Fires of Kelvin Canyon

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Abstract

The objective for this study was to determine the effects of a surface burn on the soil in Kelvin Canyon. Ten soil pits were dug, five affected by the burn and five relatively unaffected and many tests were ran on the samples. Percent clay and water retention differences do not vary from burned to unburned pits, and all sites are classified as well-drained. Soil pH in the surface horizon of burned soils is more alkaline than the surface horizon of unaffected soil. Another result of a burn is the formation of a hydrophobic layer, formed when hydrophobic compounds in the soil secrete a waxy substance which coats soil particles. The hydrophobic layer is present in all burned pits, but absent in pits that were not burned. Sites that were not scorched have a higher percentage of native vegetation and more total percent cover than burned sites. Invasive annuals quickly colonized the burned areas, but perennial natives show some signs of recovery. Burned sites have darker colors in their surface horizon than unaffected sites. Structure is very similar in all horizons except the surface, where burned pits tend to have angular blocky shape and unaffected pits tend to be granular.

Background

Portuguese Bend Nature Preserve, approximately 1500 acres overlooking the Pacific Ocean on the southern slopes of the P.V. Peninsula, is managed by The Palos Verdes Peninsula Land Conservancy (Figure 1). On June 13 2005 a brush fire scorched more than 200 acres of land near Del Cerro Park in the Preserve (Figure 2). I selected Kelvin Canyon on Peacock Flat of the Nature Preserve for my tests (Figure 3). This study's purpose is to determine how the fire's impacts on the soil drainage changed the landscape.

Figure 1. Map of Palos Verdes Peninsula Land Conservancy's managed land

Figure 2. 2005 Crenshaw burn © 2005 JM Kotler

Figure 3. Soil Study Site

Introduction

Generally, there is less soil-water percolation after a fire as a result of ash and char plugging up soil pores. Post-fire temperatures tend to be hotter because of the darker soils (Figure 4). The additional exposure to the sun, depending on the degree of overlying vegetation that gets burned and the amount of residual canopy, can increase evaporation dramatically in the few months following a fire. Ash residue and the amount of remaining organic matter also effects percolation.

Another result of a burn is the formation of a hydrophobic layer, which is formed when hydrophobic compounds in the soil (such as organic matter and plants) get burned and these compounds secrete a waxy substance which coats soil particles (Dicus, 2006) (Figures * and *). The result is a water repellent layer that is typically below and parallel to the soil surface and can last for years. Soil that becomes water repellent can present problems due to enhanced runoff and rainsplash causing erosion, and poor water infiltration leading to reduced plant growth (Buczko and Bens, 2006).

Figure 4. Smoldering soil

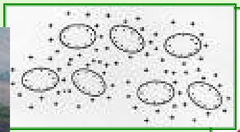

Figure 5. Hydrophobic colloidal particles

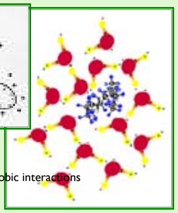

Figure 6. Hydrophobic interactions

Methods

We selected the backslope of one steep hill in Kelvin Canyon to run all tests on the soil so all pits would have a similar aspect, soil type, climate, and elevation. Ten soil pits were dug, five burned by the June 2005 fire and five unburned to depth of 40 cm or to hardpan (Figures 7 and 8). In the field I measured pH, soil color, structure, and other soil properties with litmus strips, a Munsel Color Book, and determined texture by pencil and ribbon test combined with soil textural triangle. The drip test determined if a hydrophobic layer is present.

In order to determine vegetation, we recorded the species and estimated the percent cover of one-meter^2 plot around each pit. We also noted differences in distribution of the vegetation in the burned vs. unburned plots.

Figure 7. Burned soil pit #4 horizons

Figure 8. Unburned soil pit # 9 horizons

Results

Using the water drip test, we discovered a hydrophobic layer in all 5 burned pits, but found no layer in the unburned pockets and were significant ($p>0.05$) (Figure 9). The pH was also higher in the top layer of soil in the burned, but the underlying horizons of all pits were statistically similar (Figure 10). Fire did not alter the structure of any horizon in all soil pits. Scorched soils had a darker chroma and value in the surface horizon than unburned. Despite the high clay percentage, all 10 pits are classified as well drained. No redoximorphic features were found.

Burned areas have a much lower total percent cover (5.2%) than unburned areas (15.2%) and also have a lower percentage of cover as native (Figures 11, 12, and 13).

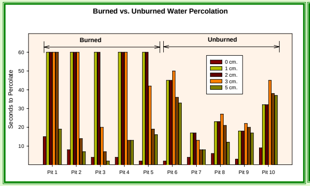

Figure 9. Water Percolation Rates

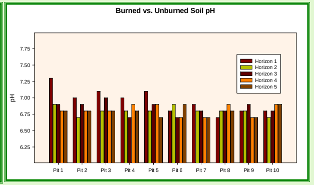

Figure 10. Soil pH by Horizon

Figure 11. *Encelia californica*, native

Figure 12. *Mirabilis californica*, native

Figure 13. *Malacothrix saxatilis*, native

Figure 14. Purple Sage thriving in a burned area

Figure 15. Burned Woody Perennial Directly Above Soil Pit

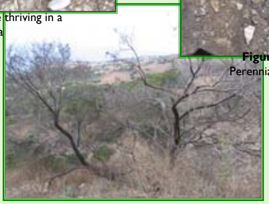

Figure 16. Burned woody perennial

Discussion

Areas affected by the fire have less rapid percolation than unburned areas, which caused a change in vegetation to more hearty plants (Figure 14). Natives such as *Rhus integrefolia* and *Opuntia littoralis* were only found on unburned sites (Figures 17 and 18). The burned sites consistently have a higher pH than the unburned sites. Burned sites range from neutral to slightly alkaline, while all burned sites are more neutral because of base elements present in ash and because there are less organic acids from decomposition.

The change in vegetation indicates that an alteration of soil properties had an effect on both plants and organisms. The presence of a hydrophobic layer leads to less available water for plants, which resulted in reduced vegetation growth. The degree of water repellency is related to amount of hydrophobic organic matter. In general, as fire frequency increases, the amount of non-native weeds increases dramatically (Haidinger, T.L., and J.E. Keeley. 1993) (Figure 19).

Another reason why different types of vegetation thrive on burned sites is because additional soil is exposed after the overlying plants are burned in a fire, which can lead to a harsher, warmer environment for seedlings. Annuals are the most common plants colonizing over burned areas because of their light, wind-borne seeds and their ability to regenerate quickly. There has been some perennial recovery, but many were burned in the fire and have not yet been able to significantly regenerate (Figures 14, 15, and 16).

Figure 17. *Rhus integrifolia*, native

Figure 18. *Opuntia littoralis, native*

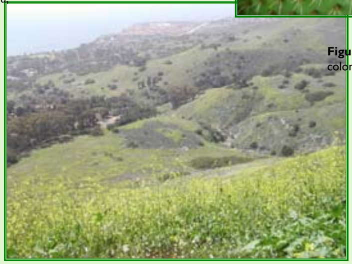

Figure 19. Invasive *Brassica nigra* colonizing after 2005 burn