Malheur Lake Project Looks to Improve Habitat by Clearing Turbid Water

Carp and invasive plant species continue to present challenges

April 2026
by Lauren Brown

The Malheur National Wildlife Refuge was established in 1908 by President Theadore Roosevelt to protect migratory waterfowl. In 1935, the Donner und Blitzen Valley was added under the conservation umbrella to protect water resources for the lake.

Along the way, the health of the lake has fluctuated as carp were introduced to the basin in the 1920s. Carp are an invasive species that are destructive to the lake because they outcompete other fish and create turbidity (cloudy water) through their foraging methods of rooting through the lakebed, stirring sediment into the water column. As the carp population has ebbed and flowed, so has the proliferation of sago pondweed, a submergent vegetation and a high-quality food source for migratory waterfowl. The presence of sago pondweed is an indicator that sunlight is making it to the lakebed.

The refuge serves as an important stop on the Pacific Flyway, as millions of birds migrate north in the spring. Malheur Lake and the wet meadows of the Great Basin offer birds a place to stop and refuel on the long journey. On a global scale, wetland habitats are disappearing at a rate three times faster than forests according to the Global Wetland Outlook. To conserve the bird species and other wildlife that depend on these places, it is important to look at ways to preserve these crucial wetlands.

In the case of Malheur Lake, the turbid water was discouraging both emergent and submergent vegetation. This vegetation is what helps to create a habitat that can fuel birds on their migratory journey.

Looking at turbidity

Partners of the Harney Basin Wetlands Collaborative, including U.S. Geological Survey, U.S. Fish and Wildlife, have worked together to study conditions in Malheur Lake and its surrounding wet meadows to see what will help improve habitat and what won't.

Pictured: A mesocosm installed in Malheur Lake is an enclosed structure that allows scientists to study conditions — including reduced wind-wave action — in a controlled setting.

Casie Smith, an ecologist with the U.S. Geological Survey, and partners started a mesocosm study in Malheur Lake in 2021. The study involved using wave barriers and flocculation to see how both would impact turbidity in the lake.

While carp removal has been one way refuge staff have tried to decrease turbid conditions, the mesocosm study specifically looked at using wave barriers to try and keep wind-wave action from stirring up sediment in the water. They also studied flocculation by adding aluminum sulfate to see if it could

help clear the water. The aluminum sulfate gathers the fine particulate in the water into larger particles that are heavy enough to settle out to the bottom.

Lake fluctuations

While this study was conducted, the size of the lake was changing greatly as the Great Basin experienced an extreme drought in 2021 and 2022. An increased snowpack in 2023 saw the depth of the lake double. The flush of clear water naturally helped to lower the turbidity, allowing more light into the water column, which in turn helped plants grow. There was more bulrush and sago pondweed than had been seen in Malheur Lake for decades.

The drought also killed off many of the carp in the lake. It was estimated that 30,000 to 50,000 adult carp died off in 2021 and another 10,000 to 15,000 died the following year. In the fall of 2022, refuge staff, partners of the Harney Basin Wetlands Collaborative, and others joined forces to remove 43 tons of carp.

Vegetation flourished from a combination of fewer carp and a flush of fresh water from the healthy snowpack in 2023.

Mesocosm study results

During the mesocosm study which took place in 2021 and 2023 (but not 2022 because of the drought), the lake decreased to 4,000 acres and then grew to 25,000 acres.

The mesocosm study found that the wave barriers were not effective in reducing wind-wave action. Smith said that is a useful finding. “This is why we do these types of pilot restoration studies,” she said. “We want to test these approaches before a lot of resources are invested in them. It was useful because we found out that wave barriers would not be a viable approach to restore clear water and vegetation in the lake.”

However, the flocculation study had impressive results. Smith noted that prior lab studies were done to see what kind of impact aluminum sulfate had on the pH levels in the water so that they were using as little as possible to get the needed effect. Flocculation temporarily decreased turbidity in the water by more than 90 percent and significantly increased light in the water column by more than 400 percent. “The overarching conclusion is that it is a viable approach to clear the water column and to get light to hit the lakebed, enough light that sago pondweed needs,” Smith said.

However, it was a temporary result. Because the wave barriers weren’t working, the wind-wave action stirred up sediment from the bottom and everything that had settled out got mixed back into the water column. “Within a few days to a week, the turbidity was back,” Smith said. “It helped us understand that the next step, if we were to do something like this in the future, would be to make sure that we added an effective capping layer on top of the lakebed after applying the aluminum sulfate.” This capping layer would make it harder for the fine particulate to resuspend in the water column.

Moving forward

In 2023, there was a significant increase in emergent and submergent vegetation in and around Malheur Lake. The carp had been knocked back, and the habitat was much improved. Smith said things continued in that vein for 2024 and 2025.

Pictured: An underwater scene of the lush vegetation growing in Malheur Lake, August 2023.

However, this year things could be shifting as the weather warms. Smith noted that many baby carp have been observed at the boat launch. Young

carp could take advantage of the increased amount of vegetation, and the population could expand greatly. “Since the drought, we’re seeing a new lake with new conditions, including algal blooms observed in 2025,” Smith said.

Another issue that refuge staff is considering is the spread of invasive plants such as hybrid cattail and reed canary grass, which have moved into some of the wet meadows and Malheur Lake. Hybrid cattail can spread quickly and reduce the amount of open water in the lake. “This lake functions best when it is a hemi-marsh of roughly half open water and half emergent species,” Smith said. Invasive species can have unpredictable effects. Combining invasive carp with invasive hybrid cattail could shift the lake in a completely different direction.

In the lake’s current state, there is no need for flocculation treatment. “The turbidity is not high enough to be a problem,” Smith said. The flocculation results from the mesocosm study are something the refuge can hold onto and perhaps implement in the future. “We've learned how degraded the lake can get, and if it starts to get that way in the future, maybe there's a way that we can intervene with something like flocculation to jumpstart vegetation before it totally reverts into that turbid feedback loop,” Smith said.

Integrated monitoring

She noted that one thing that could help gather more information about Malheur Lake is integrated monitoring. It’s currently under discussion among partners. “We've all been collecting data out on the lake, but it hasn't really been coordinated to answer some of the broader questions about how, for example, water quality relates to food resources like bugs in the water and how that relates to sago pondweed and ultimately birds,” Smith said. “Partners are proposing to change that starting this year. We're planning to now collect all of the data types.” That would include collecting data on water quality, submergent aquatic vegetation, emergent vegetation, macroinvertebrates, and birds at the same sites in the lake so that they can draw connections between the different parameters and try to assess habitat quality for the birds.

The refuge was created in 1908 with the primary focus of protecting birds, and Smith sees integrated monitoring as a way to continue that mission. “Ultimately, the bird habitat and food resources are what they were preserving the lake for, so we want to better understand what is affecting bird productivity out there,” she said.

This article is provided by High Desert Partnership; a Harney County nonprofit convening and supporting six collaboratives including the Harney Basin Wetlands Collaborative.

HIGH DESERT Partnership