The Ecology of Recovery: from mines to marshes

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Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

Frank Slide

Over time natural processes “restore” these sites

How does this happen?

At one point not long ago most of Canada was covered by ice…

…making some of our largest disturbances look small.

200 tonne trucks
Natural disturbances dwarf human disturbances...

...and give us opportunities to see how these disturbances are reclaimed.

How do ecosystems unravel?

What are the “filters” and how can we solve them?

Compaction
Limits root growth, nutrient exchange.
Once the soil is in the air, it can easily be moved down the slope.

Erosion
During a heavy rain, as much as 224 t/ha of soil can be lifted in the air ready for erosion...

Steep Slopes
“A rolling stone gathers no moss...”

Adverse Texture
Limits moisture and nutrient holding capacity

Adverse Chemical Properties
“Sudbury Syndrome” is indicative of metal toxicity

Soil Temperature Extremes
Soil surface temperature measured to be 140°F

Excess Herbivory
Seeded agronomic grasses and legumes leads to extreme ungulate populations that eat everything,
So, what can we do?

By pushing the fine textured materials over the face we can eliminate the limitations of the coarse substrate.

By making the surface rough and loose we can control erosion.

Fine textures at the top, free draining in the middle, larger rock at the bottom.
Erosion solution - Kemess Mine tailings dam

“D 10” Bulldozer

Spreading soil material...

“D 10” Bulldozer

Erosion starting on smooth surface before spreading is even completed.

Making it rough and loose

Rough and Loose

Roughened the whole surface

Cenovus Energy, Foster Creek
July 12, 2011
August 5, 2009

No signs of erosion from spring break-up

August 5, 2009

Where spring melt overwhelmed infiltration capacity each hole acted as a settling pond

Cost of rough and loose treatment at Kemess Mine was $715/ha while hydroseeding costs over $2,500/ha

Making surfaces rough and loose controls erosion and enhances native species establishment.

September 22, 2014
The rough and loose treatment has been used throughout the mine.

Controls erosion, addresses compaction and promotes vegetation establishment.

The rough and loose treatment deals with compaction.

West Portal July 8, 2005

West Portal July 27, 2008

West Portal September 17, 2011

West Portal September 17, 2011

West Portal September 17, 2011

West Portal September 17, 2011

BC Hydro removed the Heber River Dam and was faced with the need to restore the disturbed sites.

There was a 3 km penstock that was also removed.

We made project sites rough and loose (= increased topographic heterogeneity) and covered them with woody debris...

By November 13th, 2012 the project sites were ready for winter.

Monitoring transects were established at 5 project locations, July 16, 2013.

An average of 5,410 Red Alder seedlings/hectare were found in 2013.
Including between the rocks of the rip-rap

By 2014 an average of 8,554 Red Alder seedlings/hectare (and 67 other species) were found

IOL Battle Lake gas plant site to be restored, March 11, 2010

Rough and loose surface treatments control erosion by preventing overland flow.

Rough and loose, April 14, 2010

Rough and loose traps snow

Planting pioneering vegetation, April 14, 2010
Planting pioneering vegetation, April 14, 2010, note fence.

Watering in the cuttings, April 14, 2010

Cuttings growing, June 24, 2010

August 17, 2010

September 11, 2010

Red-osier Dogwood
The use of natural processes can provide cost-effective solutions for the restoration of drastically disturbed sites.

Creek dredging in 2004 created a berm that prevented flooding of the Tall Wooly Head habitat.

This resulted in an initial increase in population numbers…

Restoration of Tall Wooly Head (Psilocarphus elatior) habitat

Red Listed Species
...but eventually invasive species took over and almost eliminated the *Psilocarphus*.

Seed of *Psilocarphus* was collected before active restoration was undertaken (July 31, 2013)

The dense willow and reed canary grass cover was cut (September 20, 2013)

After brush cutting September 20, 2013

Excavator brought in to breach the berm October 13, 2013
Several openings were made in the berm, October 13, 2013

These were dug down to creek level, October 13, 2013

Over the winter, the area flooded January, 2013

With spring the vegetation started to re-grow, April 8, 2014

April 8, 2014

The locations of remaining Psilocarphus were carefully identified, June 23, 2014
Mowing was initiated when the offending plants had reached the low point in energy reserves.

This occurs slightly before full leaf expansion.
What about steep slopes?

0.8 : 1 or 51.3° Rock Cut

Seeding Sitka alder, October 30, 1986

Alder seedlings from seeding

Alder seeded slope, May 23, 1994

Alder seeded slope, July 16, 1999
Conifers continue to move in 23 years after the alder seeding.

Other steep slope treatments.

Ivy Removal

First row of wattle fences
Wattle Fences

Going up

December 9, 2014

Nearing the top

December 12, 2014

Almost done

December 15, 2014

Completed

December 15, 2014

Slope completed

December 15, 2014
Soil bioengineering can be used to initiate successional processes on steep slopes.

UBC Slopes, Winter 1988/89

Point Grey Cliffs

UBC Slopes, March 6, 1989

70° slope

Doesn’t change slope

Changes conditions for vegetation growth

UBC Slopes, May 28, 1990

Cuttings sprout and grow
Vegetation establishment on coarse talus – the genesis of pocket planting.
Pocket planting Seaton River
June 13, 2006

Pocket planting Seaton River
May 30, 2013

Pocket planting Seaton River
March 24, 2014

Wascana Creek
Restoration

Small slumps threaten the integrity of the dike

Wave erosion along the shoreline undermines the dike slopes.
Shoreline pioneers can control erosion and start the processes of succession.

May, 2003

Soil bioengineering treatments incorporated into slope designs

October, 2003

Collecting plants for Wave Protection Zone

Planting Wave Protection Zone
Using emergent aquatic plants to protect shores

Very successful treatments on Wascana Creek

Fall colours add to visitor enjoyment

Building soil bioengineering into designs can provide ecological, social and financial benefits

Volunteers from the Cowichan Valley Naturalists helps remove invasive species from Eagle Heights

Probably the most pristine Garry Oak Ecosystem in Canada
It has not been invaded by agronomic grasses.

Native Garry oak grasses allow a diversity of species to occur.

What is the motivation of these folks?

In addition to ecological and socio-economic values that are critical to restoration, personal and cultural values are essential, and I would say...

...the social values and...

...the spiritual values.
What role do spiritual values play in the restoration of disturbed sites?

I believe that we are connected with everything.

...and that this connection is what is meant by the “Spiritual” part of our world. I believe that there is this spiritual part in every person (thing) and from this belief stems the view that we can all connect directly with this spiritual part of the Universe.

So when we work to restore damaged sites we connect with spiritual part of the site/organisms/ecosystems.

Sometimes when I am in an old forest...

...beside a babbling brook...
...in a quiet wetland...

...in the alpine...

...or in a Garry Oak ecosystem in spring...

...I get a sense of this spiritual part of our world.

By working to restore those that have been damaged, I can connect with this spiritual part.

Natural processes provide solutions to even the toughest restoration problems.

Of course there are many other elements of restoration, but…
… if you identify the filters, find and follow the natural solutions and build in the social and spiritual values, restoring difficult sites is relatively straightforward.

Remember…
Whatever you do… Have Fun!

Questions ???