

**FIFTH ANNUAL MEETING
OF THE
ARIZONA RIPARIAN COUNCIL
TUCSON, ARIZONA
2-3 NOVEMBER 1990**



**PROGRAM AND ABSTRACTS
1990**

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TUCSON HILTON-EAST
7600 E. BROADWAY
TUCSON, ARIZONA**

Friday, November 2, 1990

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| 8:00-9:30 AM | Registration |
| 9:30-9:45 | Welcome and Introduction—Andy Laurenzi, President, Arizona Riparian Council |
| 9:45-10:15 | Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP)—Bill Kepner, Environmental Protection Agency, Las Vegas, NV |
| 10:15-10:45 | Arizona Department of Environmental Quality's Nonpoint Source Demonstration Projects Program—Carol Russell, Arizona Department of Environmental Quality, Phoenix, AZ |
| 10:45-11:00 | BREAK |
| 11:00-11:30 | The Governor's Riparian Habitat Task Force—Bruce Taubert, Arizona Game and Fish Department, Phoenix, AZ |
| 11:30-12:00 | Environmental Protection Agency's Advance Identification Program (ADID)—Mary Butterwick, Environmental Protection Agency, Region XI, San Francisco, CA |

- 12:00-1:30 LUNCH
- 1:30-1:40 Effluent-Dominated Waters and Riparian Habitats: A General Overview—Andy Laurenzi, President, Arizona Riparian Council
- 1:40-2:00 A Preliminary Survey of the Issues Surrounding Arizona's Effluent-Dominated Riparian Areas—Barbara Tellman, The Water Resources Research Center, University of Arizona, Tucson, AZ
- 2:00-2:20 An Update of the Environmental Protection Agency's Draft Policy on Effluent-Dominated Waters and Other Related Topics—Maria Rea, Environmental Protection Agency, Region XI, San Francisco, CA
- 2:20-2:40 An Update of Arizona Department of Environmental Quality's Triennial Review of Surface Water Quality Standards and the Possible Effects to Riparian Habitats Supported by Effluent—Bill Wiley, Arizona Department of Environmental Quality, Phoenix, AZ
- 2:40-3:00 Effluent-Dominated Waters and Riparian Habitats: A Regulated Community Perspective—Hugh Hulob, Attorney at Law, Tucson, AZ
- 3:00-3:20 Effluent-Dominated Waters and Riparian Habitats: A Public Interest Perspective—David Baron, Center for Law in the Public Interest, Tucson, AZ
- 3:20-3:45 BREAK
- 3:45-4:15 Panel Discussion of Dominated Waters and Riparian Habitats—Andy Laurenzi, Barbara Tellman, Maria Rea, Bill Wiley, Hugh Hulob, and David Baron

- 4:15-5:00 Business Meeting
- 5:30-7:00 Mixer poolside ---- No-host bar available
- 5:30-6:15 Optional forum in main meeting room: Jurisdictional delineation of U.S. waters, wetlands, and riparian areas — Carol Russell, Chairperson Arizona Riparian Council Classification and Inventory Committee
- 7:00 PM Buffet Dinner in Salon C
- Saturday, November 3, 1990
- 8:30-8:45 AM Canyon Creek Habitat Restoration—An Update—Tom McMahon and Jim Warnecke
- 8:45-9:00 Use of the Floodplain Relief Curve in Riparian Ecology Studies—Brian D. Richter
- 9:00-9:15 Riparian Plant Diversity in Grand Canyon: Stress, Catastrophe, and Adaptation—Lawrence E. Stevens
- 9:15-9:30 Hydrology and Plant Relations in Canelo Hills Cienega, an Emergent Wetland in Southeastern Arizona—Judith C. Davis and D. Phillip Guertin
- 9:30-9:45 Lost Perennial Habitats of the Southeastern Sierritas: Geology, Hydraulic Change and the 1887 Earthquake—Jeff Zauderer
- 9:45-10:00 The Effects of Fire on Water Relations in a *Salix-Tamarix*-Dominated Plant Community—David E. Busch and Stanley D. Smith

- 10:00-10:15 Effects of Groundwater Withdrawal on Velvet Mesquite (*Prosopis velutina*) in Tanque Verde Creek—Julie C. Stromberg, James A. Tress, and Scott D. Wilkins
- 10:15-10:30 Augmenting Flood Frequency Estimates Using Flood-Scarred Trees—V. Alexander S. McCord
- 10:30-11:00 BREAK
- 11:00-11:15 Riparian Habitat Preservation Techniques in Pima County—Julie Fonseca
- 11:15-11:30 Cottonwood Pole Production—Bruce Munda
- 11:30-11:45 Status of the Dude Fire Rehabilitation Efforts and Riparian Regeneration—Robert S. Ingram and Don A. Pollock
- 11:45-12:00 Riparian Habitat Degradation on the Bill Williams River—Jay K. Banta
- 12:00-12:15 Preliminary Report On Evaluation of Riparian Enhancement Projects in Region 3, U.S. Forest Service—Russell Lafayette and John N. Rinne
- 12:15-12:30 Sawmill Canyon Riparian Enhancement Project—Mike Hill
- 12:30-12:45 Ethnoecology and Riparian Habitats—Al Bammann, Darrell Sanders, and Mike McQueen
- 12:45-1:00 An Evaluation of Riparian Revegetation Projects in Arizona—Mark K. Briggs
- 1:00-1:15 Importance of Xeroriparian Ecosystems at Organ Pipe Cactus National Monument—R. Roy Johnson, P. S. Bennett, and M. R. Kunzmann

POSTERS

Posters will be located near the main meeting room. Individuals will be available to discuss their posters a short period before and after paper sessions and during breaks.

BOGGS, J., C. OLSON, M. LOWRY, M. LONGSWORTH, R. WILLIAMS, J. CLAYTON, E. SWANSON, and F. WOODWICK. Arizona Department of Environmental Quality and University of Arizona, Tucson, AZ. Aquatic macroinvertebrates as biological indicators of water pollution in Arizona.

PETERS, G. Friends of Arizona Rivers for Arizona Rivers Coalition. Wild and scenic rivers in Arizona.

RANDALL, K. E., and D. T. PATTEN. Center for Environmental Studies, Arizona State University, Tempe, AZ 85287-1201. Development of a revegetation plan for a desert riparian area in Arizona.

THORNBURG, T. Arizona State Parks, Phoenix, AZ. Arizona Rivers Assessment.

BAMMANN, A., D. SANDERS, and M. McQUEEN. Safford District, Bureau of Land Management, 425 E. 4th Street, Safford, AZ 85546. Ethnoecology and riparian habitats.

For the past 13,000 years riparian areas have been the focal point of human activities in southeastern Arizona. Current and better knowledge of past impacts are crucial to understanding present ecological conditions. The Safford District, Bureau of Land Management, has begun to use the anthropological discipline of "ETHNOECOLOGY" to systematically collect information on historic human uses of important riparian areas. We have expanded the traditional use of this discipline into a method for organizing information and assessing the ecological impacts of historic use patterns on the development of riparian plant communities. Knowledge gained through this process will be used to guide future management decisions to attain desired riparian habitat conditions.

BANTA, J. U.S. Fish and Wildlife Service, Havasu National Wildlife Refuge, Parker, AZ 85344. Riparian habitat degradation on the Bill Williams River.

The Bill Williams Unit of Havasu National Wildlife Refuge preserves the largest remnant of riparian habitat on the lower Colorado River. This Refuge Unit provides habitat that is critical for a number of sensitive species. In the last decade several factors have caused the quality of this habitat to decline. In the early 1980s, extensive flooding, due to excessive releases at Alamo Dam, caused widespread cottonwood and willow mortality. During the last two years, releases have been inadequate for riparian maintenance causing substantial losses of native vegetation species. Groundwater removals immediately adjacent to the Unit have further reduced flows. Major wildfires during those two years, the intensity of which was exacerbated by the lack of streamflow and saltcedar invasion, have further reduced the value of native cover and increased the rate of saltcedar encroachment. Ensuring that this key habitat maintains the historical biodiversity will require establishment of a more controlled and dependable streamflow.

POSTER

BOGGS, J., C. OLSON, M. LOWRY, M. LONGSWORTH, R. WILLIAMS, J. CLAYTON, E. SWANSON, and F. WOODWICK. Arizona Department of Environmental Quality and University of Arizona, Tucson, AZ. Aquatic macroinvertebrates as biological indicators of water pollution in Arizona.

The Arizona Department of Environmental Quality and the University of Arizona are cooperatively studying the utilization of aquatic macroinvertebrates in the assessment of surface water quality for the Verde and Santa Cruz Rivers. A semi-quantitative method (U.S. Environmental Protection Agency [EPA] Rapid Bioassessment Protocols) is being applied to data collected from these streams. Aquatic communities from Verde River collection sites appeared somewhat similar, whereas those sampled from the Santa Cruz River demonstrated lower diversities (family level) in the effluent-dominated sites than the control site. Species typically tolerant of low dissolved oxygen and mediocre habitat (Chironominae) dominated the fauna at effluent-dominated sites. The data, while providing valuable aquatic community ecology information, will be useful for the implementation of programs consistent with the U.S. EPA guidelines for biological standards and monitoring mandated by the 1987 Clean Water Act.

BRIGGS, M. K. University of Arizona, Tucson, AZ 85721. An evaluation of riparian revegetation projects in Arizona.

Efforts to restore the condition of degraded Southwestern riparian ecosystems have frequently relied heavily on various revegetation techniques. However, the outcome of many of these revegetation efforts has generally not been monitored. We evaluated 23 riparian revegetation projects in Arizona to identify variables critical to the outcome of the revegetation project. Each of the 23 projects were placed into one of four categories based on the results of the revegetation project. These categories are as follows. The revegetation project:

1. met its stated objectives;
2. has not yet met its stated objectives, but present conditions suggest that the objectives will ultimately be met;
3. has not yet met its stated objectives and present conditions suggest that the objectives may never be met;
4. did not meet its stated objectives.

The results of each revegetation project were then compared to site information such as: planting methods, environmental site characteristics, and land management practices. Unfortunately, the uniqueness of riparian ecosystems dictate that mitigation efforts for riparian sites need to be considered on a case-by-case basis. However, certain general, yet critical, rules can be applied to most sites. Our results indicate, for example, that revegetation alone will not succeed in bringing back a degraded riparian area if factor(s) that caused the degradation are not considered. Of the revegetation projects that were in category 1 or 2, 87% involved using other mitigation tools such as fencing (for livestock and/or wildlife control), bank stabilization structures (rip rap, stabilization jacks), and/or changes in land use.

BUSCH, D. E., and S. D. SMITH. Bureau of Reclamation, Boulder City, NV 89005 and University of Nevada, Las Vegas, NV 89154. The effects of fire on water relations in a *Salix-Tamarix* -dominated plant community.

The supposition that biological invasions cause alteration of whole ecosystem properties is applicable to the spread of exotic *Tamarix* sp. (saltcedar) in low-elevation Southwestern riparian communities. Although altered fire frequencies or intensities accompanying certain plant invasions of North American ecosystems have been well-researched, little attention has been paid to fire in plant associations dominated by woody phreatophytes. It has been estimated that *Tamarix*-dominated plant associations are subjected to fire with a frequency < 20 yr. Based on fire reports from the 1980s, an average $> 1,000$ ha of riparian vegetation burn annually in the lower Colorado River floodplain.

Lower Colorado River riparian zone areas where *Tamarix* and native *Salix gooddingii* (Goodding willow) codominate provide an excellent opportunity to study possible competitive factors which may favor the exotic. Because post-fire new growth in both taxa is in the form of stump-sprouting, altered water relations may be important in recovery and ultimately community structure. Relative to plants growing in an unburned stand, lower water potentials in burned *Salix* and higher stomatal conductance in burned *Tamarix* are evidence for greater water stress in recovering *Salix* but not *Tamarix*. Comparison between regressions of water potential on transpiration indicate lower hydraulic efficiency in burned *Salix*. These factors appear to contribute to increasing *Tamarix* community dominance after fire.

BUTTERWICK, M. U.S. Environmental Protection Agency, Region 9, San Francisco, CA. Verde River Advanced Identification Project.

The Region 9 office of the Environmental Protection Agency (EPA) has initiated an advance planning project, known as advanced identification (ADID), for the upper Verde River, in central Arizona. Section 404 of the Clean Water Act (CWA) regulates the discharge of dredged and fill material into waters of the United States. Under the ADID process, EPA and the U.S. Army Corps of Engineers will identify aquatic sites which are potentially suitable as disposal sites for fill material or which are generally unsuitable for such use. The intent of ADID is to provide an applicant with information in advance on potential Section 404 permit issues and to encourage avoidance of areas designated as unsuitable because of their special environmental values.

The Verde River is one of the major perennial streams in Arizona and is well-known for its extensive riparian forests of cottonwood and willow. The upper Verde River was selected for an ADID project because of the important resource values of the area, documented threats to these resources, and local and state efforts to protect the river. An overview of the Verde River ADID project is presented.

DAVIS, J., and D. P. GUERTIN. University of Arizona, Tucson, AZ 85721.
Hydrology and plant relations in Canelo Hills Cienega, an emergent wetland
in southeastern Arizona.

Cienega ecosystems are rare and unique environments in the arid Southwest. As these and other wetlands continue to vanish, an increased need for research into the functions and requirements of these habitats is vital to their protection and potential restoration. An important parameter to examine in any wetland is the hydrologic regime driving the system. This paper discusses research done at Canelo Hills Cienega examining the yearly fluctuation of water levels within the cienega as well as the relationship with a nearby spring and the adjacent O'Donnell Creek. Water level fluctuations ranged from 0 to over 3 feet per year. The examination of the water levels suggested zones within the cienega. An elevational gradient indicates the throughflow nature of this important wetland and its tie with O'Donnell Creek. In addition, the distribution of wetland vegetation as it relates to these water levels was examined. This information will be useful for future management practices and restoration projects in areas supporting similar vegetation and water regimes.

The goal of the project is to return the remnant riparian area into a healthy riparian ecosystem. After an undetermined time period riparian woody species will be planted as the water table rises and the needed amount of water is available. The area has already attracted turkey and elk into the area as forage and water for both species became available. The outlook of the project is very promising at this point in time.

FONSECA, J. Pima County Flood Control District, Tucson, AZ 85701. Riparian habitat preservation techniques in Pima County.

Actions taken by floodplain managers affect the future of the state's dwindling riparian areas. In Pima County, floodplain managers have used a number of different techniques to preserve these areas, in response to community concern. Techniques include floodplain dedication, erosion hazard setbacks, area plan policies and conditions of rezoning, basin and river management studies, and fee simple acquisition for riparian habitat preservation purposes.

The effectiveness of these techniques varies. Floodplain dedication can be a powerful tool, but is limited to subdivisions and development plans. Erosion hazard setbacks may reduce impacts of single lot development on riparian habitat, but can encourage construction of bank protection in some instances. Area plan policies are often weak, but can assist riparian habitat preservation. Conditions of rezoning are more likely to be implemented than area plan policies. Basin and river management plan studies can be helpful, particularly where flood storage effects are considered. Fee simple acquisition is highly effective, but the need for management should be taken into consideration.

HILL, M. U.S. Forest Service, Gila National Forest, Quemado Ranger District, Quemado, NM 87829. Sawmill Canyon Riparian Enhancement Project.

This project is located in the Gila National Forest on the Quemado Ranger District. Challenge cost funds were provided by both the Turkey Foundation and Rocky Mountain Elk Foundation. Before implementation of the project the canyon bottom had an intermittent stream channel with eroding streambanks. Although there is a remnant of riparian, the area lacks uneven-aged riparian species and related understory. The system had become a flashy watercourse without a healthy riparian ecosystem.

The purpose of the project is to restore riparian vegetation, control the damaging heavy peak flows, impede the movement of silt, raise the water table, and increase storage capacity of the channel banks.

The area has a history of being overgrazed, therefore, the fence in the bottom of the canyon was moved to the ridge top to eliminate the concentration of livestock. This area will also exclude livestock during the critical growing seasons through a managed grazing system. A series of 17 earthen structures were installed to slow the peak flows and collect the silt moving through the system. The structures were designed to allow the overflow to move around the structures and captured water to percolate through the dams. A road running through the canyon was blocked on each end and ripped and seeded. After building the structures all disturbed areas were seeded with a grass and clover mixture.

The goal of the project is to return the remnant riparian area into a healthy riparian ecosystem. After an undetermined time period riparian woody species will be planted as the water table rises and the needed amount of water is available. The area has already attracted turkey and elk into the area as forage and water for both species became available. The outlook of the project is very promising at this point in time.

INGRAM, R. S., AND D. A. POLLOCK. USDA Forest Service, Tonto National Forest, Payson, AZ 85541. Status of the Dude Fire rehabilitation efforts and riparian regeneration.

On June 25, 1990, a lightning strike started a fire under the Mogollon Rim in the Dude Creek drainage approximately 12 miles northeast of Payson, Arizona. The fire consumed nearly 28,000 acres. Extremely intense fire behavior resulted in classification of the majority of the burn area as severe. Included within the Dude Fire are seven important riparian corridors and numerous smaller ones. Ecologically, the entire area has been severely disrupted.

Planning was initiated for rehabilitation immediately. Of utmost importance was the stabilization of the area as quickly as possible in an attempt to minimize the potential for both soil loss from the site and flood damage. The rehabilitation was broken down into three phases:

- I. Fire Suppression Rehabilitation
- II. Emergency Burned Area Rehabilitation
- III. Long Range Rehabilitation

The first phase was carried out even as control efforts were still being completed. This largely involved seeding and water barring of both hand and dozer fire lines. The second phase accomplished measures including aerial seeding of the entire area, construction of protective fencing, removal of stream debris, and road and trail protection. Resource needs are currently being analyzed in the IRM process for phase III.

Heavy rainfall after the fire resulted in considerable soil loss and erosion. Seeding to date has been considered a success. Natural brush species recovery has been excellent. Identified needs include riparian stabilization, development of a fisheries reestablishment plan, continued protection from livestock grazing, and controlled salvage of timber and fuel wood. Reforestation potential is also being evaluated.

JOHNSON, R. R., P. S. BENNETT, and M. R. KUNZMANN. National Park Service, University of Arizona, Tucson, AZ 85721. Importance of xeroriparian ecosystems at Organ Pipe Cactus National Monument.

Organ Pipe Cactus National Monument is located in one of the more arid parts of Arizona, adjacent to the U.S.-Mexican boundary. Annual precipitation for the region varies from <5 inches to >10 inches, depending on elevation and related factors. Aquatic and wet riparian habitats are scattered. Quitobaquito (in Organ Pipe Cactus National Monument), consisting of several small springs and an artificial pond, is the only relatively major perennial water in the area. The major riparian ecosystems of the region consist of xeroriparian vegetation and attendant biotic and abiotic components along ephemeral watercourses. The more arid portions of the region are so dry that saguaros (*Carnegiea gigantea*) occur mainly in these xeroriparian ecosystems. A major percentage of the flora and fauna also occurs largely along ephemeral watercourses. The role of these xeroriparian ecosystems in maintenance of the Monument's flora and fauna will be discussed.

KEPNER, W. G. U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV 89193-3478. Environmental Monitoring and Assessment Program: an ecosystem approach to environmental assessment with special reference to arid systems and Western riparian communities.

Historically, assessment and management of environmental problems have been focused at local scales related to specific issues or problems; monitoring programs to determine condition of ecological resources have also largely operated at this level. As a result, little consistency exists among different monitoring programs and none are designed to address the distribution and condition of ecological resources at regional and national scales. Recent widespread declines in regionally distributed species and increased public interest in continental and global environmental issues suggest a need for a more fully comprehensive, integrated large-scale approach. The Environmental Monitoring and Assessment Program (EMAP) is a long-term ecological status and trends monitoring program designed to answer fundamental questions about the extent and condition of the nation's ecological resources. This is a multi-agency effort coordinated by the U.S. Environmental Protection Agency. Several federal agencies, research institutes, and universities are involved in the design and implementation of the program. Arid ecosystems comprise nearly 48% of the land surface area of the contiguous United States. They represent important centers for biodiversity and are an important thrust within the EMAP program. Arid ecosystems are considered to be the most vulnerable systems to climatic change and alterations in availability of water resources. Nowhere is this more clearly evident than in riparian communities which comprise less than 1% of the Southwestern landscape and provide important habitat for an estimated 40-90% of its vertebrate species. Riparian habitats are being lost on a regional scale throughout the West in alarming proportions, frequently as the result of human activities. As a result of imminent threats to the survival and integrity of riparian systems and the ecological importance these habitats provide to arid ecosystems, riparian systems have been selected for an EMAP pilot examination in 1992.

LAFAYETTE, R., and J. N. RINNE. U.S. Forest Service, Albuquerque, NM and Rocky Mountain Station, Tempe, AZ. Preliminary report on evaluation of riparian enhancement projects in Region 3, U.S. Forest Service.

Riparian enhancement and improvement projects were first implemented on National Forest lands in the 1930s by the Civilian Conservation Corps program. In the ensuing half century these efforts have continued, some endeavors appearing to be successful, while others are obvious failures. Little effort has been expended in evaluating these projects, determining the reasons for their success or failure, or attempting to transfer technology.

In summer 1990, 25 sites involving riparian enhancement projects were evaluated by U.S. Forest Service contract. These sites were refined from an initial list of 125 received from 11 National Forests in Region 3, Arizona and New Mexico. Selection of sites was based on date of initiation, type of enhancement (structural versus nonstructural), and location to be representative of all forests. A basic premise of the evaluation was that watersheds and riparian environments are not separate but interactive components. Projects evaluated included instream habitat improvement for fishes, riparian exclosures, riparian pastures, riparian areas in allotments with varying grazing strategies, vegetation plantings, streambank protection structures, arroyo control structures, and wetland improvements.

Enhancement projects in riparian areas have been increasing and they will continue because of the high emphasis on management of these valuable wetland resources. Ultimately, the objective is to pool all information and delineate general principles or common factors that bring about either success or failure of riparian enhancement projects. Some preliminary comments on the influence of "targets," interdisciplinary interactions, personnel changes, monitoring and research, and historic independent management of riparian-stream areas and watersheds on success or failure will be offered.

McCORD, V. A. S. Laboratory of Tree-Ring Research, University of Arizona, Tucson, AZ 85721. Augmenting flood frequency estimates using flood-scarred trees.

Large floods cause damage to valley-bottom trees, and this damage remains as long-term evidence of their passage. Dendrochronological analysis of flood-damaged trees can provide accurate information about the magnitude and frequency of floods occurring over the lifetime of the trees. Tree-ring dating of flood damage to trees along streams and rivers at 20 localities in Arizona, Colorado, New Mexico, and Utah has produced evidence for 18 floods during the last 125 years, and for at least 4 floods prior to 1866. Most of the scar dates from the historic period coincide with major floods on the waterways from which they were collected, or from nearby streams.

For a given channel gradient, scars develop only when the flood depth is above a particular threshold level. This threshold was defined by plotting inferred flow depth versus channel slope for floods causing scarring of trees, and for other nonscarring floods. The scarred and unscarred points were observed to be grouped into two well-defined fields, separated by a fairly straight line. Discriminant function analysis showed the separation to be highly significant, and classification of individual points as scarred or unscarred was usually correct.

The implication of the scar threshold is that even in drainages with no gage or historical records at all, the presence or absence of flood scars on channelside trees should indicate the occurrence or nonoccurrence of floods over a definable threshold depth during the lifetime of the trees. Field measurement of the appropriate channel geometry allows this threshold depth and the corresponding flood discharge to be calculated.

McMAHON, T., and J. WARNECKE. Arizona Game and Fish Department, Mesa, AZ 85207. Canyon Creek habitat restoration -- an update.

In 1986, the Canyon Creek Aquatic Habitat Improvement Plan (CCAHIP) was developed by an interagency (Arizona Game and Fish, U.S. Forest Service -- Tonto National Forest) and public (Trout Unlimited) team to identify problems and devise solutions to major aquatic problems. These included a management directive to produce a quality "Blue Ribbon" brown and rainbow trout fishery and manage it appropriately thereafter through proper riparian management and various fisheries strategies. Discussions will include activities of riparian plantings, livestock exclosures, beaver trapping, habitat surveys, photo points, fish population and angler surveys, Arizona Game and Fish Department law enforcement efforts, and a cost breakdown from the Arizona Game and Fish Department's perspective.

MUNDA, B. Soil Conservation Service, Tucson, AZ 85705. Cottonwood pole production.

The Soil Conservation Service/Tucson Plant Materials Center is producing cottonwood poles for the U.S. Fish and Wildlife Service -- Havasu National Wildlife Refuge near Parker, Arizona. The interagency agreement calls for the collection, evaluation, selection, and production of indigenous cottonwoods for the improvement of the Havasu National Wildlife Refuge.

On February 2 and 3, 1990 dormant poles were collected along the Bill Williams River. Poles were cut into 2-ft lengths, packed in plastic trash cans with wet rice hulls and transported back to Tucson. Stubs were planted in Field 3, Borders 1 and 3 on February 6. Soils in these borders are Comoro fine sandy loam. Planting procedure involved furrowing out, with rows on 3-ft centers and a pre-irrigation. Stubs were planted on a 3-ft spacing in the bottom of the furrow, exposing only the top 2-4 inches of the stub above the soil. Cut surfaces were then painted with white latex paint to reduce drying. Due to a compaction layer at 18 inches, holes were augered to allow hand planting of the stubs. The average diameter of the planted stubs was 0.5 to 1.0 inches.

The total number of cottonwood stubs planted was 1,072. The total surviving to date is 878, representing a survival rate of 82%. However, ants denuded and eventually killed several trees in one border. The average height obtained as of August 23 is approximately 12 ft, indicating an average growth rate of 2 ft per month. Basal stem diameters have increased to an average of 2.0 inches. The total water applied to the cottonwoods as of October 3, 1990 is 5.4 ft.

POSTER

PETERS, G. Friends of Arizona Rivers for Arizona Rivers Coalition. Wild and scenic rivers in Arizona.

Many people cannot believe that Arizona has rivers that qualify for federal Wild & Scenic River designation. We would like to explain the Act, how dozens of Arizona rivers do qualify for this protective status, and how the designation will help to protect the riparian values along rivers in Arizona.

The Wild & Scenic River Act was passed in 1970 to preserve examples of free-flowing rivers and streams throughout the nation and to balance previous government policies which degraded river systems by damming, diverting, and withdrawing the flows. To be eligible for designation the waterway must meet only two criteria: it must be free-flowing and it must possess at least one outstandingly remarkable value, such as scenic, recreational, geological, fish and wildlife, historic, cultural, or other similar value.

Using this criteria, rivers eligible for protection by the Act range from the Virgin River in northwest Arizona, its banks covered with Joshua trees; to Cave Creek near Portal, which provides habitat for some of the most intensively birded sites in the U.S.; to the White Mountains, the headwaters of numerous pristine streams and rivers flowing in every direction.

According to the Act, a designated river must be managed "to provide for the protection of the river values" and "shall address resource protection."

Arizona Rivers Coalition is developing a Wild & Scenic River proposal in order to provide protection for these resources. We feel this campaign will also help educate the public and Congress regarding the importance of free-flowing rivers and protecting our riparian habitat.

RANDALL, K. E., and D. T. PATTEN. Center for Environmental Studies, Arizona State University, Tempe, AZ 85287-1201. Development of a revegetation plan for a desert riparian area in Arizona.

A plan to restore riparian vegetation along a portion of the Salt River, a once perennially flowing river in Arizona, focused upon ecological interactions between water availability, soils, stream morphology, and riparian plant growth. Locations for revegetation of woody riparian species were based on (1) historic distributions of cottonwoods (*Populus fremontii*) and willows (*Salix gooddingii*), (2) present distributions of cottonwood, an indicator of groundwater or other water sources, and (3) physiological responses of cottonwood (e.g., radial growth and water stress as xylem water potential). These variables along with information on the area's geology, hydrology, and fluvial processes were used to prepare maps that create a mosaic within which locations were ranked for potential success of revegetation.

Cottonwood growth parameters were used to rank areas for potential revegetation success. The areas were ranked from good to those areas that should be avoided (barren). Preferred sites were ranked based on the following conclusions.

1. Cottonwood growth is significantly greater on sites with more resources available and water occurs perennially.
2. Fluvial processes greatly effect distribution of cottonwoods in the channel.
3. Regeneration of cottonwoods occurs on sites with perennial water and occasional water releases that overflow channel banks.
4. Cottonwoods throughout the study area on the Salt River are water stressed. Water availability is necessary for maintenance as well as establishment.

RICHTER, B. Hassayampa River Preserve, Wickenburg, AZ. Use of the floodplain relief curve in riparian ecology studies.

A floodplain relief curve is described as a graphical plot of floodplain width versus the height above the streambed (or alternatively, above the water table). Such a relationship is developed from field surveys of floodplain topography along transects perpendicular to the stream orientation (preferably using at least 5-10 transects).

The floodplain relief curve can then be used as the template for illustrating plant species distribution across the elevational gradients of the floodplain. For example, many plant species are limited in their proximity to the stream elevation due to vulnerability to flood scour. Likewise, the upper elevational limit may be set by drought intolerance at some height above the water table elevation. Plotting these limits onto the floodplain relief curve can help to illustrate the optimal habitat band for a particular riparian plant species.

The floodplain relief curve can therefore also aid in interpreting how plant communities may respond to changes in the water table elevation or to alteration of the flood regime. The curve can also be useful in identifying appropriate elevational bands within the floodplain for introducing plant material as part of a restoration effort.

STEVENS, L. E. P.O. Box 1315, Flagstaff, AZ 86002. Riparian plant diversity in Grand Canyon: stress, catastrophe and adaptation.

Nonequilibrium diversity and community organization models involving disturbance, stress, competition and temporal effects were tested using riparian vegetation in Grand Canyon National Park. Perennial riparian plants (clonal and nonclonal phreatophytes and xerophytes) were censused on three flood terraces (low, intermediate and high disturbance) along ephemeral and perennial tributaries, at springs, and along the flood-controlled Colorado River between 400 m and 950 m elevation.

Most models predicted a curvilinear ("humpbacked") response of species richness to a disturbance gradient, but riparian plant species richness was linearly negatively correlated with flood disturbance intensity. Tributary and spring data revealed that flooding impacts on species richness were conditionally dependent on moisture availability. Competitive exclusion, if present, was suggested only by reduced species richness at low disturbance/high productivity spring sources. Adaptation to moisture and disturbance gradients was apparent from differential performance (basal cover) of species and architectural groups, and by low community similarity between flood terraces within and between the four riparian environments.

Partial failure of predictive models arose from inappropriate assumptions, negative correlation between moisture stress and flood disturbance, and because few models considered adaptation to stress, disturbance and other gradients.

STROMBERG, J. C.¹, J. A. TRESS², and S. D. WILKINS¹. ¹Center for Environmental Studies, Arizona State University, Tempe, AZ 85287-1201 and ²SWCA, Inc., Tucson, AZ 85719. Effects of groundwater withdrawal on velvet mesquite (*Prosopis velutina*) in Tanque Verde Creek.

Mesquite bosques are dependent on alluvial aquifers for most of their water supply, and are destroyed if groundwater declines too rapidly or to too great a depth. Increased rates of groundwater pumping since 1987 from Tanque Verde Creek, Tucson, Arizona, have resulted in rapid and extensive declines in groundwater for much of the riparian habitat. As a result, there exists a gradient of plant water stress, with stress of the mesquite trees increasing with proximity to the cone of depression induced by groundwater withdrawal. The stress level of many of the trees was extreme in May and June of 1990 (< -5 MPA xylem water potential), suggesting that little photosynthesis and plant growth were occurring. Upstream, in areas with less groundwater decline, trees showed less evidence of stress. The abundant "monsoon" rains in 1990 temporarily alleviated internal water stress for trees near the cone of depression, but did not alter stress patterns for the upstream trees. These data indicate that groundwater pumping, rather than natural weather patterns are responsible for the stress in the mesquite trees. The late-season recovery of the trees indicates their potential to recover to prepumping status if rates of groundwater pumping are decreased. However, if pumping continues at rates that exceed natural aquifer recharge, there is a high probability that large, contiguous tracts of high-quality mesquite bosque and mixed broadleaf riparian woodland will be destroyed.

TELLMAN, B. Water Resources Research Center, University of Arizona, Tucson, AZ 85721. A preliminary survey of Arizona's effluent-dominated riparian areas.

The majority of Arizona's free-flowing riparian areas have long since been altered by man into intermittent, ephemeral or fully regulated streams. There are, however, approximately 40 free-flowing riparian areas existing in the state, with vegetation and wildlife dependent on perennial water. These streams depend entirely or largely on effluent from municipal wastewater treatment facilities. Many of these areas support thriving riparian vegetation and wildlife. Most of them are, however, threatened by pressures to reuse the effluent for "beneficial uses" such as golf courses; increasing costs of meeting NPDES standards; and/or demands for "bank protection" for flood control purposes.

This preliminary survey lists the effluent-dominated riparian areas, and describes their status and issues surrounding them. Several case studies are offered in more depth, illustrating particular problems and solutions. This paper is considered preliminary with expectation of additional input from Council attendees.

POSTER

THORNBURG, T. Arizona State Parks, Phoenix, AZ. Arizona Rivers Assessment.

The Arizona Rivers Assessment is a statewide, comprehensive, inventory and evaluation of river and riparian-related resource information. Its purposes are the determination of the relative significance of each river segment based on all its environmental values, and the compilation of data to support this determination. The Assessment stresses the use of existing data and input from a variety of sources, including academic institutions, public agencies, Native American tribes, industries, interest groups, and various publications.

The Arizona Rivers Assessment is a cooperative, multigroup effort, involving local, state, and federal agencies, tribes, organizations, and individuals who own or manage rivers and riparian areas, have regulatory responsibilities for those areas or who have information about the resources and uses of those areas. The Arizona Streams and Wetland Heritage Program of the Arizona State Parks Board and the Rivers and Trails Conservation Assistance Program of the National Park Service are providing staff and coordination. A Steering Committee directs the project and many other organizations are contributing staff time or resource information.

The goal of the Arizona Rivers Assessment is to provide a planning tool that can be used by resource management agencies, organizations, and decision-makers to plan for the future of Arizona's priceless river and riparian heritage and to balance the needs for resource conservation and economic development. The project has been divided into two phases. Phase I emphasizes six categories of river-related resources: fish, wildlife, riparian vegetation, stream hydrology, geology and soils, and cultural resources. Phase II will concentrate on the public, economic and recreational uses of the rivers and riparian areas.

A team of experts in each of the Phase I resource categories has begun the evaluation process by defining the parameters and criteria for each resource. Data collection and analysis for Phase I has already begun and will continue throughout the next year. Work on Phase II will begin in mid-1991. Approximately 600 rivers have been initially identified for study. The Arizona Rivers Assessment is a broad-based, planning tool that provides information at a scale suitable for broad preliminary project scoping and impact assessment, identification of conflict areas, priority setting, and development of statewide policy for rivers and riparian areas.

ZAUDERER, J. Office of Arid Lands Studies, University of Arizona, Tucson, AZ 85719. Lost perennial habitats of the southeastern Sierritas: geology, hydraulic change and the 1887 earthquake.

From about 1880 the Santa Cruz River system has been dewatering and readjusting hydraulically. The area of study is seen to have been a perched perennial stream-marsh system that was lost as a result of hydraulic readjustments in the Santa Cruz system. The perennial habitat was maintained by the geologic situation, which also reflects the broad hydrogeological history of the Tucson Basin. In the study area, climate and human impacts have accelerated degradation perhaps initiated by the 1887 earthquake. Perching mechanisms are responsible for perennial and cienega habitats of the Santa Cruz system; these habitats are integrated into a regional adjustment extending to at least 4,000 feet elevation.