Effect of fire and mechanical brush removal on plant community dynamics and distributed recharge of the Carrizo-Wilcox aquifer

Dirac Twidwell

Faculty Advisor: Dr. William E. Rogers
2138 TAMU, Department of Ecosystem Science and Management, College Station TX, 77843
Email: wer@tamu.edu Phone: 979-845-0317

Proposed Research

With the increased interest in water conservation and aquifer recharge in Texas, landowners and resource managers are attempting to devise management plans that utilize various brush removal techniques aimed at sustaining economically profitable livestock and wildlife enterprises while simultaneously increasing soil-water recharge. However, devising these types of management plans is proving to be difficult. Our understanding of soil-water recharge is currently limited by a lack of quantitative information on how different brush removal strategies alter the structure and composition of vegetation and how those alterations impact recharge across different soil types.

Prescribed fire is one type of brush removal technique that is gaining favor among landowners and resource professionals. In central and south Texas, over 1,000,000 acres of private land are enrolled in prescribed burn associations to control woody plant density and cover, increase forage production for livestock, and improve wildlife habitat. In addition, prescribed fire is increasingly being used to increasing ground-water recharge. Nevertheless, little information is available to landowners or natural resource professionals regarding how prescribed fire alters the structure and composition of the plant community and how those alterations impact ground-water recharge. Moreover, direct experimental comparisons between prescribed fire and commonly utilized mechanical brush removal strategies (e.g. root plowing, bulldozing) have not been performed across multiple sites and multiple soil types to test their effect on vegetation and subsequent recharge.

We are establishing an experimental manipulation to study the effects of prescribed fire, mechanical brush removal, and their interactions on plant community dynamics and distributed recharge over the Carrizo-Wilcox aquifer in the Wintergarden region of south Texas. Three sites were selected in different counties (Zavala, Dimmit, and La Salle) of the Carrizo-Wilcox recharge zone. At each site, the experimental design was repeated across three different soil types: sand, sandy loam, and clay loam. The treatment combinations at each soil type are: 1. Control (no mechanical removal and unburned), 2. Burned (no mechanical removal), 3. Cut-stump (unburned), 4. Cut-stump and burned, 5. Root plow (unburned), 6. Root plow and burned, 7. Roller-chop (unburned), 8. Roller-chop and burned.

The findings from this project will provide a more complete understanding of how prescribed fire compares with commonly utilized mechanical treatments across a variety of soil types to alter plant community structure and composition and resulting hydrologic impacts. Landowners and natural resource managers in Texas will find the information obtained through the proposed manipulations particularly useful. This experiment provides a direct comparison of how commonly utilized brush removal strategies impact the plant community components that are critical to economically viable rangeland enterprises, while simultaneously comparing their effects on groundwater recharge processes, and how those processes vary across different soil

configurations. Such quantitative information and practical management comparisons is precisely what landowners and resource professionals need to develop a multifaceted management plan that includes water conservation.

Academic Qualifications

Ph.D. Ecosystem Science and Management, Texas A&M University.
Dissertation: From Theory to Application: Extreme Fire, Resilience, Restoration, and Education in Coupled Social-Ecological Disciplines.

M.S. Rangeland Ecology and Management, Oklahoma State University.
Thesis: Extreme Fire and Fuel Limitations Drive Fire Effects in Juniperus Woodlands.

B.S. Biological Sciences (*cum laude*), Chemistry (minor), Missouri University of Science and Technology.
Research Topic: Impacts of endocrine disrupting chemicals on the endangered Ozark hellbender, Cryptobranchus alleganiensis bishopi

GRE Score:

PhD Selected Coursework: intelligence and creativity; landscape analysis; multivariate analysis of fossil communities; nutrient cycling; range and plant ecology; statistics for researchers II; systems analysis in ecology and renewable natural resources.

Peer-Reviewed Publications:

Twidwell, D., S.D. Fuhlendorf, D.M. Engle, C.A. Taylor, Jr. 2009. Surface fuel sampling strategies: linking fuel measurements with fire effects. Rangeland Ecology and Management 63:223-229.

Huang, Y.W., **D. Twidwell**, J. Elrod. 2003. Occurrence and effects of EDCs in the environment. *in:* Endocrine Disrupting Compounds in the Environment, ASCE Hazardous, Toxic, and Radioactive Waste Management (HTRWM) Practice Periodical, 7:241-252.

Manuscripts in Review:

Twidwell, D., S.D. Fuhlendorf, C.A. Taylor, Jr., W.E. Rogers. Forecasting collapse and restoration of social-ecological systems by quantifying resilience.

Taylor, Jr., C.A., **D. Twidwell**, N.E. Garza, C. Rosser, J.K. Hoffman, T.D. Brooks. Long-term effects of fire, livestock herbivory removal, and climatic variability in Texas semiarid savanna.

Proposed Use of Funds

Funds will be used to pay for tuition and fees since the grant for this study did not cover all academic expenses. Funds were previously secured to conduct the proposed experiments, to purchase necessary equipment, and to travel to the sites.

Intended Career Path

I intend to pursue a career as a researcher in ecology. I have a broad academic training in restoration, disturbance ecology, landscape and spatial ecology, plant ecology, and extensive experience in the application and study of extreme fire behavior. I am particularly interested in bridging the gaps between theory and practice and between social and ecological issues in natural resource management.