Mitigating erosion on trails at SSU's Fairfield Osborn Preserve

SONOMA STATE UNIVERSITY | The Preserves
Fairfield Osborn Preserve
Los Guilllicos Preserve
Galbreath Wildlands Preserve

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Introduction

At Fairfield Osborn Preserve, rainwater flows across or down various sections of trail during heavy rain events causing incising of the trail[1], which contributes to soil loss[2], erosion[3], and water quality issues[45]; furthermore, Sudden Oak Death pathogen *Phytophthora ramorum*, is transmitted via flowing water[6]. Hikers tend to walk around the incised trail[1], contaminating their boots with *Phytophthora* ramorum[7], and causing damage to vegetation[8] Trail maintenance can direct flowing water off-trail[9]. and stop water from flowing downhill along a trail[10]. On March 22, 2014, land managers prescribed a trial maintenance treatment to a portion of the Marsh Trail, and applied the treatment the following day. This treatment includes addition of stairs to the downhill section, channel infill in deepest portions, diversion of the trail and water channel through drainage ditches, and revegetation. Data includes mapped location of our project site, GPS locations of high risk trails, and soil loss data for the project site located on Marsh Trail. Our results are specific to our project site. We are not conducting research; however, we are using our treatment tools as land managers to address issues on this trail, and we are reviewing literature to identify problems to suggest solutions for future Land Managers and Land Stewards at Fairfield Osborn Preserve.

Purpose

Preserves staff initially ascertained that rainwater flows down parts of trails during heavy rain events, which causes several problems:

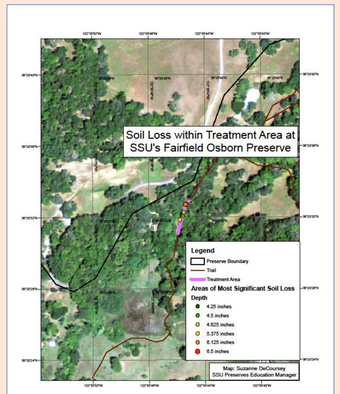
- Soil loss
- Erosion
- Decrease in water quality
- Vegetation damage
- Transmission of Sudden Oak Death via flowing water on trail
- Transmission of Sudden Oak Death via hikers' boots

Water flowing across a trail causes soil loss and channel incisement. Soil loss due to water flowing across a trail also decreases water quality. Furthermore, flowing water transmits Sudden Oak Death, *Phytophthora ramorum*. Erosion of a trail contributes to soil loss and decreased water quality; in addition, hikers tend to walk around eroded areas causing damage to vegetation and contamination of hikers' boots with the Sudden Oak Death pathogen, *Phytophthora ramorum*.

Methods

Data Collection

1. Locations of similarly incised sites were collected by teams of land managers using hand-held GPS. Land managers identified sites with soil loss greater or less than 5 inches. This information will be used by Fairfield Osborn Preserve Land Stewards to locate, treat, and monitor soil loss and trail incisement.
2. Soil loss data pertaining to our project site on Marsh Trail. Soil loss data was collected by a team of land managers using a 3 foot section of string, a 6 inch ruler, a 25 foot tape measure, and a 100 foot tape measure. Width of incised channel was measured with the 25 foot tape measure, and depth was measured with the 6 inch ruler and the section of string stretched across the incised channel.



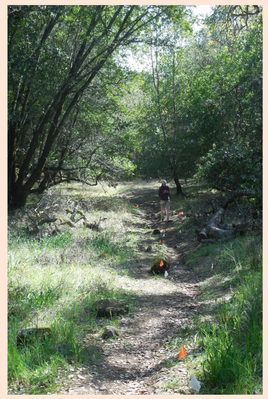
Points	Width of Soil Loss Before Treatment	Depth of Soil Loss Before Treatment	Total Area of Loss (square inches)	Width of Soil Loss After Treatment	Depth of Soil Loss After Treatment	Total Area of Loss (square inches)
Top	27 in	0.125 in	3.375 sq in	35 in	0.5 in	17.5 sq in
1	24 in	6.5 in	156 sq in	24 in	1.5 in	36 sq in
2	24 in	6.125 in	147 sq in	24 in	3.25 in	78 sq in
3	21 in	4.25 in	89.25 sq in	38 in	1.125 in	42.75 sq in
4	24 in	4.5 in	108 sq in	33 in	3.50 in	107.25 sq in
5	46 in	5.375 in	247.25 sq in	30 in	2.75 in	82.5 sq in
6	49 in	4.625 in	226.625 sq in	48 in	4.25 in	204 sq in
Bottom	21 in	3.25 in	68.25 sq in	21 in	0.5 in	10.5 sq in

Methods

Land Management Prescription and Treatment

Land management prescription and treatment of 256 feet of trail: our project site on Marsh Trail. On day one, land managers walked the project site and determined areas that required treatment. Our treatment tools include: drainage ditches with channel infill (rock or woody debris), waterbars, steps, revegetation of sides of trail with perennial deep-rooting native species, boardwalk, switchback for deep grades, and assisting the water in seeking its own level to promote infiltration. Materials used in trail maintenance include: pin flags, landscaping timbers, logs and limbs sourced from the project site, rocks from the creek, pick-mattocks, transfer shovels, trench shovels, mallets, digging bars, and a McLeod. On day two, we applied the following treatment:

Point A - top of the project site
3 steps: 2 standard milled, 1 locally sourced
Channel infill with woody debris and use as drainage ditch
Redirect trail to make new route along drainage ditch
At the end of the new route extend natural rock steps
Redirect route back to existing trail and walk across existing waterbar
Install drainage ditch to divert water along the right of trail into drainage area
Remove old water bar
Add rock wall and redirect trail to make new route
Drainage ditch along new route
Redirect trail to existing route
Point B – bottom of project site



Conclusion

Land Managers and Land Stewards completed their work in time for our project site to experience heavy rain events prior to this presentation. From our observations, the steps are slowing down and holding water, the drainage ditches are directing the flow of water off the trail and soil is settling in the channels. Vegetation is flourishing on the side of the trail, and hikers are following the redirected route. In conclusion, our observations suggest that the treatment prescribed for this project site will direct water off the trail and slow down soil loss. These conclusions are specific to this project and we are not conduction research; however, we are providing useful treatment strategies for future Land Manager and Land Stewards at Fairfield Osborn Preserve.

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References

1. Marion, Jeffrey L. and Yu-Fai Leung. "Indicators and Protocols for Monitoring Impacts of Formal and Informal Trails in Protected Areas." Journal of Tourism and Leisure Studies 17, no. 2 (2011): 215-236.
2.Olive, Nathaniel D. and Jeffrey L. Marion. "The Influence of Use-Related, Environmental, and Managerial Factors on Soil Loss From Recreational Trails." Joural of Environmental Management 90 (2009) 1483-1493.
3. Pickering, Catherine Marina, Wendy Hill, David Newsome and Yu-Fai Leung. "Comparing Hiking, Mountain Biking and Horse Riding Impacts on Vegetation and Soils in Australia and the United States of America." Journal of Environmental Management 91 (2010) 551-562.
4. Clow, David W., et al. "Effects of Stock Use and Backpackers on Water Quality in Wilderness in Sequoia and Kings Canyon National Parks, USA." Environmental Management 52 (2013): 1400-1414.
5. Beylich, Anneke, Hans-Rudolf Oberholzer, Stephan Schrader, Heinrich Höper and Berndt-Michael Wilke. "Evaluation of Soil Compaction Effects on Soil Biota and Soil Biological Processes." Soil & Tillage Research 109 (2010): 133-143.
6. Davidson, Jennifer M., Allison C. Wickland, Heather A. Patterson, Kirsten R. Falk and David M. Rizzo. "Transmission of Phytophthora ramorum in Mixed-Evergreen Forest in California." Phytopathology 95, no. 5 (2005): 587-596.
7. Peterson, Ebba, Everett Hansen and Alan Kanaskie. "Spatial Relationship Between Phytophthora ramorum and Roads or Streams in Oregon Tanoak Forests." Forest Ecology and Management 312 (2014): 216-224.
8. Amrein, Dominik, Hans-Peter Rusterholz and Bruno Baur. "Disturbance of Suburban Fagus Forests by Recreational Activities: Effects of Soil Characteristics, Above-Ground Vegetation and Seed Bank." Applied Vegetation Science 8 (2005): 175-182.
9. Michigan Department of Natural Resources and Michigan Department of Envoronmental Quality. "Water Diversion Devices." In Sustainable Soil and Water Quality Practices on Forest Land, 28-34. Harrison Township, MI: Michigan Department of Natural Resources, 2009.
10. Marttila, Hannu and Bjørn Kløve. "Managing Runoff, Water Quality and Erosion in Peatland Forestry by Peak Runoff Control." Ecological Engineering 36, no. 7 (2010): 900-911.