

Biodiversity in Ecosystem Mine Reclamation, South-Central British Columbia: Proposed Work

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Fraser, L.H. (2019): Biodiversity in ecosystem mine reclamation, south-central British Columbia: proposed work; in Geoscience BC Summary of Activities 2018: Minerals and Mining, Geoscience BC, Report 2019-1, p. 105–108.

Introduction

Environmental laws and regulations govern mining and oil-and-gas extraction in Canada, including reclamation. Prior to development, resource-extraction companies are required to post a bond as a promissory that their activity and closure will meet approved government environmental standards. Despite the rising demand for restoration management, there is limited research on environmental restoration and there are few dedicated university postgraduate training programs in Canada to address the complexities of ecosystem reclamation. There is a critical need to work with the mining and oil-and-gas industries, in partnership with governmental agencies, to develop better management practices for successful ecosystem restoration, and to train Highly Qualified Personnel (HQP) for reclamation work.

Current restoration plans and mine-closure proposals for land reclamation are generally not based on sound scientific evidence. They are more likely to be based on past practice and administrative and logistical constraints. In order to rectify this lack of information, optimize reclamation methods and allow for a more harmonious coexistence between industry and environment, research focused on understanding and mastering ecosystem reclamation is needed.

This project will study biodiversity of the invertebrate community along a chronosequence of reclamation sites at the New Afton mine and Highland Valley Copper mine in south-central British Columbia (Figure 1).

Biodiversity

Biodiversity describes the variety and variability of living species in an environment and can be used as a measure for ecosystem health, especially if baseline data are available and are followed over time at locations of interest. Patterns in plant diversity, and the measures to identify plant diversity, use standardized sampling and field guides; however, during biodiversity assessments, the identification of spe-



Figure 1. Locations of the New Afton mine and the Highland Valley Copper mine, south-central British Columbia.

cies, particularly invertebrates, is often best achieved using genetic analyses. Much effort has gone into finding signature genes, called ‘DNA bar codes’ for different groups of invertebrates. Each species can now be rapidly and cost-effectively identified and, with the proper sampling protocols, quantified in terms of relative abundance and diversity by site. New Gold’s New Afton mine, the industry partner for this project, is the first in Canada to employ DNA bar-coding as part of their commitment to measuring and ensuring environmental sustainability. Tracking biodiversity against pre-mining benchmarks informs restoration efforts in real time and allows changes and adjustments when needed. Restoration of animal communities to date has been based primarily on vegetation recovery, with the assumption that the animals will naturally follow. This ignores the growing scientific evidence that feedback from animals can cause top-down control that determines the abundance and diversity of plants, as well as the rate at which nutrients cycle through ecosystems. Whole ecosystem-based approaches will be employed in this study, including biodiversity planning and monitoring of all ecosystem functions and services, to guide restoration efforts throughout the entire life cycle of the mine. DNA bar-cod-

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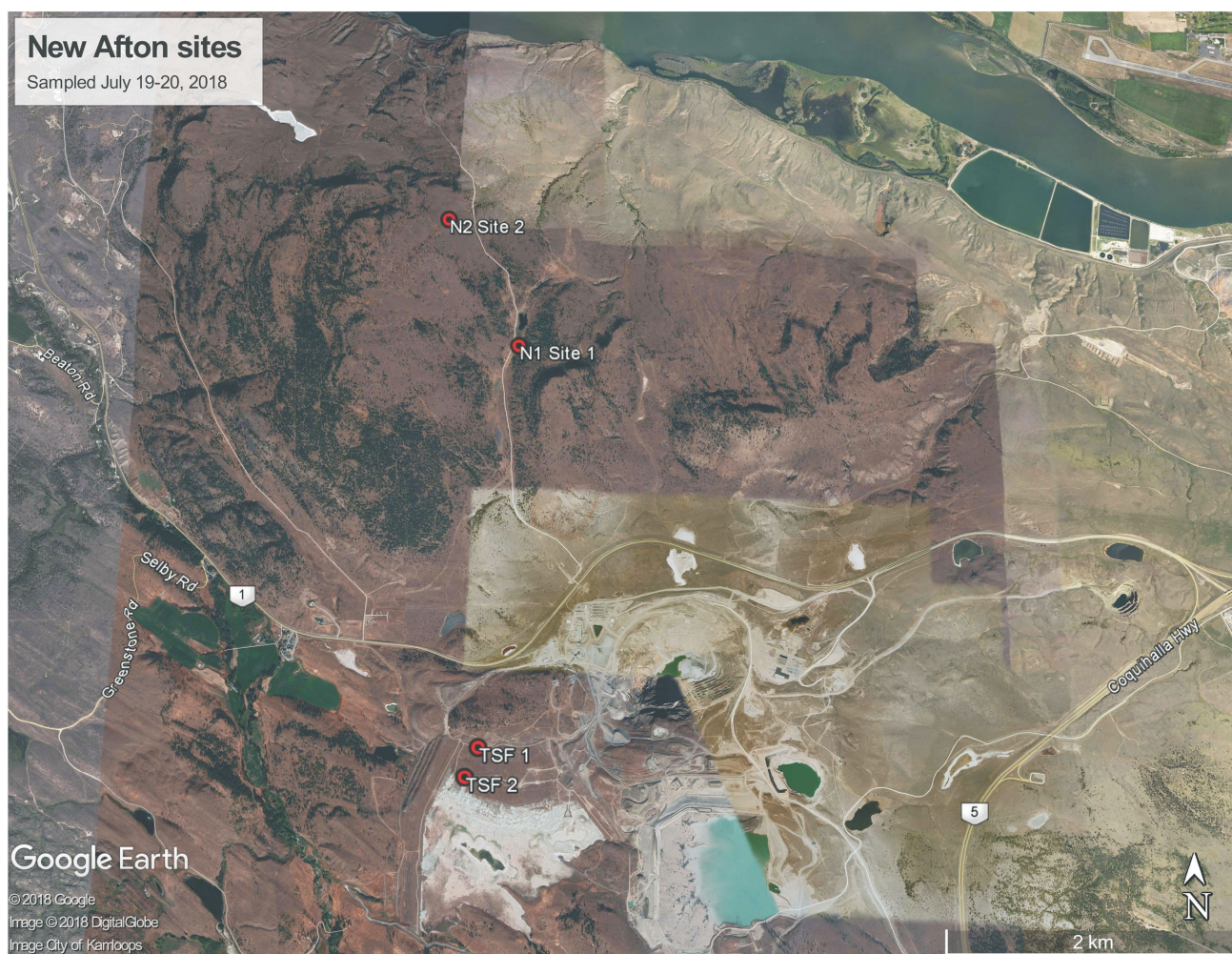


Figure 2. New Afton mine with locations of sample sites: reference sites (N1 Site 1 and N2 site 2) and old tailings storage facility (TSF 1 and TSF 2).

ing, a tool for rapid species inventory and food-web structure, will be utilized for testing species diversity and composition by focusing on invertebrates, a technique successfully adapted by New Gold Inc. for biodiversity assessment.

Methodology

Malaise traps and pitfall traps will be used at the New Afton mine and the Highland Valley Copper mine in undisturbed control sites and mine-reclamation sites. At the New Afton mine, two reference sites (Figure 2, N1 Site 1 and N2 Site 2) and two reclamation sites on the old tailings storage facility (Figure 2, TSF 1 and TSF 2) were sampled. At the Highland Valley Copper mine, thirteen sites have been selected (Figure 3). Malaise traps are tent-like structures that are used to capture flying insects. The trap intercepts insects that then fly upward toward the light and are captured in a container of an ethanol solution. Pitfall traps are small ground-insect collection traps that consist of a hole in the ground approximately 10 cm deep filled with a collection cup that contains

an ethanol solution to preserve the specimens for DNA analysis. Pitfall traps will be placed approximately every 10 m on a 90 m transect at each site for a total of 10 traps per site. One malaise trap will be placed randomly at every site. Specimens from both the pitfall and malaise traps will be collected and identified to order-level taxonomic assignment, then stored individually in ethanol solution to be sent for molecular phase analysis. Tissue samples will be collected to recover the bar code region of the cytochrome c oxidase I gene. After implementing methods used in DNA bar-coding within a genomics lab, the DNA bar codes will be compared with existing records on the Barcode of Life Database (BOLD; Ratnasingham and Hebert, 2007) to obtain species identifications for all study sites.

Conventional soil, plant and larger animal sampling will help develop a better understanding of food-web structure and complement the molecular analyses. Standard operating procedures will be drafted for users so tools incorporating markers from bar-coding and metadata can be tested, revised and validated by mine operators.

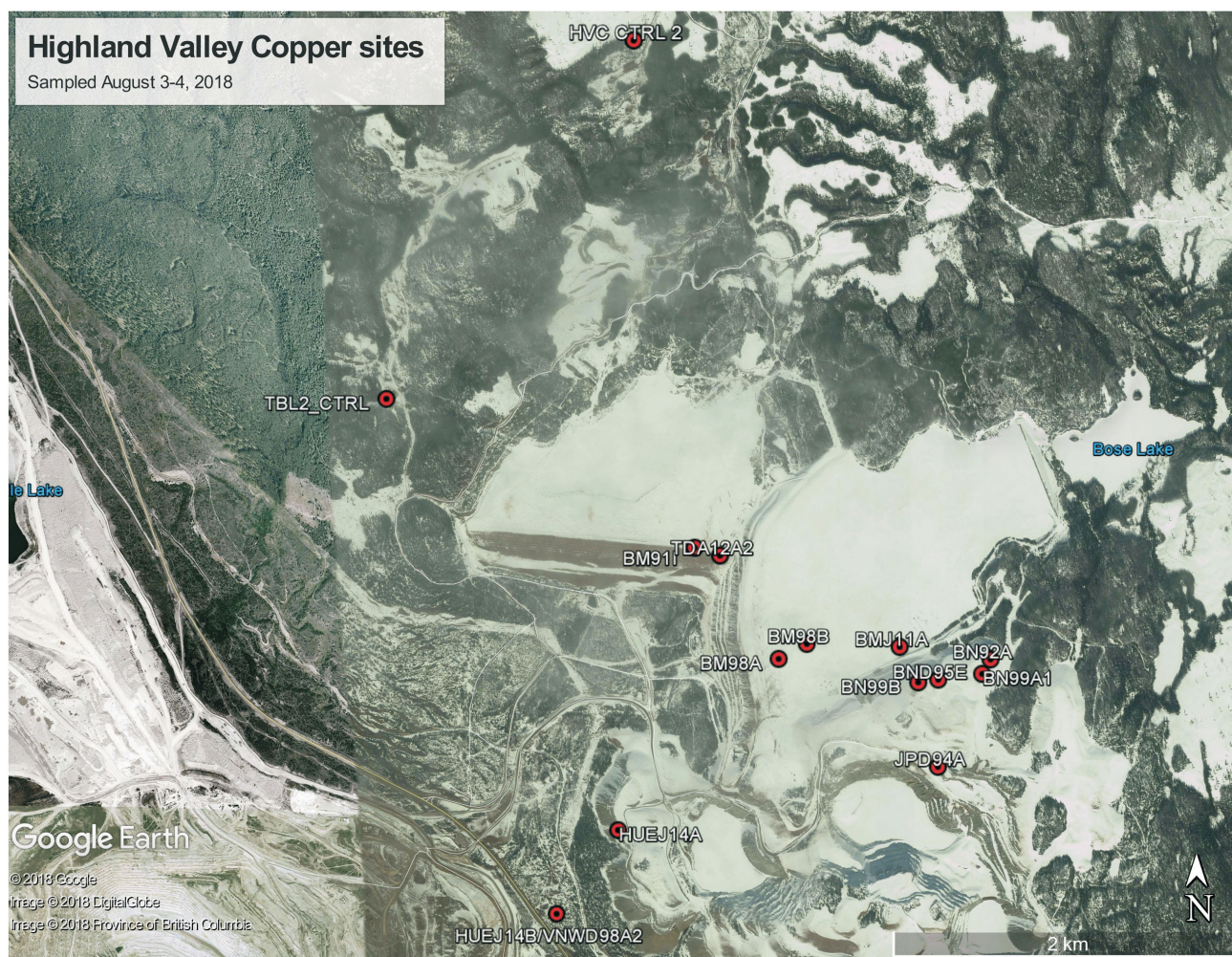


Figure 3. Highland Valley Copper mine with locations of 13 sample sites in a range of reclamation areas.

Acknowledgments

In addition to Geoscience BC, funding for this project is being provided through a Natural Sciences and Engineering Research Council of Canada Industrial Research Chair in Ecosystem Reclamation, with the following industry partners: Metro Vancouver, New Afton mine, Highland Valley Copper mine, Genome BC, Arrow Transportation, the Real Estate Foundation of BC, Kinder Morgan Canada and the

BC Cattlemen's Association. Peer reviewed by J. Van Hamme and C. Gervan.

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Ratnasingham, S. and Hebert, P.D.N. (2007): BOLD: The Barcode of Life Data System (www.barcodinglife.org). Molecular Ecology Notes, v. 7, p. 355–364, URL <<https://doi.org/10.1111/j.1471-8286.2007.01678.x>> [December 2018].

