Special Focus Session

Session # 06140300

Ecology, Monitoring, and Management of Tamarisk: Monitoring Responses to Tamarisk and its Control

Chair: Deborah Finch

Rationale for Special Focus Session: Tamarisk invasion has had serious effects on the structure and stability of native plant and animal communities. New methods for monitoring and managing Tamarisk have been developed over the past decade, but many considerations influence how, when, and where to monitor and control Tamarisk. The decline of riparian stands of cottonwood (Populus fremontii) along the Rio Grande in New Mexico is partially attributable to the invasion of tamarisk which has limited the number of germination sites suitable to cottonwood. Water uptake by salt cedar is higher than most native plants owing to its high leaf, stem, and shrub densities, contributing to drying of rivers. Efforts to salvage water by removing Tamarisk have led to mixed results that need to be understood by managers. Current drought conditions aggravate salt cedar spread, contributing to increased fuel loads. Salt cedar ignites easily and quickly burns out of control, damaging river habitats and posing hazards to homes and structures. Salt cedar thickets form barriers that are often impenetrable to animals and humans. Wildlife habitat invaded by salt cedar is structurally and floristically less diverse posing negative consequences for native species.

The suitability of tamarisk as wildlife habitat has been a subject of considerable debate. However, from a structural standpoint it does provide cover for some species, particularly birds. It is important to note that all published studies of the value of tamarisk as wildlife habitat have focused on birds during the breeding season. Purported benefits to selected birds do not necessarily extend to other animals. Additional research is needed on the relationship between tamarisk and other groups of species including invertebrates as compared to native vegetation types. These two sessions will review the needs and methods for controlling Tamarisk, review water salvage and wildlife responses to managing Tamarisk, and discuss some of the controversies associated with Tamarisk control.

Keywords: Tamarisk, High Resolution Remote Sensing, Southwest United States, Mapping, Monitoring, salt cedar, rio grande, new mexico, cottonwood, wildlife habitat, native vegetation

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Tamarisk Mapping & Monitoring Using High Resolution Satellite Imagery

Authors: Jason San Souci (NCDC) & John Doyle (DigitalGlobe)

QuickBird high resolution multispectral satellite imagery (60 cm GSD, 4 spectral bands) and calibrated products from DigitalGlobe's AgroWatch program were used as inputs to Visual Learning System's Feature Analyst automated feature extraction software to map localized occurrences of pervasive and aggressive Tamarisk (Tamarix ramosissima), an invasive species found along riparian corridors throughout the Western United States. Mapping was carried out along two major river systems known for widespread tamarisk invasions (Colorado River near Grand Junction, CO & Rio Grande River near Albuquerque, NM) using imagery acquired in late Fall, 2003. Mapped tamarisk occurrences were conservative, because only tamarisk vegetation with spatial areas greater than 10 square meters were classified and senesced tamarisk were not taken into account. Classification accuracies were greater than 80% based on ground verified data. Overall, these results confirm that high spatial but low spectral resolution remote sensing data coupled with machine learning classifiers can be used effectively for local precision mapping of Tamarisk in dominant environments found in riparian landscapes.

Keywords: Tamarisk, QuickBird, High Resolution Remote Sensing, Southwest United States, Mapping, Monitoring

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Chair: Deborah Finch, USDA Forest Service, Rocky Mountain Research Station, Albuquerque, NM, 505-724-3671, dfinch@fs.fed.us

Remote Sensing of Saltcedar Biological Control Effectiveness

Authors: Raymond I. Carruthers[1], C. Jack DeLoach[2], Jeff Knight[3], Gerald Anderson[4], and Peng Gong[5, 1]USDA-ARS, Albany, CA; [2] USDA-ARS, Temple, TX; [3] Nevada Dept. Agric., Reno, NV; [4] USDA-ARS Sidney, MT; [5] Univ. of Calif. Berkeley, CA.

Biological control of saltcedar has been a priority project within the USDA-ARS for well over a decade and has recently been field tested in several western states including CA, CO, NM, NV, OR, TX, UT and WY. A leaf beetle from Eurasia, *Diorhabda elongata* has now been tested at several locations, where the beetles have successfully overwintered, established reproductive populations and spread substantially within saltcedar infested areas. Within these sites, the beetles have caused extensive defoliation for multiple seasons and are severely impacting saltcedar growth and development. The impact on the saltcedar has been extensive while no non-target plants have been impacted. Ground sampling of beetle populations and their impact on target saltcedar and adjacent beneficial species was conducted at all of the release sites for several years, however the scale of impact is now making field sampling both difficult and expensive. In support of these assessment efforts, extensive remote sensing work was conducted both to characterize saltcedar infestations and to follow beetle establishment and spread. A comprehensive assessment program has used a combination of color aerial photograph and hyperspectral imagery to assess saltcedar populations prior to beetle release and to follow beetle defoliation patterns from the original release sites across wide areas of impact. A combination of color and texture analysis was used to identify, classify and map invasive *Tamarix parviflora* during spring bloom, along a 50 miles segment of Cache Creek in central California with an estimated 90% accuracy. Hyperspectral imagery has further been used during mid-summer to evaluate identification of vegetative saltcedar interspersed with other background native vegetation in this and other infested areas. Additional use of hyperspectral image assessment and GIS mapping has allowed biological control specialists to track and evaluate beetle performance over thousands of acres. A combination of aerial and ground sampling clearly has documented the success and safety of this project in multiple study areas. Based on these assessments, several State and Federal Agencies are highly enthusiastic about saltcedar biological control and have proposed to use this technology over wide areas. Remote sensing is expected to play a major role in the continued assessment of this beneficial project.

Keywords: saltcedar, *Tamarix*, biological control, remote sensing, hyperspectral image analysis

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Groundwater, Vegetation, and Atmosphere: Comparative Riparian Evapotranspiration, Restoration, and Water Salvage

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As water shortages persist throughout much of the Western U.S., a great deal of money and effort is directed toward decreasing depletions, thereby enabling continued water use in irrigation, industry, and by municipalities. This study has focused upon long-term measurement of evapotranspiration (ET) by native and non-native riparian species along the Middle Rio Grande, New Mexico, where riparian ET has been estimated to be 20-50% of water budget depletions. Leaf area index (LAI) was most strongly related to average ET rates, irrespective of species composition at a site. Decreased LAI caused by crown dieback in native cottonwood is found at sites where the drought has also resulted in groundwater decline. Saltcedar ET, on the other hand, increases from 6 to 9 mm/day during groundwater declines 7.5 cm/day. Atmospheric conditions that influence ET rates include vapor pressure deficit, net radiation, precipitation, friction coefficient, and the relative contribution of wind speed that are tangential and transverse to the riparian corridor. Some of these conditions interact to affect ET rates. For example, precipitation events are associated with lower net radiation, vapor pressure deficit, and ET. Potential water salvage due to non-native removal and restoration attempts was predicted by comparing ET and LAI rates in various vegetation types. Lowest LAI and ET are found in a saltcedar/saltgrass non-overlapping mixed stand. In contrast, a dense monospecific saltcedar stand frequently loses 11.5 mm/day through ET, especially when flooded. ET from other vegetation types along the Middle Rio Grande seldom spikes so high. Conversion from dense monospecific saltcedar to sparse saltcedar/saltgrass woodland is predicted to be 0.3 m per year, based upon both ET and LAI changes in such a conversion. Previous studies of water salvage place this value between 0.6 and –0.5 m/yr, in which unsuccessful removal of saltcedar may result in increased LAI.

Keywords: water shortage, evapotranspiration, salt cedar, Middle Rio Grande, leaf area index, water salvage

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Wildfire, Exotic Vegetation, and Breeding Bird Habitat in the Rio Grande Bosque

Authors: D. Max Smith, Jeffrey F. Kelly, and Deborah M. Finch

Wildfires in the Rio Grande Bosque have likely increased in frequency due to absence of the natural flood regime and current drought conditions. Native cottonwoods (*Populus deltoides*) do not withstand or recover from wildfire as well as exotic vegetation, particularly salt cedar (*Tamarix ramosissima*). There is concern that a shift in primary disturbance process from flood to fire will shift vegetative succession away from structurally diverse mesic native communities to structurally simple xeric exotic shrublands, which provide inferior habitat for riparian-dependant animals. In 2003, we initiated a study to evaluate effects of wildfire on quality of riparian habitat for birds breeding in the Middle Rio Grande Bosque. We are currently comparing nest success of birds breeding in wildfire and unburned sites. Initial arthropod sampling results show that surface-active arthropods, important prey for many bird species, were more common in unburned sites. In addition, we are monitoring the growth and survival of native and exotic re-sprouts in wildfire areas, and sampling foliage arthropods on these sprouts. Our results will provide managers with information about the post-wildfire dynamics of native and exotic vegetation in riparian forests and the usefulness of this habitat to different species of breeding birds.

Keywords: wildfire, cottonwood, salt cedar *Populus deltoides*, *Tamarix ramosissima,* arthopods, birds, riparian, native, exotic

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Herpetological Communities Of The Middle Rio Grande Bosque: What Do We Know, What Should We Know, And Why?

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Amphibians and reptiles (herpetofauna) play important roles within ecosystems. Compared to birds and mammals, herps are more efficient at converting food they consume into biomass and also are a higher quality food source for predators. Herp populations respond to abiotic factors, such as structural heterogeneity and substrate moisture, as well as biotic factors such as insect availability and predation. Recent declines in herpetofaunal populations have stimulated a greater interest in the monitoring of these populations. Although studies have examined the use of exotic plant-invaded ecosystems by birds and mammals, few have focused on the herpetofaunal component of these systems. Specifically, there is little information on the ecology and management of herpetofauna within riparian cottonwood forest (Bosque) along the Middle Rio Grande in New Mexico. Saltcedar and other exotics have significantly increased fuel loadings and thus the risk of catastrophic fire in the bosque. Land managers are interested in removing exotics and reducing fuels using various techniques. To effectively manage habitat and conserve biodiversity, managers must understand how various exotics-removal techniques will affect the distribution, abundance, and ecology of resident herp populations. In 2000, the U.S. Forest Service, Rocky Mountain Research Station initiated a study to monitor and evaluate the response of vegetation and wildlife to three fuel reduction treatments along the Middle Rio Grande Bosque. The goal of this component of the study is to evaluate the impact of these treatments on herpetofauna. Using mark-recapture methods, we will analyze species-specific and community level responses to the treatments and describe how herps respond to local and ecosystem-level changes. Specifically, we will address how these treatments affect survivorship, species richness, abundance, diversity, reproduction, and community energy flow.

Keywords: Amphibians, reptiles, herpetofauna, bosque salt cedar, Middle Rio Grande, mark-and-recapture, fire

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Monitoring Bird Populations in Relation to Fuel Loads and Fuel Treatments in Riparian Woodlands with Tamarisk and Russian Olive Understories

Authors: Deborah M. Finch and June Galloway

Over the past decade, wild fire events in riparian bosque (forested) areas along the Middle Rio Grande between Elephant Butte and Albuquerque have increased dramatically owing to flood suppression and accumulation of dead wood and exotic Tamarisk and Russian olive. This problem culminated in a large wild fire in July 1993 that resulted in the evacuation of hundreds of City of Albuquerque residents and captured the national media's attention. Prior to this event, the Rocky Mountain Research Station, in collaboration with the Middle Rio Grande Conservancy District, City of Albuquerque Open Space, and Bosque del Apache National Wildlife Refuge, designed a study in 1999 to compare effectiveness of three methods of fuel removal for reducing fire risk, preventing re-occurrence of exotics, and restoring native habitats, plants and animals. A goal of managers is to preserve cottonwoods while reducing or eliminating Tamarisk and Russian olive stems, so study sites were selected that had cottonwood overstories and Tamarisk and olive understories. As part of this study, the population and nesting responses of breeding bird species have been evaluated prior to and following fuel removal treatments. My talk reports on 1) the numbers and kinds of bird species inhabiting bosque habitats with cottonwood overstories and varying amounts of Tamarisk and Russian olive, 2) nest substrate use and nesting success of selected bird species prior to treatment, and 3) preliminary results after the first year of mechanical treatments. In addition, I predict short-term and long-term responses of birds and plant communities following treatments.

Keywords: tamarisk, Russian olive, cottonwood, bosque, riparian habitat, Rio Grande, fuel removal, wild fire, breeding birds, nesting success

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Saltcedar and Southwestern Willow Flycatchers: Lesson from a Long-Term Study in Central Arizona

Authors: Mark K. Sogge, Eben H. Paxton (U.S. Geological Survey, Southwest Biological Science Center, Flagstaff, AZ) and April A. Tudor (Arizona Game and Fish Department, Phoenix, AZ).

The Southwestern Willow Flycatcher (*Empidonax traillii extimus:* SWWF) is a riparian-obligate bird that breeds only in dense, typically wet riparian vegetation. In the mid-1990s, biologists discovered a substantial number of flycatchers breeding in habitat dominated by exotic saltcedar (*Tamarix ramosissima*). SWWFs nest in saltcedar-dominated riparian habitats at sites in Arizona, New Mexico, Nevada, and Utah. Approximately 25% of SWWF breeding sites, supporting one-third of the roughly 1,300 known flycatcher territories, are in saltcedar-dominated sites. Just as SWWFs do not breed in all native-dominated riparian habitat patches, they breed in only a small fraction (<1%) of the saltcedar habitats that are present in the Western U.S.. Although diet of flycatchers in native and saltcedar habitats differs, dietary differences are not proof that food resources are limiting or insufficient in one habitat compared to the other. Therefore, studies were conducted to determine if there are negative effects to SWWFs breeding in saltcedar. Long-term (1996 – present) studies of flycatcher physiology, immunology, site fidelity, productivity, and survivorship found no evidence that nesting in saltcedar-dominated habitat is detrimental to willow flycatchers at breeding sites in central Arizona . It is likely that saltcedar habitats vary with respect to suitability for breeding flycatchers, just as do native habitats. Therefore, results from a single study or site may not be applicable across the ranges of the SWWF or saltcedar. Ultimately, multiple long-term studies over a large geographic area must be compared to determine the relative suitability of native and saltcedar habitats at the landscape scale.

Keywords: endangered species, invasive species, exotic species, southwestern willow flycatcher, habitat use, saltcedar, tamarisk, riparian, riparian restoration, American Southwest, United States

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Southwestern Avian Community Organization in Exotic *Tamarix*: Current Patterns and Future Needs

Author: Hira A. Walker

Tamarisk (saltcedar: *Tamarix*), an invasive exotic tree native to the Eastern Hemisphere, is currently the dominant plant species in most southwestern riparian ecosystems at elevations below 1500 m. Tamarisk alters abiotic conditions and the floral composition of native southwestern riparian ecosystems and, in turn, affects native southwestern animal communities. However, information on the overall effects of tamarisk on avifauna is somewhat conflicting and incomplete. This paper attempts to resolve conflict in the literature by addressing several questions: (1) Are there consistent broad geographic patterns in avian species richness and abundance in tamarisk?; (2) Which groups of birds use tamarisk?; and (3) Which attributes are most useful in predicting avian use of tamarisk? A survey of published literature found that overall avian species richness and abundance in tamarisk are not consistent across broad geographic scales, but vary consistently between the Rio Grande and the Pecos and Colorado Rivers. Examination of geographic variation in food and nesting resources provided by tamarisk-dominated vegetation does not fully explain overall geographic patterns; most groups of birds show consistent use of tamarisk across geographic locations. However, use of tamarisk by cup nesting breeding birds does vary with geographic location. Since most research on avian use of tamarisk has been completed on breeding birds, patterns in breeding birds appear to drive the documented geographic patterns. Overall, avian use of tamarisk is best explained by species-specific nesting and foraging requirements, which in turn covary with vegetation structure and floristics, and are mediated by climatic influences. Since large gaps still exist in the knowledge base, especially for wintering and migrating birds, more research should be completed on both local and regional avian use of tamarisk and a classification system of tamarisk vegetation types should be developed to aid in defining which types of tamarisk are most useful or detrimental to wildlife.

Keywords: Tamarisk, *Tamarix*, saltcedar, southwest, avifauna, birds, biogeography.

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