Joint Fire Science Program

Fire Science Brief

RESEARCH SUPPORTING SOUND DECISIONS

Despite its dramatic, sometimes explosive burning characteristic, saltcedar growth usually needs more than a prescribed burn alone for effective, long-term control. Credit: ©2009 Nick Rice.

Saltcedar: Is Burning an Option?

Summary

Saltcedar, an invasive plant genus, is difficult to eliminate. A 2001–2002 research project, partially funded by the Joint Fire Science Program, investigated burning as a tool to combat the growth and spread of saltcedar in Western riparian environments. It also evaluated the subsequent survival characteristics of saltcedar after the prescribed burn. The research was performed by a team from Texas Tech University, Lubbock, Texas.

Researchers concluded that fire behavior in saltcedar-dominated communities is largely dependent on whether the areas have burned in the recent past. Decadent stands of saltcedar carry fires through the crowns with extreme flame lengths. Firebrands can be transported to at least 500 feet from the edge of the fireline. Because of the likelihood of spotting during burning operations, proper planning of prescribed burns and placement of adequate firelines is essential. Burning saltcedar did not provide consistent mortality for any of the treatments studied, thus burning alone is useful primarily to reduce hazardous fuel accumulations. However the use of fire, together with other vegetation management tools, can be effective in reducing the dominance of saltcedar.

Key Findings

- Fire behavior in saltcedar growth is dependent on whether the areas have burned previously.
- Decadent stands of saltcedar carry fires through the crowns with extreme flame lengths.
- Firebrands can be carried distances of at least 500 feet, and prescribed burn planning for spot fires is essential.
- Burning alone does not provide consistent mortality, but is useful in reducing fuel levels.
- Burning could be combined with other vegetation control techniques to successfully suppress the dominance of saltcedar.

About saltcedar

Saltcedar, or tamarisk (*Tamarix* spp.), is an invasive woody plant originally brought from the Middle East and Asia into this country as early as the mid-19th century for its ornamental and supposed erosion control properties. Not long after its introduction, it was observed spreading quickly from initial plantings. The genus encompasses more than a dozen species and has established itself in the wild, most dominantly in riparian environments in the Southwest.

Depending on the species and on growing conditions, saltcedar can range in form from low-growing dense shrubs less than a meter tall, to tree-like growths up to five meters in height. As plants mature, they often form dense woody crown growth. Saltcedar is widespread in the drainages of the Rio Grande, Colorado, Pecos and many other southwestern river basins.

Various saltcedar species were introduced to the U.S. as ornamentals, but have escaped and are a nuisance growth in the Southwest. Credit: Steven Dewey, Utah State University.

The plant is undesirable because it crowds out native vegetation, and has little value as either wildlife habitat or as a source of livestock forage. It reproduces both through seeds, and vegetatively from roots. Its deep, spreading root system extracts water from the subsoil, preventing other plants from surviving, and in some cases even dries up sources of surface water. Its propensity to shed leafy vegetation with high salinity suppresses germination of desirable species. Most western states list saltcedar as a "noxious plant" or some similar classification.

Saltcedar spreads aggressively, crowds out desirable native vegetation, and is a special problem along stream banks. Credit: Steven Dewey, Utah State University.

Study goals

Methods of controlling this species that have been investigated include hand-clearing, mechanical removal, herbicide treatment, biological control and burning. To date, none have proven both economical and completely effective. An investigation was performed in 2001–2002 on this subject by a team from the Range, Wildlife and Fisheries Department of Texas Tech University in Lubbock, Texas. Principal investigators were Brent Racher, Carlton Britton and Rob Mitchell.

According to Racher, the goal of the research project was to further investigate prescribed burning for saltcedar, and test its effectiveness under a variety of conditions. The hope was to identify a methodology for achieving high mortality or at least good control with a safe and economical prescription for controlled burning.

Experimental sites

Research encompassed a series of prescribed burns on two sites north of Roswell, New Mexico. Burning was conducted under documented conditions during a variety of stages of growth of saltcedar-dominated wooded areas under varying temperature and humidity conditions. Results were compared for areas with no recent history of burns, and for areas that had undergone a burn within the last five years.

Sites were located at the Red Bluff Ranch property north of Roswell on the Pecos River flood plain, and a U.S. Department of Interior (USDI) Bureau of Land Management property called Garcia Flats along the drainage of the Arroyo Del Macho, also north of Roswell. Both sites receive about 11 inches of precipitation annually, with the greatest amount in the months of July and August, and the least in the spring months.

Burn history

Both experimental sites had areas which had been burned five years prior to conducting the experimental treatments, and areas which had not seen a fire for the past 25 to 30 years. Estimates of the length of time since the last fire for the areas where there was no record of recent burning were based on tree sizes, fuel accumulation, and level of decadence of the vegetative community.

On both sites, the areas that had been burned five years earlier still had saltcedar as the dominant overstory plant, though the canopy was considerably more open than those sites with a longer burn interval. Each site was divided into plots separated by bulldozed firelines to mineral soil for the various treatments.

The previously burned areas on both sites received two replications per treatment per site, and the non-burned areas had three and two replications per treatment for sites at Red Bluff Ranch and Garcia Flats, respectively. Firelines were burned out 500 feet on the north and east sides of the sites to prevent fire escape to adjacent private property at each area. Racher notes, "This blackline width is practical and is often used for highly volatile fuels. They become impractical only when burning relatively small acreages."

Evaluating burning

In order to evaluate the characteristics and effectiveness of burning at various stages of plant growth through the year, burns were staged through the growing season, April 2001 into February 2002. Treatments on plots on each of the sites were done at leaf elongation, first bloom, full canopy, leaf senescence and dormancy. This roughly corresponds to April, June, August, October, and February. The goal was to determine the times when fire did the most damage.

Fuel characterization

Prior to each burn, descriptions of the fuel characteristics were made. Fine fuels were estimated by clipping twelve, 0.5 square meters randomly assigned quadrats (sampling squares) to a stubble height of 1 centimeter in each plot. Fuel removed was dried and weighed to the nearest gram.

Woody fuels were estimated using four vegetation measuring transects on each plot. Several methods were used. First, canopy cover measurements were taken using a proven line intercept method. Additionally, tree density, tree heights, tree canopy cover (expressed as a percentage), and tree volumes were measured.

Ten-hour timelag fuel moisture (TLFM) was estimated with three-10-hour TLFM pine dowels. These were placed near the plot being burned to provide a good estimate without the fire affecting subsequent readings. The dowels were weighed to give 10-hour TLFM to the nearest percent within minutes of ignition of the fire behavior transect. Another measurement of fuel moisture was made using an electronic fuel moisture gauge on natural 100-hour TLFM (dead saltcedar branches) lying above the soil surface near the fire behavior transects.

Green-foliage moisture content was estimated for trees using five 100-gram samples per plot the day of each burn. Samples were taken from numerous trees in the vicinity of the fire behavior transect and were immediately weighed to provide a fresh weight, then dried and again weighed to determine green foliage moisture content on a dry weight basis.

Firebrand measurement

Firebrand behavior is an important element of the development of a safe burning prescription. To develop information on the firebrand generation potential of the saltcedar fires, heavy 6-mil plastic strips were placed at distances up to 1,500 feet outside the firelines on the downwind side of the prescribed fires.

These sheets provided an indication of firebrands being elevated, transported downwind from the fire, and landing with enough heat to burn a hole in the plastic. After the fire had dissipated, the plastic sheets were collected and the number of firebrand holes in each sheet counted. Additionally, any spotfires occurring outside of the plot were measured for their distance from the nearest edge of the plot.

Weather conditions

Ambient weather conditions were determined within five minutes of ignition. Air temperature and relative humidity were estimated using a standard sling psychrometer. Average wind speed measurements were made with a windmeter held at eye level. Daily estimations of 100-hour TLFM and 1,000-hour TLFM were provided by the USDI Southwest Area Coordination Center.

Fire evaluation process

To evaluate burn behavior, transects were placed within the plot, parallel to the wind direction at the time of ignition. The transects in plots that had been burned five years earlier were placed in saltcedar-dominated fuels with visually estimated continuity of fine fuels to carry the fire through the areas.

Ignition of a separate plot headfire for each transect was done with a driptorch at the edge of the plot to allow the flaming front to build before entering the transect. If fuel conditions caused the headfire to halt, it was re-ignited as near as possible to the stopping place to allow the fire to continue its forward progress. As the fire passed through each transect, flame height, flame length and flame zone depth were visually estimated.

Research results

Influences on fire behavior

Data was collected on 45 headfires under a wide range of conditions at each burn time. Temperatures ranged from 63°F to 102°F, relative humidity from 8 to 48 percent, and windspeeds from 1 to 12 miles per hour. The 10-hour TLFM ranged from 4 percent to 10 percent. Comparisons of fire behavior between treatments and the stage of annual plant growth were examined. Flame length and flame zone depth were greater during the dormant season. Rate of spread and flame height showed no significant difference in the dormant season versus the growing season.

Prescribed burns during "full canopy" conditions moved quickly and consumed the available fuel almost explosively. Credit: Brent Racher.

The treatments imposed during the middle of the summer under "full canopy" conditions were the fastest moving and consumed the available fuel most quickly. Fires during "first bloom" and "leaf senescence" showed the lowest fire behavior in comparison. The "dormant" and "first leaf" fires produced impressive fire behavior not far different from "full canopy" fires.

Spotting potential from firebrands

Downwind spotting greater than 100 feet occurred with temperatures between 66 and 81°F, higher windspeeds and with 10-hour TLFM less than 7 percent. These combinations of conditions produced the greatest number of firebrands and the firebrands created spotfires at the distance of 500 feet or more. No firebrands were collected or spot fires started greater than 102 feet downwind when temperatures were 84°F or above. It is believed that the firebrands with spotfire potential burned out earlier at these temperatures, possibly because a stronger convection column allowed them to stay suspended long enough to burn out before landing. The distance firebrands carried within the wind speed classes was the greatest between 6 to 9 miles per hour.

Racher feels it is practical to manage a fire with this firebrand potential. "However," he notes, "in order to properly manage and staff such a fire, planning must occur early. We emphasize the need to place mineral lines and to burn in blacklines weeks and months in advance to be able to contain the fire under prescribed weather conditions."

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Burn effects on canopy cover

The study documented that burning mature saltcedar stands at any time of year for the first time greatly reduced canopy cover compared to pre-treatment levels. At the Red Bluff site, canopy cover was reduced from pretreatment levels that often exceeded 70 percent to less than 15 percent following all burn treatments. At the Garcia Flats site, canopy cover was reduced from pre-treatment levels by 39 percent or more for all burn treatments. One full growing season after all treatments were imposed, the saltcedar-dominated canopy cover in burned areas had increased by an average of 13 percent from the previous year, compared to no change in the control plots.

Despite dramatic reduction in canopy cover by prescribed burning in areas that had not been previously burned, mortality was low, and regrowth was dominant the following year. Credit: Brent Racher.

In stands that had been previously burned, burning was not particularly successful in reducing canopy cover. This is believed to be because these areas had lower stocks of fuel at canopy levels. At both sites, re-burning of previously burned areas showed the greatest reduction in canopy cover when treatments were applied during the dormant season.

Saltcedar mortality

Mortality of saltcedar resulting from burning for the first time varied moderately between treatments, and highly within treatment areas. One-year mortality averaged 30 percent in these areas. Treatments applied at Garcia Flats appeared to have a higher level of mortality among all treatments compared to the Red Bluffs site. Overall, consistent saltcedar mortality was not achieved in any of the phenological stages studied.

In the saltcedar plots that had previously burned, mortality ranged from low to non-existent. Some burning treatments at Garcia Flats averaged one-year 32 percent mortality, but researchers were unable to replicate this result at the Red Bluff site. Overall, no consistent differences were found between treatments in reburned plots.

Importance of burn history

This research revealed that fire behavior in saltcedar dominated communities in New Mexico is largely controlled

by whether the areas have burned in the recent past or not. Areas that have not burned in the recent past have a fuel build-up that favors extreme fire behavior under a broad range of weather conditions, and is quite independent of the annual stage of growth. Burning will move through these saltcedar monocultures as crown fires.

In previously burned communities, burning usually takes the form of a surface fire, carried by fine fuel. Substantial fine fuel loading is necessary to carry a fire that will partially top-kill saltcedar at a five year interval. No benefit was noticed by burning during times of low relative humidity. This showed that saltcedar's reputation for volatility comes from the build-up of dead, woody fuels, not from the green leaf growth.

Crown fires from decadent growth

The research documented that decadent stands of saltcedar can carry fire through the crowns with extremely high flame lengths. These fires are difficult to stop with standard fire-fighting methods. This is further exacerbated by the fact that many saltcedar communities are in areas with little accessibility to equipment.

Recommended burning approaches

Use of the strip headfire or the flank fire ignition methods were determined to be useful for burning firelines, but backfires could also be used if the saltcedar is not too dense to walk through. After the firelines have been burned, headfires can be used to burn the remainder of the areas. For headfires, air temperatures of 64° to 95°F are recommended. Wind should push the fire into the prepared firelines.

Caution is advised for burns where temperatures exceed 90°F because of potential risks to the safety of fire crews. Additional caution is advised for conditions where temperatures are over 100°F, wind gusts are over 20 miles per hour, or a cold front has passed within the past 12 hours. These conditions should be considered red flag conditions and a burn should not be attempted.

Coupling burning with other controls

Burning did not provide consistent mortality for any of the treatments. Racher explains, "Burning alone only solves the fuel loading problem. If plants aren't killed, that fuel loading will re-occur because of the rapid growth rate of saltcedar." Thus, Racher points out, "Fire needs to be coupled with some other treatment in order to meet ecological and watershed goals while reducing fire danger from high fuel loading." Companion treatments might include herbicide treatment, mechanical clearing, or the use of biological controls, for example the use of *Diorhabda*, sometimes called the "saltcedar leaf beetle."

Racher indicates that mechanical clearing could be used prior to burning, with the uprooted saltcedar being placed in windrows to facilitate burning. He notes, "Since a one-time mechanical control is not going to be 100 percent effective, follow-up treatment with mechanical means or spot herbicide treatment are desirable to prevent re-infestation." Prescribed burning alone is not recommended as a tool for long-term management of saltcedar.

Management Implications

- Prescribed burning alone during any point in the annual growth cycle will not cause widespread mortality of saltcedar.
- For effective reduction of saltcedar infestations, it is important to combine other management tools with prescribed burning. These could include mechanical clearing, herbicide treatment or biological control.
- Prescribed burning can be an effective tool for reducing fuel levels in saltcedar growth, especially areas with high levels of decadent growth. Because of extreme and erratic fire behavior, it is important to plan such burns carefully and allow ample firelines.
- For wildfires in saltcedar, it is important to allow for rapidly advancing crown fires in decadent growth and extreme flame length.

According to scientist Brent Racher, one useful option is mechanical clearing of saltcedar and placement of uprooted plants in windrows to facilitate burning, as demonstrated above. Credit: ©2009 Nick Rice.

Wildfire considerations

Racher feels the research has documented the fire behavior characteristics and firebrand potential, and can be used for planning and managing personnel safety in a wildfire incident. He notes, "Knowing what fire behavior and spotting behavior is possible from this ecosystem, fire managers can better plan and organize resources to keep firefighters safe and mitigate losses from these wildfires."

Further Information: Publications and Web Resources

Mitchell, R., R. Fox, M. Davin, and B. Racher. Saltcedar Invasion in Riparian Ecosystems: Problems and Prospects for Management. American Fisheries Society Abs. 2001.

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Scientist Profile

Brent Racher is proprietor of Racher Resource Management, LLC. The firm is a natural resource management company. Its specialty is prescribed burning but also includes almost any type of land management planning, monitoring, and/or implementation including habitat and range improvement, management planning, wildland fire protection and mitigation, and vegetation monitoring.

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