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The National Invasive Species Council Up-Date and *Tamarix* Economics-based Planning Tool Development

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Modeling aboveground biomass of *Tamarix* (*Tamarix ramosissima*) in the Arkansas river basin in southeastern Colorado, USA

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Abstract:

We developed predictive models of total aboveground biomass of non-native *Tamarix ramosissima* using canopy area (m^2) and average height (m) as predictor variables. Destructive sampling was used to collect field data on 50 individuals and four 100 m^2-plots from Oxbow State Wildlife Area and Grenada State Wildlife Area, Colorado. Each sample was measured for average height (m) of stems and canopy area (m^2) prior to cutting, drying and weighing. Canopy area for each individual/plot was calculated by multiplying plot area (m^2) by the percent canopy cover (%) recorded in the field. From a set of candidate models, five competing regression models were evaluated using Akaike's Information Criterion corrected for small sample size (AICc). The best model explained 97% of the variation in total aboveground biomass of *Tamarix ramosissima* and included canopy area, average height (Ht), and Ht^2 as predictors (F3, 53 = 494.99, adjusted $R^2 = 0.97$, $P < 0.0001$). In this model canopy area was one of the best predictors (partial R2 = 0.95). Other four models explained 70% to 95% of the variation in total aboveground biomass. For example, the models that included only canopy area and only average height, explained 95% and 70% of the variation in total aboveground biomass, respectively. Since the response variable, total aboveground biomass, was log transformed, we also calculated correction factors for each model to correct for bias due to log transformation. Land managers can use these models directly to predict Tamarisk aboveground biomass.

Native species displacement and dominance by saltcedar (*Tamarix* spp.) over time—is it a continuous, linear process? A conceptual framework for assessing ecological restoration potential, strategies and techniques

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Abstract:

Numerous layers of riparian resource data (habitat structure, condition and suitability; soils; consumptive water use; surface and groundwater hydrology), compiled by various agencies and research entities, exist in the literature. Little effort, however, has been placed on synthesizing these diverse and often incomplete or segmented data across land ownership and use boundaries into a multi-agency decision-support framework and tool for use in management of saltcedar-infested lands. Utilitarian methods for development of habitat suitability classifications, risk assessment, treatment prioritization, and restoration potential assessment are needed to serve as models for evaluation of similar riparian ecosystems infested by saltcedar. Control of saltcedar without prioritization based on expected response to treatment and feasible objectives for recovery of beneficial use(s) is not sound, scientifically or environmentally.

Of more specific interest regarding treatment prioritization in ecological terms -is saltcedar simply one of several symptoms reflecting more basic underlying “drivers” (i.e., anthropogenic floodplain hydrologic alteration), or does saltcedar independently modify the soil environment as stands increase and mature? This concept needs scientific study in lieu of ongoing anecdotal evidence. Related questions include: If this process of self-induced soil modification is occurring, is it linear? Is the soil microbial community depleting at linear rates in relation to age and nature of infestation, physiology of saltcedar (e.g., salt exudation rates), and displacement of native species? Are there temporal and spatial (stand age / density) scenarios of saltcedar infestation in relation to soils at which the native plant and microbial communities "crash", having reached a threshold of adverse soil alteration? How is this correlated with / separated from effects of competition, shading, and hydrologic impacts? Is this soil modification permanent as long as these stands of saltcedar remain intact, or does the soil alteration process rate decline or even reverse itself under older age classes (i.e., very mature saltcedar with long-term, undisturbed canopy closure)?

In research initiated this summer (2006), state-of-the-art sampling design and techniques, remote sensing, soils and vegetation inventories, cost:benefit assessment, present and potential land use and management, and statistical analysis are incorporated into GIS-based depictions and decision support criteria that will a) correlate saltcedar presence, treatment response, canopy characteristics, and distribution with site environmental conditions; and b) assess habitat suitability, risk, treatment priority, and restoration potential. Current research results and technology from universities and agencies on quantification of evapotranspiration rates and groundwater salvage will be incorporated into these models to project estimated water savings based on plant community structure and composition, prioritized treatment prescriptions, and projected restoration response toward desired habitat goals.

Upper Colorado River Saltcedar Management Program—A case history

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Abstract:

The Colorado River, measured in length and drainage area, is the largest river wholly in the State of Texas. The river begins in northeastern Dawson County, and then flows southeast for 600 miles until it drains into Matagorda Bay. At present, saltcedar has invaded the upper Colorado

River and its tributaries from the headwaters above Lake J.B. Thomas to the dam at O.H. Ivie Reservoir, a distance of more than 240 river miles.

Phase 1. To address the issue of saltcedar control along the upper Colorado River, Texas Cooperative Extension (TCE) organized a task force in 2001 to develop a saltcedar control plan. Represented on the task force were Texas Parks & Wildlife Department (TPWD), Colorado River Municipal Water District (CRMWD), Natural Resources Conservation Services (NRCS), Texas State Soil & Water Conservation Board (TSSWCB), North Star Helicopters, BASF Chemical Co., Texas Department of Agriculture (TDA), Texas Agricultural Experiment Station (TAES), Upper Colorado River Authority (UCRA), Lower Colorado River Authority (LCRA), Texas Farm Bureau, U.S. Army Corps of Engineers (USACE), U. S Department of Agriculture – Agriculture Research Service (USDA-ARS), U.S. Fish & Wildlife Service (USFWS) and Dow AgroSciences.

The highest priority issue identified by the Task Force was the current Arsenal 24(c) label restriction that prohibited spraying within 2 miles of the Colorado River in 3 counties that lay within the middle of the Colorado River saltcedar infestation. To address this issue, task force members from TCE, CRMWD, and TDA began informal consultation with the USFWS to investigate control options that would allow treatment of saltcedar without risk to the Texas poppy-mallow. For two years these task force members worked on this issue culminating in an amended Arsenal 24(c) label that reduced the spray buffer from 2 miles on either side of the river down to 60 ft. from known Texas poppy-mallow habitat. Under this amended label saltcedar along the Colorado River was now legal to treat with Arsenal.

Phase II. In 2003 a proposal ($2.2 million) was submitted through the TSSWCB to obtain Clean Water Act Section 319(h) funding to control saltcedar from the headwaters of the Colorado River to the Lake Spence dam. The proposal was funded in 2004. With TSSWCB providing leadership and working through local SWCD's, herbicide spraying was initiated in August, 2005, beginning at the Lake Thomas Dam and extending to the confluence of Beals Creek (2416 acres). Herbicide spraying continued during 2006, reaching the top of the Lake Spence basin (1700 acres), and will continue during 2007 extending treatment to the Lake Spence dam (6000 acres). All herbicide applications have been applied using rotary wing aircraft, the herbicide Arsenal at a rate of ½ gal/ac and a total spray volume of 15 gal/ac. All herbicide spraying to this date has been conducted on private land, requiring a landowner easement. Initially, 85% of the targeted landowners in 2006 participated. As of this date, the percentage of eligible landowners participating has increased to 95%.

Phase III. Biological control is an important part of this project to extend treatment life following herbicide applications and to provide a control option for small localized populations of saltcedar,. Under the direction of USDA/ARS, TCE and TAES, the first release (within cages) of saltcedar leaf beetles, *Diorhabda* species, were made at Lake Thomas and Beals creek in 2003. The immediate objectives of Phase III are to 1) establish field populations of saltcedar leaf beetles at 1-2 locations per county in the Upper Colorado River Watershed and 2) redistribute beetles from these sites to local landowners, land managers and water districts.

A total of about 3,280 adult saltcedar leaf beetles were released at 10 sites in 7 counties during May through July, 2006. All saltcedar leaf beetles were collected from the field population established (2003) on Beals Creek near Big Spring, TX.

Beetles completed one generation following release at all sites. As of mid-August, several hundred eggs and larvae were present at each of three sites and 20-40 egg masses and larvae were present at the 7 remaining sites. Predation by red imported fire ants and native ants significantly reduced beetle numbers at three sites. With another generation to be completed in late August, it is hoped that numbers will increase at all release sites. Ultimately, success will be measured by the number of beetles present one year after the release.