Serpentinitic Problematic Hydric Soils in a Mediterranean Climate along the Central Coast of California

Ariel N. Namm and Karen L. Vaughan

California Polytechnic State University, San Luis Obispo

Abstract

Wetlands are unique and sensitive environments important for ensuring water quality and encouraging species diversity. In order to protect wetlands, it is important to use proven scientific methods to delineate these habitats from seemingly similar uplands. A groundwater seep was chosen as a project site in Poly Canyon in San Luis Obispo, California for field and laboratory analyses. The soil has wetland hydrology with seasonal prolonged saturation and hydric vegetation. However, the soil does not meet a meet a visual field indicator for hydric soils. Therefore, the purpose of the study is to determine if this problematic soil site is a wetland. Soil pH, temperature, and volumetric water content were measured at 10-cm increments to a depth of 50 cm. These data were collected weekly from January through June of 2013. Concurrently, a set of 5 Indicator of Reduction in Soil (IRIS) tubes were installed and removed biweekly at each site. The IRIS tubes were visually analyzed to determine amount of iron removed from the tube surface. IRIS tubes are an effective tool for identifying and delineating wetlands based on iron reduction. The results of the field and laboratory analysis will verify if the project site is a wetland and aid in the determination of a new visual field indicator for hydric soils.

Figure 1. Map of Project Site

Background

Objectives

- To document the hydrology and biogeochemistry as related to a serpentinitic soil in Central California.
- To understand the significance of a soil in Central California that appears to be hydric but lacks redoximorphic features.
- To create a new morphological indicator for hydric soil that exhibits similar soil features as those at the Project Site.

Problem Statement

The Project Site exhibits both wetland hydrology and hydrophytic vegetation but does not meet any of the Field Indicators of Hydric Soils (USDA-NRCS, 2010).

Hypothesis

- Despite the lack of appropriate Field Indicator, this soil qualifies as a wetland based on existing field conditions as well as physical and chemical analyses.

References

Berkowitz, J.F. and J.B. Sallee. 2011. Investigating Problematic Hydric Soils using Hydrology, IRIS Tubes, Chemistry, and the Hydric Soils Technical Standard. Soil Science Society of America Journal 75: 2379-2385. doi:10.2136/sssaj2011.0040.

Brady, N.C. and R.R. Weil. 1996. The nature and properties of soils. The nature and properties of soils.: xi + 740 pp.-xi + 740 pp.

Rabenhorst, M.C. and S.N. Burch. 2006. Synthetic iron oxides as an indicator of reduction in soils (IRIS). Soil Science Society of America Journal 70: 1227-1236. doi:10.2136/sssaj2005.0354.

United States Department of Agriculture, Natural Resources Conservation Service. 2010. *Field Indicators of Hydric Soils in the United States*, Version 7.0. L.M. Vasilas, G.W. Hurt, and C.V. Noble (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

Materials and Methods

Field Morphology and Sampling

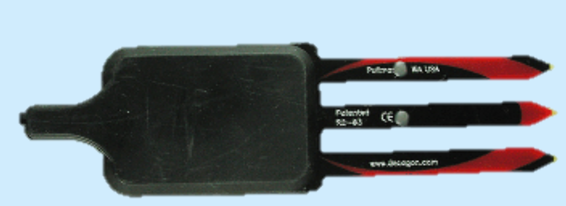
At a project site in the Central Coast of California (Figure 1), a pit was excavated in order to carefully document the soil morphology. Special attention was given to redoximorphic features related to translocation of iron found in the upper 50 cm of the profile. The results were compared to the features specified in the *Field Indicators of Hydric Soil* in the U.S. (USDA-NRCS, 2010).

Indicator of Reduction In Soils (IRIS) Tube Implementation

Iron oxide paint was made by mixing ferric chloride, potassium hydroxide, and silver nitrate in the laboratory. The paint was then applied to polyvinyl chloride (PVC) pipes that were an inch in diameter and 60 centimeters long and placed in the soil for a 2 week period. Pictures were taken in the field in order to later complete a visual analysis. Reduction of iron is demonstrated on IRIS tubes by removal of the iron paint, revealing the white PVC pipe underneath. The standard established for a soil to be considered hydric is a minimum of 30% iron paint removal within the top 30 centimeters of the IRIS tubes (Rabenhorst, 2006).

Soil Temperature and Volumetric Water Content

Probes measuring volumetric water content and temperature were inserted into the soil at the Project Site at approximately 10-centimeter increments. The probes were connected to a data logger that collected measurements once every 12 hours.

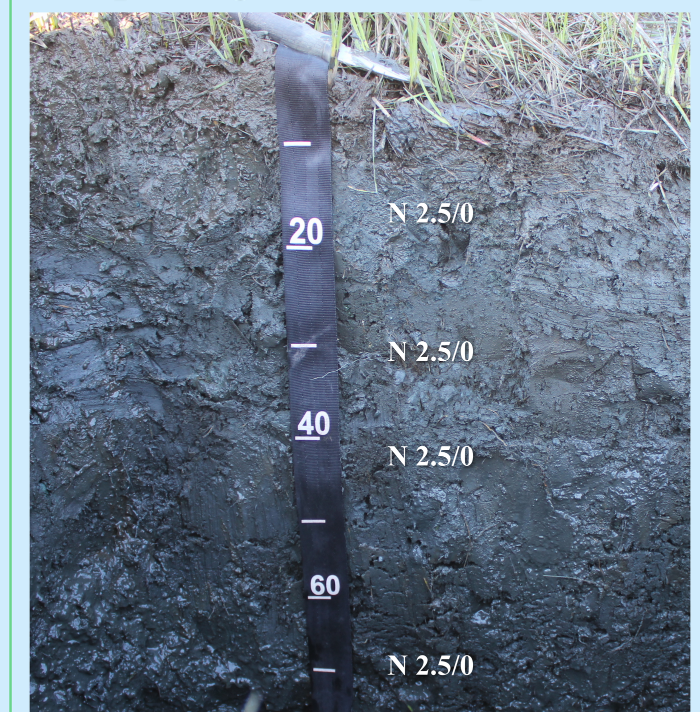


Acknowledgements

- College of Agriculture, Food & Environmental Sciences (CAFES) Graduate Programs
- Agricultural Resource Institute (ARI)
- Cal Poly's Natural Resources Management and Environmental Sciences (NRES) Department
- Department Technician, Craig Stubler

Results and Discussion

Morphological Description

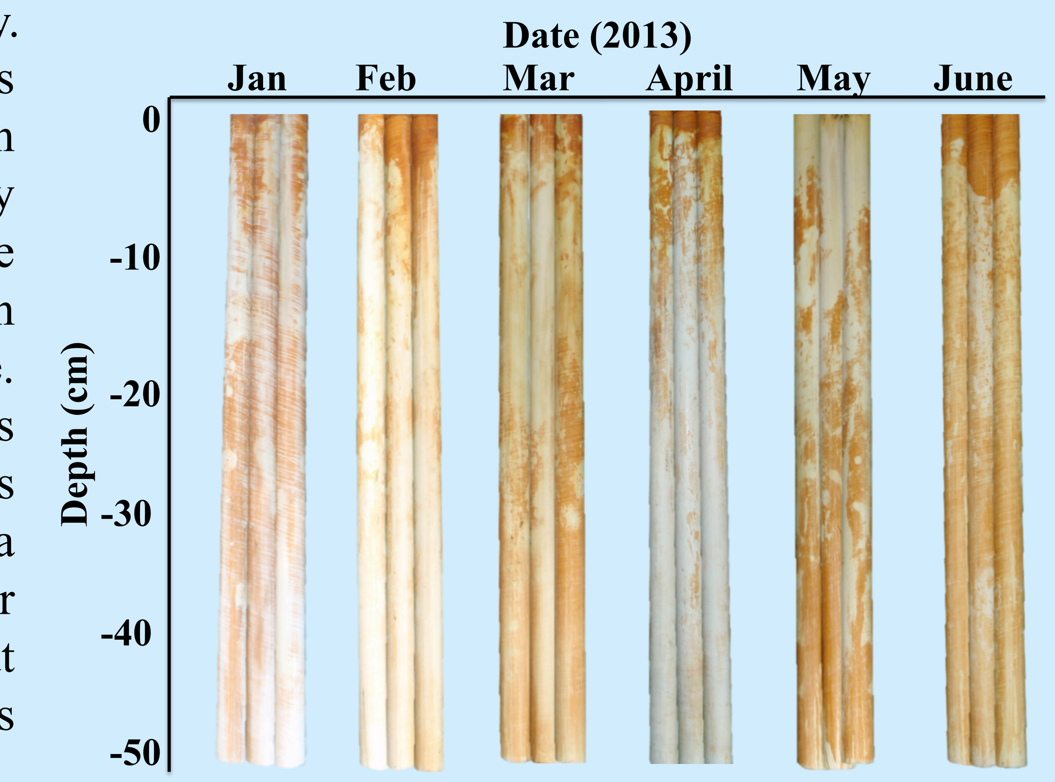


Soil Profile of Project Site
Does not meet a hydric soil indicator

Field indicators of hydric soils are based on morphological features that result from prolonged and repeated reduced soil conditions. The Project Site (Figure 1) did not display any redoximorphic features and thus, lacks a soil morphology consistent with approved field indicators. This type of soil is considered "problematic." Problematic soils do not have common hydric soil morphologies but may still be considered a wetland. This problematic soil at the Project Site will be investigated to determine if it is indeed a wetland by other methods including IRIS tubes, redox measurements with platinum electrodes, volumetric water content, and temperature of the soil (Berkowitz, 2011).

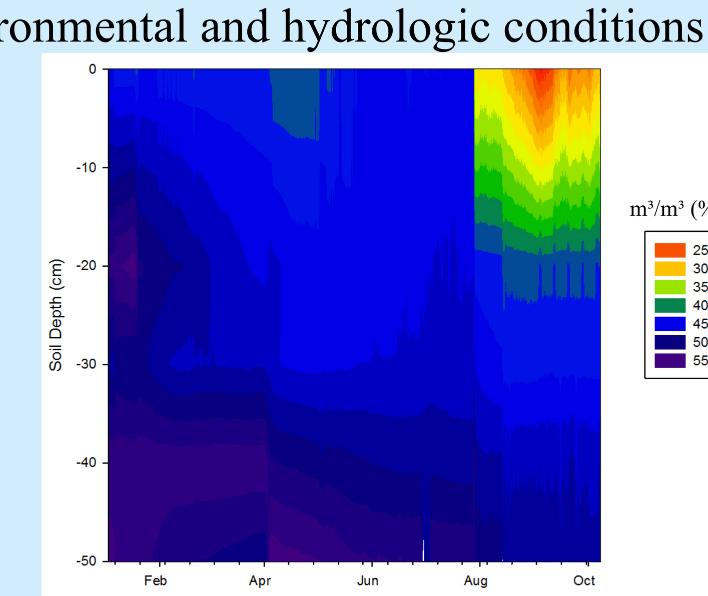
IRIS Tube Analysis

To capture the entire IRIS tube, 3 pictures of each tube were taken at approximately 120° intervals then cropped together to form one picture. A representative picture from each month of the study is shown here. It is clear that there is reduction in the winter months especially after a rainfall in February. In the spring, reduction decreases with the decrease in water. Although reduction decreased significantly towards the end of the study, there was still a small amount of reduction that occurred in the soils into June. This indicates that the soil undergoes seasonal saturation that creates reduced conditions, typical of a wetland. Such results did not appear in the morphological analysis but was detected on the IRIS tubes (Berkowitz, 2011).

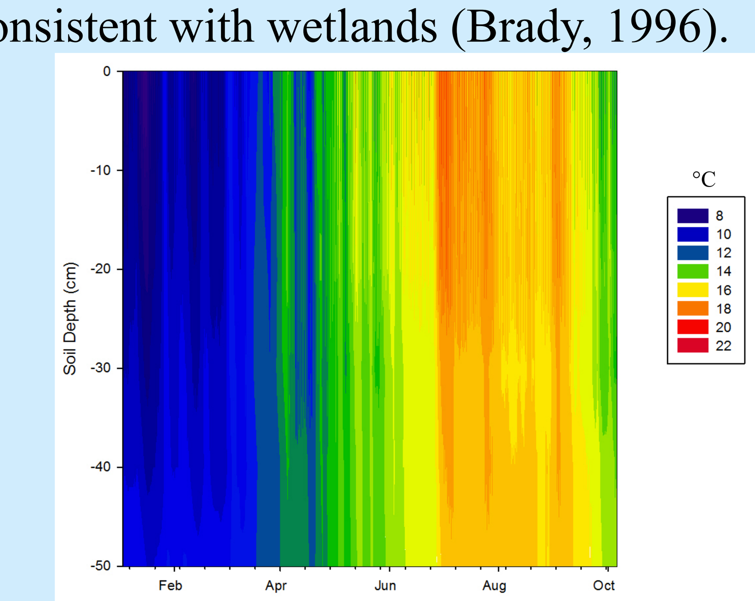


Soil Temperature and Volumetric Water Content Data

The graphical depiction of the volumetric water content through the soil profile visually displays the total volume of soil that is occupied by water at varying depths. This soil is saturated at percent water content of approximately 50 or greater. The lower depths remain saturated through October and the shallower depths. The greatest times of saturation for the shallower depths, which are crucial for wetland delineation, are from January to March when the temperatures were lowest and rainfall was highest. Such environmental and hydrologic conditions are consistent with wetlands (Brady, 1996).



Soil Volumetric Water Content



Soil Temperature

Future Work

The results are from the first year of a two year study. After the morphological analysis, the project site does not meet a visual indicator of hydric soils. The preliminary IRIS tube, volumetric water content, and temperature data leads us to believe the site is a wetland. Physical and chemical analyses on the site will continue in early 2014 to prove the project site is indeed a wetland. Such analyses will include a redox setup with platinum electrodes as well as particle size and bulk density determination.