling of water. Steps ideally should be taken to prevent the decline from ever reaching that level. Mitigation that can be performed includes: re-routing trails; bordering trails to contain the damage; building boardwalks; closing trails; public education; and, creating new ones. In addition, reducing the number of facilities, wood-chipping trails, and closing the site completely to visitor use

have been successfully undertaken. There are many islands in the park that should have these mitigation measures taken as soon as possible in order to allow for recovery of the trails, the surrounding vegetation in some instances declared at risk by COSEWIC (Committee on the Status of Endangered Wildlife in Canada), and soil affected by the trail degradation. Other mitigation measures include removing docks on certain sides of islands to reduce accessibility, building boardwalks and steps, decreasing mowed area, and providing public education. Public education, including the "Too Many Feet" program, is a positive step in reducing the impact on certain trails.

Methods

For the VIM, the Islands are visited by a Resource Management technician twice during the open season - once early in May before the visitors arrive and then again on a designated date later in the summer. Each facility including the docks, picnic shelters, and privies, is thoroughly evaluated for damages and photographed. Each trail is walked end-to-end and photographed. This record can be compared from year-to-year. The digital format allows for immediate evaluation of the images on site and retakes if necessary. The photographs are arranged into a PowerPoint presentation, and a report that contains tables of damages with a scale showing whether mitigation is urgent, necessary, or not required. This format allows for important management decisions to be made with the accuracy of the photographs and tables to back them up. An example of this decision-making ability put into practice was performed in the spring of 2002 when it was decided to close one docking facility at the end of Endymion Island. Due to the sensitivity of the species present on the Island, (at least two of which are in the Priority 1 classification), the high average compaction of the trails, and high visitor numbers, the impact on the Island was found to be beyond the limits of acceptable change. In order to appease the public by not decreasing the facilities and services provided in the Park, six mooring cans (the equivalent to the docking space closed) were added to non-sensitive Islands.

For the compaction study, 57 transects of length 2.7 m-4.5 m running perpendicular to the trail, were established on randomly selected sites on 12 islands and the mainland property within SLINP. Each field season, on approximately the same date, weather-permitting, a transect ruler was placed across the selected site marked on both sides by metal stakes, level with the ground, but raised above the micro topography of the site to increase precision (Cole, 1991). The vertical depth below this "bar" was measured every 30 cm along the transect ruler, as well as the compaction using a Humboldt Mfg. Co. Pocket Penetrometer. Also noted was the width of the central aspect of the trail where bare soil was present, and the vegetation present in each 30cm segment. In addition, digital photographs of the transects from both sides, including close-ups of the central trail region and a widened view of the transect were taken for yearly comparison. This also helps to visually show erosion/deposition. All the statistical analysis was performed using DataDesk Version 6.0 (Velleman, 1997).

In 2002, in order to establish baseline measurements, 10 samples, three each from high-impact, medium impact, and low-impact islands, and one random site, were taken very early in the field season. These will be factored into the analysis once the final analysis

is completed in 2003.

As suggested in Cole (1991) the accuracy of these measurements was evaluated by performing 10 replicate measures of one transect. The mean cross-sectional area of loss for these trails was 1 264.5 cm^2, with a 95% confidence interval of +/- 7.31, well within accepted values. The bare trail width (zone of no vegetation), was also measured at each transect. The average for each year was found and statistical analysis was also performed on this data.

Results and Discussion

The VIM has had mixed results. There are important points to remember in establishing a VIM. They include establishing baseline measurements, completing the study at the same time each year, providing public education in order to reduce negative press related to closings, provide services or facilities elsewhere in order to compensate for those removed, and ensure consistency in data collection by having an instruction manual and management plan.

The mean cross-sectional area and compaction from each year was found. In 2000 the mean cross-sectional area was 3,339 cm^2, in 2001 it was 3,465.24 cm^2, and in 2002 it was 3,110.6 (baseline studies performed in that year indicated a mean cross-sectional area of 4,696 cm^2). These results were not significant.

Of the 57 transects, 20 had a significant increase in depth below bar indicating erosion, while 27 showed a decrease in depth below bar and thus, deposition, while 10 remained relatively unchanged. The transects that showed improvement were mainly clustered on islands such as Beaurivage and Aubrey which had wood chips applied to the trails in order to minimize impact.

The average compaction increased steadily both years. In 2000 it was 1.64 kg/cm^3, while in 2001 it was 1.80, and in 2002 it was 1.85. Although from 2000 to 2001, and 2001 to 2002, there was no significant difference at the 0.05 level, between 2000 and 2002 a significant difference was found. It has, however, been shown that compaction measures done using a penetrometer are highly sensitive to soil moisture content (McBride *et al.*, 1988). This will be compensated for in 2004 when the final evaluation is performed.

Finally, the bare trail width did not change significantly throughout the study years starting in 2000 with an average width of 0.95m +/- 0.36, in 2001 it was 1.05 +/- 0.33, and in 2002 it was 0.97 +/-0.31. Information on the three collected variables is summarized in Table 1.

Management Implications

The main objective of this study is to continuously monitor the state of the facilities, docks, and trails at SLINP. Along with the quantitative data provided by penetrometer,

depth and width measurements, analyzed in this paper, there are a large amount of digital photographs to provide qualitative measurements. Furthermore, the baseline data collected this field season, once compared with the yearly-collected data will help to establish what the visitor impact in the park is since there is very light visitation on the islands prior to the field season.

The study has shown so far that the mitigation measures being taken at SLINP to maintain EI and to preserve the natural ecosystem within the Limits of Acceptable Change are working in the trail maintenance field. Although there is a mild increase in cross-sectional area, and bare trail width, this increase is not significant at the 0.05 level. The significance found in the compaction data has been over a short period of data collection and may prove to increase in the long-term, as two years of data collection does not adequately reflect long-term trends. The study will need to continue to evaluate this.

Table 1. *Cross-sectional area, trail compaction and trail width information.*

VARIABLE	AVERAGE MEASUREMENT	SIGNIFICANCE LEVEL
Cross-sectional area		
2000	3339 +/- 2152cm^2	
2001	3465 +/- 2603 cm^2	NS
2002	3111 +/- 1859 cm^2	NS
Trail Compaction		
2000	1.64 +/- 0.51 kg/cm^3	
2001	1.80 +/- 0.50 kg/cm^3	NS
2002	1.85 +/- 0.47 kg/cm^3	0.05
Trail Width		
2000	0.95 +/- 0.36 m	
2001	1.05 +/- 0.33 m	NS
2002	0.97 +/- 0.31 m	NS

Several factors seem to play a role in trail conditions in the park. The first is visitor numbers. There was a large increase in numbers from 2000 to 2001, which correlates with the increases in the collected variables; however, in 2002 there was some improvement in cross-sectional area and trail width. This may be due to the fact that the islands were closed to visitors for a large part of the field season due to dangerous trail conditions induced by several late-winter and spring storms. Furthermore, the rate of increase in compaction was markedly lower from 2001 to 2002, which leads to the hypothesis that since fewer visitors were on the trails, the compaction occurred only later in the season

after visitors were permitted on the islands.

Since there were some specific areas and islands showing large increases in compaction, trail width, and cross-sectional areas, a thorough one-by-one evaluation of trails should be performed to highlight areas in need of re-engineering or relocation. Trails in low-lying areas or close to water sources on a down-slope can become more susceptible to trail deterioration. These areas are also evaluated by using the photographic record kept of each transect.

In conclusion, the trail transect study at St. Lawrence Islands National Park is a valuable tool in monitoring and maintaining the ecological integrity of the park and its management efforts. It is recommended that this study continue in order to establish long-term trends in trail compaction, cross-sectional area, and bare width, as well as fulfilling the mandate of protecting Canada's natural heritage. This study is also an illustration of how Parks Canada is remaining accountable to its policies by using responsible monitoring programs.

References

Cole, D. 1991. *Changes on Trails in the Selway-Bitterroot Wilderness, Montana, 1978-89.* Pp. 1-5. INT-450 US Department of Agriculture, Forest Service, Intermountain Research Station: Fort Collins, CO.

McBride, R.A., H. Martin and B. Kennedy. 1988. *FACTSHEET: Soil Compaction.* University of Guelph and the Ontario Ministry of Agriculture and Rural Affairs: Guelph, ON.

Parks Canada. 1994. *Guiding Principles and Operational Policies.* Canadian Heritage, Minister of Supply and Services: Ottawa, ON.

Velleman, P. 1997. *DataDesk Version 6.0.* Data Description Inc. Available: www.datadesk.com