

Santa Cruz River Researcher's Day

March 27, 2009



Proceedings

- Sponsored By –

Tumacácori National Historic Park
Sonoran Institute
Friends of the Santa Cruz River
Global Community Communications Alliance
Santa Cruz Valley Heritage Alliance
Friends of Tumacácori
Western National Parks Association

Table of Contents

Introduction	3
Program.....	4
Posters	5
Presentation Abstracts.....	6
Poster Abstracts.....	14
Coordination of Monitoring Data: Discussion Summary	18
Attendees and Contact Information.....	20

Introduction

On March 27, 2009 Tumacácori National Historical Park, Sonoran Institute and partners hosted “Celebrate the Santa Cruz River: Researcher’s Day”. This day was an opportunity for those conducting monitoring, research, or studies along the Santa Cruz River to share their work and findings through technical presentations and posters. The following is a brief proceedings of the event, including abstracts of the papers and posters presented.

This proceedings and copies of the presentations and posters can be found on the Sonoran Institute website under the page describing Santa Cruz River work. ([Link to Sonoran Institute website](#))

Program

8:00 - 8:30	Poster set-up and presentation loading	
8:30 - 8:40	Welcome	
8:40 - 9:00	Andy Hubbard	<i>Resource inventories and ecological monitoring at Tumacácori NHP: program overview and important findings</i>
9:00 - 9:20	Chris Kirkpatrick	<i>Monitoring the Health of Riparian Birds at Tumacácori NHP</i>
9:20 - 9:40	Sarah Studd and Steve Buckley	<i>Plants of Tumacácori NHP: A Comprehensive Field Guide to the Plants of Tumacácori</i>
9:40 - 10:00	Amy McCoy	<i>The Forest for the Trees: Applications of Dendrochronology to Riparian Conservation</i>
10:00 - 10:20	Miguel Villarreal and Raul Romo	<i>Seven Decades of Landscape and Vegetation Change at Tumacácori NHP</i>
10:20 - 10:40	BREAK - (presentation loading)	
10:40 - 11:00	Prescott Vandervoet	<i>TAAPing the Sources: Santa Cruz Database Creation for the Transboundary Aquifer Assessment Program</i>
11:00 - 11:20	Tom Meixner	<i>Stream Groundwater Interactions and Clogging on the Upper Santa Cruz</i>
11:20 - 11:30	Sherry Sass	<i>Friends of the Santa Cruz River – Riverwatch water quality data</i>
11:30 - 11:50	Jeremy Moss and Channah Rock	<i>E. coli Monitoring and Microbial Sourcing Project, Tumacácori NHP</i>
11:50 - 1:00	Lunch and Poster Session	
1:00 - 1:20	Jason Sutter and Colin Breslin	<i>TMDL Development for Impaired Stream Reaches on the Santa Cruz River and Nogales Wash</i>
1:20 - 1:40	Evan Gwilliam	<i>Stream Monitoring at Tumacácori NHP</i>
1:40 - 2:00	Cheryl McIntyre	<i>Assessing the Health of the Upper Santa Cruz River</i>
2:00 - 2:20	BREAK	
2:20 - 3:30	Possibilities for Coordination of Monitoring Data - discussion (<i>optional</i>)	

Posters

Sam Drake and Miguel Villarreal	<i>USGS-NPS Vegetation Characterization Program: Vegetation Map of Tumacácori NHP</i>
Carianne Funicelli	<i>Nogales Wash Area A: Mitigation Restoration along Potrero Creek</i>
Wade Leitner	<i>A Network for Inventory and Monitoring of Bird Populations on the Santa Cruz River Watershed</i>
Lisa Brooke McDonough	<i>Aquatic Organisms as Biological Indicator Species</i>
Janice Przybyl	<i>Connecting Volunteer Effort to Conservation Action by Training and Engaging Citizen Scientists to Record Data On Wildlife Activity Within the Santa Rita-Tumacácori Wildlife Linkages</i>
Francisco Trujillo and Diane Austin	<i>Composting Toilets in Nogales, Sonora: Results from an Ongoing Pilot Survey</i>
Jim Washburne	<i>The Arizona Rivers Project: Water Science, teachers, kids, stewardship</i>
Margaret White	<i>Spatial Patterns of Treated Wastewater and Discharge into Surface Water Courses in Arizona</i>

Presentation Abstracts (Listed in order of presentation)

Inventory & Monitoring at Tumacácori NHP

Andy Hubbard National Park Service, Sonoran Desert Network

The National Park Service Inventory & Monitoring Program Sonoran Desert Network (SODN) covers the geologically and biologically diverse Sonoran Desert and Apache Highlands ecoregions of southern Arizona and southwestern New Mexico. The network comprises 11 national parks containing biomes ranging from low-elevation desert scrub to mixed conifer forests, as well as critical riparian systems associated with perennial rivers, ephemeral and intermittent washes, seeps, springs, and tinajas. The SODN is designing and implementing a long-term monitoring program to measure key indicators of ecological integrity, or “vital signs.” This coordinated, multi-perspective ecosystem monitoring effort will help inform managers and the public as to the condition of key park resources and provide an early warning system for potential problems. This paper describes SODN activities at Tumacácori National Historical Park (NHP).

Set aside to protect and commemorate the unique mission and settlements along the Santa Cruz River, Tumacácori NHP also protects and manages the rich riparian ecosystems that attracted early peoples to the site. Tumacácori NHP was a focus for early research and development efforts for SODN streams monitoring, with preliminary efforts starting in 2006. Full implementation of streams monitoring at Tumacácori NHP began in 2007. The SODN will begin monitoring terrestrial vegetation and dynamic soil vital signs at Tumacácori NHP in summer 2009. In conjunction with park staff, the SODN compiles and analyzes depth to groundwater information at Tumacácori NHP at two monitoring wells located on the park. The SODN initiated annual bird monitoring at Tumacácori NHP in 2007, to provide insights into human perturbations and natural events. Natural resource inventories are extensive, point-in-time surveys of the locations of plants, animals, and the physical environment. From 2000 to 2003, biologists from the University of Arizona and SODN conducted comprehensive field investigations of mammals, birds, amphibians, reptiles, and vascular plants at Tumacácori NHP. These surveys documented the occurrence and distributions of 378 plant species, 168 of which were new to park species lists.

Monitoring the Health of Riparian BirdS Populations at Tumacácori National historical park

Chris Kirkpatrick, School of Natural Resources, University of Arizona

Courtney J. Conway, USGS Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona

Dominic LaRoche, School of Natural Resources, University of Arizona

Gabrielle Robinson, School of Natural Resources, University of Arizona

Riparian woodlands bordering the Santa Cruz River at Tumacácori National Historical Park (NHP) provide important habitats for numerous breeding, wintering, and migratory birds. However, a recent increase in the number of riparian birds exhibiting physical abnormalities (e.g., lesions, tumors) near the Santa Cruz River has raised concerns about the overall health of the park’s riparian bird community. Poor water quality in the Santa Cruz River, infectious diseases, or an interaction between these two factors

may be responsible for the observed abnormalities, but to date, no effort has been made to assess the prevalence or diagnose the cause of the abnormalities. To address these issues, we are monitoring breeding populations of several riparian bird species at Tumacácori NHP and Cienega Creek Preserve (our control site) in 2008 and 2009 by 1) locating bird nests and estimating reproductive parameters (e.g., egg volume, hatching success, nestling growth rate), 2) examining nestling and adult birds in the hand for physical abnormalities, and 3) collecting avian tissue samples (e.g., blood, feathers, infertile eggs) for subsequent analysis. In 2008, we monitored a total of 272 nests of 39 species and examined >200 nestling and >100 adult birds in the hand. We found that physical abnormalities were rare in nestling birds (<0.5%) but were slightly more common in adult birds (~5%) at Tumacácori NHP, including lesions on adult Bewick's Wrens (*Thryomanes bewickii*; $n = 1$), Lucy's Warblers (*Vermivora luciae*; $n = 1$), and Yellow-breasted Chats (*Icteria virens*; $n = 3$). In addition, we found that reproductive parameters measured at Tumacácori were either equal to or greater than those measured at our control site at Cienega Creek. Overall, breeding populations of riparian birds appeared to be relatively healthy at Tumacácori NHP in 2008. Nevertheless, the effect of some environmental contaminants can be subtle, producing negative effects in bird populations that are not readily apparent through simple physical examinations of birds or the comparison of reproductive parameters between study sites. Therefore, we intend to analyze tissue samples collected in 2008 and 2009 to determine if elevated levels of environmental contaminants (e.g., heavy metals, organochlorines) originating from the Santa Cruz River are present in the tissues of adult and nestling birds at Tumacácori NHP.

Plants of Tumacácori National Historical Park – A comprehensive field guide to the plants of Tumacácori

Steve Buckley, University of Arizona, Arizona Remote Sensing Center/NPS – Sonoran Desert Network
Sarah Studd, NPS – Sonoran Desert Network

The Plants of Tumacácori is a comprehensive technical botanical guide to all plant species that have been documented at the park. This guide was developed as a complementary product to vegetation mapping work conducted at Tumacácori in 2008. As such, the introduction documents and describes the plant communities that were mapped in the park and provides an overview of the contemporary ecological conditions. Organized as an edited technical resource for managers, educators, and researchers, the guide includes sections for flowering trees and shrubs, wildflowers, cacti, grasses and sedges. Within each section, species are further organized by plant family and then alphabetically by scientific name. Each entry details species lifeform, habitat, morphology, identification characteristics, potential ethnobotanical uses, synonymy and common names. Exotic, invasive and non-native species are highlighted within the text for clarity and rapid identification. The guide also includes an index, glossary and comprehensive plant check list.

Overall this effort was intended to synthesize former inventory data, all herbarium collection records and other sources of historic data into one field compatible and user friendly guide that was specific to the park. The guide will be available for and through Tumacácori NHP staff and the Sonoran Desert Network; it is not intended for sale or distribution.

The Forest for the Trees: Applications of Dendrochronology to Riparian Conservation

Amy L. McCoy, Sonoran Institute & Arid Lands Resource Sciences Program, University of Arizona

Paul R. Sheppard, Laboratory of Tree-Ring Research, University of Arizona

David M. Meko, Laboratory of Tree-Ring Research, University of Arizona

Tom Meixner, Hydrology and Water Resources, University of Arizona

Barron J. Orr, Office of Arid Lands Studies, University of Arizona

Visibly evident as a green ribbon of life within arid and semi-arid landscapes, riparian zones are unique in their integration of both upland and aquatic processes. Riparian ecosystems are among the most diverse, dynamic, and complex terrestrial habitats and are integrally important to human and ecological populations in the American Southwest. Current riparian conservation efforts are endeavoring to link ecological research and monitoring with policy outcomes and management actions to ensure that riparian areas remain viable functioning systems in the future. In light of changing climate conditions and growing human populations, this is a daunting, though imperative, challenge. The overall aim of this presentation is to explore this challenge by examining the integration of ecohydrological research with site-specific conservation policies and management actions in the Upper Santa Cruz River watershed. The first presentation objectives will highlight two novel riparian monitoring techniques within the field of dendrochronology that may lead to new insights into the ecohydrological relationships between climate, hydrology, and riparian vegetation. The third presentation objective will explore opportunities for science-based management of functioning riparian ecosystems under changing climate conditions and within the context of Arizona water law. The ultimate goal for this research is to create an applied and sustainable feedback loop between science and policy to ensure that flows in the Santa Cruz River fulfill the water requirements of the local population while maintaining the health of this unique riparian corridor.

National Park Service Landscape Dynamics Monitoring: Seven Decades of Landscape and Vegetation Change at Tumacácori National Historical Park

Miguel L. Villarreal, Department of Geography and Regional Development, University of Arizona

J. Raul Romo Leon, School of Natural Resources, University of Arizona

Willem J.D. Van Leeuwen, Ph.D., Office of Arid Lands Studies/Geography and Regional Development, University of Arizona

Effective landscape dynamics monitoring requires a multi-scale and multi-temporal remote sensing approach to model spatial and temporal patterns of land cover change occurring in and around U.S. National Parks. Using Tumacácori National Historical Park (NHP) of Arizona and the surrounding Upper Santa Cruz River watershed as a case study, we developed a series of land cover maps using multi-date 30m resolution Landsat Thematic Mapper (TM) imagery (1984, 1996 and 2006) and high-resolution historical aerial photographs (1936-2006). We developed Landsat-based land cover classifications that exploit phenological cycles of vegetation types through the use of multi-season satellite imagery. We derived various spectral vegetation indices and image transformations (e.g. tasseled cap, texture) from pre-and post-monsoon Landsat TM imagery and combined these with topographic data (e.g. aspect, slope), and consequently classified these variables into land cover classes using non-parametric

Classification and Regression Tree (CART) models. We mapped historical riparian vegetation along a 51 km stretch of the Santa Cruz River using six dates of aerial photography (1936, 1956, 1975, 1984, 1996, and 2006). Using land cover maps generated from both the Landsat imagery and historical aerial photographs we quantified the rates and types of land use and vegetation change in and around Tumacácori NHP using landscape pattern metrics. This multi-scale approach to landscape dynamics monitoring allows for broad analysis of watershed-level processes (e.g. woody plant encroachment, urbanization), as well as more localized vegetation dynamics (e.g. riparian disturbance and succession).

TAAPing the Sources: Santa Cruz Database Creation for the Transboundary Aquifer Assessment Program (TAAP)

Prescott Vandervoet, University of Arizona

James Callegary, United States Geological Survey

Sharon Megdal, Water Resources Research Center, University of Arizona

Christopher Scott, Udall Center for Studies in Public Policy, and Dept. Geography and Regional Development, University of Arizona

The Transboundary Aquifer Assessment Act, passed by Congress as Public Law 109-448 on December 6, 2006, authorizes the Secretary of the Interior to cooperate with the States and other U.S. and Mexican stakeholders along the southern international border to conduct hydrogeologic characterization, mapping, and modeling for priority transboundary aquifers. The Santa Cruz River Valley aquifer was designated as one of four priority transboundary aquifers by the Act.

The Transboundary Aquifer Assessment Program of Arizona (TAAP-AZ) is the Arizona component of assessment activities; related assessments are also occurring in New Mexico and Texas. A stated objective of the Act is to evaluate all available data and publications as part of the development of study plans for each priority transboundary aquifer. As a result, the TAAP-AZ is currently compiling a database of information materials related to hydrology, geology, land use, water quality, and institutions of the transboundary Santa Cruz River Valley aquifer. The defined area of interest begins at the headwaters and extends to the northern limit of the Santa Cruz Active Management Area, as defined by the Arizona Department of Water Resources. Materials relevant for database entry range from research reports to urban management plans. A wide variety of entities have made their resources available for inclusion in the TAAP-AZ database. Federal, state, municipal, and binational water authorities in Sonora, Mexico and Arizona, USA have assisted in the data-gathering process. Similarly, non-governmental interests have also participated and provided useful input to the database.

The TAAP-AZ Upper Santa Cruz Database will serve as an interactive data and information resource to agencies, researchers, and policymakers. By using a Microsoft Access® format, the database will provide a searchable platform in which users will be able to view citation details (e.g., a query can be conducted to find all reports or databases that contain information on geology, water quality, or other topics of interest), brief summaries/abstracts, and information about accessing these items (the database will not house all references). The preliminary version of the TAAP-AZ Upper Santa Cruz Database includes over 125 unique entries and will be accessible via the website of the University of Arizona's Water Resources Research Center beginning in spring 2009.

Stream Groundwater Interactions and Clogging on the Upper Santa Cruz

Tom Meixner, Amy McCoy, Sam Treese, Paul Sheppard and Ty Ferre

University of Arizona – Hydrology and Water Resources, Arid Lands and Laboratory for Tree Ring Research

Water managers in arid and semi-arid regions increasingly view treated wastewater (effluent) as an important water resource. Artificial recharge basins allow effluent to seep into the ground relieving stressed aquifers, however these basins frequently clog due to physical, chemical, and biological processes. Likewise effluent is increasingly used to maintain perennial baseflow for dry streambeds, however, little is known about the impact of effluent on streambed hydraulic conductivity and stream-aquifer interactions. We address this issue by investigating: if a clogging layer forms; how the formation of a clogging layer alters stream-aquifer connections; what hydrologic factors control the formation and removal of clogging layers and investigate signals for how clogging might be changing over time and space. We focused on the Upper Santa Cruz River, Arizona where effluent from the Nogales International Waste Water Treatment Plant (NIWTP) sustains perennial flow. Monthly sampling, along a 30 km river reach, was done with two foci: physical streambed transformations and water source identification using chemical composition. Historical data sets were included to provide a larger context for the work. Results show that localized clogging occurs in the Upper Santa Cruz River. The clogging layers perch the stream and shallow streambed causing desaturation below the streambed. With these results, a conceptual model of clogging is established in the context of a semi-arid hydrologic cycle: formation during the hot pre-monsoon months when flow is nearly constant and removal by large flood flows ($>10 \text{ m}^3/\text{sec}$) during the monsoon season. However, if the intensity of flooding during the semi-arid hydrologic cycle is lessened, the dependent riparian area can experience a die off. This conceptual model leads us to the conclusion that effluent dominated riparian systems are inherently unstable due to the clogging process. Further understanding of this process could lead to improved ecosystem restoration and management. We are currently pursuing the broader understanding of the clogging process with tree ring and geophysical analysis in the Upper Santa Cruz River system.

Friends of the Santa Cruz River: Riverwatch water quality data

Sherry Sass, Friends of the Santa Cruz River

RiverWatch, begun in 1992, is a joint water quality monitoring program of the Friends of the Santa Cruz River (FOSCR) and the Arizona Dept. of Environmental Quality (ADEQ). Every month, volunteers test surface flow at sites along the river in Santa Cruz County, plus a Nogales Wash site, for the following parameters: temperature (also air temp), pH, electroconductivity, turbidity, dissolved oxygen, chlorine, fecal coliform, discharge (calculated with a flow meter measuring about 20 points across a cross-section of flow). Quarterly measurement of heavy metals was added by ADEQ several years ago, in addition to monitoring for E. coli, for which State standards exist (there are currently no State standards for fecal coliform). Sites are photographed both upstream and down, and a narrative description of river and bank conditions is recorded. Sites are (upstream to downstream): Chavez Siding Rd. in Tubac; Santa Gertrudis Lane in Tumacácori; the Rio Rico Bridge on Rio Rico Drive; and Nogales Wash at the Ruby Road exit off Interstate 19. Originally, a "control" site near the Guevavi Ranch was monitored, since it was

upstream of inflow from the Nogales International Wastewater Treatment Plant (NIWTP), but lack of flow eliminated that site. A replacement site, the Johnson Ranch near Buena Vista, is currently monitored quarterly.

The data from this database, the most comprehensive available on the upper Santa Cruz River, are available from ADEQ, or on the FOSCR website: <http://www.friendsofsantacruzriver.org/>

FOSCR is an all-volunteer community group dedicated to the protection of the Santa Cruz River, its flow, water quality, and the riparian habitat flanking the river in the upper part of the watershed.

Characterizing the Sources of Microbial Contamination: DNA Testing of Excessive E. coli in the Santa Cruz River, Tumacácori NHP

Jeremy Moss, Tumacácori National Historical Park, NPS
Channah Rock, University of Arizona

Understanding the origins, transport and fate of contamination is essential to effective management of water resources and public health in the project area. Individuals and organizations with management responsibilities need to understand the risks to humans and to ecosystems from contact with contamination. They also need to understand how key contaminants vary over time and space in order to design management strategies and make choices among various options. Further, understanding of the sources of contamination is needed for developing mitigation strategies and comprehensive policy.

Tumacácori National Historical Park (NHP) is responsible for management of its water resources for the benefit of the park and for the health of its visitors. Monitoring at three sites within the park shows that E. coli counts exceed ADEQ standards (PBC) for most of the year, especially during monsoon season. The data show a direct relationship between rainfall/stream flow and E. coli count and suggest that fecal matter in the watershed is washing into the stream during rainfall events. The existence of microbial contaminants in the park poses risks that must be considered in park planning and operations. In the project area, outside the boundaries of the park, different land ownership and jurisdictions mean different risk management challenges. An assessment of risks in this area will provide needed information for public and private decision making.

The proposed study will provide assistance, in addition to sampling and data analysis, by providing interpretation of results for management context. The proposed study will develop generalized guidance for interpreting the results of data analyses for microbial contamination risks in this area. Microbial source tracking (MST) includes a group of methodologies aimed at ascertaining the dominant source(s) of fecal contamination in resource waters. Over the past several years, methods focused on members of the genus *Bacteroides* have been increasingly utilized in MST studies for identifying and quantifying sources of non-point fecal contaminations (Fiksdal et al 1985, Kreader 1995). By characterizing the sources of microbial contamination and their spatial and temporal variations in the Santa Cruz River, the results of this study will help to define water quality biomarkers, which can be used to determine the public health and ecological significance in the area. Moreover, results of this study will strengthen the microbial occurrence database and help to develop an improved management plan for future uses of the river.

Santa Cruz River and Nogales Wash Total Maximum Daily Load Studies

Jason Sutter and Colin Breslin, Arizona Department of Water Quality – TMDL Unit

This project will collect water quality data to determine a Total Maximum Daily Load (TMDL) for two stream reaches in the Santa Cruz Watershed that have been assessed by the Arizona Department of Environmental Quality (ADEQ) as impaired and placed on the state's 303(d) List. The two stream reaches are the Santa Cruz River from the Mexico border to the Nogales International Waste Water Treatment Plant (NIWWTP) and the Nogales Wash from the Mexico border to Potrero Creek. The Santa Cruz River reach is impaired for *Escherichia coli* (*E. coli*) exceedances and the Nogales Wash reach is impaired for *E. coli*, ammonia, chlorine, and dissolved copper. The TMDL will determine the maximum amount of each pollutant that these streams can assimilate without causing impairment to the streams designated uses. The sources of each pollutant and the critical conditions that are causing the impairments will also be established so that pollutant loads can be reduced by the necessary amount.

Stream Monitoring at Tumacácori NHP

Evan Gwilliam, National Park Service, Sonoran Desert Network

Perennial streams are among the most critical and impacted natural resources of the Sonoran Desert. Most species in the ecoregion utilize aquatic ecosystems for some portion of their lifecycles, yet natural surface waters have decreased by an estimated 99% since the mid-19th century due to human demands for water. The National Park Service recognizes the importance of riparian areas, and is developing, testing and implementing monitoring plans for selected ecological indicators, or "vital signs" (e.g., stream channel morphology, water quality) in perennial streams in Southern Arizona. The objective is to detect long-term changes in these "vital signs" and provide this information effectively and rapidly to Park managers

Assessing the Health of the Upper Santa Cruz River

Cheryl McIntyre, Amy McCoy, and Claire A. Zugmeyer, Sonoran Institute

In recent years, numerous planning and research efforts have focused on understanding and conserving the Upper Santa Cruz River. Collectively, these efforts speak to the importance of the river to the history, culture, and quality of life in Santa Cruz County. These efforts also provide a valuable foundation of information on the health and changing conditions of the river. Reporting the status and trend of stream health can be effectively accomplished through an annual ecosystem health assessment. The Santa Cruz Science Advisory Committee (SC-SAC), a group of scientists and local experts, guided the Sonoran Institute in the development of a health assessment for the Upper Santa Cruz River and its surrounding riparian area. The health of the Upper Santa Cruz River is tracked using ten indicators grouped in two categories representing major components of the riparian and aquatic ecosystems.

Monitoring data from numerous agencies and organizations are evaluated against an appropriate standard that is set by state and federal agencies or the scientific community. Most water quality indicators are compared to Arizona Department of Environmental Quality (ADEQ) standards. These regulatory standards define water quality goals for streams in the region, which are designed to protect wildlife and/or human health. In some cases, ADEQ defines a standard for streams that are effluent-dominated. For other indicators, standards have been determined by the scientific community. Finally, some indicators, such as aquatic animals and riparian vegetation, do not have standards to which they can be compared. For those indicators, this assessment serves as a baseline to which future data will be compared.

Poster Abstracts

(listed in Alphabetical order by first author)

USGS-NPS Vegetation Characterization Program: Vegetation Map of Tumacácori National Historical Park

Sam Drake and Miguel Villarreal, University of Arizona, Office of Arid Lands Studies

The USGS-NPS Vegetation Characterization Program (<http://biology.usgs.gov/npsveg/>) is an ongoing, national-level collaboration between the US Geological Survey and the National Park Service to classify and map the vegetation communities in all national park units. The National Vegetation Classification system is being used as a framework for classifying vegetation in a standardized way, so that maps from different parts of the country are comparable. Locally, the 11 park units of the Sonoran Desert Network, including Tumacácori, are being mapped cooperatively by the NPS Sonoran Desert Network Inventory and Monitoring Program and the University of Arizona's Office of Arid Lands Studies. Mapping methods employ high spatial resolution satellite imagery as a base, and extensive field observation aided by GPS-linked handheld computers to identify plant species and delineate vegetation communities. Vegetation maps of all three units of Tumacácori National Historical Park were recently finished and are displayed in the accompanying poster. Nineteen different vegetation types were mapped in the park.

Nogales Wash Area A: Mitigation Restoration along Potrero Creek

Carianne Funicelli, RECON Environmental, Inc.
Lori Woods, RECON Environmental, Inc.
Michael J. Fink, U.S. Army Corps of Engineers
Ken Zehentner, Santa Cruz County Flood Control District

A proposed project will address flood control issues related to the community of Chula Vista, Arizona, located between the banks of Nogales Wash and Potrero Creek. Annual flood flows from Potrero Creek and Nogales Wash overflow into the residential community, resulting in significant property damage and unsafe conditions that may threaten human lives. The flood control project has resulted in the loss of most of the riparian vegetation lining Nogales Wash within the project area. A Mitigation and Restoration Plan was developed to restore the structure and function of riparian communities impacted by the construction of the flood control project and to minimize impacts to cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*) and southwestern willow flycatcher (*Empidonax traillii extimus*). Restoration will take place on areas graded for flood control along Nogales Wash and in the interceptor channel along the existing banks of Potrero Creek, on lands owned by the Santa Cruz County Flood Control District located between Potrero Creek and Nogales Wash, and on areas temporarily impacted by construction. Surveys for vegetation composition and soil qualities were conducted in June 2005, and restoration prescriptions were developed for each area. Mitigation restoration was completed on the first phase of the project, along Potrero Creek (Area A), concurrent with construction activities, during November and December 2008. A total of 74 species were included in the container planting palette and seed mix.

A Network for Inventory and Monitoring of Bird Populations on the Santa Cruz River Watershed

Wade Leitner, BirdWorks LLC

The Santa Rita Experimental Range (SRER) hosts one of the two long term bird banding stations in the Upper Santa Cruz River watershed. The station in Florida Canyon (FLAC) has operated since 1999 the other at Tumacácori National Historical Park (TUMA) since 1997. The stations are part of the Monitoring Avian Productivity and Survivorship (MAPS) program. The analysis of data collected from observations and captures has produced an inventory of the natural history of the birds at FLAC and TUMA. Further, a baseline for monitoring the productivity and diversity of the bird community now exists. As a part of the MAPS network, population trends and estimates of vital rates can be obtained.

Aquatic Organisms as Biological Indicator Species

Lisa Brooke McDonough, University of Arizona, School of Natural Resources

Biological indicator species give us clues about the environment we share with them. Just as the canary in the coal mine signaled poor air quality, aquatic organisms can signal ecological distress in streams, lakes, and rivers. Characteristics such as the presence/absence of species and the health of those species provide information about ecosystem conditions. Aquatic organisms spend at least part of their lives in the water and are excellent sentinels for determining if a system is in distress. They permit researchers to observe effects of many stressors over an extended period of time. These chronic effects are relevant and often not observed when studying a single contaminant for short durations. Native fish and aquatic invertebrates (such as insects and snails) provide valuable information about sources, transport mechanisms, bioaccumulation, and bioremediation of contaminants in Arizona waters. Current studies examine the sources and transport of contaminants in southern Arizona waters.

Connecting volunteer effort to conservation action by training and engaging citizen scientists to record data on wildlife activity within the Tumacácori-Santa Rita wildlife linkage

Janice Przybyl, Sky Island Alliance, Wildlife Linkages Program Coordinator

Sky Island Alliance's Wildlife Linkages Program strives to preserve, restore, and increase landscape permeability for the regions' wildlife by building strong public and political support for both the concept and value of wildlife linkages within the Sky Island region of the United States and Mexico. Through innovative methods of education and field studies the Program works to motivate community involvement in conservation research and advocacy for wildlife linkages. We maintain five project areas throughout southeast Arizona including the Tumacácori -Santa Rita Linkage in Santa Cruz County. As dedicated "citizen scientists" for the Wildlife Linkages Program, area volunteers hike the washes and roads of the Santa Cruz Valley looking for the tracks and other signs left by targeted species, including mountain lion, black bear, coati, and bobcat. Volunteers adhere to strict documentation protocol, filing

out data forms and properly photographing tracks for verification of species identification. Point data is then depicted on maps reflecting presence/absence of the four species on each transect. With this information Sky Island Alliance gains insight into wildlife utilization of the linkage between the Santa Rita and Tumacácori mountains. The challenge is to use the collected data to guide local and international management decisions related to the preservation and restoration of landscape connectivity. To qualify for the Program, volunteers attended a five-day training workshop where regional wildlife experts taught tracking techniques and wildlife sign recognition - such as the difference between canine and feline tracks. Workshop participants learned where to look for sign and about the ecology and behavior of local mammal species.

Composting Toilets in Nogales, Sonora: Results from an Ongoing Pilot Survey

Francisco Trujillo, Frente Cívico Nogalense, Nogales, Sonora
Diane Austin, University of Arizona

Many homes along the U.S.-Mexico border lack connections to potable water supplies and wastewater collection systems, and the widespread use of latrines constitutes one of the most significant environmental hazards in the region. In Nogales, Sonora, it is estimated that as many as one-third of all households lack sewer service. Installing composting toilets that safely and naturally break down human waste into sanitary and valuable compost can eliminate the need for sewage infrastructure and lessen the amount of water that is pumped out of aquifers in the Santa Cruz watershed to flush conventional toilets. In collaboration with the municipal government of Nogales, a demonstration project is underway to install composting toilets in Colinas del Sol, a neighborhood on the outskirts of the city, and to work with recipients to explore the function and feasibility of these toilets within the region. The project has received support from the Border Environment Cooperation Commission and the U.S. Environmental Protection Agency, as well as local organizations such as the Friends of the Santa Cruz River. A key element of the project is to explore whether these toilets can be a long-term, waste-management solution. A project advisory board composed of community leaders, educators, and government officials from both sides of the border has helped select the final designs for the toilets, develop a plan and criteria for selecting the households receiving the toilets, and develop the monitoring program through which students from the University of Arizona and local high schools are tracking residents' use of and experiences with the toilets. This poster will share information about the project and results from the first eight months of monitoring.

The Arizona Rivers Project: Water Science, Teachers, Kids, Stewardship

Jim Washburne, Martha P.L. Whitaker, John Madden, UA-Hydrology & Water Resources, SAHRA

Arizona's rivers and washes represent some of the most unique and ecologically diverse areas of the state. While Arizona's riparian environments might not always be obvious, many of us have sampled their richness and have made a commitment to maintain them for the future. Our children and our students can share in this stewardship of the land while preparing for challenging technical and scientific careers by undertaking individual and group research projects focused on a multitude of topics ranging from water quality monitoring to invasive species mapping; or from stream restoration to plant or animal identification and mapping. The Arizona Rivers Project seeks to facilitate student research skills

by promoting partnerships and collaborations between watershed and riparian “experts” and the next generation of Arizona citizens and scientists.

Arizona Rivers involves students and volunteers of all ages in addressing issues or questions that are developed locally and pertain to Arizona’s streams, including water quality, stream restoration, riparian ecology, and habitat preservation. A primary goal is to foster effective partnerships among schools, watershed management groups, state, county, or municipal regulators, and other water professionals. Workshops in Tucson, Phoenix, and Flagstaff have been held to train teachers, students, water professionals, and other volunteer river monitors about standard protocols for environmental data collection, and to promote new collaborations and data exchange. These workshops are crucial to offering teachers professional development in the context of real field experience, technical training, and collaborations with professional scientists who can offer support and mentorship. (www.azrivers.org)

Spatial Patterns of Effluent Dependent Waterways in Arizona

Margaret White and Juliet C. Stromberg, Arizona State University – School of Life Sciences

As population centers continue to expand throughout Arizona, societal demands are changing the flow regimes of many rivers and altering spatial patterns across the water landscape. Today, a new hydrologic dynamic has emerged as water consumption for growing urban development is increasing the generation of wastewater effluent and its discharge into stream channels or aquifers. As of 2008 Arizona has approximately 40 waterways designated as effluent- dependent. We present an analysis of the changing spatial patterns of effluent discharge and development of effluent dependent waterways over the past thirty years in Arizona using historic aerial photography and treatment plant discharge data. We also present a framework for categorizing the fate of municipal effluent. One aspect includes the intended use of the effluent; here, we quantify the degree to which effluent is 1) re-used directly, 2) recharged to aquifers for later re-use, or 3) used to create or sustain wetland/riparian habitat. We also categorize effluent discharge with respect to hydrogeomorphology of the receiving water bodies, recognizing that each type has different capacity to sustain hydroriparian vegetation. Our categories include 1) ephemeral channels within an endogenic dryland river; 2) channels of perennial or spatially intermittent rivers; 3) stream (alluvial) aquifers, and 4) regional (interbasin) aquifers. Over the coming decade both the number of municipal discharge points and the total effluent discharge is expected to increase, intensifying the need to understand ecological implications of effluent dependent systems.

Coordination of Monitoring Data: Discussion Summary

Suggestions have been made regarding the formation of a Santa Cruz River Monitoring Group for all agencies, organizations, and researchers conducting any monitoring along the Santa Cruz River. This optional discussion at Researcher's Day on March 27, 2009 was primarily a brainstorming activity that addressed the following:

- 1) what could be the benefits of such a group,
- 2) what structure would the group take
- 3) what ideas can be implemented immediately

(Note: any mention of 'we' or 'our' etc, refers to the monitoring group as a whole, and not any one organization)

1) What could the benefits be of a Monitoring Group?

A monitoring group could provide:

- context for our work
- a point of contact to know what has and has not been done and where data can be found
- prioritization of projects and/or data needs
- identification of data gaps

2) What structure would the group take?

There was a long discussion of how the group would work and what we would hope to accomplish. Was the group mainly to inform each other? Or both inform and influence management and policy?

In order to inform each other, annual meetings such as this year's Researcher's Day were thought to be helpful. In addition a website with a data clearing house would be helpful for accessing data in one location. The latter prompted discussion about the difficulties of having everyone's data in one location, a task that would require funding and challenging standardization/coordination of data. In addition, many organizations have already made data available on organizational websites and are thus unlikely to want to spend resources to replicate the effort.

An idea that would cost less money would be to meet annually and produce proceedings of the work presented, thus providing an account of the year's work. A website could host copies of the proceedings and serve as a central location for obtaining information pertaining to the Santa Cruz River. To create a less expensive 'data clearing house', information on available data, past and active projects, etc. could be made available with active links to other websites and/or providing contact information. Thus this website would serve as a 'first stop' in searching for information and data pertaining to the River. The

Friends of the Santa Cruz River (FOSCR) website was suggested as a logical option for such a website. The new Southwest Learning Center website could also serve as a potential location.

Regarding the desire to influence management and policy, discussion focused on providing more publicity and public education of the work on the Santa Cruz River. Tumacácori NHP suggested hosting a lecture series at the park that would invite a speaker to share their work with the public. This lecture series would occur throughout the year and provide a regular means of interacting with the public.

3) What ideas can be implemented immediately?

- Annual symposium/conference such as this year's Researcher's Day
- Data clearinghouse in the form of links and contact information added to an existing website such as Friends of the Santa Cruz River or the Learning Center
- Lecture series to inform the public

Future possibilities that are important but may lack funding to complete immediately:

- A synthesis document that combines and examines existing data
- Identification of data and research gaps and/or needs
- Development of Best Management Practices and policy actions that benefit the Santa Cruz River

Attendees and Contact Information

Name	Affiliation	email
Affolter, Dick	Tumacácori NHP volunteer	affolters@hotmail.com
Austin, Diane	University of Arizona - BARA	daustin@u.arizona.edu
Barcenas, Alejandro R.	ADWR	arbarcenas@azwater.gov
Bechtol, Vanessa	Santa Cruz Valley Heritage Alliance	vanessa@santacruzheritage.org
Becker, Jennifer	Pima County	Jennifer.Becker@rfcd.pima.gov
Blue Evening Star	Global Community Communications Alliance	acelanodaughter@gmail.com
Bremer, Lah-May	Global Community Communications Alliance	lahmay.bremer@gmail.com
Brusca, Rick	Sonoran Desert Museum	rbrusca@desertmuseum.org
Buckley, Steve	Arizona Remote Sensing Center, NPS – Sonoran Desert Network	buckleys@email.arizona.edu
Carrico, Lisa	NPS - Tumacácori NHP	Lisa_Carrico@nps.gov
Casavant, Robert		rcasavant@azstateparks.gov
Case, Natalie	Arizona State University	ncase@asu.edu
Coes, Alissa	USGS	alcoes@usgs.gov
Danforth, Carla	PCRCD	Carla.Danforth@rfcd.pima.gov
Drake, Sam	University of Arizona - OALS	sdrake@nexus.snr.arizona.edu
Ehret, Suzanne	Arizona Game and Fish Department	SEhret@azgfd.gov
Fitzgerald DeHoog, Lindsay	Sonoran Institute	lfdehoog@sonoraninstitute.org
Fonseca, Julia	Pima County	Julia.Fonseca@rfcd.pima.gov
Funicelli, Carianne S.	Recon	cfunicelli@recon-us.com
Girard, Michele	NPS - SOAR	michele_girard@nps.gov
Green, Paul		pgreen@tucsonaudubon.org
Gwilliam, Evan	NPS - SODN	evan_gwilliam@nps.gov
Hernandez Santos, Maritza	University of Arizona	
Hubbard, Andy	NPS - SODN	Andy_Hubbard@nps.gov
Hunter, Richard	NPS - Tumacácori NHP	rtubac@aol.com
Jakle, Marty	Friends of the Santa Cruz River	mjakle@cox.net
Kirkpatrick, Chris	University of Arizona	kirkpatr@email.arizona.edu
Kroesen, Kendall	Tucson Audubon	KKroesen@tucsonaudubon.org
Leitner, Wade	BirdWorks LLC	tyrannus@cox.net
McCoy, Amy	Sonoran Institute	Amccoy@sonoraninstitute.org
McDonough, Lisa	University of Arizona	brookem@email.arizona.edu
McIntyre, Cheryl	Sonoran Institute	cmcintyre@sonoraninstitute.org
Miexner, Thomas	University of Arizona	tmeixner@hwr.arizona.edu

Name	Affiliation	email
Moss, Jeremy	NPS - Tumacácori NHP	Jeremy_Moss@nps.gov
Nelson, Wayne	Tumacácori NHP volunteer	bwayno@yahoo.com
Norris, Larry	NPS - DSCESU	lnorris@ag.arizona.edu
Powell, Brian	Pima County	Brian.Powell@pima.gov
Przybyl, Janice	Sky Island Alliance	Janice@skyislandalliance.org
Quanrud, David	University of Arizona	quanrud@email.arizona.edu
Redman, Iona	Global Community Communications Alliance	ionia@globalcommunitycommunicationsalliance.org
Rice, Marisa	PCRFC	Marisa.Rice@rfcd.pima.gov
Riley, Kelley	University of Arizona	kriley@ag.arizona.edu
Roberts, Joanne	Arizona State Parks	jroberts@azstateparks.gov
Rock, Channah	University of Arizona	channah@ag.arizona.edu
Sass, Sherry	Friends of the Santa Cruz River	sushis1@earthlink.net
Sejkora, Bob	Arizona State Parks	rsejkora@azstateparks.gov
Silins, Joe		
Studd, Sara	NPS - SODN	Sarah_Studd@nps.gov
Sutter, Jason	ADEQ	jason.sutter@azdeq.gov
Trujillo , Francisco		kiko1022@prodigy.net.mx
Vandervoet, Prescott	University of Arizona - TAAP	plv@email.arizona.edu
Villarreal, Miguel	University of Arizona	miguel@email.arizona.edu
Washburne, Jim	SAHRA	jwash@sahra.arizona.edu
White, Margaret	Arizona State University	mwhite6@asu.edu
Wilbor, Scott	Tucson Audubon	swilbor@tucsonaudubon.org
Wong, Julie	University of Arizona - LTRR	juliebob_00@yahoo.com
Zaragoza, Gilberto	Rep. Raul Grijalva	Gilberto.Zaragoza@mail.house.gov
Zugmeyer, Claire	Sonoran Institute	czugmeyer@sonoraninstitute.org