

# **Establishing Alvar Mosses on Quarry Floors: A Necessary Step in the Restoration of Quarries to Alvars**

## **Sixth Progress Report – Spring 2010**

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*Setting up an experiment on substrate amendment and nutrients. Lawless Quarry, 2009.*

**Suzanne Campeau, M.Sc.**

**Bryophyta Technologies Inc.**

240 Rang 4, Lambton, Québec, G0M 1H0

bryophyta@globetrotter.net

Tel.: (418) 486-2060

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### Introduction

This sixth progress report is submitted as part of the project “Establishing Alvar Mosses on Quarry Floors” which was accepted for funding by the MAAP Program in January 2008. The objectives of this study are to investigate whether targeted species of alvar mosses can successfully establish colonies after the introduction of moss fragments to quarry floors, and to determine which environmental factors at the quarry floor level need to be manipulated or alleviated to allow or enhance moss establishment and growth.

This report includes:

- ✚ A progress report on the work conducted between December 1, 2009 and March 31, 2010;
- ✚ An overview of the experimental work to be conducted in 2010 to complete the project;
- ✚ Details of the project expenses incurred for the period covered by this report.

## **Work Conducted Between December 2008 and April 2010**

### ***Data Analyses and Reporting***

Data collected in 2008 and 2009 on Experiments 1 and 2 at Lawless and Hendry quarries were compiled and organised for statistical analyses. Preliminary figures were drawn for both experiments and were presented in the Fifth Progress Report. Arrangements were taken with the statistical analysis consulting at the Université Laval in Québec City to run the repeated measures ANOVA analyses on the SAS software. These analyses should be completed by late April 2010.

### ***Preparation of the 2010 Field Season***

Since experiments to be established in western Ontario in spring 2010 are repeats of experiments 1 and 3 that were established at the Lawless and Hendry quarries in 2008 and 2009, the protocols for the 2010 experiments are already defined and were described in previous progress reports. Early on in the project, the Toth Quarry, located near Welland in western Ontario, was identified as a potential experimental site for western Ontario. Discussions are also underway with the Hamilton Conservation Authority to obtain permission to conduct experiments at the Fletcher Creek quarry site, near Puslinch.

## **Experimental Work to be Conducted in 2010**

### ***Experiment 1 : Effect of Straw mulch on Moss Establishment***

This experiment was initiated in June 2008 at the Lawless Quarry near Brockville and in August 2009 at the Hendry Quarry, near Kingston. In response to the rapid development of moss cover observed in this experiment, more efforts than initially anticipated were devoted in 2009 to measurements and data collection. With this rapid development of the moss cover in our trial, we can now consider that Experiment 1 conducted at Lawless and Hendry Quarry is basically completed and we are currently waiting for a consulting service to perform detailed statistical analyses of the data (planned for this spring or early summer) before moving on to the writing of a scientific publication in 2010-2011. Minimal monitoring of the experiment will continue in fall 2010, in order to confirm the stability of the developing moss colonies over time.

Experiment 1 will be repeated in a western Ontario Quarry in early spring 2010. Data on this experiment will be collected in fall 2010 and late spring 2011. One growing season should be enough to corroborate or not what was observed at the Lawless and Hendry Quarry. Result of this third trial will then be incorporated in the same scientific publication as the results obtained at the Lawless and Hendry quarries.

### **Experiment 2 : Effect of a Protective Topographical Element**

This experiment was initiated in October 2008 at both the Lawless and Hendry quarries. As for experiment 1, the rapid development of moss cover brought us to devote more time in 2009 to measurements and data collection than originally planned. Minimal monitoring of this experiment will be conducted in fall 2010 at the two quarries. Results obtained after one field season were already fairly conclusive: the presence of a protective rock ridge had very little impact on moss establishment compared to the use of a straw mulch. We are therefore suggesting not to repeat this experiment in a third quarry and to instead concentrate our efforts on the study of factors such as substrate amendments that have a higher potential at improving moss establishment success.

### **Experiment 3 : Effect of Substrate Amendments and Nutrients**

The third field experiments aimed at determining if the presence of a thin sand layer, or of a sand and organic matter layer helps mosses to establish on bare limestone pavement. In addition, we examined the effect of adding low doses of slow-released nutrients, provided by sprinkling compost, on moss establishment. The experiment was established at the Lawless Quarry site in late October 2009. In order to make sure that the added nutrients will be efficiently used by the mosses and not washed out by late fall rain or snow melt, compost will be added to the plots in the spring of 2010. Our original intention was to initiate a similar experiment at the Hendry Quarry but the sandy / gravelly substrate already present on the site made it not adequate for the experiment we were planning. This third experiment will be repeated in another western Ontario quarry site in spring 2010. The sites will be monitored in the fall of 2010 and in late spring 2011.

### **Experiment 4 : Establishment of Mosses That can be Found in Alvars but not in Old Quarries**

The experiments conducted in 2008 focused on three species of mosses (*Tortella tortuosa*, *Schistidium rivulare* and *Tortula ruralis*) that can be found both in alvars and in old quarries (Tomlinson et al. 2008). Some small-scale trials using two or three species of mosses that are found on alvars but not in old quarries will also be conducted in 2010, such as *Ditrichum flexicaule*, *Campylium stellatum* or *Dicranum polysetum*. The final choice of the species will depend on our capacity to access adequate sources of plant material. This trial will focus on the effects of soil amendments and mulch on moss establishment, as these are the factors that, according to statistical analyses of moss species occurrences in alvars and quarries of different ages and conditions, that are most likely to determine the presence of later successional alvar mosses (Matthes and Campeau, in press).

### ***Experiment 5 : Effect of Cracks in the Rock Pavement***

Moss establishment within natural cracks will be explored at the Kingston site quarry, where some shallow natural cracks occur in the upper part of the quarry. Moss fragments will be “seeded” at intervals along the crack that will be first cleaned of soil and debris. A protective mulch cover will be added on some of the reintroductions zones.

### **Project Expenses**

Table 1, on page 7, details the expenses incurred in the project for the December 1, 2009 to March 31, 2010 period (this project report), and summarizes all expenses incurred this year for the project in comparison to the annual budget. Please note that a budgeted amount of \$715, contribution of Bryophyta Technologies, was not used this year and is reported to next year.

### **Literature Cited**

- Tomlinson, S., U. Matthes, P.J. Richardson and D.W. Larson. 2008. The Ecological Equivalence of Quarry Floors to Alvars. *Applied Vegetation Science*, 11:73-82.
- Matthes, U. and S. Campeau. In press. The Use of Community Ordination in the Establishment of Restoration Protocols. *In Canadian Land Reclamation Association. Proceedings of the 34<sup>th</sup> Annual Meeting and Conference of the CLRA/ACRSD, Québec City, August 23-25, 2009.*