



University of
Montana's
Flathead Lake

Bio Station





Investing in the Long-Term Success of the Flathead Watershed

OUR MISSION

To serve the Flathead region, state of Montana, nation, and world by advancing a cutting-edge research, education, and outreach platform for limnology, ecology, and environmental science in the Flathead Watershed.

We fulfill our mission in three ways:

-  advanced research,
-  sustained monitoring,
-  and education at all levels.

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We're here for the long-term. This thought comes to mind a lot as we pursue our three-pronged mission of research, monitoring, and education at the Flathead Lake Biological Station (FLBS). In this annual report, you'll see several stories highlighting our long-term commitment to freshwater science and monitoring, and the benefits such a commitment provides to the past, present, and future of our waters.

First and foremost, one of our most significant long-term efforts is our **Flathead Monitoring Program (FMP)**, which for nearly 35 years benefited from the expert leadership and guidance of senior scientist **Jim Craft**. Jim has played a primary role in delivering the stream of high-quality data from Flathead Lake and its watershed that is a hallmark contribution of FLBS. Jim retired from his post in 2022, putting a distinguished punctuation on his long career at FLBS, and you can read more about his lasting legacy later in this issue.

Another benefit of the Bio Station's long-term commitment comes in the form of FMP's long-term data, which recently appeared in the pages of the prestigious *Proceedings of the National Academy of Sciences*. The results of the study, which you can read about in the pages of this report, are a tribute not only to the dedication of Bio Station scientists, but to all of those in our community who have made the right decisions to protect our watershed from nutrient pollution over the past decades, including rigorous wastewater treatment.

Of course, there is more to water in Montana than the Flathead Watershed. In this issue you'll read about FLBS assistant research professor **Rachel Malison** and her efforts to grow **Monitoring Montana Waters**, which we hope will be a long-term program to help community groups around the state test water quality in a variety of streams, rivers, and lakes.

You'll also read about a few of the many things our scientists are doing to sustain our waters, including FLBS aquatic invasive species (AIS) specialist **Phil Matson's** research to ensure accuracy and efficiency of AIS environmental DNA sampling and analyses; the collaborative efforts of FLBS environmental economist **Nanette Nelson**, FLBS aquatic microbial ecologist **Matt Church**, and others to proactively address the growing septic leachate challenges in the Flathead; and FLBS associate research professor and USGS aquatic ecologist **Clint Muhlfeld's** work exploring the impact of our changing climate on the resilience of Montana's trout fishing industry.

Additionally, one of the best long-term investments we can make is in the education of our younger generations. Whether connecting with local schools to immerse students and teachers in hands-on Flathead Watershed science, or training the next generations of freshwater scientists right here on the shores of Flathead Lake, our commitment to education and outreach remains as strong as ever. Catch up on the latest with our **Summer Session classes**, our **diverse internships**, and our **FLARE K-12 program**, which all had busy and exciting years in 2022.

What we hope you can see, shining through the pages of this annual report, are the hallmarks of a sustained commitment to excellence that we can trace from the Bio Station's founding in 1899 to our current year of 2023. During the coming year we'll be setting the stage for a special year in 2024, when we will celebrate 125 years of long-term research, monitoring, and education excellence on the shores of Flathead Lake.

So stay tuned and get ready! Thanks to your continued support and investment, we have so much to look forward to at FLBS!



Jim Elser
Director



Tom Bansak
Associate Director

Cabin Naming Opportunity Supports FLBS Infrastructure



Since 1899, all areas of our mission have depended upon our facilities and infrastructure. Today, many of our buildings at Yellow Bay are nearly fifty years old, and our museum once served (among many other things) as the Bio Station's laboratory back at the start of the 20th Century.

To help us take our facilities to the next level, we are currently offering up the exciting opportunity to join this effort by sponsoring one of our historic residential cabins. A gift of \$10,000 or more towards the FLBS Facilities Endowment gives you the opportunity to honor your family's name or another name of your choosing on one of our cabins for a period of ten years.

This is a wonderful way to honor your loved ones while providing a much needed investment in the Bio Station's future, helping us to fortify our research, monitoring, and education programs for generations to come. For more information, contact FLBS assoc. director **Tom Bansak** by email at tom.bansak@umontana.edu



The End of an Era at FLBS

We celebrated and bid a fond farewell to FLBS research scientist **Jim Craft** in 2022, who officially retired after nearly 35 years of dedicated service. Jim's retirement ends his post as Captain of the *Jessie B.* research vessel and solidifies his place as one of the longest tenured researchers in the history of FLBS.

Since 1988, when he graduated from UM, Jim has played a pivotal role in overseeing and sustaining the Bio Station's world-renowned long-term ecological and water quality data sets. While most of his work centered on investigating the physical, chemical, and biological interactions impacting the ecology of Flathead Lake, he also studied the effects of human and natural disturbances on streams and lakes in northwest Montana. These areas included Swan

Lake, Whitefish Lake, Lake Mary Ronan, Lindbergh Lake, Little Bitterroot Lake, Lion Creek, Dog Creek, the Middle and North Fork Flathead Rivers, and the Swan River.

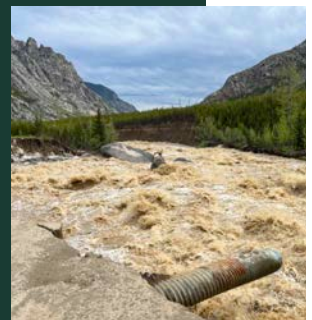
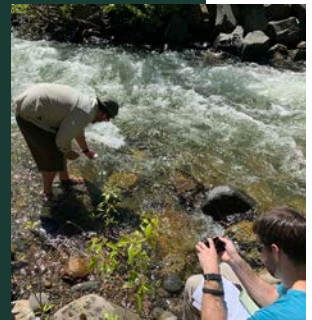
Jim's work will continue to play a significant role in our ability to best understand and sustain our waters, as his mentorship of countless students and generosity of his time and knowledge have created a lasting legacy that will carry on through the FLBS researchers who will build upon his work for many years to come. We wish Jim nothing but the best as he embarks upon retirement, and look forward to seeing him cheer on the Grizzlies at University of Montana Football games!

Expanding Monitoring Montana Waters

FLBS assistant research professor **Rachel Malison** recently developed and launched a program at FLBS called Monitoring Montana Waters (MMW). The program provides scientific expertise, guidance, and funding to citizen-led watershed groups across Montana to build capacity for freshwater monitoring and ensure the use of scientifically sound methodologies.

Thanks to the help of Big Sky Watershed Corps Member Claire Kirk, MMW funded nine watershed groups in 2022, provided four groups with in-person and on-site training, and conducted an annual road trip to visit participating watershed groups. MMW also expanded further eastward last year, supporting the Red Lodge Rock Creek Watershed Group that experienced historic flooding back in June.

Looking ahead to the 2023 monitoring season, the program is already hard at work assisting citizen-led watershed groups with standard operating procedures, sampling plans, training, equipment, lab analyses, and financial support as it seeks to continue its eastward expansion to help ensure all Montana waters are clean and blue for future generations.





Microplastics Found in Flathead Lake

Thanks to an FLBS study, scientists now have a greater understanding of the amount of microplastics polluting Flathead Lake, the likely sources of these microplastics, and what can be done to prevent more from finding their way into the lake's world-renowned pristine water.

Published in the scientific journal *Environmental Pollution*, this microplastics study was led by FLBS visiting researcher **Dr. Xiong Xiong** from the Chinese Academy of Science's Institute of Hydrobiology with support from FLBS director **Jim Elser** and FLBS research scientist **Tyler Tappenbeck**. Through the study, Xiong identified three main ways that microplastics reach Flathead Lake. One way is atmospheric deposition, where microplastics are transported to Montana from other more populated areas by the atmosphere via wind and clouds, and then fall into Flathead Lake, either directly from the air or through snow and rainfall.

At the mouth of the Flathead River, the biggest source of microplastics is most likely from plastic waste disposal. Although landfills located in the Flathead Watershed are not open-pit, microplastics are mobilized through water that picks up contaminants and via the soil of the landfill when winds carry away dust.

In more populated shoreline areas of the lake, researchers found that concentrations of microplastics were especially high. In addition to plastic packaging, many of today's clothes

are made from fibrous plastics. These synthetic fabrics break apart on a microscopic level during washing, and are then transported and deposited into our waters through home septic systems and community water treatment plants. Plastic waste from other human activities is also worthy of attention.

Though the levels of microplastics in Flathead Lake are relatively low, they are concerning. However, researchers are quick to point out that much can be done to reduce their presence in Montana's waters. Fibrous microplastics can be reduced by improving laundry practices and wastewater treatment, or by reducing the use of synthetic fiber material in favor of natural fiber clothing and materials. Further strengthening disposal measures for plastic waste by both residents and visitors could also greatly help reduce microplastic contamination in Flathead Lake.

When it comes to reducing atmospheric microplastic deposition, researchers say extensive solutions are needed. Flathead Lake will remain at risk from microplastics arriving by air until global measures can be taken.

Did you know...

...The total production of plastic waste in the United States is 42 million tons per year, which is much higher than in other countries per capita.

Getting Proactive with Septic Leachate Challenges



In collaboration with the National Science Foundation, the Flathead Basin Commission, the Whitefish Lake Institute, and the University of Montana, FLBS aquatic microbial ecology professor **Matt Church** and FLBS environmental economist **Nanette Nelson** hosted a workshop focused on septic systems and water quality at the start of the 2022 summer season.

With stakeholders, legislators, scientists, managers, and community members in attendance, the aim of the workshop was to proactively address challenges and solutions related to septic leachate from septic systems around Flathead Lake and its watershed. Septic leachate containing fecal coliform and nutrients like nitrogen is considered a nonpoint source pollutant.

Nonpoint source pollutants don't come from one specific spot, but from multiple dispersed locations, like the septic systems around Flathead Watershed. Nutrient and biological pollutants are indicators of septic system contamination and are harmful to both water quality and human health. Proper maintenance of septic systems can prevent negative impacts.

Investing in Accuracy and Efficiency at FLBS



Securing a grant from the Montana Department of Natural Resources & Conservation, FLBS aquatic invasive species (AIS) specialist **Phil Matson** and FLBS graduate student and environmental DNA (eDNA) coordinator **Leif Howard** are working to optimize the decontamination protocol for eDNA sampling gear to minimize the potential for false results and eliminate uncertainties regarding AIS detection sensitivity.

Matson and Howard are advancing another study that examines sample preservation protocols. Initially launched in 2021, this study has—to this point—found that extracted DNA from samples held in long-term storage are still viable over a year later. This study will help scientists around the nation better understand the long-term effects of time on stored samples and how to increase their shelf lives.



Working Together for the Future of our Waters

It's been another active year for invasive mussel prevention for the Bio Station's Aquatic Invasive Species (AIS) program. Led by FLBS AIS specialist **Phil Matson**, FLBS completed four rounds of early detection sampling for invasive zebra and quagga mussels around Flathead Lake, which resulted in nearly 700 collected samples and accounted for over 80% of total plankton tow net samples collected at Flathead Lake in 2022.

All samples collected by FLBS are analyzed by researchers at state and Bio Station laboratories. To date, none of the processed samples have tested positive for the presence of invasive mussel DNA.

The importance of accurate early detection plays a key role in the ability of stakeholders and managers to rapidly respond to the arrival of zebra or quagga mussels and prevent full-blown invasion. Nearly 100,000 boats were inspected this year by state, tribal, federal, and local watercraft inspectors, which resulted in the successful discovery and decontamination of fifty-three mussel-infested watercraft. If a mussel-fouled boat ever does make it through the front lines of the boat inspection stations, early detection in our waters is critical to mitigate the negative and harmful impacts of an invasive mussel infestation.

The FLBS AIS program also celebrated its sixth consecutive year partnering with the Confederated Salish and Kootenai Tribes (CSKT), and continues to work closely with Montana Fish, Wildlife &

Parks (FWP). FLBS educators and scientists partnered with CSKT to hold the 6th Annual Mussel Walk at three separate events, through which nearly 200 students and educators from Bigfork Middle School, Polson Middle School, and Two Eagle River School learned about AIS prevention. Each Mussel Walk culminated in a survey along the beach at Wayfarers State Park or Salish Point for mussels and other invasive species.

Matson and his team also held important conversations with marina workers and State Park staff and volunteers, and conducted trainings about early detection and monitoring protocols for invasive mussels, where they were joined by participants from federal, tribal, state, and local watershed institutions. Additional trainees included a cohort of Big Sky Watershed Corps Members, CSKT and FWP staff members, FLBS summer interns and staff, and local volunteers.

“Through the continued connection between responsibility and respect for our waters, we can truly make a difference for future generations.”

FLBS AIS Specialist Phil Matson



Flathead Monitoring Making a Difference

The Bio Station's long-term Flathead Monitoring Program (FMP) is excited to report that after another year of rigorous monitoring, Flathead, Whitefish, and Swan Lakes all remain clean, clear, and blue. This in spite of another challenging wildfire year in the Flathead, which saw another significant shoreline wildfire—this time in the Elmo area on the western shoreline—devastate local communities and wildlife for the second consecutive summer.

As fire crews bravely fought the fire, FMP maintained consistent sampling procedures, and though significant ash and char was deposited into Flathead Lake, FLBS scientists don't believe any long-term issues will impact Flathead Lake water quality as a result of the 2022 fire season. Additionally, FLBS scientists once again produced a number of significant water quality-related research accomplishments this year.

These accomplishments included, among many others, collaborating with international stakeholders to protect U.S. waters from transboundary mine pollution and partnering with the Confederated Salish and Kootenai Tribes to assess mercury levels in Flathead Lake fishes.

Largely funded through philanthropic investment, your support is the driving force behind our ability to keep watch over our waters. The Flathead Watershed continues to be free from impacts of widespread nutrient pollution that are degrading almost all other freshwater lakes and rivers around the world. While these results are worthy of celebration, as our region's popularity continues to rise and our climate continues to change, we need to be more vigilant and collaborative than ever to ensure the health of our waters for future generations.

Nutrient Levels Remain Low But Imbalanced in Flathead Lake



Through a study published by the *Proceedings of the National Academy of Sciences*, a team of researchers led by FLBS director Jim Elser and other FLBS scientists examined nearly 40 years of nutrient dynamics in Flathead Lake. The researchers found that the overall levels of nitrogen and phosphorus in Flathead Lake and its surrounding rivers and streams are low and not increasing. In fact, nitrogen and phosphorus levels coming into Flathead Lake from its larger rivers actually appear to be slowly declining.

This is great news for Flathead Lake because water quality in many of the world's lakes is declining due to increasing nutrient inputs. However, researchers also discovered that Flathead Lake has sustained a high ratio of nitrogen to phosphorus across a span of four decades. This high ratio has often reached values that greatly exceed the normal nitrogen-to-phosphorus recipe that matches the needs of most phytoplankton.

These findings have implications not only for Flathead Lake but also for lakes globally. Like our own diets, it's clear that when it comes to the building blocks of our lake ecosystems, nutrient balance matters.

An Uncertain Future for Montana's Trout Fishing Industry



Despite decades of resiliency, climate change may be putting Montana's popular trout fisheries at risk. Scientists with the U.S. Geological Survey, Montana Fish, Wildlife & Parks, and FLBS recently studied how climate change affected trout fisheries across 3,100 miles of rivers in Montana from 1983 to 2017. The study, which was published in the scientific journal *Science Advances*, found that Montana's trout fishing economy has been remarkably resilient in the face of climate extremes since the early 1980s, but they also discovered that resiliency may be on the brink of running out. If current trends continue, researchers say that 35% of Montana's cold-water habitats may no longer be suitable for trout by 2080, resulting in the loss of \$192 million per year in state revenue and an uncertain future for Montana's world renowned trout fishing industry.

FLBS Open AIR Artists Connect with Community



This year's FLBS Open AIR Artist-in-Residences culminated in two community-focused opportunities. The first was held during the 2022 FLBS Open House, when Summer Artist-in-Residence Jennifer Ogden offered a creative activity to Bio Station visitors that provided a first-hand experience with her artistic process.

The second opportunity took place at the end of the fall residency, when Fall Artists-in-Residence Sophia Hart, Kelsie Leonard, Kate Mostad, and Maria Uhas led an event called *Inquiry: A Day of Art & Science at FLBS*.

Free and open to the public, this event invited local communities to the Bio Station to interact directly with Open AIR artists and FLBS scientists and educators. The event featured presentations, activities, art making, and music performances that engaged audiences in conversations on place, art, and science.

We're grateful for our continued collaboration with the Open AIR organization, and are excited about the 2023 FLBS Open AIR Artist-in-Residence season.



A Big Year for Student Opportunities

We enjoyed another busy summer at FLBS, as we welcomed sixty students to Yellow Bay from eighteen universities to take one or more of our nine field-based experiential ecology courses. Now under the guidance of FLBS summer session program manager **Hannah Gerhard**, our summer courses offered students hands-on learning and real-world research opportunities alongside world-renowned FLBS scientists, and included fourteen overnight field trips to Glacier National Park and other ecologically significant locations.

Additionally, nearly half of all 2022 FLBS students received scholarships to make their summer education possible. FLBS was honored to award nearly \$70,000 in total philanthropic funding to students, thanks in large part to the named and endowed scholarships created by our generous Bio Station community.

These scholarships continue to play a vital role in expanding access to FLBS courses for college students in Montana and throughout the country.

"I can't imagine a better summer program anywhere than the program here at FLBS to study ecology in the field."

Olivia Sheldon, University of Virginia
Courses attended at FLBS: Conservation Ecology, Alpine Ecology, and Forest & Fire Ecology

In addition to our summer academic program, FLBS hosted a fantastic group of interdisciplinary interns who all played a crucial part in advancing all areas of the Bio Station's mission in 2022. With four interns from the University of Montana and another six hailing from universities across the U.S., these philanthropically-funded interns conducted important interdisciplinary work ranging from environmental journalism to aquatic insect ecology that will have a positive impact on FLBS research, monitoring, education, and outreach for years to come.

Qualified Charitable Distributions

A Tax-Savvy Way to Support the Bio Station

Generally, individuals age 70½ or older can transfer up to \$100,000 directly from their traditional retirement account to support critical research, monitoring, and conservation of Flathead Lake each year, without paying federal income tax on the withdrawal.

This tax-efficient way of giving is called a qualified charitable distribution. For couples, each spouse may give up to \$100,000 from their respective IRAs. For those 73 and older, qualified charitable distributions count toward satisfying the required minimum distribution (RMD) for the year of the gift.



FLARE K-12 Returns to Full Operation

Funded entirely by generous philanthropic support, the Flathead Lake Aquatic Research Education (FLARE) K-12 program returned to full operation in 2022. Led by FLBS education liaison **Monica Elser** and FLBS education coordinator **Stephanie Hummel**, the program interacted with over 2000 children in 2022, engaging over 650 students through hosted field trips to FLBS and reaching an additional 1500 students through classroom visits, after-school programs, and local events including regional powwows.

FLARE K-12 also had the opportunity to once again partner with educators from the Confederated Salish and Kootenai Tribes, the Flathead Lakers, and Montana State Parks to increase invasive mussel awareness through the 2022 Mussel Walks. Utilizing Aquatic Invasive Species curriculum that FLARE K-12 educators helped create and pilot, the Mussel Walks culminated in hands-on learning activities with middle school students from Polson, Pablo, and Bigfork right on the shores of Flathead Lake.

In addition to connecting with western Montana's youth, FLARE K-12 continues to provide opportunities for teachers to learn about current science and receive on-site educator professional development training.

As an example, thanks to grants and private funding, FLARE K-12 once again partnered with the Flathead Community of Resource Educators to participate in the highly popular Flathead Watershed Through The Seasons educator workshop. This year-long training opportunity for K-12 teachers in the Flathead Watershed provides a one-of-a-kind program aimed at offering place-based professional development opportunities for up to twelve local educators each year.

With a full spring schedule on the books, and reservations for the 2023-24 academic year already underway, it doesn't appear the momentum behind the FLARE K-12 program will be slowing anytime soon. If you are a K-12 educator and are interested in engaging the FLARE K-12 program, visit the FLBS website and contact our FLARE K-12 educators today.

Did you know...

...you can help protect our waters and support the Flathead Lake Biological Station with a qualified charitable distribution?

For more information, contact:

Alison Schultz
Director of Planned Giving
Univ. of Montana Foundation
406-243-5121 | alison.schultz@supportum.org



The University of Montana Foundation provides information about the benefits of charitable gifts and does not provide legal, financial or tax advice. Please consult your advisor(s) before making a gift.

Students Organize Flathead Fun Run for FLBS



Thanks to the hard work of Columbia Falls Junior High students Ashley Andrews and Sol Masters, FLBS was the beneficiary of a 3K Flathead Fun Run fundraiser held last spring. Over \$700 was raised for the Flathead Monitoring Program, which will directly support our ability to track water quality trends and threats throughout the Flathead Watershed. Our heartfelt gratitude goes out to Ashley and Sol for their ingenuity, generosity, effort, and support, and to everyone who helped make the Flathead 3K Fun Run a wonderful success!

"On the strong foundation of our past, we are building the future of aquatic ecology on the shores of Flathead Lake."

Jim Elser
FLBS Director

Stay Tuned!
Big things are coming to FLBS!





Upcoming FLBS Events in 2023

- **Open House:** In early August, we invite you to come to our beautiful facilities to engage in hands-on science activities; meet our faculty, staff, and students; and get an update on the State of the Lake and Bio Station. Come early and get a boat ride on the *Jessie B!*
- **Research Cruise:** Hop aboard the *Far West* for a cruise that features great food, refreshing beverages, and an ample dose of innovative science. You'll learn directly from our scientific staff and students as we discuss how to Keep Our Waters Blue.
- **Science on Tap Flathead:** We're excited to partner with the Flathead Lakers to host informal science presentations at various locations in local Flathead Lake communities. Join us for topics that range from osprey to water quality to grizzly bears!
- **Data and Donuts:** During the first four Mondays of our summer program, scientists from FLBS, Montana, and around the world give a one-hour lecture on a fascinating research topic. This is a great opportunity to learn while enjoying a tasty pastry or two!

For up-to-date information on all things FLBS, visit our news blog at flbs.umt.edu