Pecos River Ecosystem Project

Progress Report

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SUMMARY

The Pecos River Saltcedar Project is currently in progress to attempt to decrease the impacts that saltcedar has on the river ecosystem. The project is designed to decrease the number of saltcedar by aerial application of herbicide along the banks of the river. The project is concerned with the effect of saltcedar on both quality and quantity of the water of the Pecos River as a result of mortality of the plant from its banks, treatment of the saltcedar with different combinations of herbicides that will give the best mortality rate, and the vegetation response after the treatments have been implemented. The study will also attempt to show that decreasing the amount of saltcedar on the river will result in increased water yield and decreased salinity of the river water.

The study has been designed to look at the river as a whole and at twelve individual plots. The entire river will be treated with the same aerial application, while the twelve plots have six different aerial applications applied. Two 100 ft. transects have also been established in each plot to determine the vegetative change that occur after treatment. The density of the saltcedar has also been determined for each transect. The effects of saltcedar on water quality will be observed through a series of water samples taken along the river from Red Bluff Reservoir to Girvin, as well as comparison to historical water quality data. Any change in water quantity will be determined by comparing historical release/delivery schedules to current schedules from the Red Bluff Water and Power Control District. Additional data will be obtained from USGS monitoring stations at various locations within the project area.

PROBLEM/INTRODUCTION

Saltcedar is the most widely and evenly distributed phreatophyte in Texas. Saltcedar was introduced to the United States in the early 1800's and in 1925 saltcedar was planted along the Pecos River to decrease overland flow and soil erosion. Since its introduction to the Pecos River, saltcedar has dominated the native vegetation and developed into a monoculture. Saltcedar has enormous impacts on river ecosystems. It causes increased salinity of the soil and water it surrounds, increased flooding due to increased sedimentation and decreased channel width, and increased water loss due to high evapotranspiration rates.

OBJECTIVES

1. Evaluate selected aerial herbicide application techniques on saltcedar along the Pecos River.
    a. Characterize native vegetation present before treatment that may have the potential of establishing along the river banks once the competition from saltcedar is removed.
    b. Determine effect of herbicide application on non-target vegetation.
    c. Determine density (number of trees per acre) of saltcedar before treatment.
    d. Characterize soil conditions under the canopy of the saltcedar.
    e. Determine which applications result in the most effective control along the river system.

2. Develop sampling protocol for measurement of water quality and quantity of the Pecos River and characterize the effects of saltcedar control strategies on the quality and quantity of water available in the Pecos River.

MATERIALS/METHODS

Aerial Application of Herbicides (Objective 1)
The application of herbicides to the saltcedar infesting the Pecos River was applied to 30 river miles on September 15-18, 1999, from Red Bluff Reservoir to the Mentone bridge. Application was made with a helicopter equipped with a .047 mm Accuflo nozzle that delivers a 1500 micron droplet size. The treatment consisted of a mix of four pints Arsenal (Imazapyr) per acre with two pints per acre of the surfactant Induce, applied in a total spray volume of fifteen gallons per acre. Additional applications were made on September 6-9, 2000 to 30 river miles from the Mentone bridge to Barstow Dam. Application technology was identical to 1999 except the nozzle was changed to a .027 Accuflo delivering a droplet size of 1000 micron.

During 1999, study plots were established to evaluate the use of fixed wing vs. rotary wing aircraft for application along the river system. Additionally, tank mixes of Arsenal and Rodeo were evaluated for efficacy in controlling saltcedar. Twelve study plots consisted of six replicated treatments. The treatments with the airplane delivering 10 gallons per acre, were applied on October 10 and the helicopter treatments delivering 15 gallons per acre were applied on September 15-18. Treatments were applied as follows:

- **Treatment 1** ÷ Control, no treatment applied.
- **Treatment 2** ÷ Application with an airplane with a mix consisting of four pints Arsenal and two pints of Induce and was delivered with one pass.
- **Treatment 3** ÷ Application with an airplane with a mix consisting of four pints of Arsenal and two pints of Induce. This mixture was delivered with two passes, with a half rate with each pass (two pints and two pints).
- **Treatment 4** ÷ Application with an airplane with a mix consisting of two pints Rodeo (Glyphosate), two pints of Arsenal, and two pints of Induce delivered in a single pass.
- **Treatment 5** ÷ Application with a helicopter equipped with the Accuflo .047 millimeter nozzle that delivered a 1500 micron droplet. The mix consisted of four pints Arsenal and two pints Induce delivered with one pass.

- **Treatment 6** ÷ Application with a helicopter equipped with the Accuflo .027 millimeter nozzle that delivered a 1000 micron droplet. The mix consisted of four pints Arsenal and two pints Induce delivered with one pass.

In each of the twelve plots, two100 ft. permanent transect were established and evaluated, in August 1999 and again one year post treatment in August 2000. At each transect, percent cover was taken every ten ft., with the use of a meter squared frame. The percentages taken every ten ft. were then averaged for each species found within the transect, giving an average cover for each transect. That data has also been summarized by averaging the species found by treatments and by grouping the species by cover type and averaging for each treatment and for the treated area as a whole.

Density of the saltcedar within the boundaries of the transect was determined through the use of 100ft. belt transects. This was accomplished by counting the number of trees within the transect and measuring the width of the bank from the edge of the canopy to the waters edge of the river. The density of saltcedar for each transect was then determined with the following formula:

$$\frac{43{,}560}{100(width)}(\#trees)$$

The same technique was used to evaluate the plots in August 2000 after treatment. The number of live trees, which were trees with any type of green growth, were counted. The same calculations were performed with the data from August 2000 and then the percent mortality was determined by dividing the number of trees per acre in August 2000 by the number of trees per acre in August 1999 and subtracting this number from one.

Water Quality and Quantity Data (Objective 2)

The water quality of the river will be determined by water samples taken at ten locations from the Red Bluff Reservoir to Girvin (Figure 2). Total Dissolved Solids (TDS), Total Suspended Solids (TSS), and Electroconductivity (EC) will be measured for each sample. The procedures involved with determining TDS starts with washing the filter disk with 500 ml of reagent-grade water. This is accomplished by placing the filter disk into a filtration apparatus attached to a vacuum. The 500 ml of water is gradually added as the vacuum is applied and suction is continued until all traces of water is removed. The filter is then placed in a heat cleaned dish and placed in a drying oven at 180/C for 24 hours. The filter is cooled in the desiccator and then weighted to determine original weight. The filter is stored in desiccator until needed. The next step is to filter the water sample. The cleaned and dried filter is again placed in the filtration apparatus. A 500 ml sample is then poured gradually onto the filter as the vacuum is applied. Reagent-grade water is then used to rinse the inside of the filtration apparatus to insure all of the sample has gone through the filter. The filtration is then poured into a 100 ml flask and then transferred into 125 ml flask, that has been heat cleaned, weighted for original weight, and placed in a desiccator until needed. A duplicate for each of the ten water samples taken was also prepared, as well as a control using filtered reagent-grade water. The flask is then placed in the drying oven at 100/C until the filtrate is completely evaporated. Then the flask is dried for an additional 24 hours at 180/C. The flask is cooled in the desiccator and then weighted. The difference between the original weight and the weight after drying of the flask multiplied by two gives the TDS (g/l) of the water sample.

Total Suspended Solids is determined from the before and after weight of the filter disk following filtration. After filtration, the filter is placed back into the dish and dried in the oven for 24 hours at 103/ - 105/C. A control was also prepared here using the filter used to filtrate the reagent-water for the TDS control. The difference between the original weight and the weight after filtration and drying multiplied by ten results in the TSS (g/l) of the water sample.

Electroconductivity is determined through the use of a conductivity meter. An unfiltered sample of water in placed in a 50 ml beaker. The conductivity meter is placed in the sample up the maximum immersion level without touching the bottom of the beaker. Stir the meter gently around in the solution and then read from the conductivity from the meter when the it stabilizes. The reading is in µS/cm. This reading was then converted to parts per million (ppm) by dividing the reading in µS/cm by 1000 converting it to dS/cm. The number in then multiplied by 640 making the number equivalent to ppm. A control using reagent-water was also performed here.

RESULTS/DISCUSSION/ECONOMIC IMPACT

Transect Data

The average percent mortality one year post treatment for each of the six treatments is given (Table 1). Percent cover estimates were taken in August 1999 and August 2000. The results give the average cover estimates by the total species present by cover type for all the treatments averaged together (Table 2).

Water Quality and Quantity Data

Water quality data, both TDS and TSS, was determined from samples that were also obtained in August 1999 and 2000. Electroconductivity, which yields results in parts per million were measured in August and December 1999 and August and December 2000 (Table 3 and Figure 1). A map showing the area of study and the location of the ten water sampling sites is also given (Figure 2).

Table 1: Average density (# trees/ac) for August 1999 and 2000 and average percent mortality one year post-treatment given for each of the six treatments.

Treatment	Avg. # of Trees/Ac. Aug. 1999	Avg. # of Trees/Ac. Aug. 2000	Avg. % Mortality
1	184	184	0
2	195	138	26
3	170	115	30
4	145	81	41
5	248	50	79
6	256	31	87

Table 2: Average percent cover by type across treatments.

Type of Cover	Aug. 1999	Aug. 2000
Bare Ground	42.94	65.48
Litter	8.71	17.65
Grasses	17.56	4.51
Forbs	27.48	9.50
Shrubs/Woody	3.30	2.85
Total % Cover	100	100

Table 3: Electroconductivity (ppm) measured at the ten sample sites.

Sample Site #	Aug. 1999	Dec. 1999	Aug. 2000	Dec. 2000
1 (Girvin)	8128	7872	6720	8320
2	7040	7168	4928	8384
3	6144	6848	4736	8000
4	5504	6720	4672	7808
5	5504	7104	5056	8000
6	3840	4480	4224	4416
7	3968	4672	4160	6720
8	4352	4800	4160	6464
9	4096	4800	4160	6336
10 (Red Bluff)	4224	4288	4096	5056

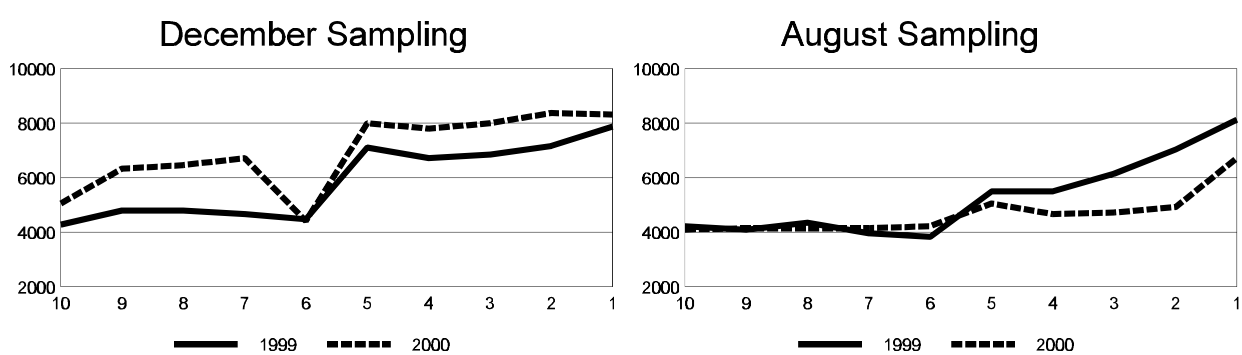

Figure 1: Electroconductivity (ppm) of water samples collected on the Pecos River at ten sample sites, where #10 is Red Bluff the upstream site and #1 is Girvin the downstream site.

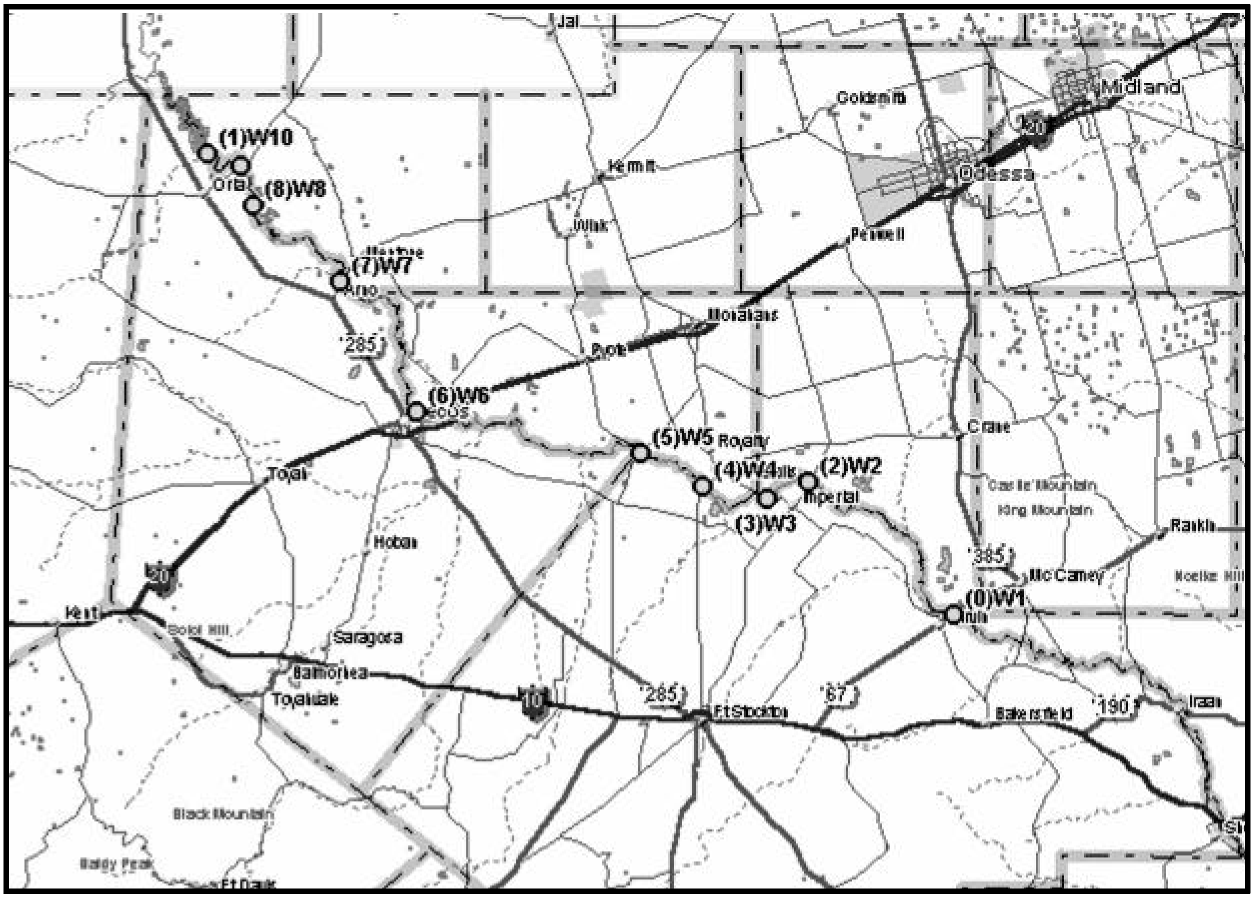

Figure 2. Water sampling sites along the Pecos River.

ACKNOWLEDGMENTS

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Pecos River Groundwater Monitoring Project

Progress Report

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SUMMARY

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PROBLEM/INTRODUCTION

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OBJECTIVES

1) Demonstrate the amount of increased water supplies resulting from control of saltcedar along the Pecos River,

MATERIALS/METHODS

The Pecos River Saltcedar Project in Texas was initiated in 1999 to decrease the impacts that saltcedar has on the river ecosystem. A single (paired plot) location of wells equipped with water level loggers is installed on the Pecos River. Herbicide application will take place this fall following summer calibration of the paired plots. The current Pecos River Ecosystem Project will document changes in the vegetation and water quality and quantity (using stream gage stations and water grab samples) at ten locations from Red Bluff Reservoir to Girvin, Texas. However, the ground water profile, use by vegetation including saltcedar and direction of water movement within the riparian soil zone needs to be fully documented to identify actual water savings by the control of saltcedar, change as native vegetation reestablishes, and the amount of water losses into the surrounding landscape occurring through subsurface flows.

Ground water Monitoring
This study established shallow ground water monitoring wells to measure hourly changes in the ground water table and water quality in relation to the river surface flow (Figure below). Wells are located along the river to determine the influence of subsoil and vegetation changes on water savings and or losses to the surrounding landscape or aquifers. The soil profile was sampled at one foot intervals during well installation to determine hydraulic conductivity, texture, salinity, and location of seams. The pattern of wells at each location will allow identification of the direction of subsurface flow. Wells within treatments will be calibrated as paired plots prior to saltcedar control to determine actual changes over time. One plot will remain untreated.

"Global Water Quality Sensors" were installed to monitor EC (salinity) at each plot location. "Water Level Loggers" were installed in each two inch well. Measurements will be taken hourly. Data will be downloaded quarterly for analysis.

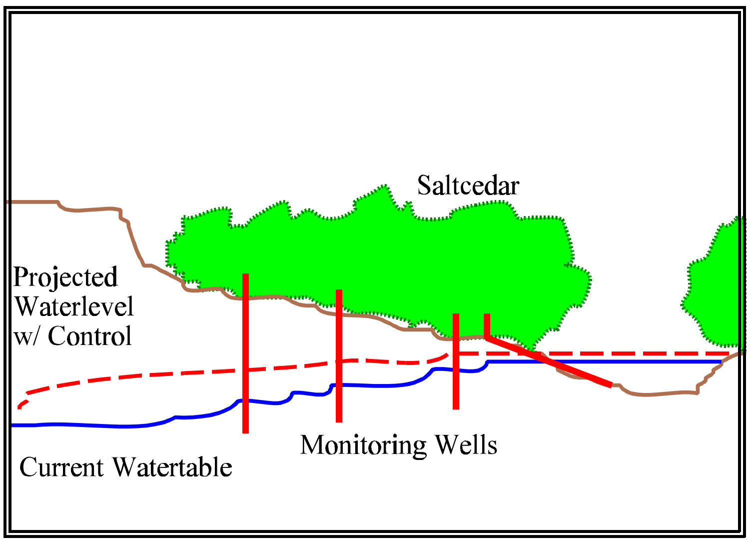

Figure 1. Schematic depicting the location of groundwater monitoring wells, river level monitoring well, and projected watertable/level following control of saltcedar. The difference between water levels before and following treatment will allow calculation of the total volume of water saved, excluding soil component.

River Water Balance
A GIS database will be constructed for the river to calculate acreage of saltcedar, open water, and subsoil type to estimate the water balance. All sources of data will be coupled with the water monitoring to determine seasonal losses and downstream flow. Pan evaporation rates times the

acreage of open water in each river system will be used to estimate open water evaporation. Flow to the surrounding landscape will be estimated from the differential changes in the riparian water table and direction of flow.

RESULTS/DISCUSSION/ECONOMIC IMPACT

Results from this study will not be available until 2001.

ACKNOWLEDGMENTS

This project was supported by The Sid Kyle Rangeland Research & Education Program, Monsanto, BASF, Upper Pecos Soil and Water Conservation District, Natural Resource Conservation Service, Reeves County, and the Texas Department of Agriculture.

Figure 2. Groudwater sampling sites along the Pecos River.