Bathymetric Mapping of Donner Lake

Peter Webster, University of California Davis, College of Engineering

Mentor: Erik Young

Special Thanks: Alexander Forrest PhD, Michael Welsh, Mike Cane, Nick Bentley

Donner Lake

Donner Lake is located along Highway 80 northwest of Lake Tahoe. The lake is a popular recreational spot and is surrounded by homes. Recently, Donner Lake has been the subject of increased scientific interest as local agencies have investigated better management practices and introduced the annual State of Donner Lake Report.

Northeast shore, Donner Lake, CA

Why is this Important?

Gaining a better understanding of Donner Lake is the key to better management. This data will be available to lake management agencies providing them with updated metrics on available water volume. This data will also allow us to identify any changes in the lake's shape since 1980.

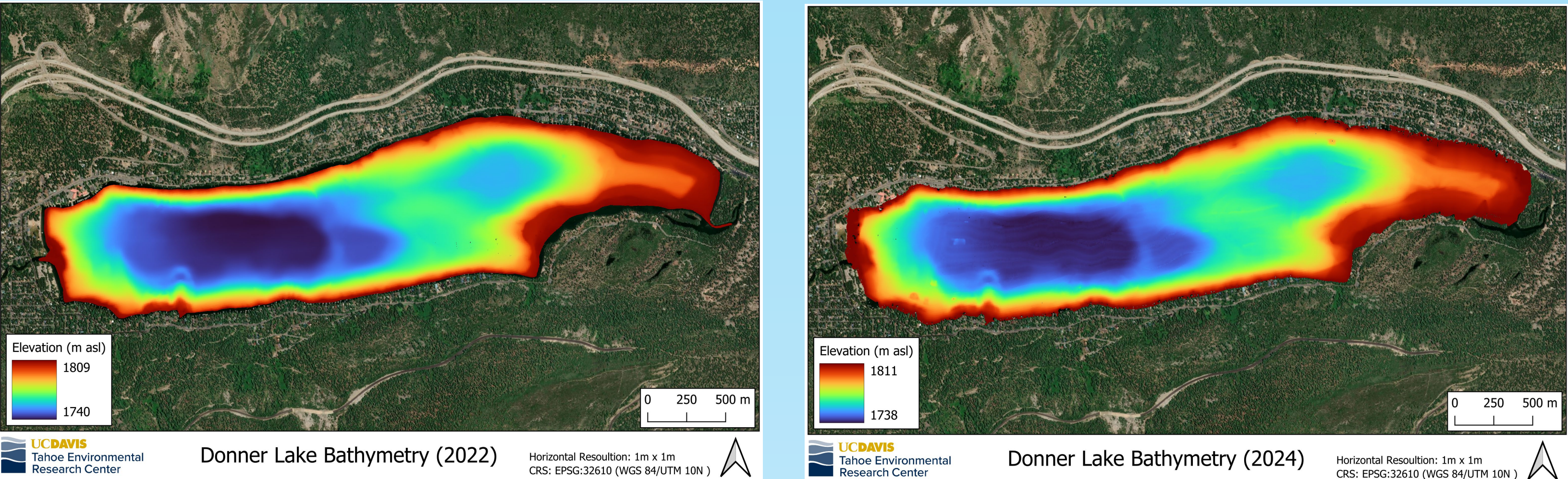Research Vessel: Ted Frantz

What is Bathymetry?

Bathymetry is the measurement and mapping of the depths of bodies of water such as oceans, seas, or lakes. Bathymetry is very similar to topographical mapping, except underwater!

**Contact:** pgwebster@ucdavis.edu and ewyoung@ucdavis.edu

UCDAVIS
Tahoe Environmental Research Center

Results and Conclusions

Donner Lake Bathymetry (2022)

Donner Lake Bathymetry (2024)

Volume Calculations

Year	Total Volume (m^3)
2024	122,824,592
2022	118,787,064

Year	Usable Volume (top 4 m) (m^3)
2024	12,208,272
2022	12,751,152
1980	11,915,417

Volumes are reported below a datum of 1809 m asl
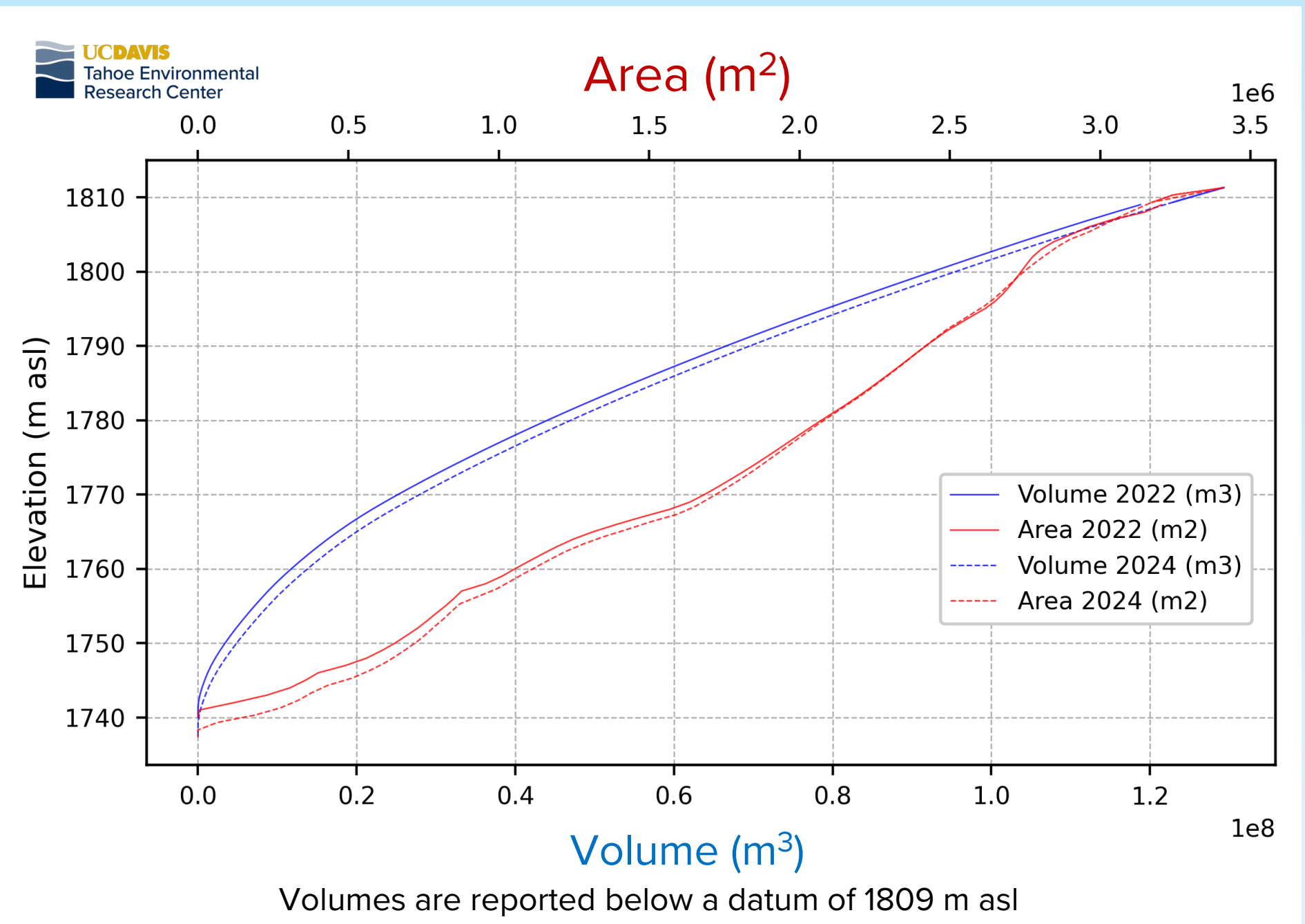
Volume Comparisons

When the 2022 data (UNR) and the 2024 data (TERC) are compared there is an apparent increase in total lake volume of 3.4% (4,037,528 m^3) below 1809 m above sea level. This difference is well within the margin of error of both surveys and does not indicate any significant changes to the lake's volume. This difference may also be due to differences in data interpolation.

The analysis of Donner Lake's usable volume since 1980 indicates a slight increase, but this difference is also well within reason and doesn't prove any significant changes. There is a possibility that the lake's volume may have increased as boat wakes erode the shoreline and sediment exits the lake through the dam, but this is difficult to confirm.

## Future Impact and Implications

This map and data will be passed along to the Nevada Department of Water Resources and made available to agencies such as the Truckee River Watershed Council, Donner Lake Property Owner's Association, and Clean Up the Lake. The usable volume metric will help NDWR determine if they need to adjust outflow rates from the lake during the year.

Components of a Bathymetric Survey

Bathymetry employs sonar transducers to emit soundwaves which reflect off the lakebed. The time it takes for the reflected waves to return to the transducers is measured. The depth can be estimated based on the sound velocity in water. These depth measurements are paired with GPS locations and stitched together to give us a map.

Submerged sonar head

Sensor Layout
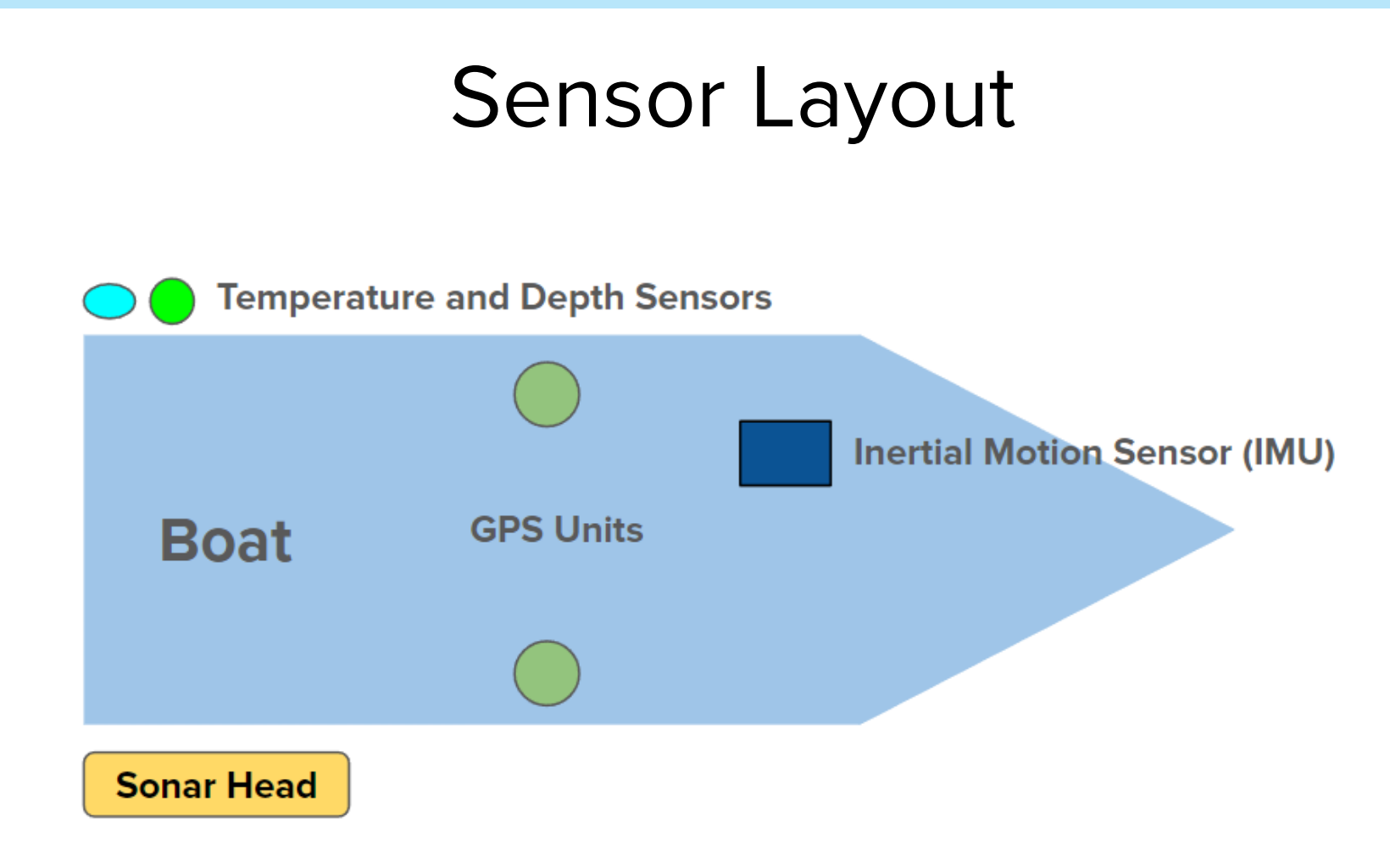
Overcoming Technical Difficulties

During our time on the lake, the bathymetry team spent about twice as many hours troubleshooting and fixing equipment as we spent conducting the survey itself. Challenges included:

- Unstable or broken cable connections
- Setting up a new accelerometer and software
- Boat motor and generator issues
- Mapping software freezing or crashing mid survey
- Avoiding recreators on the lake

Data Processing

1. Combine sonar, GPS, inertia, sound velocity, and lake level data in Sonarwiz software
2. Trim out bad data in Sonarwiz
3. Interpolate data in QGIS software
4. Calculate lake volume and surface area using Python scripts
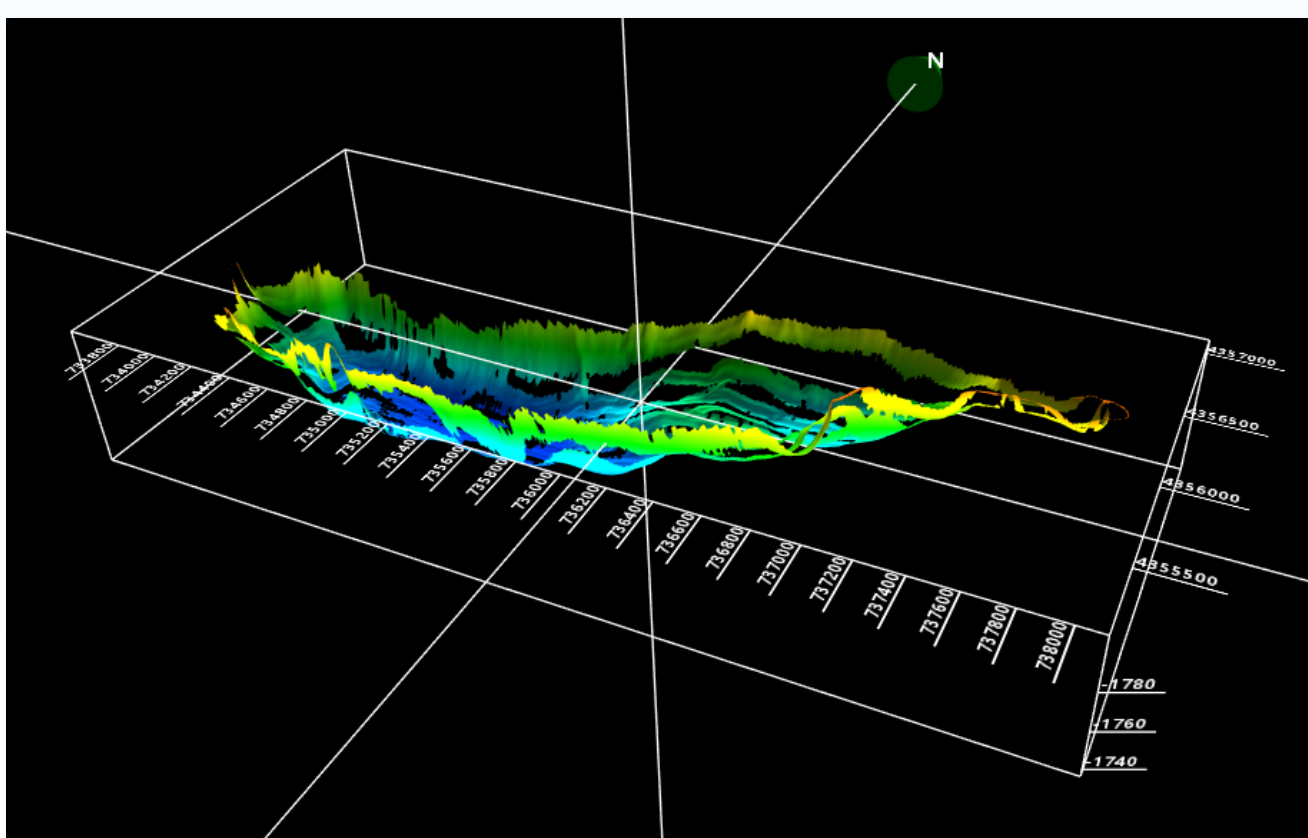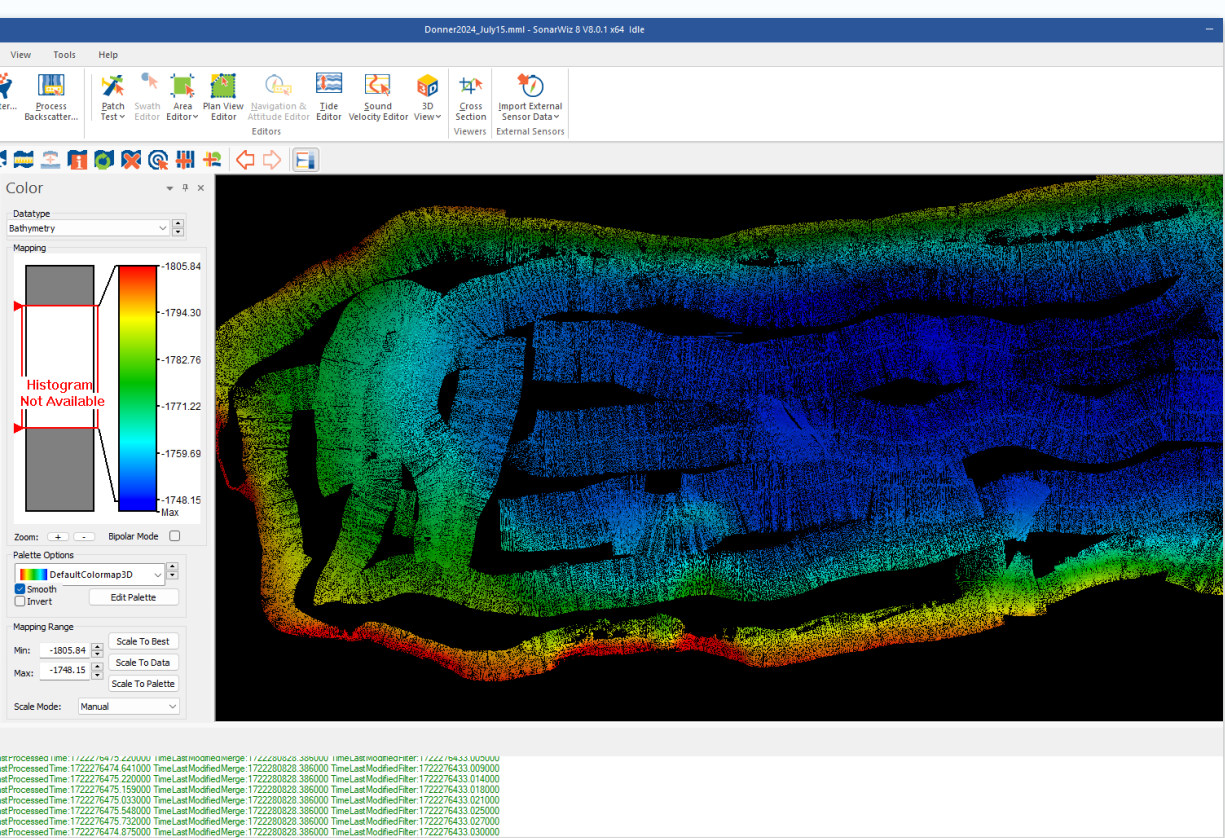
The Search for the Native Western Pearlshell Mussel in the Truckee River

Soffia Ramsey, University of California, Irvine – Department of Ecology and Evolutionary Biology
& Katie Senft, UC Davis Tahoe Environmental Research Center

UCDAVIS
Tahoe Environmental
Research Center

Introduction

1. Freshwater is a hugely important yet scarce resource globally.[5]
2. Climate change and human impacts on freshwater ecosystems are severely understudied.[1]
3. We need to improve our knowledge of native species that provide important water quality services to fill this information gap.

The **Western Pearlshell Mussel (WPM)**, *Margaritifera falcata*, is a native freshwater mussel in the Truckee River. It improves water quality through filter feeding algae, plankton, and bacteria from the water column.

Murphy (1942) described a population of >20,000 individuals located by the San Francisco Fly Casting Club in Truckee.

WPM bed in the Truckee River. (USFS)

Example of human activity in the Truckee River. (SMR)

Similar to other freshwater mussels, the WPM is highly sensitive to environmental changes. It may be particularly vulnerable in more trafficked areas and to long-term changes in river temperatures.[7]


Western Pearlshell Mussel size comparisons. (USFS)

By assessing the location and habitat of WPM populations in the Truckee River, we can help wildlife managers determine vulnerable areas of concern. Furthermore, we can contribute to the protection of freshwater ecosystems worldwide that are under increasing threats of climate change.

Methods

- Snorkel surveyed along two sites of the Lower Truckee River:
  - (1) Tahoe City, Lake Tahoe Dam
  - (2) San Francisco Fly Casting Club, Glenshire Dr.
- Floated and crawled different stretches at each site.
- Documented mussel locations, sediment type, mussel size (cm), trash presence, and host-fish. presence using Esri-Survey123
- Maps created using Esri-FieldMaps and ArcGIS Online.
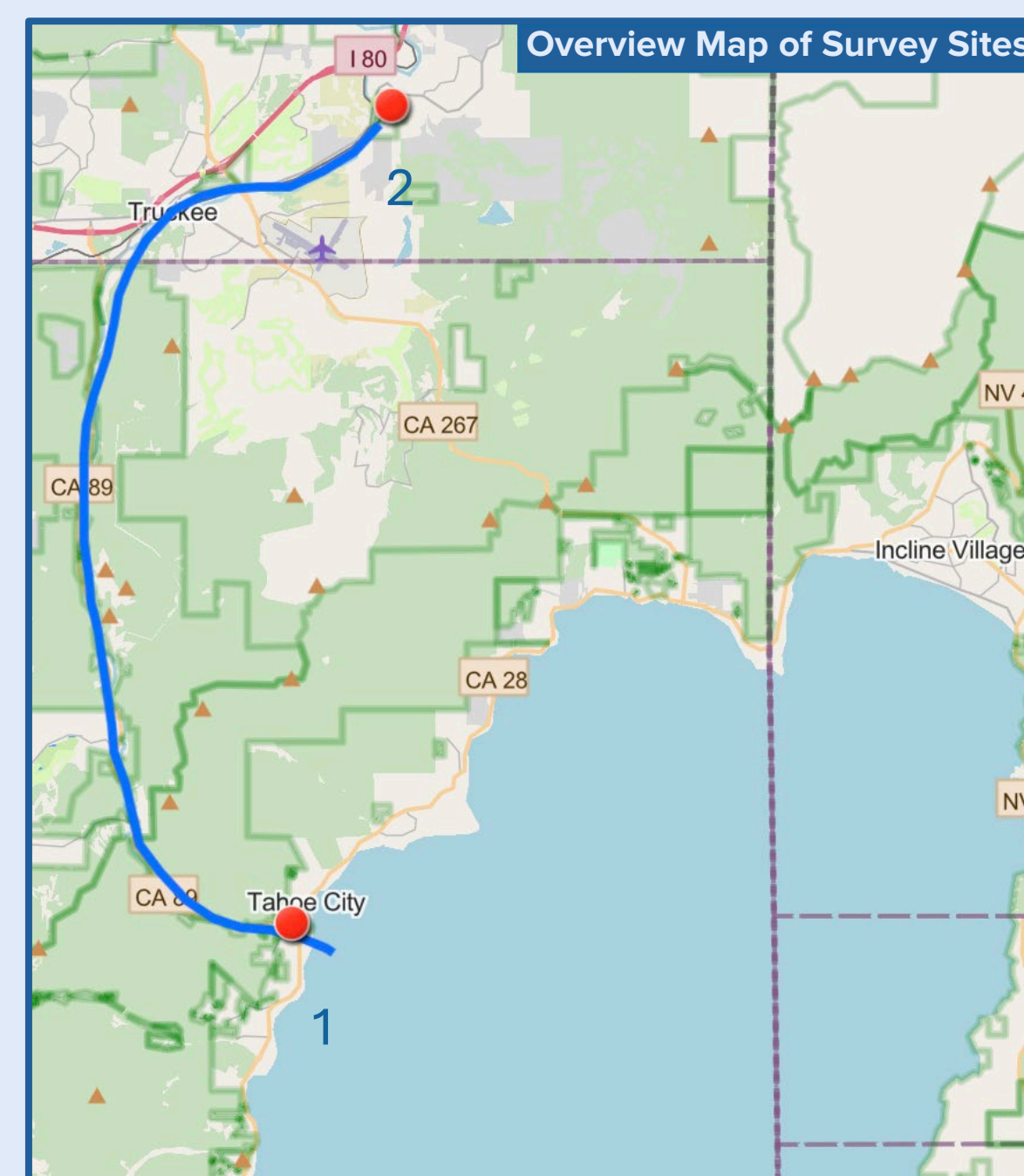
Overview Map of Study Sites (red points) along the Lower Truckee River (outlined in blue).

Results

(1) Three live individuals were found at the Tahoe City, Lake Tahoe Dam site.

Parameters:
- Avg. Mussel Depth: 3 feet
- Trash Presence: High
- Habitat: Rocky, gravel, fine sediment, mostly medium flow
- Host Fish Presence: High abundance & diverse
- Human Activity: High

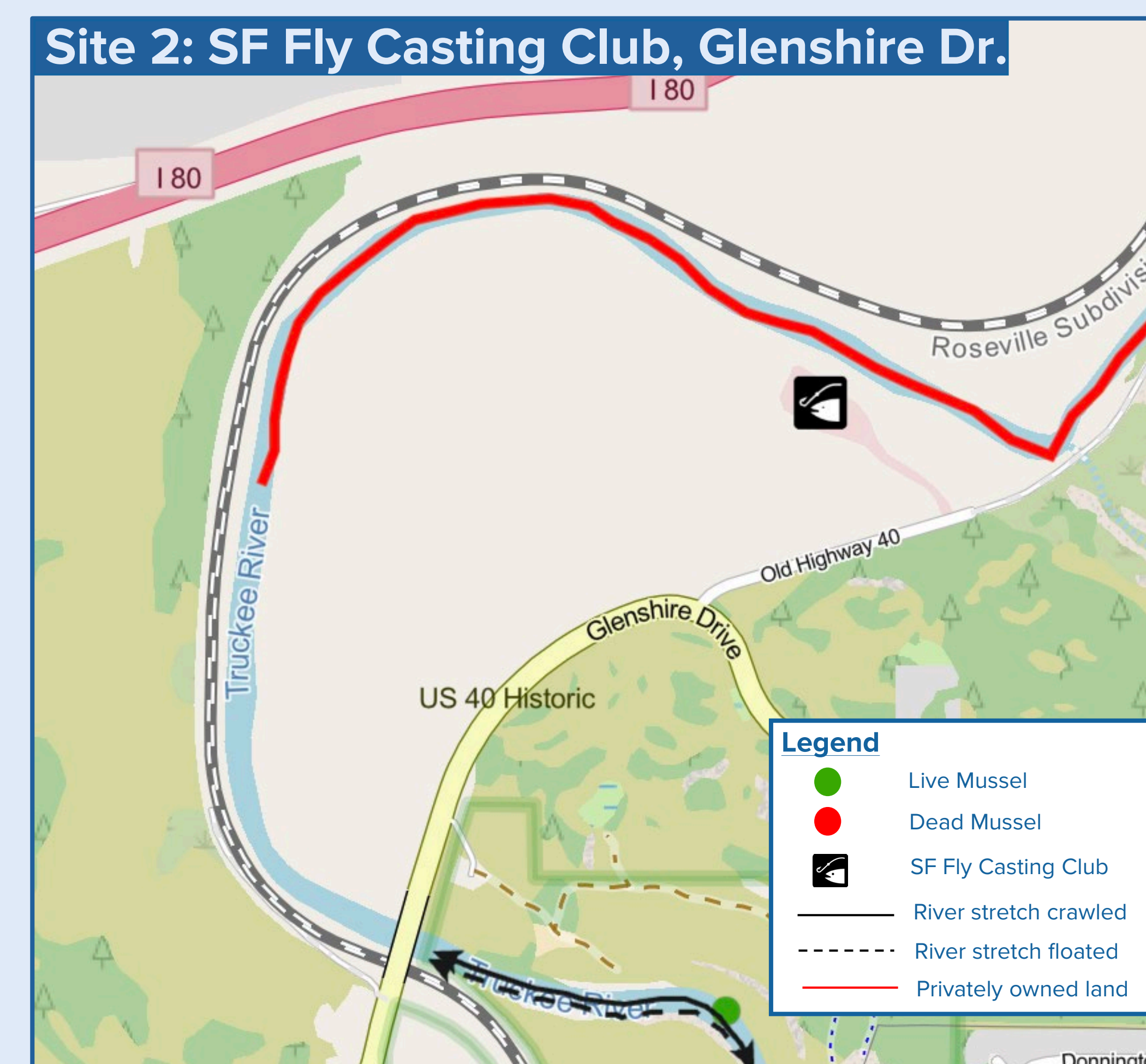### Site 1: Tahoe City, Lake Tahoe Dam
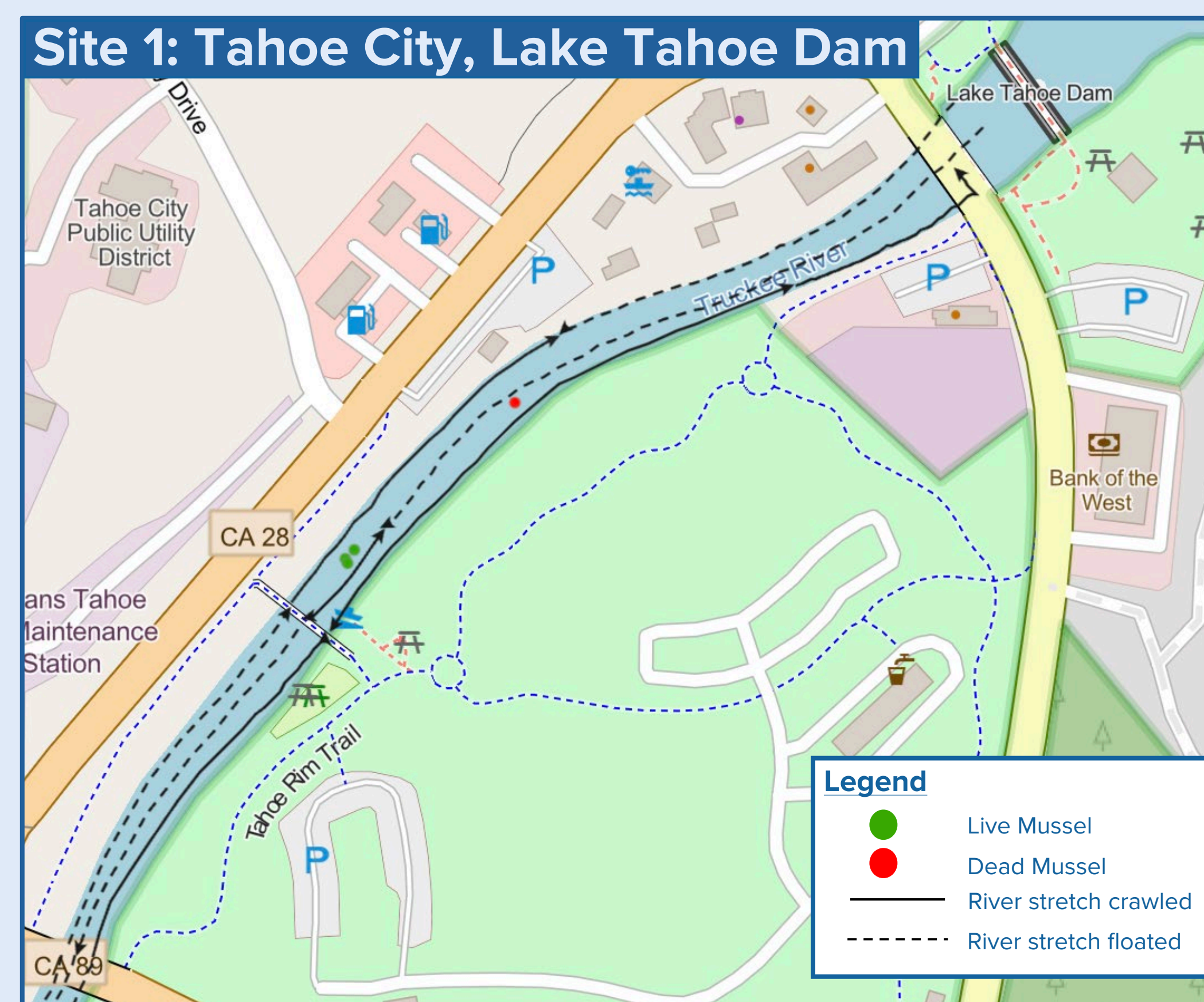
Survey Map of the Tahoe City, Lake Tahoe Dam site. Points represent individual mussels. Black Lines display length and method of survey.

(2) One live individual was found upstream of the SF Fly Casting Club site.*

Parameters:
- Mussel Depth: 3 feet
- Trash Presence: Medium
- Habitat: Big rocks, fine sediment, higher flow
- Host Fish Presence: Medium abundance
- Human Activity: Medium

*Original Murphy (1942) site is now privately owned and inaccessible for this study.

Site 2: SF Fly Casting Club, Glenshire Dr.

Survey Map of the SF Fly Casting Club off Glenshire Dr. Points represent individual mussels. Black Lines display length and method of survey.

Can you spot the Western Pearlshell Mussel?

Take a shot at conducting your own river survey! Each of these pictures contain individuals found during surveys for this project.

(SMR)

***PLEASE DO NOT** handle or disturb individuals due to their sensitivity and rarity in the Lake Tahoe basin.*

Discussion

Main Takeaways:

1. There are no obvious thriving mussel beds at sites surveyed.
2. Surveys revealed ideal habitat[3] despite low mussel counts.
   - Ideal sediment type – big rocks and gravel.
   - Ideal river conditions – medium flows and shallow water.
   - Ideal host fish – many types of host trout.
3. Human activity does not seem to play a significant role in WPM population decline.
4. Climate change may play a larger role in the decline of the WPM in the Truckee River.
   - Ideal water temperature range is 5 – 20 °C (41 – 68 °F).
   - Tolerance is 25-30 °C (77 – 86 °F) but can be as low as 21 °C (70 °F). [2,6,9]
   - Historic summer temperature was 13 °C (56 °F) during Murphy (1942) report.
   - Tahoe City river temperature has, at times, passed the ideal threshold (>20 °C; 1993-2014). [10]

Freshwater ecosystems are extremely vulnerable. It is important we take action to protect native biodiversity for the long-term conservation of crucial natural freshwater services.

Soffia collecting observational data on a group of mussels in the field.

Limitations:

1. Parts of the river flowed too fast to get a good visual of the area.
2. Time constraints on ability to resurvey certain areas during project time scale.
3. Private land made original site inaccessible for surveying.

Future:

1. eDNA analysis is a method of detecting mussel presence at different points along the river & other less explored tributaries.
2. Underwater cameras could aid in surveying areas of faster river flow.
3. It may be useful to create local signage to educate the public about native vs invasive mussels.

Soffia measuring an empty WPM shell.

Connect With Us!

1. Soffia Ramsey – Limnology Research & Field Intern
   email: smramsey@uci.edu
2. Katie Senft – Staff Research Associate
   email: kjsenft@ucdavis.edu
3. Alison Toy – Education & Outreach Program Manager
   email: natoy@ucdavis.edu

References:

Improving Sugar Pine Restoration: Exploring Relationships Between Vegetation & Seedling Survival

Meera Putz, University of California, Davis, College of Agricultural & Environmental Sciences

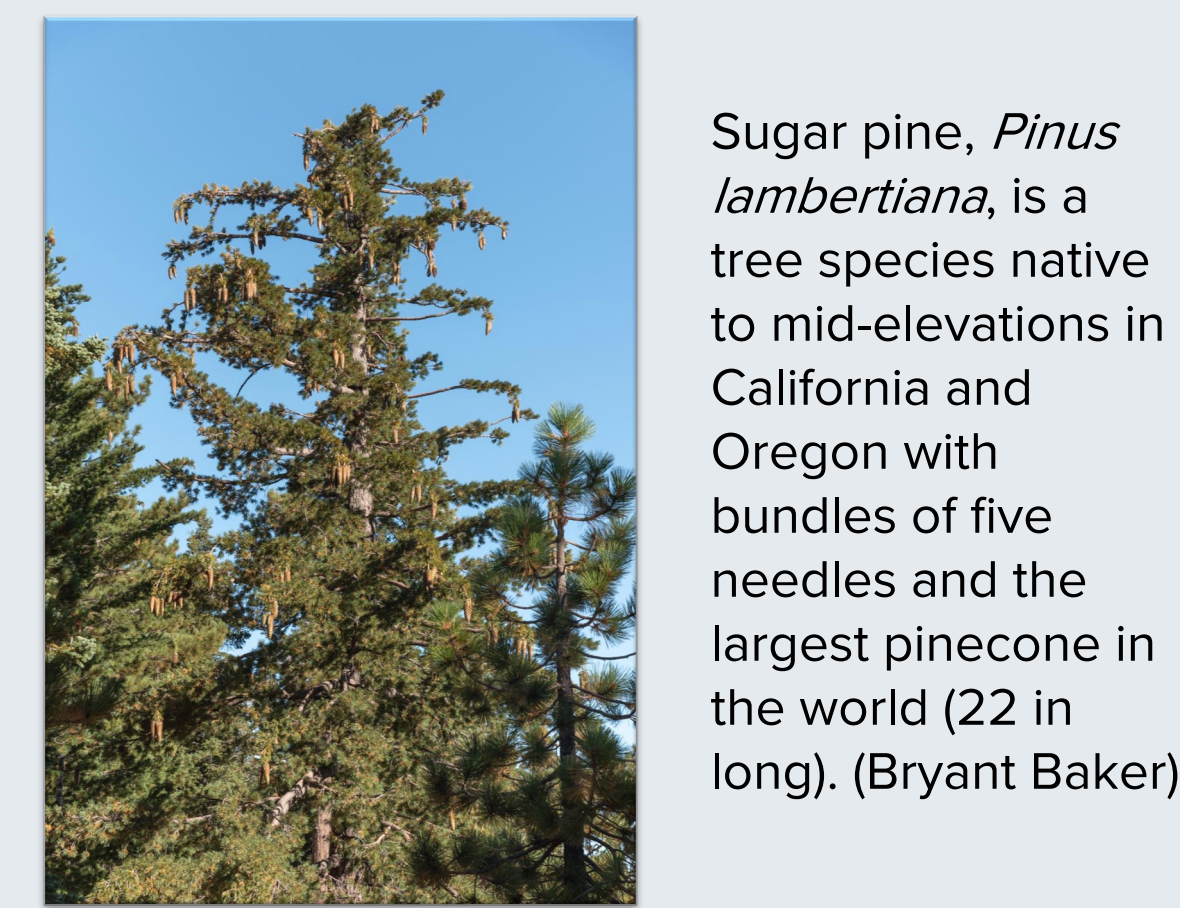## Background

Sugar Pine Decline

- In less than two centuries, sugar pines have declined from 25% of Tahoe's forest composition to just 5%.
- Historic logging during the Comstock Era selectively cut old-growth sugar pines for their straight and durable wood.
- Present-day threats are numerous: white pine blister rust, mountain pine beetle outbreak, wildfire, and drought threaten remaining populations.
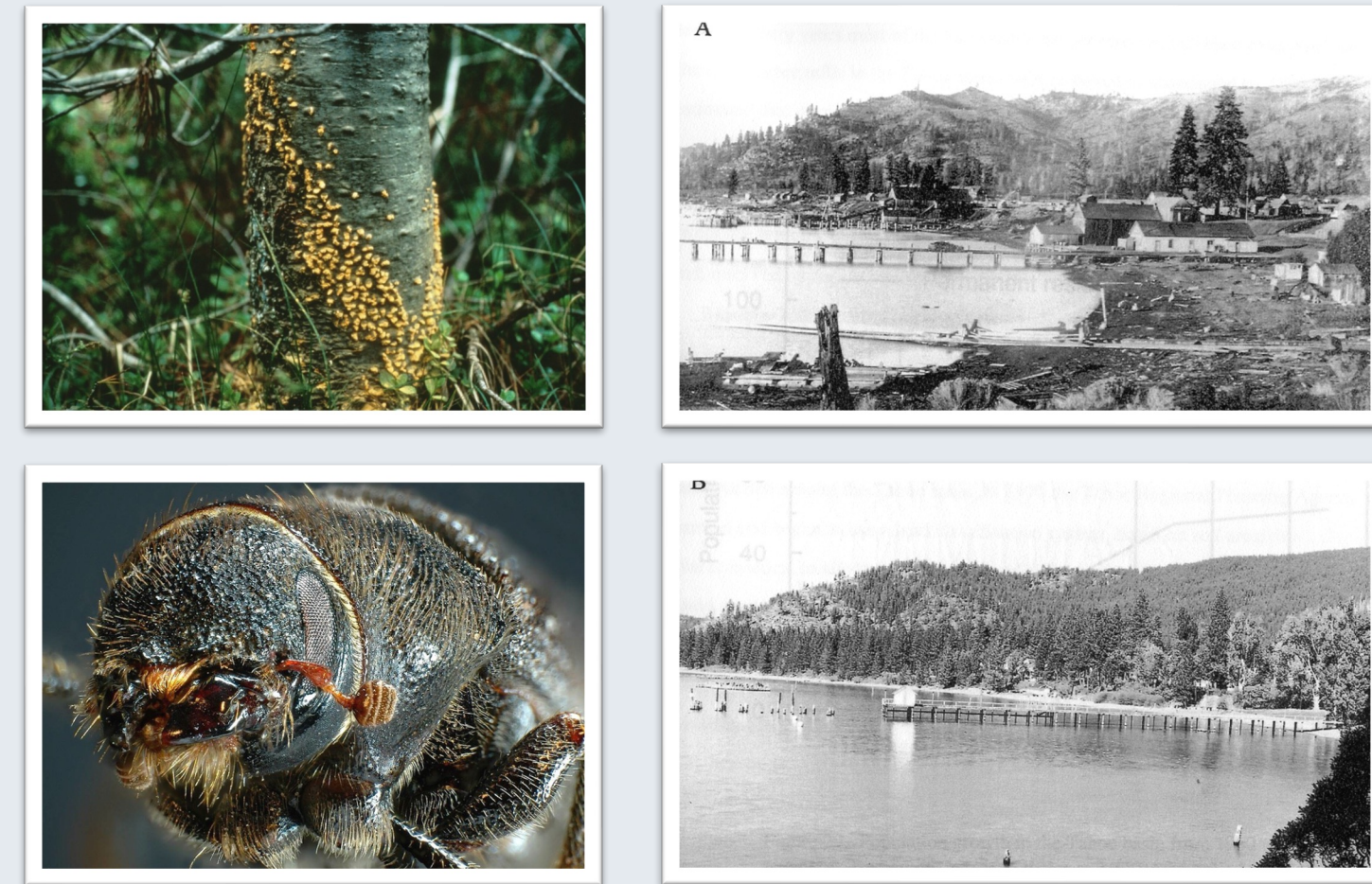
From top left, clockwise: Tree infected with white pine blister rust; Impacts of Comstock Era logging on Tahoe's forests - (top) 1900, (bottom) 1998; Close-up of mountain pine beetle. (USFS; Ward Strong, Flickr).

Sugar pine, *Pinus lambertiana*, is a tree species native to mid-elevations in California and Oregon with bundles of five needles and the largest pinecone in the world (22 in long). (Bryant Baker)

Sugar Pine Planting Roadblocks

- Restoring sugar pines is imperative for both conservation and wildfire resiliency.
- Sugar pines have fire-resistant bark and fewer ladder fuels than species like white fir, making them less susceptible to fire.
- Plantings can have very low success rates. Trial plantings from 2019-2020 had 1-3% survival.

Building a Restoration Algorithm

- This project was founded to understand the factors that influence survival and create an algorithm to help land managers improve sugar pine restoration outcomes.
- Three locations with declining sugar pine populations were identified as prime restoration areas: Tahoe Vista, Kings Beach, and Ward Creek.
- California Conservation Corps (CCC) members planted 5,000+ seedlings and water them in warm months.
- Sites were analyzed for a variety of metrics including snowpack retention, aspect, and soil properties.

Camille Jensen (top right) and CCC members plant sugar pines at Kings Beach (KB). (Patricia Maloney)

My project is a vegetation survey of all three restoration locations. Together, our data will establish what factors carry the most weight in seedling survival and inform an accurate algorithm to improve efficiency and outcomes for sugar pine restoration.

Methods

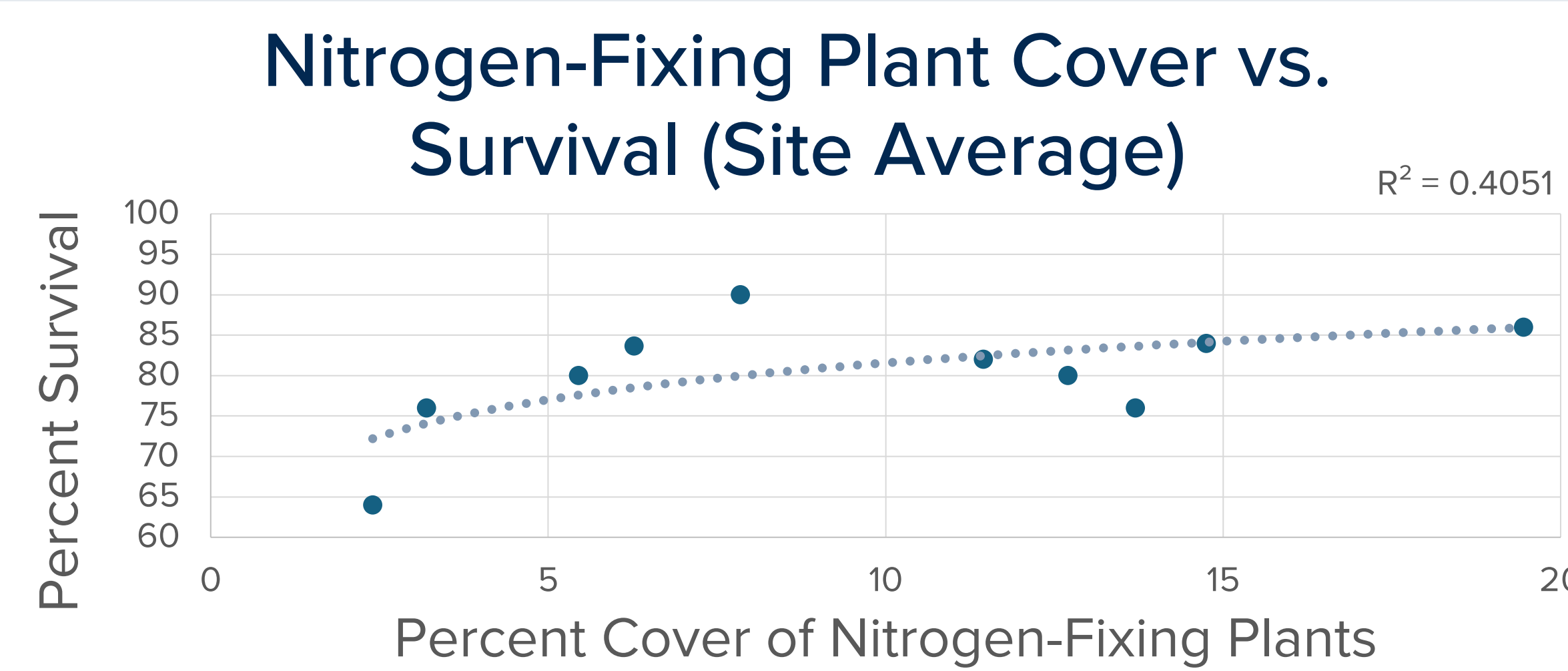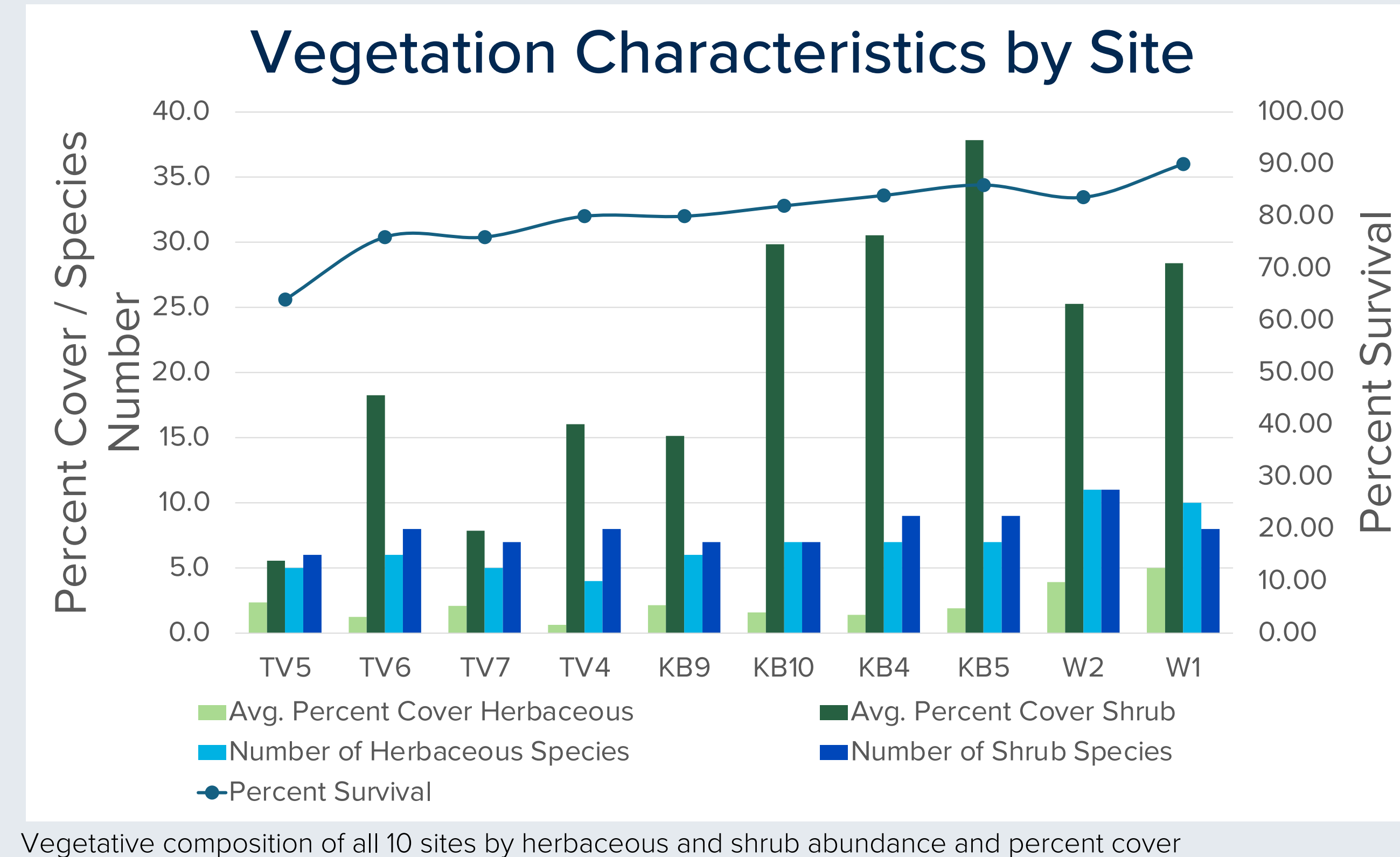| Site Selection	Randomly select half of all plots at each site across all 3 locations to survey in July 2024.
Surveying	Identify and quantify spread of all plants at successive radii from plot center (herbaceous = 2m, shrub = 3m, tree = 5m) and take soil temperature.
Survival Analyses	Cross-reference soil and vegetation data with mortality surveys conducted earlier this summer.

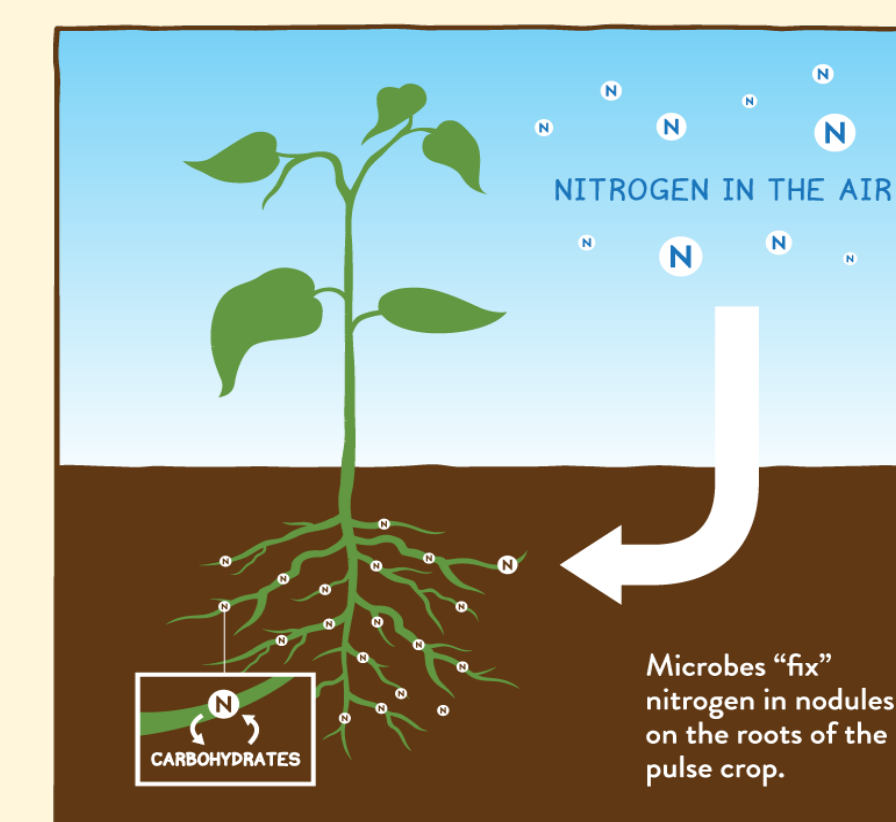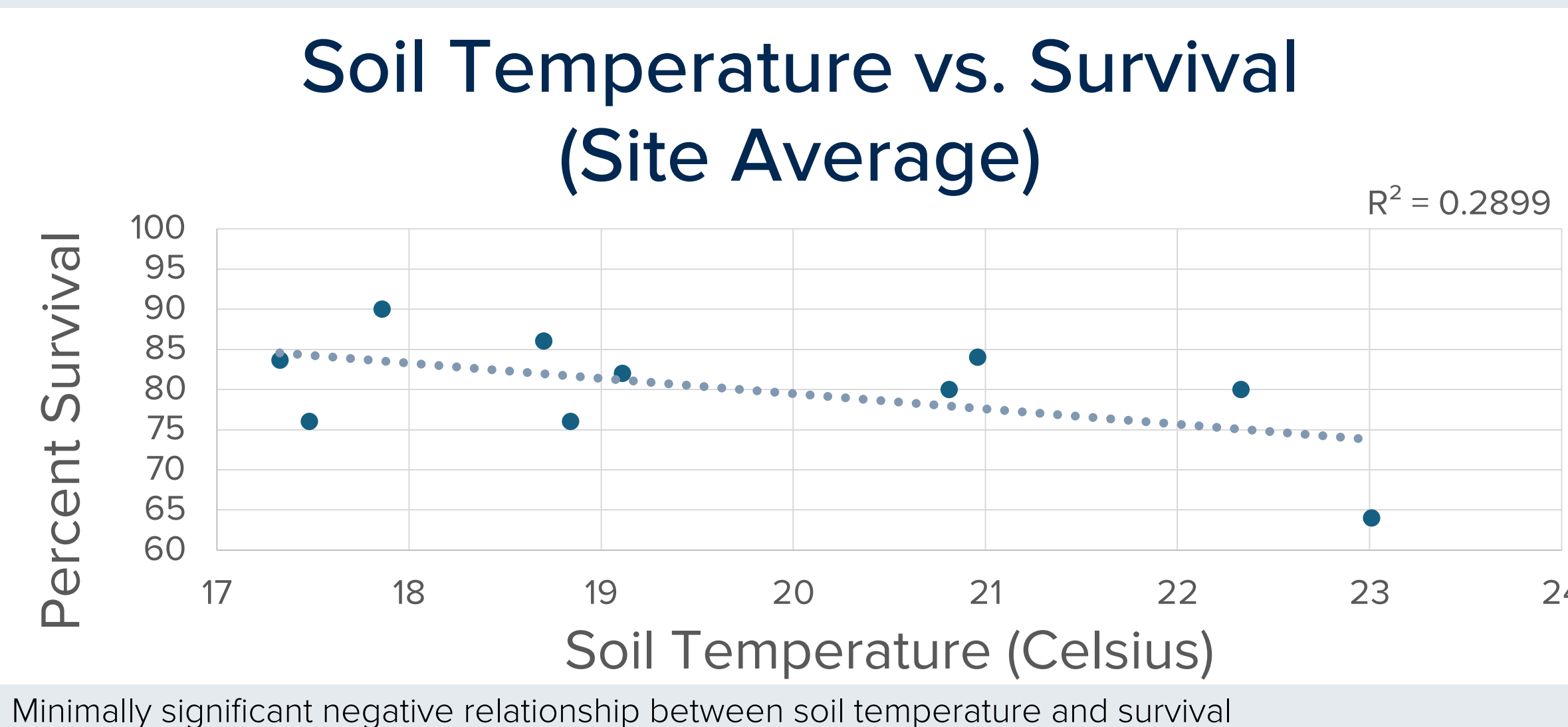Measuring trees at Ward Creek; seedlings in foreground. (Putz)
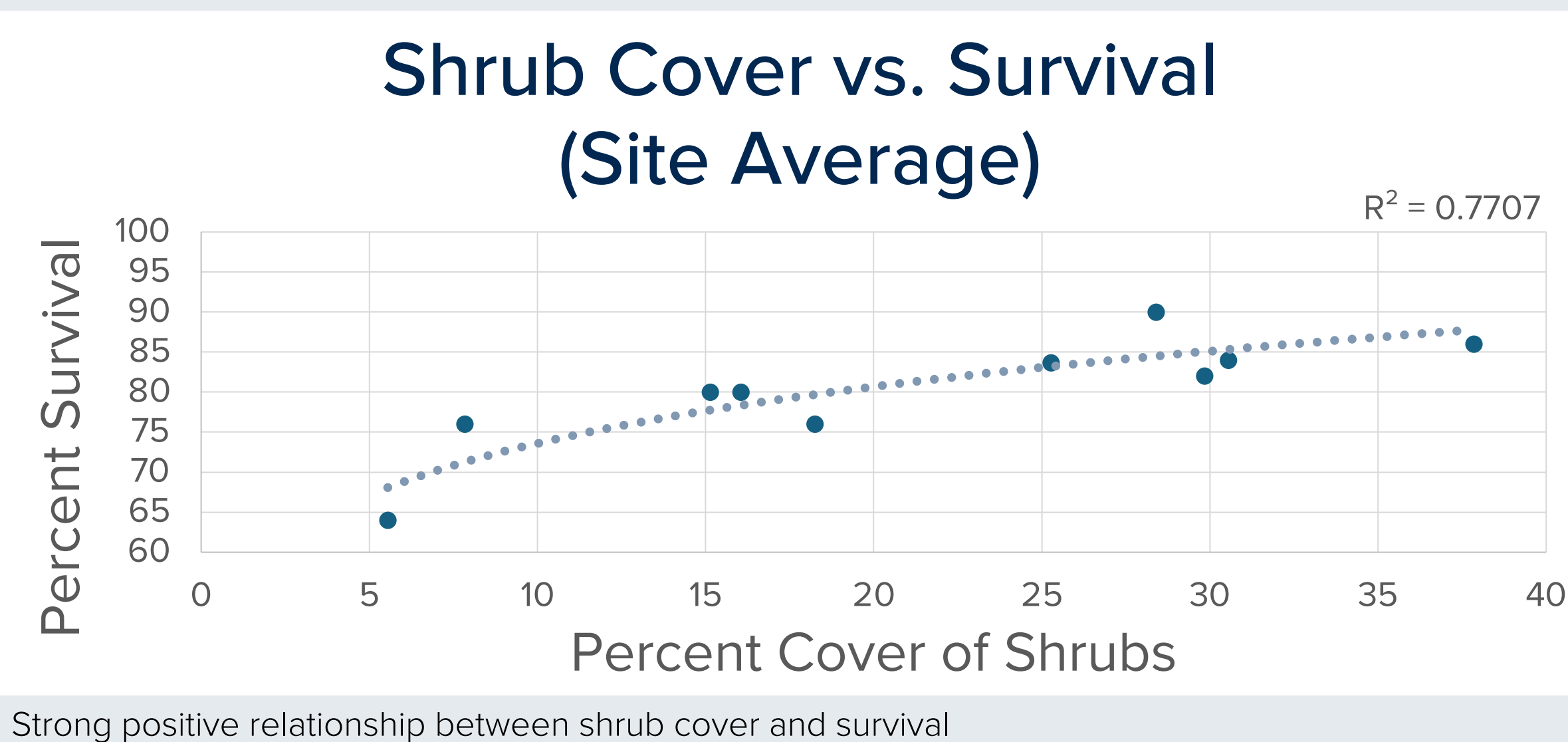
Results

Quick Facts

- 650+ individual plant observations
- 50+ unique species identified
- Ward Creek (W) had the highest survival rate at 86%, Tahoe Vista (TV) had the lowest at 74%
- **Sugar pine survival increased with greater plant diversity and cover**

Vegetation Characteristics by Site

Vegetative composition of all 10 sites by herbaceous and shrub abundance and percent cover

- Avg. Percent Cover Herbaceous
- Number of Herbaceous Species
- Avg. Percent Cover Shrub
- Number of Shrub Species
- Percent Survival

Nitrogen-Fixing Plant Cover vs. Survival (Site Average)

$R^2 = 0.4051$

Possible positive relationship between nitrogen-fixing plant ground cover and survival

Snowplant (*Sarcodes sanguinea*), a mycotrophic plant found at Ward (Philip Bouchard, Flickr).

Soil Temperature vs. Survival (Site Average)

$R^2 = 0.2899$

Minimally significant negative relationship between soil temperature and survival

Nitrogen-fixing plants host bacteria that take nitrogen from the air (N2) and convert it into usable forms for plants. (PulseGrowers, Wikimedia)

Shrub Cover vs. Survival (Site Average)

$R^2 = 0.7707$

Strong positive relationship between shrub cover and survival

Four common nitrogen-fixing shrubs, three in the genus *Ceanothus*. (Putz)

Conclusion

Discussion

- Some vegetation characteristics do correlate with sugar pine survival.
- Percent cover of shrubs and nitrogen-fixing plants have especially strong relationships with mortality.
- Soil temperature had a low correlation with survival. This result should be further examined due to possible probe depth error.
- This study had a small sample size, which makes these conclusions preliminary.
- Future studies should pursue potentially significant correlations and decipher causal relationships among these factors.

Left: Leading a tour at the Kings Beach site and giving naturalist talk about sugar pines (Ingrid Peters); *Right:* Bears in a whitebark pine, an endangered species that may benefit from the algorithm (National Parks).
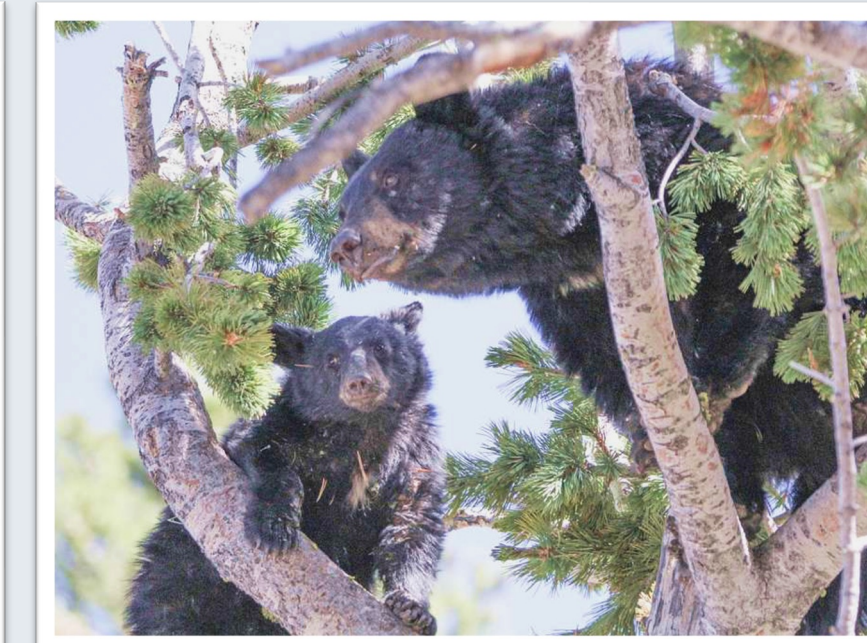
Looking Ahead

These initial results illuminate potentially significant relationships between plant communities and sugar pine survival that may enhance a restoration algorithm. This algorithm has the potential to drastically improve sugar pine planting outcomes and help make Tahoe's forest more disturbance-resilient. It also could be expanded to other five-needled white pines, such as the endangered whitebark pine, and optimize restoration projects to protect our world's forests for generations to come.

References

Maloney, P., Vogler, D., Eckert, A., Jensen, C., & Neale, D. (2011). Population biology of sugar pine (*Pinus lambertiana* Dougl.) with reference to historical disturbances in the Lake Tahoe Basin: Implications for restoration. *Forest Ecology and Management*, 262, 770-779. https://doi.org/10.1016/j.foreco.2011.05.011

Habeck, R. J. (1992). Pinus lambertiana. *Fire Effects Information System*, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.usda.gov/database/feis/plants/tree/pinlam/all.html

Acknowledgements

Citizen science: a valuable research tool at Lake Tahoe

Maddy Mouw, California Polytechnic State University, San Luis Obispo
Mentor: Sarah H.
A Special Thanks: Alison T., Heather S., Katie S., Brandon B.

UC DAVIS
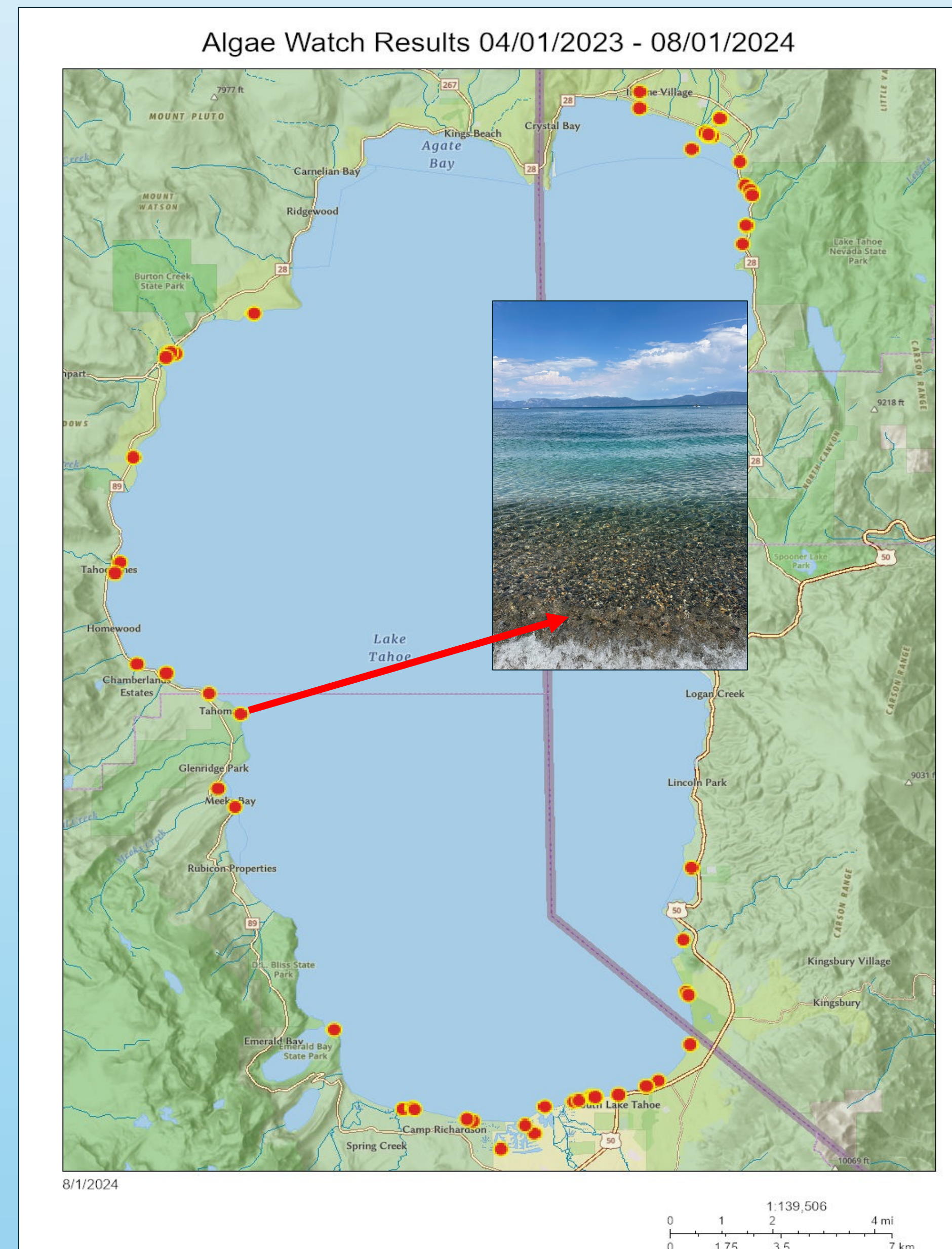Tahoe Environmental Research Center

Introduction and purpose

Lake Tahoe experiences very high visitation rates as well as extremes in climate variability. Renowned for its crystal-clear waters and unique ecosystem, the region faces numerous environmental challenges such as threats to water quality, algae growth, invasive species, and litter/microplastic pollution. Harnessing the power of volunteer citizen scientists provides valuable data and insights that TERC's research scientists might not be able to gather alone.

The goal of this project is to increase data available to researchers using the Citizen Science Tahoe webapp by submitting observations, as well as encouraging visitors and community members to submit observations.

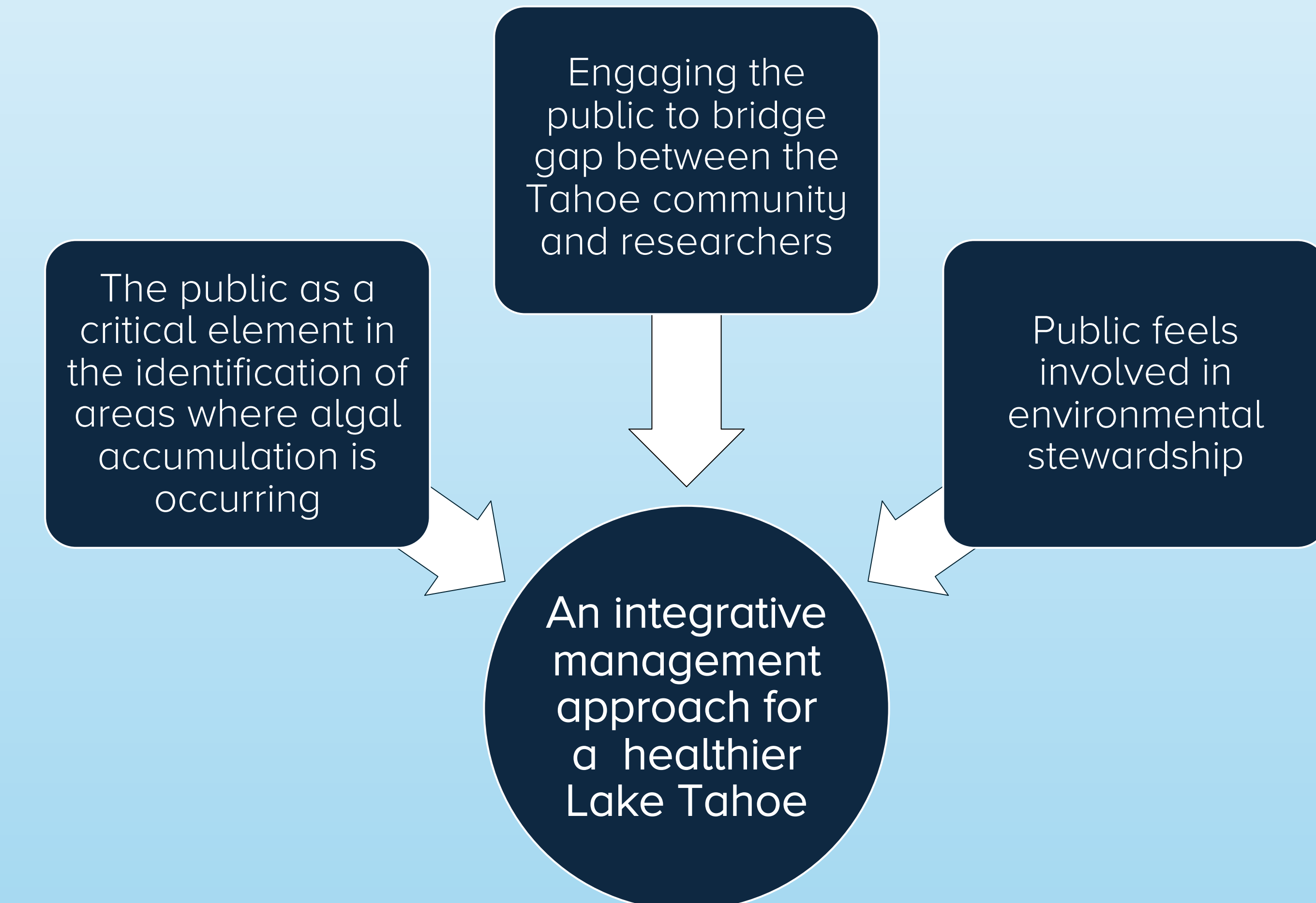Research vessel John Le Conte on Lake Tahoe

Results

Algae Watch Results 04/01/2023 - 08/01/2024

Algae Watch_results: Maddy Mouw

Name	Maddy Mouw
Add additional comments	
Are any of these conditions present?	clean_low_nutrients
Date/time of observation	7/24/2024, 2:32 PM
Do you see algae?	No
Email	madelinemouw@gmail.com
Other - Are any of these conditions present?	
Other - What is the dominant substrate beneath the water?	Sand with cobbles
Rate how the algae growth appears to you	1 - No growth
What is the dominant substrate beneath the water?	Other
What kind of algae do you see?	

8/1/2024

Map of citizen science submissions for the Algae watch category

Survey and photo collected from Sugar Pine Point State Park monitoring site. Observational data collected by citizen scientists are analyzed by TERC's field team bi-annually to better understand conditions around the lake and to compare visitor perceptions with sensor readings. Public submissions are live and available to view at: www.citizensciencetahoe.org

Discussion and ideas

Engaging the public to bridge gap between the Tahoe community and researchers

The public as a critical element in the identification of areas where algal accumulation is occurring

Public feels involved in environmental stewardship

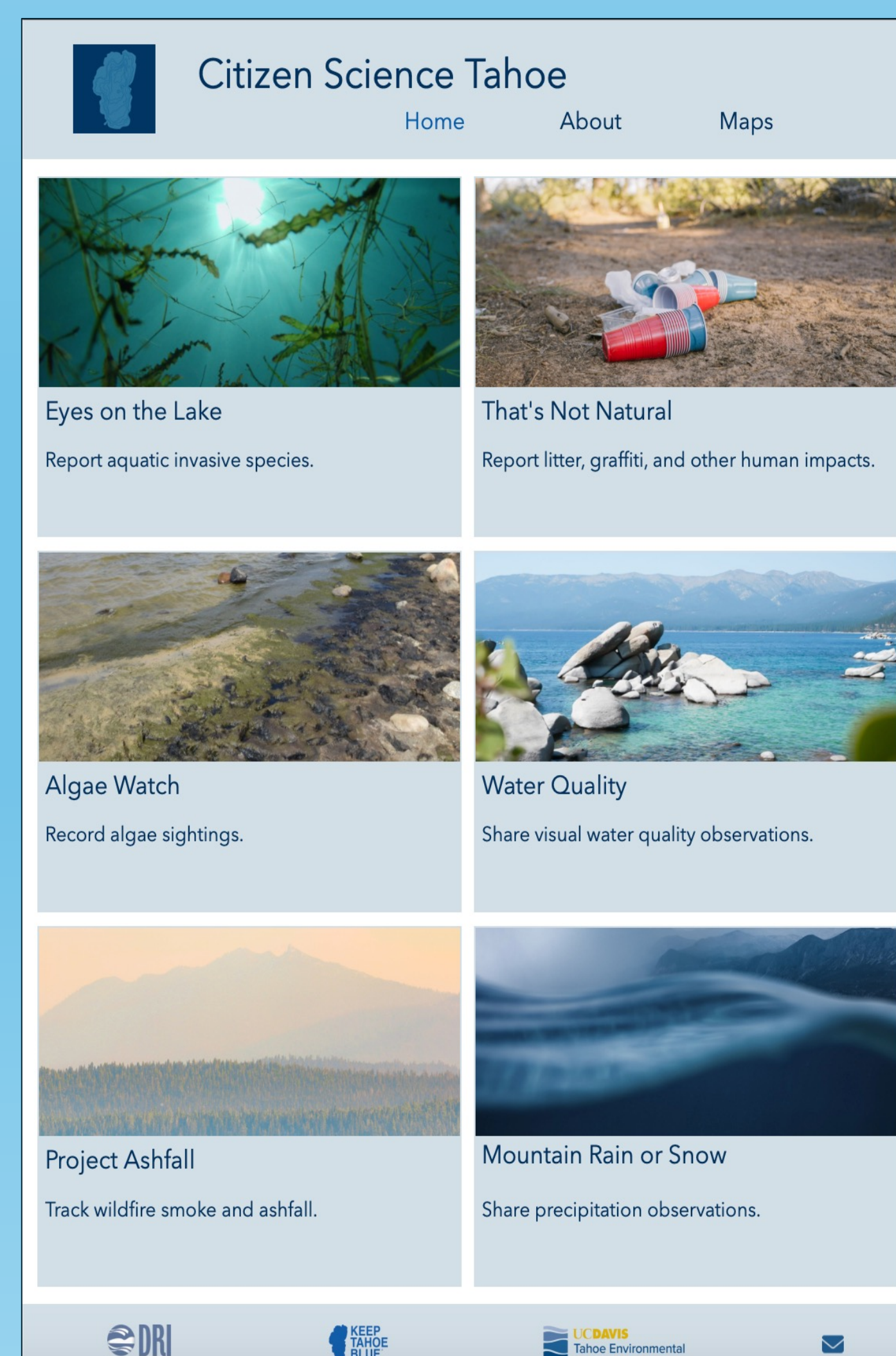An integrative management approach for a healthier Lake Tahoe

Correlation between placements of QR codes and public submissions were found. We believe there are additional avenues for encouraging public participation in citizen science in the future, including lakeside business participation, targeted education programs, and expanding partnerships.

Methods

Monitoring and outreach efforts included the use of:
- helicopter
- drones
- scientific divers
- snorkel surveys
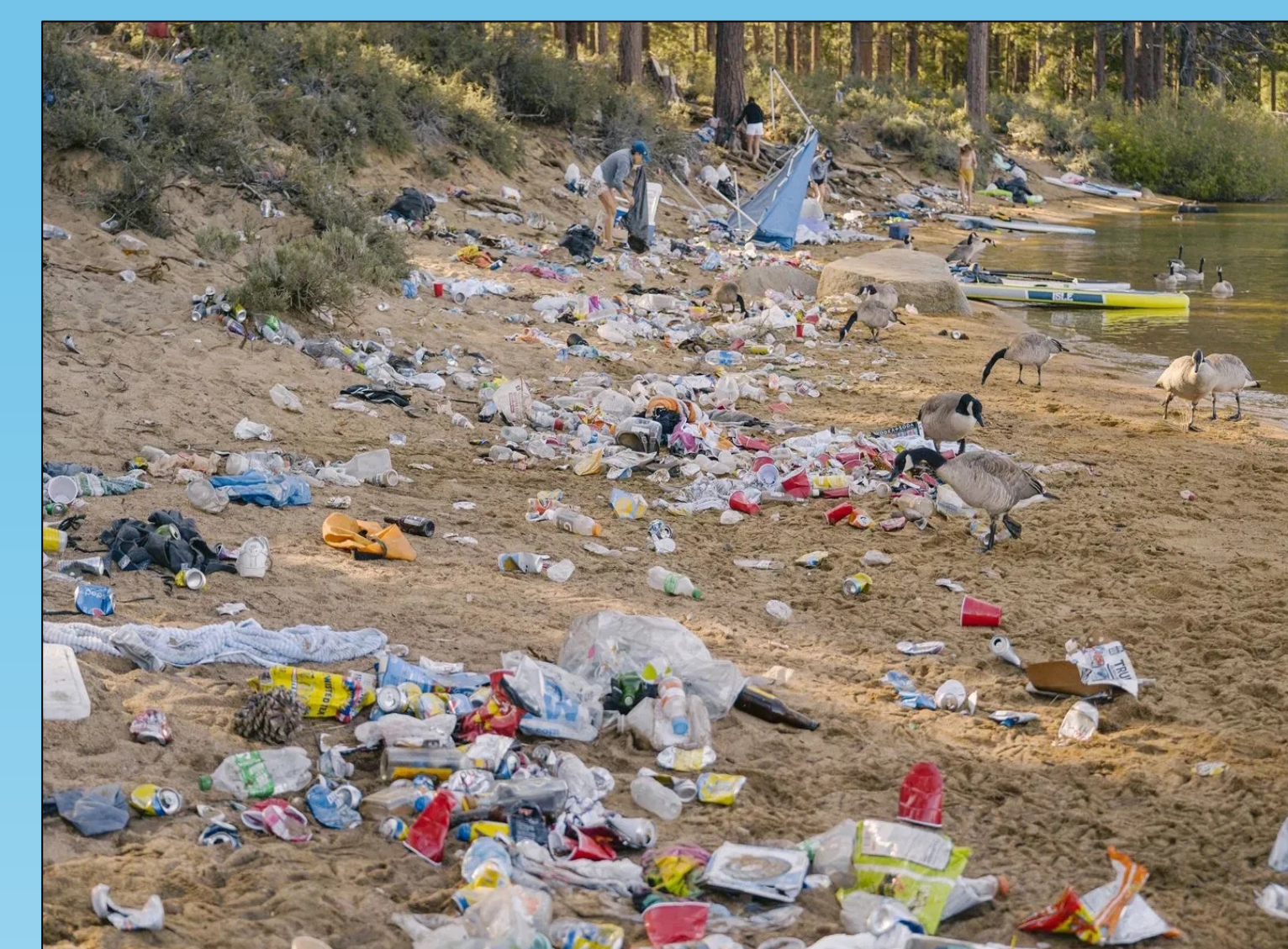- ground monitoring
- placing QR codes

Citizen Science Tahoe
Home   About   Maps

Eyes on the Lake
Report aquatic invasive species.

That's Not Natural
Report litter, graffiti, and other human impacts.

Algae Watch
Record algae sightings.

Water Quality
Share visual water quality observations.

Project Ashfall
Track wildfire smoke and ashfall.

Mountain Rain or Snow
Share precipitation observations.

To get to this page ⟶ scan the QR code or go to www.citizensciencetahoe.org

What are we looking for?

The CST webapp is an interagency monitoring effort. While TERC manages public data input for Algae Watch and Water Quality, the League to Save Lake Tahoe and the Desert Research Institute manage CST data for litter, invasive species and ash fall. Lake Tahoe's nearshore appearance is indicative of its overall health.
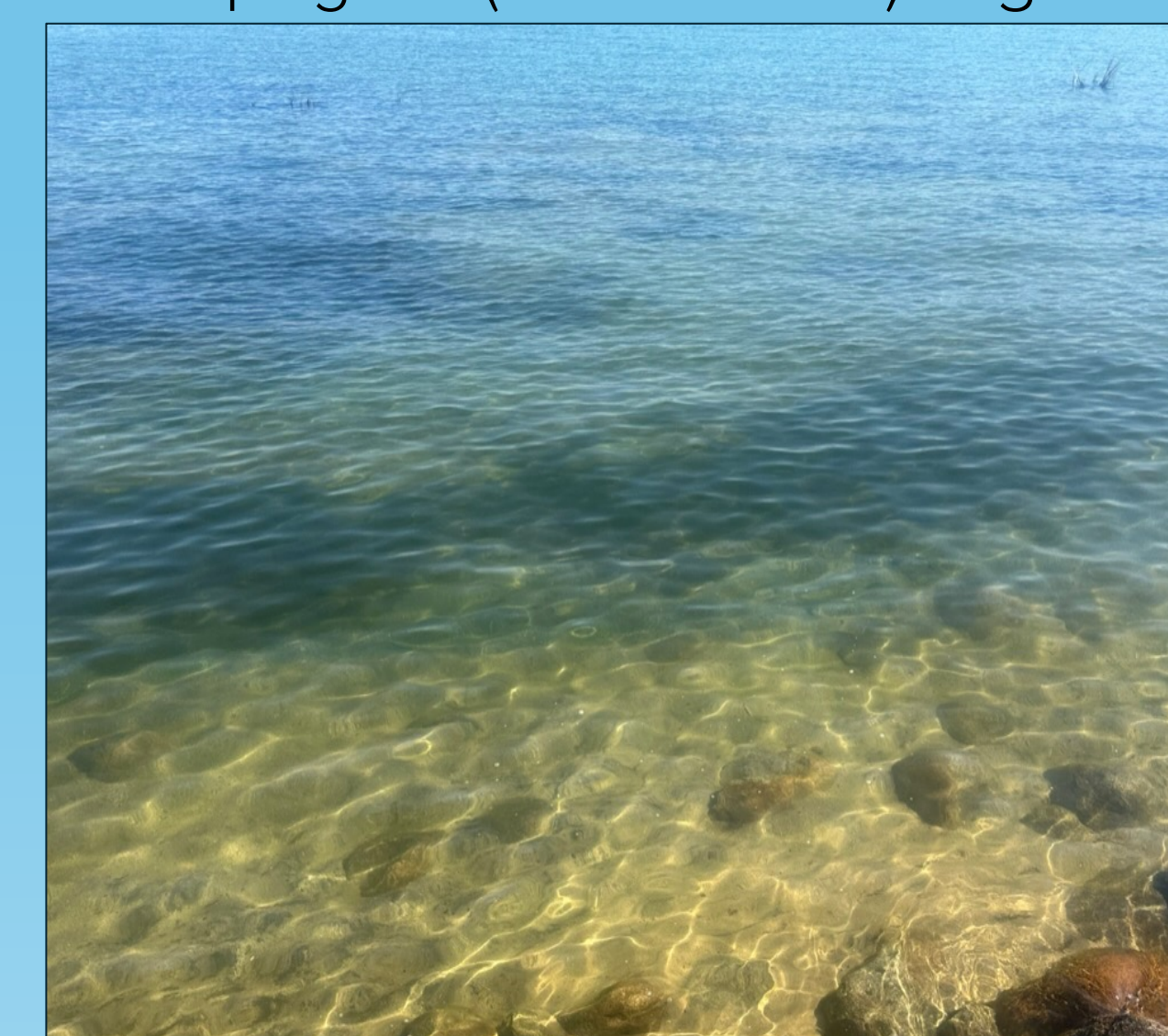
Periphyton (attached) Algae

Water Quality

Litter (courtesy of The League to Save Lake Tahoe)
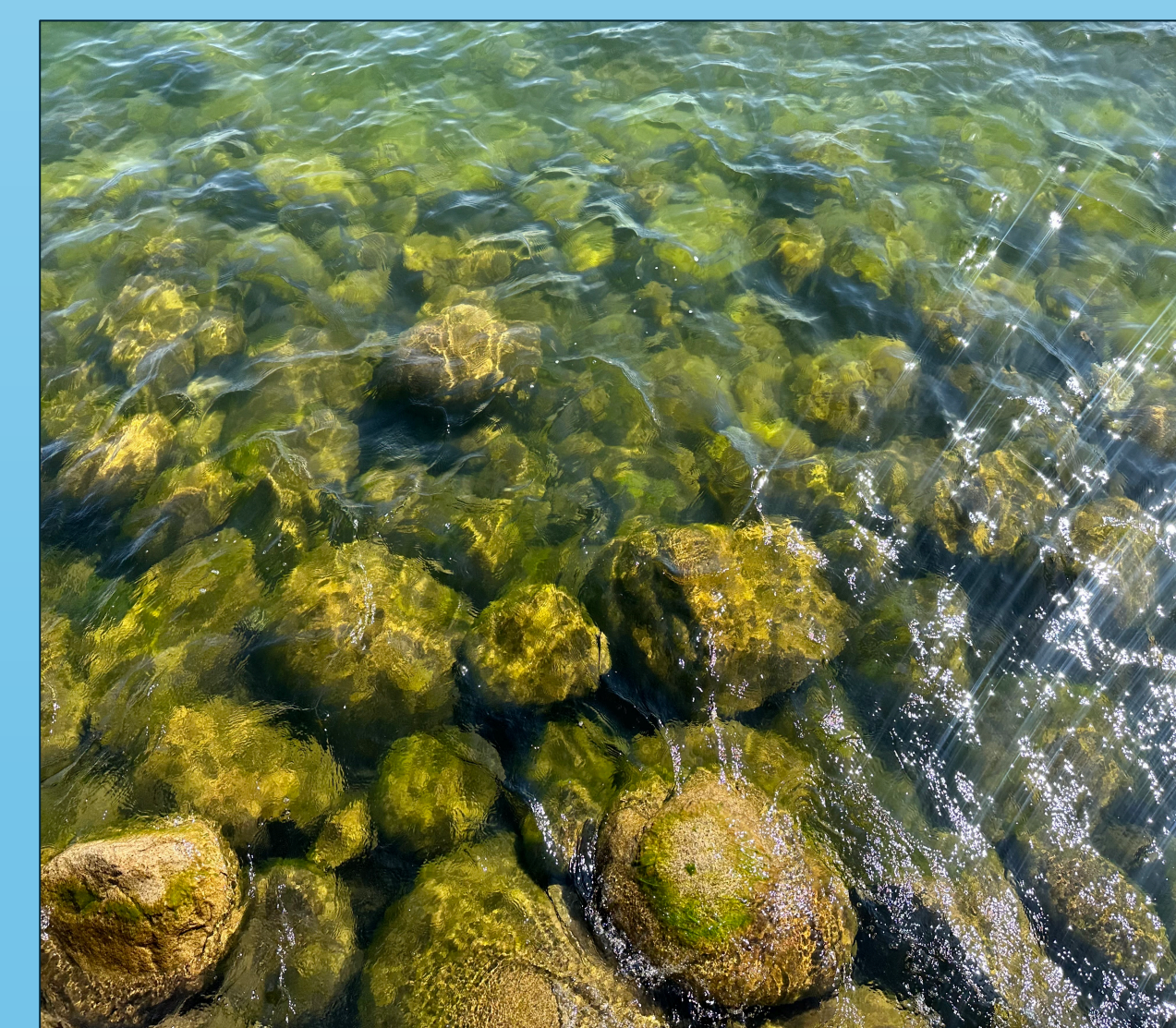
Metaphyton (unattached) Algae

Invasive Species

Become a citizen scientist

- Be **observant** of changes around Tahoe's nearshore
- Sign up for an **Eyes on the Lake** training with the League to Save Lake Tahoe
- **Take pictures** of the nearshore any time you visit the lake
- Upload your observations to the **Citizen Science Tahoe webapp**
- **Tell your friends and family** how they can also be citizen scientists when visiting Lake Tahoe

SCAN ME

Questions? Contact Us!

1. Maddy Mouw, Summer Intern – mamouw@calpoly.edu
2. Sarah Harry, AmeriCorps Member – skharry@ucdavis.edu
3. Alison Toy, Education and Outreach Program Manager – natoy@ucdavis.edu
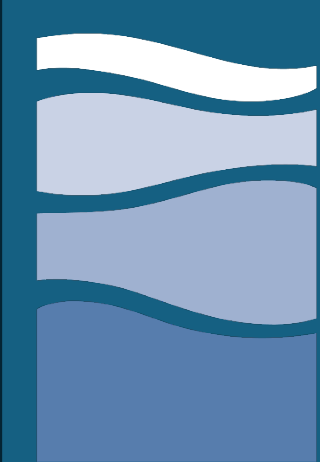
Solving the Mystery of the Elevated Dissolved Phosphorus Data

Ingrid Peters, Montana State University Department of Microbiology & Cell Biology
Contact: ingridpeters78@gmail.com, amliston@ucdavis.edu

UCDAVIS
Tahoe Environmental Research Center

Introduction to Phosphorus in Lake Tahoe

Phosphorus is a nutrient which plays a key role in algal growth in a lake. Elevated phosphorus levels in Lake Tahoe is a huge concern since it causes excessive algae growth and impacts water clarity. Phosphorus comes from streams and runoff. It is studied by UC Davis Tahoe Environmental Research Center (TERC) at Lake Tahoe. The Mid-Lake Tahoe Profiling (MLTP) project is a rare long-term monitoring project active since 1969. During sampling, lake water is collected from 0-450 m (near the lake floor). The samples get analyzed for nutrients including Total Phosphorus (TP) and Dissolved Phosphorus (DP). TP analysis uses raw water while DP analysis uses filtered water to measure dissolved particles. **When TP and DP are analyzed, TP should be greater or equal to DP. However, in the chemistry data there are mystery outliers where DP>TP. This project seeks to find why.**

The Importance of Bottle Washing

Bottle washing improves the quality of the data by reducing cross-contamination of chemicals and nutrients during sampling and analysis.

It is extremely difficult to differentiate between Tahoe water and deionized (DI) water since the lake is nutrient poor. The laboratory tests are involved, multistep processes which allow the chemists to meet appropriate benchmarks to ensure quality data is produced. Proper bottle washing of each piece of equipment is imperative for controlling variability in the data.

Intern Soffia Ramsey bottle washing
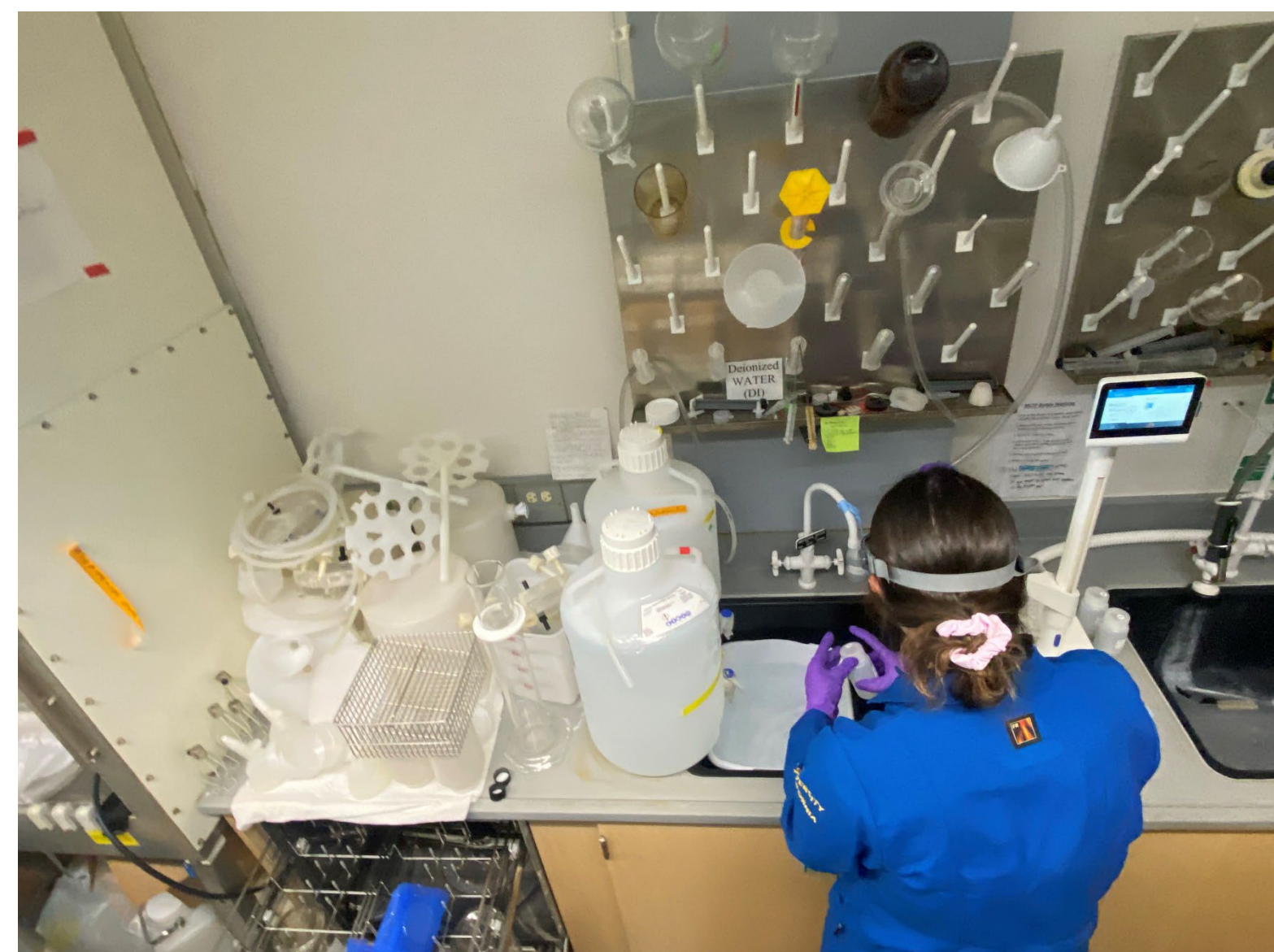
Source Blank = Laboratory water sample to test how well we clean sample bottles

Jug Blank = Laboratory water sample stored on the research vessel, used to clean field equipment. Tests how clean the field DI water is plus the sample bottle

Field/Filtering Blank = Laboratory water run through the field equipment to test how clean the filtering apparatus, DI water and bottle is

Introduction to Field Sampling & Lab Analysis

- Field sampling begins and ends with bottle washing in the lab.
- A source blank (SB) is filled prior to sampling with lab DI water. The filtering equipment is acid-washed. The Field Blank (FB) is used on the boat to test the equipment.
- A Van Dorn water sampler is lowered into the lake to collect samples from 0-450 m (1476.38 ft).
- Raw water is filtered for dissolved phosphorous analysis (DP). Raw water is unfiltered for total phosphorus (TP).
- Care goes into cleaning the filtering equipment between filtering samples.
- TP analysis uses knowns (standards) and unknowns (samples) to measure phosphorus. Reagents are added which turn the solution blue and prepare samples to be read on a Spectrophotometer.
- The concentration is measured in parts per billion with a detection limit of 1 microgram per Liter (ug/L) or 1 ppb.
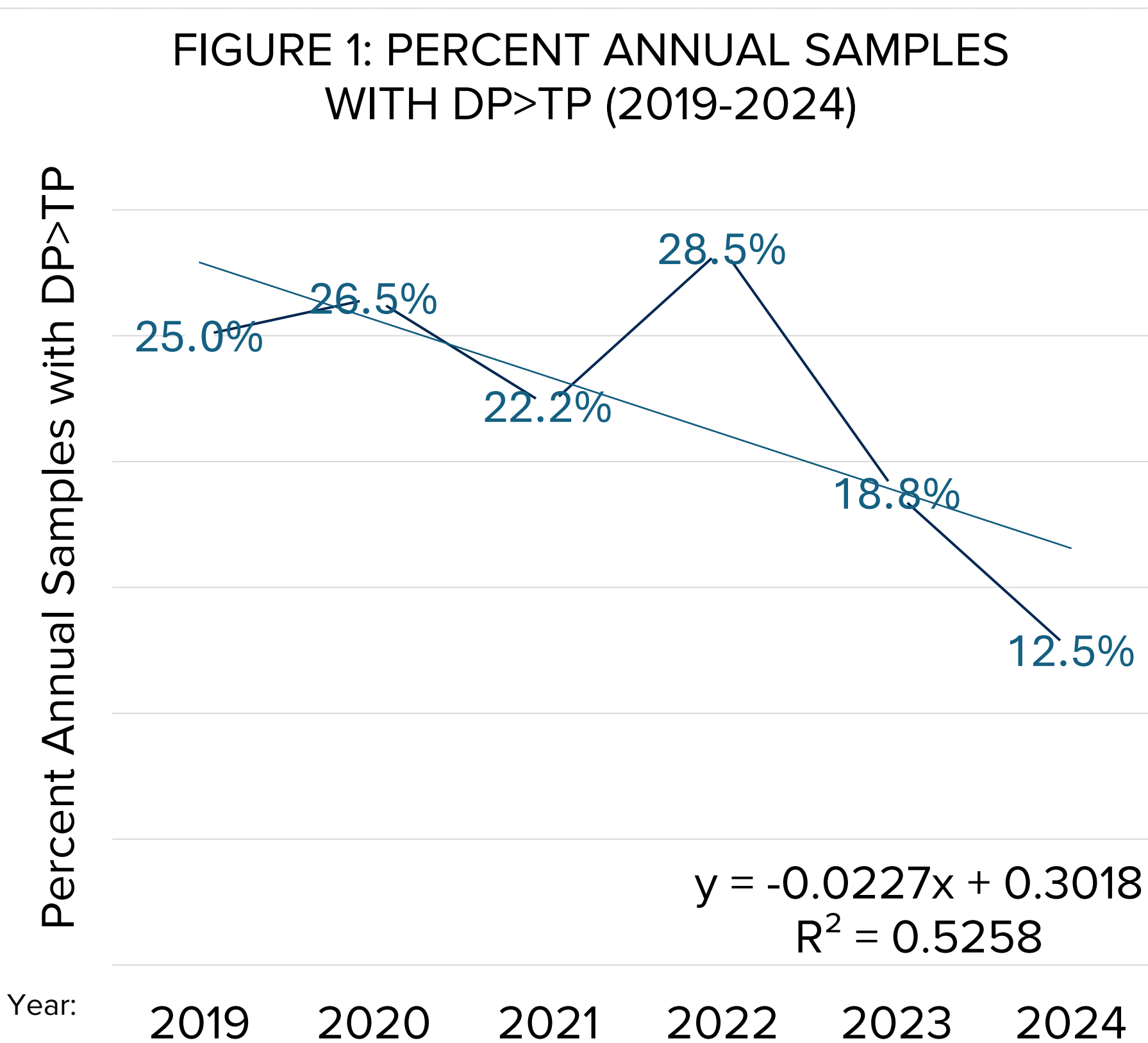
Van Dorn Sampler

Test tubes wiith blue phosphorus gradient ready for analysis

Methods for Data Analysis

1. Analyze 2019-2023 data from United Tahoe Database
2. Fill in missing data with Labtrack
3. Ignore duplicate entries if higher than initial run
4. Incorporate duplicate entries if values were lower
5. Do not incorporate failed runs unless no runs passed
6. Incorporate SB, JB, and FB
7. Removed values above 30.0 ppb
8. Marked values above 4.0 ppb for blanks indicates bottle-washing error
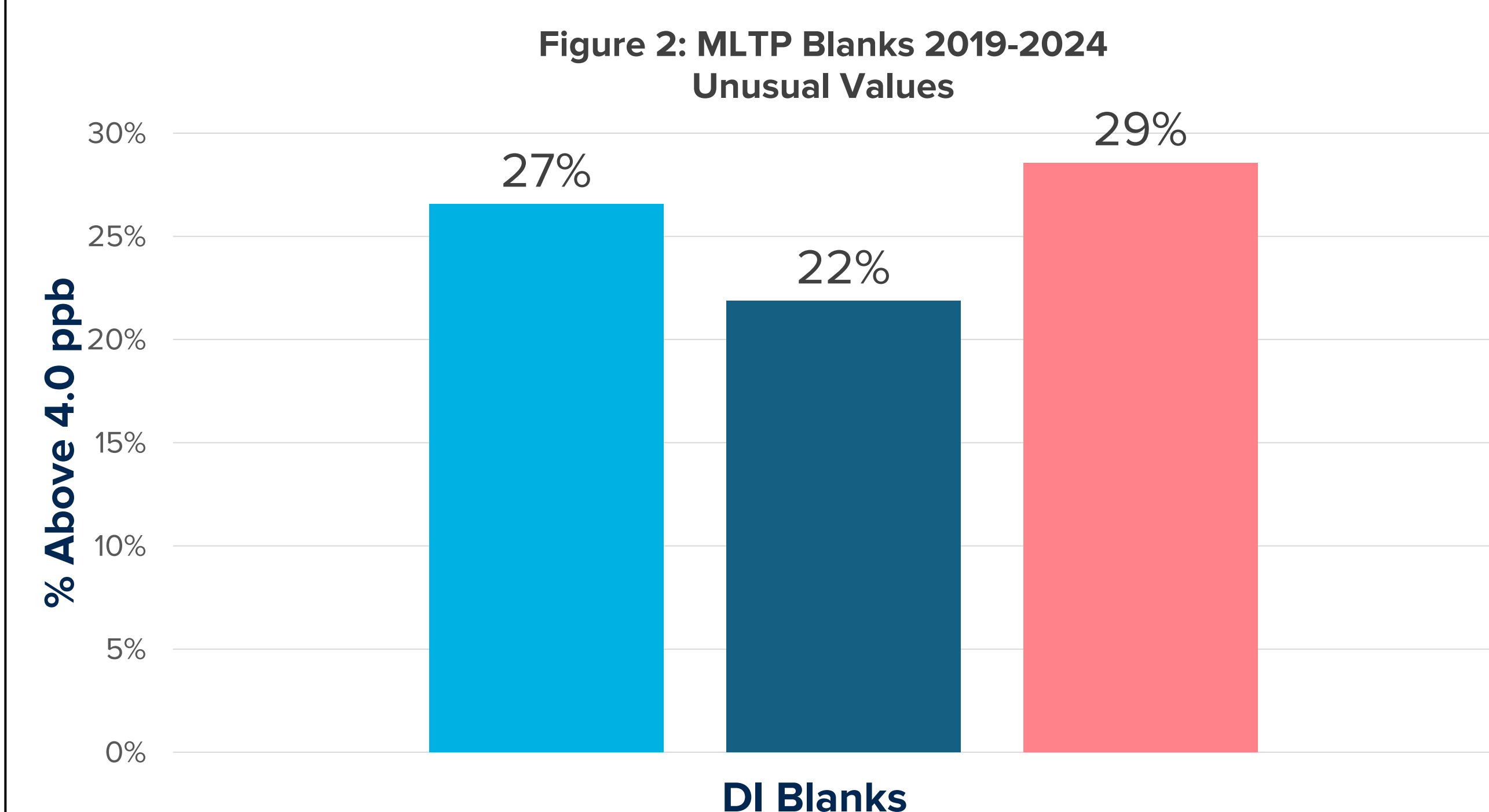9. Compare this data to preliminary 2024 data

Results Visualized

FIGURE 1: PERCENT ANNUAL SAMPLES WITH DP>TP (2019-2024)

25.0% 26.5% 28.5% 22.2% 18.8% 12.5%

$y = -0.0227x + 0.3018$
$R^2 = 0.5258$

Year: 2019 2020 2021 2022 2023 2024

The Mystery of the Elevated Dissolved Phosphorus

Controlling variables is important in chemistry. Variables include bottle washing, humans washing/filtering and filtering equipment

Each year TERC staff wash over 1000 sampling bottles for the two long-term monitoring projects alone (MLTP and LTP)

Filtering equipment is washed 12 times per year and MLTP bottles are washed & re-used between sampling events.

The results from TP vs DP analysis for 2019-2024 show a *decline* in percentage of dissolved phosphorus levels which exceed total phosphorus. 0% would be perfect. (The R^2 value is the correlation coefficient. R=0.53 indicates data are moderately correlated. A value of 1 is a perfect correlation)

- The results from TP vs DP analysis for 2019-2024 show a decline in frequency of DP exceeding TP (Figure 1)

- The 2024 data are preliminary

Figure 2: MLTP Blanks 2019-2024 Unusual Values

27% 22% 29%

SB
FB
JB

DI Blanks

Results Analysis

- A decreasing percentage of samples with DP>TP indicates method controls including bottle washing and bottle tracking may be improving data precision.
- Average DP and TP values have decreased from 25%-28.5% to 18.8% (Figure 2).
- In 2023-2024 the presence of high DP, FB and SB values indicates the importance of continued effort to minimize contamination in the field and lab.
- The predicted 2024 percent samples with DP>TP is less than or equal to 18.8% if bottle washing methods are working. The high JB and SB values mean bottle washing can still be improved (Figure 2)

MLTP April 2019 (DP>TP)
DP / TP
2019 (High, DP>TP)

MLTP March 2023
DP / TP
2023 (Improved)
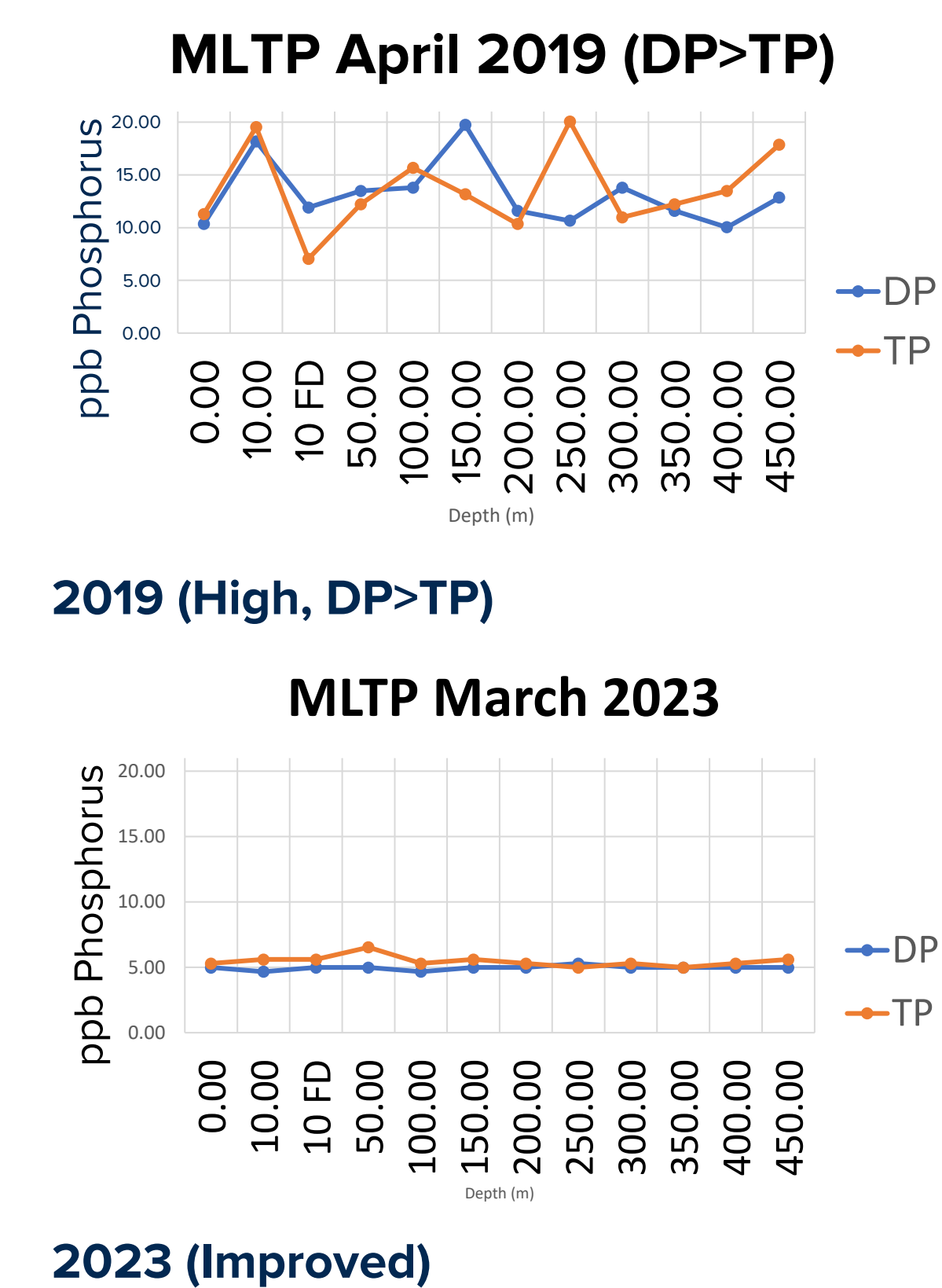
Conclusion

The mystery remains unsolved, but many clues have been gathered. Based on the the high Source Blank values (Figure 2) bottle washing, DI water problems or re-used bottles are likely contributing to high values in the blanks (this affects the data quality). The TERC chem and field team will continue working to lower the incidence of DP>TP concentrations by improving bottle washing and bottle tracking to further minimize cross-contamination.

Spotlight on TERC's Chemistry Team

Twice a year TERC chemists are sent an unknown that they are required to measure. They have a 95-99% accuracy rate at identifying the samples due to strict quality control.
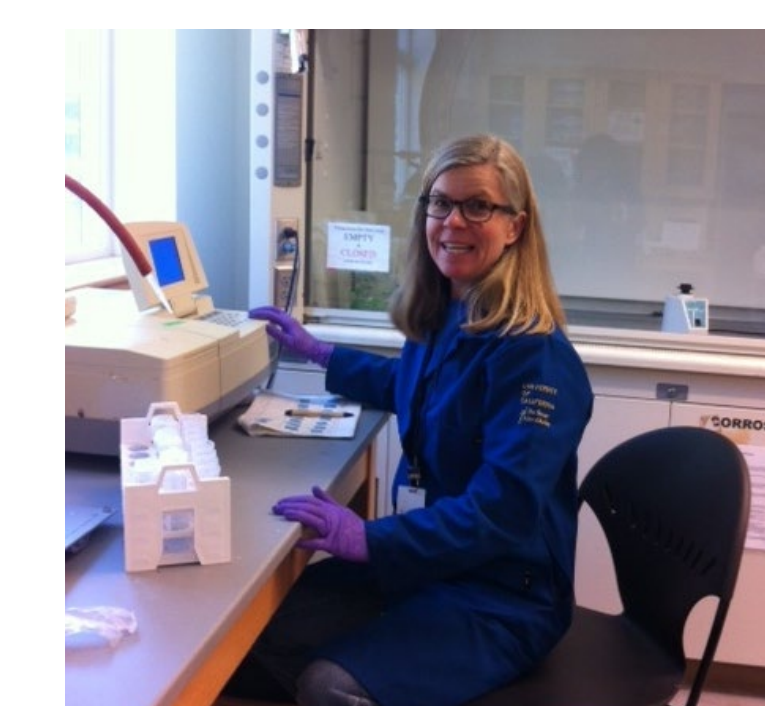
Lab Manager Anne Liston reading results on the Spectrophotometer.

Chemist Lily Dailey prepares samples for TP analysis.

Above Chemist Steven Sesma conducts microplastics analysis. Below Chemist Keeley Martinez pipettes samples.

References

Liston, A., Hammell, T., Edirveerasingam, V., Allen, B., Hackley, S., Reuter, J., & Schladow, G. (2013). Laboratory procedure, field protocol and quality assurance manual. In *Tahoe Environmental Research Center, University of California, Davis* (p. 158). https://tahoe.ucdavis.edu/sites/g/files/dgvnsk4286/files/inline-files/QA_manual_TERC_2019_FINAL5.pdf
TERC.UCDAVIS.EDU. (2017). *TAHOE: STATE OF THE LAKE REPORT 2017.* https://tahoe.ucdavis.edu/sites/g/files/dgvnsk4286/files/inline-files/9_nutrients_0.pdf
UC Davis Tahoe Environmental Research Center. (n.d.). TAHOE: STATE OF THE LAKE REPORT 2023. In S. G. Schladow, A. Toy, & S. Watanabe (Eds.), *TAHOE.UCDAVIS.EDU.* https://tahoe.ucdavis.edu/sites/g/files/dgvnsk4286/files/inline-files/SOTL_2023_web.pdf

ACTIVE HOPE FOR LAKE TAHOE'S ENVIRONMENTAL FUTURE

Presented by Sofia Nawaz under the mentorship of Logan Witt.

INTRODUCTION

The "Active Hope for Lake Tahoe's Environmental Future" project aims to foster environmental stewardship in the Tahoe Basin. The goal of this project is to build a community and cultivate a culture of action to improve planetary health. Inspired by the Association of Science and Technology Centers Seeding Action's work in planetary health education, the initiative leverages Yale's Climate Communications to survey community sentiments on climate change, ensuring strategies reflect diverse perspectives.

Summer Interns, Soffia Ramsey and Sofia Nawaz, and AmeriCorps member, Sarah Harry, doing community outreach at the Tahoe City Farmer's Market. Courtesy of Alison Toy.

METHODOLOGY

We gathered data from community members and visitors, with additional inputs from Tahoe Environmental Research Center (TERC) staff and environmental scientists. Our activities include sharing examples of successful conservation activities (hope spots), participatory science projects, and educational workshops on climate change. This outreach includes engaging with the public at the Tahoe City Farmer's Market, where we invite residents to complete the survey, provide feedback on local climate concerns, and suggest ideas for reducing carbon impact and enhancing sustainability. This survey is the first step in engaging the local community using the Seeding Action guide.

The climate change survey is designed with 4 questions:

1. **How important is the issue of climate change to you personally?**
2. **How worried are you about climate change?**
3. **How much do you think climate change will harm you personally?**
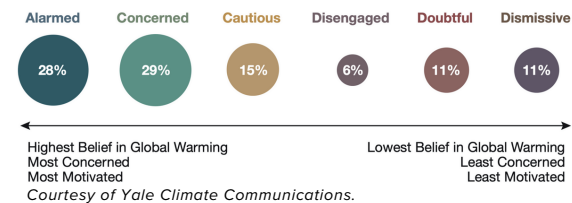4. **How much do you think climate change will harm future generations?**

KEY FINDINGS & ANALYSIS

Top Climate Change Concerns:

47.3% extreme weather

21% wildfires

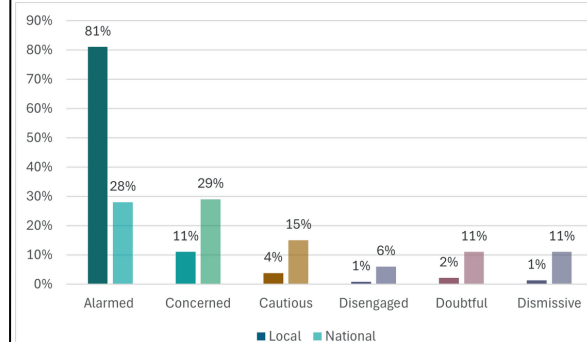19.8% biodiversity loss

11.9% loss of snowpack
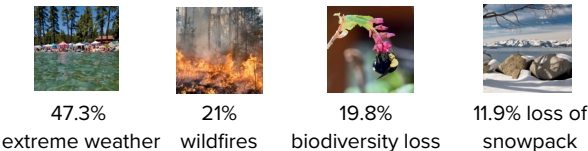
The above images demonstrate Lake Tahoe's community largest climate change concern. 9.9% of responses stated All of the Above.

Global opinions regarding Climate Change:

Alarmed	Concerned	Cautious	Disengaged	Doubtful	Dismissive
28%	29%	15%	6%	11%	11%

Highest Belief in Global Warming
Most Concerned
Most Motivated

Lowest Belief in Global Warming
Least Concerned
Least Motivated

Courtesy of Yale Climate Communications.

Local opinions regarding Climate Change:

	Alarmed	Concerned	Cautious	Disengaged	Doubtful	Dismissive
Local	81%	11%	4%	1%	2%	1%
National	28%	29%	15%	6%	11%	11%

The above graph compares Lake Tahoe's community attitude against Yale's national dataset.

- **Dominant attitude in Lake Tahoe: "Alarmed."**
- **92% of respondents indicate they are alarmed and concerned.**
- Primary concerns of respondents include extreme weather, wildfires, biodiversity loss, and loss of snowpack.
- **Lake Tahoe's level of alarm is over 50% higher than the global average (Yale's Climate Communications dataset).**
- **52.9% of residents feel their actions don't significantly impact climate change.**
- Actions from responders include composting, dietary changes, and reducing plastic.

Conservation Efforts in the Tahoe Basin: *Explore the map at eip.laketahoeinfo.org. Courtesy of Lake Tahoe's Environmental Improvement Program.*

Restoration Volunteers: *Volunteers at a forest health conservation event. Courtesy of The League to Save Lake Tahoe.*

CONCLUSION & THE FUTURE

Lake Tahoe's community indicates a sense of hopelessness about the region's environmental state. Despite ongoing conservation efforts, residents remain stressed. The Active Hope project aims to counter this by sharing positive conservation stories. By highlighting these achievements and encouraging community participation, the project seeks to foster a culture of sustainable environmental management. Strategies include enhanced signage, expanded community and educational outreach, conservation spotlights, and the development of a Climate Summit to build community engagement.

ACKNOWLEDGEMENTS & REFERENCES

A sincere thank you to Alison Toy, Heather Segale, Logan Witt, Penelope Holland, and Sarah Harry at TERC for providing feedback and mentorship. Please contact ssofianawazz@gmail.com or hmsegale@ucdavis.edu for any questions or concerns.

Seeding Action | Cultivating a Culture of Action. (n.d.). https://seeding-action.org/.
Six Americas Super Short Survey (SASSY!) - Yale Program on Climate Change Communication. (2024, April 24). Yale Program on Climate Change Communication. https://climatecommunication.yale.edu/visualizations-data/sassy/.

UC DAVIS Tahoe Environmental Research Center

Association of Science and Technology Centers SEEDING ACTION

TAKE THE SURVEY!