The Arizona Riparian Council Newsletter

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SALTCEDAR AND BIOLOGICAL CONTROLS

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Editor's Note: Our annual spring meeting this year will concentrate on saltcedar management and habitat issues. One of the important management issues involving this plant is biological control. The following is an abstract from a World Wide Web page that is currently under construction (http://www.nevada.edu/home/0/schofier/webpages/wkshp.html). The entire paper will be available there when the page is published online.

The invasion since the 1920's by exotic saltcedar (*Tamarix ramosissima*) has caused enormous damage to native plant and animal communities in riparian ecosystems of the western United States. Conventional controls (manual, mechanical, herbicidal, and fire) are expensive, may damage the natural vegetation, and must be applied repeatedly. An analysis of the damage caused by and the beneficial values of saltcedar (both economic and ecological), and natural enemies potentially available for introduction, indicate that biological control has a high potential for success, and without the disadvantages of the other control methods.

Damage by saltcedar includes the displacement of the extremely valuable cottonwood/willow (*Populus* sp./*Salix* sp.), seepwillow baccharis (*Baccharis salicifolia*), and other native plant communities often by monotypic stands of saltcedar. Many wildlife species (especially birds) are unable to utilize saltcedar because its small fruits and seeds, lack of insects, and unpalatable foliage provide little or no food, and its density and structure is unsuitable as cover or for nesting. Also, it uses great amounts of groundwater and lowers water tables, causing springs to dry up and plants to perish. It increases soil salinity and is highly susceptible to fires, both of which kill intolerant cottonwoods and other plants. Several endangered species, especially birds and fishes, are severely impacted and common species are made more rare. Also, it causes sedimentation and narrowing of channels, increases flooding, and interferes with recreational usage.

Saltcedar has only minor beneficial values, mostly as ornamental shrubs and for honeybee pollen and nectar. Some wildlife species utilize it for cover or nesting (especially the white-winged dove, *Zenaida asiatica*) in the absence of their native habitat that saltcedar has displaced, and feed elsewhere or on insects from other nearby plants.

The potential for successful biological control is very high. The taxonomic isolation of *Tamarix* in the Old World has promoted the evolution of many host-specific insects: 26 genera (with over 200 species) are restricted to developing entirely or in major part on the genus *Tamarix*. The taxonomic isolation of saltcedar in the Western Hemisphere (no species of *Tamarix* or of the family Tamaricaceae are native) implies a very small risk that introduced insects might

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Inside This Issue

PRESIDENT'S MESSAGE

I would like to wish everyone a happy, prosperous and productive New Year! It seems every year brings more new and exciting riparian projects to work on. But remember to "stop and smell the desert willow" once in awhile. In fact, the perfect time to do that would be during the field trips at our annual meeting. This year we will be convening along the San Pedro River, at Sierra Vista, on April 11-12. Be sure to mark your calendars. Hope to see you there.

This past October, the Arizona Riparian Council offered a two-day technical workshop in lieu of our regular fall meeting. The workshop was held at Red Rock Center for Environmental Education in Sedona and was well attended. In fact, because we had to limit the number of attendees, a waiting list of over 30 people was compiled. This suggested to us that there is both interest in and need of more technical training in riparian inventory, survey and management methods.

Because this was our first attempt at organizing this type of training, we learned a great deal about what worked and what didn't. I would like to thank the instructors for agreeing to try something new, and for volunteering or discounting their time to us. My deepest appreciation is extended to all those who volunteered their services including Matt Chew, Kelly Fuhrmann, Eric Glomski, Nita Halso, Jeff Inwood, Marty Jakle, Diane Laush, Kris Randall, Valerie Swick, Debra Yazzie, and Cindy Zisner. Your assistance and professionalism was greatly appreciated and helped make the workshop run very smoothly. And finally, I would like to acknowledge the contributions and assistance of the Red Rock State Park staff, especially Barbie Hart and Jon Schreiber. They donated the classroom and rescheduled staff to accomodate us.

I would also like to thank everyone who attended for their patience, and for providing us with evaluations and suggestions for improving future workshops. After reviewing the workshop evaluations, it was clear that we have much work to do before offering another workshop. In fact, I think workshop organizers have been their own harshest critics. Before offering this workshop again, we would like to revamp the curriculum, reorganize the schedule to provide for field exercises, and find alternative locations. Some instructors may not be available for future workshops, so we will also need to locate other individuals interested in teaching these subjects. If you would like to assist with planning and/or organizing the next workshop, or if you know someone who would be a good instructor, please contact Cindy Zisner (965-2490) or me (345-9558).

LETTER TO THE EDITORS

RE: 1996, Vol. 9, No. 3, *Roosevelt Dam and the Southwestern Willow Flycatcher* [*Editor's Note:* A similar version of this letter was published in the *Arizona Republic.*]

FALSE ROOSEVELT LAKE COMPROMISE WILL LEAD TO EXTINCTION OF FLYCATCHER

Just how thirsty is the Phoenix metropolitan area? This question begs a response as controversy rages on over operation of the newly raised Theodore Roosevelt Dam and the impending extinction of the southwestern willow flycatcher. In light of other reasonable alternatives which would truly protect the flycatcher and benefit the Phoenix area, the U.S. Bureau of Reclamation (BOR) must reconsider immediate filling of Roosevelt's new reservoir space.

The southwestern willow flycatcher is going extinct before our very eyes. Obligated to dense riparian vegetation, the species' downward spiral is the result of tremendous habitat losses associated with dam construction, groundwater pumping, and grazing.

Today, fewer than 430 flycatcher pairs remain in Arizona, southern California, and New Mexico. According to the U.S. Fish and Wildlife Service (USFWS), these last pairs contain genetic information which is approaching the absolute minimum needed to ensure species survival. Many flycatcher pairs are widely scattered and are not likely to reproduce. *(Cont page 8....Editor)*

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attack nontarget plants. The somewhat beneficial athel (*Tamarix aphylla*) is distinct from the weedy species and the insects considered for introduction do not damage it.

Our cooperators in France, Israel, Turkmanistan, Kazakhstan, and China have conducted preliminary testing on 21 insect species, including 10 species being tested in quarantine at Temple, Texas. Two of these have been recommended by the Animal and Plant Health Inspection Service (APHIS) Technical Advisory Group for the Introduction of Biological Control Agents of Weeds (TAG) of the U.S. Department of Agriculture APHIS for field release, pending approval of an Environmental Assessment. These species are the mealybug (*Trabutina mannipera*) from Israel and the leaf beetle (*Diorhabda elongata*) that occurs from China to Turkey. Other promising species under study are two other *Trabutina* species; two weevils, *Coniatus* sp. and *Cormalia* sp.; two gall midges, *Psectrosema* spp.; two foliage-feeding moths, *Ornativalva* sp. and *Agdistis* sp.; two psyllids, *Crastina* sp. and *Colposenia* sp.; another leaf beetle (*Cryptocephalus* sp.); and a scale insect, *Adiscodiaspis* sp.

The research protocol and methodologies of biological control of weeds are well understood and strong safeguards are in place to minimize risk to nontarget plants. The 130 years of experience worldwide (729 projects in 51 countries against 94 weed species), in North America (control agents released to control 33 weeds since 1945), and Hawaii (control agents released to control 21 weeds since 1902) have demonstrated a high degree of safety and ca. 33% rate of complete or substantial control to date. The objective of biological control is to reduce the weed below the threshold of important damage; the method has never eradicated a target weed. Attack on nontarget plants has been rare, especially during the past 30 years since strict safeguards have been in place, and such attack has always been of minor importance.

At present, we are preparing a Biological Assessment for consideration by the U.S. Fish and Wildlife Service that evaluates possible impacts on endangered species in southwestern riparian areas that are infested with saltcedar, especially on the southwestern subspecies of the willow flycatcher (*Empidonax traillii extimus*). If an opinion of No Jeopardy is reached, then an Environmental Assessment can be prepared by APHIS, which will satisfy the requirements of the National Environmental Policy Act. If APHIS reaches a Finding of No Significant Impact on the Environmental Assessment, then permits for release can be issued.

Biological control is expected to reduce the abundance of saltcedar by up to 75-85% but will probably require the introduction of several agents over several years. Control at a given site may require 5 to 10 years and control may not be satisfactory in all areas. As saltcedar is controlled, the native vegetation is expected to gradually return, though some areas may already be too saline for any but salt-tolerant species. Ultimately, saltcedar should be reduced to an uncommon (or common), but not an abundant, member of the plant community. The insects introduced to control saltcedar will also potentially provide food for wildlife.

CURRENT RIPARIAN RESEARCH

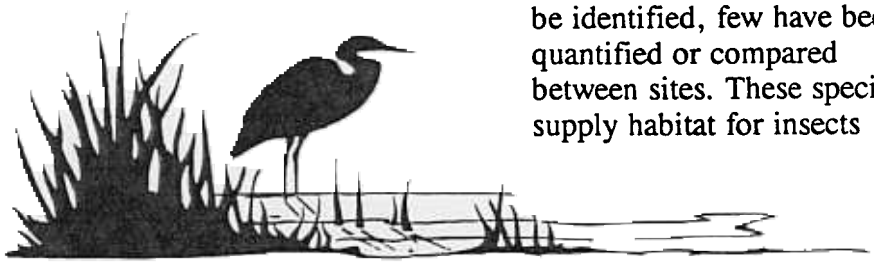
COMPARING HERBACEOUS STREAMSIDE SPECIES FOR EROSION-PREVENTION POTENTIAL

by Caitlin Cornwall, Department of Botany, Arizona State University

Trees and shrubs are the most obvious elements in most riparian landscapes, and most riparian research has focused on the woody component of riparian plant communities. On many streams the original understory layer has been altered, possibly irrevocably, by land-use practices, lowered water tables, reductions in surface water supply, or reductions in fine sediments. These changes have decreased herbaceous plant cover and increased populations of non-native species which are more adapted to current conditions. No wonder the observer's eye passes over the sparse weedy under-layer that is present on many streams, and rests instead on the trees. But it appears that the current dominance of trees and shrubs is an artifact of history, at least on some western streams. Before large numbers of Europeans settled here, many riparian areas were meadow-like or marshy, with expanses of herbaceous vegetation (Hendrickson and Minckley 1984). Herbarium collections in Arizona show that native riparian graminoids were more widespread as recently as the 1920's than currently, especially at lower elevations (Al Medina, USFS Rocky Mountain Forest and Range Experiment Station, Flagstaff, pers. comm.). Even now, on most high-elevation, low-gradient streams and some low-elevation watercourses, herbaceous plants outnumber woody ones. As streams recover from past land uses, herbaceous species may once again increase.

What plants are in this herbaceous category? The native species are primarily graminoids, a group that includes grasses (Poaceae), rushes (Juncaceae), and sedges (Cyperaceae). Many are perennial and have adaptations for growing in water-logged soils. What ecological services do these kinds of plants provide? Considering the national spotlight being shone on riparian areas as cornucopias of biodiversity and workhorses of watershed maintenance, the contributions of herbaceous plants, especially rich assemblages of native riparian species, are under-researched. Although many functions can be identified, few have been quantified or compared between sites. These species supply habitat for insects (Kathy Williams, San Diego State University, pers. comm.) which feed terrestrial and aquatic (Cadwallader et al. 1980) vertebrates; provide nesting areas for waterfowl and forage for grazers; and encourage development of overhanging banks which provide shade and cover for aquatic animals. They may also help maintain a mesic microclimate that improves plant germination and survival (pers. obs.). For my master's thesis, I am focussing on yet another function of herbaceous plants: the prevention of excessive bank erosion.

All alluvial streams feature erosion, a constant process as intrinsic as breathing. However, erosion of streambeds and banks accelerated in the American Southwest starting in the late 1800's (Hendrickson and Minckley 1984), causing decimation of riparian plant communities and dramatic downcutting. Human activities such as livestock grazing, agriculture, tree cutting, road building, and brush control continue to devegetate land and destabilize the soil surface, although at a slower rate. Water erosion of sediment from streambanks, contrasted with erosion of upland sediments, constitutes a large proportion of total watershed sediment loss; rough estimates range from 26% for the U.S. (Van der Leeden et al. 1990) to



50% for large western watersheds (Rosgen 1993). Consequences of excessive streambank erosion include instream turbidity; instability and lateral movement of stream channels; destruction of channel morphologies necessary for aquatic species; loss of property, infrastructure, and land-based income; loss of the riparian buffer against future flooding and against inflows of upland sediments and pollutants; loss of trees, wildlife habitat, and recreational areas; and resuspension of pollutants. Downstream, sediment settles in reservoirs and estuaries, reduces channel capacity, and buries property and natural areas.

There are several mechanisms by which plants lessen streambank erosion. Plants and litter roughen the ground surface, creating friction against flowing water and decreasing its velocity (Boto and Patrick 1979, Brown 1984, Knight and Bottorff 1984) as long as water height is less than shoot height (Temple 1982). Slower flows erode and carry less sediment. Dense plant shoots and litter filter particles from flowing water (Hayes et al. 1984). The plant canopy softens the impact of raindrops and trampling so that soil particles remain attached to the surface, but only when vegetation is less than 0.75-1.0 m tall (Morgan 1985). Plant roots increase soil cohesion (Tengbeh 1989, Waldron and Dakessian 1981), form a physical barrier between water and soil, and cause water to infiltrate the soil instead of running over the surface (Ambasht et al. 1984). It follows that traits that increase plants' effectiveness at stabilizing banks include dense shoots < 1 m tall, a thick thatch of live or dead vegetation to protect the ground surface, and a deep dense network of strong roots to bind the soil.

Despite the negative economic and biotic effects of bank instability and the general agreement on qualities that enable plants to hold streambanks, quantitative research that documents plants' streambank-stabilizing traits is lacking. The sediment retention capabilities of plants have been studied mostly in wetlands, sometimes artificial ones constructed to improve wastewater quality. Abt et al. (1992) and Temple (1982) have measured sediment retention in artificial grass-lined channels. Field observations of streambank erosion prevention by plants have generally focused on trees and shrubs. Root depth and strength, and therefore capacity to hold streambank soil, are often assumed to decline from trees to shrubs to perennial grasses to herbaceous annuals. However, Ziemer (1981) found that some shrubs stabilized slopes as well as trees, Fisher and Minckley (1978) observed that Bermuda grass held streambanks during a flood at least as effectively as trees and large shrubs, and O'Loughlin (1984) concluded that roots $>$2cm had no significant effect on hill-slope stability. The relative contributions to streambank stability of herbaceous versus woody plants remains an important and unaddressed question. My study includes only graminoids. In this group, perennial bunch grasses may be more effective than annual grasses, and sod-forming species may be more effective than bunch grasses (Medina 1995, Hansen et al. 1989, Youngblood 1985).

Vegetation is clearly not the only factor controlling bank stability. Soil texture, grazing intensity, hydrologic events, and anthropogenic disturbances are also important. These variables are often difficult to control or quantify. Therefore, direct comparison of erosion rates between areas with different herbaceous species is problematic. As a proxy, however, it is fairly straightforward to compare accepted streambank-stabilizing traits between species. The traits I am measuring are shoot density and height, above-ground biomass, and root depth, volume, and biomass by depth.

The study is funded by the Arizona Water Protection Fund. My data is from two locations. Drawing data from more than one site allows examination of whether the study's conclusions may be applicable across climates, elevations, and plant communities.

The perennial reach of Ciénega Creek is located in southeastern Arizona, northeast of the town of Sonoita at 4500 ft elevation. The reach lies inside a Bureau of Land Management Resource Conservation Area. Vegetation cover alternates between cottonwood-willow riparian forest and herbaceous marsh. The riparian zone has been grazed inten-

sively historically, but for the last 1 to 3 years has had minimal to no grazing. Substrates grade from very fine to coarse to bedrock from south to north. I am sampling 10 species at Ciénega Creek, including a rush, a spikerush, and native and non-native grasses of various shapes and sizes.

Another set of data comes from two montane meadows. Cattle and elk exclosures have been installed in both meadows by the Rocky Mountain Forest and Range Experiment Station in Flagstaff. Houston Draw is at 7320 ft elevation on the Dane Canyon USGS 7.5-inch topo in Coconino National Forest. The Boggy Creek exclosure is at 7750 ft on the Big Lake South USGS 7.5-inch topo in Apache National Forest. Species from the meadows include a bulrush, a sedge, a grass, and a spikerush.

The measurements of streambank-stabilizing traits come from a 15 cm-diameter random location inside a 1 m^2 plot established in a pure stand of one of the target species. I counted stem number and measured stem lengths in the field, and collected aboveground plant material and soil samples to analyze in the lab. Soil samples for root analysis were collected in four sections, down to 1 m depth whenever possible. Now I am determining dry weights of aboveground biomass and preparing root samples for root length and biomass determinations. Soil texture analysis has also begun.

For each site, I will look for correlations between the measured traits within and across species, comparing traits between species and life-forms (e.g., comparing sod-forming species with bunchgrass), and asking whether these results are consistent for the different sites. I don't have statistical results yet, but the data so far are consistent with common-sense predictions. For example, at Ciénega Creek, deergrass (*Muhlenbergia rigens*), a large bunchgrass, has the deepest roots. The rush (*Juncus mexicanus* and *J. balticus*) and Bermuda grass (*Cynodon dactylon*) have more extensive root systems than knotgrass (*Paspalum distichum*), which in turn has a more extensive root system than rabbit's-foot grass (*Polypogon monspeliensis*). Above ground, *Eleocharis montevidensis* has very high stem densities but the stems are thin and short, and there is almost no litter. It is still unclear how deergrass compares with the rush and Bermuda grass: do the very high stem densities of deergrass compensate for the bare ground between bunches? These are the sorts of comparisons the data will allow.

These are some of Arizona's most common riparian plant species. Data comparing the soil-holding traits of important streambank plants is a contribution to better riparian land management decision-making. The data will be available for future studies on the bank-stabilizing capacity of trees, shrubs, and herbaceous species. Comparisons with other species will be instructive for riparian managers and ecologists, as will any measurements of actual bank erosion rates in the field or artificial channels under varying vegetation types. The results of this study, especially the comparisons of bank-holding potential between native and non-native species, may alert managers of riparian areas to the importance of native streamside perennial graminoids in channel maintenance and watershed-level erosion prevention. The results may also suggest that far-sighted riparian restoration in some locations requires establishment of native graminoid species on streambanks.

If any readers want to talk about the contributions, history, or natural history of riparian graminoids, native or not, I would welcome your feedback or ideas. Contact me at the Center for Environmental Studies at Arizona State University, 965-2975 or xenia@asu.edu.

Literature Cited

Abt, S. R., W. P. Clary, and C. I. Thornton. 1992. Ability of streambed vegetation to entrap fine sediments. Pp. 249-259 *in Interdisciplinary approaches in hydrology and hydrogeology*. American Institute of Hydrology.

Ambasht, R. S., M. P. Singh, and E. Sharma. 1984. Soil, water and nutrient conservation by certain riparian herbs. *Journal of Environmental Management* **18**:99-104.

Boto, K. C. and W. H. Patrick, Jr. 1979. Role of

wetlands in the removal of suspended sediments. Pp. 479-489 *in* P.E. Greeson, J. R. Clark, and J. E. Clark, eds. *Wetland functions and values: the state of our understanding. Proceedings of the National Symposium on Wetlands*. American Water Resources Association, Minneapolis, MN.

Brown, R. G. 1984. Effects of an urban wetland on sediment and nutrient loads in runoff. *Wetlands* **4**:147-158.

Cadwallader, P. L., A. K. Eden, and R. A. Hook. 1980. Role of streamside vegetation as a food source for *Galaxias olidus* Gunther (Pisces: Galaxiidae). *Australian Journal of Marine and Freshwater Resources* **31**:257-262.

Fisher, S. G., and W. L. Minckley. 1978. Chemical characteristics of a desert stream in flash flood. *Journal of Arid Environments* **1**:25-33.

Hansen, P., R. Pfister, J. Joy, D. Svoboda, K. Boggs, L. Myers, S. Chadde, and J. Pierce. 1989. *Classifcation and management of riparian sites in southwestern Montana*. Draft version 2. Montana Riparian Association, School of Forestry, University of Montana, Missoula.

Hayes, J. C., B. J. Barfield, and E. W. Tollner. 1984. Performance of grass filters under laboratory and field conditions. *Transactions of the American Society of Agricultural Engineers* **27**:1321-1331.

Hendrickson, D. A., and W. L. Minckley. 1984. Ciénegas — vanishing climax communities of the American Southwest. *Desert Plants* **6**:131-175.

Knight, A. W., and R. L. Bottorff. 1984. The importance of riparian vegetation to stream ecosystems. Pp. 160-167 *in* R. F. Warner and K. M. Hendrix, eds. *California riparian systems: ecology, conservation, and productive management*. University of California Press, Berkeley, CA.

Medina, A. L., and D. G. Neary. 1995. Geomorphological response of a montane riparian habitat to interactions of ungulates, vegetation, and hydrology. Arizona Riparian Council Ninth Annual Mtg. 12 May 1995. Payson, AZ.

Morgan, R. P. C. 1985. Effect of corn and soybean canopy on soil detachment by rainfall. *Transactions of the American Society of Agricultural Engineers* **28**:1135-1140.

O'Loughlin, C. L. 1984. Effectiveness of introduced forest vegetation for protecting against landslides and erosion in New Zealand's steeplands. Paper at Symposium on *Effects of Forest Land Use on Erosion and Slope Stability*. Honolulu, HI.

Rosgen, D. L. 1993. Overview of the rivers in the West. Pp. 8-15 *in* B. Tellman, H. J. Cortner, M. G. Wallace, L. F. DeBano, and R. H. Hamre, tech. coords. *Riparian management: common threads and shared interests. A western regional conference on river management strategies*. 4-6 February 1993, Albuquerque, NM. US Forest Service Gen. Tech. Rept. RM-226. Fort Collins, CO.

Temple, D. M. 1982. Flow retardance of submerged grass channel linings. *Transactions of the American Society of Agricultural Engineers* **25**:1300-1303.

Tengbeh, G. T. 1989. *The effect of grass cover on bank erosion*. Ph.D. thesis. Silsoe College, Cranfield Institute of Technology, UK.

Van der Leeden, F., F. O. Troise, and D. K. Todd. 1990. *The water encyclopedia*. 2nd ed. Lewis Publishers, Chelsea, MI.

Waldron, L. J., and S. Dakessian. 1981. Soil reinforcement by roots: calculation of increased soil shear resistance from root properties. *Soil Science* **132**:427-435.

Youngblood, A. P., W. G. Padgett, and A. H. Winward. 1985. *Riparian community type classification of eastern Idaho-western Wyoming*. US Forest Service Reg. 4 Ecology 85-01. Intermountain Res. Sta., Ogden, UT.

Ziemer, R. R. 1981. Roots and the stability of forested slopes. Pp. 343-357 *in* T. R. H. Davies and A. J. Pearce, eds. *Symposium on erosion and sediment transport in Pacific Rim steeplands*. Christchurch, New Zealand. Jan 1981. Publ. 132, Internl. Assoc. of Hydro. Scientists, Paris.

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Despite Endangered Species Act recognition, flycatcher habitat and individuals continue to be lost. In Arizona alone, the USFWS has approved the loss of flycatchers at eight locations since the species was listed in early 1995. Fire has also destroyed miles of occupied habitat.

As of 1995, only two relatively large populations remained in Arizona. Disaster struck in June this year [1996] when wildfire completely burned riparian habitat at the larger of the two along the San Pedro River. Through a wrenching process of elimination, Roosevelt Lake now supports the most important flycatcher population in Arizona.

It came as no surprise when the USFWS, in consultation with the BOR and Phoenix area cities, determined that reservoir filling behind the new Roosevelt Dam would jeopardize the flycatcher. Yet biologists and conservationists were shocked when the USFWS allowed the filling to proceed along with a spendy but deficient mitigation plan, all the while ignoring the most obvious reasonable alternatives.

Mitigation recommended by the USFWS is way off the mark. It involves purchase of an 800-acre habitat preserve on the San Pedro River, creation of a trust fund to manage this area for the benefit of the flycatcher; hiring of a biologist to plan for flycatcher recovery and conservation; continuation of flycatcher research; and cowbird trapping. The inadequacy of these plans is obvious even after the most cursory analysis. First, groundwater pumping is killing the San Pedro River. Even if this trend is miraculously reversed, the 2 flycatcher pairs which occupy the newly purchased area hardly make up for the 28 pairs, Arizona's largest population, that will be lost with the filling of Roosevelt Lake. Cowbird trapping in the preserve won't help flycatchers that aren't there. Elsewhere, wide-scale access to private lands is not likely to be granted for cowbird trapping. Near future loss of Roosevelt Lake population, along with the recent loss of the San Pedro River population, will virtually ensure flycatcher extinction, so the idea of hiring a biologist to plan for conservation and recovery is dubious at best. Most significantly, Congress may ax these mitigation funds at any time in years to come. Such was the case last month [September 1996] when Central Arizona Project (CAP) mitigation funds for endangered fish were eliminated during Senate budget negotiations.

Yet this doesn't mean filling of the new reservoir space can never proceed. It must instead be delayed. It is important to note that water to be stored behind the newly raised dam *is not currently needed*. Just the opposite, Phoenix area cities chipped in for the dam to insure a 100-year water supply for growth as required by State law. Other water is readily available should a short-term need arise. For example, Phoenix area cities could put the CAP to full use and take back Arizona's Colorado River water from California.

This and other reasonable alternatives, such as retiring water intensive farmland and using Roosevelt's new reservoir space for short-term flood control, clearly exists which will actually benefit the growth fueled economy of the Phoenix region *and* the flycatcher. Yet these have been tossed aside in favor of some perceived maximum economic gain. Reclamation must therefore suspend filling of the new reservoir until flycatcher population numbers have been stabilized or show signs of increasing. If other USFWS and BOR plans are carried out, this will be possible in the very near future.

Dave Hogan, Desert Rivers Program, Southwest Center for Biological Diversity

THE VALUE OF SALTCEDAR TO NESTING SOUTHWESTERN RIPARIAN BIRDS

by William H. Howe, U.S. Fish and Wildlife Service, Albuquerque, New Mexico

The importance of southwestern native lowland cottonwood (*Populus fremontii*) and willow (primarily *Salix gooddingii*) woodlands in supporting the highest breeding diversity of birds of any habitat in the United States has been well documented over the past 25 years (e.g., Hubbard 1971; Carothers et al. 1974). As an example of this incredible diversity, over 100 species of birds (nearly half of New Mexico's breeding avifauna) have been documented nesting in the gallery cottonwood woodland along the Rio Grande within 50 miles of Albuquerque, New Mexico (Hink and Ohmart 1984; pers. observ.). Unfortunately, the construction of dams along nearly all southwestern rivers has resulted in severe degradation or elimination of most native riparian woodland, both through the loss of flooding events vital to the maintenance of cottonwood and willow habitats, and through the resulting invasions of woody exotic plants such as saltcedar (*Tamarix chinensis*) at lower elevations and Russian-olive (*Elaeagnus angustifolia*) at slightly higher elevations or farther north (see discussions in Knopf et al. 1988, Rosenberg et al. 1991, and Ohmart 1994). Because many species of cottonwood- or willow-dependent species have declined severely, especially from conversion to saltcedar habitats (e.g., yellow-billed cuckoo [*Coccyzus americanus*], Bell's vireo [*Vireo bellii*], summer tanager [*Piranga rubra*], and six other species on the lower Colorado River; Rosenberg et al. 1991), efforts to revegetate areas with native cottonwoods and willows are increasing as is the desire by many to find ways to get rid of the existing saltcedar.

Although saltcedar is an inferior habitat for riparian birds relative to native riparian habitats in most areas (e.g., Anderson et al. 1977; Hunter et al. 1988), these habitats are by no means devoid of nesting riparian birds. Avian use of saltcedar varies by geographic location, elevation, habitat structure, and whether or not the stands are pure or are mixed with native trees or shrubs. There is a gradient in the level of use, ranging from relatively very low on the lower Colorado River to fairly high use on the Pecos River in eastern New Mexico (Hunter et al. 1988; Rosenberg et al. 1991).

This note is a plea for land managers to consider the potential value of the saltcedar habitats themselves before launching into saltcedar removal activities. The relative importance of saltcedar to riparian birds depends largely on whether or not it can be replaced with anything better. Saltcedar is an infinitely preferable habitat for most riparian birds if the alternative is dirt or open brushy fields. Ideally, saltcedar should be replaced by superior habitats like cottonwood or willow woodlands, or extensive mesquite bosques. But if that is unlikely, then you may want to reconsider the perceived value of a clearing operation and be aware that more harm than good may be done to riparian bird populations, despite one's good intentions.

I provide here several examples of the extent of use saltcedar receives by riparian birds during the nesting season as a reminder that saltcedar is not an avifaunal wasteland.

LOWER COLORADO RIVER VALLEY

Saltcedar habitats along this river receive the lowest bird use of any known southwestern river, probably due in part to a lack of thermal protection from the excessively high summer temperatures that would otherwise be ameliorated by cottonwood gallery forests (Hunter 1988). But even there, pure saltcedar stands support decent numbers of verdins (*Auriparus flaviceps*), Lucy's warblers (*Vermivora luciae*), yellow-breasted chats (*Icteria virens*), blue grosbeaks (*Guiraca caerulea*), and Abert's towhees (*Pipilo aberti*). Honey mesquite (*Prosopis glandulosa*) with a dense saltcedar understory ranked second in use (after

(Cont page 11...Birds)

ELEVENTH ANNUAL MEETING OF THE ARIZONA RIPARIAN COUNCIL

The Eleventh Annual Meeting will be held April 11-12, 1997 at the Windemere Resort and Conference Center, 2047 S. Highway 92, Sierra Vista, Arizona. The theme of this year's meeting is *Saltcedar: Friend or Foe?* The meeting will begin with registration at 8-8:30 AM on Friday, April 11. The President's Welcome will be at 8:30 AM and be followed by invited speakers in a morning session with a roundtable discussion. At lunch there will be an update on environmental issues at the Arizona Legislature. The afternoon session will be technical papers. Abstracts are still being accepted so don't forget to send yours in. Our Friday evening dinner will be at the Windemere. Saturday's field trips will include the San Pedro National Riparian Conservation Area and one of the nearby Nature Conservancy preserves to see their current projects.

INTRODUCTION TO ISSUES IN SALTCEDAR MANAGEMENT
What are the issues?
What should be done about them?
What more do we need to know?

USDA SALTCEDAR BIOCONTROL PROGRAM
Why was the program initiated?
What are regulatory and testing procedures required?
What are the monitoring procedures?
What is the current status of the program?

INSECT CONTROL OF INVASIVE PLANTS
How common is control of invasive plants with introduced insect species?
How safe is it? How effective is it?

SALTCEDAR ECOLOGY
History of saltcedar invasion
Its habitat and distribution
Competition with native species
What will replace it if we eradicate it?

IMPACTS TO WILDLIFE
When is saltcedar beneficial to wildlife? Detrimental to wildlife?
Summary of current state of knowledge
Implication of new biocontrol programs

EFFECT OF THE ENDANGERED SPECIES ACT (ESA) ON SALTCEDAR CONTROL
US Fish and Wildlife Service's view of saltcedar with respect to the ESA
Evidence of listed species using saltcedar
Southwestern willow flycatcher
Mitigation implications

The Windemere will hold a block of rooms for us until March 11, 1997. Their rates are: Government rate, single $53, double $61; Nongovernment rate, single $58, double $66. These rates include tax and full privileges (full breakfast, health club, etc.; check with hotel for details). Government employees must show their ID for the government rate. Their toll-free number is 800-825-4656.

Please fill out the enclosed form (one per person, please copy). If there is no form, please call Cindy at (602) 965-2490, fax (602) 965-8087, or e-mail Cindy.Zisner@asu.edu to obtain one.

(Cont from 9...Birds)
Goodding willow) by Bell's vireos, and contained the highest densities of yellow-breasted chats in the valley. Screwbean mesquite (*Prosopis pubescens*) with a dense understory of saltcedar contains absolutely massive numbers of nesting white-winged (*Zenaida asiatica*) and mourning doves (*Z. macroura*) plus some of the other species mentioned above. This information is from Rosenberg et al. (1991).

Middle Rio Grande Valley, New Mexico

In this area, saltcedar savannah is used during the breeding season by good numbers of mourning doves, blue-gray gnatcatchers (*Polioptila caerulea*, the only nesting birds in the valley), northern mockingbirds (*Mimus polyglottos*), crissal thrashers (*Toxostoma dorsale*), black-headed grosbeaks (*Pheucticus melanocephalus*), blue grosbeaks, and lark sparrows (*Chondestes grammacus*). Common yellowthroats (*Geothlypis trichas*), yellow-breasted chats, and blue grosbeaks are fairly common breeders in the dense stands of saltcedar at Bosque del Apache National Wildlife Refuge. At one site, saltcedar in the understory of Goodding willow stands provides adequate stem densities for nesting by species that normally place nests in willow thickets, such as yellow warbler (*Dendroica petechia*), willow flycatcher (*Empidonax traillii*), and possibly Bell's vireo. The above information is from Hink and Ohmart (1984) and personal observations.

Rio Grande Valley near Presidio, Texas

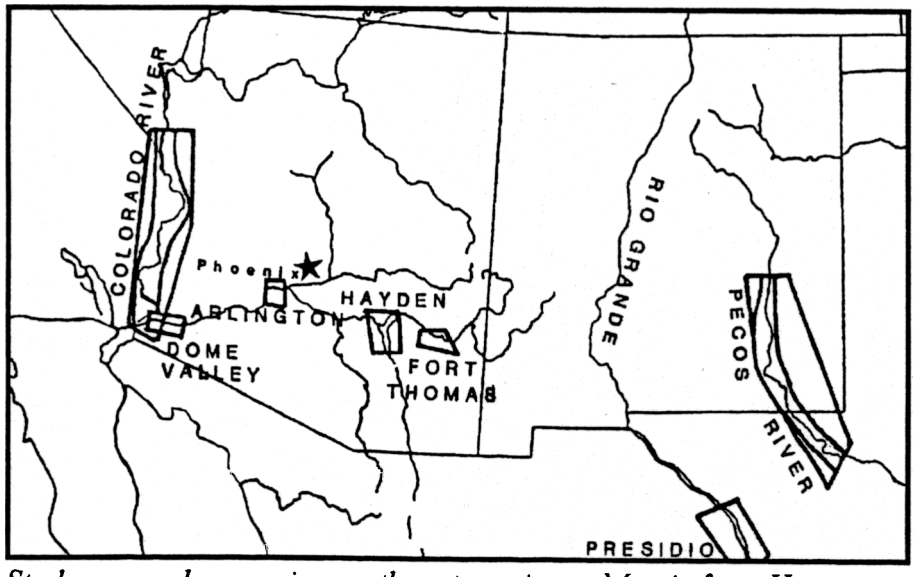
Large numbers of white-winged and mourning doves nest in these pure stands of saltcedar, as do moderate numbers of black-chinned hummingbirds (*Archilochus alexandri*), ash-throated flycatchers (*Myiarchus cinerascens*), verdins, northern mockingbirds, Bell's vireos, Lucy's warblers, common yellowthroats, yellow-breasted chats, summer tanagers, blue grosbeaks, painted buntings (*Passerina ciris*), and orchard orioles (*Icterus spurius*). The above information is from Engel-Wilson and Ohmart (1979).

Lower Pecos River, New Mexico

Saltcedar along this river receives the highest use by birds yet documented. In some cases the avian densities and diversities are close to that found in the (decadent) cottonwood bosques in this stretch. Censuses during the breeding season have found high-to-moderate numbers of ring-necked pheasant (*Phasianus colchicus*), mourning dove, yellow-billed cuckoo, greater roadrunner (*Geococcyx californianus*), northern mockingbird, crissal thrasher, yellow-breasted chat, blue grosbeak, painted bunting, spotted towhee (*Pipilo erythrophthalmus*), and (predictably) brown-headed cowbird (*Molothrus ater*).

Additionally, observations in the above studies have detected fair to moderate use of saltcedar during migration by many species of insectivores, especially in areas where there is little or no other woody riparian vegetation. However, those studies have revealed that saltcedar is little used during winter by birds in any of the river systems relative to other habitats.

Many of the above species are those we normally associate with native cottonwood,



Study areas along major southwestern rivers. Map is from Hunter (1988).

willow, or mesquite woodlands, and several of them are without doubt doing poorly as a result of the widespread loss of those habitats (e.g., yellow-billed cuckoo, willow flycatcher, yellow warbler). However, the number of species of birds that use saltcedar is an impressive subset of those using native riparian habitats, though nearly always in smaller numbers. Important questions as yet unanswered are how breeding success of birds nesting in saltcedar compares with those nesting in cottonwood/willow habitats, whether or not saltcedar is a source or sink habitat, and how either of those may vary geographically or by the size of the vegetation patch.

Given the lack of flooding and high soil salinity levels along most southwestern rivers, our ability to reestablish native cottonwoods and willows either naturally or artificially has been seriously impaired. At many locations saltcedar may be the most productive riparian habitat that can be hoped for under current hydrologic regimes. Although it will never be as valuable for birds as are cottonwood or willow habitats, saltcedar habitats are potentially valuable for a good number of riparian birds, and stands should not be automatically cleared or killed except in those instances where we know that better habitats will result. The above information is from Hildebrandt and Ohmart (1982), Hunter et al. (1988), and personal observation.

LITERATURE CITED

Anderson, B. W., A. E. Higgins, and R. D. Ohmart. 1977. Avian use of saltcedar communities in the lower Colorado River valley. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. RM-43:146-155.

Carothers, S. W., R. R. Johnson, and S. W. Aitchison. 1974. Population structure and social organization of southwestern riparian birds. *American Zoologist* 14:97-108.

Engel-Wilson, R. W., and R. D. Ohmart. 1979. Floral and attendant faunal changes on the lower Rio Grande between Fort Quitman and Presidio, Texas. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. WO-12:139-147.

Hildebrandt, T. D. and R. D. Ohmart. 1982. Biological resource inventory (vegetation and wildlife) - Pecos River Basin, New Mexico and Texas. Final report to U.S. Bureau of Reclamation, Amarillo, Texas.

Hink, V. and R. D. Ohmart. 1984. Middle Rio Grande biological survey final report. U.S. Army Corps of Engineers, Albuquerque, New Mexico.

Hubbard, J.P. 1971. The summer birds of the Gila Valley, New Mexico. *Nemouria* No. 2.

Hunter, W. C. 1988. Dynamics of bird species assemblages along a climatic gradient: a Grinnellian niche approach. Master's Thesis, unpubl., Department of Zoology, Arizona State University, Tempe, Arizona.

Hunter, W. C., R. D. Ohmart, and B. W. Anderson. 1988. Use of exotic saltcedar (*Tamarix chinensis*) in arid riparian systems. *Condor* 90 (1):113-123.

Knopf, F. L., R. R. Johnson, T. Rich, F. B. Samson, and R. C. Szaro. 1988. Conservation of riparian ecosystems in the United States. *Wilson Bulletin* 100(2):272-284.

Ohmart, R. D. 1994. The effects of human-induced changes on the avifauna of western riparian habitats. *Studies in Avian Biology* No. 15:273-285.

Rosenberg, K. V., R. D. Ohmart, W.C. Hunter, and B. W. Anderson. 1991. *Birds of the Lower Colorado River Valley*. University of Arizona Press, Tucson, Arizona.



SPECIES PROFILE



SALTCEDAR AND ATHEL TAMARISK

by Donald J. Pinkava, Department of Botany, Arizona State University

There are 54 species (Baum 1967) of *Tamarix* L. (Tamaricaceae) native to desert, semi-desert and steppe areas of Europe, Asia, the Middle East, northern Africa (coastal landscapes) but even in mountains to 1,200-2,100 (-2800) m altitude; disjunct in Canary Islands and South Africa (Gorschkova 1949, Baum 1967). Representatives are utilized as fine ornamental plants; for afforestation, particularly on sands and saline/alkaline soils; as honey plants; as a dense hard wood suitable for the lathe; as tanning material; and medicinally for rheumatism, hemorrhage and ailing spleen (Gorschkova 1949).

Tamarix L. are much branched trees or shrubs.The branches are fine, lace-like or cedar-like with alternate, scale-like leaves that are 1-7 mm long, crowded, sessile and clasping part way around stem or the base ensheathing the stem. These branches also bear salt-secreting glands. Inflorescence of simple or compound racemes or panicles. Flowers perfect, 1.5-3 (-5) mm in diameter, bracteate; calyx 0.5-2.5 mm long, coriaceous or fleshy, usually deeply four-five-parted, the lobes ovate to lanceolate to suborbicular, acute to obtuse; petals 1.3-5 mm long, usually four-five, persistent or deciduous, ovate to oblong to elliptic, dull white or rose to lavender, rarely scarlet or red, commonly inequilateral, the apices obtuse to emarginate, erect or spreading; stamens usually four-five, distinct, the filaments slender to basally enlarged, attached to sub-ovarian disk; pistil one, apically oblong-elliptic, conic or bottle-shaped; styles three-four, much shorter than the ovary, capitate. Fruit a capsule, 3-5-seeded, pyramidal with three valves dehiscing to base. Seeds 0.5-0.7 mm long, narrowly obovoid, ±compressed, comose with white hairs.

About six to eight species are introduced to North America as cultivars. Some have become aggressive weedy shrubs in wetlands. Earliest introductions, apparently for horticulture and documented by garden catalogs and/or herbarium specimens are detailed by Horton (1964). There are two species of note in Arizona, though others have been reported. Athel, *Tamarix aphylla* (L.) Karsten, forms a tree up to 12 m tall and has rounded sepals and leaves that are basally ensheathing the stem, abruptly pointed and not overlapping. It is planted for windbreaks, shade, and ornament; it rarely reseeds itself. The other, a deciduous shrub species (*Tamarix chinensis* Loureiro or a cluster of species) growing to 6+m tall has overtaken wetlands to the extent that it reseeds itself and forms its own habitat which virtually excludes all other species over extensive areas.

The taxonomy of this species group is complex and needs much study. A cursory review indicates that *T. chinensis* probably includes *T. ramosissima* Ledebour as described for North American material (see also Wilken 1993), with intermediates known (Baum 1967). They differ (Baum 1967) by the latter having denticulate sepals (vs ± entire) petals obovate (vs elliptic to ovate), all flowers with all five filaments inserted beneath disk and between its lobes (vs only 3-4 and only on just flowers borne on green branches). Also, *Tamarix parviflora* DC. has been reported for Arizona but it has 4-merous flowers, occasionally with more than four filaments, all of them as extensions of the lobes of the disk.

Salt is secreted from specialized glands on the surfaces of leaves and branchlets of Saltcedar, a name first applied for Tamarisk by J. J. Thornber in the early 1900's (Horton 1964). Campbell and Strong (1964) describes the salt glands as distinct eight-celled structures derived from a single protoderm cell that divides

vertically into two, each dividing horizontally into two adjacent of four cells. Usually the glands occur in pits but sometimes rise above the surface and are bounded by cuticle and thick-walled epidermal cells, thus differing from only the two guard cells of the stomate with thin surrounding walls.

Thomson et al. (1969) conclude that the major pathway of salt movement into and within the gland is probably through plasmodesmata, tiny connections of cytoplasts through the cell walls of adjacent cells. The salts accumulate in the microvacuoles which move salts to pores at apex of gland and are secreted externally. There is no connection between the gland and the vascular system.

Tamarisks are phreatophytes with roots connecting to subsurface water. Seeds are produced over the long flowering season. The seeds are small and are dispersed by wind and water. Horton et al. (1960) report that the seeds are viable for only a few weeks. Fresh seeds germinate in less than 24 hours on water or saturated soils. Seedlings grow slowly, depend on saturated soils, especially during the first 2-4 weeks of growth. One way of controlling the spread of tamarisk may depend upon reducing or preventing survival of seedlings.

LITERATURE CITED

Baum, B. R. 1967. Introduced and naturalized Tamarisks in the United States and Canada [Tamaricaceae]. *Baileya* 15: 19-25.

Campbell, C. J., and J. E. Strong. 1964. Salt gland anatomy in *Tamarix pentandra* (Tamaricaceae). *Southwestern Naturalist* 9:232-238.

Gosrschkova, S. G. 1957. Salt Cedars (*Tamarix*, Tamaricaceae) of the Soviet Union. Translation and commentary by L. H. Shinners. *Southwestern Naturalist* 2:48-73.

Horton, J. S. 1964. *Notes on the introduction of deciduous Tamarisk.* USDA, Forest Service Research Note RM-16:1-7.

Horton, J. S., and J. H. Flood. 1962. Taxonomic notes on *Tamarix pentandra* in Arizona. *Southwestern Naturalist* 7:23-28.

Horton, J. S., F. C. Mounts, and J. M. Kraft. 1960. *Seed germination and seedling establishment of phreatophyte species*. Rocky Mountain Forest and Range Experiment Station Paper No. 48:1-26.

Thomson, W. W., W. L. Berry and L. L. Liu. 1969. Localization and secretion of salt by salt glands of *Tamarix aphylla*. *Proceedings of the National Academy Sciences* 63: 310-317.

Wilken, D. H. 1993. Tamaricaceae, Tamarisk family. Page 1080 *in* J. C. Hickman (ed.), *The Jepson Manual, Higher Plants of California*. University of California Press, Berkeley.

GLOSSARY

Apically - At the pointed end; at the tip.

Bracteate - Having bracts which are reduced or modified leaves.

Calyx - The outer envelope of a flower, usually green and of firmer texture than the corolla.

Capitate - Headlike.

Comose - Having a tuft of hairs.

Coriaceous - Leathery, thick, and tough.

Corolla - The inner floral envelope, when different from the calyx in texture and color.

Corymb - a flat-topped or convex open inflorescence, with flowers opening successively toward the center.

Denticulate - Very small teeth.

Emarginate - Notched, usually at the tip.

Filaments - The stalk of an anther, which is the enlarged pollen-containing part of a stamen or male part of the flower.

Gynecium - The pistil or pistils collectively.

Inflorescence - The flowers collectively when not solitary.

Lanceolate - Narrow and tapering to the tip, broadest below the middle.

Meristem - the growing point or area of rapidly dividing cells at the tip of a stem, root, or branch.

Obovoid - Inversely egg-shapped.

Ovate - Flat but having the outline of an egg, being broadest below the middle.

Panicle - A compound inflorescence compased of several racemes, corymbs, etc.

Pedicel - The stalk of a single flower.

Petiole - The foot stalk of a leaf.

Pistil - Female part of the flower, comprising the ovary, style when present, and stigma.

Protoderm cell - The outer layer of the meristem, from which the epidermis is formed.

Raceme - An unbranched, indeterminate, more or less elongate inflorescence with pedicelled flowers.

Sepal - One of the segments of the calyx or outer envelope of a flower.

Sessile - Not stalked, without a petiole, pedicel, or stipe.

Stigma - The apical part of the pistil on which the pollen is deposited and germinates.

Stipe - In ferns, the stalk of a frond; the stalk of a pistil or gynecium; the stalk of an anther cell.

Style - The portion of the pistil, above the ovary, that supports the stigma.

Suborbicular - Somewhat flat and of circular outline.

LEGAL ISSUES OF CONCERN

Chris Vamos and David Nelson, Law Offices of Kane Jorden von Oppenfeld Bischoff & Biskind, P.L.C.

ARIZONA'S SOIL REMEDIATION AND GROUND WATER CLEANUP TASK FORCES

The Arizona Legislature enacted major revisions to the Arizona Water Quality Assurance Revolving Fund (WQARF) program during the 1996 session. The Fund is Arizona's Superfund program and authorizes the Arizona Department of Environmental Quality (ADEQ) to force responsible parties to clean up waste sites that threaten waters of the State, or alternatively, allows ADEQ to conduct the remedial actions and recover costs from the responsible parties. With the creation of the soil remediation actions and recover costs from the responsible parties. With the creation of the Soil Remediation and Ground Water Cleanup Task Forces, the Legislature hopes to reform the current WQARF program into a more streamlined, efficient, and cost-effective program that will result in more expedient and protective cleanups.

SOIL REMEDIATION TASK FORCE

The Soil Remediation Task Force was created to establish the minimum concentration levels of harmful substances that may remain in soil following environmental cleanups. In recent years, various soil remediation programs administered by ADEQ utilized different remediation standards and, according to ADEQ, the resulting array of standards caused delayed remediations, unpredictable outcomes, inconsistent results, and a general lack of voluntary remediations. The Arizona Legislature responded to ADEQ's concerns by enacting a requirement that uniform standards be adopted that will be applicable to all soil remediations overseen by ADEQ, including those conducted under Arizona's WQARF program.

The soil remediation standards are to be developed based on recommendations from the Soil Remediation Task Force. The final standards must establish predetermined risk-based remediation levels for various pollutants, as well as guidance on methods for calculating levels that are custom-tailored to particular sites based on the risk to human health. Separate predetermined levels for each pollutant must be established for residential and nonresidential property. The requirements applicable to residential property are to be more stringent to account for the increased human contact with soil that may be expected where people live, especially children. If soil is remediated to meet the less stringent nonresidential standards, the property owner must file with the county recorder a use restriction limiting the property to nonresidential use. If the property is later meant for residential use, the owner must first remediate to the stricter residential standards before changing the property's use.

At a meeting of the Soil Remediation Task Force held on September 30, 1996, ADEQ Director Russell Rhoades announced that after review of the interim Health Based Guidance Levels (HBGLs) recommended by the Task Force, he was proposing to replace the Task Force's recommendations with different standards based on the narrowly accepted Environmental Protection Agency (EPA) Region IX cleanup standards. (Region IX of the EPA has jurisdiction over Arizona, California, Nevada, and Hawaii.) Unlike the HBGLs, the Region IX standards take into consideration an "inhalation pathway," which would come from the volatilization of soil contaminants. Additionally, the standards are based on an excess cancer risk factor for known carcinogens of 10^{-6}, which is more protective than the HBGL's level of 10^{-5} for certain carcinogens.

The practical effect of Director Rhoades' proposal is that some soil cleanup levels recommended by the Task Force will increase and some levels will fall. For example, the interim residential HBGL recommended by the Task Force for benzene is 47.00 mg/L. Using the EPA Region IX levels, benzene must be remediated to a level of 0.62 mg/L. This would be expected from the inclusion of the air pathway for the highly volatile characteristics of benzene. However, using the EPA Region IX methodology, the volatile organic PCE will not have to be remediated as extensively as the Task Force recommended. The interim residential HBGL for PCE is 27.00 mg/L. Region IX proposes a cleanup level of only 53.00 mg/L due to the likelihood that PCE will adsorb to soil particles and not enter the air pathway.

Currently, the Task Force recommended HBGLs are still in effect and Director Rhoades' proposal should not be relied on for remediation levels. The Arizona Legislature mandated a final rule from ADEQ by August 1, 1997.

GROUND WATER CLEANUP TASK FORCE

As enacted in 1986, WQARF held responsible parties "jointly and severally liable" for remedial action costs. This meant that ADEQ could

hold one or a few parties responsible for the *entire* cost of cleanup. The burden would shift to those named parties, rather than ADEQ, to seek contribution for cleanup costs from other potentially responsible parties. Oftentimes joint liability would cause the named parties to be responsible for "orphan share liability," which is that liability attributable to insolvent parties or responsible parties that cannot be located.

A major change to the WQARF program this year was the rescinding of joint liability until July 31, 1997. The Ground Water Cleanup Task Force was created in part to investigate how to restructure WQARF without the need for joint liability. Additionally, the Task Force will be examining issues such as mechanisms to increase public participation in remediation activities, obtaining dedicated funding for the WQARF program, and prioritizing sites for cleanup. The findings and recommendations of the Task Force should be presented to the State Legislature.

The mandated deadlines for both the final soil remediation standards and the suspension of joint liability are just around the corner. The State Legislature and ADEQ still have much work ahead of them to achieve the goal of a more workable cleanup program. For more information, contact Rolf von Oppenfeld or the authors at (602) 955-9200.

AWPF Commission Shells Out $5.4 Million

The Arizona Water Protection Fund (AWPF) recently selected 29 of 70 projects for funding for the 1996 funding cycle. The 70 AWPF application funding requests exceeded $14.2 million. Funding requests for the 29 selected projects totaled $5,428,422. The Tres Rio-River Management and Constructed Wetlands Project, City of Phoenix, received the largest individual grant of $1,000,000 from the AWPF. The projected total funding amount for the Tres Rio Project is $5,000,000.

Four projects from the Research category were selected for funding from the 16 research grant applications received by the AWPF Commission. The selected research projects funding totaled $254,255 or approximately 4.7% of the overall grant funding. The remaining 25 projects that were funded were selected from the Water Acquisition, Capital Projects, and Other category. A total of $5,174,167 was committed to projects within this category. No projects were selected from the Water Conservation category.

Third Annual Educator's Institute to be Held at Hassayampa River Preserve

The Arizona Nature Conservancy's Hassayampa River Preserve, through the generosity of the Environmental Protection Agency, is offering a two-day REEP Educator's Institute on Riparian Ecology. (REEP is the acronym for Riparian Ecology Education Program.) This third annual Institute is designed to help teachers of all levels and subject areas gain a greater understanding of one of Arizona's most unique and beautiful ecosystems. Hands-on and "feet-in" activities will be conducted at the Preserve to train educators in techniques to teach riparian ecology to their students.

Participants will explore the significance of biodiversity and the relationships between the many species found in riparian areas. They will also participate in a problem-solving exercise based on real-life management issues. The Institute is scheduled for March 1 (8:30A-5:30P) and March 2 (8:30A-2:30P). All attendees will receive a copy of the Preserve's REEP curriculum for use in their classrooms. Space is limited to 20 participants. The registration fee of $25 includes lunch for both days.

For information or to register, call Carol Weeks, Interpretive Services Coordinator at (520) 684-2772 or write to her at Hassayampa River Preserve, PO Box 3290, Wickenburg, AZ 85228.

NOTEWORTHY PUBLICATIONS

by Ron Tiller

Anderson, B.W. 1996. Salt cedar, revegetation and riparian ecosystems in the Southwest. Pages 32-42 *in* J.E. Lovich, J. Randall, and M.D. Kelly (eds.). *Proceedings of the California Exotic Pest Plant Control Council, Symposium '95.*

This paper provides soil data indicating that saltcedar is widespread in arid land river systems because it is better adapted than native species to the suite of abiotic factors currently found in many river systems. It provides evidence that saltcedar removal followed by revegetation with native tree species is often not and cannot be expected to be successful because the balance of autecological variables now favor saltcedar over native species. Accordingly, revegetation efforts can be expected to have lower wildlife use values than the stands of saltcedar they replace, unless careful consideration is given to this possibility. The author states that where revegetation sites are prudently selected on the basis of autecological factors present, native species can be successfully reintroduced and that habitats resulting from these efforts can be better than saltcedar as wildlife habitat. *[Proceedings from this meeting can be obtained by sending $10 to CalEPPC '95 Proceedings, P.O. Box 15575, Sacramento, CA 95852-0575.]*

Stromberg, J.C., R. Tiller, and B. Richter. 1996. Effects of groundwater decline on riparian vegetation of semiarid regions: The San Pedro, Arizona. *Ecological Applications* 6(1):113-131.

This paper demonstrates the important role of shallow groundwater in structuring the San Pedro River plant community, portions of which function as reference areas for a globally rare forest type (Sonoran riparian *Populus-Salix* forests). Several ecological indicators varied with depth to groundwater, including a weighted average wetland indicator score calculated for herbaceous and woody plant species, cover of plants within wetland indicator groups, and frequency of indicator plant species. The authors propose that these relationships can be used in a space-for-time substitution to predict consequences of groundwater decline.

Collier, M., R.H. Webb, and J.C. Schmidt. 1996. Dams and Rivers: Primer on the Downstream Effects of Dams. U.S. Geological Survey. Circular 1126. Tucson, Arizona. 89 p.

This circular explores the emerging scientific arena of change in rivers below dams. This science tries to understand and then anticipate changes to river beds and banks, and to riparian habitats and animal communities. The authors illustrate that these downstream changes can be influenced by specific changes of dam management. This circular first looks at a free-flowing river, the upper Salt River of Arizona, and its natural cycles of flow and sedimentation. It then examines six regulated rivers: the Snake, Rio Grande, Chattahoochee, Platte, Green and Colorado. Each of these rivers highlights a particular downstream effect. This document closes with a discussion on the role of science in managing dams. *[Copies of this report can be obtained free of charge from the U.S. Geological Survey, Branch Information Services, Box 25286, Denver, CO 80225.]*

Ellis, L. M., M. C. Molles, Jr., and C. S. Crawford. 1996. *Seasonal flooding and riparian forest restoration in the middle Rio Grande Valley.* Final Report to U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, New Mexico. 53 p.

Water management and flow regulation along the middle Rio Grande during this century has decoupled the linkage between the floodplain and the river and has resulted in

extensive changes in the riparian forest ecosystem. The elimination of flooding has disrupted the functional integrity of these disconnected forests and has contributed to the decline of the Rio Grande Valley cottonwood. This study suggests that reestablishing a regime of seasonal flooding in the cottonwood forest, known locally as the bosque, lining the middle Rio Grande will initiate a reorganization phase of restoration characterized by distinct changes in biological populations and ecological processes. Three years of experimental, seasonal flooding at the Bosque del Apache National Wildlife Refuge in central New Mexico increased leaf and wood decomposition, growth of mature cottonwood trees, and populations of soil bacteria and fungi, and also initiated a restructuring of surface-active arthropod populations. Groundwater chemistry changes suggested that overland flooding began to decrease the accumulation of carbon on the forest floor by saturating organic litter; concurrently, ammonium-rich water was made available for soil microflora and sorptive processes in this previously nitrogen-limited system. Comparisons with a naturally-flooded bosque provided estimates of steady-state conditions within the riparian forest. Data from this site suggest that long-term annual flooding significantly decreases the accumulation of wood and leaf litter on the forest floor. Based on the results of these studies, the authors conclude by making several recommendations for restoring the middle Rio Grande riparian ecosystem.

VOLUNTEER CORNER

If this newsletter reaches you in time, a group of individuals is very interested in cleaning up Velkol Wash near Maricopa, Arizona. The cleanup day is scheduled for Saturday, February 15, 1997. Assemble at 9 AM in the RV parking lot of the Ak Chin Casino about 3 miles south of the town of Maricopa. Training of pickup crews and materials will be provided.

We can always use volunteers to help at the meetings and workshops. Volunteers are also needed to help exhibit our booth at educational fairs. Please contact Cindy and she'll put you in touch with the proper committee chair.

A possible cleanup and restoration project is being worked on with the Arizona Department of Transportation in the Tempe/Phoenix area. If you'd like to know more or volunteer to help please contact Kris Randall or Cindy Zisner or talk to us at the spring meeting.

The Arizona Riparian Council (ARC) was formed in 1986 as a result of the increasing concern over the alarming rate of loss of Arizona's riparian areas. It is estimated that <10% of Arizona's original riparian acreage remains in its natural form. These habitats are considered Arizona's most rare natural communities.

The purpose of the Council is to provide for the exchange of information on the status protection, and management of riparian systems in Arizona. The term "riparian" is intended to include vegetation, habitats, or ecosystems that are associated with bodies of water (streams or lakes) or are dependent on the existence of perennial or ephemeral surface or subsurface water drainage. Any person or organization interested in the management, protection, or scientific study of riparian systems, or some related phase of riparian conservation is eligible for membership. Annual dues (January-December) are $15. Additional contributions are gratefully accepted.

This newsletter is published three times a year to communicate current events, issues, problems, and progress involving riparian systems, to inform members about Council business, and to provide a forum for you to express your views or news about riparian topics. The next issue will be mailed in May with the deadline for submittal of articles April 15, 1997. Please call or write with suggestions, publications for review, announcements, articles, and/or illustrations.

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CALENDAR

Educator's Institute on Riparian Ecology, March 1-2, 1997, Hassayampa River Preserve, Wickenburg, Arizona. See information inside page 16. Contact Carol Weeks for more information (520) 684-2772.

Eleventh Annual Arizona Riparian Council Meeting, April 11-12, 1997, Windemere Resort and Conference Center, Sierra Vista, Arizona. See information inside page 11. Contact Cindy Zisner for registration information (602) 965-2490.

The Soil and Waster Conservation Society Conference: Cover Crops, Soil Quality, and Ecosystems, March 12-14, 1997, Sacramento. California. Contact Nacny Herselius, SWCS, 7515 NE Ankeny Rd, Ankeny, Iowa 50021-9764; (515) 289-2331 X18 or (800) 843-7645 X18.

Fifth National Watershed Conference. May 18-20, 1997, Nugget Hotel, Reno, Nevada. Contact John Peterson, National Watershed Coalition, 9304 Lundy Court, Burke, Virginia 22015-3431, (703) 455-4387.

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