

## Southwest Biological Science Center Monthly Update

As a unit of the U.S. Geological Survey (USGS), the mission of the Southwest Biological Science Center (SBSC) is to provide quality scientific information needed to conserve and manage natural and biological resources, with an emphasis on the species and ecosystems of the southwestern United States. The SBSC has two research branches: Terrestrial Dryland Ecology and Rivers Ecosystem Science (which includes the Grand Canyon Monitoring and Research Center (GCMRC)). Both branches conduct research on the biology, ecology, and processes of the Southwest. SBSC has two field stations in Arizona (Flagstaff and Tucson) and one in Moab, Utah.

### WELCOME

Below are recent products and activities coming from the SBSC. Underlined names indicate SBSC personnel. If you would like more information on anything in this month's update contact Todd Wojtowicz ([twojtowicz@usgs.gov](mailto:twojtowicz@usgs.gov)).

### IMAGE OF THE MONTH



The endangered Sonoran tiger salamander (*Ambystoma tigrinum stebbinsi*)  
(photo credit: Brent Sigafus, USGS)

## OUTREACH

### Media, Broadcasts, and Films

**National Geographic** highlights USGS and **citizen science** in the Grand Canyon. A wide array of river guides, private boaters, and educational groups like **Grand Canyon Youth** collaborate with USGS scientists to study the Colorado River in the Grand Canyon. Through this partnership, citizen scientists collect samples from this remote ecosystem that are then analyzed by USGS scientists, thereby contributing to a deeper understanding of the Grand Canyon ecosystem. National Geographic highlighted USGS and citizen science efforts in the Grand Canyon through this video (<http://video.nationalgeographic.com/video/short-film-showcase/17-million-years-old-grand-canyon-still-has-lessons-to-teach>). SBSC's Carol "Fritz" Fritzinger, Adam Copp, and Anya Metcalfe are featured in the video.

The **Society for Freshwater Science** newsletter for Fall 2016 features an interview with Research Ecologist Ted Kennedy concerning his 2016 **BioScience** article that investigated the effects of hydropower production on river food webs. Eric Kortenhoeven, Anya Metcalfe, and Jeff Muehlbauer were mentioned in the article. The link to the interview is: <http://www.freshwater-science.org/Publications/Newsletter-In-The-Drift/ITD--Fall-2016.cfm#itdqna>.

### Public and Partner Outreach Activities

David Ward participated in the Colorado River Days event on September 3 at the **Willow Bend Environmental Education Center** in Flagstaff, AZ. David educated the public, including many children, about the native and nonnative fishes of the Colorado River.

Pamela Nagler was one of the judges who evaluated student (undergraduates, graduates, and recent doctorates) oral presentations and posters at the recent **Ecological Society of America** meeting. The Murray F. Buell award was given to the best student oral presentation, and the E. Lucy Braun award was given to the best student poster.

The U.S. Geological Survey's Grand Canyon Monitoring and Research Center (GCMRC) participated in Flagstaff's Science in the Park, part of **Flagstaff Festival of Science**, on September 24th. Fish Biologists David Ward and Ken Sheehan educated children about the native and nonnative fish found in the Colorado River. Aquatic Ecologists Anya Metcalfe and Moriah Evans provided information on the aquatic insects within the Colorado River Basin. Kyrie Fry, Communications, and Scott VanderKooj, Chief of GCMRC, provided additional science support to attendees. It is estimated that over 2,000 people were in attendance.

Kortenhoeven, E., Muehlbauer, J., and Kennedy, T., 2016, **Hydropower waves, insect eggs, and citizen science - What's up with the aquatic foodbase in Grand Canyon?:** Boatman's Quarterly Review, no. 3, no. 29, p. 19-22.

## SCIENCE

**Presentations, Posters, Lectures, Workshops, and Panels**

Aanderud, Z.T., Wu, N., Zhang, Y. Bahr, J., Zhuang, W.W., and Belnap, J., 2016, **Bacterial networks and fungal connections; understanding interactions among biocrusts biological constituent** [presentation]: BioCrust3 International Meeting.

Antoninka, A.J., Bowker, M.A., Chuckran, P.F., Barger, N., and Belnap, J., 2016, **Rapid culture of N-fixing soil lichens and biocrusts for rehabilitation of drylands** [presentation]: BioCrust3 International Meeting.

Belnap, J., 2016, **Reflections on a life: the awesomeness of studying biocrusts** [presentation]: BioCrust3 International Meeting.

Bradford, J.B., Schlaepfer, D.R., Lauenroth, W.K., Duniway, M.C., Hall, S.A., Hochstrasser, T., Jamiyansharav, K., Jia, G., Lkhagva, A., Munson, S.M., Pyke, D.A., Tietjen, B., and Wilson, S.D., 2016, **Climate change impacts on drought and ecosystem services in temperate drylands** [presentation]: World Congress Silvo-Pastoral Systems 2016.

Chapman, K., Parnell, R., Smith, M.E., Grams, P.E., and Mueller, E.R., 2016, **Evaluating the effectiveness and long-term sustainability of experimental floods on the Colorado River in the Marble Canyon reach of Grand Canyon, AZ** [presentation]: The Geological Society of America 2016 Meeting. Link to abstract: <https://gsa.confex.com/gsa/2016AM/webprogram/Paper280556.html>.

Darrouzet-Nardi, A., Reed, S.C., Grote, E.E., and Belnap, J., 2016, **Effects of warming and watering-induced moss death on CO<sub>2</sub> exchange in biocrust soils over an 8-year period** [presentation]: BioCrust3 International Meeting.

Dean, D., 2016, **The Little Colorado River revisited: analysis of nearly a century of hydrologic and geomorphic changes** [presentation]: Binghamton Geomorphology Symposium.

Duniway, M.C., 2016, **Biological soil crusts and rangeland management: role for crusts in state and transition models?** [presentation]: BioCrust3 International Meeting.

Duniway, M., and Nauman, T., 2016, **New tools for assessing land-uses impacts on Colorado Plateau landscapes** [presentation]: Southern Rockies Landscape Conservation Cooperative.

Fairley, H.C., Sankey, J.B., Caster, J., and East, A.E., 2016, **Sustaining archaeological sites in a sediment-deprived ecosystem: designing a monitoring program to assess Glen Canyon Dam effects on downstream archaeological resources in Glen and Grand Canyons, Arizona** [presentation]: The Geological Society of America 2016 Meeting. Link to abstract: <https://gsa.confex.com/gsa/2016AM/webprogram/Paper285412.html>.

Faist, A., Antoninka, A.J., Nelson, C., Giraldo Silva, A., Velasco Ayuso, S., Bowker, M.A., Reed, S.C., Duniway, M., Garcia-Pichel, F., Belnap, J., and Barger, N.N., 2016, **Biocrust inoculum development and soil stabilization strategies to promote biocrust restoration** [presentation]: BioCrust3 International Meeting.

Ferrenberg, S., Tucker, C., Reibold, R., Howell, A., and Reed, S.C., 2016, **Interactions among biocrust community states and warming temperatures could drastically reduce dryland soil fertility** [presentation]: BioCrust3 International Meeting.

Glenn, E.P., Nagler, P.L., Jarchow, C.J., and Shafroth, P. B., 2016, **Effectiveness of environmental flows for riparian restoration: a tale of four rivers** [presentation]: 5<sup>th</sup> International Ecosummit on Ecological Sustainability, Special Session, Resilient Rivers.

Hernandez-Morlan X.I., Peterson G., Rhemtulla J., Hinojosa-Huerta O., and Nagler P.L., 2016, **Landscape dynamics and resilience in the riparian corridor of the Colorado River Delta, Mexico** [poster]: 5<sup>th</sup> International Ecosummit on Ecological Sustainability, Special Session, Resilient Rivers.

Huber-Sannwald, E., Belnap, J., Arredondo, T., and Smart, D.R., 2016, **Biological nitrogen fixation and N flows in an arid grazed ecosystem using a stable isotope approach** [presentation]: BioCrust3 International Meeting.

Jarchow, C.J., Nagler, P.L., Glenn, E.P., Hernández, J.R., and Rodríguez-Burgueño, E., 2016. **Environmental flows as a tool for riparian ecosystem restoration: an analysis of greenup and evapotranspiration (ET) of the Colorado River Delta following the minute 319 pulse flows to Mexico** [poster]: 5<sup>th</sup> International Ecosummit on Ecological Sustainability, Special Session, Resilient Rivers.

Kuske, C.R., Mueller, R.A., Belnap, J., Reed, S.C., and Gallegos-Graves, L.V., 2016, **Seasonal distribution of soil fungal and bacterial communities in seven microhabitats of an arid grassland** [presentation]: BioCrust3 International Meeting.

McIntyre, C.L., Archer, S., and Belnap, J., 2016, **Influence of biocrusts on grass germination and establishment in two North American deserts** [presentation]: BioCrust3 International Meeting.

Mech, A., Tobin, P.C., Marsico, T.D., and Thomas, K., 2016, **Looking for black and white in the grey: variation in invasion success and management challenges in a global environment** [presentation]: 2016 International Congress of Entomology.

Mueller, E.R., Grams, P.E., Hazel Jr., J.E., and Schmidt, J.C., 2016, **Variability of eddy sandbar response during two decades of controlled flooding along the Colorado River in Grand Canyon** [presentation]: The Geological Society of America 2016 Meeting. Link to abstract: <https://gsa.confex.com/gsa/2016AM/webprogram/Paper284233.html>.

Mueller, E.R., Schmidt, J.C., and Topping, D.J., 2016, **Post-dam geomorphic transformation of the Colorado River in its delta and implications for controlled flow releases**

[presentation]: The Geological Society of America 2016 Meeting. Link to abstract:  
<https://gsa.confex.com/gsa/2016AM/webprogram/Paper284212.html>.

Nagler, P.L., Jarchow, C.J., van Riper III, C., Nguyen, U., and Glenn, E.P, 2016, **Estimating wide-area greenness and evapotranspiration in riparian corridors at multiple scales using optical remote sensing vegetation index methods** [presentation]: 101<sup>st</sup> Ecological Society of America Meeting, Special Session, Ecosystem Consequences of a Changing Water Cycle in the Southwest.

Nouri, H., Anderson, S., Sutton, P., Nagler, P. Jarchow, C., Beecham, S., and Roberts, D., 2016, **NDVI, scale invariance and the modifiable areal unit problem: an assessment of vegetation in two arid land regions** [poster]: 5<sup>th</sup> International Ecosummit on Ecological Sustainability, Special Session, Resilient Rivers.

Rutherford, W.A., Painter, T.H., Ferrenberg, S., Belnap, J., Okin, G.S., Flagg, C., and Reed, S.C., 2016, **The energy of biocrusts: how climate change disturbances in drylands may induce large, novel global climate change feedbacks** [presentation]: BioCrust3 International Meeting.

Sankey, J.B., Kreitler, J., Hawbaker, T.J., Staley, D.M., Rengers, F.K., Mueller, E.R., Mcguire, L, and Kasprak, A., 2016, **A multi-model approach to project regional post-fire sediment dynamics** [presentation]: The Geological Society of America 2016 Meeting. Link to abstract:  
<https://gsa.confex.com/gsa/2016AM/webprogram/Paper280247.html>.

Sigafus, Brent discussed **amphibian diseases** as a guest lecturer in a Disease of Wildlife class at University of Arizona on September 8.

Smith, M. Elliot, Finnegan, Noah J., and Mueller, E.R., 2016, **Durable terrestrial geology and catchment slope promote submarine canyon headwall incision** [presentation]: The Geological Society of America 2016 Meeting. Link to abstract:  
<https://gsa.confex.com/gsa/2016AM/webprogram/Paper288090.html>.

Tucker, C.T., Ferrenberg, S., and Reed, S.C., 2016, **Warming results in accelerated carbon loss from biological soil crust and soils in greenhouse mesocosms** [presentation]: BioCrust3 International Meeting.

Walker, A.E., Schmidt, J.C., Moore, J.N., Grams, P.E., Dean, D.J., Shafroth, P.B., Scott, J., Rubin, D.M. and Topping, D.J., 2016, **The relative influence of rare snowmelt floods, regular snowmelt floods, and summer thunderstorms to floodplain development on the Green River in Canyonlands National Park, UT** [presentation]: The Geological Society of America 2016 Meeting. Link to abstract:  
<https://gsa.confex.com/gsa/2016AM/webprogram/Paper286564.html>.

Weber, B., Budel, B., and Belnap, J., 2016, **Biological soil crusts: new findings, knowledge gaps, new directions** [presentation]: BioCrust3 International Meeting.

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## **Published Papers, Reports, and Data Releases**

Bair, L.S., Rogowski, D.L., and Nehr, C., 2016, **Economic value of angling on the Colorado River at Lees Ferry: using secondary data to estimate the influence of seasonality**: North American Journal of Fisheries Management: no. 6, p. 1229-1239. Online link to paper: <http://dx.doi.org/10.1080/02755947.2016.1204388>.

Buscombe, D., and Grams, P.E., 2016, **Stochasticity of riverbed backscattering, with implications for acoustical classification of non-cohesive sediment using multibeam sonar** in Constantinescu, G., Garcia, M., and Hanes, D., eds., River Flow 2016: London, UK, Taylor & Francis Group, p. 1496-1509. Link to chapter: [https://dbuscombe.usgs.github.io/media/pdfs/BuscombeGrams\\_RiverFlow2016\\_fullpaper\\_final.pdf](https://dbuscombe.usgs.github.io/media/pdfs/BuscombeGrams_RiverFlow2016_fullpaper_final.pdf).

Dzul, M.D., Yackulic, C.B., Korman, J., Yard, M.D., and Muehlbauer, J., 2016, **Incorporating temporal heterogeneity in environmental conditions into a somatic growth model**: Canadian Journal of Fisheries and Aquatic Sciences, DOI: 10.1139/cjfas-2016-0056. Online link to paper: [http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2016-0056#.V\\_KEvkrJhF](http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2016-0056#.V_KEvkrJhF).

East, A.E., Jenkins, K.J., Happe, P.J., Bountry, J.A., Beechie, T.J., Mastin, M.C., Sankey, J.B., and Randle, T.J., 2016, **Channel-planform evolution in four rivers of Olympic National Park, Washington, U.S.A.: the roles of physical drivers and trophic cascades**: Earth Surface Processes and Landforms. Early online link: [http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1096-9837/accepted](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1096-9837/accepted).

Henderson, R.A., Puffer, S.R., and Lovich, J.E., 2016, **Gopherus agassizii (Mohave Desert tortoise). Nest Depredation**: Herpetological Review, Notes, vol. 47, no. 3, p. 446-447.

Hoover, D.L., Duniway, M.C., and Belnap, J., 2016, **Testing the apparent resistance of three dominant plants to chronic drought on the Colorado Plateau**: Journal of Ecology, DOI: 10.1111/1365-2745.12647. Early online links: <http://onlinelibrary.wiley.com/doi/10.1111/1365-2745.12647/full> and <http://dx.doi.org/10.1111/1365-2745.12647>.

Jarchow, C.J., Nagler, P.L., and Glenn, E.P., 2016, **Greenup and evapotranspiration following the Minute 319 pulse flow to Mexico: an analysis using Landsat 8 normalized difference vegetation index (NDVI) data**: Ecological Engineering. Early online link: <http://www.sciencedirect.com/science/article/pii/S0925857416304906>.

Kimiti, D.W., Riginos, C., and Belnap, J., 2016, **Low-cost grass restoration using erosion barriers in a degraded African rangeland**: Restoration Ecology. Early online links: <http://onlinelibrary.wiley.com/doi/10.1111/rec.12426/abstract> and <http://dx.doi.org/10.1111/rec.12426>.

Lee, K.C., Archer, S.D.J., Boyle, R.H., Lacap-Bugler, D.C., Belnap, J., and Pointing, S.B., 2016, **Niche filtering of bacteria in soil and rock habitats of the Colorado Plateau Desert, Utah, USA**: Frontiers in Microbiology, v. 7, p. 1489. Early online links: <http://journal.frontiersin.org/article/10.3389/fmicb.2016.01489> and <http://dx.doi.org/10.3389/fmicb.2016.01489>.

Lovich, J.E., 2016, **Desert scrublands**, in Jones, L.L.C, Halama, K.J., and Lovich, R.E., eds., Habitat management guidelines for amphibians and reptiles in the southwestern United States, Technical Publication HMG-5: Partners in Amphibian and Reptile Conservation, Birmingham, Alabama, p. 50-54.

Lovich, J.E., and Ennen, J.R., 2016, **Energy development**, in Jones, L.L.C, Halama, K.J., and Lovich, R.E., eds., *Habitat management guidelines for amphibians and reptiles in the southwestern United States*, Technical Publication HMG-5: Partners in Amphibian and Reptile Conservation, Birmingham, Alabama, p. 31-34.

Metcalf, A.N., Kennedy, T.A. and Muehlbauer, J.D., 2016, **Angel lichen moth abundance and morphology data, Grand Canyon, AZ, 2012**: U.S. Geological Survey data release, <http://dx.doi.org/10.5066/F7154F5S>.

Mueller, E.R., Schmidt, J.C., Topping, D.J., Shafroth, P.B., Rodríguez-Burgueño, J.E., Ramírez-Hernández, J., and Grams, P.E., 2016, **Geomorphic change and sediment transport during a small artificial flood in a transformed post-dam delta: the Colorado River delta, United States and Mexico**: Ecology Engineering, online version, <http://dx.doi.org/10.1016/j.ecoleng.2016.08.009>.

Munson, S.M., Sankey, T.T., Xian, G., Villarreal, M.L., and Homer, C.G., 2016, **Decadal shifts in grass and woody plant cover are driven by prolonged drying and modified by topographic properties**: Ecological Applications, DOI: 10.1002/eap.1389. Online link: <http://onlinelibrary.wiley.com/doi/10.1002/eap.1389/abstract>.

Palmquist, E.C., Ralston, B.E., Sarr, D., Merritt, D., Shafroth, P.B. and Scott, J.A., 2016, **Southwestern riparian plant trait matrix, Colorado River, Grand Canyon, 2014 to 2016-Data**: U.S. Geological Survey [data release](http://dx.doi.org/10.5066/F7QV3JN1), <http://dx.doi.org/10.5066/F7QV3JN1>.

Proença, V., Martin, L.J., Pereira, H.M., Fernandez, M., McRae, L., Belnap, J., Böhm, M., Brummitt, N., García-Moreno, J., Gregory, R.D., Honrado, J.P., Jürgens, N., Opige, M., Schmeller, D.S., Tiago, P., and van Swaay, C.A.M., 2016, **Global biodiversity monitoring: from data sources to essential biodiversity variables**: Biological Conservation, v.(online), <http://www.sciencedirect.com/science/article/pii/S0006320716302786> and <http://dx.doi.org/10.1016/j.biocon.2016.07.014>.

Reynolds, R.L., Munson, S.M., Fernandez, D.P., Goldstein, H.L., and Neff, J.C., 2016, **Concentrations of mineral aerosol from desert to plains across the central Rocky Mountains, western United States**: Aeolian Research, v. 23(A), p. 21–35. Online link: <http://dx.doi.org/10.1016/j.aeolia.2016.09.001>.

Rossmann, S., Yackulic, C.B., Saunders S.P., Reid, J., Davis, R., and Zipkin, E.F., 2016, **Dynamic N-occupancy models: estimating demographic rates and local abundance from detection-nondetection data**: Ecology, DOI: 10.1002/ecy.1598. Early online link: <http://onlinelibrary.wiley.com/doi/10.1002/ecy.1598/full>.

Topping, D.J., Wright, S.A., Griffiths, R.E., and Dean, D.J., 2016, **Long-term continuous acoustical suspended-sediment measurements in rivers – theory, evaluation, and results from 14 stations on five rivers** in Constantinescu, G., Garcia, M., and Hanes, D., eds., *River Flow 2016*: London, UK, Taylor & Francis Group, p. 1510-1518. Link to book: <https://www.crcpress.com/River-Flow-2016-Iowa-City-USA-July-11-14-2016/Constantinescu-Garcia-Hanes/p/book/9781138029132>

Wertin, T.M., Belnap, J., and Reed, S.C., 2016, **Experimental warming in a dryland community reduced plant photosynthesis and soil CO<sub>2</sub> efflux although the relationship between the fluxes remained unchanged**: Functional Ecology. Online links: <http://onlinelibrary.wiley.com/doi/10.1111/1365-2435.12708/full> and <http://dx.doi.org/10.1111/1365-2435.12708>.

Wertin, T.M., and Reed, S.C., 2016. **Experimental design plant and soil measurement data, Colorado Plateau, 2011**: U.S. Geological Survey [data release](#), <http://dx.doi.org/10.5066/F7PG1PVH>.

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## **New Grants and Other Funded Opportunities**

Pamela Nagler's proposal titled, **Effects of changes in tamarisk evapotranspiration on groundwater flow and contaminant transport at a southwestern uranium mill tailings site**, was submitted to the [National Unmanned Aircraft Systems \(UAS\) Workshop 2015](#) and was selected for funding. Pamela Nagler and her colleagues from Navarro Research and Engineering, Jody Waugh (DOE contractor), and Edward Glenn (University of Arizona) were awarded the opportunity to have a UAS team of pilots from Flagstaff, AZ based in the USGS Western Geographic Science Center. Geoffery DeBenedetto (Arizona Water Science Center) and John Vogel (Western Geographic Science Center) operated the UAS with visible and infrared data acquired to assist Pamela and her colleagues with their research proposal. The researchers acquired the data on Augusts 21-27 with permission from the Navajo Nation in Shiprock, New Mexico and the DOE Office of Legacy Management for the UMTRCA sites in Shiprock and Moab, Utah. More information about this project can be found in the article, "[Unmanned aircraft systems used to improve methods for estimating groundwater discharge by plants](#)" ([http://energy.gov/sites/prod/files/2016/10/f33/2016\\_Q3\\_ProgramUpdate.pdf](http://energy.gov/sites/prod/files/2016/10/f33/2016_Q3_ProgramUpdate.pdf)).

Sasha Reed is a part of a graduate education program with [Utah State University](#) that was recently funded by the [National Science Foundation](#). The title of the graduate program is, **Graduate climate adaptation research that enhances education and responsiveness of science at the management-policy interface (Grad-CAREER)**, and this graduate program was selected for funding as part of the National Science Foundation Research Traineeship (NRT) [program to help train the next-generation of scientists and managers in the context of climate change](#), with a focus on drought and fire. The project anticipates training 80 MS and PhD students, including 28 funded trainees, from natural, physical, and social sciences, engineering, and mathematics. This project will prepare **STEM** graduates for careers that integrate science with management and policy to understand and adapt to changing climate, and will provide new science-based understanding of adaptation to changing climate. For more information, please contact Sasha at [screed@usgs.gov](mailto:screed@usgs.gov).

## **OTHER NOTABLES**

Joel Sankey presented a webinar titled, **Climate, wildfire, and erosion ensemble foretells more sediment in western USA watersheds**, on August 30. The webinar was hosted by USU Extension Forestry, Utah State University. Over 100 people watched Joel's presentation, including people from federal agencies, state agencies, and conservation organizations.

An article recently published in [Science](#) titled, "How dams can go with the flow", highlighted recent USGS research efforts in [Grand Canyon](#) (<http://science.sciencemag.org/content/353/6304/1099>). The article was



authored by LeRoy Poff (Colorado State University) and Jack Schmidt (Utah State University) and showcased research by SBSC ecologists Theodore Kennedy, Jeff Muehlbauer, Charles Yackulic, Kim Dibble, Eric Kortenhoeven, and Anya Metcalfe that was published in the July issue of BioScience and titled, **Flow management for hydropower extirpates aquatic insects, undermining river food webs.**

Jeff Lovich served on a National Science Foundation project review panel.

Ted Melis, Jayne Belnap, Pamela Nagler, Sasha Reed, Seth Munson, Chris Jarchow, Charles van Riper III, Matt Johnson, and Charles Yackulic from the SBSC were involved in a tamarisk removal coordination meeting with Ray Suazo, BLM AZ State Director. Personnel from the New Mexico Water Science Center and the Arizona Water Science Center also took part in the meeting.

The first ever Festival of Science in Moab, UT, which is a multi-agency event designed to highlight the wonder and utility of science on the Colorado Plateau, occurred on September 22-25. USGS scientists Sasha Reed and Erika Geiger helped lead a group that included BLM, NPS, Utah DNR and DWR, Utah State Parks, DOE UMTRA, the Canyon Country Discovery Center, Clark Planetarium, the Colorado Plateau Dark Sky Cooperative, the Grand County Library, and Utah State University. This Festival is modeled after the long-running and very successful Festival of Science in Flagstaff, AZ, and all events are free and open to the public. Please go to [www.moab-scifest.org](http://www.moab-scifest.org) or contact Sasha at [screed@usgs.gov](mailto:screed@usgs.gov).

On September 21, Kathryn Thomas presented and led a discussion on future directions for monitoring the listed Arizona hedgehog cactus at the Arizona Hedgehog Cactus Summit hosted by the Desert Botanical Garden. Thomas is working with the US Fish and Wildlife Service for this endangered cactus to conduct a systematic review of monitoring efforts, current and potential future, in support of recovery planning. The Arizona hedgehog cactus has a restricted range in central-east Arizona in areas where several large mining operations are ongoing and/or planned. For more information contact Kathryn Thomas at [kathryn\\_a\\_thomas@usgs.gov](mailto:kathryn_a_thomas@usgs.gov).

BioCrust3, an international workshop on biological soil crusts, took place in Moab, UT from September 26-30. Sash Reed (Southwest Biological Science Center) and Matthew Bowker (Northern Arizona University) were the co-chairs of the meeting. The goal of the meeting was to provide the definitive forum for the productive exchange of ideas and the forging of new collaborations in biocrust research and management, and the meeting brought together more than 150 participants with speakers from 17 countries. For the first time, the meeting also focused on the inclusion of resource managers and experts from BLM, NPS, NRCS, and the USFS attended and contributed. Hilda Smith, Erika Geiger, Adam Kind, Armin Howell, Robin Reibold, Sarah Fisher, and Ed Grote of the SBSC assisted with the meeting and Jayne Belnap was awarded a lifetime achievement award. USGS Public Affairs Specialist Jenn LaVista covered the event. For more information, including an agenda, go to: <http://nau.edu/merriam-powell/biocrust3/welcome> or contact Sasha at [screed@usgs.gov](mailto:screed@usgs.gov).