



United States Department of Agriculture

2022 Monitoring Report

Fossil Creek Comprehensive River Management Plan

Coconino & Tonto National Forests



Forest Service

December, 2024

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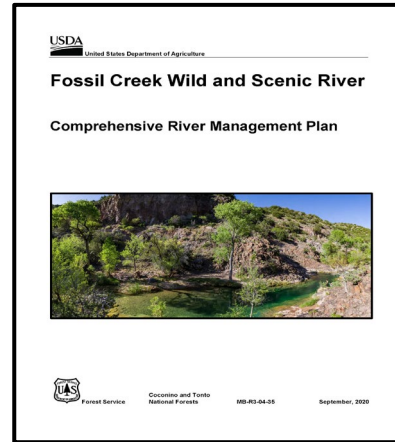
About the Fossil Creek CRMP Monitoring Plan

Purpose

The purpose of this 2022 Fossil Creek Comprehensive River Management Plan (CRMP) Monitoring Report is to inform the public, partners, stakeholders, other government agencies, and tribes of the current status of the monitoring prescribed in the Fossil Creek CRMP monitoring plan, as well as other ongoing monitoring in the drainage.

In the Fossil Creek CRMP, monitoring and adaptive management is related to multiple river values (water, biological, geology, recreation, and cultural values). Monitoring is intended to protect river values, inform CRMP implementation, and highlight the need for adaptive management actions.

If assessment of monitoring data indicates adverse impacts attributable to management actions or visitor use may be occurring, adaptive management actions that are anticipated to lessen these impacts will be implemented. Reaching a soft threshold indicates adverse impacts may be occurring. The monitoring results presented in this report help the district rangers and forest supervisors assess monitoring results, and recommend and implement adaptive management actions where needed. Partners, community members, and subject matter experts can lend valuable expertise and institutional knowledge to this process, which can increase capacity, promote innovation, develop a shared sense of stewardship, and build trust in the management of Fossil Creek.



The Fossil Creek CRMP monitoring and adaptive management plan (Fossil Creek CRMP, pp. 115-145) addresses the following monitoring topics. These topics are grouped in this report as follows.

- ❖ Bare soil/Potential for delivery of sediment or fecal matter to Fossil Creek
- ❖ Stream flow
- ❖ Common black-hawk occupied territories
- ❖ Fossil springsnail habitat and populations
- ❖ Aquatic macroinvertebrate index of biological integrity (IBI)
- ❖ Non-native plant species
- ❖ Travertine dams
- ❖ Visitor use data/Opportunity for river-based recreation
- ❖ Visitor satisfaction
- ❖ Traditional cultural use practitioners/Cultural sites

Objectives

- Track monitoring and adaptive management plan implementation.
- Evaluate monitoring data for indicators of adverse impacts attributable to management actions or visitor use (reaching a threshold), and implement adaptive management actions that are anticipated to lessen these impacts.
- Document and report the results of completed monitoring. Document monitoring that has not been completed and the reasons and rationale why. Determine if updates to the monitoring plan are needed to increase the CRMP's efficiency or effectiveness.
- Present recommendations to responsible officials.

Summary

Some monitoring was conducted in 2022 to address the following monitoring topics in the Fossil Creek CRMP Monitoring and Adaptive Management Plan.

- Bare soil/Potential for delivery of sediment or fecal matter to Fossil Creek
- Stream flow
- Common black-hawk occupied territories
- Fossil springsnail habitat and populations
- Aquatic macroinvertebrate index of biological integrity (IBI)
- Non-native plant species
- Visitor use data/Opportunity for river-based recreation

Monitoring for the following topics was not conducted in Fossil Creek in 2022, primarily due to safety concerns from and burned area emergency rehabilitation work for the Backbone Fire.

Other reasons reported in the topic sections below include needed adjustments to monitoring protocols, repairs needed to baseline data, or simply that monitoring for a topic was not planned or needed in 2022. Monitoring for these topics will be reported in subsequent years as monitoring methods are finalized and safety is no longer a concern.

- Travertine dams
- Visitor satisfaction
- Traditional cultural use practitioners/Cultural sites

The monitoring results that we do have for 2022 show that, in general, monitoring conducted per the Fossil Creek CRMP monitoring plan has not shown any resource topics approaching either their soft or hard thresholds.

Table 1 summarizes the findings of the monitoring in 2022 for each of the Fossil Creek CRMP monitoring topics and its identified thresholds.

Table 1. Summary of Findings by Fossil Creek CRMP Monitoring Topics

Monitoring Topic	Progress Implementing CRMP?	Thresholds Reached?		Recommendation/Adaptive Actions Needed
		Soft	Hard	
Bare soil/Potential for delivery of sediment or fecal matter to Fossil Creek	Yes. In November 2022, baseline data were collected showing bare areas that persisted after Backbone Fire closures up to the waterfall. However, the Flume Trail, Fossil Springs, and areas above the waterfall were not surveyed in this effort.	Unknown, this is the baseline dataset	Unknown, this is the baseline dataset	<p>Update application protocol and begin training Forest Service employees in survey methods.</p> <p>Begin surveying bare areas before and after permit season.</p> <p>Decommission unauthorized access routes that are hydrologically connected to Fossil Creek.</p>
Stream flow	Yes. In 2022, mean annual flows were collected and recorded, then compared to the five-year flow data (2017-2021). Water quality monitoring was conducted at five locations along Fossil Creek.	No	No	<p>Provide updated flow data next year, compare 2018-2022 to 2023, and report on water quality monitoring completed in 2023.</p>
Common black-hawk occupied territories	Yes. The most recent monitoring of common black-hawk occupied territories was conducted by Northern Arizona University students in 2020. Although monitoring was not required in 2022, it was completed.	No	No	<p>Conduct surveys for black-hawks in Fossil Creek between 2023 and 2025 for occupied territories and the presence of any user-created trails within 300 yards of nesting areas.</p> <p>Educate recreationists on their impacts on riparian habitat and wildlife.</p> <p>Establish monetary fines for recreationists that abuse riparian areas.</p> <p>Conduct an estimation of and enforcement of the proper human capacity levels in Fossil Creek.</p> <p>Encourage gallery forest and nest tree regeneration through appropriate water management when and where possible.</p> <p>Manage grazing as needed to encourage success of cottonwood, willow, and sycamore regeneration.</p>

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Fossil springsnail habitat and populations	Yes. During 2022, 8 spring locations were surveyed.	2 of 4 sites fell below hard threshold due to wildfire, baseline for one site established	2 of 4 sites fell below hard threshold due to wildfire, baseline for one site established	<p>Establish a submeter resolution baseline location for each spring to ensure that springs can be successfully and efficiently relocated and habitat parameters can be more accurately compared between each survey in the future. Implement the following: (1) georeference each springhead and its boundaries using submeter GPS unit, and/or (2) create a photo library that shows and describes each spring and springhead. The wetted area of each spring may vary between years, but having a baseline reference for the spring site will ensure survey repeatability.</p> <p>Consider thinning/treating vegetation around known springsnail sites to remove non-native plants enveloping the spring and allow solar radiation to reach some open water to enhance aquatic vegetation growth.</p>
Aquatic macroinvertebrate index of biological integrity (IBI)	Yes. In 2022, nine sites that varied in disturbance severity, based on post-fire sedimentation from the 2021 Backbone Fire, were sampled for benthic macroinvertebrates. Macroinvertebrates were sampled in the spring and again in the summer of 2022.	No	No	<p>Continue macroinvertebrate sampling and monitoring to calculate IBI scores. Identify potential improvements to monitoring methods such as Surber sampling.</p> <p>Contract with AZDEQ or a company that specializes in macroinvertebrate identification and analysis.</p> <p>Monitor aquatic habitat to identify post-fire impacts.</p>
Non-native plant species	Yes. In 2022, a Friends of the Verde River crew conducted a treatment on invasive Himalayan blackberry at Fossil Springs, and dabbed the cut canes with herbicide. Friends of the Verde River staff and Southwest Conservation Corps monitoring technicians also monitored vegetation in the Fossil Springs/Flume Trail area, focusing on inventory of Himalayan blackberry and invasive riparian plant species within the Fossil Springs Botanical Area.	No	No	<p>Per the Fossil Creek CRMP, continue to monitor one third of the Fossil Creek corridor each year. Compare monitoring results in future years to 2020 baseline for lower Fossil Creek.</p> <p>Continue monitoring in areas where sacred datura has replaced Himalayan blackberry, such as in the pilot treatment area, to see if the blackberry reestablishes.</p> <p>Monitor Arizona dewberry populations that are adjacent to invasive Himalayan blackberry populations.</p> <p>In areas where Himalayan blackberry is established, cut and treat plants with an aquatic-approved glyphosate in 2023.</p> <p>Coordinate with Friends of the Verde River staff to determine which stands of blackberry to prioritize. Arizona dewberry populations should be buffered and protected from Himalayan blackberry encroachment when possible.</p>

				<p>Treat the population of yellow bluestem near Irving in 2023.</p> <p>Complete a Minimum Requirements Decision analysis to allow herbicide use in the wilderness.</p> <p>Schedule treatment of Class E species in lower Fossil Springs in fall and winter of 2023.</p> <p>Treat the small stands of salt cedar and giant reed above Stehr Lake, working downstream to the Narrows, then from the confluence of Fossil Creek and the Verde River upstream.</p> <p>Monitor for new occurrences of Class A species, including mulberry, in Fossil Creek in 2023. If 2023 monitoring shows an increase in relative vegetation cover or establishment of new populations, then management actions should be considered.</p>
Travertine dams	No. While forest staff have discussed bringing on experts from RMRS or a university, no progress has been made in identifying a travertine contact to advise on photo point development.	Unknown	Unknown	<p>Identify a travertine expert who is interested in advising on photo point development.</p> <p>Explore additional ways to monitor travertine formations over time (magnets?).</p>
Visitor use data/Opportunity for river-based recreation	No. Visitor-use data was not collected in 2022 due to the Backbone Fire.	No	No	<p>Continue visitor-use data collection when Fossil Creek is opened again to visitors. Begin data collection and build over time.</p> <p>In future years, potential visitation may be increased incrementally up to a maximum (as stated in the Oct. 1, 2021, Fossil Creek CRMP Record of Decision). Each incremental increase will require additional monitoring to determine if use at that level is continuing to protect river values. The decision allows for a corridor-wide user capacity of 212 vehicles and approximately 1,120 PAOT.</p>

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Visitor satisfaction	Yes. The Coconino National Forest signed an agreement with the University of Montana and U.S. Forest Service Rocky Mountain Research Station in April 2022 to collaboratively work on developing and administering visitor surveys at Fossil Creek. Ph.D. Candidate Jaclyn Rushing coordinated with USFS staff and drafted a survey based on past efforts and current management needs.	Unknown, baseline monitoring still underway	Unknown, baseline monitoring still underway	Initiate or complete the following tasks in 2023: <ul style="list-style-type: none"> • Finalize the survey instrument and sampling plan • Initiate required Office of Management and Budget review • Recruit survey administrators
Traditional cultural use practitioners/ Cultural sites	No.	No	No	Due to Backbone Fire closures and staffing limitations, no cultural monitoring was done in the area in 2022.

Forest Supervisors' Certification

This report documents the status of monitoring activities in the Fossil Creek drainage in 2022 per the Fossil Creek Comprehensive River Management Plan (CRMP). It includes both the status of the monitoring required by the Fossil Creek CRMP and other monitoring also performed in the Fossil Creek subwatershed.

We have evaluated the status of Fossil Creek monitoring, the results of completed monitoring, and the recommendations presented in this report and endorse them. We find that there are no recommended changes to the Fossil Creek CRMP monitoring plan at this time. There is, however, work to be done to increase the monitoring conducted to meet the requirements in the CRMP. The recommendations contained in this report will be carried forward by the Coconino and Tonto National Forests, and a deeper examination of them conducted with district and forest leadership and resource specialists.

The Fossil Creek CRMP monitoring plan may be modified in the future if more effective or efficient monitoring methodologies become available; if changes to objectives, indicators, metrics, measurement and assessment frequencies, thresholds, or adaptive management actions are needed as understanding of the river values improves; to answer monitoring questions more effectively; or to better ensure protection of river values (Fossil Creek CRMP, p. 120).

This 2022 Fossil Creek CRMP Monitoring Report is posted on the forest website and available for public review here: <https://www.fs.usda.gov/goto/coconino/planning>.



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Aaron Mayville
Forest Supervisor
Coconino National Forest

Date

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Tonto National Forest

Date

Bare Soil/Potential for Delivery of Sediment or Fecal Matter to Fossil Creek

The monitoring topics of Bare Soil and Potential for Delivery of Sediment or Fecal Matter to Fossil Creek are combined in this report.

These two topics are to be monitored together annually with the Fossil Creek Bare Soil app, designed with ArcGIS Online for use with the ESRI mobile app, Field Maps. Per the CRMP Monitoring Plan, “Bare soil monitoring should be completed in conjunction with dispersed recreation BMP monitoring to provide additional information about potential water quality impacts” (p. 121). The app will be used by FS employees, interns, volunteers, and other stakeholders to map bare soil around developed and dispersed recreation areas within the Fossil Creek Wild and Scenic River corridor. Detecting areas of bare soil such as unauthorized trails outside of locations of planned visitor use may indicate a need to adjust management of visitor use in the WSR corridor to protect river values. The location (upland, floodplain, or stream bank, as well as hydrological connectivity to Fossil Creek), type (e.g., unauthorized trails and roads or other denuded areas), and amount of bare soil caused by visitor use outside of recreation sites, roads, and trails within the Fossil Creek WSR corridor will be monitored.



Potential impacts on water quality will be measured with bare soil monitoring and dispersed recreation best management practice (BMP) monitoring. Indicators have been chosen because of their ability to directly detect impacts such as erosion and fecal matter that may affect water quality *before* water quality is affected, rather than water-borne sediment and fecal bacteria that show pollution is already occurring and not related to visitor use. The dispersed recreation BMP protocol will be implemented in conjunction with bare soil monitoring. Bare soil monitoring will support detecting streambank impacts that may influence the findings of the dispersed recreation BMP monitoring. This protocol looks for evidence of bank trampling or instability (streambank alteration); erosion and sediment input to the stream; and trash, domestic animal, and human waste (human-related waste deposition), and chemical spills or leaks.

Thresholds for which adaptive management actions have been identified based on bare soil monitoring results are when:

- Black-hawk – There is evidence of increased bare soil caused by visitor use within 300 yards of a nest site within those territories (soft threshold). Unauthorized trails or other areas of bare soil caused by visitor use within 300 yards of a nest site are expanding

despite implementation of adaptive management actions (hard threshold).

- Bare soil – New unauthorized trails or other areas of bare soil caused by visitor use are detected in refugia areas (soft threshold). Unauthorized trails or other areas of bare soil in refugia areas caused by visitor use are expanding despite implementation of adaptive management actions, or recreation sites at the segment-wide scale are connected by unauthorized trails (hard threshold) (CRMP, p. 122).
- Water quality – Evidence of sediment transport or visitor use-related waste within the Aquatic Management Zone (AMZ) but not reaching Fossil Creek (soft threshold). Evidence of sediment from erosion or waste caused by visitor use reaching Fossil Creek (hard threshold).

Monitoring Results

A baseline dataset was collected to look at dispersed impacts in November 2022, after more than a full year with the area closed to public access due to effects from the Backbone Fire. These observations covered an area including all developed areas off of Forest Roads 708 and 502 along Fossil Creek, as well as the areas adjacent to the Dixon-Lewis Trail up to the waterfall. However, it does not cover the area above (northeast of) the waterfall, the Flume Trail, or the Fossil Springs area.

Baseline data surveys identified 19 bare areas (barren cores) that persisted through the closure. The total bare area recorded outside of developed and dispersal areas was 9,262 square feet (0.21 acre). Additionally, the surveys found 29 unauthorized access routes outside of developed and dispersed areas identified in the CRMP. These routes had a total length of 2,490 feet (0.47 mile). Five of these routes with a total length of 404 feet (0.08 mile) are hydrologically connected to Fossil Creek.

Finally, 15 observation points were recorded with micro trash and evidence of tree damage (including one tree swing), as well as an area where trash had been dumped off of a bridge. There was only one observation of human waste; it is located within the AMZ but is not hydrologically connected to Fossil Creek.

This survey work was used as an opportunity to finalize the bare area monitoring protocol. It is ready for use by Forest Service employees, volunteers, and other stakeholders who have been trained in its use, and will be updated to reflect recent changes.

Recommendations

- Update application protocol and begin training Forest Service employees in survey methods.
- Begin surveying bare areas before and after permit season.
- Decommission unauthorized access routes that are hydrologically connected to Fossil Creek.

Stream Flow

The monitoring topic of Stream Flow in the Fossil Creek CRMP is intended to support detection of conditions that may adversely impact flows within Fossil Creek, and other key components of Fossil Creek's water, a specific river value.

Flow data from the USGS stream gage located at the Fossil Creek Bridge is assessed to track changes in flow and provide context for assessing other monitoring data (such as to help determine whether conditions have been influenced by flood events). This gage is upstream of perennial tributaries and therefore serves as an indicator for spring discharge. Because Fossil Creek's base flow is comprised of groundwater discharge from springs, flow data collected at this gage serves as an indicator for spring discharge. Continued operation of this gage is essential to understanding resource conditions in Fossil Creek.



No thresholds for adaptive management actions have been identified for this monitoring topic.

Monitoring Results

A five-year average of the mean annual flow in cubic feet per second (cfs) is used in lieu of just the prior year in order to remove interannual variability. The time frame used is based on the USGS "water year" which begins on October 1st and ends on September 30th of the next year.

During the 2022 water year, mean annual flows were 13 cfs below the previous five-year average.

Table 2. Five-year (2017-2021) and 2022 Mean Annual Flow Comparison

Mean Annual Flow 2017-2021 (in cfs)	Mean Annual Flow 2022 (in cfs)	Difference 5-year average – 2022 (in cfs)
54	41	13

Recommendations

- Provide updated flow data next year, compare 2018-2022 to 2023, and report on water quality monitoring completed in 2023.

Common Black-hawk Occupied Territories

The monitoring topic of Common Black-hawk Occupied Territories is one of three (3) topics geared to address the Biological Outstandingly Remarkable Value (ORV) for the Fossil Creek Wild and Scenic River. Common black-hawks in Fossil Creek are used as an indicator for the biological ORV because they are an indicator for other canopy-nesting, riparian-obligate bird species. They are susceptible to disturbance that may result from high levels of recreational use.



Black-hawk monitoring has occurred during nine field seasons in Fossil Creek (Johnson et al. 2012; Johnson and Calvo 2012; Johnson and Calvo 2020). Data collected through this monitoring informed soft and hard thresholds, as well as where monitoring is likely needed.

A rapid assessment monitoring effort for black-hawks is being employed and focuses on nests or regular territories that occur in refugia and within 300 yards of high-use recreation sites (which currently are Fossil Springs, Waterfall, and Irving), or when unplanned trails in refugia are detected within 300 yards of black-hawk nest territory (if nest location is unknown). The intent is early detection of increasing recreation use within refugia in close proximity to a regular territory or a known nest.

Monitoring will be completed in black-hawk territories once every three to five years or in the nesting season after unauthorized trails are detected in refugia within 300 yards of a territory or nest. However, if adaptive management actions are needed, monitoring will be conducted in the breeding season following implementation of the adaptive management action for those specific nest sites.

Thresholds for which adaptive management actions have been identified for common black-hawk occupied territories are when:

- Black-hawks abandon a regular territory near a high use site and/or there is evidence of increased bare soil caused by visitor use within 300 yards of a nest site within those territories (soft threshold).
- Black-hawks abandon two or more regular territories near high use sites and/or unauthorized trails or other areas of bare soil caused by visitor use within 300 yards of a nest site are expanding despite implementation of adaptive management actions (hard threshold) (CRMP, pp. 127-128).

Monitoring Results

In 2022, surveys for Common Black-hawks (*Buteogallus anthracinus*) were conducted along the upper reach of Fossil Creek (0.5 km upstream of Fossil Springs Diversion Dam – Fossil Creek Bridge (Waterfall Section)), and along the lower reach from Fossil Creek Bridge to the constructed fish barrier (Roadside and Fish Barrier Sections). Three formal Common Black-hawk surveys were completed and three known nests were monitored, finding 31 Common Black-hawks and four active black-hawk nests. Five nests were located: three of the active nests fledged one black hawk each, one nest fledged two, and the other nest's status is unknown. This black-hawk survey was only the second formal black-hawk survey in Fossil Creek since 2019.

In 2019, 28 black-hawks were detected along with four active nests. The previous surveys were in 2011, from 0.5 miles upstream of the Fossil Springs Diversion Dam to the fish barrier, resulting in 38 black hawk detections in the upper and lower reaches and five of the six active nests fledging one nestling each. In 2019, disturbance (i.e., trash, trails, roads, human interaction, and noise) was low to moderate at three of the four known nests, including a nest in the Waterfall Section which was relocated from near the popular pool to 150 meters upstream and off the main channel where human disturbance is lower. One nest with high disturbance was located within Roadside Section, close to popular swimming holes and adjacent to the Homestead camping area and Fossil Creek access road.

Historically, Common Black-hawk surveys in Fossil Creek were conducted from 2005 through 2011. The survey effort from 2005 through 2007 included five surveys from 0.5 miles above Fossil Spring to one mile below the Irving Power Plant. In 2008, four surveys were completed in the same area, and in 2009 and 2010 three surveys were completed there.

In 2020, surveys were only conducted from the waterfall down to the fish barrier (below Mazatzal). There were three active and successful (fledged young) nests and one nest that was previously active but not active at that time.

In June 2021, the Backbone Fire burned approximately 41,920 acres in the Fossil Creek watershed. In the 3,000 acres of the Fossil Creek corridor, 10 percent of those acres did not burn, 54 percent had low-severity burns, and 34 percent had moderate to severe burns (USDA 2022). Only two percent of the area burned with high severity. Along the creek, approximately 95 percent of the 650 acres that burned suffered moderate to low-severity burns, and only three percent burned with high severity. The fire impacts on the specific black-hawk sites were sporadic. In the Homestead and Irving areas, approximately 90 percent of the habitat burned, including one of the nest trees that black hawks occupied in 2019. While the Water Fall Trail, its surrounding area, and the Fish Bridge saw limited damage, approximately 10 percent of the habitat was burned at these sites.

The fire could affect Common Black-hawk productivity in Fossil Creek if the pools along the corridor fill in with mud and debris. These pools are habitat for aquatic invertebrates and vertebrates such as fish, frogs, and snakes that are the black-hawk's main food source during the breeding season. The impacts on this food source could affect adult black hawks who depend on it for themselves as well as the nestlings during breeding (Etzel et al. 2014).

In 2022, disturbance was low since visitors were not allowed to visit Fossil Creek. Black-hawks

established nest sites within dispersed recreation use areas at Fossil Springs, the 708 Bridge, and Purple Mountain. Future monitoring will tell if recreational use since re-opening Fossil Creek causes these black-hawks to move their nests. Black-hawks nesting below Irving and Mazatzal are in areas not impacted by recreation.

In 2022, each nest tree was surveyed, with three nests in Fremont cottonwoods (*Populus fremontii*) and one nest in an Arizona Sycamore (*Platanus wrightii*). The average height of the nest trees is 16.7 meters and the average height of the nests is 13.8 meters.

Other Biological ORV Monitoring

Bats

The Coconino participates in the North American bat monitoring program which uses acoustic recorders. One quadrant is located along Fossil Creek at the Heinrich site that has been surveyed annually since 2018. Data analyzed by Bat Conservation International specialists found that 13 species were detected in 2022 at Heinrich: pallid bat, big brown bat, hoary bat, red bat, silver-haired bat, California myotis, small-footed myotis, fringed myotis, cave myotis, long-legged myotis, Yuma myotis, canyon bat, and Mexican free-tailed bat.

Native Fish

Early in FY2022, the Coconino fisheries biologist visited the Fossil fish barrier to determine its conditions after the Backbone Fire. Water was still flowing over the barrier as it had in the past, and pools both above and below the barrier had filled in like many other pools in the stream. It is unknown whether AZGFD conducted any fish monitoring in Fossil Creek in FY2022. But no fish kill from the Backbone fire was ever detected by FS employees or reported by other agency biologists.

Recommendations

- Conduct surveys for black-hawks in Fossil Creek between 2023 and 2025 for occupied territories and the presence of any user-created trails within 300 yards of nesting areas.
- Educate recreationists on their impacts on riparian habitat and wildlife.
- Conduct an estimation of and enforcement of the proper human capacity levels in Fossil Creek.
- Encourage gallery forest and nest tree regeneration through appropriate water management when and where possible. Manage grazing as needed to encourage success of cottonwood, willow, and sycamore regeneration.

Fossil Springsnail Habitat Condition/Populations

Fossil springsnails are a species of interest in Fossil Creek because 1) they are a Forest Service sensitive species; 2) they are only known to occur in the Fossil Creek corridor (they are endemic to Fossil Creek); 3) there are only a few small populations isolated to specialized ecological niches within a narrow geographic range, so they are vulnerable to population die-offs and risk of extinction; and 4) they can be indicators of spring health.

The habitat assessment rating protocol developed by AZGFD is used to assess the condition of riparian areas occupied by Fossil springsnails, and Fossil springsnail population counts are used to assess the abundance of springsnails at key locations in Fossil Creek. Collaboration with the U.S. Fish and Wildlife Service and AZGFD facilitate monitoring Fossil springsnail populations and habitat. Springs that support suitable habitat for the Fossil springsnail are surveyed to protocol in order to determine occupancy. The numerous springs that occur on steep slopes and where access is difficult are a lower priority for inventory.



Thresholds for which adaptive management actions have been identified for Fossil springsnail habitat and populations are when:

- Monitoring shows the habitat rating of occupied springs is trending downward as a result of visitor use. Monitoring shows a reduction of 25-50% of the mean cumulative Catch-Per-Unit-Effort (CPUE) estimates (soft thresholds).
- Visitor use interferes with occupied springs' ability to attain and maintain high or moderate habitat condition in the long term. Monitoring shows a reduction of >50% of the mean cumulative CPUE estimates (hard thresholds) (CRMP, pp. 128-130).

Monitoring Results

During 2022, the Arizona Game and Fish Dept (AZGFD) was funded through a Good Neighbor agreement to collect monitoring data on springsnails to comply with the Fossil Creek CRMP. AZGFD determined the status of the Fossil springsnail at select monitoring sites within the Fossil Spring Upper Focus Area and the Middle Irving Reach Focus Area of the Fossil Creek (Figure 1). These 2022 surveys were conducted approximately one and a half years after the

Backbone Fire that started in June 2021. Results from this monitoring will help ensure that Fossil springsnails and their habitat are conserved and thus protected from natural and anthropogenic impacts in Fossil Creek.

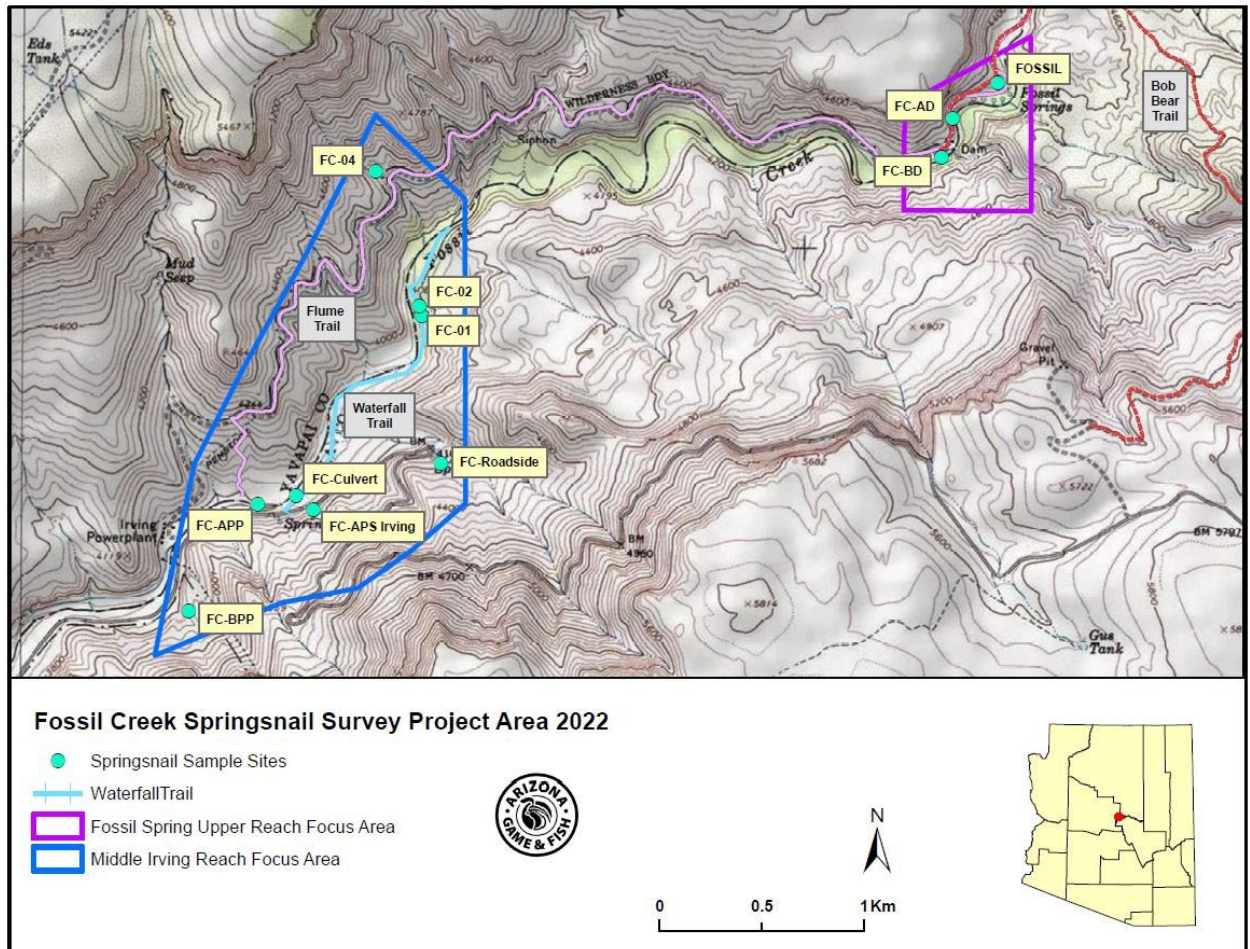


Figure 1. Surveys and sample sites were located within the Middle Irving Reach and Upper Spring Reach Focus Areas during 2022.

During November and December 2022, an attempt was made to locate 12 spring sites. A total of eight springs were located; four sites were not located despite search efforts. A single survey was conducted at each of the eight spring sites. Springsnails were detected at five of the eight spring sites. Four springs surveyed have prior survey data. One spring was surveyed for the first time, establishing a baseline; three springs that were visited for the first time had no springsnails. The four sites that were not found due to mapping discrepancies were resolved in working meetings between Forest Service and AZGFD biologists, and those sites are slated for survey in 2024. Catch per unit effort (CPUE) at two of the four sites with existing baseline data did not reach soft or hard thresholds. However, the other two sites had numbers below the hard threshold. Habitat

conditions support that the population declines at these two sites were a result of the Backbone Fire, specifically burned vegetation, felled dead trees, sedimentation, and erosion. Beyond some trimmed limbs thrown on one portion of one spring (for road maintenance), no recreation or management-related impacts were found.

In general, fire scars from the Backbone Fire were apparent within the two focal areas and across the broader landscape surrounding Fossil Creek (near the main channel of Fossil Creek and upslope to the upper reaches of the drainage which encompasses Fossil Creek). All spring sites visited except FC-02 and FC-04 Springhead#1 and #2 appeared to have been directly impacted by the wildfire in some notable manner.

Recommendations

- Establish a submeter resolution baseline location for each spring to ensure that springs can be successfully and efficiently relocated and habitat parameters can be more accurately compared between each survey in the future. Implement the following: (1) georeference each springhead and its boundaries using submeter GPS unit, and/or (2) create a photo library that shows and describes each spring and springhead. The wetted area of each spring may vary between years, but having a baseline reference for the spring site will ensure survey repeatability.
- Consider thinning/treating vegetation around known springsnail sites to remove non-native plants enveloping the spring and allow solar radiation to reach some open water to enhance aquatic vegetation growth.

Aquatic Macroinvertebrate Index of Biological Integrity

Macroinvertebrate populations are a common indicator that integrate many aquatic impacts over time, and macroinvertebrate studies are used as a safety check that aquatic resources are indeed being protected. Negative results indicate the potential that there is a problem and that more analysis is needed to identify the cause.

Fossil Creek CRMP monitoring of macroinvertebrate populations is conducted annually during the spring index period (April – May), and uses the warm and cold-water criteria and protocols developed by the Arizona

Department of Environmental Quality (ADEQ). These use benthic macroinvertebrate abundance and diversity to calculate an Index of Biological Integrity (IBI) score that is then used to monitor the “health” of aquatic systems (ADEQ 2015). The five sites sampled are: 1) near Fossil Springs; 2) about ¼ mi above the waterfall; 3) less than ¼ mile below the waterfall; 4) near the Irving power plant; 5) below Sally May Wash. Because travertine may affect the diversity and density of aquatic invertebrates, ADEQ does not sample Fossil Creek below the Fossil Creek springs (avoiding any area with travertine deposition), so it is important to establish baseline collections and identify appropriate methods and metrics for future monitoring.

Thresholds for which adaptive management actions have been identified for aquatic macroinvertebrate monitoring are when:

- An Index of Biological Integrity (IBI) score that falls between the 10th and 25th percentile of reference score (score of 40-49 for warm water streams), which is inconclusive and requires a repeat test (soft threshold).
- An IBI score that falls below the 10th percentile of reference score violates the biocriterion (less than or equal to 39 for warm water streams) or a repeat test that falls below the 25th percentile (hard threshold) (CRMP, p. 131).

Monitoring Results

In 2022, macroinvertebrate samples were collected with Arizona Department of Environmental Quality (ADEQ) guidance. The samples from six sites were collected and analyzed. Stream ecosystem health was measured using the Arizona Index of Biological Integrity (AZ IBI), a



measurement of ecosystem health specific to Arizona streams, as required by the FC CRMP. The following variables tell the story of Fossil Creek's response to the Backbone Fire:

- Invertebrate density per meter squared: a standardized value of abundance
- Richness: number of unique species
- Evenness: distribution of each unique species

Higher AZ IBI scores indicate healthier stream ecosystems while lower scores indicate degradation or impacts from human activities like pollution, habitat destruction, and flow regime alterations (ADEQ, 2015). IBI scores calculated from this study will not be used for official water quality assessment by the Department of Environmental because Fossil Creek violates the site condition requirement of "not dominated by bedrock or travertine deposits" (ADEQ, 2007). However, the CRMP calls for utilization of IBI scores to monitor for impacts on Fossil Creek aquatic resources and as a baseline for future annual comparisons.

In 2022, the AZ IBI decreased from approximately 84 to 77, indicating degradation from pre-fire conditions. However, ADEQ determined a properly functioning warm water stream will have an IBI score above 50. Therefore this value indicates no soft or hard thresholds, as indicated in the CRMP, were reached in 2022. The greatest threat to Fossil Creek's aquatic community is sediment loading from the post-wildfire bare soil in the upper watershed and recreational use of the watershed. The data show that the macroinvertebrate community experienced high sediment loads in 2022, which affected the community but did not cause a relevant decrease in the IBI score. Therefore, there is no concern that the IBI will reach threshold values in the near future.

The Forest Service has collected eDNA samples from various locations for detection of special status species (spikedace) and non-native species (green sunfish and New Zealand mudsnail). Future monitoring and analysis will include targeting the Gila topminnow. Sample sites include locations along Fossil Creek, Spring Creek, the Verde River, West Clear Creek, Wet Beaver Creek, Oak Creek, and West Fork Oak Creek. An eDNA lab has been set up to prepare samples to the well plate stage. However, the Forest Service doesn't currently have the personnel or expertise to prepare the well plates nor the equipment to run the qPCR analysis. The forest plans to train personnel in preparing well plates that would then be delivered to AZGFD to run the qPCR analysis.

Recommendations

- Continue macroinvertebrate sampling and monitoring to calculate IBI scores. Identify potential improvements to monitoring methods such as Surber sampling.
- Contract with ADEQ or a company that specializes in macroinvertebrate identification and analysis.
- Monitor aquatic habitat to identify post-fire impacts.

Class A or E Non-native Plant Species

Class A species are defined as those that are newly established or have the potential to become established and pose unacceptable threat to watershed condition. Yellow bluestem is a Class A invasive found along the Flume Trail.

Class E (for extreme) species have wide distribution within a particular area and pose an unacceptable, extreme hazard to watershed condition. Class E species that have been detected in the Fossil CRMP corridor include tamarisk, tree of heaven, Siberian elm, giant reed, Himalayan blackberry, and Malta star-thistle. Of these, the only Class E species detected in lower Fossil Creek have been detected are tamarisk, giant reed, and Himalayan blackberry. While mulberry, Johnson grass and red brome are invasive plants, they are not Class A or E non-native invasive plants.



Thresholds for which adaptive management actions have been identified for Class A or E Non-native Plant Species are when:

- Existing class A or E non-native invasive plant populations increase in size or new populations become established (soft threshold).
- Non-native invasive plant species pose a risk to ecosystem function, including displacing or diminishing native plant and animal species (hard threshold) (CRMP, p. 133).

Monitoring Results

The Friends of the Verde River, through an agreement with the Coconino National Forest, conduct invasive species mapping and treatment for four non-native invasive species: giant reed (*Arundo donax*), tree of heaven (*Ailanthus altissima*), Russian olive (*Elaeagnus angustifolia*), and salt cedar (*Tamarix* spp.). The Arizona Conservation Corps crew was contracted to inventory invasive species and map invasive plants in a 30-acre area around Fossil Springs. Preliminary results reflect that the primary invasive species of giant reed, tree of heaven, mulberry, and salt cedar were detected in minor amounts, while Himalayan blackberry was found over most of the area. About ¼ of an acre of Himalayan blackberry was treated in 2022.

Recommendations

- Per the Fossil Creek CRMP, continue to monitor one third of the Fossil Creek corridor each year. Compare monitoring results in future years to the 2021 baseline for lower Fossil Creek.
- Continue monitoring in areas where sacred datura has replaced Himalayan blackberry, such as in the pilot treatment area, to see if the blackberry reestablishes.
- Monitor Arizona dewberry (*Rubus arizonensis*) populations near Fossil Springs where plants occur adjacent to Himalayan blackberry. Limit encroachment of Himalayan blackberry and buffer Arizona dewberry populations where possible.
- In areas where Himalayan blackberry is established or encroaching, treat plants with an aquatically-approved glyphosate.
- Coordinate with Friends of the Verde River staff to prioritize areas for Himalayan blackberry treatment.
- Monitor the population of yellow bluestem near Irving in 2023.
- Complete a Minimum Requirements Decision analysis to allow herbicide use in the wilderness. Schedule treatment of Class E species in lower Fossil Springs in the winter of 2023.
- Treat the small stands of salt cedar and giant reed above Stehr Lake, working downstream to the Narrows, then from the confluence of Fossil Creek and the Verde River upstream.
- Monitor for new occurrences of Class A species, including mulberry, in Fossil Creek in 2023. If 2023 monitoring shows an increase in relative vegetation cover or establishment of new populations, management actions should be considered.

Impacts to Travertine Dams Attributable to Visitor Use

The presence, extent, and high deposition rate of calcium carbonate forming travertine in Fossil Creek are the key elements of Fossil Creek's geology ORV. In particular, the formation of travertine dams in certain reaches of Fossil Creek contributes to an extraordinary stream channel morphology, creating a complex aquatic habitat. Human impacts to these dams, such as persistent notching from repeated boat passage, may alter the flow of water and indirectly affect travertine deposition, dam formation, and aquatic habitat.



Monitoring is focused on impacts to travertine dams that, if found to occur, may indicate a need for management changes to ensure that human activities do not risk adversely impacting the geology ORV. The focus of monitoring is on physical impacts to travertine due to ease of detection and corresponding ability to adjust management relatively quickly. Monitoring is being performed on the reach of Fossil Creek from 1/4-mile upstream of the waterfall upstream to the historic diversion dam. Photo points are being established in this reach to detect notching or other human impacts to travertine dams. Repeat photography will be performed at least annually, at each established photo point, more often if a significant flood event occurs. The protocols for these photo points follow those detailed in Hall 2002. Ocular monitoring and informal photo documentation will likely supplement photo point monitoring.

Thresholds for which adaptive management actions have been identified for impacts to travertine dams are when:

- Travertine dams in the reach of Fossil Creek from 1/4-mile upstream of the waterfall upstream to the historic diversion dam display new (as of implementation of the CRMP) evidence of impacts resulting from visitor use (soft threshold).
- A series of spatially-connected travertine features in the reach of Fossil Creek from approximately 1/4-mile upstream of the waterfall upstream to the historic diversion dam display measurable evidence of human impacts (hard threshold) (CRMP, p. 136).

Monitoring Results

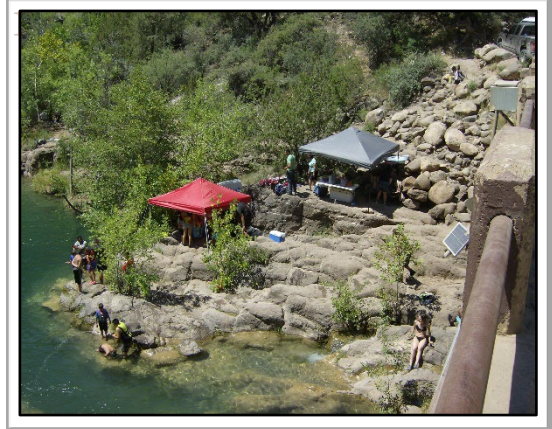
Due to extremely difficult access to the creek in the travertine reach, and concerns about future repeatability, no photos were taken of travertine dams in 2022.

Recommendations

- Explore additional ways to monitor travertine formations over time.

Visitor Use Data/Opportunity for River-based Recreation

Forest Service employees collect a variety of visitor use data each year, including the number of visitors, number of vehicles, patterns of use (including the distribution of visitor use), pounds of trash, and number of law enforcement incidents and other emergencies. This information is used to evaluate the effectiveness of current management practices, determine if adjustments are needed, and provide context for assessing other monitoring data. Assessment of these data include whether user capacity established by the CRMP is exceeded and, if so, what actions, such as adjusting the kinds, locations, and amounts of use, could be taken to ensure capacity is not exceeded.



The recreation ORV includes protecting and enhancing outstanding opportunities for river-based recreation in Fossil Creek. The recreation opportunity monitoring indicator uses the total number of people who can access Fossil Creek during the limited entry period (April 1 – October 1) as a proxy for river-based recreation opportunities in the wild and scenic river corridor.

Thresholds for which adaptive management actions have been identified for visitor use and recreation opportunity (river-based opportunity) are when:

- Visitor use – User capacity is exceeded; an increasing trend in incidents is observed.
- Recreation opportunity – Ten (10) percent decline from the 2009 baseline in the number of people who may access Fossil Creek due to management restrictions other than temporary closures for public safety due to extreme fire danger, monsoon storms, or similar hazards (soft threshold). Twenty-five (25) percent decline from 2009 baseline condition in the number of people who may access Fossil Creek due to management restrictions other than temporary closures for public safety due to extreme fire danger, monsoon storms, or similar hazards (hard threshold) (CRMP, pp. 137, 140).

Monitoring Results

The Backbone Fire was contained in July 2021 after burning nearly 42,000 acres, including the Fossil Creek area. Some of the burned area, including the Fossil Creek corridor, remained closed for the entirety of 2022 due to post-fire hazards and rehabilitation efforts. A public safety closure order was in place throughout the 2022 calendar year. Access of any type – by bike, hike, boat,

or vehicle – was prohibited within restricted areas, including all of Fossil Creek.

There is no visitor use data for 2022 because Fossil Creek was closed and experienced no public use. Efforts to repair infrastructure continued throughout this time and into 2023.

Recommendations

Collection of Fossil Creek visitor-use data stopped in mid-June 2022 because of the area's full closure due to the Backbone Fire. The area remained closed for all of 2022.

- Continue visitor-use data collection when Fossil Creek is opened again to visitors. Begin data collection and build over time.
- In future years, potential visitation may be increased incrementally up to a maximum (as stated in the Oct. 1, 2021, Fossil Creek CRMP Record of Decision). Each incremental increase will require additional monitoring to determine if use at that level is continuing to protect river values. The decision allows for a corridor-wide user capacity of 212 vehicles and approximately 1,120 PAOT.

Visitor Satisfaction

The recreation ORV is comprised of outstanding opportunities for a variety of river-related recreational activities. Recreation ORV monitoring addresses the quality of the recreation experience and the variety of recreational activities available.

The quality of the recreation experience in Fossil Creek can be assessed by asking a representative sample of visitors a set of questions that focuses on the key setting attributes, activities, and other relevant topics. Results can then be compared to a 2011 survey conducted by Northern Arizona University. The principal setting attributes reported by participants in the 2011 study were trash, crowding, current regulations, and facilities. Taken together, these four attributes as well as other topics can provide an indication of change in the quality of the visitor experience.



Thresholds for which adaptive management actions have been identified for recreation experience (visitor satisfaction) are when:

- Five (5) percent decline in satisfaction index (soft threshold). Fifteen (15) percent decline in satisfaction index (hard threshold) (CRMP, pp. 138-139).

Monitoring Results

In 2022, the Coconino National Forest developed and signed an agreement with the University of Montana and the U.S. Forest Service Rocky Mountain Research Station. Ph.D. candidate Jaclyn Rushing then coordinated with USFS staff and drafted a survey instrument based on past survey efforts and current management needs. This was a challenge as CRMP thresholds for visitor satisfaction are based on quantitative data (survey scales that produce numbers), while past surveys were based on qualitative data (interviews). Ms. Rushing worked to bridge this gap by addressing the same topics, but in a quantitative manner which should allow for a useful comparison with older data, as well as set the project up for success for future replication and data comparison using statistical methods. At the end of 2022, the survey instrument had been through multiple drafts, incorporating USFS feedback each time.

Recommendations

With the area still closed to public visitation due to post-Backbone fire hazards, it is uncertain if surveys will be possible in 2023. However, the following tasks are expected in 2023:

- Finalize the survey instrument and sampling plan
- Initiate required Office of Management and Budget review
- Recruit survey administrators

Satisfaction of Traditional Cultural Practitioners/Impacts at Specific Cultural Sites

Monitoring of the cultural values ORV for Fossil Creek will consist of consulting with the affected Western Apache and Yavapai tribes annually, preferably with traditional practitioners or elders who are recognized as experts by those tribes, to determine the condition and trend of traditional cultural resources within the corridor. It is important to maintain open communication with concerned Western Apache and Yavapai tribes to receive feedback in real time on resource conditions and other cultural concerns.



Two indicators for the condition of this ORV have been developed: monitoring of traditional and contemporary cultural values through consultation with tribes associated with the ORV and monitoring of culturally sensitive sites in the Fossil Creek area. The goals are to: (1) ensure that the Fossil Creek area retains its traditional cultural value for the affected tribes, and (2) ensure specific areas considered to be of the greatest sensitivity are not negatively affected by visitor use.

Thresholds for which adaptive management actions have been identified for tribal consultation (satisfaction of traditional cultural practitioners) and culturally sensitive sites (impacts at specific cultural sites) are when:

- Tribal consultation – Results of consultation indicate the Outstandingly Remarkable Value (ORV) condition has trended downward for two consecutive years (soft threshold). Results of consultation indicate that the Fossil Creek area does not look, sound, and feel natural and untrammled. Examples include widespread occurrences of overcrowding, numerous recreationists off of system trails and away from established recreation sites, presence of trash and human/pet waste, or vegetation or soil impacts (hard threshold).
- Culturally sensitive sites – Indication of new visitor use (faint indications of unauthorized trails or new ground disturbance) within site boundaries (soft threshold). Development (or continued use) of one unauthorized trail, presence of additional bare soil areas, evidence of ground disturbance, evidence of the removal of artifacts, or

evidence of feature disturbance within site boundaries (hard threshold) (CRMP, pp. 142-144).

2022 Monitoring Results

No monitoring of cultural sites occurred in 2022.

Recommendations

- Continue monitoring cultural resources in 2023 when area is re-opened for public use.

Partnerships

Partners working with the Coconino National Forest on monitoring and data collection in the Fossil Creek drainage include, but are not limited to:

- ❖ Tribes
 - San Carlos, Tonto, Yavapai, and White Mountain Apache – Emory oak
 - Arizona Tribes with Northern Arizona University (NAU) – Identification and mapping of traditional use plants
 - Yavapai Apache Nation – traditional use, cultural sites
- ❖ U.S. Geological Survey (USGS)
- ❖ Arizona Department of Environmental Quality (ADEQ)
 - Aquatic macroinvertebrates
- ❖ Oak Creek Watershed Council – recreational trail photo points, trail rehabilitation monitoring, analysis of trail BMPs
- ❖ Arizona Department of Game and Fish (AZGFD)
 - Riparian birds
 - Bald and golden eagle flights
 - Fossil springsnail
 - Native fish
 - Ranid frogs program (lowland leopard frog)
- ❖ Bat Conservation International
- ❖ Bureau of Reclamation – fish barrier inspections
- ❖ U.S. Fish and Wildlife Service (FWS)
 - Native fish
 - Western yellow-billed cuckoo, southwestern willow flycatcher
- ❖ Northern Arizona University (NAU)
 - Black-hawk, western yellow-billed cuckoo, southwestern willow flycatcher
- ❖ Bat Conservation International (BCI) – acoustic monitoring recording echolocations
- ❖ Friends of the Verde River (FOVR)
 - Inventory, mapping, and treatment of non-native plants
 - southwestern willow flycatcher