Verde River Institute

2022 Annual Report

The Verde River Institute is proud to present the following annual report of our activities and accomplishments during calendar year 2022. Our programs will be presented individually, but it's important to remember that all of our projects are synergistic with each other, and that any one of them could not be as effective as it is without the others.

Verde River Monitoring and Education Program

The Verde River Monitoring and Education Program gives a dedicated cohort of students a broadly-based understanding of how the Verde River works. Each of the 12 classes (one per week for 12 weeks) starts with a 1-hour discussion of that day's topics followed by a 3 to 4-hour kayak trip in the Verde River @ Clarkdale stretch of the river in Clarkdale. This gives our students a hands-on practical exposure to that day's topic. If course, every trip exposes the class to ad hoc lessons that reveal themselves along the way. We've also created a curriculum text for the classes that the students will study before each class. If you'd like, you can download a copy of the text from our website by clicking here.

In 2022, we taught half of our students on Wednesdays and the other half on Saturdays, as their schedules preferred. Each class had 6 students. In 2023 we will increase the daily class size, or add class days as demand increases.

Daily lessons include:

1. **Basic Kayaking in the Verde River**
    a. Equipment
    b. Safety
    c. Kayaking techniques
    d. General boating knowledge

    This class teaches the students basic kayaking so that they can operate safely and comfortably during the following on-river classes.
2. **Verde River Basics**
    a. Hydrology of the river
        i. Where does all that water come from?
        ii. What threatens the river's flows?
        iii. Flood regimes and results
    b. Fluvial Geomorphology of the Verde River
    c. History of the Verde and its ecosystems

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Doug Von Gausig, Executive Director

d. Human impacts on the river
e. Stream gages – what they tell us and what they don't
f. Climate Change and its impact on the Verde
g. Arizona Water Law

3. **Ecology of the Verde River (3 lessons)**
    a. Use of iNaturalist to monitor life forms in the Verde's ecosystem
    b. The riparian forest
    c. Rapids, riffles, runs and pools – how each supports unique habitats
    d. Micro habitats
    e. Macroinvertebrates and why they are important to the ecosystem
    f. Vertebrates and how each class interacts with the Verde
    g. Invertebrates and how each class interacts with the Verde
    h. Restoration and Invasives
4. **Restoration and Invasives**
    a. Goals and methods of restoration
    b. Long-term monitoring the ecosystem and why we do it
    c. Invasive removal/revegetation – methods and sustainability
5. **Botany of the Verde River**
    a. A comprehensive study of the plants in and around the Verde River
    b. Last year, we hosted Verde River botany expert Frankie Coburn as a visiting educator. We expect Frankie to join us again this year.
    c. We identified 240 species of plants during last year's lessons
6. **Water Quality of the Verde River and Drone Photogrammetry**
    a. Techniques of water quality monitoring
    b. How does water quality change over time, over distance, with flow changes, and with weather?
    c. Drone use in gathering samples (including a short drone lesson!)
    d. Why do we monitor water quality and which parameters do we measure?
    e. E. coli monitoring and its relationship to other pathogens
    f. Drone-deployed photogrammetric mapping of the Verde.
7. **Macroinvertebrate Assessments**
    a. Techniques in assessments and monitoring
    b. Why do we monitor the aquatic "bugs?"
    c. What does our data tell us?
8. **Tree Measurements and Monitoring**
    a. Tree identification
    b. Techniques in measuring and monitoring
    c. Why do we do this?
    d. What do we learn?
9. **eDNA (Environmental DNA) Sampling and Monitoring**
    a. What is eDNA sampling?
    b. Techniques and equipment used
    c. What does eDNA tell us?
    d. What does it not tell us?

This program is the single most comprehensive education program being conducted on the Verde River today. Students graduate with an excellent understanding of the river and its ecosystems, its values, threats, and solutions. Students will be qualified to do high level volunteering on river

projects and will be excellent candidates for jobs in Verde River conservation. We believe having a large cohort of knowledgeable people in the community increases the river's chances of continued good health and sustainability. Our students will be extremely effective and passionate Verde River advocates.

One of the most valuable deliverables from this program has been the establishment of the Main Street Bridge Monitoring Tract. This is a 2.1-acre riparian tract along the river near the old Main Street Bridge abutment in Clarkdale. The tract contains an excellent mix of vegetation, including a diverse riparian forest. Two of our Verde River Monitoring and Education Program students have adopted the tract and they are gathering baseline data on species present, mapping those species and measuring all trees in the tract. They also operate 2 game cameras, which have been incredibly useful to our understanding of which animals use that area and how they use it. These students intend to continue monitoring the tract for the foreseeable future. We're conducting periodic eDNA sampling of the water at the downstream end of the tract.

We also had an unexpected and very exciting discovery come from the monitoring program. That was the discovery of a new species of Broomrape in Arizona. *Aphyllon riparium* (Bottomland Broomrape) is a parasitic plant that is rare wherever it lives. Prior to the Verde River Monitoring and Education Program finding several specimens parasitizing the Cocklebur infestations along the Verde, the plant had never been reported in Arizona.

Bottomland Broomrape, Aphyllon riparium

Students Diane Greathouse and Brennan Jurnigan at the Main Street Monitoring site

The Verde River Ranger Program

The Verde River Rangers had a great third year in 2022. Rangers patrolled the Verde River @ Clarkdale stretch of the river. This 4-mile stretch is the most active boating area on the river by far, accounting for more than half of the entire river's traffic. The Rangers continued their core

mission, which is to educate the boating public about the river, boating safety, and recreational boating ethics. Rangers pay special attention to promoting PFD use by all boaters. Since we started the program in 2020, average PFD use among non-commercial boaters hovered around 25%. In 2022, PFD use in the same cohort was over 40% and climbing! This is a wonderful outcome, but the work's not done yet, and we expect to improve that to 50% this year.

Rangers also pick up river-bottom and riverside trash. In 5 month of 2020, we removed more than 1100 pieces of trash, weighing 397 pounds. In 2021 (10 months), we removed 858 pieces of trash weighing 347 pounds. In 2022, we removed 631 pieces of trash weighing 320 pounds. We attribute the steady decline of trash in a stretch that continued to experience heavy traffic to 2 things: the "broken windows" effect and the Rangers' presence and education efforts. When people see Rangers picking up trash, and they see a pristine river, they are far less likely to toss trash overboard.

Rangers also help teach basic kayaking to novice boaters, explain the best way to get through the rapids along the way, and answer questions about the river, its ecosystem, etc. In 2022, we spoke to 81% of the non-commercial boaters we saw while we were on duty!

Rangers also posted signage at the most difficult rapid on this stretch – Rocky (or Boulders) rapid. A large percentage of the boaters floating through this rapid were capsizing and spilling trash and endangering themselves at Rocky, so we posted a "Stay Far Left Through The Rapid" sign upstream from the rapid. Our observations (though we didn't keep strict numbers) was that this reduced problems at Rocky by more than 50%. We also surveyed boaters after their trip through the rapid and every person said that the sign had been very helpful.

Water Quality Assessment

We continued our periodic water quality assessments through 2022. Our drones collected water samples and the results were posted to our website and our Facebook page each time. We concentrated on those times when E. coli was likely to be high, and the E. coli results were shared with the Town of Clarkdale, the kayaking outfitters, and Arizona State Parks. This allowed each of these entities to operate safely and gave them the information needed to take special precautions in times of higher risk. All water quality data is also shared with ADEQ and becomes part of their water quality database.

Drone Deployed Photogrammetry and Monitoring

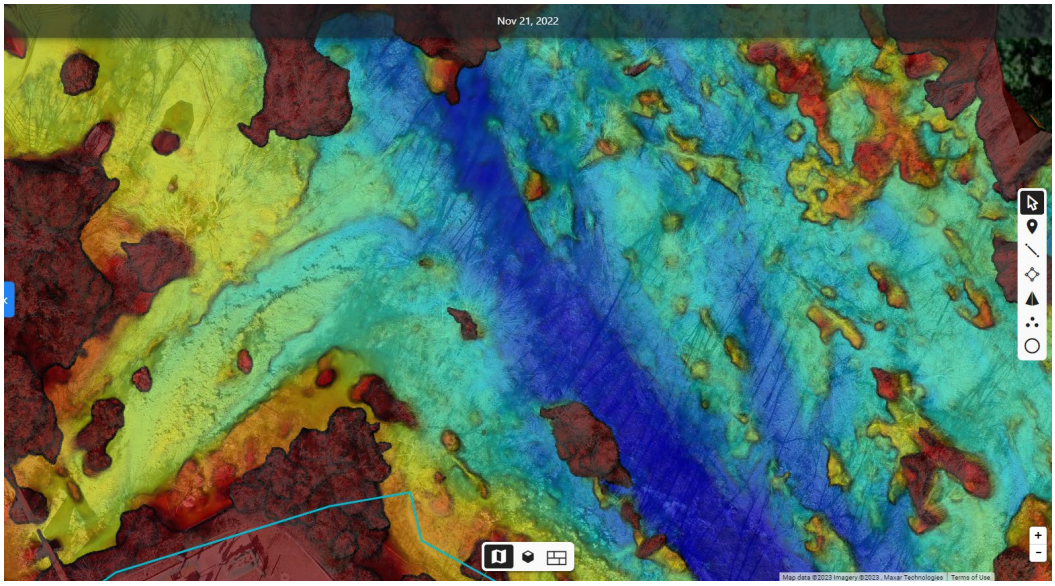
Brewer's Tunnel Dam removal

In late February of 2020, Freeport McMoRan (FMI) removed the 108-year-old Brewer's Tunnel diversion dam. We were there every day of the process, recording the historic event photographically. We used drones as well as land-based cameras to document the dam's removal, from the first preparations to the final cleanup. We also recorded periodic photogrammetric documentation of the project, which gives us a massive amount of data from which we can derive elevations, timing, topographic and other measurable mapping data on the project. We also helped FMI understand the challenges of head cutting, finding hidden steel debris, etc. We are grateful to FMI for the great job they did and for taking this important step in the health of the Verde River!

The last piles are extracted from the riverbed on 2/16/22

Other photogrammetry

The Verde River Institute conducted drone-deployed photogrammetric mapping on an ad hoc basis and as requested by land managers. One such mapping mission was at the request of the Tonto National Forest to map and identify hazardous conditions in the Fossil Creek fire scar area. Our photogrammetric maps are available at no charge to any agency that needs them.



Deception Wash confluence with the Verde at Rocky Rapid – elevational depiction

Environmental DNA Studies

Environmental DNA, or eDNA, is a relatively new process that allows us to survey for the presence of species in the Verde without disturbing the subjects at all. The process is straightforward – just pump 5 liters of river water though a very fine glass fiber filter, send that filter to the National Genomics Center for Wildlife and Fish Conservation, and they perform PCR DNA sampling on it to tell us whether the animals we are looking for are present in the sample. eDNA can't tell us the abundance of the species, just whether they are present or not. This has made a formerly cumbersome and very expensive survey much faster, cheaper, and more accurate. We asked the Center to look for 5 species: Smallmouth Bass, Roundtail Chub, Sonoran Sucker, Lowland Leopard Frog and Northern Mexican Gartersnake. We received positive results on Sonoran Sucker and Roundtail Chub. This was great news, as there was some indications that these native species may have been extirpated from the Middle Verde. While we didn't find Norther Mexican Gartersnake, we did record the species photographically at Lower Tapco RAP this year. Smallmouth Bass were sampled because there was some question whether the species existed at all in the Middle Verde. The fact that we did not find the fish gives credence to the assumption that all of the "Smallmouth Bass" people catch in our area are actually Coosa, or Redeye Bass.

To our knowledge, the Verde River Institute is the only non-profit entity conducting eDNA studies on the Verde.

The equipment we use to gather samples was rather expensive, but it is durable and should serve us well for many years. Each test we request is also expensive, so we only test for species in question, or whose presence is unclear. We will continue to do sampling in various seasons and at various locations as we learn how to get more meaningful results.

The Verde River Institute coordinated closely with the US Forest Service monitoring teams to be sure our techniques and data meet their standards for inclusion in the National database.

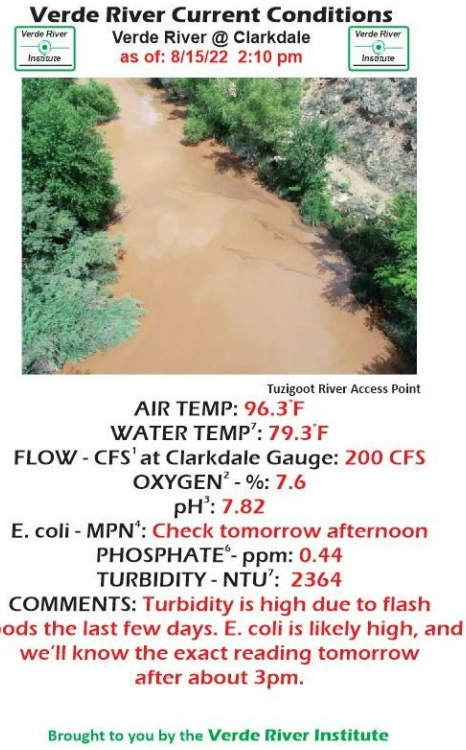
Student Pat Fischer gathers an eDNA Sample at TuziRAP

Community Services

In addition to all the above, the Verde River Institute participated in public information and education. We made a presentation to the Clarkdale Town Council about where their water comes from, how they and other well owners affect the Verde River, what threatens their supply, and why some wells are more reliable than others. We also contributed to countless discussions on Facebook and other social media platforms to ensure the interests of the Verde were represented accurately and often.

During the heavy kayaking season, and especially during monsoons, we posted current conditions at TuziRAP, including E. coli numbers, water and air temperatures, etc. as seen in one of our Facebook posts, below. These posts tell the recreating public as well as land managers what to expect when they visit the Verde, and whether there are hazards they should be aware of. When conditions presented safety concerns, we notified the land managers along the middle Verde of those conditions so they could take appropriate actions. To our knowledge, we are the only organization posting current conditions.

We were active members of the Verde Front coalition's River Safety Committee. We hosted a kayak trip for law enforcement on which we helped our first responders understand the hazards on the river and how we could make the Verde a safer experience for everyone. We also assisted the creation of new on-river signage (we should see it this year sometime!) and provided drone aerials of all emergency access point on the Verde River @ Clarkdale to be used by responders and dispatchers.



Verde River conditions post on Facebook

Conclusion

The Verde River Institute has made huge strides in the last year, achieving some key goals in our mission, which is to provide scientific data and education that can be used by organizations, agencies, policy makers, the general public, and stakeholders to improve the health and sustainability of the Verde River.

We have worked for the last 10 years to record baseline data, explore trends in the river's ecosystem, and improve our understanding of the river's key systems. In 2022, we began the process of teaching what we've learned to a passionate group of students in our Verde River Monitoring and Education Program. We believe this to be our highest and best use among the scientific and conservation communities, and we are extremely proud of the outcomes accomplished in the first year.

In 2023, we will continue to provide all the services mentioned in this report. We will double the number of Verde River Monitoring and Education Program students, increase our Ranger presence, and provide better, more timely information to stakeholder who need the information quickly.

Our New Year's resolution is to work harder this year than last to help the Verde River remain the healthiest, most diverse ecosystem in Arizona, and to do whatever we can to help the river thrive and flow forever!

Our Thanks

We want to thank Arizona State Parks, Salt River Project, the Arizona Community Foundation, Friends of the Verde River, the U.S. Forest Service, the Verde Front coalition, Main Street Bridge landowners Cliff and Nancy Pollay, our dedicated Board of Directors and many, many private donors for their support of our mission. We could not have done our work without you!