9th Annual
Science on the Sonoita Plain Symposium
June 3, 2017

Annual Meeting of the Sonoita Valley Planning Partnership

Sponsored by:
Cienega Watershed Partnership
National Audubon Society

With Support from Partnering Organizations:
The Nature Conservancy
Bureau of Land Management

At the
Appleton-Whittell Research Ranch of the National Audubon Society
Elgin, Arizona

The Science on the Sonoita Plain symposium was established to bring together and share the results of scientific investigations that are occurring within and informing us about the unique and diverse resources of the Sonoita Plain in the upper watersheds of Cienega Creek, Sonoita Creek, and the Babocomari River.

These symposia grew out of an important effort that began in 1995, the Sonoita Valley Planning Partnership (SVPP), a voluntary ad hoc association of agencies, user groups, conservation organizations, and individuals working together to achieve community-oriented solutions to local and national issues affecting public lands within the Sonoita Valley. The Cienega Watershed Partnership, a 501c(3) non-profit organization that was founded in 2007, administered the SVPP until 2015 when regular meetings ceased. The CWP mission is to facilitate cooperative actions that steward the natural and cultural resources of the Sonoita Valley while enabling sustainable human use.

This year, the primary thematic focus was on "How is science being used"? including a series of presentations, panel discussions, and poster sessions. We hope you enjoy this recap of the 9th annual Science on the Sonoita Plain Symposium.

Proceedings compiled by Suzanne Wilcox (Audubon)

Planning Committee: Gita Bodner (The Nature Conservancy), Larry Fisher (Cienega Watershed Partnership, University of Arizona, Linda Kennedy (Audubon), Shela McFarlin (Cienega Watershed Partnership), Thomas Meixner (Cienega Watershed Partnership), and Mead Mier (Pima Association of Governments), Dave Murray (Bureau of Land Management), Suzanne Wilcox (Audubon) and Amanda Smith (Cienega Watershed Partnership).

Thanks also to:
Shela McFarlin for organizing the
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Tahnee Robertson (CWP) for technical support.
Mead Mier (PAG) for serving as timekeeper.
Amanda Smith poster session awards
Photos courtesy of
Linda Kennedy (Audubon)

AGENDA
SCIENCE ON THE SONOITA PLAIN
NINTH ANNUAL SYMPOSIUM
June 3, 2017

8:00 **Registration and Refreshments –** provided by CWP

8:30 **Welcome and Introduction**: Shela McFarlin CWP, Linda Kennedy AWRR

8:40 **Panel Presentations – Science Applications, Part I:**

- *8:40* Introduction to session and speakers: Shela McFarlin/Linda Kennedy, Moderators
- *8:50* Kim McReynolds, Cooperative Extension Service
- *9:10* Ian Tomlinson, Vera Earl Ranch/Empire Ranch
- *9:30* Bill Brake, Rose Tree Ranch

9:50 **COFFEE BREAK/POSTER SESSION**: Amanda Smith

- Poster presentations – brief introductions
- Opportunities to visit and review posters

10:20 **Panel Presentations – Science Applications, Part II:**

- *10:20* Daisy Kinsey, Coronado National Forest
- *10:40* Karen Simms, Bureau of Land Management

- *11:00* **Sawmill Fire Update - Panel**

11:20 **Panel Discussion, Q and A on Science Applications**

- Moderators and all panelists participate in interactive discussion with the audience

Ian Tomlinson, Bill Brake, Kim McReynolds, Karen Simms & Daisy Kinsey

11:50 **Update on the Endangered Desert Pupfish**: Doug Duncan, (U.S. F.W.S.)

12:00 **LUNCH BREAK**

• Also - further opportunities to visit poster presentations

12: 45 **Miscellaneous Topics, Part I; Water and Landscape**: Tom Meixner, Moderator

- *12:50* Using Isotopes and Solute Tracers to Infer Groundwater Recharge and Flow in the Cienega Creek Watershed, SE Arizona, Rachel Tucci and Jennifer McIntosh (University of Arizona), Andrew Salywon and Ron Tiller (Desert Botanical Gardens), Jeanmarie Haney and Gita Bodner (The Nature Conservancy)

- *1:10* Creating an Environmental Flows Water Budget for the Upper Santa Cruz River, Ashley Hullinger (University of Arizona Water Resources Research Center), Claire Zugmeyer (Sonoran Institute), Kelly Mott Lacroix (U.S. Forest Service), and Bailey Kennett (WRRC)

- 1:30 A dynamic flow budget for Lower Sabino and Tanque Verde Creeks, C. Shipek

- 1:50 CWP's "Indicators Project": Assessing the Health of the Cienega Watershed, A. Zuniga Teran, L. A. Fisher, T. Meixner, and S. McFarlin

- 2:10 Tools for Interpreting Landscape History in the Cienega Watershed, by Robin Pinto, Alison Bunting, David Tuggle, Bill Gillespie and Shela McFarlin

2:30 – 2:50 **COFFEE BREAK** – Cookies provided by Tony Leonardini

2:50 **Miscellaneous Topics, Part II**: Gita Bodner, Moderator

- 2:55 Encroachment by woody plants alters demography and species richness of breeding grassland birds, Erik M. Andersen and Robert J. Steidl (School of Natural Resources and the Environment, University of Arizona)

- 3:15 Where Mountain Lions Traverse: Insights from Landscape Genetics in the Southwestern United States and Northwestern Mexico, A. Naidu

- 3:35 Hinge-felling: A preferred restoration method for restoring incised ciénegas, A.T. Cole

- 3:55 Brush management: an ecosystem services perspective, Adam T. Naito, Steven R. Archer, Katharine I. Predick, and Greg A. Barron-Gafford (University of Arizona), Joel A. Biederman, Phil Heilman, and Russell L. Scott (Agricultural Research Service), Tyson L. Swetnam (Cy-Verse), Heather L. Throop, Nicole P. Templeton, and Enrique R. Vivoni (Arizona State University)

- 4:15 Las Cienegas National Conservation Area update, Karen Simms (Bureau of Land Management)

4:25 – 4:35 **Presentation of Poster Awards:** Amanda Smith

4:35 – 4:50 **Evaluation, WOW! Moments**:
Tahnee Robertson

4:50 **Closing Remarks**: Shela McFarlin, Linda Kennedy

5:00 **Adjourn**

KEY

CWP – Cienega Watershed Project
AWRR – Appleton-Whittell Research Ranch of the National Audubon Society
WRRC – University of Arizona Water Resources Research Center
US FWS – US Fish and Wildlife Service
BLM – Bureau of Land Management
CNF – Coronado National Forest

Posters

Using Water Isotopes and SO_4/Cl Ratios to Investigate the Hydrology of Wetlands in the Las Cienegas National Conservation Area, **Erin Gray**, Jen McIntosh, and Rachel Tucci (University of Arizona),
Andrew Salywon and Ron Tiller (Desert Botanical Gardens)

Ten Year Summary of Grassland Bird Point Counts at Appleton-Whittell Research Ranch, **Vashti** "**Tice**" **Supplee** (Audubon Arizona)

Assessing the Conservation Effects on Cienega Creek Watershed, **Haiyan Wei**, D. Phillip Guertin, David Goodrich, Ken Spaeth, I. Shea Burns, and Jane Barlow

The Effect of Gabion Construction on Infiltration in Ephemeral Streams, **Chloe Fandel** (University of Arizona)

Using repeat aerial imagery to quantify long-term rates and patterns of *Prosopis velutina* across Las Cienegas National Conservation area, **Scott Jones** (University of Arizona)

Surveying Public Values and Preferences to Guide Environmental Management in the Sonoita Creek Watershed, **Oliver Lysaght**, Laura M. Norman, Richard Pritzlaff, David Seibert, and H. Ron Pulliam

Conservation Easements in the Madrean Archipelago: Random Acts of Conservation or a Landscape-scale Strategy? **Damian Rawoot** (University of Arizona)

Social and Ecological Consequences of Sexual Size Dimorphism in Mountain Spiny Lizard (*Sceloporus jarrovii*), Kortney Jaworsky and **Matthew Lattanzio** (Christopher Newport University)

Near-Surface Geophysics Surveys at Empire Gulch in the Las Cienegas National Conservation Area, SE Arizona, **Rachel S. Tucci**, Daniel Basabe, Gita Bodner, Riley J. Burkart, Erica A. Cupp, Patrick O. Dougherty, Jeanmarie Haney, Libby Kahler, Dr. Ben K. Sternberg, and Thomas D. Tuten

Welcome to the Ninth Symposium!

SHELA MCFARLIN, *Cienega Watershed Partnership*

On behalf of the Science on the Sonoita Plain organizers, we thank you for attending and look forward to your active participation throughout the day. I'd like to recognize the core team that put together this year's ninth symposium: members from the Audubon Research Ranch (our host), The Nature Conservancy, Tucson Bureau of Land Management, and Cienega Watershed Partnership board members and volunteers. Our team leader is Larry Fisher (CWP/University of Arizona) who could not attend today. Thank you organizing team and hosting staff and volunteers.

This symposium has a direct line to the Sonoita Valley Planning Partnership which recognized over 20 years ago that good science makes good planning. The 2017 morning theme is highly appropriate addressing the question of "How is science being used"? A great deal of scientific work has taken place across the landscape on a myriad of topics, often reported at the SOSP symposiums. In our grab bag session this afternoon, speakers address a wide range of studies and interpretations from restoration to mountain lions.

The purpose of our morning session is to address whether science has been useful to those who are engaged in economic or management activities on the land, and where applied science/scientists need to go next. We invited panelists to share their experiences and views. Each speaker brings expertise in the watershed, science applications, and hands on management. This is a bit of a gamble since we don't know what each will say and how their perspectives will fit together. To "guide" the panel discussions, we've identified questions for them to address:

What do you do in the Cienega Watershed/Sonoita Plain and for how long engaged?

- What "science" has been useful in managing and resolving issues?
- What gaps exist for you in applying science? Is it techniques, access, funding?
- What do you need from science? From scientists?

And we threw in this question to elicit more discussion, How are you dealing with climate change?

In planning the 2017 agenda, the team was faced with a wonderful problem---more excellent proposals than the time slots could handle. Several potential speakers offered posters instead, giving us an excellent array of topics. We have allocated time for poster presenters to provide a snapshot of their work and for you to engage. Amanda Smith will explain the poster competition to you shortly.

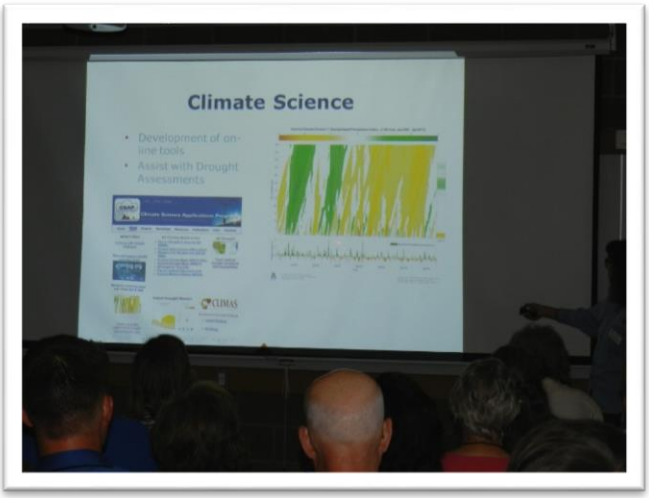
You have already shown your interest in this landscape and in science by attending today. Please participate as much as possible to make this a great exchange of information.

The Role of Science Applications

Kim McReynolds, Cooperative Extension Service

The history that created the Cooperative Extension Service began with the Land Grant. The first Land Grant was the Morrill Act signed on June 2, 1862. This was a result of Thomas Jefferson's philosophy for the need of knowledge regarding farming practices and food for the nation. This in turn created the need for public institutions to make college available to use science to solve practical problems. At this time each state had a Land Grant College. The Smith-Lever Act of 1914 created the Cooperative Extension Service. At this time there was a train running through each state and provided the extension office the ability to travel to different towns to give presentations. Some examples of the presentations include the proper way to prune, water demonstrations and Cattle Demonstrations. This also allowed them to create development in the area. The first paid position for Cochise County passed July 1, 1915 for a state coordinator. States had the right to buy into the program giving authority to each county which the county and the federal agencies supported. The Cooperative Extension Service was created to discover the needs of the people in the community by providing assessments by researchers providing practical solutions. Some of the best tools used by the Cooperative Extension Service is it's partnerships with other groups. The development of online access for tools has been critical in their effectiveness. The main key for us is education.

The Cooperative Extension Service uses science to find practical applications to combat and/or solve problems that have been identified in emerging research. Simply their job is to use science to try and answer research questions.



The Role of Science Applications

Ian Tomlinson, *The Vera Earl Ranch, Sands Ranch & the Empire Ranch*.

When combining all of our ranches together we manage them all differently but the one constant is that we use science to base our decisions on how to manage. Science helps us to decide when the right time is to move cattle for better utilization and plant cover. The two main factors for science being useful for us is 1. Science is key for decision making. And 2. Science gives us data to support our decisions, otherwise we would be flying blind. We look at the production data before rotation to present to our land managers like BLM for our state and federal allotments. This helps us explain the why to our management plan. To collect this data we use people like Dan Robinett in Rangeland Management as a consultant with BLM to preform our assessments. The three things we are concerned with as a calf/cow operation is the ecological health of the land, what the maximum production the land can produce and the overall cattle health. The financial impact is a huge positive factor for ranch operations. With the scientific data we can now plan for our season giving us a much higher yield. Even with changes to this projected plan we can see better yields. Without the scientific data it was a guessing game and very hard to get agencies on board with our plans. Weather is a big driving factor for many of our plans for the cattle and that being ever changing, interoperations of the data give us a helping hand on what to expect and how to plan for changes with the season. This data makes our plans more solid creating an even bigger impact.

When dealing with invasive species like Lehmann's lovegrass we use more of a maintenance program. We may graze on this earlier in the season since this grass greens up earlier and then graze on it later in the season since it will green up again after monsoons. What we are looking for with our calf/cow operation is the correlation to weight, pregnancy rate and production rate. Results for this can present itself in the body condition score rating the fat layers over the spine and in the hip joint. The further cattle have to travel for food will decrease this layer providing unwanted results. To answer the question of how I feel about climate change, ranchers do not have the luxury to think 20 years ahead, we must live and work for the now and dealing with it when it happens. Ranchers must be open minded and willing to change plans on the fly, like changing the type of cattle they run to not run on particular land and the willingness to move cattle to adjust from knowledge obtained from previous years. I feel that we

are getting exactly what we need from scientists now, maybe even a little too much. Cattle is a profit driven business and with all the data presented to us we may only really care about a small amount but we also may not see or understand how all this other data could contribute to other successes for our business. This is why it is also critical to have scientists out here to explain to us how this data relates to our end goal of making a profit on out cattle business.

The Role of Science Applications

Bill Brake, *Rose Tree Ranch*

One major misconception about cattle ranching is that we grow cattle. Well we actually grow grass. Without the grass we would be not be able to raise cattle. We simply use cattle to maintain our grass lots. Ranchers have land and desire to use that land in order to make a profit. The only reason why we run cattle on our land is because that is what can make the most use of the grass we grow on it. If elephants happened to be the animal that would best use our grass we would run elephants on our land. Our main job is to make sure the water is working and that the cattle are where they are supposed to be. If a ranchers does not do a good job of raising the grass and maintaining the land it ultimately hurts them the most. It is in the ranchers best interest to take great care of the land. One of the ways science helps ranchers for instance is when wanting to put in a new well. In order to do this we must get monitoring data first along with a rangeland assessment including scientific data to back up our suggestions to move and modify the land for the cattle by putting in the new well. Without this science we have nothing to present to help support our suggestion or desire. Also the scientific advancements with solar technology has greatly helped with the consistency of having water no matter what the winds are doing. Plus to not have to pay the added cost of electricity. One of the major things in my opinion that gets overlooked when thinking about ranching is the economic benefits to the surrounding community. One example would be having a rancher but in drinkers that not only benefit the cattle but ultimately benefit the wildlife. When the wildlife benefits there are more hunting tags available which generate more money for the area. And when these hunters come in the area they need a place to stay and use local businesses to eat at which in turn generates money for the local community. As a rancher I feel that I have a responsibility to the community and when they thrive I to will thrive. With regards to Lehmanns love grass and how to manage, I turn out my cattle on that pasture when it is in seed. I do this because with my personal experience this is

what works best. One of the major things that must happen in order to have continues success between ranchers and agencies is communication and trust.

The Role of Science Applications

Daisy Kinsey, *Coronado National Forest, District Ranger*

The Forest Service responsibility is to manage the land for multiple use. We started in 1905 where we were initially in water protection but then Congress said we needed to expand. Now we manage for range grazing, watershed, recreational use…multiuse.

As you can imagine, where different uses overlap in areas where these different uses might compete is where we see most conflicts. Multiple use doesn't always work. This is where science comes in and we are able to use that data from the research to make our decisions. Forest Service has the Rocky Mountain Research Station as an entity we can reach out to that does research for twelve states including Arizona. We rely on a lot of outside research from universities & U.S.G.S. to find effects and impacts on our forests. We rely a lot on research to help us understand the effects and then help in our decision making with what to do.

One of our gaps is our inability and even an unwillingness to partner with others in order to understand a certain set of questions, X, Y & Z about a problem. You start to look at X and come up with other questions and then someone wants to really look at Y and more questions arise and then Z is completely forgotten because of all the focus on X and Y.

Another gap is with our resources and budget. This is why it is critical for us to work with other agencies. The goal is to gather as much data available. We have to go through the process and that takes time which may be discouraging but we need you to understand that this is just a part of how we operate. One of the cool things about research is that you have an idea and if you want to go after it you can. We have the ability to hire people to come out and do those studies. One of our restraints is that we must complete a "form for everything" that includes partners to contribute and those forms must be processed which takes time. For example the NEPA process. One side effect of these collaborative efforts on some projects is that the use of science information and data benefits multiple parties. Direct research leads to indirect research, which is a good thing. Climate change is something that the Rocky Mountain Research Station is undertaking.

"What creative ways are you looking into in order to do your job with less resources?" We have a list of people we reach out to in order to fill those gaps. It's all about federal agencies.

The Role of Science Applications

Karen Simms, Assistant Manager, Tucson Bureau of Land Management

Our field office covers about 700,000 acres. It's really scattered compared to a lot of the other lands. It's all around the Tucson basin, almost over to Douglas, North of the Gila River and The Tohono o' odham nation. So we have a lot of area that we cover. The other part of my job is being the manager over at the Las Cienegas National Conservation Area. I started out there, almost 30 years, as the wildlife biologist on Las Cienegas. I did that for a number of years and then I became the planner. I was the lead for the Las Cienegas Management Plan which we finished in 2003. Five years ago I became the manager.

How do we use science? The Las Cienegas and the San Pedro River Riparian National Conservation Area get the bulk of our focus on scientific research because they are such amazing diverse systems and they do attract a lot of research. On Las Cienegas we use science in a broad sense of being everything from monitoring all the way up through the hypothesis. How have we used that over the years? We collected a whole lot of baseline inventory data and that coupled with additional inventories up until 1995 really formed a nice baseline for our resource management plan. This was the first way the data got used and let us understand more about the area and give us a baseline condition of the area. This helped us to form objectives for our work and research management plan, what is it we want? How do we want this area and land to be measured being as quantitative as possible? Data. We formed a partnership with the TNC in 2004 as part of our goal as the Sonoita Valley Partnership process to help us really address that. What is it that we should do in an ecological monitoring program in Las Cienegas that is really going to help us look at those objectives we established? We found that some of those things we were looking at weren't telling much in return. So with those things we were able to transition out of and go with more kinds of monitoring that were giving us the data we were looking for. Out of that collaboration, I encourage those of you that haven't gone to The Nature Conservancy site to check out their site. We did a series of technical reports, one was on grasslands and one was on riparian areas and one was on fish. That was where we took all the data for the resource management plan and really focused that … it has been very valuable with the work we have done. We kind of transitioned from doing that kind of monitoring and implementing our research management plan. And then we were needing to know how effective are these treatments we are doing? How effective is our weed control? How effective are we being on invasive species? These are a priority piece of the plan. So that lead to other efforts to learn by looking at the monitoring TNC and others were doing really helped us focus on... so we had reports on sacaton areas and we had a report on other areas for vegetation treatments. All of these kind of filtered into the plan for Las Cienegas. It's an adaptive focus on that area. Trying to have these natural systems in good health and functioning you have to be able to be flexible and something's that flexibility gets stretched to the limits but it's what we're about. We really want to build into those flexibilities so all are using the land for maximum usage. We established a focus on biological planning and I certainly

invite you to come talk to me about it and if you're interested in participating in that I will put a little signup sheet in the back. We get together and in the fall it's focused on the landscape areas, and we focus a lot on grazing management and wildlife management. Especially how it relates to those two areas. In the fall we get a lot of information to create a two way dialog, a way we can explain to every person, why things change. And with that we build so much trust and partnerships in the areas. So basically it's just two times a year and anyone who wants to join us for a talk and a series of presentations on field work around Las Ciénegas. We discuss trends, resources, projects that we have coming up. Different kinds of things depending on what's pressing at the time. We also have some technical teams. Voluntary teams, anyone is welcome to join me, and they help us get additional info into our whole adaptive management system.

We also manage for multiple use and we do have these special areas, and conservation lands. We have grazing. We have recreation. We have multi use. We have a lot of different uses. The only thing that gets excluded is mining on those properties. So we do a lot of this monitoring but we do really try to facilitate and encourage research. You can get a lot of information out of monitoring but you aren't going to get the cause necessarily. So you're going to find out that you know all of a sudden you have a downward trend and that's what the science will help you detect and helps us understand. A lot of these posters on the wall have really been focused on specific issues in Las Cienegas and helps us better understand the area and help us do better managing it. It's really important. 2/3 of the research in this room is represented by the partners we have.

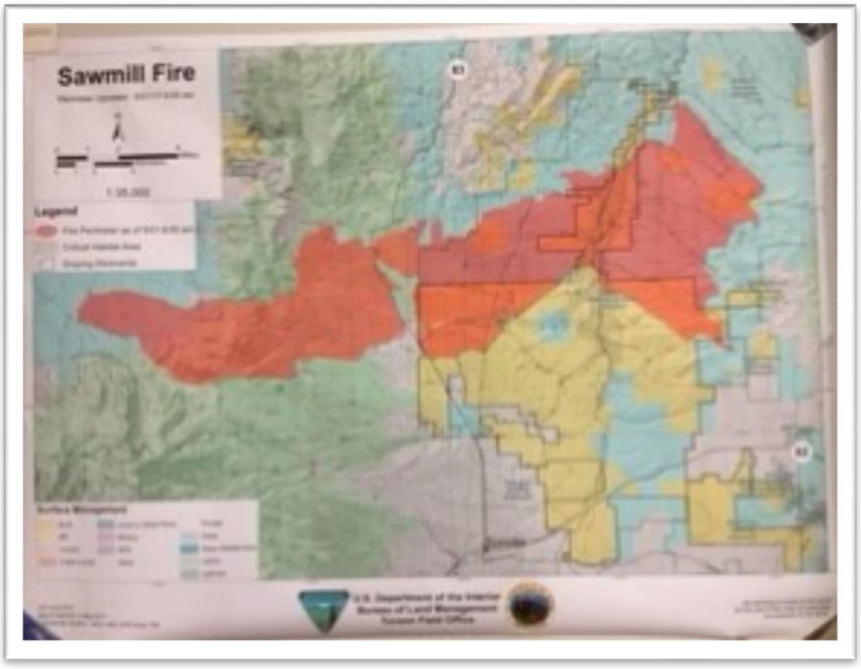
Some of the specific research we have had come out of the area include the avian response to mesquite shrubs. And that is real important for us to understand because yes we have objectives but we do AZ Antelope Foundation work that they are doing with the pronghorn and the figures that we are getting from them that kind of feedback really tells us that we are doing something that is making a difference with this restoration work.
Ground water models for the ciénegas watershed. There's a big project on the Forest Service because we are worried about a lot of impacts potentially on the Las Cienegas water so having this better understanding of how this water pours into our wetlands. We really want to understand those things.

The UofA, DBG, TNC can really provide a much better understanding now
We need help finding the science that would be beneficial, we are often running around with our heads cut off in crisis mode and you don't have the time to really figure things out. To stop and think about what do us really need? Focus on what would really be helpful with that. Something that is really challenging for us is time. It's very hard for agency staff to keep current on everything. I do think it's hard on everybody. This kind of symposium helps us to stay current on recent research.

We deal with most issues by being flexible and look at the past with a scenario planning effort to look at different futures that we could have and try and predict the very broad range of features we could have. Whether or not you believe its climate change doesn't matter, the weather is always unpredictable so there's nothing wrong with just better understanding and being as flexible as possible to deal with these changes. Keep up with basic monitoring. We will always be looking to non-profits for information.

Sawmill Fire Update - Panel Discussion

Ian Tomlinson, Karen Simms & Jeff Simms



Implementation of the Topminnow and Pupfish Safe Harbor Agreement at the Appleton-Whittell Research Ranch of Audubon

DOUG DUNCAN, *U.S. Fish and Wildlife Service*
and Ross Timmons*, Arizona Game and Fish Department*

The Arizona Game and Fish Department has a Safe Harbor Agreement that can help conserve and recover four endangered native fishes, the Gila topminnow *Poeciliopsis o. occidentalis*, Yaqui topminnow *P. o. sonoriensis*, desert pupfish *Cyprinodon macularius*, and Sonoyta pupfish *C. eremus*. Currently, 20 ponds have been enrolled, supporting 24 fish populations. Landowners are interested in native species for several reasons, foremost being their desire to assist with the conservation of native species. The Safe Harbor has assisted recovery by creating duplicate populations of remaining topminnow and pupfish lineages, establishing and fostering partnerships between nontraditional groups and individuals for the conservation of the species, reducing the use of mosquitofish as a vector control agent, and educating interested people on the plight of native fishes and their conservation.

The Audubon Research Ranch signed on to the Safe Harbor in 2010, with the first release of desert pupfish occurring at the third annual Science on the Sonoita Plain. A total of 229 pupfish were released by meeting participants on June 4, 2011. Ever since, monitoring of the pupfish population in the pond has been done during Science on the Sonoita Plain, with 2016 continuing that tradition. The Safe Harbor and desert pupfish in the Audubon Research Ranch Pond are yet another example of cooperative conservation in the area, and an outstanding example of how such sites contribute to the education of the public regarding native fishes.

Date: 3 JUNE 2017
Purpose: desert pupfish monitoring @ Science on the Sonoita Plain
Location: Appleton-Whittell Research Ranch
Personnel: Doug Duncan

This was the sixth year of monitoring desert pupfish *Cyprinodon macularius* at this Safe Harbor site. We set four baited Gee metal minnow traps in the pond at ~1000 hrs. Traps were set for about two hours each: checked at ~1230 hrs. Size class break for adult and juvenile was 15mm. Most fish captured were greater than 15mm. Just before pulling traps, an estimated minimum of 50 pupfish, mostly adults, were still swimming free outside the traps. There were probably another 25 fish unseen in vegetation. The amount of emergent vegetation in the pond likely reduces population size, but it also protects fish from avian predation and cold temperatures. Very cold winter temperatures may severely reduce the population. We captured 298 fish captured in the traps; 250 adults and 48 juveniles. This was the highest number of fish captured in the six years of monitoring. Many adult males were in breeding color, though no very young fish (YOY) were captured or seen in the pond. Temperatures in May were fairly cool, making reproduction unlikely before the monitoring. All fish appeared healthy and no nonnative fish were found. The catch per unit effort (fish/trap hour) was 32 (18 last year). Minimum number in traps and swimming free was 348. About 40% of the water is covered by *Eleocharis*. Flat rocks placed in the pond by Audubon staff were observed being heavily used by juvenile pupfish, but need to be adjusted. Plants are beginning to grow on some of the rocks. This pupfish population should be augmented with pupfish from other sources.

Desert pupfish *Cyprinodon macularius* monitoring history at Audubon Appleton-Whittell Research Ranch, Arizona.						
Date	Event	Adults trapped[2]	Juveniles trapped[2]	Catch per unit effort (fish/trap hour)	Number pupfish observed outside of traps	Minimum number pupfish present
4 June 2011	fish released	-	-	-	-	229
9 June 2012	Monitoring[1]	146	148	37	48	342
8 June 2013	monitoring	13	0	2	17	30
7 June 2014	monitoring	55	27	11	40	122
6 June 2015	Monitoring	143	23	21	50	216
4 June 2016	Monitoring	161	32	18	75	268
3 June 2017	Monitoring	250	48	32	25	348
[1] Four baited Gee metal minnow traps deployed two hours each. [2] Number of fish.						

Miscellaneous Topics, Part 1; Water and Landscape: Tom Meixner, Moderator

Using Isotopes and Solute Tracers to Infer Groundwater Recharge and flow in the Cienega Creek Watershed, SE Arizona

Rachel Tucci and Jennifer McIntosh (University of Arizona), Andrew Salywon and Ron Tiller (Desert Botanical Gardens), Jeanmarie Haney and Gita Bodner (The Nature Conservancy)

Reaches of Cienega Creek and Davidson Canyon in the Cienega Creek Watershed (CCW) are registered "Outstanding Arizona Waters" and wetlands in the Las Cienegas National Conservation Area support several threatened and endangered species. The lack of baseline hydrologic and water quality studies in the CCW leave important land management questions unanswered, such as how might increases in urbanization, ranching, agriculture, or possible mining impact groundwater resources? To help address this question, this study investigates the hydrologic connection between recharge in the surrounding mountain blocks and basin groundwater, which is contained in alluvial and Cretaceous aquifers and wetlands (ciénegas) in the central portion of the basin. Specifically, we aim to determine: (1) what are the flow paths, seasonality and elevation of groundwater recharge? (2) What is the residence time of groundwater across the basin? And (3) what is the source of water in the ciénegas, and possible influence of monsoon floodwater recharge?

Groundwater samples from domestic water supply and previous mining exploration wells, springs, and alluvial aquifers were collected along a broad transect from the Santa Rita Mountains eastward across the basin to Cienega Creek. Samples were analyzed for major ion chemistry, stable isotopes ($\delta^{18}O$, δD, $\delta^{13}C$, $\delta^{34}S$) and radioactive isotopes (^{3}H, ^{14}C). Initial results indicate springs and alluvial aquifers are dominantly sourced year-round from basin groundwater and $\delta^{18}O$ values and sulfur to chloride ratio values indicate little infiltration of summer monsoon floodwaters. Most of the basin groundwater samples analyzed for tritium are below detection limit or lower than modern precipitation values for the region, and ^{14}C values were low (3.33-77.09 pMC),

which indicates recharge occurred prior to the 1950's. The low sulfate concentrations and $\delta^{34}S$ of basin groundwater, springs, and alluvial aquifers are typical of local rain water values consistent with the lack of sulfate sources in basin sediments. The lack of recent recharge even in shallow alluvial aquifers beneath the washes and near Cienega Creek suggests that groundwater throughout the basin is a fossil resource, and that future increases in groundwater pumping may impact the ciénegas.

Rachel Tucci received her undergraduate degree in Hydrology and Water Resources in 2015 from the University of Arizona in the Hydrology and Atmospheric Science department. She is currently a master's student at the UofA and advised by Dr. Jennifer McIntosh. Her initial introduction to the Cienega Creek Watershed was when she attended the 2014 Science on the Sonoita Plains symposium. She has been conducting hydrological and geochemical research with a team of collaborators in the Las Cienegas National Conservation Area and surroundings since.

Creating an Environmental Flows Water Budget for the Upper Santa Cruz River

Ashley Hullinger (University of Arizona Water Resources Research Center), **Claire Zugmeyer** (Sonoran Institute), Kelly Mott Lacroix (U.S. Forest Service), and Bailey Kennett (WRRC)

In development of a community vision for the Upper Santa Cruz River (USCR), the Sonoran Institute partnered with the University of Arizona Water Resources Research Center (WRRC) to create a conceptual water budget exploring the inflows, outflows, and seasonal variation of one of Arizona's rare perennial streams. With a focus on maintaining flow in the river to support aquatic and vegetative communities, this water budget illustrates existing or potential gaps between water supply and demand in order to understand and protect the USCR into the future. This approach emphasizes aspects of environmental flows and was aligned with ongoing work in other parts of the watershed by comparing methods with Watershed Management Group (WMG) and others. The study area stretched from the outfall of the Nogales International

Wastewater Treatment Plant to the terminus of flow from the wastewater treatment plant (approximately Amado, Arizona) during wet, dry, and winter seasons in order to evaluate the riparian conditions in the USCR and inform community outreach efforts. This presentation will share lessons learned, along with relevant discussion of methods that could be applied in the Cienega Watershed.

A water budget is a key component in planning for the challenges and opportunities in keeping water in the channel and recharging groundwater supplies, while taking into account the uncertainties about continued flow from the wastewater treatment plant, along with drought, population growth and other factors. The long-term goal of this community outreach program, led by the Sonoran Institute, is to ensure adequate flows in the river in support of shared community values and environmental conditions.

Ashley Hullinger is a Research Analyst for the Water RAPIDS (Water Research and Planning Innovations for Dryland Systems) program at the University of Arizona Water Resources Research Center (WRRC). Much of Ms. Hullinger's work revolves around developing effective means of stakeholder engagement to promote resilient water management throughout Arizona. As part of the Cooperative Extension unit of the University of Arizona, she has been able to work directly with rural communities looking at issues that span beyond physical water resources to consider the people and history that have contributed to current conditions. Originally from Kansas, Ms. Hullinger received her MS degree in Urban Planning from the University of Arizona after receiving BA degrees in Geography and History from the University of Kansas.

Claire Zugmeyer is an Ecologist leading the Santa Cruz River Initiative within the Sun Corridor Program. Joining Sonoran Institute in 2007, she has led a variety of efforts including monitoring vegetation and fish along the river, production of the Living River series that summarizes the river health, and organization of the annual Research Days, an event promoting collaboration and awareness of regional research and conservation efforts. She completed a Masters in Wildlife and Fisheries Biology at the University of Arizona, a B.S. in Ecology, Behavior, and Evolution at the University of California, Los Angeles, and has worked on a variety of research and management projects focusing on birds, mammals, fish and amphibians, including Arizona's endangered Mt. Graham red squirrel.

A dynamic flow budget for Lower Sabino and Tanque Verde Creeks

C. Shipek, (Watershed Management Group)

Restoring seasonal and annual flow to Lower Sabino and Tanque Verde Creeks is the first targeted effort in WMG's 50 Year Program to restore Tucson's flowing springs, creeks, and rivers. Sabino and Tanque Verde creeks are in designated shallow groundwater areas, where groundwater levels can recover rapidly with reduced pumping from nearby wells and recharge with local infiltration. WMG is building a 'River Run Collective' for each streamshed for the purposes of strengthening community connections with each other and to the local river.
Each streamshed has an online-based stewardship plan to facilitate priority actions, track progress, and monitor flow and groundwater response. Analysis of seasonal and annual flow budgeting by streamshed areas has assisted towards setting meaningful conservation and stormwater recharge augmentation targets. This flow 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. To learn more about WMG's Sabino and Tanque Verde program as part of the River Run Network please visit watershedmg.org/RRN.

Catlow Shipek is a founding member of Watershed Management Group (WMG), a Tucson-based non-profit organization. He received a MSc in Watershed Management from the University of Arizona. Catlow has over ten years of experience in applied watershed management, planning and policy specializing in urban applications like water harvesting, green infrastructure, stream restoration, and eco-sanitation. Catlow has worked on several successful local policy initiatives including Tucson's residential greywater ordinance revision process, Tucson's Green Streets Active Practice Guidelines, and Tucson Water's residential rainwater rebate program. Catlow also serves on the Citizens' Water Advisory Committee for Tucson Water including Chair of the Conservation & Education subcommittee. Catlow's passion is to link people to their local environment for improved stewardship and prosperity.

CWP's "Indicators Project": Assessing the Health of the Cienega Watershed

A. Zuniga Teran , L. A. Fisher, and **T. Meixner** (University of Arizona), and S. McFarlin (Cienega Watershed Partnership)

Over the past two years, the Cienega Watershed Partnership (CWP) has worked with partners to identify a core set of indicators that can provide an annual snapshot of watershed health. The State of the Watershed Report is part of a larger effort to provide a regular assessment of conditions and trends in the Cienega Watershed, drawing on existing data to provide a mechanism for long-term monitoring, regular evaluation, and adaptation of CWP program priorities and actions. The State of the Watershed Report will also offer a range of opportunities to engage with the public on watershed issues.

To identify these core indicators and data sources, CWP convened a series of workshops, conducted an electronic survey, and held several smaller working group sessions. This extensive input from partners helped identify the basic criteria for selecting indicators, and trim a very long list of possible indicators to a core set of 19 indicators – representing climate, water, ecological, and socio-cultural attributes – that offer a real-time assessment of watershed health.

This presentation summarizes the initial State of the Watershed Report, providing an updated synthesis of data, based on feedback received from CWP partners during the March 2017 State of the Watershed Workshop. The final Report will be made available in an online format, as well as a shorter, brochure-type hard-copy report that can be shared with the public during community presentations.

Adriana Zuniga Teran is a Senior Researcher at the Udall Center for Studies in Public Policy, University of Arizona. Larry A. Fisher is Research Professor at the School of Natural Resources and the Environment, University of Arizona, and a member of the CWP Board of Directors. **Thomas Meixner** is Professor in Hydrology and Atmospheric Sciences, University of Arizona, and a member of the CWP Board of Directors. **Shela McFarlin** is Chair of the CWP Board of Directors.

Tools for Interpreting Landscape History in the Cienega Watershed

Robin Pinto, Alison Bunting, David Tuggle, Bill Gillespie and Shela McFarlin

In recent years, aspects of the Cienega Watershed Heritage and the Empire Ranch History have been revealed through efforts ranging from map interpretation to oral history stories. The most in-depth historic landscape documentation was done in 2016 for the Historic American Landscapes Survey which not only described the Empire Ranch Headquarters in architecture and history, but provided the wider context of the Empire Ranch, neighboring ranches, and the Bureau of Land Management Las Cienegas National Conservation Area.

The Cienega History Project (CHP) continues to document and explain the landscape history, addressing both specific questions and broad contextual ones such as: the acquisition of land and water and resources control; understanding the interdependencies in broad economic patterns such as ranching, water development, transportation, and markets; and what resources are available to provide a baseline for future historical analysis and interpretation.

This presentation focuses on the tools currently available and being applied for this work which include: oral histories and interviews, secondary sources and studies, archived materials, family histories especially about the Vails, Boices and Sanfords; newspaper articles; government land records and other documents, and reports on archaeology, ecology and natural resources. Especially important are comparisons between historic maps and photographic images including aerial photography from 1936 and 1970.

All presenters are members of the Cienega History Project: **Robin Pinto**, historian, independent researcher, PhD in Renewable Natural Resources from the University of Arizona; **Alison Bunting**, retired librarian and archivist for the Empire Ranch Foundation, MLS Library Science, and Wall of Honor member of the Cienega Watershed Partnership; **Harold David Tuggle**, retired archaeologist and GIS specialist for the Cienega History Project, PhD in Anthropology, University of Arizona; **Bill Gillespie**, archaeologist, Coronado National Forest (retired), **Shela McFarlin**, MA Anthropology, the Chair of the Board of Directors of the CWP.

Encroachment by woody plants alters demography and species richness of breeding grassland birds

Erik M. Andersen and Robert J. Steidl (School of Natural Resources and the Environment, University of Arizona)

Worldwide, grasslands are transitioning from being dominated by perennial grasses to being dominated by woody plants. In semidesert grasslands of North America, mesquite (*Prosopis* sp.) has increased in density and distribution since the late 1800s, converting large areas of grasslands into shrub-savannas. This conversion has reduced the quantity and quality of habitat for many wildlife species endemic to grassland communities, including grassland birds, which have declined more rapidly than any other group of birds during the last 30 years. On 140 plots in southeastern Arizona that we established across a gradient of encroachment by *Prosopis velutina*, we studied how species richness, density, and nesting success of breeding birds changed in response to cover of woody plants. We found that species richness increased during early stages of encroachment and peaked when cover of woody plants reached ~23%, where losses of grassland-associated species surpassed gains of shrub-associated species. Densities of all common species changed in response to variation in cover of woody plants, but the direction and magnitude of effects varied highly. Density of most grassland-obligate species decreased as cover of woody plants increased, but some species, such as Cassin's sparrow, were affected only by larger-statured woody plants. Density of many species, including some classified as grassland-obligates, such as Botteri's sparrow, increased during early stages of encroachment and peaked at intermediate values of woody plant cover. Total density of birds, as well as density of species not associated with grass-dominated systems, such as Lucy's warblers, increased as grasslands transformed into savannas. Although woody plants exerted a strong influence on density and community composition of birds, the effects on nesting success were less pronounced. Increasing cover of woody plants did not affect nesting success of a grassland-obligate species (Botteri's sparrow), a shrub-obligate species (black-throated sparrow), or all species combined, but did affect nesting success of a generalist species (mourning dove). An understanding of how bird populations and communities are affected by encroachment by woody plants can inform conservation and restoration efforts by identifying achievable targets of shrub control that would benefit imperiled grassland species.

Erik Andersen is a Research Specialist and Ph.D. candidate in the Wildlife Conservation and Management program in the School of Natural Resources and the Environment at The University of Arizona. His dissertation research focuses on understanding how grassland birds are affected by shrub encroachment and invasions of nonnative grasses

Additionally, Erik is studying the habitat requirements and effects of livestock grazing on the endangered southwestern willow flycatcher. Prior to joining Bob Steidl's lab at the University of Arizona, Erik earned a M.S. from Sul Ross State University in Alpine TX, and conducted ecological and avian research for multiple federal, academic, non-profit, and tribal entities in Hawaii and throughout Alaska and the southwestern United States. Erik enjoys travel and has spent over two years abroad tracking down rare birds and exploring the world's natural areas; he is proud to report that his two-year-old's first word was "bird."

Where Mountain Lions Traverse: Insights from Landscape Genetics in the Southwestern United States and Northwestern Mexico

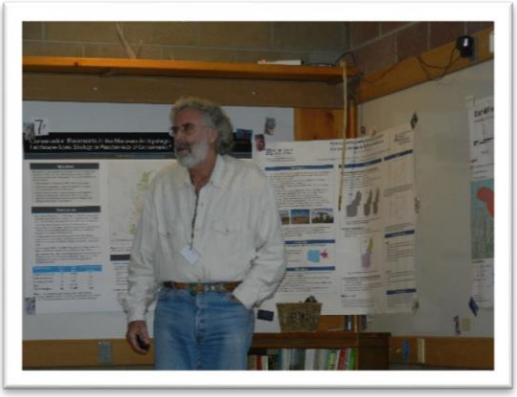
A. Naidu (University of Arizona)

The projected growth in human population, rapid urbanization, and expansion of structures like highways and canals pose a major threat to the future survival of wildlife, particularly large terrestrial mammals. In many cases, wild animal populations have been restricted to fragmented habitat islands due to anthropogenic developments, endangering them to local extinction. Current and future wildlife conservation and management strategies are leading to the implementation of mitigation measures such as creation of wildlife habitat corridors. In this light, novel and interdisciplinary research methods such as approaches in the field of landscape genetics are proving to be increasingly useful and necessary for assessing the status of wildlife populations and furthering efficacy of conservation programs and management efforts. In this 5-year research study, I use a landscape genetic approach to understand the potential impact of natural and human-made barriers in and around the northern Sonoran Desert on one of the widest-ranging mammals in the world, the mountain lion (*Puma concolor*). I employ recently developed genetic tools to assess the current population genetic status of mountain lions in this region and Geographic Information Systems (GIS) tools to relate observations to landscape features through interpretive maps. I further investigate the utility of GIS and expert-based models in connectivity conservation and suggest validating them with information on genetic relatedness and functional connectivity among mountain lions. Lastly, I emphasize the use of these methods and data sharing in conservation planning as well as wildlife management.

Ashwin Naidu is currently an Assistant Research Scientist at the University of Arizona working for the Desert Landscape Conservation Cooperative. Ashwin received his Ph.D.

and M.S. Natural Resources with an emphasis in Wildlife Conservation and Management from the University of Arizona. Ashwin's interests are in applying interdisciplinary scientific and educational approaches for the conservation and management of endangered species and their habitats. Ashwin's expertise spans a variety of fields including non-invasive surveys on wildlife, forensic genetics, landscape ecology, GIS, citizen science, science communication and conservation education/outreach. Over the last decade, Ashwin completed projects on tigers, leopards and fishing cats in South India, and mountain lions and bobcats in the southwestern United States. You can read more on Ashwin's past research at https://snre.arizona.edu/people/ashwin-naidu

Hinge-felling: A preferred restoration method for restoring incised ciénegas



A.T. Cole (Pitchfork Ranch)

Bill Zeedyk, author of *Let the Water Do the Work, Induced Meandering, an Evolving Method for Restoring Incised Channels,* designed a grade control structure using Willow trees and first experimented with it on the Pitchfork Ranch. We have continued the practice and see it as the preferred restoration method for restoring incised ciénagas. With 95% of ciénaga habitat lost, the 68 known ciénagas are commonly incised with succession Willow trees along the incised channel. We have continued using Hinge-Felling and expect to see it as the main feature in our efforts to restore the 1.5-mile reach of the Burro Ciénaga on the ranch.

Here's how it works: cut the tree half way through the trunk 6-inches above ground level, create 4 successive "notch" cuts above the main cut, bend the tree across the watercourse as close to ground level as possible. The new structure is "perpetual" in that it not only captures debris and sediment, but "grows" branches vertically and thus there is no need to stack additional "tiers" atop earlier installed structures that have captured sufficient sediment to be "covered" and no longer capable of capturing additional sediment and further raising the watercourse bed.

A.T. Cole retired from the courtroom and classroom, and with his wife, Lucinda, retired to the Pitchfork Ranch in southwest New Mexico. For the last 14-years they have been restoring the reach of the Burro Ciénaga and surrounding habitat on the ranch. One of the treatments is a grade control structure, Hinge-Felling, a recently developed practice

that is effective, inexpensive, although under-appreciated and has application to incised, willow lined channels.

Brush management: an ecosystem services perspective

Adam T. Naito, Steven R. Archer, Katharine I. Predick, and Greg A. Barron-Gafford (University of Arizona), Joel A. Biederman, Phil Heilman, and Russell L. Scott (Agricultural Research Service), Tyson L. Swetnam (Cy-Verse), Heather L. Throop, Nicole P. Templeton, and Enrique R. Vivoni (Arizona State University)

Brush management efforts on rangelands typically rely on chemical and/or mechanical methods to reduce woody vegetation cover in order to improve forage production and reduce erosion. Yet, the true value to short- and longer-term increases in ecosystem function remain understudied. By evaluating the long-term effects of brush management on a suite of ecosystem services (ESs) (herbaceous diversity, net ecosystem exchange, erosion and runoff, carbon storage potential) at watershed-scales, we will be in a better position to enumerate its costs and benefits objectively. We are currently quantifying the effects of brush management on a suite of ESs on four instrumented watersheds on a mesquite-encroached desert grassland on the Santa Rita Experimental Range in southern Arizona. Pre-treatment herbaceous diversity and aboveground (herbaceous and woody live and litter) and belowground (soil organic C and roots to 20 cm) carbon pools were quantified prior to an aerial herbicide application in June 2016 on two of the watersheds. We re-measured these variables from September 2016 through February 2017 to determine their initial response to the treatment. Our analyses suggest that the relative abundance of both native and nonnative grasses has increased on the treated watersheds relative to controls. In addition, forage production increased by an average value of 24.7 kg/ha (22 pounds/acre), but there is significant variability in production response across the treated watersheds. Specifically, forage production generally increased under larger mesquite only (basal diameter > 25 cm (9.84 in)). These and additional ESs (related to runoff and sediment yield, net ecosystem exchange (flux towers), herbaceous diversity and soil carbon) will be quantified at regular intervals over the next three years. Initiated with USDA-AFRI funding, this will be a long-term study supported in the Agricultural Research Service LTAR (Long-Term Agricultural Research) program network.

Field data, combined with remotely sensed data from an unmanned aerial vehicle, will be used to parameterize computer simulation models to predict long-term ecosystem responses and provide for more effective cost-benefit analyses to brush management.

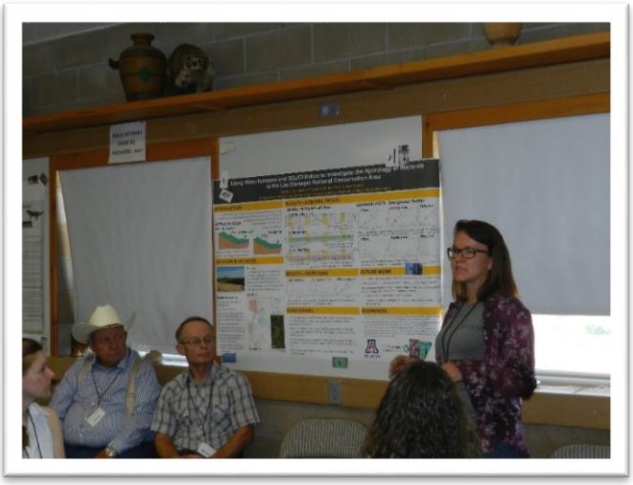
Dr. Adam T. Naito is a postdoctoral researcher in the School of Natural Resources and the Environment at the University of Arizona. He has expertise in landscape ecology, physical geography, Geographic Information Systems (GIS), remote sensing, and simulation modeling. Adam has conducted research in the montane forests of northern California, the Appalachians, and the Alaskan Arctic. He received his Bachelor's and Master's degrees in Geography at the Penn State University. Between his undergraduate and graduate programs, he interned in the Maps Division at the National Geographic Society in Washington, D.C., where he helped produce maps for the magazine. Adam then moved to Texas A&M University, where he received his PhD in Geography. As both a graduate student and assistant professor at Texas A&M, Adam taught courses in physical geography and GIS. He looks forward to the potential to return to a university as a professor in the next few years.

http://www.u.arizona.edu/~anaito/

Posters

Using Water Isotopes and SO_4/Cl Ratios to Investigate the Hydrology of Wetlands in the Las Cienegas National Conservation Area

Erin Gray, Jen McIntosh, and Rachel Tucci (University of Arizona), Andrew Salywon and Ron Tiller (Desert Botanical Gardens)



Wetlands are surface water systems that support diverse habitats which are frequently integral parts of regional ecosystems. Analysis of water stable isotopes and solute chemistry can reveal the nature and seasonality of the hydrologic connection between wetlands and local and regional groundwater. This research uses water stable isotopes and sulfate to chloride ratios to investigate the seasonal sources of water and degree of evaporation in wetland complexes (cienegas) and associated surface- and ground-water within the Las Cienegas National Conservation Area (LCNCA), an area of unique biodiversity within Southern Arizona. Surface water, springs, and shallow groundwater from piezometers within the multiple cienegas in the LCNCA were sampled seasonally and analyzed. Preliminary results suggest that the main source of water within shallow groundwater and wetlands in the LCNCA is basin groundwater, with little ephemeral input from direct winter or summer precipitation. There is little evidence of seasonal changes in water source, indicating that basin groundwater sustains these ecosystems year-round. Their apparent reliance on basin groundwater implies that the cienegas could be impacted by increased groundwater pumping. This insight, as well as the baseline hydrologic data that this research provides, will aid research efforts and help inform groups interested in the preservation of the LCNCA regarding future management decisions.

Erin Gray is an accelerated master's student in the Environmental Hydrology program the University of Arizona. In her first two years as a returning student, she was involved with the student groups Engineers Without Borders and the UA Green Fund, an elected group dedicated to the advancement of sustainable practices and projects on campus though grant funding. She is currently the student assistant at Arizona Project WET, where she provides support for a team that spreads water conservation education throughout the state via direct student outreach and teacher development. In the past

year, she has worked with Dr. McIntosh's research group using water chemistry to investigate wetland hydrology. Her experiences with research, outreach, and involvement will be valuable tools to she enters the workforce as a hydrologist focused on restoration and conservation after her expected graduation in December, 2018.

Ten Year Summary of Grassland Bird Point Counts at Appleton-Whittell Research Ranch

Vashti "Tice" Supplee
(Audubon Arizona)

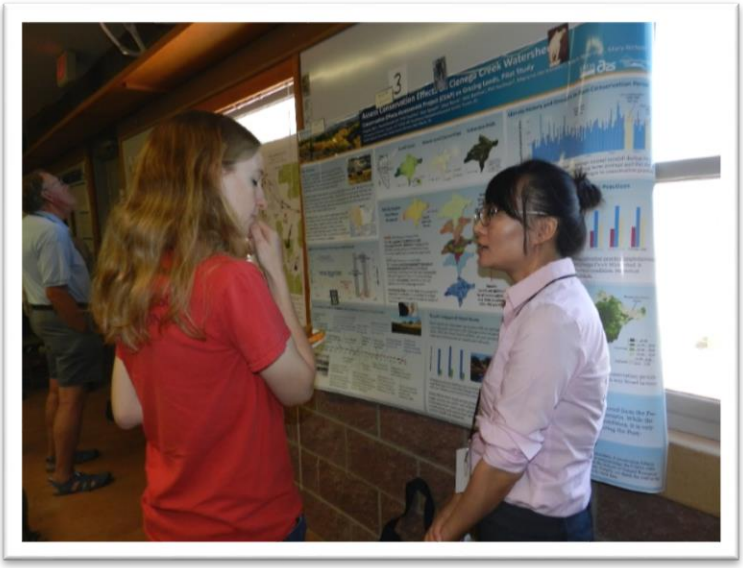
Roadside point counts for grassland birds were established on the Appleton Whittell Research Ranch of the National Audubon Society (AWRR) in 2006. Points are located in half mile increments on the main road from the Upper Elgin Road junction to the AWRR headquarters (17 points) and on the East Mesa Road and that portion of the West Gate Road within the AWRR boundary (14 points). The main access road route includes 8 points on the Babacomari Ranch pasture that has livestock grazing. The East Mesa route includes points that are Oak Savannah and Oak – Riparian.
The points are surveyed one time each year with dates varying from mid-August to early September. The protocol is a 5 minute count duration at each point and routes are begun a half hour before sunrise. Birds detected by auditory and visual methods are recorded. Singing birds are documented and when possible pairs or family groups are noted.

Apparent trends in bird species occurrence will be presented. The most commonly detected species are Botteri's sparrow (*Peucaea botterii*), eastern (Lilian race) meadowlark (*Sturnella magna lilianae*), Cassin's sparrow (*Peucaea cassinii*), and grasshopper sparrow (*Ammodramus savannarum*). Other species commonly encountered were mourning dove (*Zenaida macroura*), common nighthawk (*Chordeiles minor*), Montezuma (Mearn's) quail (*Cyrtonyx montezumae*), scaled quail (*Callipepla squamata*), western kingbird (*Tyrannus verticalis*), Say's phoebe (Sayornis saya), rufous-winged sparrow (*Peucaea carpalis*), lark sparrow (*Chondestes grammacus*), and blue grosbeak (*Passerina caerulea*).
Vashti "Tice" Supplee: Tice has been the Audubon Arizona Director of Bird Conservation since 2005, after a career with the Arizona Game and Fish Department

that included experiences in research, habitat management, game management, and urban wildlife.. She Coordinate Audubon Arizona's science related activities with National Audubon Society programs and offices in other states and co-manages the Arizona Important Bird Areas program. She earned her B.S at Cornell University and M.S. at the University of Arizona, both in Wildlife Ecology. She has received awards from the Arizona chapter of The Wildlife Society, Arizona Wildlife Federation, and National Audubon Society.

Assessing the Conservation Effects on Cienega Creek Watershed

Haiyan Wei, D. Phillip Guertin, David Goodrich, Ken Spaeth, I. Shea Burns, Jane Barlow (University of Arizona)



Conservation Effects Assessment Project (CEAP) is a multi-agency effort to quantify the environmental effects of conservation programs. Assessments are carried out at national scale on cropland, grazing lands and wetlands. Cienega Creek Watershed was selected as a pilot watershed for the CEAP grazing lands assessment, because it has a history of over-grazing and has been the focus of a long-term conservation planning process afterwards. Numerous NRCS and USFS grazing land management and soil erosion conservation activities have been implemented.

Conservation records showed that most conservation dollars, such as the Environmental Quality Incentives Program and livestock subsidies were spent after 1996. We assigned "1990-1996" as the Pre-conservation period and "2008-2012" as the Post-conservation period. Soil and vegetation data for these two periods were extracted from the National Rangeland Inventory database. We also collected data to represent the Historical Reference Condition, characterized by the least disturbed vegetation community examples from specific locations. Using the Automated Geospatial Watershed Assessment tool and the Rangeland Hydrology and Erosion Model, Cienega Creek

Watershed was broken into 974 hillslopes. Sediment yield from a 10year-1hour storm, as a watershed condition indicator, was simulated spatially across the watershed for all three conservation periods.

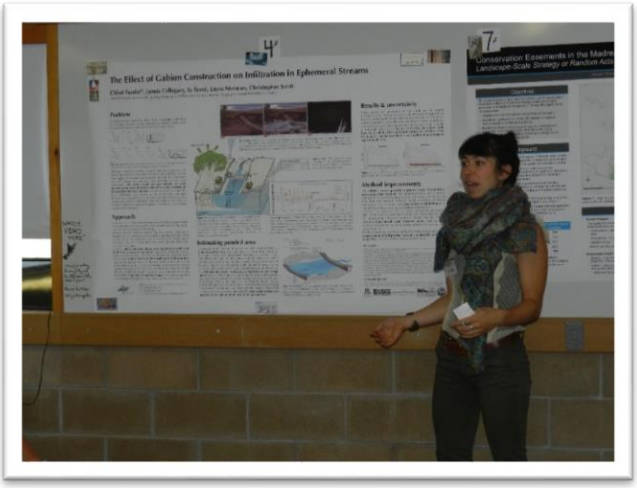
Results indicated that much of the watershed have improved from the Pre-conservation condition to the Post-conservation scenario. While the improvement is compromising comparing with the Historical Reference Condition, it is very encouraging given that about half of the 23 driest seasons in the 117-year (1895 to 2012) precipitation record occurred during the 16-year period from 1997 to 2012 when conservation spending was highest.

We also simulated the impact of a stock pond on a small subwatershed. ~75% of the sediment was trapped by the pond, following a 10year-1hour storm. If managed properly, stock ponds can serve as a conservation practice to improve downstream water quality in addition to supplying water for cattle and wildlife.

Haiyan Wei is an Assistant Research Scientist at the School of Natural Resources and the Environment, University of Arizona, and a support scientist at the USDA-Agriculture Research Service. Her research interests include rangeland hydrology and erosion modeling, model calibration, sensitivity and uncertainty analysis, drought, and remote sensing application.

The Effect of Gabion Construction on Infiltration in Ephemeral Streams

Chloe Fandel (University of Arizona)



Low-tech rock structures called gabions are commonly used in dryland stream channels to reduce erosion, slow floodwaters, and increase infiltration. Gabions may also increase water availability for riparian vegetation, and increase the duration of surface flow in ephemeral stream channels. However, their effects on infiltration and recharge are not well-understood. This study tested low-cost methods for easily quantifying the total infiltration induced by gabion construction in an ephemeral stream channel, over the course of a single flow event. We used well-established methods to find point infiltration fluxes from subsurface temperature time-series. Unique to this study, we then upscaled these measurements to the gabion's entire area of influence using time-lapse photo data, which recorded the onset of flow and the duration of

ponding. For a flow lasting ~5 hours, we ran 225 model scenarios, estimating that a single gabion could have increased the total
infiltrated volume in the channel reach between it and the next gabion by as much as 255% or as little as 0%, but the most likely scenario is a 10.8% increase. We found the photo data to be invaluable in obtaining these estimates, and in understanding the dynamics of a remote field site. Future work would benefit from more precise measurements of point infiltration fluxes and better records of ponded surface area over time. If these improvements are made and our estimates can be replicated reliably, they would suggest that gabions are a more powerful restoration and management tool than previously understood.

Chloe Fandel is a PhD student in Hydrology & Atmospheric Sciences at the University of Arizona. She is working on understanding the effects of small-scale rock structures on infiltration in ephemeral stream channels, with Prof. Ty Ferré and Prof. Christopher Scott, and with support from the NASA SpaceGrant and the NSF GRFP. Before moving to Tucson, she received a B.A. in Geological Sciences from Brown University in 2012, and worked as a GIS technician with Tug Hill Operating, as a field hydrology assistant at the USFS, and as an environmental educator through AmeriCorps. She also has a background in scientific illustration, and is currently discovering the exciting world of animation. Finally, as an instructor for the UA SkySchool, she has lead inquiry-based, multi-day science field trips into the Sky Islands for local middle and high school students, where her goal is to share the beauty and excitement of science.

Using repeat aerial imagery to quantifying long term rates and patters of *Prosopis velutina* across Las Cienegas National Conservation Area-quantifying long-term rates and patterns of shrub cover (velvet mesquite) across Las Cienegas National Conservation Area

Scott Jones (University of Arizona)

Rangelands provide a myriad of ecosystem services (ESs) giving them substantial value to socioecological systems. Over the past 150 years, many rangelands have experienced an increase of shrubs at the expense of perennial grasses. This state change, termed woody plant encroachment (WPE) or shrub proliferation, can result in alterations to ecosystem structure and functions with recent revelations suggesting

that provisions of ESs can both increase or decrease under WPE.
While the proliferation process and its drivers are varied and complex (e.g. excessive livestock grazing, increases in atmospheric CO_2, altered fire regimes, and climate change) consensus is emerging that interactions among multiple factors are key. The strength of these interactions varies with local constraints imposed by landforms, soils, and topography. Thus, long-term spatial/temporal dynamics of the proliferation process or responses to brush management are a challenge to predict. Furthermore, the long-term efficacy of brush management actions is largely unknown. Understanding spatiotemporal rates/dynamics of the encroachment process across a landscape with consideration to topoedaphic variables would provide valuable insights to land managers on where encroachment is most likely to occur. Additionally, evaluating the temporal response of re-encroachment following brush management actions across different topoedaphic constraints could aid in the development of guidelines for determining when, where and under what circumstances to use brush management and plan when retreatments might be required.

The proposed presentation will provide preliminary results from my dissertation research in which I'm quantifying long-term rates and patterns of shrub cover (velvet mesquite) across Las Cienegas National Conservation Area (LCNCA) on sites with contrasting soils, topography, and management histories (e.g. brush management). I will be utilizing historical time-series aerial photography and modern satellite imagery spanning from 1936-2015 and land use records to achieve this task. Not only will these results be valuable to BLM while creating an ecological assessment for proposed brush management on LCNCA, but spatial layers created from this will serve as a foundation for other sections of my research in which I will be assessing landscape-scale temporal changes in the provision of a suite of ecosystem services on these sites and how encroachment and subsequent brush management affects the provision and restoration, respectively of those services.

Scott Jones is a PhD candidate in the Arid Lands Resource Science program at the University of Arizona. The focus of his dissertation research is looking at the long-term rates and dynamics of the shrub encroachment process and how landscape changes (such as grassland-to-shrubland shift resulting from the proliferation process) can affect the provision of ecosystem services. He is also interested in trade-offs and synergies to ecosystem services that might be present following restoration actions. His research is focused on Las Cienegas National Conservation Area located in southern Arizona which is currently undergoing woody plant encroachment from velvet mesquite and also has a long history of brush management actions to control this phenomenon. This unique landscape is not only a working ranch but also provides numerous recreational activities as well as critical wildlife habitat truly defining what a mixed-use landscape is.

Surveying Public Values and Preferences to Guide Environmental Management in the Sonoita Creek Watershed

Oliver Lysaght, Laura M. Norman, Richard Pritzlaff, David Seibert, and H. Ron Pulliam (Borderlands Restoration)

The Sonoita Creek Watershed is bound by the Patagonia and Santa Rita Mountains, where surface water flows westerly, eventually draining into the Santa Cruz River. Over 1000 people live, work, and play in the Sonoita Creek watershed, all with varying opinions about what is important to them. Ecosystem services, including those associated with healthy, biologically diverse natural habitats such as forests, urban green spaces, wetlands (marshes and swamps), grasslands, and rivers, provide natural benefits to people. In order to better understand how ecological restoration and a restoration economy might support the ecological values of residents in, and visitors to, the Sonoita Creek Watershed, we are developing a survey to gain insight into the values placed on provisioning, regulating and cultural ecosystem services. Surveyed topics include: respondent's hydro-economic relationships; attitudes towards, and participation in, activities in the Sonoita Creek watershed; familiarity with terminology; preferences for resource management; and a spatially-explicit identification of where cultural values arise within the jurisdiction. Our end goal is to develop input for a regional decision-making tool called, "Social Values for Ecosystem Services" (SolVES), which uses GIS to assess, map, and quantify the social values assigned by stakeholders to ecosystem services. Insights from this survey will guide watershed management in the Sonoita Creek Watershed and strengthen restoration efforts via community participation.

Oliver Lysaght is a graduate of the London School of Economics, where he studied Environment and Development and became interested in the field of Ecological Restoration. He has since worked as an intern for Borderlands Restoration for a year, and in that time has been a member of the team developing the Borderlands Restoration Leadership Institute. Following his internship he will return to studies in the UK, where he wishes to advance research on which models (post-Brexit) can support agriculturalists in their production of food while too enhancing broader ecosystem service provision in the UK.

Conservation Easements in the Madrean Archipelago: Random Acts of Conservation or a Landscape-scale Strategy?

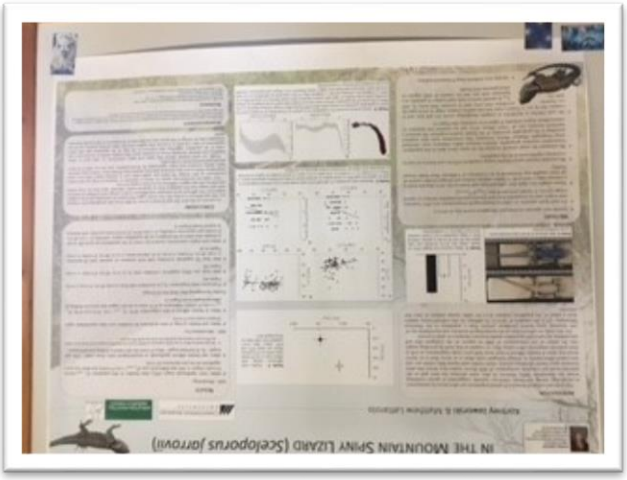
Damian Rawoot (University of Arizona)

Over the past three decades, conservation easements (CEs) have become a vital tool for protecting undeveloped private lands in the Madrean Archipelago in Arizona and New Mexico. Undeveloped private lands often form core portions of ranches managed in conjunction with leased federal and state trust lands, buffer existing protected areas, and support landscape connectivity, while development of these lands results in fragmentation, losses of habitat and connectivity, and isolates existing protected areas. Conservation easements represent a possible market-based solution these threats, but as a market-based mechanism, there is no explicit expectation that land protected supports landscape-scale conservation values. We assessed the spatial distribution of 95 conservation easements in the region relative to three local landscape-scale conservation priorities – connectivity with protected areas, riparian and aquatic ecosystems, and grassland ecosystems. Additionally, we conducted qualitative interviews with conservation easement "buyers" (organizations that seek, hold and finance CEs) and "sellers" (private landowners) to identify and characterize the process driving the spatial pattern of conservation easements in the region. Our results suggest that conservation easements do provide landscape-scale conservation benefits, and this is a result of deliberate selection by conservation easement "buyers" and the fact that a large supply of undeveloped private land with landscape-scale conservation values remains in the region.

Damian Rawoot is a native of Virginia's Shenandoah Valley. After graduating from Emory University with a BA in Political Science in 2008, he joined the Peace Corps. Serving in Panama's Darien Province, he worked with ranchers to improve production and reduce land degradation. Following completion of his Peace Corps service, Damian took a position with the US Forest Service's Office of International Program. In this role, he managed collaborative natural resource management and conservation projects in Israel, Oman, Malawi, Namibia and Botswana. In 2015, Damian returned to school to pursue a Master's degree in rangeland management at the University of Arizona's School of Natural resources, and serve as a Graduate Research Assistant with the Desert Landscape Conservation Cooperative. Following completion of his graduate studies, Damian is shifting into a new role as the Land and Water Protection Manager for Southern Arizona with The Nature Conservancy.

Social and ecological consequences of sexual size dimorphism in the mountain spiny lizard (Sceloporus jarrovii).

Kortney Jaworsky and **Matthew Lattanzio**
(Christopher Newport University)



The social and ecological dynamics of animal populations are often driven by asymmetries in morphology among individuals, which are typically exaggerated in species exhibiting sexual size dimorphism (SSD). However, to date, scant attention has been paid to the potential social and ecological consequences of SSD. Recent studies have shown that adult mountain spiny lizards (Sceloporus jarrovii), which exhibit male-biased SSD, exhibit sex- and size-related differentiation in thermal biological traits. Here we expand on that work by providing insight into the nature of the consequences of SSD on aspects of the ecological (diet and microhabitat use) and social (population spatial structure) dynamics of adult S. jarrovii. We collected data on the morphological attributes and microhabitat use of 89 lizards from a population in southeastern Arizona during June-July 2014. In addition, we also collected tissue samples from another sample of lizards from the same population for stable isotope analysis of their diet selection. Preliminary analyses support that the sexes diverge in their diet selection ($P<0.05$), but not in microhabitat use (i.e. perch type; $P>0.05$). Currently, we are incorporating additional data on 1) microhabitat quality and 2) spatial network structure into our study to evaluate the degree that SSD affects other aspects of ecology and individual association patterns in a population. We anticipate that our findings will provide key insight into how evolutionary phenomena like SSD may impact species' ecological interactions in the wild.

Kortney Jaworski is a part-time instructor at Christopher Newport University who first came to the research ranch in 2011 as part of Matt Lattanzio's team of researchers. Since then she has returned to the ranch every summer from 2011-2015. Kortney has assisted with several of the Lattanzio Lab's lizard research projects, and has completed and presented on two of her own projects. In 2011 & 2012, she studied the effects of diet restriction on the physiological responses of the ornate tree lizard (*Urosaurus ornatus*) and presented her findings at the World Congress of Herpetology in 2012. In 2014, Kortney was awarded the Apacheria Fellowship to conduct a study on the effects of sexual size dimorphism on the social interactions and ecology of a population of the mountain spiny lizard (*Sceloporus jarrovii*) in the nearby Huachuca Mountains. This research was presented at the 2016 Joint Meetings of Ichthyologists and Herpetologists.

Near-Surface Geophysics Surveys at Empire Gulch in the Las Cienegas National Conservation Area, SE Arizona

Rachel S. Tucci, Daniel Basabe, Gita Bodner, Riley J. Burkart, Erica A. Cupp, Patrick O. Dougherty, Jeanmarie Haney, Libby Kahler, Dr. Ben K. Sternberg, and Thomas D. Tuten