NORTHERN ARIZONA UNIVERSITY

Fossil Creek Ecosystem Studies Group

Newsletter, Spring 2006

Research supporting the restoration of Fossil Creek, Arizona

Unusually High Discharge Recorded for Fossil Springs

In response to the unseasonably high amount of precipitation during the winter of 2004-2005, the NAU Department of Geology has recorded unusually high discharge measurements for Fossil Springs during the winter of 2005-2006. A discharge of 66 cubic feet per second (cfs) was recorded on December 17, 2005 and a discharge of 63 cfs was recorded on February 11, 2006. These measurements were made about 400 meters upstream from the diversion dam, just below the fig tree spring, using a Swoffer 3000 flow meter. Monthly discharge measurements by the USFS from 1999-2004 recorded an average spring discharge of 45 cfs with the highest recorded flow at 52 cfs.

One theory regarding the recent high flows is that the extremely wet winter of 2004-2005 has increased recharge in the C aquifer and thus supplied more water to Fossil Springs. NAU will continue to monitor discharge from Fossil Springs over the next year to see how it is responding to these recent climate phenomena.

Photo by Ian Reed, USFS

Fossil Creek Stewardship Meeting Highlights the Importance of Collaboration

The Fossil Creek Stewardship meeting held on October 26, 2005 was designed to bring together managers, researchers, environmentalists, tribal leaders, and interested citizens to talk about the future management of Fossil Creek, specifically the short- and long-term management, stewardship, and education/outreach needs for Fossil Creek. Written comments were provided by one invitee who could not attend, while twenty four people attended the meeting at the Southwestern Academy's Beaver Creek campus. A brief summary of the needs identified at the meeting are:

For more information and research about Fossil Creek, see: www.watershed.nau.edu/FossilCreekProject

Fossil Creek Restoration a Hot Topic at 8th Biennial Conference of Research on the Colorado Plateau

The 8th Biennial Conference of Research on the Colorado Plateau, held at NAU in November 2005, provided a showcase for many aspects of research and policy making at Fossil Creek. Fourteen presentations at the conference provided updates on a wide variety of research and restoration topics at Fossil Creek. The special session entitled *Fossil Creek: An Opportunity to Restore a Diverse Native Fishery and Study the Effects of Return of Full Flows* was organized by Michele James and chaired by Allen Haden. This session was well attended and consisted of eight presentations highlighting research and the technical aspects of the native fish restoration program.

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Stewardship meeting
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Short-Term Management Needs
- recreation management to enhance experiences and reduce impacts;
- collaborative, interagency management and monitoring;
- protection of native fish (e.g., crayfish control, enforcing regulations, developing a monitoring plan).

Long-Term Management Needs
- maintain native fisheries (control of crayfish, non-natives);
- management of recreation infrastructure, including roads, trails, motorized access;
- acquiring funding and additional human resources;
- management presence/law enforcement.

Short-Term Stewardship Needs
- formation of a stewardship group – Friends of Fossil Creek;
- form relationships with other existing stewardship groups;
- collaborative planning;
- keep the area clean;
- provide stewardship information to users.

Long-Term Stewardship Needs
- Friends of Fossil Creek and agency interaction;
- keep the area clean;
- consider user fees;
- law enforcement;
- increase volunteerism (e.g., in local communities, school groups).

Short-Term Education/Outreach Needs
- On-site information sharing targeting users;
- Off-site information sharing – schools, communities, seek volunteers;
- Share information within and among agencies.

Long-Term Education/Outreach Needs
- education of visitors and locals about stewardship, ethics, Leave No Trace;
- education on native fish to prevent reintroduction of non-natives;
- gathering and sharing information on Fossil Creek research and management with the public via symposia, liaison, surveys.

While the results of this meeting are largely intended to serve as recommendations—a proposal—to land managers responsible for the short– and long-term management of Fossil Creek, it was evident from the meeting that there are many other individuals and groups who would like to be part of the future of Fossil Creek. Collaboration and partnerships are strong elements of the Fossil Creek restoration effort and will undoubtedly continue. A core working group and a "Friends of Fossil Creek" group are only two formal collaborations suggested at the meeting. Communication, knowledge sharing, and partnering on projects were suggestions for less formalized collaboration. The message was clear—working together is critical to the success of a restored Fossil Creek ecosystem.

Engineering Graduate Students Study Sediment and Feasibility of a Gaging Station

Work by students in Civil & Environmental Engineering at NAU addresses the release of sediment accompanying the planned lowering of the Fossil Springs Diversion Dam, slated to occur in late 2007, and hydrologic gaging on Fossil Creek.

Lorrie Yazzie is wrapping up her Masters of Science project to establish baseline conditions in that portion of Fossil Creek between the Fossil Springs and Irving. She has completed stream classification, pebble counting and surveying work, has placed all the data into a Geographic Information System (GIS) and is writing up her results. Lorrie has documented the fining of sediments between the Springs and the Diversion Dam, and has established a series of nearly a dozen baseline cross-sections for repeat surveys and pebble counts. These will be used to study the movement of sediment, presently stored behind the Diversion Dam, mobilized, transported, and re-deposited by large storms. Lorrie was assisted in her research by Kevin Gore and Randy Perham of NAU.

Ed Monin is finishing his Masters of Science project to identify locations, approaches and technology suitable for low-flow gaging on Fossil Creek. As part of this work, Ed has completed a stream classification, using a modification of Montgomery & Buffington's scheme, of the entire Fossil Creek stream reach, from the confluence of Calf Pen and Sand Rock Canyons, to the confluence of Fossil Creek with the Verde River.

Ed has identified and evaluated 5 potential locations for low flow-gaging system installation, which will possibly be done by SRP. A low-flow rating curve has been prepared for each location using HEC-RAS software. In addition, he has considered standard and state-of-the-art technologies. His recommendations will be forthcoming in the 2nd quarter of 2006.

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Gaging Station, *continued*

June 18, 2005 at 10:47 a.m., immediately prior to return of full flows (Ed Monin)

June 18, 2005 at 11:13 a.m., immediately after return of full flows (Ed Monin)

Ed has identified and evaluated 5 potential locations for low-flow gaging system installation, which will possibly be done by SRP. A low-flow rating curve has been prepared for each location using HEC-RAS software. In addition, he has considered standard and state-of-the-art technologies. His recommendations will he forthcoming in the 2nd quarter of 2006.

Biennial Conference

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Shaula Hedwall of the U.S. Fish and Wildlife Service provided an overview of the cooperative multi-agency effort to restore the native fish community in conjunction with restoration of flows and decommissioning. While nonnative fish removal was independent of restoration of flows, removal had to be completed before increased volume in the stream precluded the use of chemical treatment. Two national forests were involved and an environmental assessment had to be approved before a fish barrier could be built within the boundaries of a wilderness area. Bureau of Reclamation was responsible for design and construction of the barrier as well as overall project funding. Arizona Game and Fish Department was given the task of chemical treatment of the stream to remove nonnatives and the U.S. Fish and Wildlife Service was responsible for temporary removal and repatriation of native taxa. All scheduling for the various tasks had to include the cooperation of Arizona Public Service Company in order to meet their decommissioning schedule as well as take into account uncooperative weather. Cooperation among so many Federal and State agencies as well as the many non-governmental organizations and private entities was the key to successfully completing the fish restoration. David Weedman of Arizona Game and Fish Department (AGFD) described the coordinated efforts of his department and other agencies charged with removing nonnative fish from the stream. Extensive preplanning and application development were carried out during the summer of 2004 in order overcome the rapid breakdown of antimycin-a within the stream. A temporary, small-scale hatchery with 24-hour staff was built on the site of the Irving Power Plant to house all the salvaged native fish during chemical treatments. The extensive upfront work by AGFD paid off when the chemical renovation proved 100 percent effective.

From a research perspective Allen Haden and Jane Marks provided evidence that nonnative smallmouth bass and green sunfish were having a greater impact upon the abundance and feeding ecology of native fishes than discharge. Total abundance of all native fishes and especially small-bodied natives was severely depleted in the presence of nonnatives compared to dewatered portions of the stream. Likewise, stable isotope data indicated that feeding ecology of native chub and dace was disrupted in the presence of nonnatives compared to loss of water in the stream. Haden's study helps to justify the removal of nonnative fishes from the stream. Removal of nonnative fish may not have entirely beneficial effects. Ken Adams and Jane Marks presented data that showed nonnative crayfish densities increased two-fold in areas where nonnatives were removed compared to portions of the stream where nonnative fish remained. Additionally, Adams presented data on algal accrual and litter decomposition in enclosures with various crayfish densities. His results suggest that densities of crayfish in the stream previous to fish removal may have been below the threshold that can induce measurable ecosystem effects. Further research and monitoring will show if crayfish will continue to increase in abundance or if their densities remain under control after native fish populations recover.

Return of full flows to the stream will increase the number and size of travertine terraces in the stream. This important change in morphology is

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Biennial Conference
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likely to have profound effects on ecosystem processes. Cody Carter and Jane Marks found that both algal accrual on clay pots and decomposition of leaf litter was significantly faster in travertine dam forming reaches of Fossil Creek compared to areas without dams. Additionally, invertebrate communities on the algal and leaf substrates were more diverse in the travertine forming reach. Zachaeus Compson and coauthors showed that travertine dams profoundly affect the retention of leaf litter material in the stream. Travertine dams created large, wide pools and braided channels which decreased velocities and retained significantly more litter than free flowing sites over a range of discharges.

Brenda Harrop and coauthors are using cutting edge molecular techniques to describe the composition of fungal and bacterial communities colonizing leaf litter in travertine and non-travertine forming reaches of Fossil Creek. Initial data indicate that fungal communities vary by site while bacterial communities vary by both site and leaf species, yet further work is need to fully describe these communities.

Finally, from the human perspective, Paul Hancock and coauthors are exploring the impacts to recreation caused by the restoration project. Their results showed that the majority of users were from Arizona and generally were supportive of the hydropower decommissioning and nonnative fish removal. Interviewees were generally wary of regulations that might limit camping in the upper portion of Fossil Creek but were supportive of designated camping areas away from the spring area. This information combined with continued monitoring of recreational users activities and attitudes will be used by the Forest Service to build a management plan for recreation in Fossil Creek.

Fossil Creek was also the subject of presentations in other sessions of the Biennial Conference. Most provided the unique perspective of agencies, utilities, NGO's and individuals on the process that led to the decommissioning decision. All of the agency and NGO presentations stressed the high level of interagency cooperation and openness required to plan and implement large-scale restoration projects such as Fossil Creek. Jerry Stefferud provided a first person historical account of the decision process. Stefferud has been involved in the Fossil Creek process since 1989 as both fisheries biologist for the U.S. Forest Service and as private citizen. Rob Clarkson presented the role of the Bureau of Reclamation in the fisheries restoration program. The Bureau funded the fish restoration and fish barrier construction to improve native fish habitat for the existing native taxa and help with introduction of other imperiled Gila River basin native fish. Phil Smithers of Arizona Public Service Company provided the perspective of the utility, which surrendered its hydropower license and made the whole restoration project possible. Mindy Schlimgen-Wilson (formerly of American Rivers) spoke about the important lessons learned during the process of building the partnerships between agencies, APS, environmentalists and citizens which where necessary to produce the agreement to restore flows to the stream. Finally, Cecelia Overby and Janie Agyagos of the U. S. Forest Service provided a perspective from the land management agencies tasked with managing the Fossil Creek area and the restoration program.

The biennial conference provided an excellent venue for Fossil Creek research and management issues and we look forward to organizing a second session to follow up on research results in two years.

Central Repository for Fossil Creek Materials

NAU's Cline Library has agreed to provide a central repository for archiving materials related to Fossil Creek. Michele James, Fossil Creek Coordinator, is overseeing this effort for the Ecosystem Studies Group. Please contact her if you have materials associated with Fossil Creek that provide valuable information on past or existing conditions or in telling the story of Fossil Creek.

Acknowledging those who make our work possible

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NINA MASON PULLIAM
CHARITABLE TRUST

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