



Riparian Restoration in the Arid American West: Reversing the Spread of Tamarisk

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The spread of the salt cedar (*Tamarix* spp.) in the Arid American West along the Rio Grande has caused a multitude of problems for the riparian biota. Riparian forests in the American West are characterized by *Populus* and *Salix* coexisting with understory shrubs and aquatic plants (Wall 1996). The natural arid riparian forest is the ecotone between aquatic and terrestrial ecosystems with an influx of seasonal water deposits making water availability high. The vegetation growth is extremely abundant and the biodiversity of plant, insect, wildlife is extensive. Native riparian forests provides refuges, shelter, food along with fresh water for many species of vertebrates (Ceballos 1985). Another characteristic of the natural habitat is its ingenious flood control for the arid landscape. Native riparian forests are in danger of becoming extinct because of salt cedar. Salt cedar is an exotic species with strong invasiveness and no native predators. Salt cedar replaces riparian vegetation, takes up the excess water, and provides a habitat with little desirability for native species such as: Fremont cottonwood (*Populus fremontii*), various willow spp, native mesquite trees, desert bighorn sheep, insects, beaver and the yellow-billed cuckoo. A number of National Wildlife Refuges are using controls, management, and eradication to help restore the riparian sites back to their natural state. Human intervention has become necessary to control and reverse the degradation of the riparian by the salt cedar tree.

Characteristics of *Tamarix* spp.: Salt cedar is an exotic, invasive tree which was brought to the United States in the early 1800's from the Mediterranean region and Asia as an ornamental and to help with soil erosion along river banks (Glausiusz 1996). The salt cedar has since that time has become a detrimental invader of the riparian in the arid southwest. Salt cedar replaces native vegetation needed to expedite free water flow and also causes a higher salinity in the water and surrounding soil. Salt cedar leaves and litter are a fire hazard. The salt cedar produces a half million seeds per tree between April and October and grows aggressively. These traits gave salt cedar a heavy advantage over *Populus* and *Salix*, resulting in its extensive spread in the Southwest U.S. in the 1940's (Sudbrock 1993). The salt cedar has also altered the hydrology regime of the riparian by limiting the free flow of water during the seasonal flooding and making less water available for the diverse inhabitants of the riparian biota (Conservation Science 1996). The resulting damage to the riparian ecosystem is of great concern to managers of National Wildlife Refuges and many programs are being used on the salt cedar.

National Wildlife Refuges Managing Salt Cedar

The **Bosque del Apache Natural Wildlife Refuge** is located within the Chihuahuan Desert in New Mexico, an area of 57,191 acres. This desert and wetland refuge is used by millions of migrating waterfowl, cranes, songbirds, and raptors (Wall 1996). Phil Norton and John Taylor are the managers for the control of salt cedar at the Bosque del Apache NWR. The Bosque del Apache NWR is the forerunner in control, management, and eradication of salt cedar. The refuge has used many control methods: root plowing, cut-stump/herbicide, fire, mow & inundation

(Kerpez and Smith 1987). A revegetation project at the Bosque del Apache NWR is currently being conducted to study the effects of the salt cedar and the salinity surrounding the tree in the groundwater and soil. The project has set up 40 testing wells in a salt cedar infested acre to measure groundwater levels and salinities. Bruce Harrison, assistant professor of environmental geology at New Mexico Tech and Jan Hendrickx, associate professor of hydrology at Tech along with Deborah Stevens and Jelle Beekma, graduate students, are hoping to provide data to the managers of the Middle Rio Grande valley's bosque ecosystem concerning the capability of the cleared areas to be revegetated with cottonwoods and willows (Zamora 1998).

The **Bitter Lake Natural Wildlife Refuge** has 24,536 acres of desert, grassland, marshes and impoundments. Bill Radke is the manager in charge of the salt cedar control program which has been in place for the last four years. The methods of control at the refuge are: burning, bulldozing, cutting and stump treatments with herbicide. The refuge uses the cut & stump method in ecological systems with endangered species. Although some small clusters of salt cedar along the waterways & ponds have been controlled by burning, this method of control is not a choice for refuges with large populations of Tamarisk (Wall 1993). The refuge identifies salt cedar management areas according to important water sites, specific endangered species and extensiveness of monotypic stands of salt cedar. The refuge has been able to manage small stands of salt cedar using the mentioned methods.

The **Coachella Valley Preserve** is a 7600 ha preserve in California. The Thousand Palms Canyon within this preserve was chosen as the site for management of the salt cedar since this was the area with the heaviest invasion. The project was done by The Nature Conservancy, Bureau of Land Management, U.S. Fish and Wildlife Service, CA Department of Parks and Recreation and the California Conservation Corps volunteers. The project took 5 years to accomplish the task of removing the salt cedar from the site. The control of choice was the cut-stump/herbicide method. The crew was able to remove the salt cedar this way effectively except for 3 hectares which were so overrun by the salt cedar, the area was bulldozed clearing out all above-ground vegetation. The debris left from the cut-stump/herbicide method was piled around the area as shelter for quail and wintering sparrows during establishment of planted vegetation. The revegetation of the site was done with collected natural seed being spread by the crew (Barrows 1993).

The **Havasu Natural Wildlife Refuge** located in northwestern Arizona on the California border, promotes wild river habitat along the Colorado River. The refuge has a extremely large number of salt cedar trees that are a fire hazard and have already caused extensive fire damage. The manager of the salt cedar program is Matt Connolly and the managing of salt cedar started in 1989. The refuge chooses small areas, 60 acres, for management because funds and staff are limited. The large areas of salt cedar are nesting areas for the endangered "southwestern willow flycatcher" which has set back the removal of these large stands. The refuge continuously clears small areas of salt cedar and replants with cottonwood, mesquite & willow.

Techniques for Managing Salt Cedar

The **cut-stump/herbicide** is a method refined by Bill Neill of the Desert Protective Council. The salt cedar is located in the spring & summer during the pink-purple flowering. The removal of

salt cedar occurs in late fall or winter because activity of removal will not promote seed dispersal. Chainsaws and handsaws are used for the massive trees and lopping shears for the smaller trees. The workers are paired in groups of two, a person cutting & another applying the herbicide, for the most efficient eradication of the salt cedar. The tree is cut as close to the ground as possible and the herbicide is applied immediately to the entire cambium ring (Sudbrock 1993). The timing is necessary, since salt cedar can reproduce quickly from the crown area, stems & roots (Brock 1994). Only herbicides with aquatic labels can be used for this process. The brush is then removed from the site and burned to reduce any vegetative takeover by the invader. This method has been most successful in killing the salt cedar and allowing the cottonwood "poles" to rehabilitate.

The **fire** method is burning the salt cedar that prevents the invader from reaching maturity and persisting as a fully-developed community. The salt cedar sprouts vigorously after the burning, developing dense stands and replaces the fire-intolerant native riparian vegetation. This method of control is not very successful for large areas of the salt cedar (Kerpez and Smith 1987).

The **mow & inundation** method is used on areas selected because of salt cedar domination. The salt cedar are mowed down to the ground in August and September and the same areas are then flooded from October through April. These flooded areas provide wintering waterfowl with open water and "success of this practice is affirmed by the thousands of snow geese & sandhill cranes that use these areas" (Kerpez and Smith 1987). This method has a moderate success rate because the salt cedar grows back each year between April & August although not as massive but requiring this control method to be a never-ending cycle.

The **root plowing** method entails using the root plow shears below the ground and removing the root crown of the salt cedar to prohibit the lower roots from sprouting and forming new plants. The area is plowed again and ground into smaller pieces, so the salt cedar growth is slowed long enough for the native riparian species, cottonwood, willow & wolf berry, to emerge as the dominant vegetation. Some areas are planted with the cottonwood, while other areas are left open to allow natural revegetation of the site (Wall 1996). This method has been very successful but is time consuming both manpower & time allotments.

Biological Control

Dr. Jack DeLoach, entomologist at the U.S. Dept. of Agriculture in Temple Texas, has been studying which insects will feed on the salt cedar. Dr. DeLoach looked at natural predators of the salt cedar in China and Israel. Dr. DeLoach has found two insects which attack the salt cedar: Chinese leaf beetle and a mealybug (a sapsucker). These two insects feed on salt cedar which grow on the shores of the Dead Sea in Israel. Dr. DeLoach has conducted experiments on both insects to view their damage to the salt cedar. The mealybug has killed about a third of the test plants with its second generation. The leaf beetle has been so destructive in China, their government has applied insecticides to the salt cedar trees which are stabilizing the dunes in the Taklimakan Desert. Dr. DeLoach has found that the mealybug or the leaf beetle does not feed on willows or cottonwood trees. "They don't feed on anything except the genus *Tamarix*," says DeLoach. "So they're very, very safe." Dr. DeLoach wants "to control the salt cedar, not eradicate it." The Southwestern Willow Flycatcher is a species that does indeed use the salt cedar

as its home and this is a major contention on the use of Dr. DeLoach's biocontrol. The regulators are not ready to let loose biocontrol on the salt cedar for fear of completely eradicating the tree and the flycatcher (Glausiusz 1996).

The amount of damage the salt cedar causes to the riparian is large enough to warrant an attack on the invader. The continuing practices are necessary along with searches for new techniques that could provide better control and management. Biocontrol, after being extensively researched, may ultimately be the better choice for the management of the salt cedar. Biocontrol would be less labor intensive and less costly in the long run. The current control, management, eradication programs have been used extensively and the results have been not been as successful as wanted. The main problems with the current practices are cost, labor and the need to continue to frequently repeat treatment due to the salt cedar's survival rate. It may not be necessary to completely eradicate the invader, if a manageable method can be found to control it and allow other species to survive along with the salt cedar.

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