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### **Nature of the Problem**

Quality and allocation of water is an important issue in the Edwards Plateau region of central Texas. For example, San Antonio, the 7th largest city in the U.S. (3rd largest city in Texas), obtains all of its drinking water from the Edwards Aquifer (Votteler 1998). Maintaining the quality and quantity of the recharge for the Edwards Aquifer is of vital concern as growing cities like San Antonio put a strain on the aquifer's resources through human, agricultural, and industrial consumption.

The Edwards Plateau region of Texas is semi-arid and characterized by unpredictable flood events. A large percentage of water in many streams that recharge the Edwards Aquifer originates from this unpredictable source (Wilcox 2002). With water such a controversial issue in the Edwards Plateau region, people are looking for new sources and for strategies to stretch the remaining water further. A highly touted approach is the removal of brush in such semi-arid areas. However, in a review of studies examining the effects of brush removal, Wilcox (2002) notes conflicting results. For example, Dugas and Mayeux, Jr. (1991) documented "little if any additional water" in the short-term after removal of honey mesquite, but Dugas et al. (1998) documented lower evapotranspiration rates (but only for two years after the study) and estimated greater recharge after juniper removal. Furthermore, in order for brush control to be successful, Wilcox (2002) stresses that management should occur in areas where precipitation is greater than 450 mm/year, where there is a high density of shrubs, where base flow/groundwater recharge is significant, and in areas such as juniper rangelands where the canopy is very dense.

Not only is it necessary to evaluate the potential increase in water supply that brush removal might yield for human consumption, but to assess the potential effects on aquatic fauna. Studies have documented the relationship of age class and assemblage structure of fishes to water depth, current velocity, and flow variability (Chipps and Perry 1994, Poff and Allan 1995, Lammert and Allan 1999, Reichard et al. 2002). However, the effects of brush removal on aquatic macrofauna have not been well studied.

### **Research Objectives**

This study will examine the effects of brush removal on fish and benthic macroinvertebrate assemblage structure in the Pedernales River basin of central Texas. Additionally, it will characterize assemblage structure based on chemical and physical abiotic factors. The Pedernales drainage is an ideal area for this study because it is in the Edwards Plateau region of Texas, where mesquite and juniper encroachment is common (Fuhlendorf and Smeins 1997, Archer et al. 1988), and groundwater recharge is prevalent. Additionally, there are parcels of land, for example the Selah Bamberger Ranch, where landowners have managed brush. Wilcox (2003) believes that if brush removal does yield an increased water supply, the increase will not be large in magnitude.

Therefore, the focus of this study will be on headwater streams, where an effect of brush removal is more likely to be found. I hypothesize that in areas where there has been brush control, 1.) fish and benthic macroinvertebrate communities will be more diverse, and that 2.) fish assemblage structure will be highly correlated with water depth, while (based on preliminary field surveys) macroinvertebrate assemblage structure will be highly correlated with the percent of instream vegetation.

During summer 2003, approximately 100 sites on lower order streams will be sampled in the Pedernales basin. Brush-covered and brush control sites will be paired together based on common geology and hydrology. Two to three sites will be sampled on approximately thirty-five streams. Fishes will be collected by electroshocking different habitats at each site, until no new species are collected, in order to standardize catch per unit effort. Fishes will be preserved and identified to species in the lab. Benthic macroinvertebrates will be collected by kick-netting with d-frame nets at two areas in the center of sites and two areas at the edge of sites. They will also be preserved, and identified to the appropriate taxonomic level in the lab. Physical and chemical parameters such as stream width and depth, water velocity and temperature, pH, dissolved oxygen, conductivity, substrate type, and instream vegetation will be measured. Principle Components Analysis (PCA) will be used to examine site groupings based on brush control treatment. Correspondence Analysis (CA) will be used to examine fish and macroinvertebrate assemblage structure without the influence of environmental variables. Canonical Correspondence Analysis (CCA) will be used to examine relationships between chemical and physical abiotic factors, and fishes and benthic macroinvertebrates.

This study will have direct implications for management of water resources in Texas. The use of brush control to supplement water resources needs to be assessed, and this study should provide insight into the effects of brush regulation on headwater streams and their associated macrofauna in the Pedernales River Basin. It is especially important that brush control as a management technique in this area be evaluated because it is part of the sensitive Edwards Plateau region of Texas, which supplies water to major population centers.

## References

- Archer, S., C. Scifres, and C. R. Bassham. 1988. Autogenic succession in a subtropical savanna: conversion of grassland to thorn woodland. *Ecological Monographs* 58:111-127.
- Chipps, S. R. and W. B. Perry. 1994. Patterns of microhabitat use among four species of darters in three Appalachian streams. *American Midland Naturalist* 131:175-180.
- Dugas, W. A. and H. S. Mayeux, Jr. 1991. Evaporation from rangeland with and without honey mesquite. *Journal of Range Management* 44:161-170.
- Dugas, W. A., R. A. Hicks, and P. Wright. 1998. Effect of removal of *Juniperus ashei* on evapotranspiration and runoff in the Seco Creek watershed. *Water Resources Research*

34:1499-1506.

Fuhlendorf, S. D. and F. E. Smeins 1997. Long-term vegetation dynamics mediated by herbivores, weather and fire in a *Juniperus-Quercus* savanna. *Journal of Vegetation Science* 8:819-828.

Lammert, M. and J. D. Allan. 1999. Assessing biotic integrity of streams: effects of scale in measuring the influence of land use/cover and habitat structure on fish and macroinvertebrates. *Environmental Management* 23:257-270.

Poff, N. L. and J. D. Allan. 1995. Functional organization of stream fish assemblages in relation to hydrological variability. *Ecology* 76:606-627.

Reichard, M., P. Jurajda, A. Simkova, and I. Matejusova. 2002. Size-related habitat use by bitterling (*Rhodeus sericeus*) in a regulated lowland river. *Ecology of Freshwater Fish* 11:112-122.

Votteler, T. H. 1998. The little fish that roared: the endangered species act, state groundwater law, and private property rights collide over the Texas Edwards Aquifer. *Environmental Law* 28:845-879.

Wilcox, B. P. 2002. Shrub control and streamflow on rangelands: a process based viewpoint. *Journal of Range Management* 55:318-326.

Wilcox, B. P. 2003. Personal Communication.

### **Intended Career Path Statement**

I would like to manage water resources and aquatic biota as an employee in a government agency. However, I am open to a career as an aquatic ecologist in academia as well.