# Utilizing Waste Diversion Education as a Climate Solution

Sidney Barbier, University of Denver, College of Natural Sciences and Mathematics
Mentors: Claire McHenry, Alison Toy

## Project Purpose

### Reduce, Reuse, Recycle

- Increase public education on recycling as part of the solution to **reduce emissions**.
- Plastic pollution is impacting the Lake Tahoe and around the world impacting our ecosytems.
- Reycling is a very confusing isssue and it is important for people to understand **how** reycling works, **why** it matters, and how they can get more involved.

***40% of all American food produced is wasted!***


An example of one of our zero waste stations at the Tahoe City Farmers Market

***Only 9% of plastic waste is ever recycled!***

### Compost and Carbon

- Food waste is a problem in Placer County and on a global scale and is a major contributor to **climate change**.
- Food waste is a major emitter of greenhouse gases.
- When organics break down in landfills they emit methane, which is **34x** more potent than $CO_2$.
- Adding compost to soil can help **sequester carbon** and create a healthy microbiome.

## Results

Tahoe City Farmer's Market
6/22-8/3

**FARMER'S MARKET RECOVERED:**

RESOURCE IMPACTS

30.9 Pounds of recyclables

20.9 Pounds of compostable

CLIMATE & ENERGY IMPACTS

110.3 Pounds of $CO_2$

5 Gallons of gasoline

TOTAL WASTE DIVERTED FROM LANDFILL

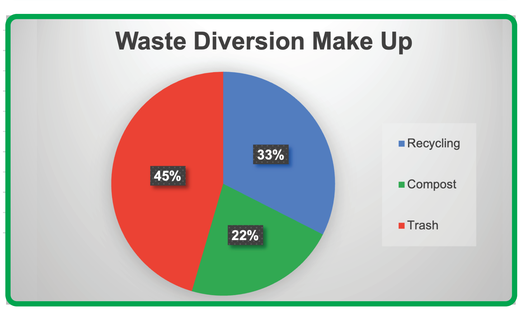
**54.5%** **Of all materials were diverted**

$CO_2$ Emissions calculated using the EPA WARM Model

**Total Outreach Over 7 weeks:**

**385 adults!**

***105 kids!***




## Project Actions

### Education and Outreach

- **Educate** people about why zero waste is important and how they can make a difference through personal actions and supporting policy.
- **Reduce** the amount of landfil waste and the resulting greenhouse gas emissions.
- Develop and use **effective** signage to educate people about local recycling and composting.
- Work with Tahoe Truckee Sierra Disposal, Placer County, and Full Circle Compost to increase **accessibility** to composting in the Tahoe City area.
- **Translate** TERC microplastics research to the public.
- **Promote** new TERC programs such as Find Tahoe Tessie, the Underwater Lounge, and the Citizen Science App.


Interns Sydney Mendelson and Sidney Barbier with a TERC outreach table at the Tahoe City Farmer's Market

**Promote Advocacy and Stewardship through Waste Diversion**

## Conclusion

### Impact

- Increased the overall **waste diversion** of the local Farmers Market.
- **Engaged** the public in discussions on the importance of waste diversion as a climate solution.
- Increased **knowledge and inspired action** in the community by educating both locals and visitors from around the United States.
- **Promoted** the TERC lecture series to the local Tahoe City audience.
- **Informed** locals and visitors on new TERC research and programs.

The entire TERC education team visited the Placer County Materials Recovery Facility (MRF) to gain insight into the complicated process of recycling. After seeing the MRF firsthand, TERC educators were able to improve and refine communications with the public.

### Future Initiatives

- **Follow up** with vendors about waste reduction and alternative materials.
- Use this years data as a **baseline** to compare future waste reduction efforts.
- Increase access to composting in Tahoe City.

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Thank you to...

Tahoe City Farmers Market · County of Placer Est. 1851 · Full Circle Soils & Compost · TTSD

# Thinking Outside the Box: Mortality and Behavior of Asian Clams (*C. fluminea*) Exposed to Hydrogen Peroxide


Olivia Nole; Drake University, College of Arts and Sciences

Mentors: Helen Fillmore, Katie Senft, Brandon Berry, Anne Liston, Geoff Schladow Ph.D.

UC Davis Tahoe Environmental Research Center


UCDAVIS Tahoe Environmental Research Center

## Background

- Aquatic bivalve species and Asian Clams in particular, are resilient to many environmental and manufactured stressors, and are thus considered to be a highly problematic invasive species
- They are sedentary filter feeders with high bioaccumulation potentials, high growth rates, rapid sexual maturity, high fecundity, and hermaphroditic reproductive behaviors
- *C. fluminea* initiate significant disturbances in Lake Tahoe's delicate and nutrient-limited ecosystem

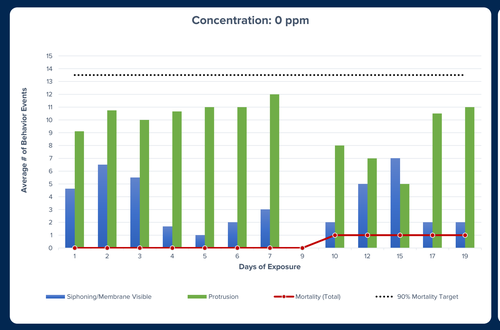
## Introduction and Aim

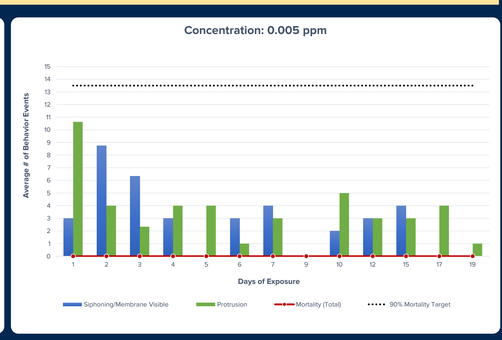
- UC Davis TERC has conducted several studies on *C. fluminea* populations and their effects in Lake Tahoe as well as the efficacy of management practices
- However, there is currently limited information and research on Asian clam mortality especially in fresh waterbodies
- The current study aims to advance our overall knowledge of the behavior and mortality of *C. fluminea,* and to shed light on potential management tools and strategies

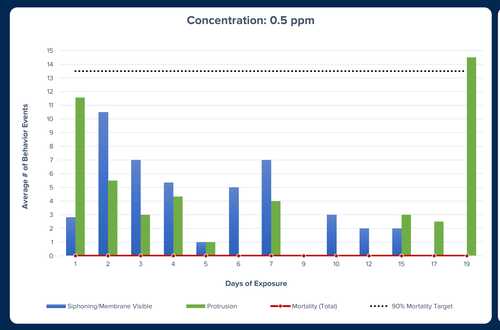

Acknowledgements

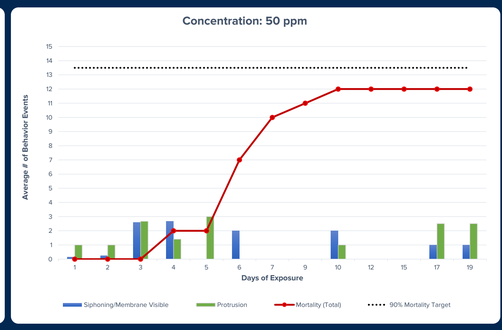
This study was conducted with the support and resources of UC Davis TERC. I would like to thank Helen Fillmore for her guidance and mentorship throughout the entirety of this project. I would also like to thank Brandon Berry, Erik Young, Katie Senft, and Steven Sesma for their assistance in making this research possible.


## Results and Discussion




### Key Points

- Lower concentrations appeared to be minimally affected by $H_2O_2$ presence
- Activity was highest in the first 4 days of exposure for all, but 50 ppm exhibited significantly less overall
  - Ammonium data may highlight the degradation of $H_2O_2$ within a rapid time-frame (< 4 days)
- 50 ppm saw an increase in death events, which could be attributed to the oxidative stress potential of Hydrogen Peroxide

### Future Endeavors

- Investigate the effects and time-frame of $H_2O_2$ degradation in water
- Test a greater range of concentrations to narrow down desirable amounts with optimal effects
- Explore different administration options, such as mortality efficiency in differing substrate environments

## Materials and Methods

### Collection

- Collected in Marla Bay
- Water, sand, and clams were collected in sealed buckets and carboy bottles
- Clams were selected based on live appearance and shell condition

### Acclimation

- 7-day acclimation period from collection date
- Three 20L tanks were prepared with sifted sand and 15L of collected lake water; air pumps were also utilized

### Exposure

- 21-day exposure period from end of acclimation period
- Four separate 20L tanks were prepared according to acclimation methods, with even ratios of coarse and fine grain sand
- Concentrations using $H_2O_2$ 30% solution:

  **- 0 ppm  - 0.005 ppm**
  **- 0.5 ppm  - 50 ppm**

- Clams from the acclimation tanks were once again selected based upon size and shell condition but also position in relation to substrate and algae presence
- 20 clams were selected from the surface of the sand (5 per tank); 40 were selected from below the surface (10 per tank) for a total of 15 clams per tank

# Fungal Infections in Lake Tahoe's Zooplankton

*The hairy truth behind fuzzy zoops*

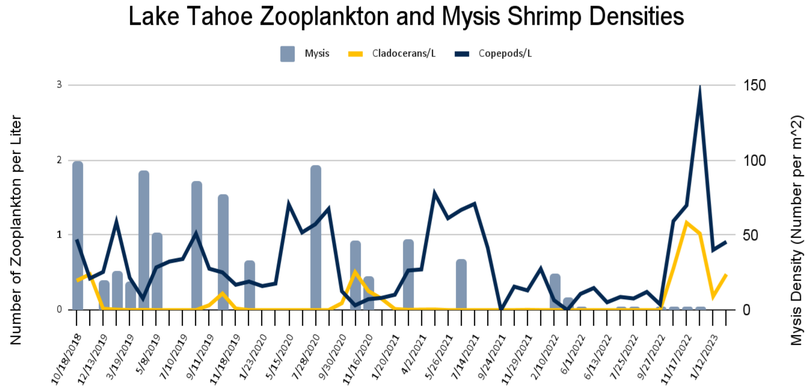

## Katie Fielder

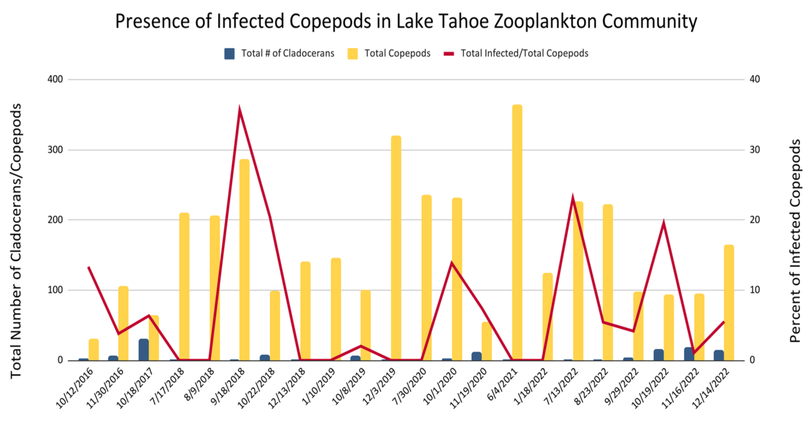
**University of Nevada, Reno; College of Agriculture, Biotechnology & Natural Resources**

## Mentor: Katie Senft


## Background

In the 1960s, *Mysis* shrimp were introduced to Lake Tahoe as an intended food source for Lake trout and other sport fishes. The *Mysis* negatively affected fish populations by feeding on native zooplankton and evading predation by hiding in the depths of the lake during the day. In the fall of 2021, zooplankton and *Mysis* populations crashed. In the years since, researchers found zooplankton, specifically copepods, infected with a fungus that may have played a role in a large die off of copepods and ultimately *Mysis*. The zooplankton, cladocerans and copepods, help to maintain Lake Tahoe's renowned clarity. Following the drop in Mysis, the lake saw an increase in cladocerans and clarity.



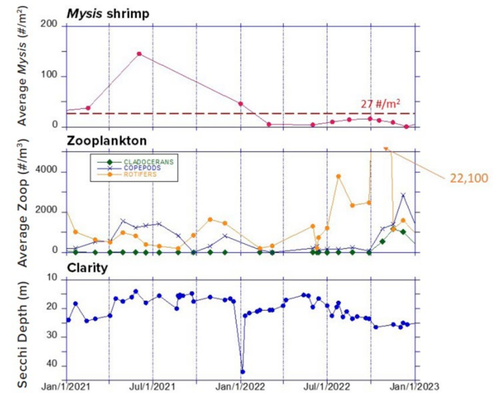




## Copepods

Diaptomus

Epischura

Copepods are the only zooplankton showing signs of infection
Diaptomus eat diatoms (algae)
Epischura consume diatoms, rotifers and other zooplankton.
They also reduce phosphorus concentrations




Within less than 6 months of Mysis populations falling, the zooplankton community rebounded including cladocerns which are efficient filter feeders. The recovery of zooplankton lead to improved lake clarity not experienced in over 40 years.

*Figure courtesy of Shohei Watanabe.*

## This is a hairy situation

Fungal infectected copepods

Infected-Alive

Infected-Alive

Infected-Dead

Left- Healthy, Middle/Right- Infected Dead

The fungus is possibly Rhizophydium (a fungal genus found in Lake Tahoe). The fungal counts were divided into two separate categories, infected but alive or infected but dead.


*Thank you to Warwick Vincent for his expertise.*


## Cladocerans

Bosmina

Holopedium

Daphnia

Currently no cladocerans are showing signs of infection. Due to a lack of predators and no infections, these zooplankton were able to rebound after the mysis crash.

## Discussion and Conclusions

Discussion: Evidence of fungal infections in zooplankton are not frequently cited in scientific literature. Rosetti (2005) found fungal infections present in copepod communities from alpine lakes in Italy. The fungus infecting those communities is likely different from the one observed in Lake Tahoe as it seems to target copepod eggs but not the zooplankton itself.

Conclusions: Based on current observations, the fungal infection seems to appear every year in late summer/early fall and disappears once lake temperatures start to cool. The percentage of the population infected by the fungus varies, so additional research to understand what factors contribute to these trends. While zooplankton species experience natural population reductions in the fall, some die offs maybe larger due to high fungal infection rates in the copepod community. Reduction in copepod densities, the primary food source for mysis, seemingly led to a large mysis die off in the fall of 2021. Cladocerans were able to recover after mysis predation pressure eased. The presence of these ultra efficient filter feeders contributed to improved clarity in late 2022.

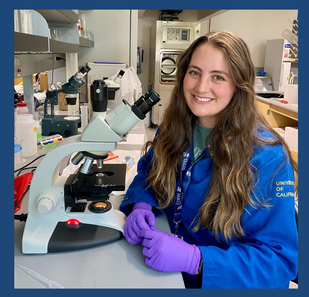
## Future Questions:

How does the fungus spread through a population?
Are other species impacted by the fungus?

How does the fungus impact reproductive success of copepods?

What environmental factors contribute to years of high infection rates?

-Wild fire smoke, increased lake temperatures due to climate change, phytoplankton community composition (poor food quality)



Work Cited

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# IncludED: Educación para Todos

Teresa Fundter: College of Agricultural & Environmental Sciences at UC Davis
Mentors: Wyatt Grognet & Heather Segale

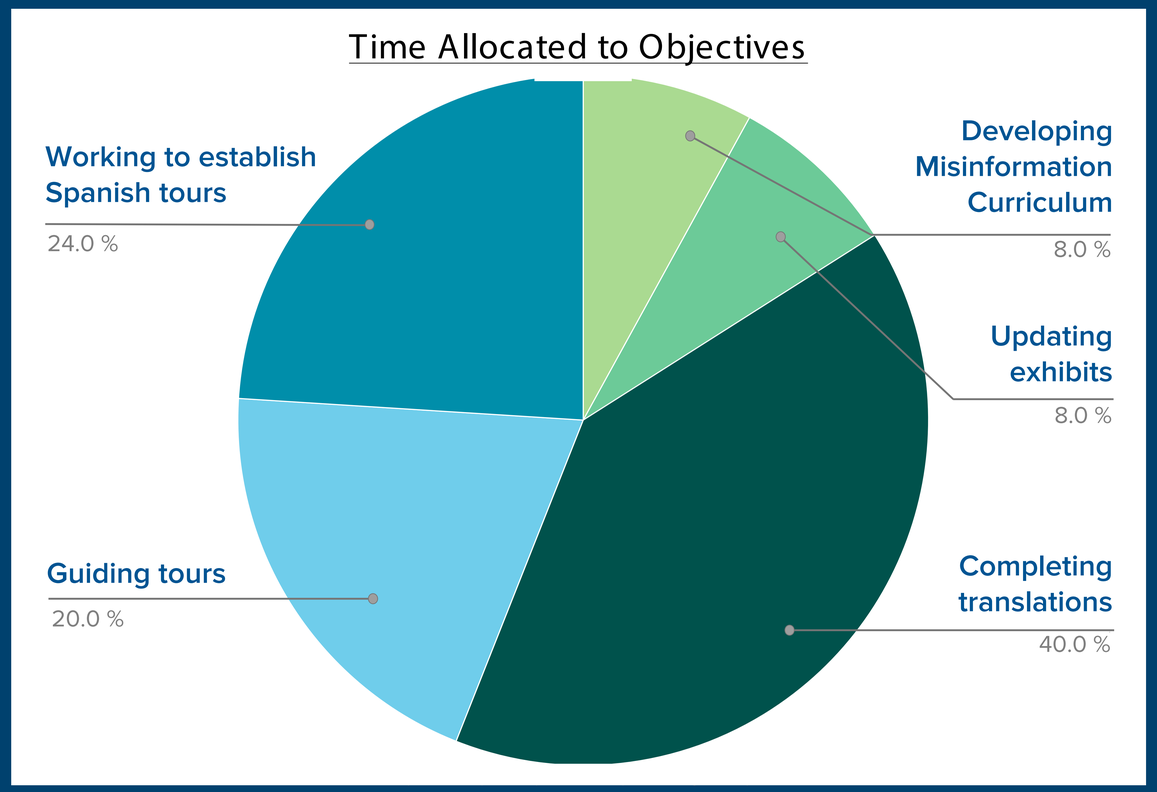
## What is Accessibility?

Any work that removes barriers which previously prevented certain visitors from having equitable access to the UC Davis Tahoe Environmental Research Center (TERC).

## Why is it important?

Accessibility in science education establishes a meaningful connection between underserved communities and the Tahoe basin, increasing quality of life and creating more invested people.

Accessibility also helps achieve TERC's mission of creating a more educated population that will make smarter decisions for Lake Tahoe.

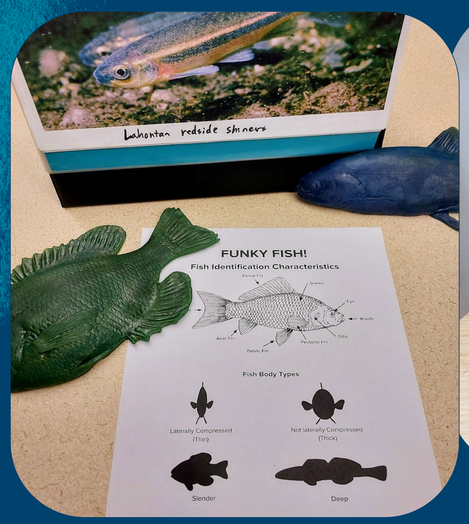



Co-developed and taught an upper elementary curriculum on misinformation

Garnered support for and contacted organizations to establish a Spanish language docent-guided tour

## Did you know?

28% of Tahoe residents are Spanish speakers




Co-developed interactive hands-on activities for younger visitors in the Underwater Lounge


Translated existing children's activity books, brochures, and exhibits into Spanish

Co-developed and translated discussion questions for self-guiding visitors with mentors Wyatt Grognet and Heather Segale

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# Investigating the Link Between Soil Moisture and Microbiomes in Relation to *Pinus lambertiana* (Sugar Pine) Survival

Abenezer Shankute; UC Davis College of Agricultural and Environmental Science
Mentors: Aaron Vanderpool, Camille Jensen, Patricia Maloney PhD, Shannon Lynch PhD

## What's the Problem?

**Where did all the sugar pines go?**
Historically sugar pine trees made up 25% of Lake Tahoe's mixed conifer forests. Currently sugar pines make up 1– 6% of conifers in the Lake Tahoe watershed, largely due to Comstock era logging.

Sugar pine trees photographed at sunset

**What do sugar pines do for Lake Tahoe?**
This species provides important habitat for wildlife and aids in preventing soil erosion across the watershed which helps maintain Lake Tahoe's blue color that visitors and residents love so much.

**Who is developing solutions?**
UC Davis TERC has received funding from Cal Fire to identify locations within the watershed that are optimal for sugar pine survival. Ward Canyon, Tahoe Vista, and Kings Beach were the first of eleven sites to be investigated.

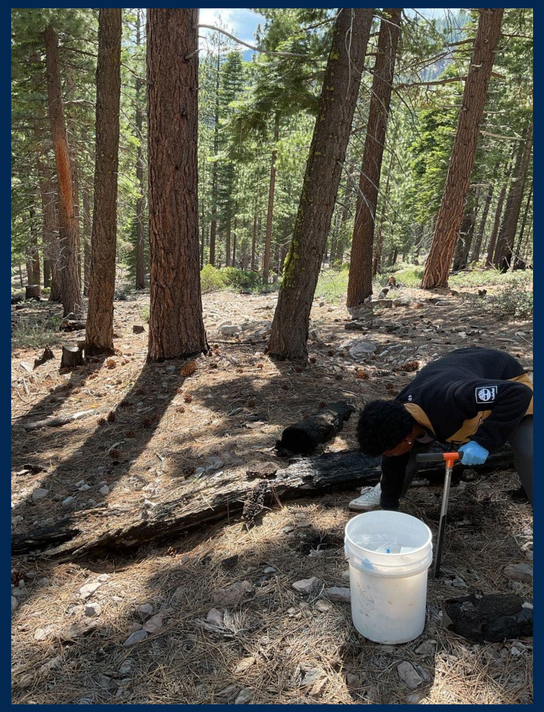
## What's Being Done?

**What are the methods?**
At each site, about fifteen samples were collected for soil moisture analysis and two samples were collected for additional microbial analysis.


**What are the results of the experiment?**
For all three sampling events, the order of highest to lowest soil moisture content is as follows: Tahoe Vista, Ward Canyon, and Kings Beach. The results of our microbial analysis showed that Tahoe Vista had the highest fungi and bacteria availability.

## What's Next?

**Where do we go from here?**
The research conducted at the three study sites has set the groundwork for further soil moisture and microbial studies to be investigated at the projects other restoration locations.



Abenezer Shankute using a soil core to extract a soil sample.

UCDAVIS Tahoe Environmental Research Center

With special thanks to our valued collaborator.
CAL FIRE

# You Matter! Connecting Visitor Feedback to Advancements in the Tahoe Science Center

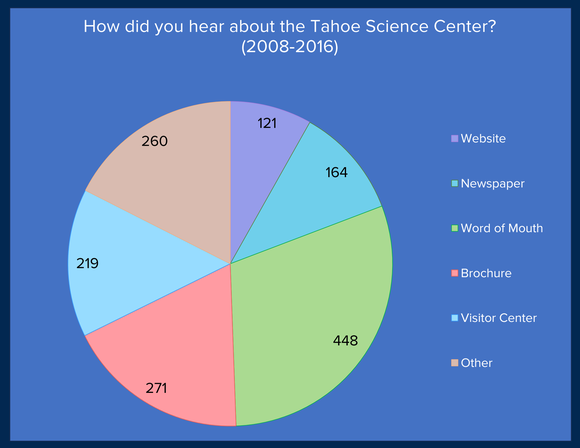
Sydney Mendelson, College of the Environment, University of Washington, Seattle
Mentors: Keeley Martinez, Heather Segale

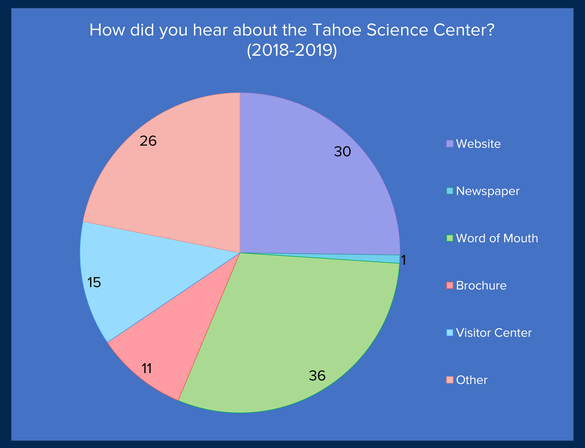
## Introduction

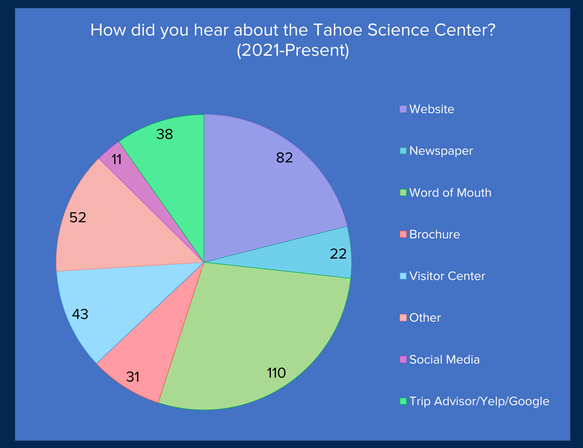
- Over the years, TERC has had significant visitor traffic and enthusiastic engagement.
- Following residual effects from COVID, TERC seeks to restore visitor numbers.
- This project will reassess protocols, redefine target audiences, and address the desire for more modern and relevant field trip curricula and increased offerings for a younger demographic.

## Methods

- Organized 13 years of data and developed a comprehensive and interactive survey to gather visitor feedback.
- Co-developed a misinformation curriculum aimed to educate middle schoolers on how to identify and fact-check news and social media.
- Co-developed activities for younger visitors to increase engagement and learning.






## Survey Analysis

- People most often hear about TERC through word of mouth.
- The effectiveness of the Science Center increased after COVID, despite a drop in visitors.
- Over 50% of visitors said their visit was “Extremely Enjoyable.”
- Docent-led tours are not ideal for children aged eight and under.
- Incorporate more current local issues.
- Frequent visitors expressed that they learn something new every time they visit.

## Curriculum Development and Exhibit Updates

- The misinformation curriculum was tested on three different age groups and demographics with the learning goal of how to determine what is misinformation and why it is important to be able to identify.
- Updated the Underwater Lake Tahoe Lounge and Trees of Tahoe Exhibit in the Tahoe Science Center.

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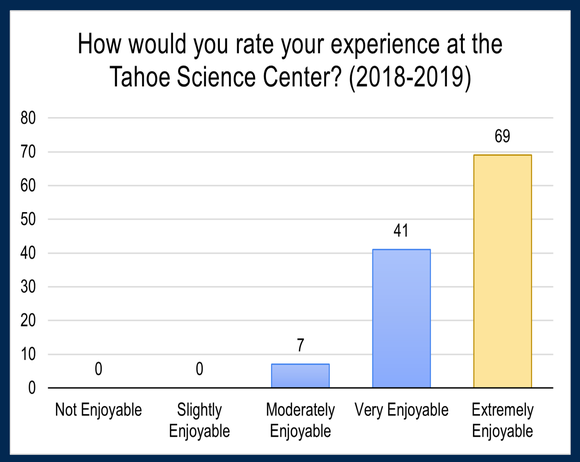
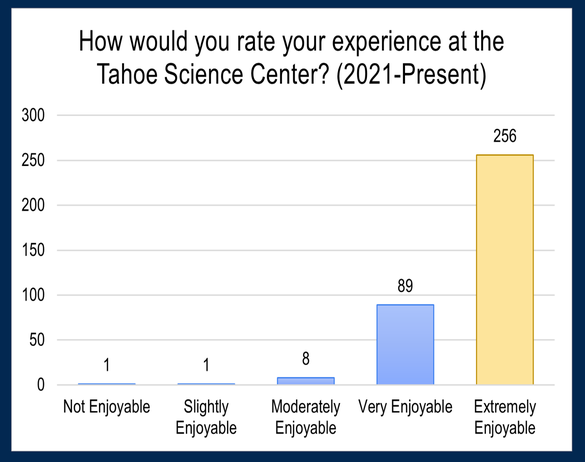
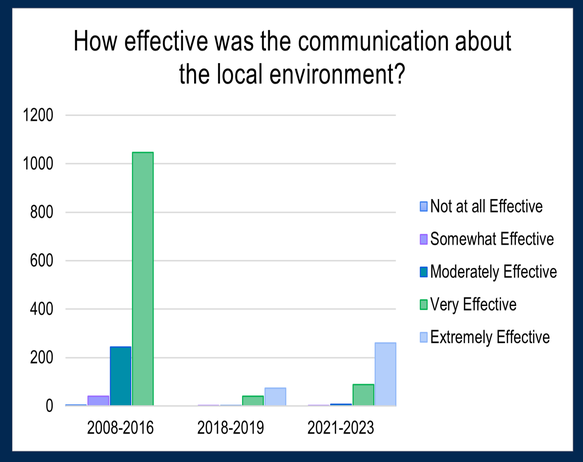


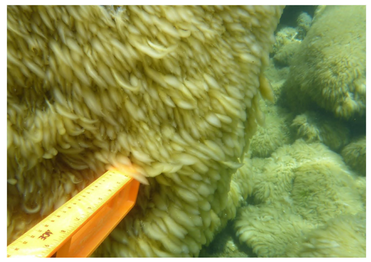
# Remote Sensing & ArcGIS to Monitor Algae in Lake Tahoe

Megan K. Root, California Polytechnic State University, San Luis Obispo
Mentors: Katie Senft & Brandon Berry

## Periphyton Algae

### *What is it?*

This algae attaches to boulders, docks, buoys, and other structures. The main causes of these algal blooms can be attributed to increased nutrient levels from various sources around the lake.

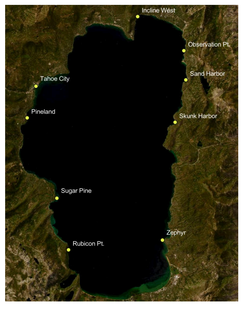


### *Why should we care?*

Periphyton algal blooms are degrading the water quality, clarity, and health of Lake Tahoe.

### *What are we doing?*

Scientific divers head to TERC's sites around Lake Tahoe and collect algae samples at both 0.5 m and 1.5 m using syringes. These samples are tested for chlorophyll, C:N:P, and species assemblages. Data on the filament length and percent coverage are collected as well. The Periphyton Biomass Indicator (PBI) can then be determined by multiplying the filament length by the percent coverage!




### *Where are the main sites?*

Incline Village West
Observation Point
Sand Harbor
Skunk Harbor
Zephyr Point
Rubicon Point
Sugar Pine Point
Pineland
Tahoe City

## Aerial Imaging

### *Helicopter Flights*

By attaching a camera to the base of a helicopter, we quickly survey Lake Tahoe's 72 miles of shoreline at roughly 700 ft above the lake in approximately one hour. These images help to quickly identify hot spots and new algal blooms.

Special thank you to Mike Bruno for making this happen!

### *Drone Flights*

After analyzing the helicopter imagery, drone imagery is gathered at TERC's routine sites, as well as any new identified hot spots found through the helicopter imagery. TERC's unmanned aerial vehicle (drone) flies at roughly 300 ft above the lake and gathers higher quality images with a larger resolution than the helicopter imagery.



### *How do we use the images?*

Using ESRI's platform Site Scan, the drone images are stitched to geographically align with Lake Tahoe's shoreline. Once the images are stitched and uploaded, TERC researchers can view the images and calculate the periphyton biomass at each site.

Tahoe City: April 7, 2022

Tahoe City: April 6, 2023

## ArcGIS Dashboards

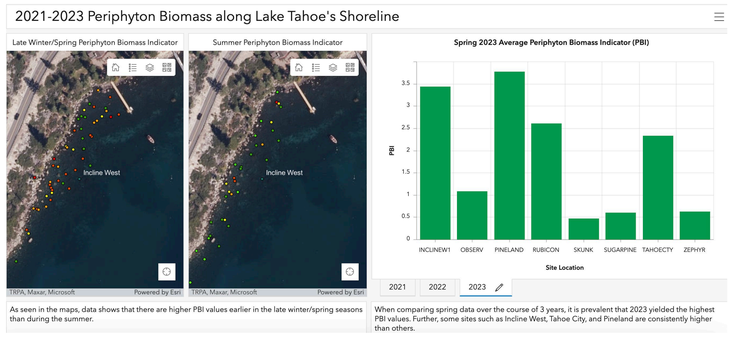
### *What is GIS?*

Geographic Information Systems (GIS) is used in many different industries to map, visualize, and analyze data.

### *What are ArcGIS Dashboards?*

Interactive data visualization and presentation platform. Dashboards help audiences identify trends, highlight data, and track real-time data.

### *Example*




### *What are the trends & conclusions?*

The aerial imagery and remote sensing has allowed TERC to identify and track algae blooms and hot spots. Over the past three years, it is evident that periphyton growth increases in density and area, and peaks during spring, while subsiding in the summer. Furthermore, Tahoe City, Pineland, and Incline West are consistently experiencing larger growth than others.

### *How can we mitigate future algal blooms?*

Engaging in our Citizen Science App to help report algae!
https://citizensciencetahoe.app/

### *Learn more about TERC's Nearshore Work:*

https://tahoe.ucdavis.edu/algae

Link to Dashboard:

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