Santa Cruz River Research Days

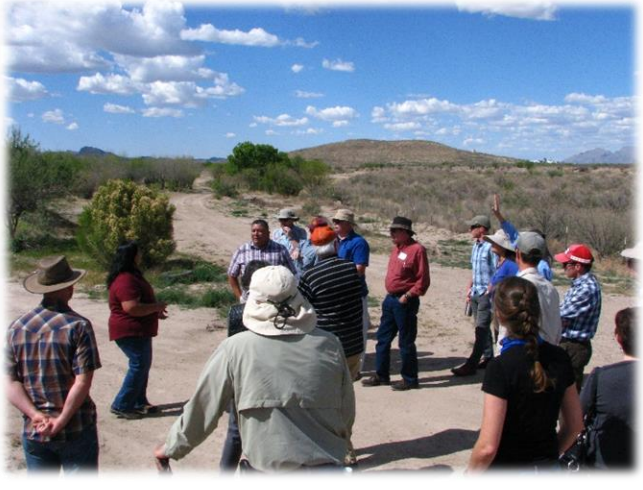
Proceedings

March 31 - April 1, 2016

Eighth Annual

Pima Community College – Desert Vista Campus

PimaCommunityCollege



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Introduction

The eighth annual Santa Cruz River Research Days took place on March 31 and April 1, 2016. This event is an opportunity for those conducting monitoring, research, restoration or other conservation efforts, focused on environmental or cultural resources along the Santa Cruz River, to share their work and findings through presentations and posters. This year included a special symposium focused on Restoration and Management of the Living River. This was followed by a field trip to the Wa:k Hik dan Riparian Restoration Project on the San Xavier District of the Tohono O'odham Nation. The following is a brief proceedings of the event, including abstracts of the papers and posters presented.

Proceedings and pdf copies of the presentations and posters from this year and past events can be found at www.tiny.cc/SCRRD_Archive. Other information about this annual event can be found at the Sonoran Institute website www.sonoraninstitute.org, use the site's search tool by entering "Research Days".

Event Sponsors and Planning Committee

Funding for this year's event was generously provided by Research Days Conference Attendees, Pima Community College – Desert Vista Campus, Pima County Regional Flood Control District, Pima County Regional Wastewater Reclamation Department, Tohono O'odham Nation – San Xavier District, and the U.S. Environmental Protection Agency.

This year's planning committee included the following individuals and organizations:

Paul Fish, Arizona State Museum
Suzanne Fish, Arizona State Museum
Sherry Sass, Friends of the Santa Cruz River
Roger Anyon, Pima County Office of Sustainability and Conservation
Evan Canfield, Pima County Regional Flood Control District
Claire Zugmeyer, Sonoran Institute
Jason Welborn, Sonoran Institute
Forrest Sherman, Southwestern Arid Grassland Ecology
Adam Springer, Tumacácori National Historical Park

Special Thanks To:

Pima Community College, Desert Vista Campus – who provided a great venue for this event; and 2016 Research Days Presenters, Symposium speakers, and Attendees.

Tohono O'odham Nation, San Xavier District - who sponsored the field trip to their riparian restoration site by allowing us access to their land and providing transportation for all participants.

Program

Thursday, March 31, 2016

8:30 - 9:00 am	Sign-in and Refreshments
9:00 - 9:10 am	**Welcome**
9:10 - 9:30 am	Keith Willett – Oklahoma State University *Economic Allocation of Water Use and Benefits in the Santa Cruz Border Region*
9:30 – 9:50 am	Claire Zugmeyer – Sonoran Institute *Living River – Changes along the Upper Santa Cruz River between 2008 and 2014*
9:50 - 10:10 am	Evan Canfield – Pima County Regional Flood Control District *The Living River Project – Community engagement and tracking changes on the Lower Santa Cruz*
10:10 – 10:30 am	POSTER INTRODUCTIONS (2-minute "rapid fire" presentations)
10:30 – 10:50 am	**BREAK**
10:50 - 11:10 am	Nick Paretti– U.S. Geological Survey *Spatial and Temporal Distribution of Bacteria Indicators and Microbial Source Tracking Markers within Tumacácori National Historical Park and the Santa Cruz River Watershed*
11:10 - 11:30 am	Natalie Brassill– University of Arizona *Engaging Citizen Scientists in the Santa Cruz River: Monitoring Biological Pollutants*
11:30 - 11:50 pm	Jennifer Duan – University of Arizona *Sediment Transport Analysis for the Santa Cruz River using HEC-RAS Model*
11:50 - 12:10 pm	Shane Snyder – University of Arizona *Fate and Transport of Glucocorticoid Steroids in the Lower Santa Cruz River*
12:10 – 1:20 pm	**BREAK FOR LUNCH**
1:20 - 1:40 pm	Janelle Gaun – National Park Service *Springing into Action: Assessing Springs and Tinajas in the Santa Cruz River Watershed*
1:40 - 2:00 pm	Matt Chadsey – Earth Economics *Including Ecosystem Services in Benefit Cost Analysis for Lower Sabino Creek*
2:00 - 2:20 pm	Catlow Shipek – Watershed Management Group *Establishing a dynamic water budget to support flow in Lower Sabino Creek*
2:20 - 2:40 pm	Forrest Sherman – Southwestern Arid Grassland Ecology, Inc. *Small scale restoration of a riparian area after major flood event*
2:40 - 3:20 pm	POSTER SESSION
3:20 - 3:40 pm	Eylon Shamir – Hydrologic Research Center, San Diego *Water Resources & Climate Assessment Tool [WARCAT] for the Santa Cruz AMA*
3:40 - 4:00 pm	David Walker – Walker Ecological Services *Assessment of Aquatic Ecosystem Integrity in the Santa Cruz River: Macroinvertebrates as Biological Indicators*
4:00 – 4:20 pm	Daniel Bunting – Harris Environmental Group, Inc. *Assessment of Streamside Herbaceous and Riparian Woody Vegetation along the Lower Santa Cruz River, Year 3*
4:20 – 4:40 pm	Elizabeth Makings – Arizona State University *A Perspective on the Flora and Vegetation of the Lower Santa Cruz River Flats*

Friday, April 1, 2016

8:30 - 9:00 am	Sign-in and Refreshments
9:00 - 9:10am	**Welcome**
SYMPOSIUM: RESTORATION AND MANAGEMENT OF THE LIVING RIVER	
9:10 - 9:35 am	John Hays – Santa Cruz County *Potrero Creek Wetland – Possibility of Flood Mitigation through Habitat Restoration*
9:35 – 10:00 am	Jennifer Becker – Pima County Regional Flood Control District *Kino Environmental Restoration Project (KERP): Harvesting Stormwater for Environmental and Community Benefit*
10:00 - 10:25 am	Deirdre Brosnihan – Pima County Regional Flood Control District *Paseo de las Iglesias: Integrating Habitat Restoration into River Park Design*
10:25 – 10:45 am	**BREAK**
10:45 - 11:10 am	Jonathan Horst – Tucson Audubon Society *Restoration through changing circumstances along the lower Santa Cruz River*
11:10 - 11:35 am	David McKee – City of Flagstaff *Frances Short Pond – A community's vision*
11:35 - 12:20 pm	Panel discussion with all symposium speakers
12:20 – 2:00 pm	**BREAK FOR LUNCH**
2:00 – 4:30 pm	**Field Trip – Tour of Wa:k Hik dan Riparian Restoration Project**

Poster Presentations (both days)

Kremena Boyanova Franck Poupeau (2 posters)	Kiel University, Victoria University of Wellington University of Arizona 1 - *Water Bankruptcy in the Land Of Plenty. Steps towards a transatlantic and transdisciplinary assessment on the nature and causes of water scarcity in Southern Arizona* 2 - *Quantification of Water-related Ecosystem Services in the Upper Santa Cruz Watershed*
Hans Huth	Arizona Department of Environmental Quality *Exploring Open Source Alternatives for Nonpoint Source Pollution Monitoring*
Holli LaBrie	University of Arizona *Influence of the Nogales International Wastewater Treatment Plant on Santa Cruz River*
Mary Reynolds	University of Arizona *How the 1887 Sonoran Earthquake Changed the Santa Cruz River*
Forrest Sherman	Southwestern Arid Grassland Ecology, Inc. *Using a Geographic Information System (GIS) to Establish Likely Water Table Elevations*
Amanda Smith	Pima Association of Governments *Using Watershed Health Indicators to Improve Management Strategies and Community Engagement*
Alexander Wassimi	University of Arizona *Evaluation of Coliphage as an Indicator for Human Enteric Viruses in Wastewater Treatment Plants*

Meeting Impact and Evaluation Results

We evaluate Santa Cruz River Research Days to do two things – 1) try to assess and track the impact of this annual gathering on conservation efforts, and 2) get feedback from meeting participants to help with planning of future events.

Quick Summary measures

OVERALL ATTENDANCE – approximately 80 attendees over the course of 2 days.

UNIQUE AFFILIATIONS – attendees listed 33 different organizations, groups, agencies, university departments, local government, state/federal government, and community members as their affiliation.

Evaluation Results

Total evaluations received - 30

Of these 30 evaluations:

- Each affiliation option was selected at least once. Options included local government, state/federal government, organization, university, community group, interested individual, and other. Other responses included – consultant and interested public
- 19 were completed by attendees who attended/participated in both days

What days did you attend?

Day 1 AM	Day 1 PM	Day 2 AM	Field Trip
22	22	23	10

QUESTION 1 – **What did you find most valuable or interesting in the workshop?**

Networking
Breadth of the topics and succinct presentations by authors. Posters excellent way to widen what is presented with limited time--chatting with 'poster people' very enlightening and interesting. Venue and services there excellent.
the diversity of presentations-- each was interesting but combined was super interesting
networking...
results of flow after the wwtp was updated, great mix of speakers, would like more graduate students presenting.
Meeting new people with similar interests and possiblities for collaboration
The emphasis on riparian areas and aquatic life in the river enhanced the thought of tradeoffs that exist in the Santa Cruz River Basin
The bulk of the presentations were great. There were a few clunkers, though (very first presentation; the one by Jennifer Duan, which was too dense and not explained well; and the one by Dave Walker, which I thought was more like an act rather than a presentation). I liked the two-minute mini poster presentations.
Symposium topics, Field trip!
panel discussion
I really enjoyed the symposium and moderator led session
very diverse talks - thank you!

Learning about all the restoration work being done within the watershed
I really loved the description of projects in the symposium - all of htem. Most useful new info was Matt Chadsey - Earth Economica. Most immediately and personally beneficial was Natalie Brassill - storm event monitoring
The variety of topics all unified by the watershed, the exposure to the variety of exciting work
Networking with other researchers, Watershed Mgmt presentation on Sabino Creek - Matt Chadsey and Catlow Shipek
The range of restoration projects. Very interesting to see concepts put into action
the viewpoints and info from the variety of projects, comparison of their experiences
learning about what's going on
keep going; more cultural/history etc
Discussion of partnerships and funding sources that make these projcts possible. Also, the types of info/research necessary and useful in accomplishing work on the ground
networking with participants and learning about local projects
the range of talks was good. The panel discussion was great (interactive with crowd)
facilitated discussion
many of the great presentations
Hearing how projects that might not be focused on a healthy functional river are finding ways to include habitat, wildlife, fauna, etc.
networking

QUESTION 2 – **Conference Value**

To date direct and in-kind funding support from numerous organizations and community members have kept admission free. As the event has grown, logistical challenges, such as finding a free venue, have increased.

If the SCRRD Steering Committee has to charge a registration fee, would you still attend?

Yes	No	Other/No Response
22	3	5

What is a fair registration fee for this event? Responses fell into the following break-down

$10-20	$25-40	$50-100	Other/No Response
5	8	8	9

QUESTION 3 - **Facility**

Was the space comfortable?

Yes	No	Other/No Response
24	0	1

COMMENTS -

Very pleasantly surprised by the venue and the quality of the food (and cafeteria at lunch) was exceptional for an event of this type.
But got a little cold in the afternoon

the dual screens was difficult
two screens was difficult for presenters

Could you hear the presentation?

Yes	No	Other/No Response
26	1	3

COMMENTS -

This is a yes-no answer . . .Please ask that all use the microphone, and when they're mumbling it's not rude to ask them to speak up.
I sat in the front row
In my experience, the "I'll talk loud" comment rarely works out. Speakers start winding down until you can't hear them. Using a lavaliere mike instead of a handheld mike would make it much easier for the speakers to accept.
People really need to be req'd to use the microphone
most of them - organizers addressed this as well as they could
speakers could have made better use of the microphones
at edge of needing mic - suggest

Was parking easy?

Yes	No	Other/No Response
17	1	12

COMMENTS -

Handicapped spaces on that side of the building consisted of one (already taken), so it was a bit of a hassle but we worked it out.
great/easy
excellent
very good
ok
convenient
fine
bad first day, difficult to find room/good day 2

Other comments about the venue?

The way you kept speakers on track timewise was great and should be adopted by more seminars and conferences.
Thursday lunch was great! Cheap and really tasty.
Split screen was a little awkward. Presenters need to speak to both sides of room and use laser pointer on both screens
The dual screen presentation format was useful
Good venue.

Location, I liked that we were right next to the river! Let's do a talk/walk lunch option next time to walk over to it.
beautiful, perfect site
very nice and great to have two screens
the split screen was a disadvantage, used better on day 2 than day 1
the catering was fabulous
good lunch at cafeteria, great scones at start
easy access
difficult setup with two screens, hard angle for presenters
signage
running out of coffee 3/31 am was bad and water 3/31 pm was bad
very good, easy to get to
single screen much better than two

QUESTION 4 - **Content**

Were the presentations useful?

Yes	No	Other/No Response
29	0	1

COMMENTS -

For the most part, found them interesting and informative. Some were a bit heavy on graphs, but with some studies that is to be expected. Would suggest a bit more review of unknown authors or out-of-state authors beyond them applying/volunteering with just an abstract--reality and quality of study can be quite different.
Both interesting and useful.
very much so, really liked the diversity and scale differences
some were repetitive March 31
a little too much govt hydrology/flood control

Was 20 min the right amount of time for each presentation?

Yes	No	Other/No Response
28	1	1

COMMENTS -

20 is needed for presentation but doesn't really allow much time for questions. Perhaps having a question/answer panel day 1 at end of day could wrap up that, or if authors could be available for questions during the poster session. . just never seems to be enough time short of deleting a presentation or two!
yes- any more is a bit too long
perfect
although some could have gone longer
25 minutes for Q and A

Were the 3 minute poster introductions helpful?

Yes	No	Other/No Response
23	0	7

COMMENTS -

Very much so, great format to present subjects that may not be apparent from initial look at the posters. Poster session very informative.
This is an especially good feature. I was not able to actually spend as much time as I would have liked to at each poster, and some were very busy posters. It was a bit difficult to get all of the info from the posters. But the short presentations made it possible to at least know what was there and to look forward to the proceedings to get the full info.
extremely so!
I liked the range of topics covered by the posters
did not hear, had to miss that
very I like that!
n/a
not memorable

QUESTION 5 – **Symposium and field trip**

Were symposium presentation useful and interesting?

Yes	No	Other/No Response
23	0	7

COMMENTS -

Yes, pretty much covered this in earlier comment.
n/a
Yes, as a rule. See earlier comment.
For me, especially interesting since one of the topics was a project of ours. I thought the 4 topics fit well together and complemented one another
liked panel discussion
could not attend :(
fantastic

Was the field trip useful/interesting?

Yes	No	Other/No Response
5	0	25

COMMENTS –

Unfortunately was not able to attend, but heard great things about it . . . very timely way to wrap everything up with a hands on-boots on the ground reality check. Good reminder of why everyone was there in the first place!
I did not go
n/a
Yes, I quite enjoyed it. It shows, though, the daunting challenge of riparian restorations. Such a small area restored,such a large area remaining.
SO wonderful, thank you!
did not attend
not sure yet but I'm excited

QUESTION 6 – **New Collaboration**

Research Days is designed primarily as a forum for learning. However, we hope this can galvanize new projects and collaborations, and help avoid duplication. The following two questions are helping us understand if we are meeting this goal.

Do you know of any new project or collaboration that has arisen in part due to networking that has occurred at Research Days?

Yes	No	Other/No Response
6	16	8

COMMENTS –

Working on these
I'm new

IF YES, CONTACT PERSON OR DESCRIPTION OF COLLABORATION –

Finally was able to put the face with some names I've seen on publications and some affiliated with local NGOs. . so good to meet them personally.
Have some ideas, but nothing has solidified yet.
Evan/Frank K. We talked about Pima Co. doing some flood irrigation at Helfrich Pond to nourish cottonwoods there IF it's possible to tap into reclaimed line, get approval etc.
springs contacts elsewhere
UA w/USGS and ADEQ
working on it
David McKee/Jonathan Horst
ADWR re: NPDES issues, KERP
TAS and SAG possible project

Has any new conservation funding resulted from this project or collaboration? If yes, was the funding new, existing, in-kind, or all of these?

Yes	No	Other/No Response
1	15	14

QUESTION 7 – **New Directions**

What are your interests in potential new topics at future Research Days?

COMMENTS –

Review of current research, especially new research or projects, any longitudinal study results if available. Perhaps a cultural component (if available). Hearing what local NGOs are doing, even if just reviewing their scope and activities, is very enlightening.
I look forward to hearing about new projects, but even more to about hearing how the existing projects are turning out, especially with longer-term monitoring.
I feel that the river upstream of Nogales is given short shrift. Part of that is due to the lack of work in Mexico, and lack of attendance from Mexican partners. I propose 30-45 minutes for shorter presentations on the San Rafael Valley for next year's agenda.
Topics on tributaries to Santa Cruz River: Pantano, Tanque Verde, Rillito. What about the Santa Cruz in Mexico?
More emphasis should be given to modeling schemes that capture the full tradeoffs of the competing uses for water
Impact of stormwater controls on water quality. More presentations by Shane Snyder--we are privileged to have him here in Tucson. Presentations on how to keep the Santa Cruz River wet considering the pressure to reuse more reclaimed water.
1- more detail and update on the San Xavier District's work (Scott Rogers had some aerials etc - very interesting. Maybe offer another field trip, since it's off limits for most of us; 2 - young persons involvement in restoration YES? Or Scouts or YCC? 3- cultural resources presentation - prehistory, history de Anza, los morteros, San Augustin/Tucson origins and historic plants/food produce
wetlands mitigation ??? For fun and long-term stewardship
this year was great
more on getting community buy-in
Economic impact, increased land values along recreational path (The Loop); solutions to high E. coli instead of just measuring it; historic changes of SC River water course
reports on work in upper watershed would be interesting
challenge of getting public behind Santa Cruz River enhancement, social values, perception of river
creative funding sources/ideas, what happens when all the reclaimed water is being used and not going into the river? Is there a way we can lobby for the beneficial guarantee of a certain flow?

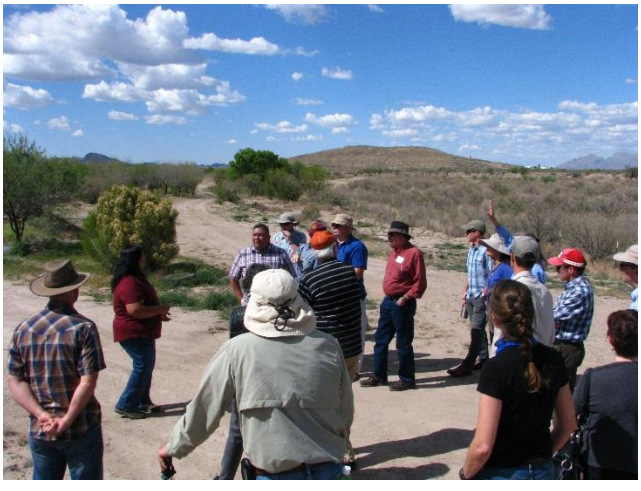
Additional Meeting Feedback

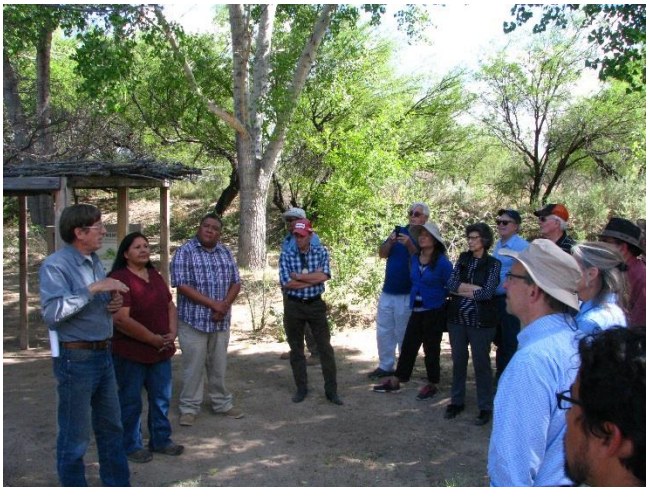
A+, obvious a lot of work, thought and time went into this . . . thank you!
It gets better each year.
We need to get more representation from Mexico! I would definitely pay more for registration as a way to defray the costs of Mexicans attending the conference.
The split screens were distracting, more space for the poster presenters
Thanks so much for coordinating it! I liked the food at Pima College also--breakfast snacks provided and my purchased lunch.

great event, lots of useful info, great connections - I really love this event!
This was my first RD conference. I'm not a researcher but I am an involved citizen and this experience leaves me hopeful that challenges can and will be met - and in ways that might actually produce a better outcome in more interdisciplinary ways
I like the presentation on springs in Rincon Mtns. The Shane Snyder presentation was a little too technical/pharmacological for me; venue - speakers need to address both sides of room and use pointers at both screen
It would be helpful if audience members introduced themselves and their organizations when they ask questions or make comments
this was my first meeting and I reall enjoyed it. Thanks
no
you guys ROCK!

Special Symposium and Field Trip – Restoration and Management of the Living River

On April 1, a special symposium moderated by Sarah Hammond, Science Producer for Arizona Public Media, and off-site field trip were organized. Included here are the full abstracts of the symposium presenters in order of presentation. Following the symposium, a field trip to the San Xavier District's Wa:k Hik dan Riparian Restoration Project was attended by 26 people.





Potrero Creek Wetland – Possibility of Flood Mitigation through Habitat Restoration

JOHN HAYS, Santa Cruz County

The Santa Cruz County Flood Control District is looking into the possibilities for doing a project to mitigate flooding along the Potrero Creek, especially in the downstream areas affecting the Pete Kitchen Trailer Park and Chula Vista Subdivision. The concept is to take the now defunct Palo Duro Golf Course and return as much of the golf course as possible back to a natural wetland by excavating and removing the fill placed at the time of construction of the golf course, and embarking on a program to restore the native wetlands in the area though plantings. Once potential concept for the restoration is to also incorporate it with the help of an appropriate non-profit environmental concern as the first ever "wetland mitigation bank" in the state of Arizona.

Kino Environmental Restoration Project (KERP): Harvesting Stormwater for Environmental and Community Benefit

JENNIFER BECKER, Pima County Regional Flood Control District

Kino Environmental Restoration Project (KERP) transformed a 1960s-era conventional flat-bottomed detention basin surrounded by chain link and barbed wire into an environmental and water resource asset. The project was a cooperative effort between the Pima Country Regional Flood Control District and the US Army Corps of Engineers, and was completed in 2001. KERP covers 140 acres and captures stormwater from a 17-square mile watershed, making it the single largest urban water harvesting project in Arizona.

KERP was designed and constructed to preserve the existing flood control benefits of the detention basin, plus retain stormwater to sustain an urban oasis with over 50 acres of open water and riparian vegetation communities. The constructed and lined ponds and streams are kept wet throughout the dry seasons by recirculating the harvested stormwater. In the event of extended drought, municipal reclaimed water can be used in the basin to prevent die-off of obligate riparian vegetation. Excess stormwater is pumped (essentially harvested) from the basin to provide irrigation for landscaping and turf throughout the adjacent Kino Sports Complex, significantly reducing the County's irrigation needs and expenses. KERP also provides passive recreation benefits including 2.2 miles of paved path surrounding the basin and fantastic birding opportunities.

KERP continues to present unique and challenging maintenance needs. Pima County Regional Flood Control manages the facility in partnership with Stadium District and Regional Wastewater Reclamation Departments. There have been many lessons learned related to design, permitting, construction, operation, and wildlife conservation. The project won the 2006 U.S. Army Corps of Engineers Chief of Engineers Award of Excellence for Environmental projects. According to the Corps, "This is truly an exceptional project. It takes an existing mud flat in an arid area and creates aesthetic landscapes, recreation features, flood control, and is a prototype for water harvesting. It is technically sophisticated while appearing natural. It has proved sustainable over the recent drought years."

Paseo de las Iglesias: Integrating Habitat Restoration into River Park Design

DEIRDRE BROSNIHAN – Pima County Regional Flood Control District

Colby Henley, Lori Woods, Kate Connor – RECON Environmental, Inc.

Historically Pima County Regional Flood Control District, in Southern Arizona, has created river parks to provide recreation opportunities along water courses where erosion protection was needed. However, the Paseo de las Iglesias River Park, located on the Santa Cruz River between Ajo Way and Silverlake Road, was conceptualized in its inception with three integrated focus areas: ecosystem restoration, erosion protection, and river park. At the beginning of the project, the 400-acre project area presented a myriad of challenges, including historic degradation, hydrologic downcutting, lowered water table, invasive species infestations, wildcat dumping, and homeless encampments. The design process was a collaborative effort among a large, multidisciplinary team seeking to balance the three primary goals of providing erosion protection, river park trails and amenities, and restoring habitat and ecosystem values. The ecosystem restoration components included: preserving native species and plant community remnants, protecting sensitive and special action species, removing invasive plant and animal species, and planting over 10,000 native trees, shrubs, cacti and perennials to create four specific habitat types.

- This session will include discussion of the unique aspects of this project and “Lessons Learned” during the design, implementation and monitoring phases, such as:
- Client with understanding of broader context of the watershed, the site and past planning efforts Interdisciplinary Design Team with unique specialties including restoration specialists
- Translating the complexities and scale of project from design to construction, and adapting implementation to field conditions
- Utilizing new techniques and materials; incorporating additional training for work crews
- Incorporating flexibility and experimental freedom into design and implementation
- Client’s commitment to monitoring success during establishment period

A summary discussion of research opportunities, public benefits, improved conditions, and elements of the project that can be applied to a different scale will be included.

Restoration through Changing Circumstances Along the Lower Santa Cruz River

JONATHAN HORST, Tucson Audubon Society

Since 2001, Tucson Audubon has been working along the lower Santa Cruz River at the North Simpson Farm in NW Marana. During that time numerous physical and environmental constraints to the project have occurred, both anticipated and unanticipated. Massive flooding, massive berms, and changes to water availability via the extent of effluent flow in the channel and changes in neighboring irrigation practices have all severely impacted what restoration approaches are appropriate and feasible. To create a site resilient to these changes, and expected regional directions of climate change, Audubon is exploring new strategies to address system function and appropriate vegetation.

Frances Short Pond – A Community's Vision

DAVID McKEE, City of Flagstaff

How a small scale community based project became the catalyst for change. This is story of Frances Short Pond and how this little pond along the Rio de Flag has become a driving force behind developing a watershed management plan, maintenance program, restoration plan along with an educational curriculum and classroom.

Oral Presentation Abstracts

(Listed in alphabetical order by presenter)

Engaging Citizen Scientists in the Santa Cruz River: Monitoring Biological Pollutants

BRASSILL, NATALIE, University of Arizona

Dr. Channah Rock - University of Arizona

Kyle Palmer, Samuel Breedlove, Krista Osterberg, Jason Sutter – Arizona Department of Environmental Quality

The Santa Cruz River is currently classified as "impaired" with the bacteria *Escherichia coli* (*E.coli*) that has exceeded water quality limits since the late 1990s. In an effort to reduce pollution within the watershed, the Arizona Department of Environmental Quality (ADEQ) and the Environmental Protection Agency (EPA) have collaborated with the University of Arizona (UA) to develop a local volunteer water quality monitoring program. Volunteer programs can be an extremely valuable asset to states' water quality monitoring programs by expanding data collection efforts and resource assessment opportunities. Volunteer collected data can also provide important baseline information to assist with decision-making and resource assessment. This project seeks to encourage collaborative efforts by individuals, partnerships, organizations, and businesses to protect, enhance, and monitor the health of the Santa Cruz River watershed through intensive training, as well as volunteer service. Since February 2015, citizen scientists have collected and analyzed samples during rain events along the Santa Cruz River and within it's surrounding watershed. Water quality data has been collected within this past year and will continue to be collected into 2017. This information helps to identify potential pollution contribution sources and will lead to better management solutions for the Santa Cruz River and it's tributaries. The collaboration between Santa Cruz County citizens, UA and ADEQ will allow for trained citizen scientists to conduct boots on the ground research along the Santa Cruz River and its tributaries. Information collected by local volunteers will be used as a basis for a Watershed Implementation Plan that will outline specific pollution sources and also detail solution Best Management Practices

Assessment of Streamside Herbaceous and Riparian Woody Vegetation along the Lower Santa Cruz River, Year 3

BUNTING, DANIEL, Harris Environmental Group, Inc.

Pima County invested $660 million for the Agua Nueva Wastewater Reclamation Facility (WRF) and the Tres Rios WRF projects, which discharge treated effluent into the lower Santa Cruz River (LSCR). Riparian vegetation is one of 16 indicators selected as part of a comprehensive, EPA-funded assessment of ecological impacts of improved water quality. Vegetation surveys were initiated in 2013, which provided baseline data prior to the WRF upgrades. Streamside herbaceous vegetation has been surveyed annually since 2013 using 1-m quadrats placed along randomized transects within the wetted margins of the active river channel. In addition, permanent belt-transects established in 2013 were revisited in 2015 to assess riparian woody vegetation. Species richness, which was similar between 2013 and 2014 (51 and 56 species, respectively) increased to 64 species in 2015. From 2014 to 2015, the average wetland indicator score across all sites increased from 2.76 to 3.19 (showing a trend toward drying conditions) and the nitrogen affinity score decreased from 6.16 to 5.76 (representing plants with lower tolerance to nitrogen), but neither differed significantly ($p=0.15$ and $p=0.38$, respectively; matched pairs analysis). Woody plant density rank remained the same for trees (saltcedar > seep willow > velvet mesquite) and shrubs (burrobrush > cattle saltbush > desert broom). More dead athel tamarisk, Goodding's willow, and Fremont cottonwood trees were observed in 2015 compared to 2013. Goodding's willow and Fremont cottonwood density slightly decreased while saltcedar density decreased significantly. While both WRFs improve the quality of water discharged into the LSCR, the total discharge volumes may decrease in the future due to increased use of recycled water for municipal purposes. While this study documents immediate impacts from the 2013 WRF upgrades, longer-term data will be required to understand long-lasting impacts to riparian vegetation.

The Living River Project – Community Engagement and Tracking Changes on the Lower Santa

Cruz

CANFIELD, EVAN, Pima County Regional Flood Control District

As communities in the Desert Southwest search for optimal use of all water resources, including effluent, stakeholders and decision-makers must be informed of the water resources benefits and ecosystem services provided by effluent in order to determine how to make wise choices for the community. In Pima County near Tucson, the annual *Living River report* has sought to track changes in the effluent-dependent reach of the Lower Santa Cruz River using a set of 16 indicators, selected by a technical committee of experts, and displayed in an easy-to-understand, graphically-engaging booklet. These indicators align with ecological features having demonstrated significance to the general public, based on a recent public perception study of this reach sponsored by U. S. Environmental Protection Agency.

The first report provided baseline conditions, and the second captured dramatic changes following upgrades to the two regional wastewater treatment facilities, which release effluent to the river resulting in a perennial effluent-dependent reach. These changes included a near-doubling of infiltration volume with a commensurate reduction in effluent flow extent, an increase in the diversity of the macro-invertebrates in the water, an increase in the diversity and extent of fish, and a substantial reduction in odor. Pima County has begun engaging school children in this discussion using the *Living River of Words* youth poetry and art contest, where children go to the river, engage in science activates and then portray what they have learned in art and poetry. Through these efforts the project team is making our community aware of the ecosystem services provided by the effluent-dependent Santa Cruz River so that wise choices can be made for our community.

Including Ecosystem Services in Benefit Cost Analysis for Lower Sabino Creek

CHADSEY, MATT, Earth Economics

Restoration projects typically provide a wide range of benefits to the local economy called ecosystem services. These services represent real and often substantial dollar contributions from nature to the local economy. Ecologists and ecological economists recognize 23 different ecosystem services ranging from flood mitigation to recreation, water supply, and cultural value. In the past these services have been difficult to identify and value and have largely been omitted from benefit cost analysis. Today, techniques are becoming more widely used and are federally accepted for certain types of analysis. Inclusion of ecosystem services in benefit cost analysis gives decision makers a more comprehensive understanding of their projects and helps identify those that provide broad, long-term benefits.

Earth Economics' has generated preliminary ecosystem service values that can be immediately used to analyze planned restoration projects within Sabino Creek and other riparian restoration sites in the Tucson area. These values will help stakeholders identify, quantify, and monetize a broad range of benefits.

Sediment Transport Analysis for the Santa Cruz River using HEC-RAS Model

DUAN, JENNIFER, University of Arizona

Since 2013, the effluent reach of the Santa Cruz River has been monitored at five cross sections. The monitoring activities include quarterly survey of selected cross sections, flow and sediment measurements. These data were used to calibrate the sediment transport model. A sediment rating curve was developed based on measured bed load and suspended load during based flow periods. To evaluate the performances of different sediment transport equations, simulations were performed by using these seven different equations while keeping the boundary conditions, the allowable maximum erodible depth, fall velocity method, and sediment sorting method the same.

The calibration run selected the reach from the Cortaro Road to the Trico Road along the Santa Cruz River. The observed flow at the Cortaro gauge was used as the upstream boundary condition. The downstream boundary condition is normal depth having a bed slope of 0.003. Cross sectional measurements at the Twin Peak, Sanders, and Cortaro Road within the study reach were used to calibrate the model. Ackers-White, Meyer-Peter, and Yang equations yielded the best results. Using the sediment rating curve, the results are not better than those from the three equations. This attributes to the fact

that sediment rating curve is developed primarily based on low flow data. At high flow discharges, sediment transport rate does not follow the trend from low flow data. Therefore, these three sediment transport equations are considered as the best for the sediment transport analysis in this study reach.

Springing into Action: Assessing Springs and Tinajas in the Santa Cruz River Watershed

GAUN, JANELLE, National Park Service

In the arid southwest, springs represent a small fraction of the landscape but can have disproportionately large ecological value as sites with high endemism and biodiversity. Although they are located in the far reaches of the Santa Cruz watershed, small bodies of surface water like springs and *tinajas*, or spring-fed stream pools, are keystone ecosystems critical to promoting landscape-scale connectivity and habitat for endemic species. Rapidly expanding urban and suburban development, groundwater pumping, and climate change are all placing springs under increasing stress. Despite their importance, springs are poorly documented and rarely studied. Over the last 4 years the Sky Island Alliance (SIA) and the National Park Service (NPS) have undertaken extensive survey, inventory and monitoring efforts at springs throughout Saguaro National Park and the Sky Island watersheds of the Santa Cruz. The goal of these surveys is to identify vulnerabilities and create management strategies to preserve habitat connectivity. We will provide an overview of this effort, natural and cultural values of springs, and spring restoration goals in the Santa Cruz watershed.

A Perspective on the Flora and Vegetation of the Lower Santa Cruz River Flats

MAKINGS, ELIZABETH, Arizona State University

The “Flats” of the Lower Santa Cruz River and adjacent floodplains is an interesting study of the resilience of riparian communities and their ability to persist in spite of profound human impacts. This talk will summarize the biogeography of the region from the river’s confluence with Arroyo Los Robles downstream to the Ak Chin and Gila River Indian reservations with an emphasis on plant communities, and will explore the impacts of recent human history on the structure and composition of the Flats.

Spatial and Temporal Distribution of Bacteria Indicators and Microbial Source Tracking Markers within Tumacácori National Historical Park and the Santa Cruz Watershed

PARETTI, NICK, United States Geological Survey

Tumacácori National Historical Park (TUMA) was initially established to protect, preserve, and tell the story of the old Spanish and O’odham mission church. In 2002 Congress expanded the Park’s purpose and mission by increasing TUMA’s area by 300 acres to include a reach of the Santa Cruz River in order to protect and improve the riparian habitat and provide visitors with a more complete picture of mission life. In 2015, the U.S. Geological Survey (USGS) Arizona Water Science Center in cooperation with TUMA initiated a 3-year study as part of the NPS/USGS Water Quality Partnership Program to better understand the spatial and temporal distribution of bacteria indicators and microbial source tracking (MST) markers within the Park. The first year objective of the investigation was to quantify the temporal and spatial variability of *Escherichia coli* (*E.coli*) concentrations and loads transported to TUMA. Year two (2016) is focusing on the source of bacteria entering the park through MST analysis. The AZWSC has installed instrumentation from Nogales Wash at Ruby Road to the USGS streamgage at Tubac, including 8 pressure transducers to measure the timing and relative magnitude of discharge, two automatic samplers to sample event hydrographs for *E.coli* and suspended sediment, and a continuous turbidity sensor to test predictive relations. A range of flow conditions and several storm types have been sampled over different event hydrographs for *E.coli*, suspended sediment, and other water quality parameters. Preliminary findings show that *E. coli* concentrations are dependent on, and vary with, the diel hydrograph and (or) flood conditions. Changes in concentrations and loads varied by as much as an order of magnitude during various hydrologic event types. Information about the range of water quality conditions is important for computing accurate loading entering the Park.

Water Resources and Climate Assessment Tool (WARCAT) for the Santa Cruz AMA

SHAMIR, EYLON, Hydrologic Research Center, San Diego

A publicly available web site that provides information to decision makers for optimal water resources management in the Santa Cruz Active Management Area is currently being developed. The site is designed as a one-stop portal that serves pertinent and timely local hydrological and meteorological datasets. The current real-time data are compared with respect to historical conditions using a set of intuitive graphical presentation. The portal, which includes a comprehensive regional database, also provides a first order seasonal and short-term hydrologic and climatic forecasts for the SCAMA, based on the Climate Forecast System (CFS) from the National Centers for Environmental Prediction (NCEP), NOAA.

Pertinent datasets are retrieved in realtime from the US Geological Survey (streamflow), US National Weather Service (rainfall), Arizona Department of Water Resources (groundwater) and the ADWR/ALERT system maintained by EFuller (rainfall and streamflow). In this presentation, we will demonstrate a retrospective analysis of the portal performance during the 2016 water year, the strongest El Nino in the modern record. The demonstration will focus on the system interpretation as it relates to water resources management in the SCAMA.

The web portal is being developed by the Hydrologic Research Center, San Diego. Funding is provided by the Arizona Department of Water Resources (ADWR), Santa Cruz AMA Augmentation and Conservation Fund – Installment, under a contract with the Water Resources Research Center (WRRC) University of Arizona.

Small Scale Restoration of a Riparian Area after Major Flood Event

SHERMAN, FORREST, Southwestern Arid Grassland Ecology, Inc.

In 2006 a large flood altered the streamflow in Bond Canyon, Santa Cruz County. About 62 acres of riparian area was effected. A small scale project treating about 4.5 acres of the heavily altered stream bed was implemented. This area was impacted by shifting the stream flow to only one side of the channel. This change in flow dewatered most of original channel leading to loss of existing of riparian vegetation. Hand built low maintenance structures were placed in the streambed to reestablish the original stream flow pattern. These structures reestablished the flow pattern with subsequent regrowth of vegetation.

Establishing a Dynamic Water Budget to Support Flow in Lower Sabino Creek

SHIPEK, CATLOW, Watershed Management Group

Restoring Lower Sabino Creek is the first targeted effort in WMG's larger 50 Year Program to restore Tucson's springs, creeks, and rivers. The creek is supported by a shallow groundwater area (SGWA), where groundwater levels can recover rapidly with reduced pumping from nearby wells and recharge with local infiltration. WMG is working with Sabino-area residents and partners to develop a stewardship plan to ensure the full recovery of Lower Sabino Creek's perennial flow. This stewardship plan will include a water budget that ensures outflows (riparian ET, pumping, and groundwater flow) are balanced with inflows from mountain front and channel recharge.

Analysis of the monthly and annual water budget has assisted in setting meaningful conservation and stormwater recharge augmentation targets. Through continued monitoring and assessment, this water budget can be updated on an annual or seasonal basis and provides a communication tool to inform sustainable use of groundwater that maintains secure groundwater resources and creek flow for riparian and aquatic system health. Currently, lower Sabino Creek's SGWA is recovering thanks to ongoing conservation and a few above average wet years. The water budget developed indicates that to fully recover and buffer the SGWA system especially in drought years, additional conservation and stormwater recharge augmentation is needed.

To learn more WMG's Sabino Creek work please visit: https://watershedmg.org/advocacy/50-year/restore-sabino-creek

Fate and Transport of Glucocorticoid Steroids in the Lower Santa Cruz River

SNYDER, SHANE, University of Arizona

Darcy Vandervort, Kevin Daniels, Shimin Wu - University of Arizona

Over the past two decades, numerous reports have shown that wastewater treatment plant effluents can discharge numerous endogenous and synthetic estrogenic hormones to the environment. Several reports also have shown that fish exposed to wastewater effluents often show evidence of estrogen exposure, including hermaphroditism. However, the occurrence and fate of other steroid hormones is far less known. In the current student, occurrence and fate of glucocorticoid receptor (GR) agonist substances and mixtures was measured using an immortalized genetically engineered human cell construct. The GR assay uses human embryonic kidney cells (HEK 293T) cells which contain a glucocorticoid receptor ligand-binding domain/Gal4 DNA binding domain chimera stably integrated into the GeneBLAzer® UAS-*bla* HEK 293T cell line. These cells contain a beta-lactamase reporter gene under control of a UAS response element stably integrated into HEK 293T cells. Fluorescence Resonance Energy Transfer (FRET) substrate that generates a ratiometric reporter response and dual-color (blue/green) reading is used to minimize experimental noise. The GR assay was employed in the monitoring of the lower Santa Cruz River (SCR) to identify potential for endocrine disruption effects caused by glucocorticoid hormones as well as contaminants that mimic these hormones. Quarterly sampling was conducted in 2014, from the wastewater discharge point from Aqua Neuva with eight sampling locations spread across nearly 30 km in a north western bearing. Glucocorticoid bioactivity was detected ubiquitous, ranging from 175 ng/L (as dexamethasone equivalents) to 25 ng/L at the furthest sampling location. In addition, a suite of glucocorticoid steroids and other emerging contaminants were simultaneously monitored using liquid chromatography with tandem mass spectrometry (LC-MS/MS) in the same samples. Substances such as DEET (insect repellant), sucralose (artificial sweetener), and naproxen (pharmaceutical) were the dominant emerging contaminants detected, with concentrations in ug/L ranges. However, substances including steroid hormones, numerous pharmaceuticals, and perfluorinated organics were also ubiquitous in the Santa Cruz River, but in concentrations generally ranging from 1-100 ng/L. Using an iterative toxicity identity evaluation (TIE) approach, the identifies of several previously unreported GR substances also were identified. Based on the bioactivity of the substances and the concentrations determined within the water samples, a complete mass balance was achieved. From an extensive literature review, we believe this is the first report showing a completed mass balance between bioactivity and concentration of GR substances in a natural system. Moreover, the bioactivity of GR mixtures in the Santa Cruz are approximately two orders of magnitude higher than estrogenic substances and well within the range of concentrations demonstrated to adversely impact aquatic wildlife.

Assessment of Aquatic Ecosystem Integrity in the Santa Cruz River: Macroinvertebrates as Biological Indicators

WALKER, DAVID, Walker Ecological Services

Under the Federal Clean Water Act (section 101), states are required to develop programs that evaluate the physical, chemical, and biological integrity of the Nation's waters, and to adopt water quality standards to restore and maintain that integrity. Aquatic macroinvertebrates (bottom-dwelling organisms including aquatic insects, crayfish, clams, snails, and worms) have long been used as indicators to assess water quality and ecological integrity of aquatic ecosystems. They are often used in studies to determine the quality of waters because of their high numbers, known pollution tolerances, relatively limited mobility, wide range of feeding habits, and varied life histories. Biological assemblages integrate all of the environmental stressors caused by human and natural activities over a longer period of time than do chemical sampling which is a snapshot in time. We have sampled aquatic macroinvertebrates and periphyton (attached algae) annually at 4 sites in the Santa Cruz River in 2013, 2014, and 2015. We follow collection, identification, and biometric techniques as developed by AzDEQ for warmwater, wadeable streams in Arizona (AZ-IBI). Variability between years existed with 2014 exhibiting the highest overall AZ-IBI scoring and 2013 the lowest (higher scores = less pollution-tolerant organisms). The 2015 results showed slightly lower overall AZ-IBI scoring than 2014. The site closest to the outfall usually has the lowest AZ-IBI scoring, lowest diversity, and most pollution-tolerant organisms. Although there was no improvement in biological integrity indices from 2014 to 2015, precipitation events leading up to the 2015 sampling

could have had an effect on metrics during this year. Also, due to drying, one sampling site (MI-02x) was approximately 2 miles upstream from the original site.

Economic Allocations of Water Use and Benefits in the Santa Cruz Border Region

WILLETT, KEITH, Oklahoma State University

The Santa Cruz border region epitomizes a recurrent problem facing several border cities of the United States like an ever increasing urban population, frequent droughts and water shortages, often aggravated by the myriad institutional laws governing water allocation. The twin cities of Nogales in Arizona and Mexico, for instance, is a case in point. The burgeoning population, economic activities and adverse climate have put pressure on groundwater resources (Santa Cruz aquifer) in both cities, while efforts to replenish surface water flows through treated wastewater have been largely unsuccessful, given high costs and divergent laws governing water allocation in the U.S. and Mexico.

Economic studies using Coasian bargaining and strategic game theoretic models have been provided as solutions to water shortages in the region, yet, there is a lack of an integrated approach that includes both institutional and economic constraints in water management. The current study determines the optimal allocation of water use among the three main sectors of water demand - agricultural, residential and non-residential (industrial and commercial).incorporating some of the economic, physical and institutional factors affecting water management along the Santa Cruz border region. The study region encompasses three cities, Nogales, Rio Rico and Tubac within the Santa Cruz Active Management Area in Arizona and Nogales, Sonora from Mexico. Utilizing a mathematical programming model for the baseline year 2010, the study finds that optimal residential water use benefits exceed nonresidential benefits by as much as 67% and 150% in selected regions of Arizona and Mexico respectively. However, agricultural benefits from water use is found to be very low in both regions. Further extensions to the study seek to assess the impact of population growth and drought related water shortages in the region and how it affects the economic benefits from water use and allocation in each sector.

Living River – Changes Along the Upper Santa Cruz River between 2008 and 2014

ZUGMEYER, CLAIRE, Sonoran Institute

The Upper Santa Cruz River in Santa Cruz County flows year round from Rio Rico to Amado and supports a culturally and ecologically diverse region. River flows are sustained by effluent discharges from the Nogales International Wastewater Treatment Plant (NIWTP) which treats and reclaims water from sewage from the binational communities of Nogales, Arizona and Nogales, Sonora. In the last seven years, two important changes in wastewater management have occurred. In 2009 the NIWTP completed significant upgrades to the treatment process resulting in reduced levels of nitrogen in the released effluent. In 2013 Nogales, Sonora completed construction of the Los Alisos treatment plant to divert and treat some of the wastewater that would otherwise be sent to NIWTP. Effluent generated at Los Alisos is released into a different river and flows south into Sonora. The *Living River* reports were developed to annually track indicators of river health and determine what is changing. Sonoran Institute recently completed a report assessing changes in conditions for the 2008-2014 water years. Overall water quality is greatly improved with decreased nutrient and metal pollution and increased dissolved oxygen. Aquatic life is more diverse and native fish have flourished. However, increased infiltration, scouring floods, and water diversions are a combination of factors that are reducing the extent of flow in the river. While increased water infiltration is good for recharge of local groundwater tables, we see reduced aquatic habitat and stressed riparian vegetation at the downstream end of the reach as flow becomes more irregular. Further monitoring of flow, groundwater, and vegetation will help determine how much water is needed to maintain desired conditions.

Poster Abstracts

(Listed in Alphabetical order by presenter)

Quantification of Water-Related Ecosystem Services in the Upper Santa Cruz Watershed

BOYANOVA, KREMENA, Kiel University, Victoria University of Wellington

Rewati Niraula – University of Arizona; Francina Dominguez – University of Illinois; Hoshin Gupta - University of Arizona; Stoyan Nedkov – Bulgarian Academy of Sciences

The ongoing drought in the Southwestern United States places pressure on both scientists and practitioners to find new solutions to water-related issues. In the state of Arizona, this situation requires that the present state of the ecosystems and natural resources be re-evaluated to assess their capacity to sustain the future flow of Ecosystem Services (ES) to society. In this poster, we present an investigation of the influence of local land use practices on the water cycle, and the consequent impact on the supply of Water-Related Ecosystem Services (WRES) that can provide support for water and land management and decision-making in areas experiencing water scarcity.

Our study focuses on the Upper Santa Cruz watershed located mainly in southern Arizona but with a small portion in the Sonora region of northern Mexico. We propose a methodology for spatially explicit quantification and evaluation of the WRES within the watershed, and use the Soil and Water Assessment Tool (SWAT) hydrological model to derive a set of hydrological indicators from model simulation for the period 1987-2006. Being a water-limited region, the vast majority (approximately 87%) of the incoming precipitation water leaves the system as evapotranspiration.

The different land use types within the watershed influence the hydrological cycle and, thereby, the supply of WRES. We assess and map impacts by analyzing the average annual values of the hydrological variables for each land use type. We highlight the importance of forested lands (evergreen forests and forested wetlands - approximately 15% of the watershed area) for providing the highest supply of WRES in the region and consequently, the importance of their preservation. Nevertheless, the predominant land use types within the watershed (shrublands, urban areas and grasslands – approximately 81%) provide the lowest supply of WRES, which significantly decreases the overall supply of WRES at the watershed scale.

Exploring Open Source Alternatives for Nonpoint Source Pollution Monitoring

HUTH, HANS, Arizona Department of Environmental Quality

Remote sites requiring nonpoint source (NPS) pollution assessment require staff and volunteer time for sample collection. Performance can be improved if the Arizona Department of Environmental Quality (ADEQ) can remotely access site environmental conditions through cell phone networks. This can help save resources by avoiding long drives or hikes to remote sites having no flow. To address this need, commercial cellular modems can be coupled with environmental sensors and samplers. However, cellular modems can cost over $2,000 and require a subscription service for online data hosting. ADEQ's Office of Border Environmental Protection (OBEP) has developed and is testing an open-source telecommunications prototype with sensor and web-posting capabilities for about a tenth the cost. The prototype may have applications for NPS pollution monitoring along the Santa Cruz River.

Influence of the Nogales International Wastewater Treatment Plant on Santa Cruz River

LABRIE, HOLLIE, University of Arizona

Mark Brusseau – University of Arizona; Hans Huth – Arizona Department of Environmental Quality

The Nogales International Wastewater Treatment Plant releases treated wastewater from both Nogales, Arizona and Nogales, Sonora, Mexico into the Santa Cruz River, potentially putting environmental and human health at risk. Due to the industrial demographic of the region, outdated infrastructure, and lack of data, the treatment facility and the treated effluent an important area of study. To understand how the treated effluent is affecting the river, data were used from existing water quality databases and flow reports from 2008 to 2015. To address how flow quantity has changed during drought periods, effluent flows were compared to historical flood data produced by the USGS. To determine any water quality issues water quality reports produced by the International Boundary and Water Commission were examined and analyzed to understand the threat of past exceedances of nickel, cadmium and cyanide. Results showed that spikes in effluent flow corresponded with rainfall events. Flow totals showed that the majority of the effluent was produced in Nogales, Sonora, suggesting that the industrial areas of the state could contribute to water quality problems. Although the quality of water has been pristine, exceedances could threaten surface soils and wildlife. Although outreach to stakeholders across the border and updated infrastructure has improved the quality of water in the river, there are still many areas to improve upon. To identify opportunities for improvement, further studies should examine the specific fate of each contaminant present in the effluent.

Water Bankruptcy in the Land of Plenty: Steps Toward a Transatlantic and Transdisciplinary Assessment on the Nature and Causes of Water Scarcity in Southern Arizona

POUPEAU, FRANCK, CNRS, University of Arizona

Kremena Boyanova – Kiel University, Victoria University of Wellington; Hoshin Gupta, Aleix Serrat-Capdevila – University of Arizona; Maria Sans-Fuentes – CNRS, University of Arizona; Susan Harris – University of Arizona; Laszlo Hayde - UNESCO

The poster presents the outline of a book, arising out of the four-year collaboration within the International Cooperation Project SWAN (Sustainable Water ActioN): Building Research Links between EU and US, granted by the European Commission (FP7-INCOLAB-2011). The book is a concerted effort to explore the interplay between a variety of related scientific disciplines including climatology, hydrology, water management, ecosystem services, societal metabolism, water governance, political ecology and social science unified around the topic of water.

In recent years, many newspapers and specialized books have been emphasizing that the Southwestern US will be facing its most severe “drought” to date. While drought is often presented as a perturbation imposed upon a coupled natural and human system, the resulting water scarcity that is supposed to impact local agriculture and urban areas is more accurately seen as a product of the complex interplay between physical availability, the environment, and human demands and behaviors.

This book proposes and explores the purposely provocative notion of “water bankruptcy” so as to emphasize the socio-economic dimension of water issues in the Southwestern US (an primarily Arizona), between the narratives of growth and the strategies or policies adopted to pursue competing agendas and circumvent the inevitable. A first of its kind, developed through close collaboration of a broad range of natural scientists, social scientists, and resource managers from Europe and United States, this book is a committed step towards the collective elaboration of a transdisciplinary approach to unveiling the inner workings of how water is fought for, allocated and used in the Southwestern US. It produces a critical diagnostic evaluation of water problems in the West, with a particular view to identifying risks for the Tucson, Arizona, area (which is facing continuous urban sprawl and economic growth).

How the 1887 Earthquake Changed the Santa Cruz River

REYNOLDS, MARY, University of Arizona

Sonora’s 7.4 earthquake lowered the water table in Tucson’s Santa Cruz River Valley in 1887. The earthquake, with epicenter 150 miles southeast of Tucson in Bavispe, Sonora, immediately changed stream flows on both sides of the international border. “Old Castle,” a rock formation atop a ridge in the Catalina Mountains collapsed, the dome of San

Xavier Mission cracked, and the Agua de Mision Spring on Tohono O'Odham land went dry. Similar hydrologic changes occurred immediately after other intercontinental earthquakes of the 19th and 20th centuries including the 7.3 Borah Peak, Idaho, earthquake in 1983 that changed the cycle of Yellowstone Park's "Old Faithful" geyser. Eyewitness reports of shaking and water changes along the Rillito River, Pantano Wash, and Santa Cruz River, show that the aquifer changed. In the 1880s, groundwater pumping for ranches, farms, and Tucson residents increased, also lowering the water table. Tucson's climate records show that three drought years in the 1880s were followed by four years of surface flooding. The 1887 earthquake occurred in the middle of this cycle, and coincided with the beginning of groundwater depletion. The aquifer water level began to drop. First it dropped by tens of feet, then by hundreds. Frontier boosters, emboldened by easy transportation via Tucson's new railroad connection, ignored warning signs and promoted agriculture and cattle ranching. Before the earthquake, rainwater sheeted across the Tucson basin, soaking into the ground and recharging the aquifer beneath the Santa Cruz Valley. After the drought years and the earthquake, rainwater behaved much differently. Unusually heavy rainfall caused massive flooding. Monsoon rain that had recharged the aquifer now drained quickly into arroyos, creeks, and rivers rushing with water brown from sediment. Instead of staying in the Tucson basin, the water sped north away from the city through ever-deepening channels.

Using a Geographic Information System (GIS) to Establish Likely Water Table Elevations

SHERMAN, FORREST, Southwestern Arid Grassland Ecology, Inc.

ESRI ArcMap was used to geographically catalog all registered wells within an area of similar geologic structure (within 10 miles) of a proposed well improvement. This required considerable data refinement as much of the well data was not located with needed accuracy. This process of data cleansing and the construction of a map illustrating the data will be described. Using this map allowed a reasonable prediction of drilling requirements.

Using Watershed Health Indicators to Improve Management Strategies and Community Engagement

SMITH, AMANDA, Pima Association of Governments

Mead Mier – Cienega Watershed Partnership, Pima Association of Governments; Melanie Alvarez – Pima Association of Governments

Riparian habitat and well owners, alike, rely on shallow groundwater resources. Pima Association of Governments' (PAG) Watershed Planning Program has been monitoring watershed health indicators for riparian areas of Tucson since 1989. Our research shows long term trends depicting the localized drought and groundwater pumping impacts on a shallow groundwater dependent system. This poster will include a comprehensive look at PAG's watershed planning studies, in collaboration with data from regional partners, and regional recommendations for management strategies that are being considered by the local governments in the PAG Council. Cienega Creek is a rare, perennial groundwater dependent stream, which flows into the Pantano near Vail, and provides important recharge into the Tucson basin. Monitoring during baseflows gives an accurate indicator of unenhanced groundwater conditions on the AMA periphery. PAG well pumping inventories are being used to aid well owner conservation strategies and stewardship of the landscape.

PAG's Cienega data is the longest, most detailed mapped record of flowing segments of the intermittent creek, revealing both seasonal and long term trends. As a result, the data for lower Cienega Creek is useful for underrepresented lowland creeks in Arizona for State drought planning. Monitoring data showed a record breaking drought in MY 2013-14. Will we see improvement after this winter's El Nino? We will also include our most recent data on baseflow contribution sources, erosion, and endangered species records. These research reports and inventories are being applied to aid effective decision making, restoration practices, policy and regional outreach. PAG is working in coordination with Cienega Watershed Partnership (CWP), Watershed Management Group and jurisdictions to assess important watershed

health indicators and to engage residents with means for stewardship efforts. These partnerships add a rich cultural heritage component including oral history records, youth engagement and art experiences to share human connections with the watershed.

Evaluation of Coliphage as an Indicator for Human Enteric Viruses in Wastewater Treatment Plants

WASSIMI, ALEXANDER, University of Arizona

Bradley Schmitz, Charles Gerba, Ian Pepper – University of Arizona; Maria Campillo

Recently the United States Environmental Protection Agency has proposed the use of coliphages as a measure of fecal contamination of recreational waters. Coliphages are viruses that infect coliform bacteria and are always present in domestic wastewater. Because many are the same size, shape and resistant to sewage treatment processes as human enteric pathogens they have long been proposed as indicators of fecal pollution. Traditional bacterial indicators (Escherichia coli) do not always provide accurate correlations and comparisons to viral pathogens. Research is underway to better understand the removal of coliphages by sewage treatment processes and their relationship to the removal of human pathogenic enteric viruses. Currently we are conducting a study at several wastewater treatment plants in Pima County, Arizona to assess the removal of coliphages by different sewage plants that use different processes. This project aims to determine if any coliphage log reductions correlates to viral human enteric pathogens throughout wastewater treatment processes, as well as recreational and reclaimed water sites.

Santa Cruz River Research Days – 2016 Participants

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