

Effects of prescribed fire on soil physical and chemical characteristics

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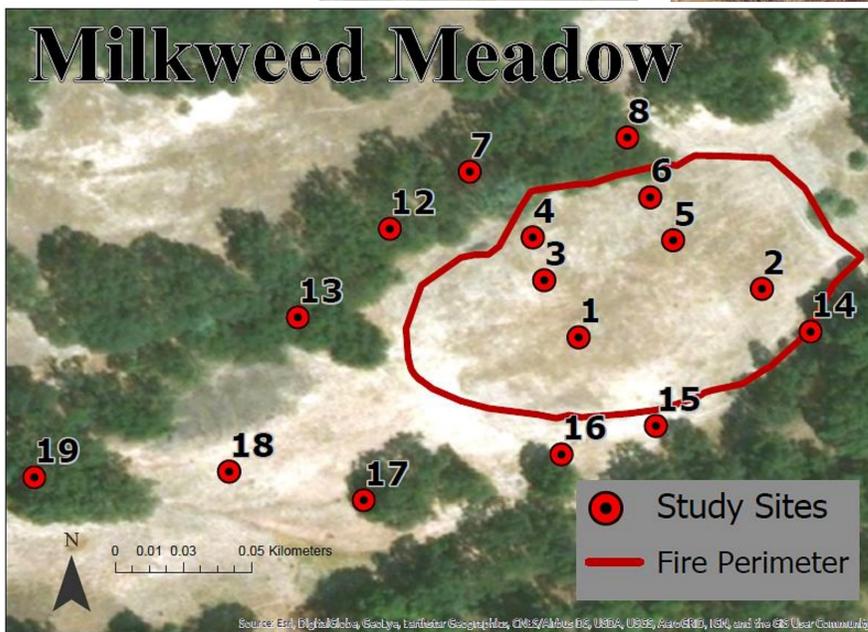


Introduction

- Wildfire plays an important role in maintaining California's landscape; removal of old growth allows pioneer species to thrive promoting diverse plant assemblages¹.
- Recent increases in wildfire intensity can reduce infiltration², increase erosional processes, reduce the likelihood of successful pioneer succession, and threaten the health of local aquatic systems³.
- Reducing accumulated fuel load in California's fire prone areas is one way to combat the increased intensity of wildfires. Current methods of reducing fuel load include mechanical thinning and the use of controlled burns⁴.
- Intense wildfire and thinning can lead to nutrient removal from the local ecosystem as nutrients are volatilized into the atmosphere, eroded and flushed into nearby waterways, or simply removed through thinning⁵.

Objective

The goal of this project is to compare soil chemistry and physical qualities before and after a low intensity controlled burn at Big Chico Creek Ecological Reserve (BCCER) to assess what changes may occur in the topsoil. It is expected that the low intensity fire will not cause major changes to soil chemistry and physical characteristics.



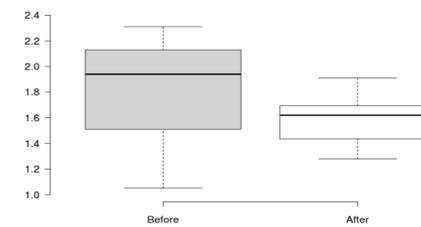
Methodology

- Topsoil samples (0 - 10 cm. depth) were gathered at 19 sites surrounding Milkweed Meadow at BCCER before (Oct. 7th, 2018) and after (Feb. 8th, 2018) the controlled burn.
- Bulk density samples were collected by use of soil coring rings.
- Particle size analysis was carried out following the hydrometer method⁶.
- Soil nutrients were extracted in deionized (DI) water and analyzed by colorimetric methods⁷.
- Electrical conductivity and pH were calculated from soil water mixtures with a EuTech pH probe⁷.

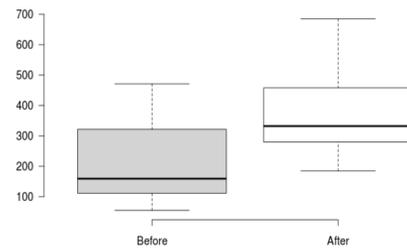
Results

- Bulk density averaged 1.84 ± 0.36 g/cm³ before the fire and 1.52 ± 0.33 g/cm³ after the fire
- Bulk density showed a significant decrease after the controlled burn** (paired t-test, $p < 0.05$, $n=16$).

Bulk Density (g/cm³)



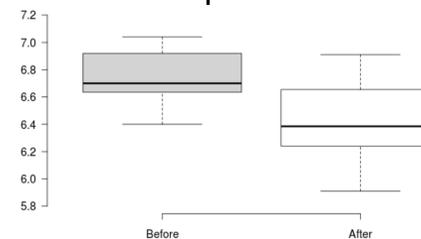
Electrical Conductivity (µS/cm)



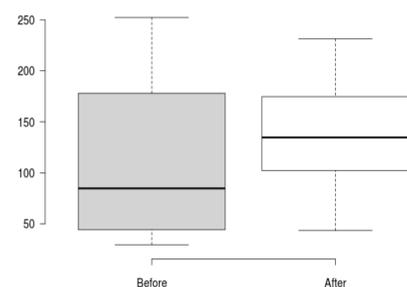
- Electrical conductivity averaged 209 ± 125 µS/cm before the fire and 375 ± 149 µS/cm after the fire
- Electrical conductivity of the topsoil increased after the prescribed fire indicating an increase in soil salinity** (paired t-test, $p < 0.05$, $n=16$)

- pH averaged 6.75 ± 0.19 before the fire and 6.42 ± 0.27 after the fire
- pH of the topsoil became more acidic after the fire** (paired t-test, $p < 0.05$, $n=16$)

pH



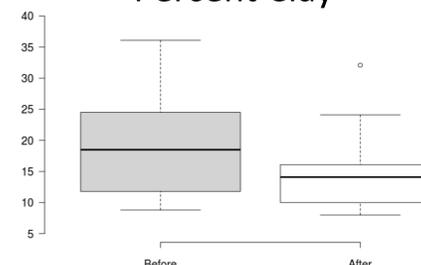
Nitrate (mg/kg)



- Nitrate averaged 108.7 ± 73.6 mg/kg before the fire and 137.6 ± 50.7 mg/kg after the fire
- Generally nitrate concentration increased in the topsoil after the fire, but the confidence level was less than 95%** (paired t-test, $p = 0.08$, $n=16$)

- Percent clay averaged $18.7\% \pm 7.8\%$ before the fire and $14.6\% \pm 6.4\%$ after the fire.
- The amount of clay present in the topsoil decreased after the fire** (paired t-test, $p < 0.05$, $n=16$)

Percent Clay



(Left) Milkweed Meadow before the prescribed fire. Of note is the dense tall grass, the meadow shimmers from a satellite's perspective.



(Right) The prescribed fire at Milkweed Meadow removed a majority of the tall grass with small tufts of grass remaining. The increased solar incidence invited gophers, worms, and new vegetative growth.

Conclusions & Discussion

- The prescribed burn increased the acidity and the electrical conductivity of the topsoil. These findings are in agreement with similar research⁸.
- The significant difference found between bulk density before and after the controlled burn may have been influenced by the change in soil moisture. Inserting soil cores into the dry ground before the fire required greater effort and the soil likely experienced more compaction when compared with the cores sampled after the prescribed burn.
- Results from the nutrient analysis show that there was no discernable change in the water soluble nitrate held within the soil before and after the fire. When compared with the estimated 5-50% loss of nitrate from intense wildfires found by Spencer et. al. (2003); the findings from this research suggest mild intensity fires could retain more nutrients in the local ecosystem compared to an intense wildfire⁵.

(Right) February 8th, grass growing from ash of fire near site 5.
(Below) October 7th, clearing grass to sample site 3.



Acknowledgements

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