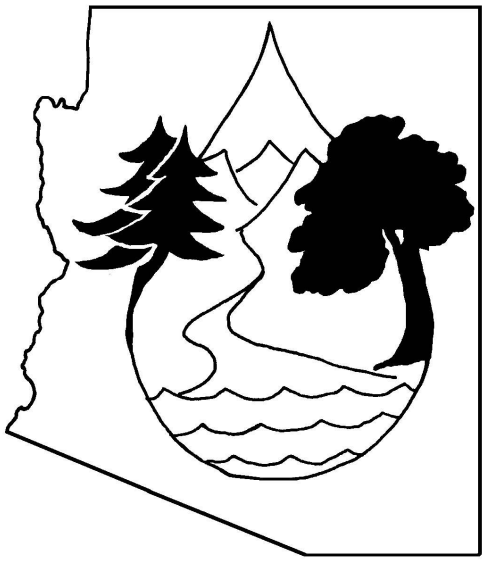
ELEVENTH MEETING OF THE ARIZONA RIPARIAN COUNCIL

Windemere Resort
and Conference Center
Sierra Vista, Arizona
April 11-12, 1997

SALTCEDAR: FRIEND OR FOE?



PROGRAM AND ABSTRACTS
1997

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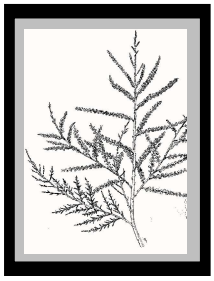
ARIZONA RIPARIAN COUNCIL
11TH ANNUAL MEETING
APRIL 11-12, 1997
WINDEMERE RESORT AND CONFERENCE CENTER
2047 S. HIGHWAY 92
SIERRA VISTA, ARIZONA

Friday, April 11

8:00-8:30	Registration
8:30-8:40	President's Welcome, **Ruth Valencia**
8:40-9:00	An Introduction to the Issues of Saltcedar Management, **Marty Jakle, U.S. Fish and Wildlife Service**
9:00-9:30	Biological Control of Saltcedar: Philosophy, Methodology, Safeguards, Progress Towards Releases, **C. Jack DeLoach, USDA/ARS Grassland, Soil and Water Laboratory**
9:30-10:00	Causes and Consequences of Saltcedar Spread, **Julie Stromberg, Center for Environmental Studies, Arizona State University**
10:00-10:20	BREAK - Poster Session
10:20-10:50	Alien Hosts: Wildlife Habitat Use of Tamarisk in the American Southwest, **Lawrence E. Stevens, Applied Technology Associates, Inc.**
10:50-11:20	Status, Distribution, and Current Threats to the Endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus),* **Rob Marshall, U.S. Fish and Wildlife Service**
11:20-11:30	BREAK
11:30-12:00	Roundtable Discussion, **Facilitator, Matt Chew, Arizona State Parks**
12:00-1:30	LUNCH (ARC Elections - Floor nominations will be accepted at this time. Ballots may be cast after the acceptance of nominations until 5 PM.)



1:30-1:55 The Effects of Tamarisk Removal on Diurnal Ground Water Fluctuations. **Curt Deuser, National Park Service, Lake Mead National Recreation Area.**

1:55-2:20 Failing Aliens: Dam Impacts on Tamarisk in the Grand Canyon, Arizona. **Lawrence E. Stevens, Applied Technology Associates, Inc.**

2:20-2:45 Extent of Saltcedar Infestation along the Lower Colorado River and its Effects on Management, Especially Concerning the Southwestern Willow Flycatcher. **John Swett*, Pablo Arroyave, and Tom Shrader, U.S. Bureau of Reclamation, Lower Colorado Region.**

2:45-3:10 Exotic Plant Control to Preserve and Restore Riparian Areas in Numerous National Park Units. **Curt Deuser, National Park Service, Lake Mead National Recreation Area.**

3:10-3:30 BREAK - Poster Session

3:30-3:55 An Analysis of Some Effects of Watershed Management Practices and Natural Events on Stream Indicators in Cave Creek and Seven Springs, Central Arizona. **Jocelyn Clifford[1], Kaolin Cummens[1], Shawn Hirt[1], April Huff[1], Tamara Peterson[1], Joshua Goldwasser[2], Julie Halbeck[2], Ashley Larsen[2], Becky Lynott[2], Cyndi Lynott[2], Alex Rozek[2], Andy Thomas[2], Patti Fenner[3], Adrienne Gibson[1], Jeff Griswold[2], and Scott Underwood[1], [1]Cactus Shadows High School, Cave Creek, AZ; [2]North Canyon High School, Phoenix, AZ; and [3]U.S. Forest Service, Cave Creek Ranger District, Tonto National Forest.**

3:55-4:20 A Proposed Methodology for Determining Groundwater Requirements of Low-elevation Southwestern Riparian Trees. **Jonathan Horton*, S. C. Hart, and T. E. Kolb.**

4:20-4:45 Cave Creek Wash Preservation Boundary Study and its Application to Urban Desert Preserve Planning in Phoenix, Arizona. **Rebecca Fish Ewan*, Joseph Ewan*, Samual Scheiner, Timothy Craig, James P. Burke, James D. Coffman, John Brock, Kevin**

Dixon, Wei Gao, Jack Gilcrest, Doug Green, Troy Grondahl, Joanne Itami, Elaine Joyal, Michael Kearsley, John Meunier, James McCarthey, Gordon Schuett, Frederick Steiner, Jianguo Wu, and Joseph Yarchin.

4:45-5:10 Ungulate Grazing, Fish Habitat and Populations in the Southwest. **John Rinne, USDA Forest Service.**

5:10-5:30 Silent Auction bids and casting of ballots for officers end.

7:00 DINNER

FIELD TRIPS

Saturday, April 12

On both field trips individuals are responsible for their own transportation, lunch, and water. We encourage car pooling There should be several individuals who will have minivans or Suburbans.

SAN PEDRO RIPARIAN NATIONAL CONSERVATION AREA

The San Pedro River originates in the foothills of the Sierra San Jose, the Sierra Los Ajos, and the Sierra Mariquitos in the northern part of the state of Sonora, Mexico and flows in a northerly direction into south-central Arizona for a little over 140 miles until it joins the Gila River at Winkleman, AZ. The Gila then flows west to join the Colorado River at Yuma, AZ.

The San Pedro Riparian National Conservation Area was acquired by the U.S. Bureau of Land Management (BLM) to protect and manage riparian resource values on 36 miles of the San Pedro River between the Arizona/Sonora border and Saint David, Arizona. Mark Fredlake, Wildlife Biologist for the BLM, will lead a field trip along the river. The BLM's planning process and how natural resource management issues and actions to address those issues are identified will be discussed. Examples of BLM management actions will be viewed on the ground. Management issues include addressing floodplain hydrology along the river, including impacts of groundwater pumping, a proposal for reintroduction of beaver, and a project to recharge effluent from Sierra Vista. In addition, management of saltcedar will be discussed. The field trip will provide an overview for newcomers and an opportunity to review progress for old hands. Birding opportunities are excellent.

The field trip will begin at 8:30 am from the motel parking lot. We encourage car pooling and expect to be back to the motel mid- to late afternoon, allowing time for people to return to Phoenix. Plan to bring water and lunch. There will be coolers to put your lunch in.

PATAGONIA-SONOITA CREEK PRESERVE, PATAGONIA, ARIZONA

In a verdant floodplain valley between the Patagonia and Santa Rita mountains of southeastern Arizona, Sonoita Creek provides for some of the richest of the remaining riparian habitat in the region. The Nature Conservancy, with the support of the Tucson Audubon

Society, purchased the Patagonia-Sonoita Creek Preserve. This was the first project for the Conservancy in Arizona. The preserve protects a magnificent example of the cottonwood-willow riparian forest. These are the largest and oldest Fremont cottonwood trees anywhere. It is one of the few remaining sites where this once-common forest type still persists. Arizona black walnut, velvet mesquite, velvet ash, canyon hackberry, and various willows are found in slightly different habitats throughout the preserve. Remnant wetlands or cienegas, a once-common feature of Sonoita Creek floodplain, and the most endangered natural community in Arizona, are also found at the Preserve. A significant number of rare and sensitive plant species are found in the Sonoita Creek watershed. Southeastern Arizona is renowned for its biological diversity. The "mountain islands" throughout the region support an astonishing array of rare and unusual species

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The Patagonia-Sonoita Creek Preserve is best known for the over 260 bird species observed here. Several unique, unusual, and rare species such as the gray hawk, green kingfisher, thick-billed kingbird, northern beardless-tyrannulet, violet-crowned hummingbird, and rose-throated becard attract birdwatchers from around the world. Other animals utilizing the preserve include mountain lion, bobcat, white-tail deer, javelina, coatimundi (chulo), coyote, desert tortoise, occasional rattlesnakes and several toads and frogs. This perennial stream, fed by surface and underground springs, is one of the very few remaining which supports four native fish species, among the most endangered in the Southwest.

This field trip will take place at The Nature Conservancy's Sonoita Creek Preserve in Patagonia, Arizona. Jeffrey Cooper, Preserve Manager, will discuss a number of the conservation and restoration projects that have been conducted at the preserve and will take us on a tour of those sites. We will also learn about the impacts of other activities in the watershed on preserve management.

Participants will be asked to drive their own vehicles. Bring lunch and water with you. There are restroom facilities on site. Ruth Valencia will be organizing the trip from the Windemere to the Preserve. Meet at the Windemere Hotel and Conference Center at 8:15 a.m. You will receive a map to the Preserve. We will reconvene at the Visitor's Center at the Sonoita Creek Preserve at 9:30 a.m., where we will be met by Jeffrey Cooper. We will return to the Visitor's Center around lunch time and will eat lunch and continue the discussion there. Following lunch, you are welcome to stay and enjoy the Preserve or to return home.

ABSTRACTS

CLIFFORD[1], J., K. CUMMENS[1], S. HIRT[1], A. HUFF[1], T. PETERSON[1], J. GOLDWASSER[2], J. HALBECK[2], A. LARSEN[2], B. LYNOTT[2], C. LYNOTT[2], A. ROZEK[2], A. THOMAS[2], P. FENNER[3], A. GIBSON (Biology Teacher)[1], J. GRISWOLD (Biology Teacher)[2], and S. UNDERWOOD (Chemistry/Physical Science Teacher)[1]. [1]Cactus Shadows High School, PO Box 426, Cave Creek, AZ 85327; [2]North Canyon High School, 1700 E. Union Hills Rd, Phoenix, AZ 85024; and [3]Cave Creek Ranger District, Tonto National Forest, PO Box 5068, Carefree, AZ 85377. *An analysis of some effects of watershed management practices and natural events on stream indicators in Cave Creek and Seven Springs, central Arizona.*

Students and teachers at Cactus Shadows and North Canyon High Schools have been working in partnership with the Cave Creek Ranger District of the Tonto National Forest for the last four years. Biology classes make monthly trips to adopted sites on Cave Creek and Seven Springs, important riparian drainages on the District, to collect information on streamflow, macroinvertebrates, and water quality.

Measurement of streamflow on a monthly basis was necessary for the Tonto National Forest to be able to apply for instream-flow water rights for these two perennial streams. At this time, a report summarizing four years of measurements is being reviewed by the State Department of Water Rights. Flow is measured with either a pygmy meter or a Marsh/McBirney meter. Data is submitted monthly to the Forest Service.

Macroinvertebrates are normally sampled every month, for students to remain proficient in collection technique using a Surber sampler and identifying collected specimens. Samples collected in spring and fall at each site are mailed to the Forest Lab in Provo, Utah, for professional analysis. Reports on findings and interpretation of data are then sent to the Forest Service and distributed to the schools.

Water quality tests include a variety of chemical and physical tests: pH, dissolved oxygen, harness, alkalinity, nitrates, and sulfates.

This year, for the first time, students were asked to evaluate and interpret the data they have collected over the last few years. They have had two meetings with both high schools' teachers and students present, in which the Forest Service reviewed the variety of land management activities and natural events that have occurred in the watershed of Cave Creek and Seven Springs. Activities range from prescribed burns, natural floods, livestock grazing according to a rest-rotation system with riparian pastures, inactive mines adjacent to Cave Creek, and concentrated and dispersed human activities in upstream campgrounds and along a popular system trail that follows Cave Creek. Students compiled data and reviewed it for accuracy, and formed hypotheses of interrelationships, some of them possibly cause and effect, on impacts of various environmental factors on stream indicators they have been monitoring.

DeLOACH, C. J. USDA/ARS Grassland, Soil, and Water Research Laboratory, 808 E Blackland Rd, Temple TX 76502. *Biological control of saltcedar: Philosophy, methodology, safeguards, progress towards releases.*

Invading saltcedar (*Tamarix ramosissima*) from central Asia has become the most damaging weed of native riparian ecosystems of the western United States. Classical biological control is the method of choice for control in these areas where the native flora and fauna should not be harmed. At least 25 genera of insects have co-evolved with the genus *Tamarix* in central Asia, with over 300 species host-specific to the genus. We are testing 15 of these species in France, Israel, China, Turkmenistan, and Kazakhstan. Six species have been introduced into quarantine at Temple, Texas, for final testing. Two species, the mealybug, *Trabutina mannipara* from Israel and the leafbeetle, *Diorhabda elongata*, from China, Kazakhstan, and Turkmenistan, have received preliminary approval for release. The other 13 species also appear suitable for release. However, final release permits await resolution of conflicts of interest that involve the endangered southwestern subspecies of the willow flycatcher, *Empidonax traillii extimus*, that now nests in the saltcedar that has displaced its native nest trees. The history and extent of usage, methodology, and safeguards for biological control of weeds, and the review of the approval process for releasing biological control agents is discussed.

DEUSER, C. National Park Service, Lake Mead National Recreation Area, 601 Nevada Highway, Boulder City, NV 89005. *Exotic plant control to preserve and restore riparian areas in numerous national park units.*

The primary objective is to control the exotic tamarisk (saltcedar) tree that is responsible for degrading riparian habitats throughout many park units. This project will not only assist with the preservation and restoration of the native flora and fauna of these valuable riparian ecosystems, but will standardize National Park Service (NPS) management efforts by utilizing safe and effective control methods to maximize results.

Exotic species management has become an increasing problem with managers responsible for preserving natural ecosystems. As with many exotic species, tamarisk infestations have become an overwhelming challenge for NPS managers. There has been a recent Department of the Interior led Weed Management Initiative to increase exotic plant management to a broader scale that represents the distribution of the individual pest plant. Many park units are initializing tamarisk control programs without experienced or well-trained labor resources, there is a definite need for sharing information, expertise, and professional labor resources. A need for a concentrated approach to tamarisk control is outstanding, considering the degree of difficulty that control involves. Planning and prioritization of control efforts is critical to maximize limited resources and to achieve success of desired objectives.

Participating park units have submitted their priority tamarisk control projects. Each project will be evaluated according to the Decision Criteria for Developing Saltcedar Management Programs or by an existing tamarisk control plan, vegetation plan, resource management plan from individual park units before implementation. Project scheduling will be developed by the program coordinator. Labor will either be provided by local resources or by an 8-10 person NPS exotic plant control program crew fully equipped with vehicles, chainsaws, herbicide application supplies, and personal protective gear.

Proven methods will be used to provide for personnel safety and environmental sensitivity. Lake Mead National Recreation Area has developed effective control methods using cut-stump herbicide, low volume basal herbicide application, prescribed fire followed by basal spray of resprouts, heavy equipment and slash pile burning. These methods have been developed and refined to produce maximum control results that are widely accepted and have withstood multiple peer reviews.

The objective of the program will be to complete initial tamarisk removal from high priority areas and to develop maintenance schedules for park staff. Development of a professional corps of NPS resource managers equipped with the knowledge and expertise to continue exotic plant management programs. Removal areas will be documented and total acres of removals will be tallied. Monitoring the ecological recovery of the project areas will be the responbility of each park unit.

DEUSER, C. National Park Service, Lake Mead National Recreation Area, 601 Nevada Highway, Boulder City, NV 89005. *The effects of tamarisk removal on diurnal groundwater fluctuations.*

The National Park Service conducted a demonstration wetland-riparian restoration project at Sacatone Wash, Lake Mead National Park Service, Nevada, during 1992-1994. The project involved removal of the exotic tamarisk (*Tamarix ramosissima*) and revegetation with native plant species. Nearly three years of water level monitoring spanning periods before and after tamarisk removal revealed a variety of daily water table fluctuation patterns. Tamarisk removal eliminated a significant pattern of daily fluctuation thought to be associated with the evapotranspiration of groundwater. A similar fluctuating pattern reappeared two years later after reestablishing native vegetation. Water consumption before was similar to two years after tamarisk removal. It appears that the tamarisk community was replaced by other species that consumed approximately the same quantity of groundwater. Comparison of the data from this study to historical work by W. N. White (1932) indicates strong similarities in water level fluctuation patterns. Thus, use of White's formula to estimate water loss due to evapotranspiration by tamarisk was determined to be applicable to this situation.

EWAN, R. F.[1], J. E. EWAN[1], S. SCHEINER[2], T. CRAIG[2], J. P. BURKE[3], J. D. COFFMAN[3], J. BROCK[1], K. DIXON[2], W. GAO[2], J. GILCREST[1], D. GREEN[1], T. GRONDAHL[1], J. ITAMI[2], E. JOYAL[2], M. KEARSLEY[4], J. MEUNIER[5], J. McCARTHY[1], G. SCHUETT[2], F. STEINER[1], J. WU[2], and J. YARCHIN[6]. [1]College of Architecture and Environmental Design, School of Planning and Landscape Architecture, Arizona State University, PO Box 2005, Tempe, AZ 85287-2005; [2]Department of Life Sciences, Arizona State University West, 4701 W. Thunderbird Rd, Phoenix, AZ 85069-7100; [3]City of Phoenix Parks, Recreation and Library Department, Phoenix, AZ; [4]Biology Department, Northern Arizona University, Flagstaff, AZ; [5] [1]College of Architecture and Environmental Design, Arizona State University, PO Box 2005, Tempe, AZ 85287-2005; and [6]Arizona Game and Fish Department, 7200 E University Dr., Mesa, AZ 85207. *Cave Creek Wash Preservation Boundary Study and its application to urban desert preserve planning in Phoenix, Arizona.*

This presentation outlines the findings and application of the Cave Creek Wash Preservation Boundary Study (1996) performed by faculty from Arizona State University (ASU), Main Campus, College of Architecture and Environmental Design; faculty from ASU West Campus, Department of Life Sciences; specialists from the Desert Botanical Garden and Arizona Game and Fish Department; and a landscape architect and planning and development manager for the City of Phoenix Parks, Recreation, and Library Department (PRLD). The intent of the study was to recommend preservation boundaries that are consistent with the existing ecology of the Cave Creek Wash and adjacent landscape within Phoenix. The recommendations were then applied to the planning of PRLD desert preserve system in north Phoenix.

The study area spanned approximately 0.5 mile on both sides of the centerline of the wash and was bounded on the north by the Carefree Highway, and on the south by the Cave Buttes Recreation Area. Vegetation sampling was performed for 90 quadrats within the study area and mapping was conducted and formed a basis for developing three boundary options: maximum, moderate, and minimum preservation. The vegetation was classified into four types. Damaged areas were also mapped. In addition, wildlife observations were noted during the field visits. Identified wildlife included: desert tortoise, Gila monster, coyote, javelina, red-tailed hawk, great horned owl, and cactus wren.

A report was then developed for the PRLD and was presented to the Phoenix City Council and the Phoenix Parks Board. The Board supported the maximum preservation boundary that included 4,500 acres of land. A significant contribution of the study and report is in its application to urban wild land planning in Phoenix. As the PRLD noted after reviewing the report, they learned that “the process of establishing preserve boundaries should be based on scientific understanding of the natural systems instead of property ownership and topography, as we commonly done in the past” (PRLD 1997).

The presenters will also briefly discuss current studies similar to the Cave Creek Wash study they are conducting for Apache Wash, Skunk Creek, and

Deadman Wash. These washes also run through presently undeveloped northern extent of Phoenix and will be considered for preservation within the desert preserve system.

HORTON, J. L., S. C. HART, and T. E. KOLB. School of Forestry, College of Ecosystem Science and Management, Northern Arizona University, Flagstaff, AZ 86011-5018. *A proposed methodology for determining groundwater requirements of low-elevation southwestern riparian trees.*

Riparian ecosystems in the American Southwest are important areas of biodiversity that support a majority of the region's species. However, in the past 100 years hydrologic alterations have contributed to a decline in southwestern riparian habitats. In lower elevations, these changes in hydrologic regime have caused reductions in the dominant *Populus fremontii-Salix gooddingii* forests and have likely contributed to the successful invasion of the exotic *Tamarix* spp. *Tamarix* spp. is known to displace *P. fremontii* and *S. gooddingii* as it spreads and is thought to alter riparian hydrologic characteristics and ecosystem properties. Both the exotic *Tamarix* and the native trees are known to be phreatophytic, relying heavily upon groundwater resources. With threats to the native *P. fremontii-S. gooddingii* forests coming from both human water use and water competition by the exotic *Tamarix*, it is important to understand the groundwater requirements of these species. Knowledge of the water requirements of these species may be a valuable tool in management decisions for both conservation and restoration of *P. fremontii-S. gooddingii* forests. Our research will focus on the groundwater requirements of these three species on two rivers in Arizona: the Bill Williams, a dam-regulated tributary of the Colorado; and the Hassayampa, an unregulated tributary of the Gila. Specifically we will address the following hypotheses:

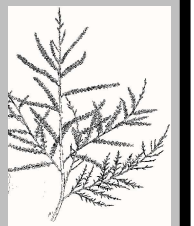
(1) a decrease in groundwater depth will cause a shift in plant water uptake from groundwater to the unsaturated surface soil where water is less available resulting in increased tree stress;

(2) the relationship between groundwater depth and tree physiological condition will show a distinct threshold beyond which tree water stress will increase rapidly due to a decrease in water uptake. These thresholds will vary with tree size, with larger, more deeply rooted trees, having greater thresholds;

(3) the relationships between groundwater depth and tree physiological condition will differ between an unregulated and a dam-regulated river, primarily to a more constant water supply on the dam-regulated river; and

(4) the relationship between groundwater depth and tree physiological condition will differ among similar-sized individuals of *P. fremontii, S. gooddingii,* and *Tamarix* spp. We plan to use the "space for time approach" along a losing reach at each river. Locations along a gradient of depth to groundwater will be used to assess long-term effects of groundwater availability on riparian tree condition. We will combine measurements of tree physiological condition, such as, net photosynthesis, water potential, and loss of hydraulic conductivity due to xylem cavitation, with stable isotope analysis

of water sources used by riparian trees throughout the growing season. This information will be compared with measurements of streamflow and groundwater availability to determine relationships between water availability to determine relationships between water availability and water sources used by riparian trees and the physiological condition of those trees.



MARSHALL, R. M. U.S. Fish and Wildlife Service, 2321 W Royal Palm Rd, Ste 103, Phoenix AZ 85021. *Status, distribution, and current threats to the endangered southwestern willow flycatcher (*Empidonax traillii extimus*)*.

The southwestern willow flycatcher (*Empidonax traillii extimus*) is a small neotropical migratory bird that breeds in riparian habitats in the southwestern U.S. and spends the non-breeding season in southern Mexico, Central America, and northern South America. Widespread loss, modification, and fragmentation of its streamside breeding habitat and documented population declines lead the U.S. Fish and Wildlife Service to list this subspecies as endangered in March of 1995.

Data from survey and monitoring efforts in Arizona, California, Colorado, Nevada, New Mexico, and Utah (>800 historic and new sites surveyed) were compiled to evaluate the current distribution, population size, breeding status, and habitat use of the southwestern willow flycatcher. Small numbers of territorial males have been confirmed at approximately 70 sites on 35 drainages in California, Arizona, and New Mexico. Flycatchers have been detected in some historically-occupied drainages in Nevada, Utah, and Colorado, but breeding attempts of known *E. t. extimus* have not been verified. Range wide, 78% of extant sites are comprised of five or fewer territories. Up to 20% of extant sites are occupied by single, unmated males. Only five known sites are comprised of 20 or more territories (two in California, two in Arizona, and one in New Mexico), and only seven drainages are known to support more than 20 territories (Rio Grande and Gila rivers in New Mexico; San Pedro River, and the confluence of the Salt River and Tonto Creek in Arizona; the San Luis Rey, Kern, and Santa Ynez rivers in California). Preliminary data from surveys on the lower Colorado River (Lake Mead to Yuma) indicate that this drainage may also support 20 or more territories. The largest known breeding group occurs in southwestern New Mexico where approximately 135 territories have been documented on the Gila River. Overall, a total of 420 territories was documented range wide during the 1993 to 1995 survey effort. A substantial proportion of those territories were comprised unmated males. Additional survey effort, particularly in California, may discover additional small breeding groups. Range wide, the *E. t. extimus* population is probably fluctuating at between 300 and 500 territories with a substantial proportion of individuals remaining unmated.

A variety of continuing threats leave the mostly-small breeding groups vulnerable to extirpation from stochastic events alone (e.g., fires). Several breeding groups monitored intensively in California, Arizona, and New Mexico have declined concomitantly with high rates of brood parasitism by brown-headed cowbirds (*Molothrus ater*). Nearly all breeding groups monitored are experiencing nest depredation at rates ranging from 30 to 50%. Exotic plant species, such as saltcedar (*Tamarix* spp.), giant reed (*Arundo donax*), and Russian olive (*Elaeagnus angustifolia*), have replaced cottonwood-willow (*Populus fremontii-Salix gooddingii*) habitat throughout much of this subspecies' historic range. While 55% of extant flycatcher sites are still dominated by native broadleaf plants, 33% of all flycatcher sites are

comprised of mixtures of native broadleaf and exotic species, and 12% are comprised of pure stands of saltcedar. Recent fires in Arizona and New Mexico have eliminated significant stands of occupied flycatcher habitat. Fire remains one of the most critical threats to this subspecies. Water development projects, urban and agricultural development in and adjacent to floodplains, and overgrazing by livestock in riparian areas continue to threaten occupied and potential habitat necessary for the survival and recovery of the southwestern willow flycatcher. Management actions are needed to provide immediate protection to occupied habitat and to increase reproductive output. Habitat protection and enhancement efforts in unoccupied habitat should be targeted at areas adjacent or close to existing breeding groups and at historically occupied locations.

RINNE, J. N. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, 2500 S. Pineknoll Dr, Flagstaff, AZ 86001.

Ungulate grazing, fish habitat and populations in the Southwest: What are the facts?

Little data are available on the relationship of large ungulate grazing and fish habitat and populations in the arid Southwest. Most of the information available in the literature addresses domestic livestock grazing and is from the Pacific Northwest and Intermountain regions of the United States. The presentation will (1) introduce grazing and fish information from the Southwest, (2) discuss what we know and do not know about the relationships of the two, (3) present data on fish population densities, diversities, and biomasses collected from two montane riparian-stream areas and one low desert riverine ecosystem, and (4) make recommendations for future approaches to this field of research.

STEVENS, L. E. Applied Technology Associates, Inc., PO Box 22459, Flagstaff, AZ 85002. *Alien hosts: Wildlife habitat use of tamarisk in the American Southwest.*

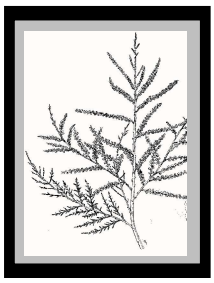
A controversy exists regarding the use of non-native tamarisk (pentandrous *Tamarix ramosissima* or *chinensis*) by wildlife in the western United States. Tamarisk has been abundant along western waterways and reservoirs since about the 1920's. Studies of tamarisk at low elevations in the Southwest have demonstrated limited herbivorous invertebrate populations and little habitat use by avifauna. In contrast, studies of tamarisk at moderate elevations have demonstrated that tamarisk supports large populations of several non-native herbivorous invertebrates, as well as numerous Neotropical migrant bird species, as well as other vertebrates.

I studied the invertebrate and vertebrate herbivore assemblage on tamarisk along the dam-controlled Colorado River in the Grand Canyon, where this species has existed since at least 1929. Tamarisk became more widely established along the river following construction of Glen Canyon Dam in 1963, and presently it is codominant in the post-dam lower riparian zone. In this system, analyses of tamarisk phenology, distribution, and stand structure suggest that tamarisk establishment is related to flooding. Comparison with unregulated reaches of the Colorado River and its tributaries indicates that tamarisk recruitment in the Grand Canyon has declined, and that other plant species (especially *Salix exigua*) are replacing tamarisk. The initial success of tamarisk along the Colorado River was likely related to high seed production and this species' greater tolerance of drought and flood stresses in comparison with native woody plant species. Analyses of differential herbivore impacts revealed low levels of invertebrate diversity on tamarisk, with dominance by non-native *Opsius stactogalus* (Cicadellidae) and *Chionaspis etrusca* (Diaspidadae) homopterans, and high levels of secondary production, as compared to coyote willow and other native woody species. Field invertebrate exclusion experiments revealed no substantial impacts of invertebrate herbivores on tamarisk growth; however, beaver (*Castor canadensis*) and winter sapsuckers (*Sphyrapicus* spp.) were occasionally important herbivores on tamarisk.

Tamarisk-specific invertebrate herbivores provide food for herpetofauna and avifauna in the Grand Canyon. In addition, some bird species, such as the endangered southwestern willow flycatcher (*Empidonax traillii extimus*), nest preferentially in tamarisk woodlands, and the plant provides food for beaver, other rodents, and sapsuckers. I hypothesize that the reason for increased wildlife use of tamarisk at middle elevations in Arizona is related to the positive correlation between xylem water potentials of < -30 bars. While increasing drought stress reduces growth, these levels of moisture stress appear to limit phloem-feeding invertebrate population growth. This hypothesis is supported by a negative correlation between invertebrate abundance and elevation in the Grand Canyon, and between the Grand Canyon and the lower Colorado River basin.

Biological control of tamarisk could be successful using several invertebrate herbivore species; however, the use of tamarisk as habitat, and tamarisk leafhoppers as food resources, indicates that the regional evaluation

and long-term planning are warranted before wide-scale biological control measures are implemented.



STEVENS, L. E. Applied Technology Associates, Inc., PO Box 22459, Flagstaff, AZ 86002. *Failing aliens: Dam impacts on tamarisk in the Grand Canyon, Arizona.*

Non-native tamarisk (pentandrous *Tamarix ramosissima* or *chinensis*) has existed along the Colorado River in the Grand Canyon since at least 1929, and became widely established following construction of Glen Canyon Dam. Tamarisk phenology, distribution and stand structure analysis suggest that establishment is related to flooding. However, comparison with unregulated reaches of the Colorado River and its tributaries indicates that tamarisk recruitment in the Grand Canyon has declined, and that other plant species (especially *Salix exigua*) are replacing tamarisk. I tested four mechanisms relating to the decline of tamarisk recruitment: plant moisture stress, competition with native species, differential herbivore impacts, and alteration of the germination niche. (1) Analysis of plant moisture stress ranges revealed that tamarisk tolerates a wider range of drought and flooding than any native plant species. (2) Experimental analysis of competition between tamarisk and coyote willow significantly reduced tamarisk growth and increased tamarisk mortality. Indirect competition analyses revealed that exploitation of space by existing tamarisk, and tamarisk-altered soil quality limited colonization by other riparian species. (3) Analysis of differential herbivory revealed low levels of invertebrate diversity on tamarisk (three dominant non-native herbivorous insect species) but high levels of secondary productivity, as compared to coyote willow and other native plant species. Invertebrate exclusion experiments revealed no substantial impacts on tamarisk growth; however, beaver (*Castor canadensis*) served as dispersal agents for coyote willow, while beaver and sapsuckers (*Sphyrapicus* spp.) negatively affected tamarisk. (4) I used field analyses and experiments to evaluate tamarisk responses to dam-related riparian soil changes (reduction of silt, moisture-holding capacity, and nutrient concentrations). Tamarisk germination was limited in the coarser soils that characterize the post-dam river corridor.

From these studies, I conclude that riparian succession along the Colorado River in Grand Canyon has advanced from early dominance by tamarisk to present dominance by clonal plant species. Changing vegetation composition results from both flood control (which limits timing and availability of germination habitats), and erratic post-dam flooding (which kills established tamarisk and reduces silt content, water-holding capacity, and soil nutrient availability, further reducing germination success). Biological control of tamarisk could be successful using several invertebrate herbivore species; however riparian Neotropical migrant birds (including the endangered southwestern willow flycatcher, *Empidonax traillii extimus*) nest preferentially in tamarisk in the Grand Canyon, and numerous vertebrates feed on *Opsius stactogalus*, an abundant non-native tamarisk leafhopper. These issues suggest that regional evaluation and planning are warranted before wide-scale biological control measures are adopted.

STROMBERG, J. Center for Environmental Studies, Arizona State University, PO Box 873211, Tempe, AZ 85287-3211. *Causes and consequences of saltcedar spread.*

Saltcedar has been in the western riparian landscape for over a century, but many questions remain about the causes and consequences of its spread. Many authors speculate that the rapid spread of saltcedar during the mid-1900's was a result of river management actions that created site conditions more favorable to saltcedar than to native species. Saltcedar is opportunistic; very tolerant of drought, inundation, salinity, and fire; and overlaps in characteristics between obligate riparian, pioneer trees (cottonwoods and willows) and facultative phreatophyte, seral trees (mesquite). Although present on most Southwest rivers, saltcedar seems to dominate at sites altered by river damming, flow regulation, stream dewatering, floodplain clearing, floodplain agriculture or livestock grazing, and that have favorable climate and soils (infrequent frost, high salt loads). These distribution patterns should be scientifically examined. Cottonwoods and willows have reduced abundance at some, but not all, rivers invaded by saltcedar. Reduced abundance may be due to competition with saltcedar, or to absence of suitable conditions of groundwater depth, soil salinity, flood timing, and other site factors.

Physical site changes attributed to saltcedar spread include stabilization of channels, increased sedimentation rates, accumulation of salts in upper soil layers, increased fire spread, and increased evapotranspiration. Associated biotic changes that have been documented include changes in understory herbaceous cover, compositional shifts to exotic and salt-tolerant plants, and disruption of successional patterns (e.g., reduced formation of mesquite woodlands). The physical and biotic changes seem to be exacerbated on sites with anthropogenic impacts. For example, salt levels under saltcedar stands may accumulate to levels that affect native species only at sites where flushing flood flows have been suppressed. Many studies do not differentiate between effects due to saltcedar and those due to other anthropogenic changes.

The future ecological status of saltcedar in riparian ecosystems depends on how land, water, and vegetation are managed. It is theoretically possible to reduce the dominance of saltcedar relative to native forests by changing water and land management. Cottonwoods and willows would be favored by restoring high magnitude winter floods to regulated rivers; restoring shallow water tables to dewatered rivers; reducing salt loads from agricultural runoff; and excluding livestock. Studies are needed to identify river sites at which management changes alone would restore favorable site conditions for native tree species. Another scenario involves biocontrol of saltcedar without land and water use changes. Depending on site conditions, this might result in “open niches” (no woody species replace saltcedar); replacement by arrowweed or other native species that germinate opportunistically and have wide tolerance for grazing, soil moisture, and salinity; or replacement by cottonwoods and willows. The extent to which saltcedar removal would restore site potential for native trees is equivocal. Detailed site studies can help us to predict the ecological future under the management *status quo*. On the San Pedro River, cottonwoods and willows have been favored over saltcedar in years with above average winter floods and stream water levels. In

the Grand Canyon of the Colorado River, saltcedar stands appear to cede to thicket-forming willows over time. Saltcedar has been present on many rivers for less time than its life span; thus we know little about long-term status of native species at sites invaded by saltcedar.

SWETT, J., P. ARROYAVE, and T. SHRADER. U.S. Bureau of Reclamation, Lower Colorado Region, PO Box 61470, Boulder City, NV 89006. *Extent of saltcedar infestation along the lower Colorado River and its effects on management, especially concerning the southwestern willow flycatcher.*

The lower Colorado River has undergone drastic change over the past century. Historically, annual flooding created a dynamic ecosystem where some riparian areas were eroded away while sediment deposition in other areas allowed for the regeneration of native riparian plant communities. Today, dam construction, channel modification, agricultural clearing, urbanization, fire, increased salinity, lower groundwater tables, and cessation of seasonal flooding has created an ecosystem that favors saltcedar over native plant species.

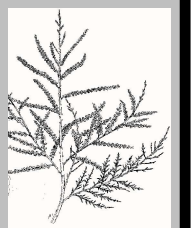
Grinnell (1914) identified five riparian plant communities. The Fremont cottonwood-Goodding willow association was found in areas that underwent annual flooding. Arrowweed communities were found in narrow bands adjacent to the cottonwood-willow type in areas where flooding was not as frequent. Monotypic stands of honey mesquite were present on the next bench where flood waters were much more infrequent. Quailbush and saltbush associations were found in monotypic stands or as clumps within the mesquite community.

Reclamation began mapping the distribution and abundance of riparian and marsh vegetation in 1976. Of the approximately 107,000 acres mapped in 1986, saltcedar comprised more than 45,000 acres. Trends indicate an increase in the amount of saltcedar acreage at the expense of native plant communities.

In 1996, Reclamation began river-wide surveys for southwestern willow flycatcher. The purpose of these surveys is to locate nesting willow flycatchers, evaluate nesting habitat, and evaluate nesting success and productivity. Forty-four territorial pairs were located during the 1996 survey between Davis Dam and the US-Mexico boundary with one confirmed nest found on Havasu National Wildlife Refuge. Twenty-seven percent of these birds were in saltcedar-dominated habitats.

TELLMAN, B. Water Resources Research Center, University of Arizona, Tucson, AZ 85721. *Stowaways and invited guests: How some non-native plant species reached the American Southwest.*

This poster illustrates the means by which nine non-native plant species reached the American Southwest. The nine species discussed include grasses, trees, and forbs. All are problem species in riparian areas or nearby watersheds. All but one has naturalized in the Grand Canyon. The methods of introduction include intentional introductions for landscape, forage, or erosion control and accidental introductions through contaminated seed or packing materials. Introducing entities include individuals and government agencies. A bibliography of plant introduction will be distributed to interested viewers.



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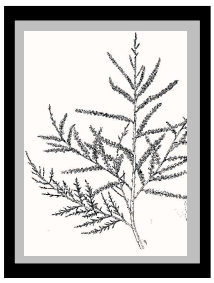

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CONTACTS