Chapter 5

BEAR LAKE

Key issues facing Utah's Bear Lake

WAVES AT BEAR LAKE | JARED RAGLAND

Chapter Introduction

ANNA McENTIRE

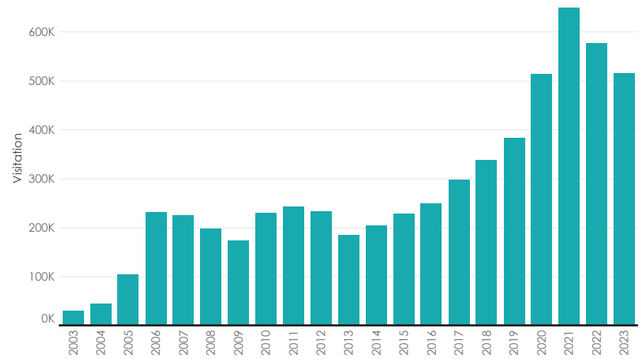
The stunning blue waters of Bear Lake have made it a rapidly growing destination for recreation. With that increase in visitation comes new challenges in managing water, plant life, wildlife, safety, transportation, and more. More than ever, we need to double down on evidence-based stewardship for the lake and its surroundings. That's why Utah State University, in partnership with the Utah Division of Forestry, Fire, and State Lands, launched a Bear Lake Needs Assessment, building off the state's recently completed comprehensive management plan for the lake.

This project has brought together faculty and student researchers from across disciplines, creating a vibrant community of practice and unique comradery. By mobilizing a diverse cohort of experts, we're not only building capacity within our academic community but also addressing urgent issues in a way that maximizes our collective strengths. The energy generated from working together on such a focused challenge has led to new ideas and innovative solutions.

At the heart of this effort is collaboration with the people who know Bear Lake best—state and local leaders, dedicated non-profits like Bear Lake Watch, and the surrounding community. These partnerships are allowing us to remain nimble and responsive to the lake's needs, whether it's addressing invasive species, residents' concerns, or the growing presence of microplastics.

In the following sections, we'll highlight a few key projects that are part of this larger effort, demonstrating how we can protect Bear Lake's future by balancing the needs of people with responsible environmental stewardship.

Figure 5.I.1 Bear Lake State Park visitation numbers (2003-2024)



Bear Lake State Park, Utah is just one destination for visitors to Bear Lake Valley, which has seen similar magnitudes of tourism increase all around the lake and surrounding areas.

Source: *Utah Division of State Parks*

WAVES AT BEAR LAKE | JARED RAGLAND

Navigating the Future of Bear Lake Valley

TODD JOHNSON & JAKE POWELL

Policy makers in Utah and Idaho need to work with Bear Lake Valley stakeholders to protect the "Caribbean of the Rockies."

The Bear Lake Valley straddles two different states and two counties. It is home to several municipalities, lands managed by both federal and state agencies, and Bear Lake. This once-tranquil valley is experiencing complex challenges faced by many other western gateway communities: explosive growth, dated infrastructure, lack of workforce housing, traffic congestion, and spiking seasonal visitation, all straining the community's social fabric. The presence of additional developments could significantly impact the preservation of the valley's small-town aspects. The greater peril is the potential loss of water quality and the impact of growth on the lake's natural systems, which will ultimately affect the livelihood of people who make the Bear Lake Valley their home.

Utah State University's Landscape Architecture and Environmental Planning's charrette program spent two semesters focusing on protecting the health of Bear Lake by identifying sensitive ecological areas, designing infrastructure, and shaping the distribution of land use (Figure 5.A.1). Multiple collaborative teams proposed a number of large-scale projects, which would accommodate and lessen the impact of growth on the environment yet maximize social and ecological benefits.

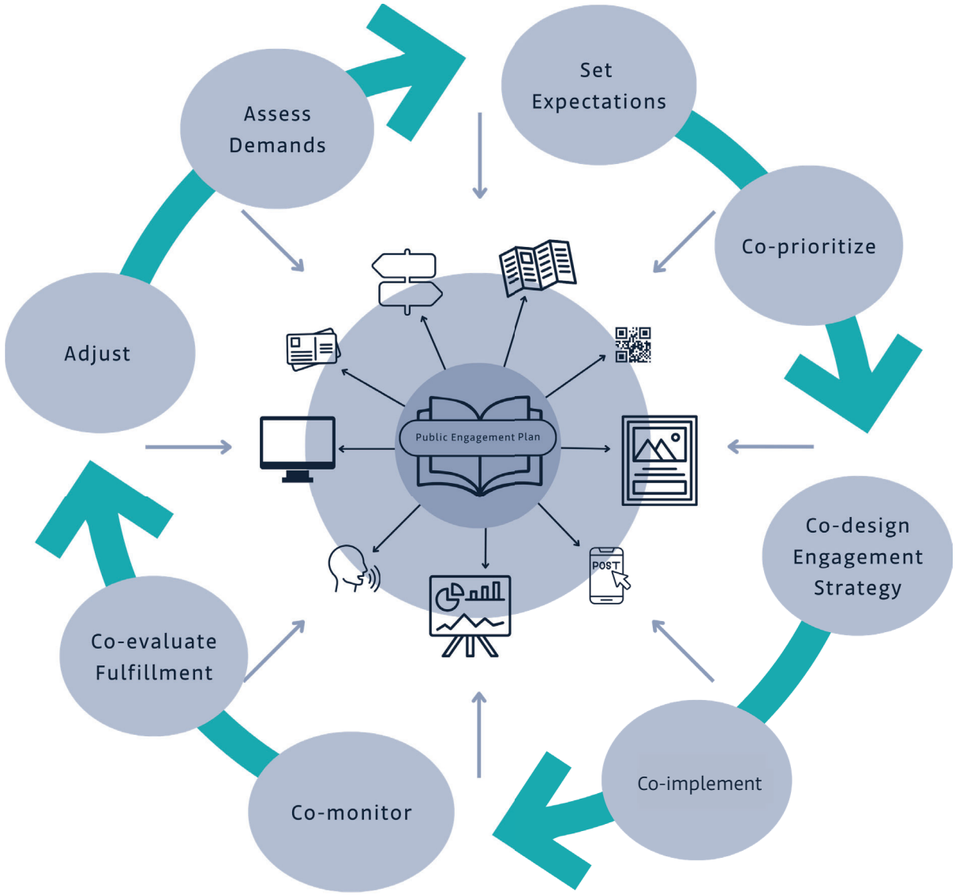
At the end of the charette, one fact was clear: unless the valley's leaders and policy makers unite across jurisdictional boundaries to create a community vision, the ecological and community assets that make Bear Lake Valley special will be compromised.

Figure 5.A.1 A current community structure diagram of Garden City, Bear Lake's primary gateway community

Multiple collaborative teams proposed a number of large-scale projects, which would accommodate and lessen the impact of growth on the environment yet maximize social and ecological benefits.

BEAR LAKE VALLEY DEVELOPMENT | JARED RAGLAND

Figure 5.B.1 Adaptive management and public engagement plan



Bear Lake Sovereign Lands Management and Stakeholder Communication

WESLEY MATHIS

More frequent communication across more channels can better align Bear Lake managers and local stakeholders.

Bear Lake management strategies and processes are guided by a comprehensive management plan, created by Utah's Division of Forestry, Fire, and State Lands. The goal of the plan, recently updated in 2022, is to set objectives for balancing the lake's many competing values, including ecological health, recreation, navigation, beauty, and economic benefits. Events such as low water levels in Great Salt Lake and increased outdoor recreation following the COVID pandemic added urgency and importance to implementing the updated plan more effectively.

USU researchers interviewed practitioners and stakeholders to understand how they viewed the plan's regulations and their expectation about how the lake should be managed. Large gaps exist in some of those groups' perceptions. Stakeholder groups have varying objectives, motives, and perspectives that change over time, and state land managers reevaluate and reprioritize management concerns based on their interpretations of Bear Lake's needs.

Opportunities exist to better align these groups' differing perceptions and expectations, through expanding communication on lake management beyond the comprehensive management plan. Because requirements for the state's role on Bear Lake—and how the public perceives that role—changes over time, state land managers can engage with the public more frequently using different communication touchpoints. Forestry, Fire, and State Lands can host regular meetings in which land managers and community partners co-prioritize concerns together. Other touchpoints include a website geared toward visitors and property owners, short videos about regulations or permitting, or interactive flyers to educate tourists. These interactions will help the state achieve management outcomes and tailor their communication to a wider audience.

BELOW: COMMUNITY ON THE SHORES OF BEAR LAKE | JARED RAGLAND

Exploring Bear Lake's future through AI

BRENNAN BEAN, BEN SHAW, SCOUT JARMAN, KEVIN R. MOON, & WEI ZHANG

AI models can make projections of Bear Lake's water levels in a future climate using publicly accessible datasets.

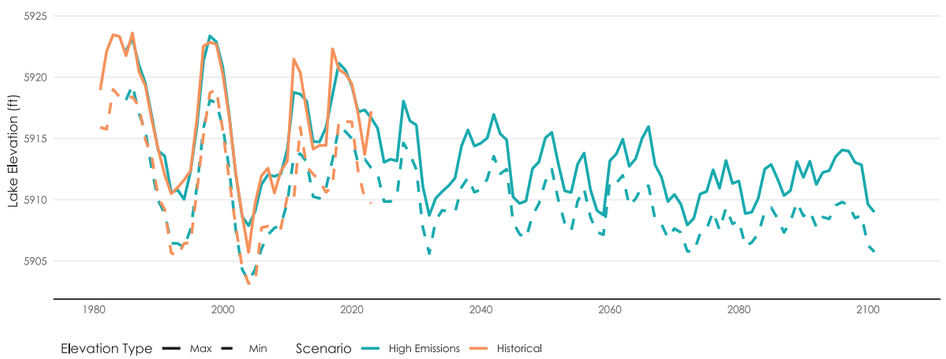
Water levels in Utah lakes and reservoirs are affected by complex cycles and interactions between weather and land use. While traditional computer models can explain some of these complexities, implementing scenarios for decades-long forecasts of future climate conditions can be challenging and time consuming. One promising alternative is a process called machine learning emulation. This technique uses advanced data-driven models such as artificial intelligence to predict different variables within a complex environmental process by training the artificial intelligence using past data. These emulators can then make predictions in a fraction of the time compared to more traditional computer models.

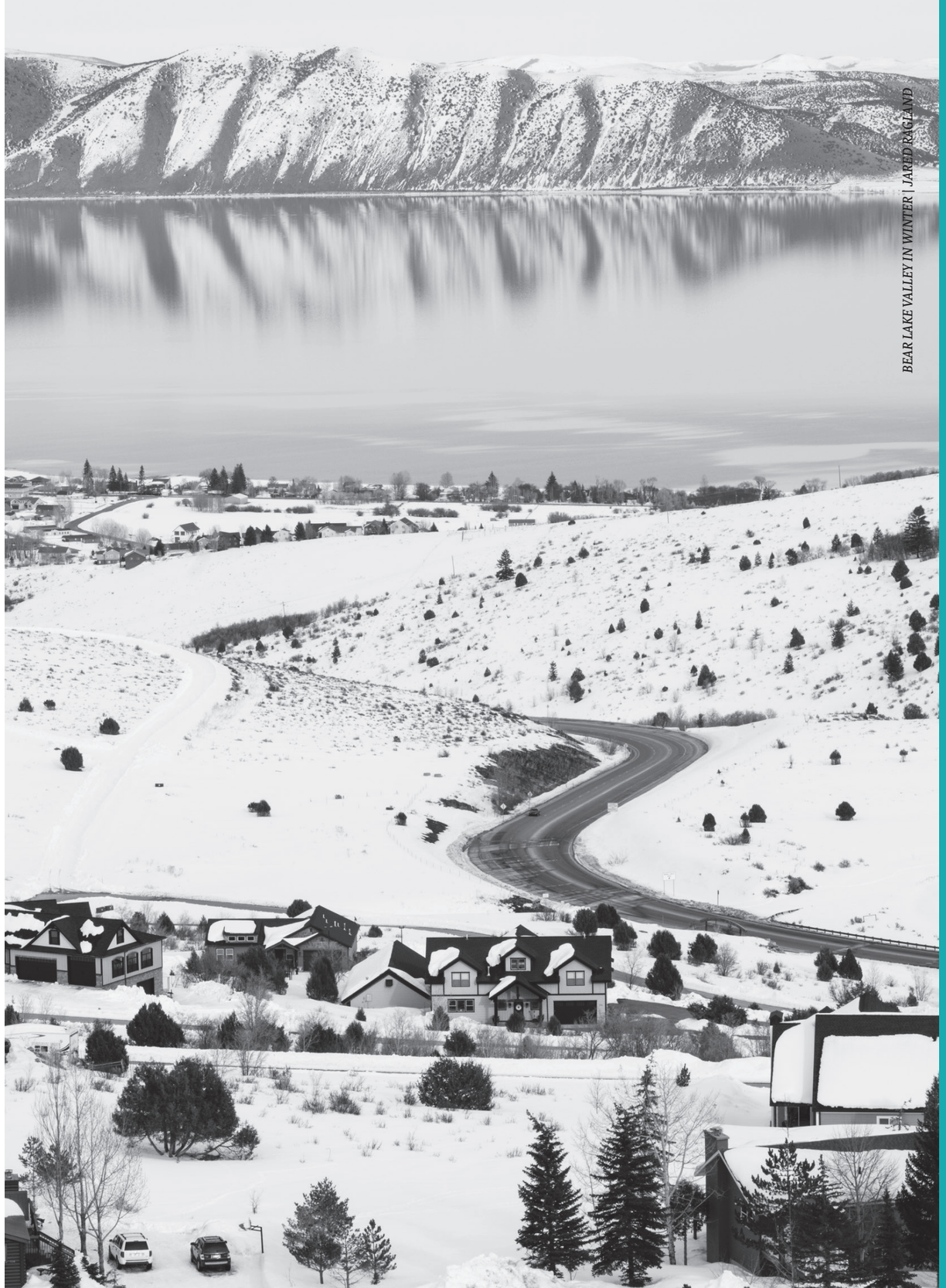
Machine learning emulation was used to predict Bear Lake's annual maximum and minimum water levels through the end of the century under different future climate scenarios. First, researchers "taught" the model using climate measurements from the last 40 years. Then, they used the models to project possible climate outcomes. The emulation results are available in a publicly accessible data dashboard.

Climate models that only accounted for annual snowpack in their analysis predicted lower average lake elevations in the future, as observed in (Figure 5.C.1). Conversely, models that used total precipitation (i.e., rain and snow combined) predicted higher average lake levels. Further research is needed to understand how lake levels might be affected by more rain and less snow.

The public can access these data models and become a "citizen climate data analyst." Allowing people to see what happens when temperatures become warmer, snowpack diminishes, and more rain and evaporation occurs helps them better understand the complexity of the Bear Lake watershed.

Figure 5.C.1 Historical and future emulations of the annual maximum and minimum water level of Bear Lake using a high emissions global climate model simulation





BEAR LAKE VALLEY IN WINTER | JARED RAGLAND

Reconnecting Fractured Streams to Restore Bear Lake's Native Fishes

TIMOTHY WALSWORTH, PHAEDRA BUDY, JAMES DERITO, & TYLER COLEMAN

Restoration work can improve access to spawning habitat and promote cutthroat population recovery and stability.

LEFT: TYLER COLEMAN CATCHES A TROUT | JARED RAGLAND

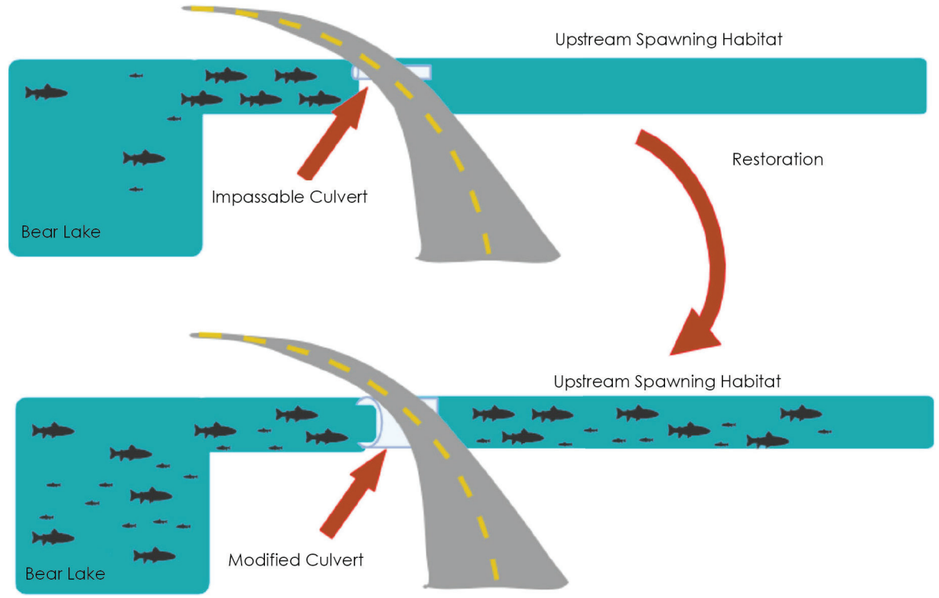
Bonneville cutthroat trout, Utah's state fish, live and move among diverse habitats to complete their life cycle. Bear Lake is home to one of only a few remaining lake-dwelling populations of the species. However, a century of land-use change, water development, and interactions with non-native fishes has created major declines in the population. Cutthroat trout must migrate into tributary streams to spawn and rear each spring. Diversion dams, culverts, and increased drought have fractured streams and limited the population's access to tributary spawning habitats, curbing their reproductive success.

Over the last 25 years, projects aimed at reconnecting small streams to the lake by improving culverts and dams have helped fish reach their spawning areas (Figure 5.D.1). These changes have led to a significant increase in the population of wild Bonneville cutthroat trout, making recreational harvest of wild cutthroat trout possible again. It's important for managers to keep finding and fixing barriers that block these trout from accessing stream habitats to ensure their population remains strong and stable.

For instance, in the fall of 2025, a culvert on North Eden Creek (on the east shore of Bear Lake) will be improved to let cutthroat trout swim upstream to spawn. Researchers at Utah State University are working with Trout Unlimited and the Utah Division of Wildlife Resources to study how this project will impact the number and size of trout living and spawning upstream. They're also designing a long-term plan to monitor the success of this restoration effort.

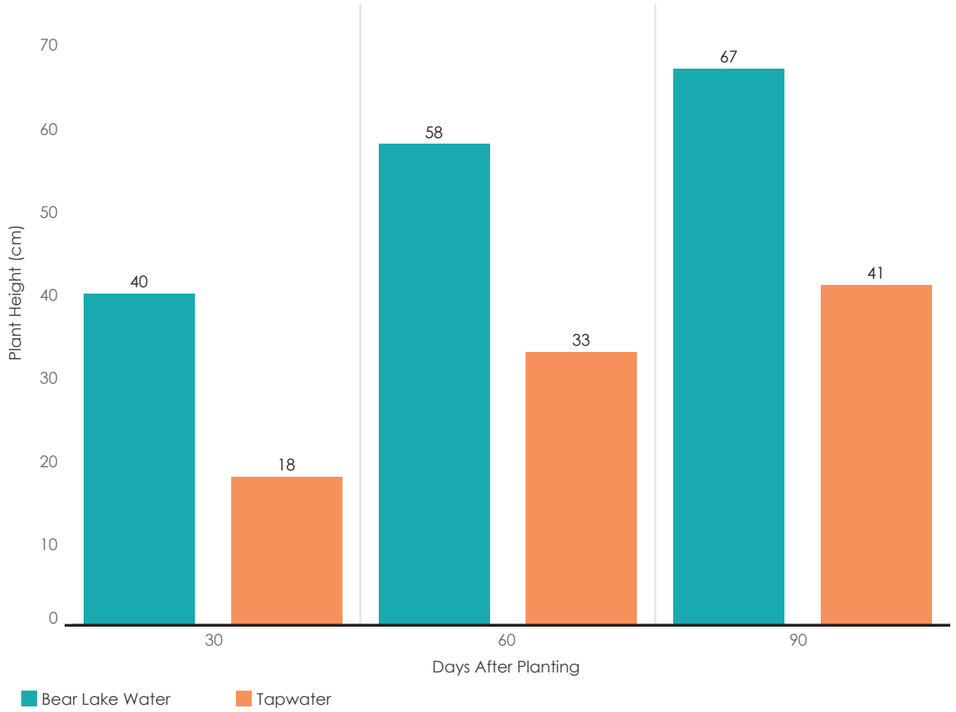
USU STUDENTS STUDY BONNEVILLE CUTTHROAT TROUT | JARED RAGLAND

Figure 5.D.1 Predicted effect of reconnecting tributary habitats to Bear Lake, allowing adult cutthroat trout to access upstream spawning habitats



ABOVE: DR. ORTIZ AND USU STUDENTS STUDY EURASIAN WATERMILFOIL | JARED RAGLAND

Figure 5.E.1 Average plant height of Eurasian watermilfoil growth in Bear Lake water and tap water at 30, 60, and 90 days after planting



Eurasian Watermilfoil: The Invasive Plant Threatening Bear Lake

OLANREWAJU ADEYEMI & MIRELLA ORTIZ

Controlling invasive Eurasian watermilfoil in Bear Lake will require specially designed methods because the lake's unique water chemistry spurs the plants' growth and impedes herbicides.

Eurasian watermilfoil is an invasive aquatic plant that disrupts natural ecosystems and degrades water quality. It forms dense canopies that adversely affect fish populations, water temperature, and oxygen levels. Additionally, Eurasian watermilfoil hinders recreational activities such as boating, fishing, and swimming, lowers property values, and promotes the spread of disease vectors.

To support management decisions for Bear Lake, USU weed scientists investigated the behavior and effectiveness of commonly used herbicides to control Eurasian watermilfoil, along with the influence of Bear Lake's unique water chemistry on Eurasian watermilfoil growth.

Eurasian watermilfoil plants were grown in the Utah State University Research Greenhouse using either Bear Lake water or tap water and monitored over three months. Researchers also assessed herbicides' degradation and how effective they were in controlling Eurasian watermilfoil in Bear Lake water.

Results demonstrated Eurasian watermilfoil's significant adaptability and potential for rapid colonization in Bear Lake water. The invasive plant grew vigorously in Bear Lake water, with significant increases in plant height (Figure 5.E.1), the number of shoots per plant, and both aboveground and belowground biomass compared to plants grown in tap water.

Herbicides degraded in Bear Lake water much as they did in tap water, indicating that the unique chemistry of Bear Lake water does not impact herbicide behavior. However, due to the vigorous plant growth in Bear Lake water, a 24-hour exposure to 2,4-D herbicide only achieved 64% control in Bear Lake water, compared to 92% in tap water. This greatly reduced effectiveness highlights the need for tailored management strategies to address Eurasian watermilfoil infestation in Bear Lake.

BELOW: EURASIAN WATERMILFOIL | JARED RAGLAND

Detecting and Quantifying Human-Caused Nanoparticle Pollution in Bear Lake

YIMING SU & JUNJIE TANG

Human activities at Bear Lake contribute to nanoparticle pollution in the water and on beaches.

Manufactured nanomaterials and naturally derived microplastics are particles that come from sources such as coatings, paint, plastic bags and food containers, water bottles, sunscreen, rubber tires, and plastic toys. These materials have been widely found in natural water bodies, posing a potentially significant threat to ecosystem and human health.

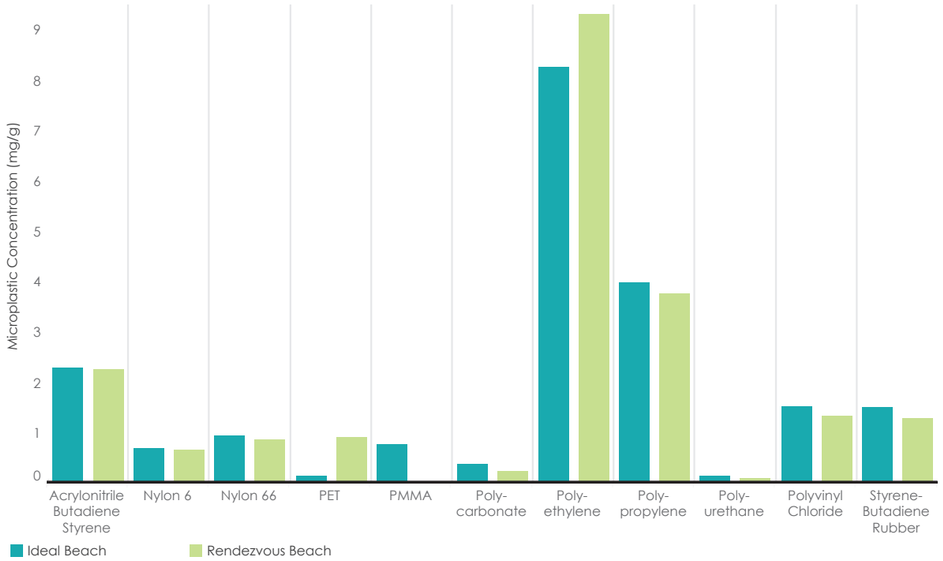
Researchers from the Utah Water Research Laboratory sampled lake water and beach sediment around Bear Lake to measure nanoparticle pollution. Zinc oxide and copper oxide particles were detected near major beaches, with the highest concentration recorded at Bear Lake State Park near the Marina and watercraft rental locations. These nanoparticles are likely from antifouling boat paints used to prevent corrosion. Samples from different beaches showed significant polyethylene contamination. Sage Springs Group Camp, Bear Lake State Park's Rendezvous Beach, and Ideal Beach Resort had the highest concentrations, with one sample containing up to 10 billion plastic particles in one gram of dry lakeshore sediment. During the summer, when tourism generally increases, samples from the popular beaches—Rendezvous Beach and Ideal Beach—had higher concentrations of nanoparticles from sunscreen, but a large portion of these particles aggregate and sink down in the sediment over time.

The study found that (1) human activity did cause nanoparticle concentrations to increase over the summer; (2) more tourism caused greater contamination; (3) boats and personal care products seem to be the major contributors to nanoparticles in the lake; and (4) microplastic contamination on beaches is significant. To maintain good water quality at Bear Lake, researchers recommend that watercraft owners limit use of antifouling paints and coatings and that beaches further develop their plastic waste management plan.

BELOW: UTAH STATE UNIVERSITY GRADUATE STUDENTS SAMPLE BEAR LAKE WATER | JARED RAGLAND

TAKING SAMPLES OF BEAR LAKE WATER | JARED RAGLAND

Figure 5.F.1 Bear Lake plastic concentration sampled at Ideal Beach and Rendezvous Beach in 2024



BEAR LAKE *Research Summary*

Additional Utah State University projects were funded by the Bear Lake research program. These projects are adding to our understanding of the lake, its ecosystem, and the surrounding community. Full reports will be released with the Bear Lake Needs Assessment in early 2025.

Bear Lake Needs Assessment Documentation and Visualization Project

JARED RAGLAND

Photos for this chapter were provided by Utah State University photography students, who worked to document the challenges facing Bear Lake. This initiative combines scientific research and visual storytelling to highlight issues related to Bear Lake's natural resources, land use, and human impact. Jared Ragland and his students conducted over 20 field visits, collaborating with local stakeholders and Utah State University researchers. Their work, reflecting Bear Lake's agriculture, infrastructure, recreation, and ecology, will be shared and archived, creating a valuable resource of several hundred images for research and communication efforts.

Assessing Bear Lake Environmental Concerns of Scientists, Residents, & Community Organizations

BETSY BRUNNER, JESSICA SCHAD, AND STACIA RYDER

Utah State University faculty and student researchers interviewed 28 Bear Lake area residents about wellbeing and future concerns. Participants valued their community's close-knit nature, outdoor recreation, and environmental connections. Key concerns included rising housing costs, traffic, and ecological impacts from tourism and development.

Irrigation Practices Impact Bear Lake Water Quality

SENA BILDIM, BURDETTE BARKER, MATT YOST, AND REGANNE BRIGGS

Irrigation practices in the Bear Lake Valley, essential for agriculture, contribute to nutrient loading in local water bodies. Runoff from irrigated lands raises mineral content in nearby waters, which could potentially impact the growth of native and invasive plants, affect wildlife, and influence the ecosystem's health.

Bear Lake's History Informs the Region's Future

LAWRENCE CULVER

Historical records are valuable for understanding Bear Lake's past and guiding future management decisions. Utah State University students made Bear Lake's historical resource records more accessible and organized. By providing insights into past management and development, these records can support informed decision-making for the lake's sustainable future.

Temperatures Affect Bear Lake Watershed's Peak Runoff and Snowpack

WEI ZHANG AND GRACE AFFRAM

Warming temperatures in the Bear Lake watershed will lead to shifts from snow to rain, resulting in reduced peak runoff. Accurately assessing the watershed's water budget is challenging, especially with climate-driven changes. The balance of precipitation and runoff impacts the region's water availability and ecosystem health.

Aquatic Exploration with Autonomous Underwater Vehicles at Bear Lake

MARIO HARPER

Student and faculty utilized the advanced Blue ROV 2 autonomous submarine robotic system to study Bear Lake's underwater environment. This project provided a holistic view of the lake's conditions, offering insights for future conservation and management efforts.

SUBMARINE ENTERING THE LAKE | JARED RAGLAND

BEAR LAKE STATE PARK MARINA | JARED RAGLAND

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