



United States Department of Agriculture

2021 Monitoring Report

Fossil Creek Comprehensive River Management Plan

Coconino & Tonto National Forests



Forest Service

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About the Fossil Creek CRMP Monitoring Plan

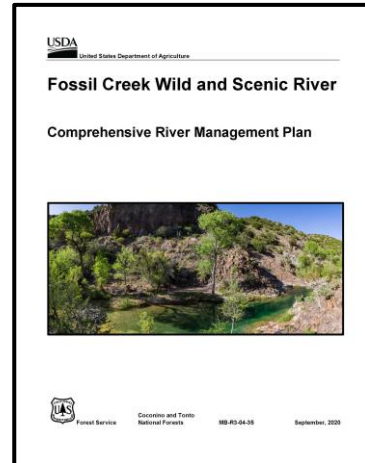
Purpose

The purpose of this 2021 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 ranger and forest supervisor 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 2021 to address the following monitoring topics in the Fossil Creek CRMP Monitoring and Adaptive Management Plan.

- Stream flow
- Aquatic macroinvertebrate index of biological integrity (IBI)
- Non-native plant species
- Travertine dams
- Visitor use data/Opportunity for river-based recreation
- Traditional cultural use practitioners/Cultural sites

Monitoring for the following topics was not conducted in Fossil Creek in 2021, 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 2021. Monitoring for these topics will be reported in subsequent years as monitoring methods are finalized and safety is no longer a concern.

- Bare soil/Potential for delivery of sediment or fecal matter to Fossil Creek
- Common black-hawk occupied territories
- Fossil springsnail habitat and populations
- Restoring riparian function to springs
- Aquatic macroinvertebrate index of biological integrity (IBI)
- Visitor satisfaction

The monitoring results that we do have for 2021 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. This first monitoring report is of necessity not a complete report for Year 1 monitoring, as there were unforeseen complications with monitoring methods and collecting baseline data for some topics, as well as the Backbone Fire closing down recreational use and monitoring for the 2021 season. Fossil Creek remains closed to recreational use for safety reasons and the Forest Service is continually evaluating when monitoring can continue for each individual topic.

Table 1 summarizes the findings of the monitoring in 2021 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 2021, training and beta testing were conducted by Forest Service employees. Additions, upgrades, and baseline data collection are expected to be completed in 2022.	Unknown, baseline monitoring still underway	Unknown, baseline monitoring still underway	Fix GPS collection errors and update the data dictionary for the bare soil monitoring app. Complete baseline data collection in the fall of 2022. Develop plan for consistent data collection twice each following year by Forest Service employees, volunteers, and other stakeholders.
Stream flow	Yes. In 2021, median, minimum, and maximum flows by season were collected and recorded, then compared to the five-year flow data (2016-2020). Water quality monitoring was conducted at five locations along Fossil Creek.	No	No	Provide updated flow data next year, compare 2017-2021 to 2022, and report on water quality monitoring completed in 2022.
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. The next surveys for black-hawks in Fossil need to be conducted between 2023 and 2025 for occupied territories and the presence of any user-created trails within 300 yards of nesting areas. Monitoring was not required in 2021.	No	No	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.

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<p>Fossil springsnail habitat and populations</p>	<p>Yes. Planned surveys in 2021 were postponed until 2022 because of the Backbone Fire. During 2021, survey locations were confirmed, logistics were solidified, and maps were produced to facilitate springsnail population and habitat monitoring in 2022.</p>	<p>No</p>	<p>No</p>	<p>Continue coordination, grant management, and survey logistics with Arizona Game and Fish Department.</p>
<p>Aquatic macroinvertebrate index of biological integrity (IBI)</p>	<p>Yes. In 2021, Northern Arizona University students, and Forest Service and Arizona Department of Environmental Quality (ADEQ) biologists collected invertebrates following ADEQ protocols. Additional seasonal collections post-fire will be compared to pre-fire collections. eDNA samples taken in 2021 are being processed now and data are anticipated by the end of June 2022.</p>	<p>No</p>	<p>No</p>	<p>Continue macroinvertebrate sampling and monitoring to calculate IBI scores. Identify potential improvements to monitoring methods such as Surber sampling.</p> <p>Identify and sort first set of post-fire invertebrate samples in the fall of 2022.</p> <p>Continue to develop environmental DNA (eDNA) methods to monitor aquatic invertebrate populations. Analyze first dataset in late 2022.</p> <p>Monitor aquatic habitat to identify post-fire impacts..</p>
<p>Non-native plant species</p>	<p>Yes. In 2021, a Friends of the Verde River crew conducted a pilot treatment on invasive Himalayan blackberry at Fossil Springs, then sprayed the new growth 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.</p>	<p>No</p>	<p>No</p>	<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 this 2021 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>In areas where blackberry is establishing, treat it with triclopyr ester in October 2022 and October 2023.</p> <p>Consult with Friends of the Verde River staff to determine which stands of blackberry to prioritize.</p> <p>Treat the population of yellow bluestem in 2022. Complete a Minimum Requirements Decision analysis to allow herbicide use in the wilderness. Schedule treatment of Class E species in lower Fossil Springs this fall (2022).</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>Consider including Class A species, as well as mulberry, in subsequent treatments if 2022 monitoring shows an increase in their percent of relative vegetative cover.</p> <p>Consider changing the monitoring metric for invasive plants from “acres occupied” by Class A or E plants to “percent relative cover by species by reach.”</p>
Travertine dams	<p>Yes. In 2021, Forest Service staff repeated a 2018 photo taken from a terrace just downstream of the administrative camping area. Initial photo points of travertine formations in 2017 were inaccessible in 2021 due to dense cattails. A second photo point location was established from the Flume Trail further downstream.</p>	Unknown, baseline monitoring still underway	Unknown, baseline monitoring still underway	<p>Establish additional photo points in 2022.</p> <p>Revisit Photo Points 1 and 2 and repeat photography for comparison.</p> <p>Explore additional ways to monitor travertine formations over time.</p>
Visitor use data/Opportunity for river-based recreation	<p>Yes. Visitor-use data was collected up to mid-June 2021, until the Backbone Fire.</p>	No	No	<p>Collection of Fossil Creek visitor-use data stopped in mid-June 2021 because of the area’s full closure due to the 2021 Backbone Fire.</p> <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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<p>Visitor satisfaction</p>	<p>Yes. In 2021, the Coconino National Forest led efforts to establish a partnership with the University of Montana and, with the help of the U.S. Forest Service Rocky Mountain Research Station, this was highly successful.</p>	<p>Unknown, baseline monitoring still underway</p>	<p>Unknown, baseline monitoring still underway</p>	<p>Initiate or complete the following tasks in 2022:</p> <ul style="list-style-type: none"> • Literature review to inform study design • Development of survey instrument and sampling plan • Completion of agreement between the U.S. Forest Service and University of Montana • Initiation of required Office of Management and Budget review • Recruitment of survey administrators <p>Administer the survey itself after the area reopens to the public.</p>
<p>Traditional cultural use practitioners/ Cultural sites</p>	<p>Yes. The number of new populations of invasive species remained low. Invasive populations were identified, inventoried, and treatments were designed and implemented to stop their spread and eliminate them. Site visitation is down because the Fossil Creek area is currently closed. Field inspections report low levels of trash at cultural sites. Cultural practitioners continue to visit Fossil Creek, e.g., Yavapai-Apache Nation youth groups have assisted with Backbone BAER efforts.</p>	<p>No</p>	<p>No</p>	<p>Recycling bins to help reduce beverage can or bottle disposal at cultural sites where visitation occurs.</p> <p>Interpretation to increase visitor engagement in site protection efforts.</p>

Forest Supervisors' Certification

This report documents the status of monitoring activities in the Fossil Creek drainage in 2021 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 have found that there are no recommended changes to the Fossil Creek CRMP monitoring plan at this time. There is, however, work to be done, when post-fire conditions in Fossil Creek allow, 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 2021 Fossil Creek CRMP Monitoring Report is posted on the forest website and available for public review here: <https://www.fs.usda.gov/land/coconino/landmanagement>.

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Date

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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 Collector. 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,



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 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

The bare soil monitoring ArcGIS Collector app is still undergoing beta testing. In 2021, training and beta testing were conducted by Forest Service employees. Initial baseline data collected and synced uncovered some data collection inconsistencies due to the use of different grades of GPS receivers, as well as some data dictionary items to be added. Additions, upgrades, and baseline data collection are expected to be completed in 2022.

Recommendations

- Fix GPS collection errors and update the data dictionary for the bare soil monitoring app.
- Complete baseline data collection in the fall of 2022.
- Develop plan for consistent data collection twice each following year by Forest Service employees, volunteers, and other stakeholders.

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

Monitoring data summarized below is broken down in to four seasons and based on the five-year period preceding the monitoring year and then compared to the monitoring year. A five-year average 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 1 and ends on Sept 30 of the next year. Seasons are as follows: Fall – Oct 1-Dec 31, Winter – Jan 1-March 31, Spring – April 1-June 30, and Summer – July 1-September 30.

During the 2021 water year, median flows were below the five-year average for all seasons except for summer. During the summer of 2021, maximum flows were higher than the five-year average and median and minimum flows were almost identical to the 2016-2020 time period. The higher summer flows are attributable to 2021 monsoonal storm events and increased runoff from the Backbone Fire burn scar. In the 2021 water year there were no fall or winter peak flow events, reflected in the 2021 maximum flows being more like the median flows than in the 2016-2020 time period (Table 2).

Table 2. Five year (2016-2020) and 2021 Median, Minimum, and Maximum Flows by Season

Season	Median cfs 2016-2020	Median 2021	Min cfs 5 yrs (yr)	Min 2021	Max cfs 5 yrs (yr)	Max 2021
Fall ¹	41	39	34.4 (2017)	37.4	2,800 (2020)	42.7
Winter ²	46.8	38.6	37.7 (2018)	35.4	6,990 (2017)	53.5
Spring	40.3	38.7	34.4 (2017)	34.3	63.4 (2020)	56.6
Summer	39.9	39.9	34.4 (2016)	34.5	566 (2018)	1,560

Other Monitoring

In November 2021, the U.S. Forest Service, with financial and technical assistance from the Arizona Department of Environmental Quality, began water quality monitoring at five locations along Fossil Creek (Table 3). Sampling for metals and inorganics occurs on a quarterly basis and sampling for dissolved oxygen, pH, E. coli, turbidity, water temperature, specific conductivity, and total dissolved solids occurs every month. E. coli samples will be further analyzed using microbial source tracking (MST) to help identify the source of any E. coli found in the creek. Results from this water quality monitoring will be reported in the 2022 annual monitoring report for Fossil Creek.

Table 3. Water Quality Monitoring Locations on Fossil Creek

Location	ADEQ ID
Fossil Creek Waterfall	VRFOS011.88
Irvine	VRFOS010.48
Fossil Creek Bridge	VRFOS009.26
Homestead	VRFOS008.32
Sally Mae	VRFOS007.36

Recommendations

- Provide updated flow data next year, compare 2017-2021 to 2022, and report on water quality monitoring completed in 2022.

¹ Significant tropical storm in 2020. Maximum for other years falls between 65.5 cfs and 352 cfs

² Three of five years had winter max >5,000 cfs

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 seven 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

The most recent monitoring of common black-hawk occupied territories was conducted by Northern Arizona University students in 2020. In three surveys between April and June four nests were found: the Purple Mtn nest was determined to be inactive by June (despite activity in May); the Homestead nest fledged one young; the Balancing Rock nest (above the fish barrier) fledged one, possibly two young; and the Waterfall nest fledged two young. These nesting areas were in similar locations as those detected in 2019.

Based on these baseline data and according to the Fossil Creek CRMP monitoring and adaptive management plan, surveys for black-hawks in Fossil need to be conducted between 2023 and 2025 for occupied territories and the presence of any user-created trails within 300 yards of nesting areas. Since monitoring occurred in 2020, the next monitoring is not required until 2023 (not required in 2021). However, funding has been obtained and monitoring for black-hawks in the Fossil Creek corridor is being planned as early as 2022, again by Northern Arizona University students.

After the Backbone Fire burned through Fossil Creek in 2021, it was observed that: 1) only a portion of the riparian trees were burned in the fire (most of the damage was from radiant heating, causing a loss of leaves); 2) riparian trees, even when burned, were quick to resprout; and 3) black-hawks have been observed nesting in the breeding season following fires in other riparian areas. The next monitoring, possibly in 2022, will tell how black-hawks fared during and after the fire.

Other Biological ORV Monitoring

Lowland Leopard Frogs

A quick survey for lowland leopard frogs was conducted in Fossil Creek in October 2021, from the historic dam upstream to where the blackberries obscure the main output of springs on the Coconino NF side of the creek. Only 11 frogs (adults and subadults) were counted as they jumped from the shore or watercress into the water. In a 2017 survey, 107 frogs were counted, but there were much more extensive stands of watercress, more areas with pools and slow water, and more surveyors. Biologists plan on conducting a replica of the 2017 survey in 2022.

Bald and Golden Eagles

In May 2021 a Forest Service range conservationist reported observing a pair of golden eagles on Nash Point overlooking Fossil Creek. This may have been the same pair seen by a Forest Service biologist in July in the Tin Can drainage at the rim of Fossil Creek. These sightings were reported to the Arizona Games and Fish Department (AZGFD) eagle biologists. AZGFD did not have any new detections of bald or golden eagles in the Fossil Creek area in their 2021 annual surveys.

Riparian Breeding Birds

In 2010, AZGFD started a statewide Coordinated Bird Monitoring effort under the guidance of the Arizona Bird Conservation Initiative. This effort identified plots that are to be resurveyed twice in a breeding season every 10 years. The Fossil Springs Plot (2902) was started in 2010 and resurveyed in 2021. AZGFD will not estimate density at the different strata of the study until after next year when their crews have completed monitoring all the riparian plots for the second time.

Western Yellow-billed Cuckoos

In June of 2020, visiting FS biologists reported a pair of vocalizing cuckoos in the Fossil Creek corridor, in a large cottonwood downstream from the main pool at Sally May. That same year, Northern Arizona University ornithologists detected a yellow-billed cuckoo near Homestead in the same area as they

detected a cuckoo in 2019.

In 2021, an agreement was made with Northern Arizona University to conduct western yellow-billed cuckoo surveys in Fossil Creek. Only one visit was made a day before the Backbone Fire started; the remaining surveys were aborted due to the fire and subsequent closure of Fossil Creek. The mesquite bosque habitat adjacent to where cuckoos were detected in 2019 and 2020 (Homestead and Sally May) was burned in the fire. It will likely take a few years for this foraging habitat to grow back and support cuckoo prey insects, therefore cuckoo surveys are not recommended for 2022 either. Biologists will continue to monitor the availability of foraging habitat adjacent to the cuckoo's riparian breeding habitat in the Fossil corridor.

Bats

In May of 2021, the Coconino and Tonto NFs continued acoustic bat monitoring efforts following the protocols described in *A Plan for the North American Bat Monitoring Program (NABat)*. Biologists and volunteers deployed ultrasonic recorders in a priority NABat cell with two quadrants in the Fossil Creek CRMP corridor, the Heinrich and Deadman Mesa areas. The data were submitted to Bat Conservation International, contracted to manually vet the recording files; however, the analysis is not yet complete.

Fish Barriers

The Forest Service has monitored the fish barrier in Fossil Creek nearly monthly since the after-fire floods in 2021, to ensure it still prevents non-native fish from moving upstream into the native fish refugia. When any potential change in flow pattern is observed (from sediment deposition, debris on or near the barrier, etc.), photos of the barrier are sent to Bureau of Reclamation engineers. In addition to watching flow and debris on the dam, the pools and runs above and below the barrier are inspected during each visit (approximately every six weeks from July 2021 to March 2022) to visually detect non-native fish. The barrier structures are inspected for cracks that might indicate a structural problem.

While sediment deposition has shallowed pools both above and below the barrier, there has not been any sediment or rock deposition that threatens barrier function or other structural problems that engineers observed from photos. No non-native fish have been detected via streamside visual surveys and May snorkel surveys. We did detect roundtail chub and Sonora suckers above and below.

Native and Non-native Fish

Non-native fish were monitored around the fish barrier with a snorkel survey on May 21, 2021. This survey was conducted prior to the Backbone Fire, and water clarity was excellent (visibility greater than 20 feet). Two observers conducted two surveys each, approximately 300 meters and 100 meters downstream of the fish barrier, working upstream in both areas. No non-native fish were detected above the fish barrier; roundtail chub and Sonora sucker were present above the barrier. Black bass (smallmouth/redeye bass) were detected in pools immediately below the barrier and in runs and pools throughout the surveyed reach.

Recommendations

- Conduct a replica of the 2017 survey for lowland leopard frogs in 2022.
- 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.

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

Prior to the 2021 monitoring season, Forest Service entered into an agreement with Arizona Game and Fish Department to complete Fossil springsnail population surveys and habitat assessments. Monitoring plans for 2021 included surveying extant springsnail populations, conducting reconnaissance surveys adjacent to extant populations, and searching for potential habitat in Calf Pen Canyon. This work was set to occur in August or September of 2021 and was postponed after the Backbone Fire. Surveys and monitoring plans from 2021 will roll over into 2022 along with additional work to assess post fire impacts on snail populations and habitat.

Recommendations

- Conduct planned Year 1 surveys and monitoring in 2022, along with additional work to assess post-fire impacts on snail populations and habitat.
- Per Fossil Creek CRMP Monitoring Plan, conduct habitat condition monitoring periodically or when an activity at an occupied spring results in habitat impacts.

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

Forest Service and Arizona Department of Environmental Quality (ADEQ) staff visited the five intended sampling sites for Fossil Creek in May and June of 2021. The site above the waterfall did not have habitat for invertebrate sampling (no shallow riffles), and only the springs site appeared to produce enough individuals to qualify for IBI measurements (500 individuals are needed). The Forest Service visited other areas of the creek and collected aquatic invertebrates from several other sites.

Samples were collected initially with ADEQ guidance using their protocols. The samples from six sites were sent to an external contractor for sorting and identification (Rhithron, Missoula MT).

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Only the site below Fossil Creek springs had enough invertebrates to calculate an IBI value, having a total of 2,352 individuals representing 41 taxa. Using ADEQ's Warm Water IBI thresholds, the Fossil Creek springs site IBI score was 67.03, which is an attaining warm water score. This indicates the Fossil Creek springs site supports an aquatic invertebrate community that typically occurs in habitat unimpacted by pollution and human alteration.

The Forest Service has been collecting eDNA samples from Fossil Creek for two years. In early 2021, Forest Service and Rocky Mountain Research Station (RMRS) staff collected environmental DNA (eDNA) samples in response to potential sightings of loach minnow in Fossil Creek. The potential sightings were in the travertine area upstream of the waterfall; eDNA samples were collected from nine sites from the Mazatzal recreation site to the springs. All eDNA samples came back negative, suggesting that 1) loach minnow are present in extremely low numbers in Fossil Creek, 2) loach minnow were present in 2019 but absent by the time eDNA sampling occurred, or 3) the sightings were not actually loach minnow.

In May and June of 2021, Forest Service staff collected eDNA samples as part of an ongoing collaboration between the Coconino NF, the Rocky Mountain Research Station, and Northern Arizona University (NAU) to understand eDNA produced by aquatic invertebrates. Samples were collected from a total of nine sites. The samples will be sent to RMRS for processing, and bulk samples will be sent to NAU for sorting and processing.

The Backbone Fire burned in the Fossil Creek watershed in late June 2021. This fire altered hydrologic and soil stability in several watersheds draining into Fossil Creek, and burned riparian vegetation through much of the recreation segment. Post-fire analyses indicated these changes would result in increased water flow runoff and sediment input into Fossil Creek for a given storm event. While flooding and sediment deposition is a natural and expected occurrence, each storm is now expected to produce greater flood flows and more sediment and turbidity than in years past. Because of the likelihood of post-fire flooding and sedimentation, the Forest Service utilized Resource Advisors on the Backbone Fire to collect eDNA samples from several sites during the fire. Future researchers can use these samples to understand the pre-fire distribution of plants and animals.

In late 2021 (and 2022), post-fire monitoring of aquatic resources focused on monitoring aquatic habitat conditions, identifying changes in the macroinvertebrate community, and collecting environmental DNA samples to document changes in fish distribution over time. When complete, these data will both provide new baseline data for Fossil Creek CRMP monitoring and be compared with pre-fire and future data to determine how the fire affected aquatic resources in Fossil Creek.

In December 2021 (through the fall of 2022), NAU students, and Forest Service and ADEQ biologists collected invertebrates following ADEQ protocols. Additional seasonal collections post-fire will be compared to pre-fire collections.

Recommendations

- Continue macroinvertebrate sampling and monitoring to calculate IBI scores. Identify potential improvements to monitoring methods such as Surber sampling.
- Identify and sort first set of post-fire invertebrate samples in the fall of 2022.
- Continue to develop environmental DNA (eDNA) methods to monitor aquatic invertebrate populations. Analyze first dataset in late 2022.
- 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

In March 2021, funded by a National Forest Foundation grant, a three-person Friends of the Verde River crew conducted a pilot treatment on invasive Himalayan blackberry at Fossil Springs. In one week, they hand mucked out a patch of blackberry on the uphill side of trail where that patch was approaching the wilderness boundary. Three weeks later they sprayed the new growth with herbicide. This patch was well away from live water and wetted soil and in agreement with the Three Forest Weed EIS mandatory buffers. The plan was to respray in November, however the Backbone wildfire burned through the Fossil Springs area. Following is a summary of their post-fire monitoring of the Himalayan blackberry in the Springs area.

In October 2021, Friends of the Verde River staff and Southwest Conservation Corps monitoring technicians conducted vegetation monitoring of the Fossil Springs/Flume Trail area. The crew focused on monitoring and inventory of Himalayan blackberry as well as invasive riparian plant species within the Fossil Springs Botanical Area.



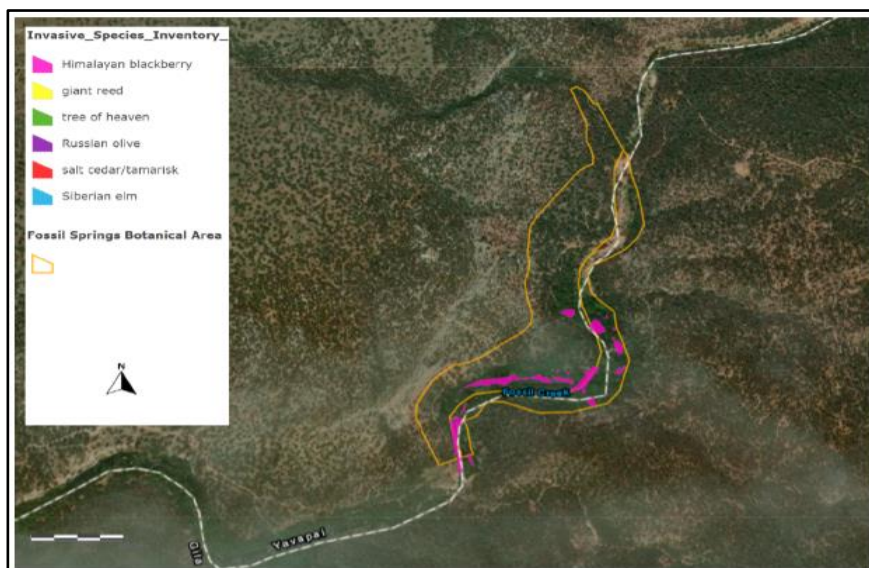


Figure 1. Fossil Springs inventory. The only species located was Himalayan blackberry.

Having previously visited the area in March, the crew noted that the blackberry was significantly reduced by the Backbone Fire. Every stand of blackberry inventoried above the dam site showed evidence of burning. Evidence included charred trees, dead trees with smaller new saplings, stump holes, blackened soil, and [only?] one layer of blackberry growth. The fire appears to have reduced the blackberry and, though large stands have regrown, they are not up to their previous height.

The pilot plot that was treated in March 2021 showed evidence of burning. The blackberry was no longer there and sacred datura (*Datura wrightii*) was growing throughout the plot area. A native dewberry, superficially similar in appearance to Himalayan blackberry, was observed on the Tonto side of Fossil Springs. Forest Service biologists and botanists will visit the springs with Friends of the Verde River in May 2022 to prioritize Himalayan blackberry treatment areas and to map the native dewberry.

Along the Flume Trail, one population of the Class A invasive yellow bluestem grass was detected. This population needs to be treated in FY 2022.

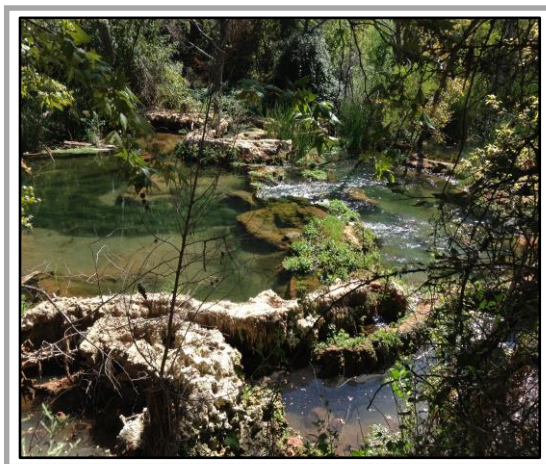
The Friends of the Verde River, through an agreement with the Coconino National Forest, conduct invasive species mapping and treatment for four non-native invasive species: giant reed (*Arundo donax*), tree of heaven (*Ailanthus altissima*), Russian olive (*Elaeagnus angustifolia*), and salt cedar (*Tamarix spp.*). In the fall of 2020, an Arizona Conservation Corps crew was contracted to inventory invasive species and map invasive plants along 2.1 miles of the riparian habitat from the base of Ike’s Backbone upstream to the Narrows and back. In the spring of 2021, the monitoring crew inventoried the remaining 5.4 river miles of lower Fossil Creek. There is no record of any previous inventory or treatment, so this effort establishes the baseline condition of invasive plants in lower Fossil Creek. Preliminary results reflect that the primary invasive species of giant reed, salt cedar, and blackberry were detected in minor amounts. Another invasive, mulberry, was found in two reaches, representing less than five percent of the vegetative cover in one reach, and six to 10 percent of the cover in the other.

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 this 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.
- In areas where blackberry is establishing, treat it with triclopyr ester in October 2022 and October 2023.
- Consult with Friends of the Verde River staff to determine which stands of blackberry to prioritize.
- Treat the population of yellow bluestem in 2022.
- Complete a Minimum Requirements Decision analysis to allow herbicide use in the wilderness. Schedule treatment of Class E species in lower Fossil Springs this fall (2022).
- 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.
- Consider including Class A species, as well as mulberry, in subsequent treatments if 2022 monitoring shows an increase in their percent of relative vegetative cover.
- Consider changing the monitoring metric for invasive plants from “acres occupied” by Class A or E plants to “percent relative cover by species by reach.”

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

In October 2021, Forest Service staff repeated a 2018 photo taken from a terrace just downstream of the administrative camping area. Due to extremely difficult access to the creek in the travertine reach, and concerns about future repeatability, photos were taken from higher vantage points than originally planned. For example, initial photo points of travertine formations in 2017 were inaccessible in 2021 due to dense

cattails. A second photo point location was established from the Flume Trail further downstream, approximately 300 feet above the channel and approximately 25 feet downslope from the trail.



Figure 2. Photo Point 2 established in 2021.

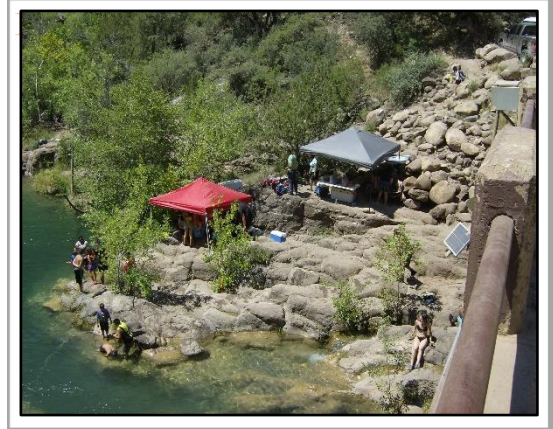
Recommendations

- Establish additional photo points in 2022.
- Revisit Photo Points 1 and 2 and repeat photography for comparison.
- 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

In any given year, visitors access Fossil Creek during the quieter off season as well as the highly visited permitted season. The Coconino National Forest only tracks the number of vehicles/visitors during the permitted season, scheduled between April 1st and October 1st. Daily use levels in 2021 remained at 148 public vehicles or approximately 810 people at one time (PAOT). From April 1 to June 16, 2021, a total of 5,597 vehicles and 17,216 visitors entered Fossil Creek. The 2021 season was cut short when a lightning-caused wildfire, called the Backbone Fire, started on June 16, 2021. This 40,000-acre wildfire shut down all public access to Fossil Creek for the remainder of 2021. Therefore, 2021 visitor-use data

was only collected up until Fossil Creek was closed due to the fire.

The 2009 baseline year documented approximately 80,000 visitors to Fossil Creek during the April 1 to October 1 high-use season. Therefore, in 2021, no thresholds were approached in comparison to 2009, as data was not collected for the entire permitted season.

In fact, no thresholds were approached in the prior five years, 2016 to 2020, lowering the number of people who accessed Fossil Creek due to management restrictions. Neither a soft threshold at a 10 percent decline nor a hard threshold at a 25 percent decline from the 2009 baseline were reached.

Table 1. Annual Visitation Estimates (2016-2021) During the Permit Season (April 1-October 1)

Year	Visitation Estimates During the Permit Season
2021	5,597 vehicles and 17,216 visitors (Fossil Creek closed June 16, 2021, due to the Backbone Fire)
2020	1,576 vehicles and 6,903 visitors (Fossil Creek closed for a period of time due to COVID restrictions)
2019	10,193 vehicles and 37,958 visitors
2018	8,509 vehicles and 34,444 visitors
2017	11,192 vehicles and 52,301 visitors
2016	11,681 vehicles and 47,927 visitors (first year of the permit system to manage visitation)

Recommendations

Collection of Fossil Creek visitor-use data stopped in mid-June 2021 because of the area's full closure due to the 2021 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

Efforts to partner with a local university to complete visitor satisfaction surveys were unsuccessful in 2020. In 2021, the Coconino National Forest led efforts to establish a partnership with the University of Montana and, with the help of the U.S. Forest Service Rocky Mountain Research Station, this was highly successful. Multiple discussions were held with Dr. Jennifer Thompson and Ph.D. candidate Jaclyn Rushing about the project. Both Dr. Thompson and Ms. Rushing have experience working with the Forest Service on visitor surveys in the Western U.S.

Recommendations

With the area currently closed to public visitation due to post-Backbone fire hazards, surveys are unlikely to be completed in 2022. However, the following tasks are expected to be initiated or completed in 2022:

- Literature review to inform study design
- Development of survey instrument and sampling plan
- Completion of agreement between the U.S. Forest Service and University of Montana
- Initiation of required Office of Management and Budget review
- Recruitment of survey administrators

The survey itself will be administered sometime after the area reopens to the public.

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).

Monitoring Results

Culturally sensitive sites – In 2021, three of the four cultural sites scheduled for monitoring were visited by Forest Service archaeologists and Tribal relations specialists prior to the start of the Backbone Fire. The sites inspected were 04-2070 Emory Dance Ground, 01-1134 Bah'loon's Place, and 01-1138 Purple Mountain Work Camp. Data collected during these site visits was entered into the national database (NRM), and cultural heritage annual reports generated. Because of the potential for impacts from the Backbone Fire, these three sites were re-visited multiple times, both during fire suppression activities and after the fire.

Pre-fire monitoring indicated the site conditions were good. There were a few depredations to site integrity pre-fire, and trash and human waste was noted. Placement of refuse and recycling bins may help mitigate the waste problem. Post-fire observations indicated increased erosion, significant vegetation loss, and flammable feature and artifact loss. These areas are the subject of Burned Area Emergency Response (BAER) efforts, and post-fire revegetation was implemented (Dowd et al. 2021). Vegetation and ground cover loss varied at each site visited but, overall, there was a significant increase in soil exposure immediately after the fire. This resulted in greater artifact and feature identification on archaeological site ground surfaces.

BAER mitigation measures designed to address site impacts are ongoing. A pilot BAER implementation program of Forest Service staff working in coordination with a volunteer Yavapai-Apache Nation youth group, consisting of high school students and adult team leaders, has made significant progress in addressing site needs.

Recommendations

- Continue American Indian Tribal consultation and archaeological site monitoring for 2022 (Year 2) as recommended in the Fossil Creek CRMP. Coconino and Tonto National Forest specialists Accomplish these activities cooperatively with Coconino and Tonto National Forest specialists and continue Yavapai-Apache Nation youth field trips.
- Compare 2021 (Year 1) monitoring results with those in 2022 (Year2).

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
 - Rapid 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