

Canadian peatland restoration framework: A Restoration experience in Chilean peat bogs

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Chilean Peatlands

Chile has several types of peatlands. In the Northern part of Chile a type of peatland called "highland bogs", extends from about 18°30' S to 31° S (Squeo et al. 2006, Ruthsatz 1993). Highland bogs are not dominated by *Sphagnum* mosses. They receive fresh and mildly saline groundwater originating from glacier streams, snowmelt and rain. Native communities are directly dependent upon the peatlands in this region where conditions are so severe (Villagrán & Castro 1997, 2003; Villagrán et al. 1999). They are mainly used for grazing by domestic herds of llamas (*Lama glama*) and alpacas (*Vicugna pacos*) or sometimes the living layer of peatland is stripped away to expose underlying organic-rich mineral soils for cultivation.

In Southern Chile, peatlands are mainly dominated by *Sphagnum*. These bogs are distributed from Los

Ríos Region (42°S), across the Region de los Lagos, until the Magallanes Region (56°S) (Hausser, 1996, Muñoz et al. 2007, Schlatter & Schlatter, 2004). They are mainly used for *Sphagnum* and peat extraction.

The situation of peat extraction in Chile

The vast majority of *Sphagnum* dominated peatlands are concentrated in the Magellan's region (800,000 ha). Only 12% (96,000 ha) of those peat deposits have potential for commercial peat extraction, but some are difficult to access (i.e. road infrastructure is not available) (Ursic, 1989). Knowledge on the economic perspective of those peat deposits is very limited.

However, if the totality of these areas was under production, it could put Chile as a very competitive peat producer globally. Up to now, in Magallanes region, 0.003%

of peatland surfaces have been economically used (Ruiz & Doberti, 2005). In that part of the country, two types of peatland are being industrially used:

i) The first type of peatland is located in the Los Lagos region and is no more than 300 years old. They are the result of past human activities, mostly peatlands initiated from post clear-cutting of the forest (Diaz et al., 2008). Out of those peatlands, *Sphagnum magellanicum* (a species particularly suited for the floral moss market) and blonde peat (low decomposed peat H1-H2) are obtained. The material is harvested manually, dried in the field and packaged.

ii) The second type of peatland is located in the Magallanes region. They originate from the last glaciations, with *Sphagnum magellanicum* being the dominant species. Peat extraction activities



Photos 1: Block cutting technique with recent introduction of mechanization. Photos: Nelson Bahamonde and Line Rochefort



Photos 2: Milling technique. Photos: Nelson Bahamonde

began about 30 years ago, using primitive processes (Hausser, 1996; Muñoz et al. 2007) with a recent introduction of mechanical extraction (photos 1).

There are mainly two techniques used by the companies to extract peat. They both use drainage systems, drying the bogs and discarding surface vegetation:

i) Block cutting technique: The blocks are air dried on the field and taken to the milling process. The peat is obtained from depths between 0.3 m to 1.5 m (Photos 1).

ii) Milling technique: The surface area is disc harrowed and discarded. Peat is collected manually after harrowing several times to reach the depth of 0.50 m (Photos 2).

Peat extraction in Chile is still in its infancy, sites in the Lagos region are used indiscriminately in order to obtain the *Sphagnum* moss resource (Diaz et al., 2008) and sites in Magallanes are systematically abandoned after peat industrial activities. In Chile, peat is considered a mineral resource, it is exploited through mining allowances according to the Mining Code (Law No. 18 248, Article 5), in force since 1986. The code does not include considerations to repair the functions of this unique ecosystem.

However, in 1994, the environmental government office CONAMA¹ was created. The objective of this office is to enhance procedures to

promote the sustainable exploitation of the natural resources with the least damage to the environment, principally by two legal tools: Environment Impact Evaluation and Environment Impact Declaration. The environmental protection system works, CONAMA is allowing peatland exploitation requesting a permanent control of a minimum water table level and vegetation surface redistribution on bare peat. It is unknown if these requirements are appropriate to ensure ecosystem recovery and if every company complies constantly with these conditions.

This is the reason why a legal framework appears urgent, to ensure peatland sustainable use. More specifically, it is important to develop management tools for peat producers (eg. peatland restoration guidelines). Nowadays, Chile is in the process of a new institutional reform which should take place when the Environment Ministry, the Environment Superintendent and the Environmental Courts start their task group, in 2011². With the creation of this task group, it is hoped that the environmental issues will get a higher priority on the government agenda, which is an opportunity to lobby for a better management of the peatlands of Chile.

Canadian peatland restoration

The Canadian peat industry is a worldwide leader in horticultural peat production. Currently, over

13,000 hectares of peatlands are under harvest (survey CSPMA Members, 2006) mainly by the vacuum harvesting technique. Therefore, the peat industry takes a lot of interest in the wise use of peatlands. Following a workshop on the topic of the after-management of peatlands at the beginning of the 1990's, the Peatland Ecology Research Group (PERG) was created and one of its first mandates was to develop restoration techniques for peatlands in order to bring degraded peat ecosystems back on the successional pathway towards a functional peatland again.

Research in peatland restoration has been developed in close partnership between the Canadian Peat Industry and the PERG. Researchers from several universities (Université Laval, University of Waterloo, McMaster University, University of Calgary, University of British Columbia) forming this group have various and complementary expertise to work towards repairing and assess the return of different ecosystemic functions.

In 1997, the PERG published a first North American Peatland restoration guide (Quinty & Rochefort, 1997) providing technical guidelines for peat producers to restore *Sphagnum* dominated peatlands after peat extraction. In 2003 came the 2nd edition, a more extensive version of the first guide (Quinty & Rochefort, 2003). In 2006, approximately 1 800 ha of peatland were under



Photo 3: 8th workshop on peatland restoration. Shippagan, New-Brunswick, Canada 2007. Photo: H  l  ne Gautreau-Daigle

restoration or reclamation by the peat industry (survey CSPMA Members, 2006).

In 2007, the PERG organized its 8th workshop on peatland restoration where peat producers and scientists were invited (photo 3). During typical workshops, the new advances in peatland restoration were discussed as well as the technical aspects of each step implied in the restoration process. Peat field managers were encouraged to share the field tips making the process easier and less costly. It is usually a good occasion to revisit restoration goals across provinces. The long term goal revolves around bringing back a peat accumulating peatland and in the short term to help the establishment of typical peatland plants, emphasising factors to facilitate the establishment of *Sphagnum* mosses and to restore hydrology. Lately, targeted plant species for reintroduction have been widened to include brown mosses and sedges typical of fens. In 2007, a group of stakeholders from Chile (researchers, peat producers, peat traders) attended the workshop and through discussions arose the idea of a joint project to develop guidelines for peatland restoration in Chile.

Sustainable development of Magellan's peatlands

The Agriculture Regional Government Branch Office³ took

the initiative with the support of the Regional Government GORE⁴, to develop a research program to study the magellanic mires. The project is financed by GORE Magallanes. *SEREMI de Agricultura* in collaboration with the Mining regional government branch office, formulated the program "Background basis for Environmental, Legal and Trade for Sustainable Development of Magellan's peatlands", which aims to achieve the following objectives:

- 1) Develop research to survey ecological functions on selected peatlands and unveil the potential impacts of peat extraction on these functions.
- 2) Conduct restoration trials on harvested peatlands and propose a restoration protocol.
- 3) Research and development of peat products with economical value.
- 4) To develop non extractive economic activities with proposals for mire conservation that include tourism, education, science, and conservation of biodiversity.
- 5) Propose a public policy and a specific legal framework for mire conservation in accordance with Chilean idiosyncrasy.

This project is executed by INIA⁵ (National Agricultural Research Institute), CRI (INIA Regional Branch Research)⁶ Kampenaike, with the collaboration of Universidad Santo Thomas, Universidad Andres Bello, Fundaci  n Centro de Estudios del

Cuaternario, Wild Conservation Society and researchers from Instituto de Ecolog  a y Biodiversidad de Chile and Universidad de Magallanes.

The aim of the second objective of the project is to test the *Sphagnum* layer transfer approach as a peatland restoration technique proposed by the Peatland Ecology Research Group. A design including various restoration treatments was determined with the support of researches from the University of Santo Tomas, Universidad Andr  s Bello, Universit   Laval and INIA.

Collaboration: Canada and Chile

From April 18th to May 2nd 2010, Jos  e Landry, Research Professional for Line Rochefort (leader of the PERG group), joined the team of Carolina Tapia (Project coordinator for INIA Kampenaike) to take part in the three years restoration project. At that time, a good part of the field work was already done by Carolina Tapia and Nelson Bahamonde (INIA Kampenaike research assistant) including preparation of the experimental plots, levelling of the field, installation of wells, management of drainage etc. However, the implementation of the restoration trials themselves in three sites of the Magallanes region took part during that visit.

This joint effort is the chance to see if the robust restoration technique elaborated with the weather of eastern Canada will perform as well in a totally different climate. In Southern Chile, variations of temperature are not as extreme, with a minimum mean of -4  C in Cameron to a maximum mean of 11  C near Punta Arenas (Pisano 1983) compared to daily minimum mean of -18  C to daily maximum mean of 25  C for Qu  bec (Environment Canada, 2010). However, the rainfall in the Magallanes region is less abundant (400-600 mm) (Pisano 1983) compared to 924 mm, the annual amount of rain received in Qu  bec (Environment Canada, 2010). Since a lot of restoration plots have



Photo 4: Carolina Tapia and Nelson Bahamonde during field work, April 2010. Photo: José Landry

fatal car accident when she and her team were on their way to fieldwork, on June 2nd 2010. We want to share our feelings of pride and satisfaction for having known and worked with Carolina these nine months. Her thoroughness and commitment to our work, her joy to face the daily work, encourages us to continue with the same commitment she had with this project.

She believed that, if given the right tools, the government and the peat producers will take action in peatland restoration. She wanted to be involved in a change. Her dedication, implication and hard work give a good push in the right direction for sustainable peatland management in Chile. We wanted to pay one last tribute to the great scientist and the great person she was, for now and forever, thank you Carolina.

already been surveyed in Canada, it will be interesting to compare the establishment rate and productivity of the *Sphagnum* in the next few years. For Chilean authorities at regional level, it's the opportunity to develop practical restoration guidelines for peat producers of the Magallanes region in order to establish sustainable management of the peat resource.

Workshop in Punta Arenas

After the installation of the restoration trials, a workshop was held in Punta Arenas city. The program included topics such as a general description of the project, a preliminary description of the vascular flora, a description of the work in the field and current status of peatland management and peatland after-use in Canada. This workshop was attended by representatives from the government, scientific institutions and private producers of the region.

In memory of Carolina

The team in charge of the project, Erwin Dominguez, Jorge Garcia Huidobro and Nelson Bahamonde with José Landry and Line Rochefort would like to dedicate this article to Carolina Tapia, who was a victim in a

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Footnotes

- ¹ National corporation of Natural environmental, Created in 1994 by law: «General rules for the Natural environment». In: www.conama.cl/portal/1301/propertyvalue-15428.html
- ² Reforma a la Institucionalidad Ambiental. In: www.conama.cl/portal/1301/propertyvalue-15546.html
- ³ SEREMI. Secretaría Regional Ministerial de Agricultura de Magallanes.
- ⁴ GORE. Gobierno Regional de Magallanes y Antártica Chilena.
- ⁵ Instituto Nacional de Investigaciones Agropecuarias.
- ⁶ Centro Regional de Investigación.

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