Are Living Shorelines Effective for Erosion Management on North Atlantic Coastlines?

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Coastal Erosion

- Loss of sediment from the coastal zone
- Highly populated with valuable assets and infrastructure (Hsu et al., 2008)
- Water quality and fish habitat (Day et al., 2012)
- Infilling of bays and costly dredging (Stoffel et al, 2013).
- Climate change

http://www.dailymail.co.uk/news/article-2052475/Entries-years-Environmental-Photographer-Year-Competition.html

Coastal Protection

- Commonly used methods – bulkheads, revetments (Davis et al., 2006)
- Costly
- Cannot adapt
- Unintended consequences (Hsu et al., 2008)
  - Habitat loss and water quality
  - "Coastal Squeeze" (Currin et al., 2010)
  - Social implications

Photos: Kirsten Ellis

Living Shorelines

- Alternative coastal protection method
- Spectrum of soft and hybrid approaches
- Reduce coastal erosion while maintaining coastal processes (Smith, 2006)
- Can provide multiple benefits (Gittman et al., 2016)

http://baypiledriving.com/ProjectTypes/ShorelineProtection/LivingShorelines

Living Shorelines

- Theory
  - Physical protection (Zhang et al., 2015)
  - Altered soil structure (Lakhdar et al., 2009)
- Helping Nature Heal Inc.
  - Developed specific techniques
  - Used in Nova Scotia and PEI
  - Funding partner

Helping Nature Heal
ECOLOGICAL LANDSCAPING

Photo: Kirsten Ellis

My Research

- First Atlantic Canadian example
- Valuable where working below the high water line is difficult or restricted
- Effectiveness of coastal bluff bioengineering techniques

Photo: Kirsten Ellis

Coastal Bluff Bioengineering

Before

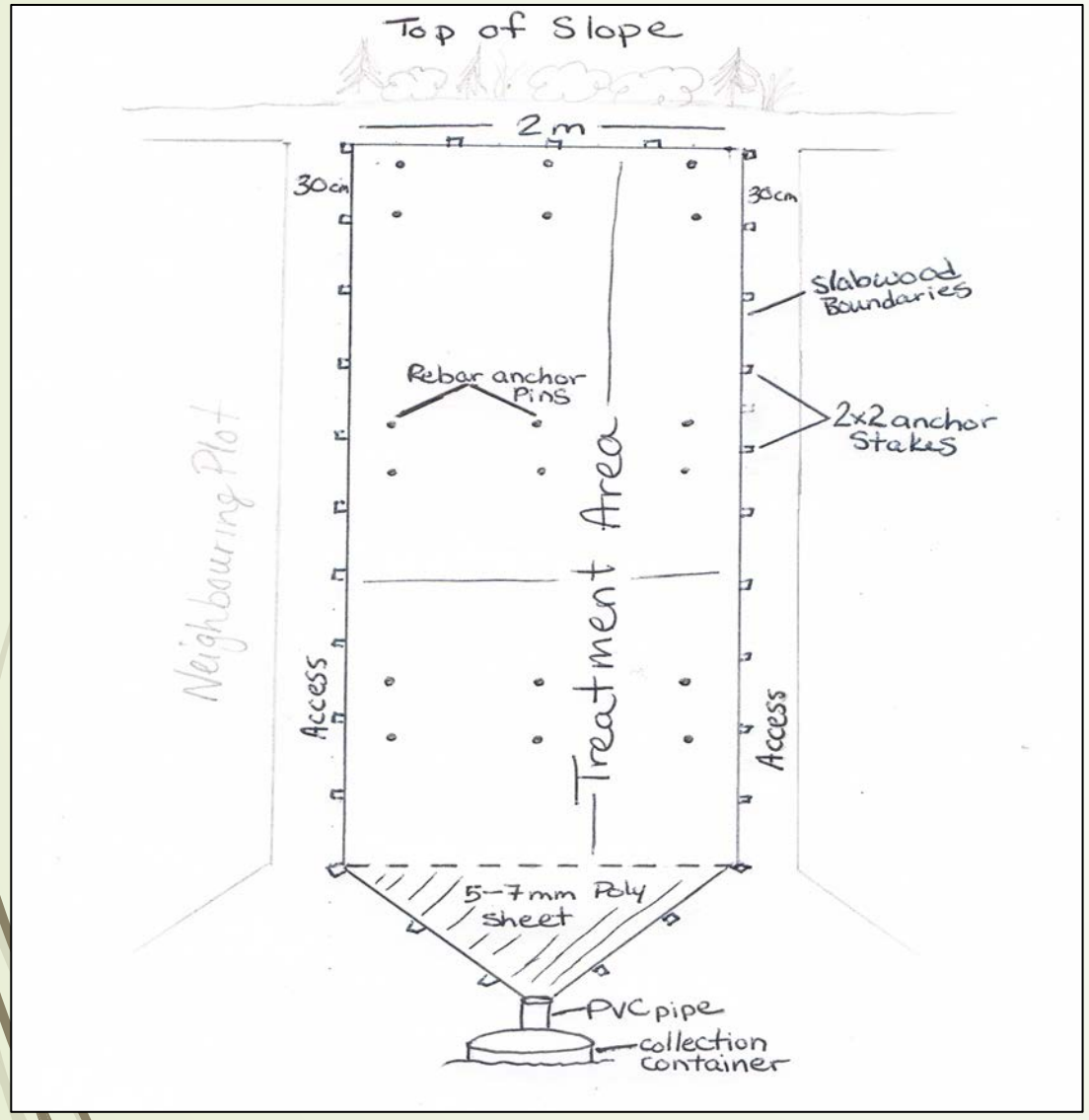
After

Methodology

- Field based
- 1) Primary experiment – 4 treatments + control
  - Random block design
- 2) Monitoring coastal reference sites
  - 4 sites representing 3 shore types
  - 2-11 years post treatment


Photo: Kirsten Ellis

Primary Experiment

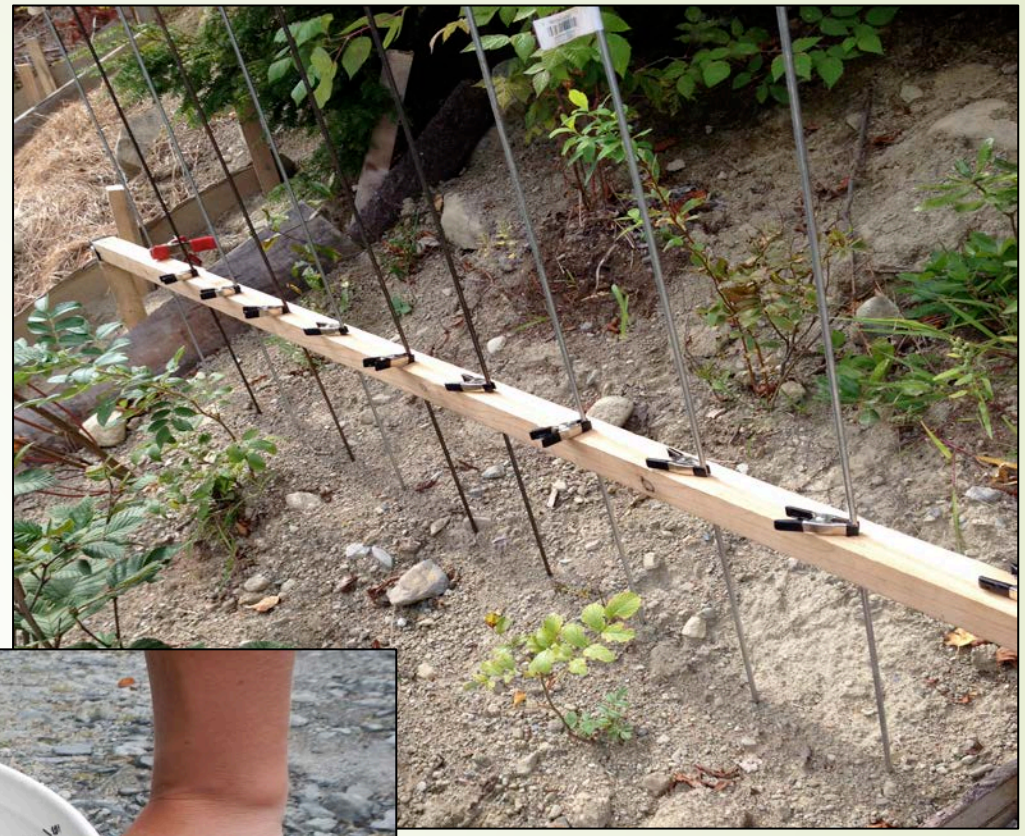


Treatments

- Control
- Hay mulch
- Brush weaving
- Planting native species
- All combined

Data Collection

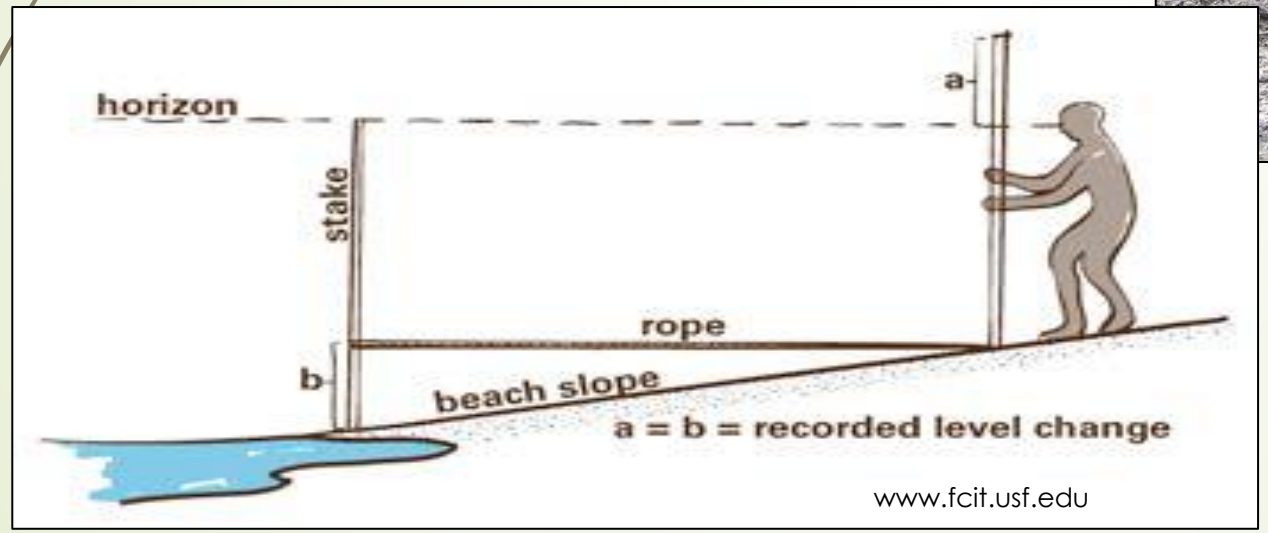
- Sediment and runoff
- Rainfall
- Profile gauge
- Rainfall simulation
- Plant survival
- Slope



Coastal Monitoring

- Small bluff
- 2 sites: 2 years post construction and 11 years post construction
- Low energy
- Emery Method

Photo: Kirsten Ellis



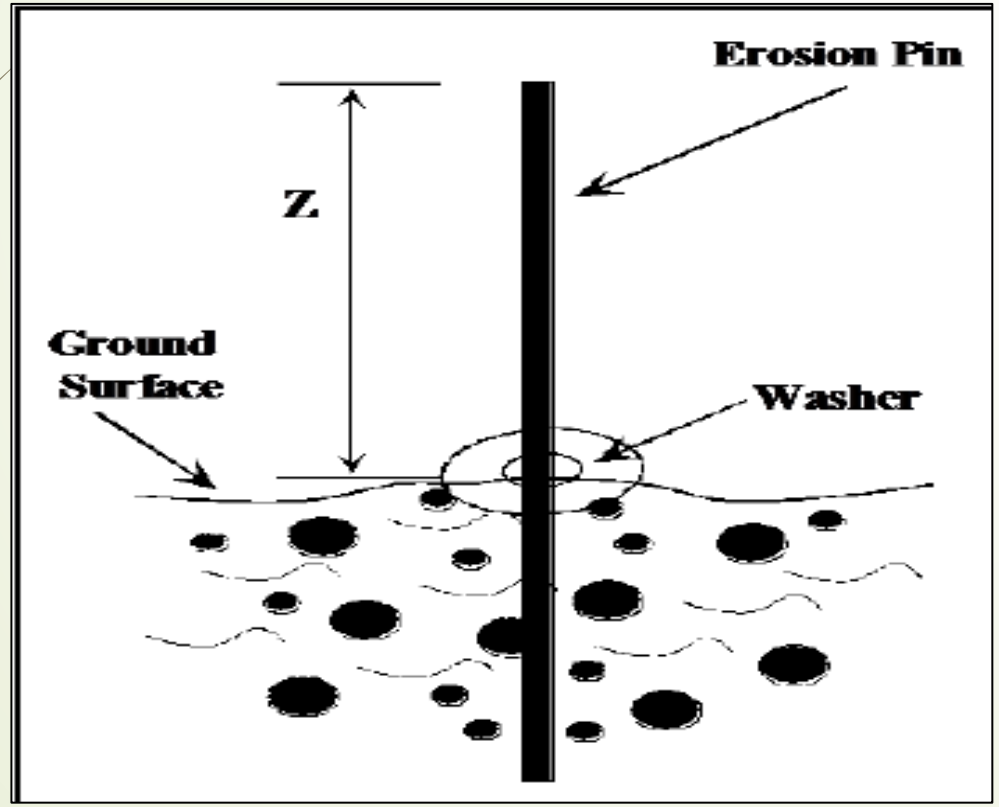
Large Bluff

- High energy, 8 years post construction
- Crest measurements
- GSC data

Photo: Kirsten Ellis

Dune

- 9 years post construction
- Erosion pins
- Vegetation density
- Toe migration



https://www.researchgate.net/figure/262336794_fig3_Figure-3-Erosion-pin-diagram-from-Benda-2003

Photo: Kirsten Ellis

Results: Rainfall Effects

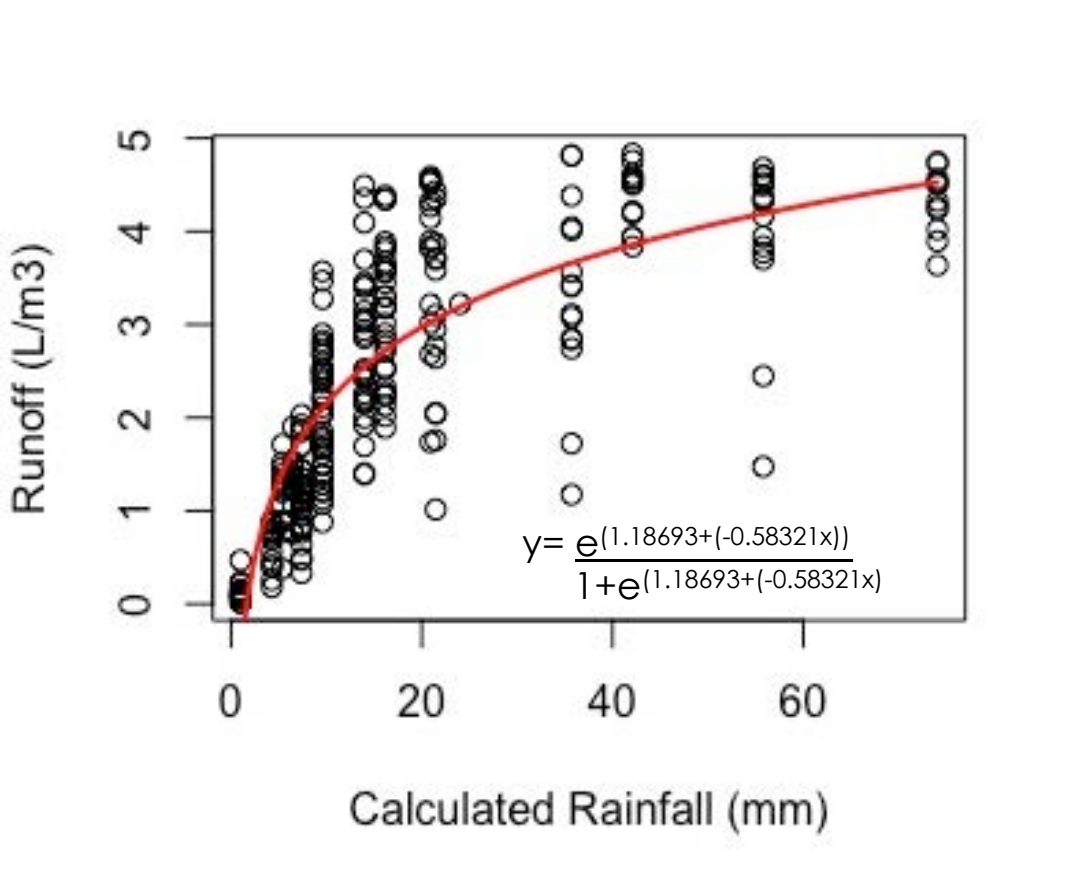


Figure 1) Runoff (L/m^3) from each experimental plot, plotted against the calculated rainfall (mm). Fitted with a logistic curve.
Residual standard error = 0.7687, df=271

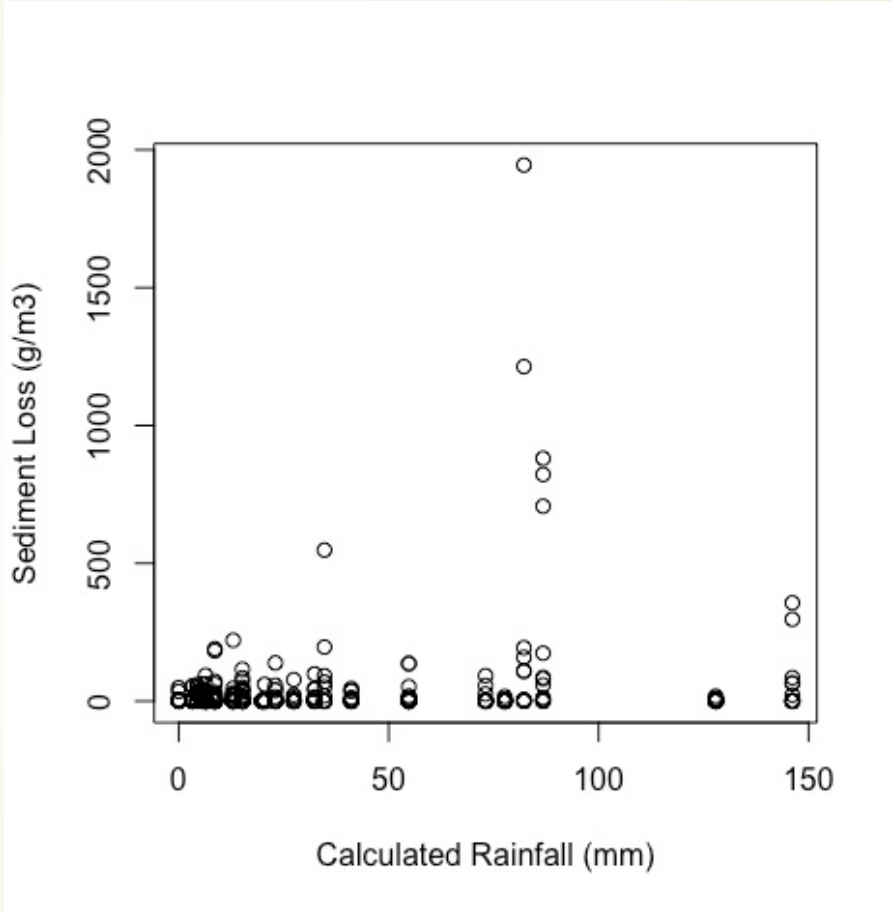


Figure 2) Sediment loss (g/m^3) from each Experimental plot, plotted against the calculated rainfall (mm).

Results: Total Sediment Loss

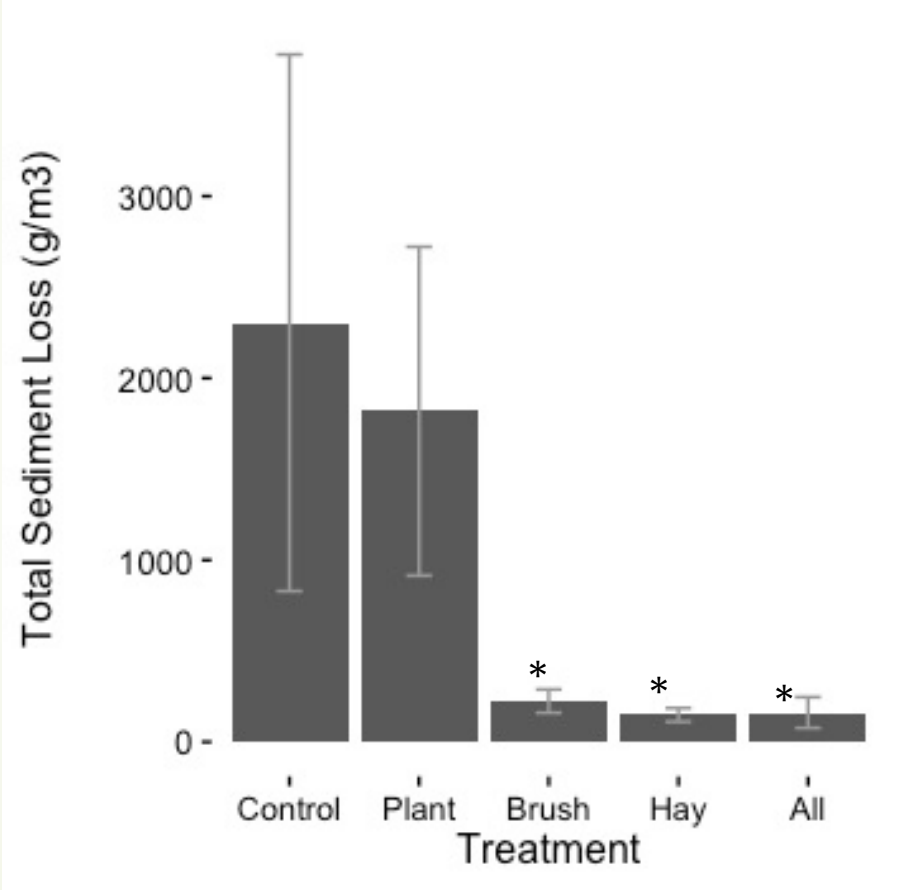


Figure 3) Total sediment loss (g/m^3) for each of the experimental treatments including standard error. Represents minimum sediment lost during natural rainfall events from September 3 – December 5, 2015 and April 28 - August 29, 2016. p=0.00516 for treatment effect. *significantly different from control.

Results: Mean Sediment Loss

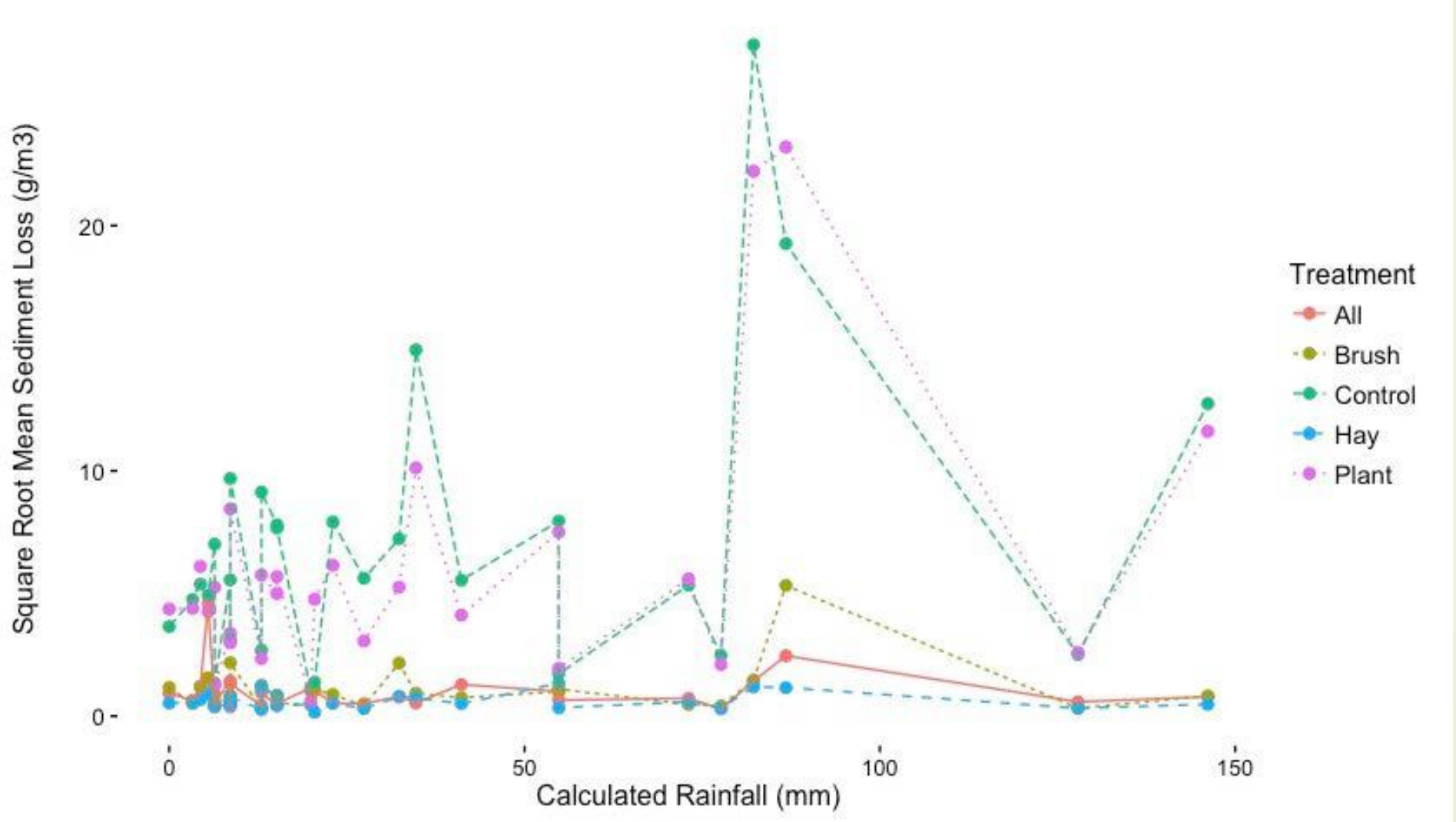


Figure 4) Square root mean sediment loss (g/m^3) for each treatment plotted against the calculated rainfall (mm).

Control

All

Photos: Kirsten Ellis

Next Steps

- Profile gauge data analysis
- Rainfall simulation data analysis
- Grain size erosion analysis
- Analysis of coastal monitoring data

Photo: Rosmarie Lohnes

Thank You!

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Helping Nature Heal

ECOLOGICAL LANDSCAPING

NSERC CRSNG

E.P.I.C Lundholm Lab: Ecology of Plants in Communities

InCoaST research unit

Questions?

Rainfall

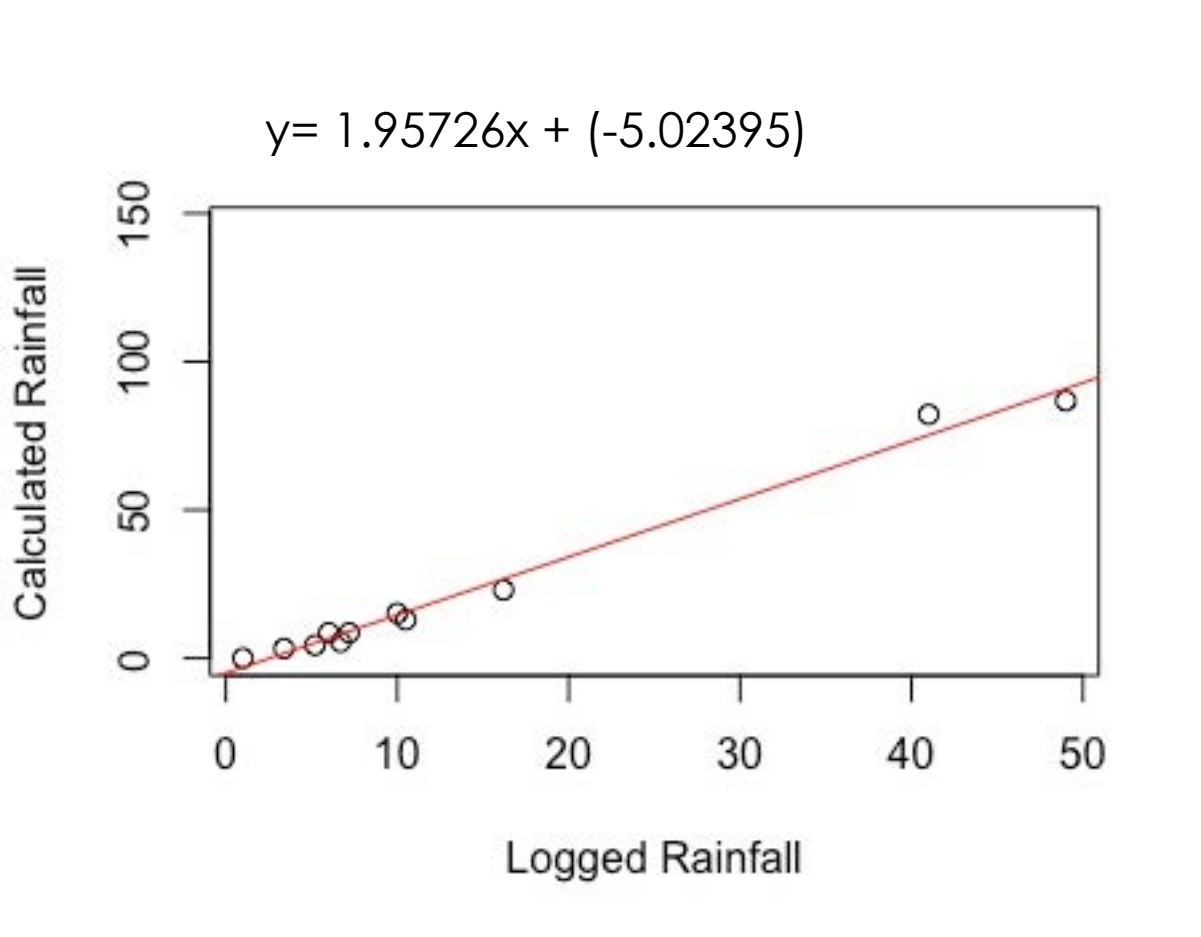
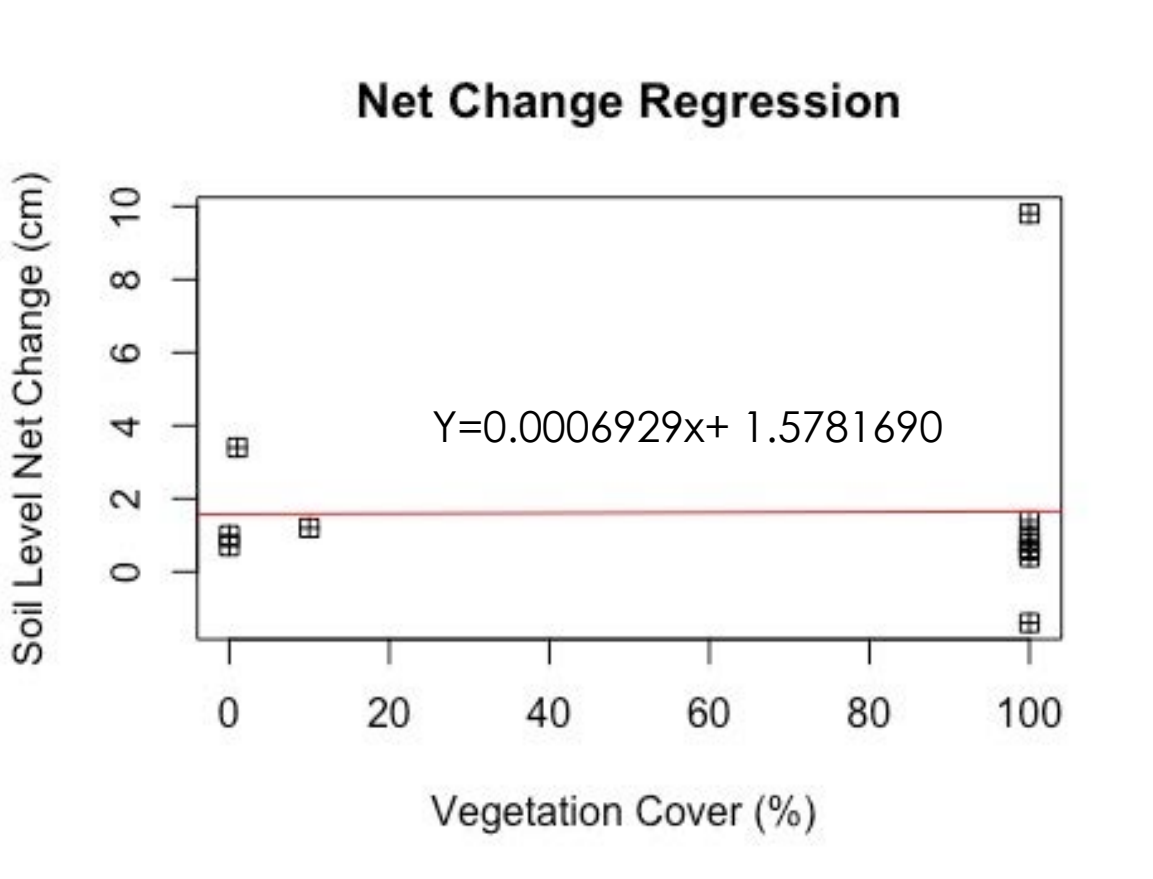


Figure 6) Regression analysis of calculated rainfall (mm) and logged rainfall (mm). Multiple R-squared: 0.9875

Dune Erosion Pin Data



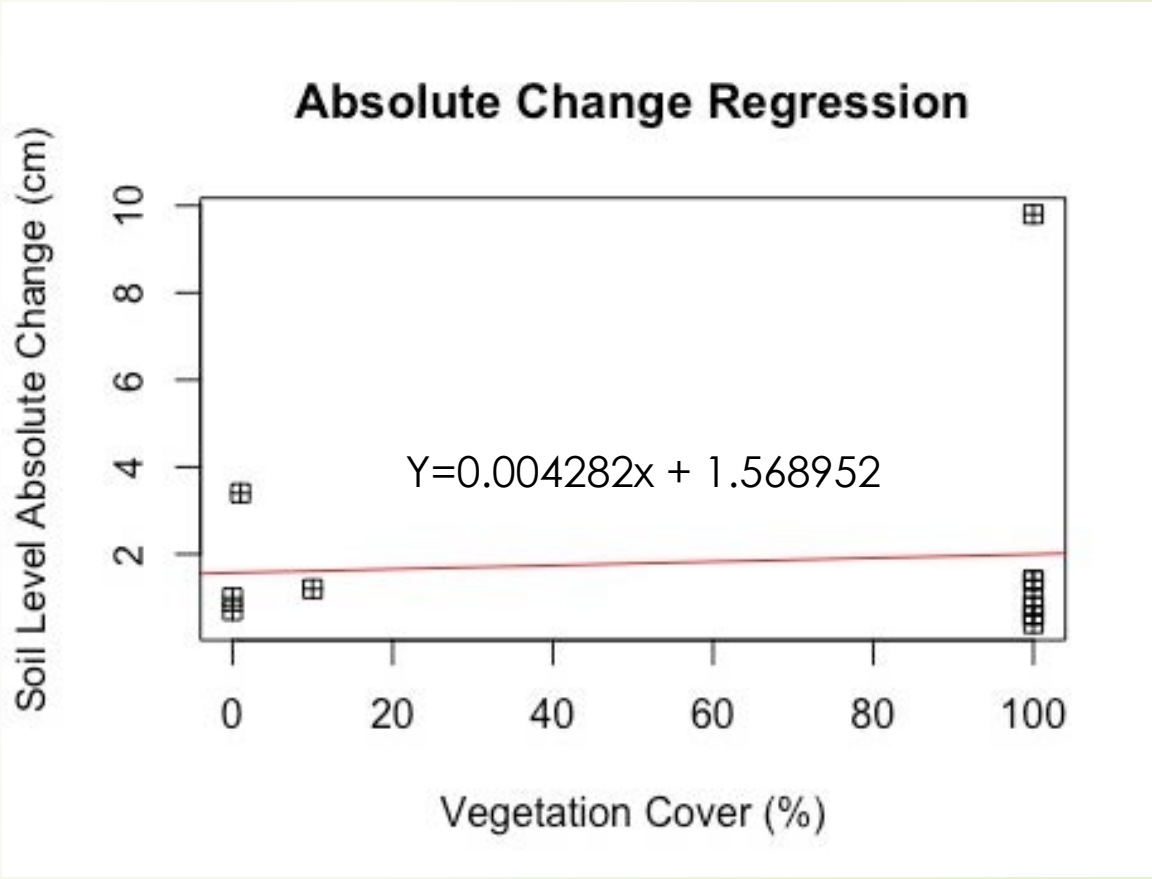


Figure 5) Regression of the effect of vegetation cover (%) on soil level change in a dune system. Multiple R-squared: 0.0001424