



**Woodwell
Climate
Research
Center**



**Inflation Reduction Act climate
change provisions / 02**

**As the climate crisis intensifies, lakes
across the Arctic are vanishing / 03**

**What to know about Alaska's historic
fire season / 05**

**Permafrost Pathways installs first
new carbon monitoring station / 06**

**Rebuilding Massachusetts' wetlands
from the ground up / 07**

In the news: highlights / 09

Notes from the Field

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Inflation Reduction Act climate change provisions

Woodwell Climate Research Center has worked for years to understand and highlight the scale of the global climate crisis and has called upon policymakers to act with urgency in addressing this threat. The Inflation Reduction Act (IRA) is historically significant legislation, providing incentives and policy tools to dramatically reduce U.S. greenhouse gas emissions and put the United States within reach of its nationally determined contribution (NDC) for climate action.

A robust analysis by Princeton University's ZERO Lab estimates the impact of IRA projects on greenhouse gas emissions to be a reduction to 40 percent below 2005 levels, by 2030. The U.S. NDC sets a target of 50 percent reduction below 2005 levels. With additional action from the private sector and state and local governments, the United States has a realistic chance to meet its current climate targets and set a path toward a safe and stable climate.

Of course, this legislation is not perfect. In particular, there are fossil fuel provisions in the bill that seem antithetical to climate action. But the net result of this legislation is overwhelmingly positive for the climate, and is the most substantial step forward for climate policy in U.S. history.

Numerous sections of the bill touch on areas of specific Woodwell expertise. Natural climate solutions are essential for meeting both U.S. and global emissions targets, and Woodwell scientists have focused much of their research on the most effective strategies to maximize carbon storage in forests and soils. The IRA invests heavily in natural climate solutions.

FORESTRY

The Inflation Reduction Act addresses the fact that climate change can accelerate wildfires, and also the importance of trees and forests for carbon sequestration and climate change mitigation. Among other forestry provisions:

- The Act includes \$2.15 billion for National Forest System land restoration and fuel reduction, with a particular focus on “the wildland-urban interface.” Fires in these areas present the most significant danger to human health and safety.
- This \$2.15 billion includes \$50 million “for the protection of old growth forests on National Forest System land and to complete an inventory of old-growth forests and mature forests within the National Forest System.” Woodwell research has shown that old growth forests are critically important for carbon sequestration.
- The Act also includes \$550 million for grant programs dedicated to non-federal forest landowners. This includes:
 - \$150 million for a grant program that will support “a cost share to carry out climate mitigation or forest resilience practices in the case of underserved forest landowners.”
 - \$250 million for grants that will help underserved forest landowners or landowners of forest lots less than 2,500 acres participate in emerging carbon markets.
- \$1.5 billion over nine years for grants that will drive urban and community forestry projects and \$700 million for the Forest Legacy Program.

AGRICULTURE

The Inflation Reduction Act provides significant incentives for improved agricultural techniques that would, among other benefits, increase soil carbon sequestration. Existing federal agricultural conservation programs, for example, are heavily oversubscribed, and the Act provides additional funds to help farmers and ranchers implement and expand practices that



would reduce greenhouse gas emissions. Woodwell scientists have been among the leaders in researching the potential of soil carbon as a climate change mitigation tool, and the processes for measuring, monitoring, and validating increased sequestration. Among other conservation and agricultural provisions, the Act includes:

- More than \$20 billion in overall funding to help farmers mitigate climate change, including significant funding for “agricultural conservation practices” that “directly improve soil carbon, reduce nitrogen losses, or reduce, capture, avoid, or sequester carbon dioxide, methane, or nitrous oxide emissions, associated with agricultural production.”
- \$1.3 billion for the Natural Resources Conservation Service to provide technical assistance and collect field-based data on greenhouse gas emissions associated with agricultural practices.

RISK

The Inflation Reduction Act recognizes the current and increasing physical hazards presented by climate change, and the fact that many communities are not prepared for climate change impacts. Woodwell works with local governments around the world to provide granular climate services, free of charge. There remains, however, an enormous need to expand this science and to provide funding to support adaptation measures.

- The Inflation Reduction Act provides \$3 billion in Environmental and Climate Justice Block Grants. Among the eligible uses of this funding are “mitigating climate and health risk from urban heat islands, extreme heat, wood heater emissions, and wildfire events,” as well as general “climate resiliency and adaptation.”
- The bill includes \$4 billion to increase drought resilience in the Western United States.



As the climate crisis intensifies, lakes across the Arctic are vanishing

Recent study shows widespread patterns of loss, upending scientists' previous projections

Lauren Barnett Writer, University of Florida
Sarah Ruiz Science Writer

The Arctic is no stranger to loss. As the region warms nearly four times faster than the rest of the world, glaciers collapse, wildlife suffers and habitats continue to disappear at a record pace.

Now, a new threat has become apparent: Arctic lakes are drying up, according to new research published in the journal *Nature Climate Change*. The study, led by University of Florida postdoctoral researcher Dr. Elizabeth Webb in collaboration with Woodwell Associate scientist, Dr. Anna Liljedahl, flashes a new warning light on the global climate dashboard.

Research reveals that over the past 20 years, Arctic lakes have shrunk or dried completely across the pan-Arctic, a region spanning the northern parts of Canada, Russia, Greenland, Scandinavia and Alaska. The findings offer clues about why the mass drying is happening and how the loss can be slowed.

The lake decline comes as a surprise. Scientists had predicted that climate change would initially expand lakes across the tundra, due to land surface changes resulting from melting ground ice, with eventual drying in the mid-21st or -22nd

Above: Aerial views of Arctic lakes in Alaska's Yukon-Kuskokwim Delta. / photo by John Schade

century. Instead, it appears that thawing permafrost, the frozen soil that blankets the Arctic, may drain lakes and outweigh this expansion effect, says Dr. Webb. The team theorized that thawing permafrost may decrease lake area by creating drainage channels and increasing soil erosion into the lakes.

These lakes are cornerstones of the Arctic ecosystem. They provide a critical source of fresh water for local Indigenous communities and industries. Threatened and endangered species, including migratory birds and aquatic creatures, also rely on the lake habitats for survival.

“Our findings suggest that permafrost thaw is occurring even faster than we as a community had anticipated,” Dr. Webb said. “It also indicates that the region is likely on a trajectory toward more landscape-scale drainage in the future.”

If accelerated permafrost thaw is to blame, that’s unwelcome news. The Arctic permafrost is a natural warehouse of preserved organic matter and planet-warming gasses.

“Permafrost soils store nearly two times as much carbon as the atmosphere,” Dr. Webb said. “There’s a lot of ongoing research suggesting that as permafrost thaws, this carbon is vulnerable to being

released to the atmosphere in the form of methane and carbon dioxide.”

According to Dr. Liljedahl, this study shifts the perspective on prior research—there is still more to learn when it comes to how climate change is altering the Arctic landscape.

“This work shows that we are “living the future” already,” said Dr. Liljedahl. “Or if you look at it from the other perspective, the current models used to project future surface water coverage and permafrost thaw across the Arctic are ‘off’. They are not capturing key processes. We have already seen reduced lake coverage happening over the previous two decades.”

There is a silver lining in the researcher’s findings. Previous models of lake dynamics predicted lake expansion, which thaws the surrounding permafrost. But because lakes are drying, near-lake permafrost is likely not thawing as fast.

“It’s not immediately clear exactly what the trade-offs are, but we do know that lake expansion causes carbon losses orders of magnitude higher than occurs in surrounding regions,” Dr. Webb said. “So it should mean that we won’t see quite as much carbon emitted as previously thought, because lakes are drying and not wetting.”

The research team used a machine-learning approach to examine the climate change mechanisms responsible for lake area change. By harnessing large ensembles of satellite images to assess patterns of surface water loss, they were able to analyze decades of data across the Arctic. The data is available on the Permafrost Discovery Gateway (PDG), a project that Dr. Liljedahl leads, the goal of which is to make permafrost data broadly accessible to encourage Arctic change research.

“We made the pan-Arctic dataset, including both long-term trend analysis and individual years, accessible on the PDG so that anyone with internet access can interact with the dataset. We are still building the PDG visualization and analysis tools so more options to enable discovery will become available in the coming two years,” said Dr. Liljedahl.

The best way to curtail the lakes’ demise and protect permafrost is to cut fossil fuel emissions and limit global temperature rise.

“The snowball is already rolling,” Webb said, stating that we need to act now to slow these changes. “It’s not going to work to keep on doing what we’re doing.”



above: Topography of a drained lake. / photo by Anna Liljedahl



What to know about Alaska's historic fire season

Looking forward to a respite year, Alaska instead faces one of its worst fire seasons on record

Sarah Ruiz Science Writer

It was supposed to be a quiet season, but only two months into summer and Alaska is already on track for another record-setting wildfire season. With 3 million acres already scorched and over 260 active fires, 2022 is settling in behind 2015 and 2004 so far as one of the state's worst fire seasons on record. Here's what to know about Alaska's summer fires:

① Historic fires are burning in Yukon-Kuskokwim Delta and Bristol Bay

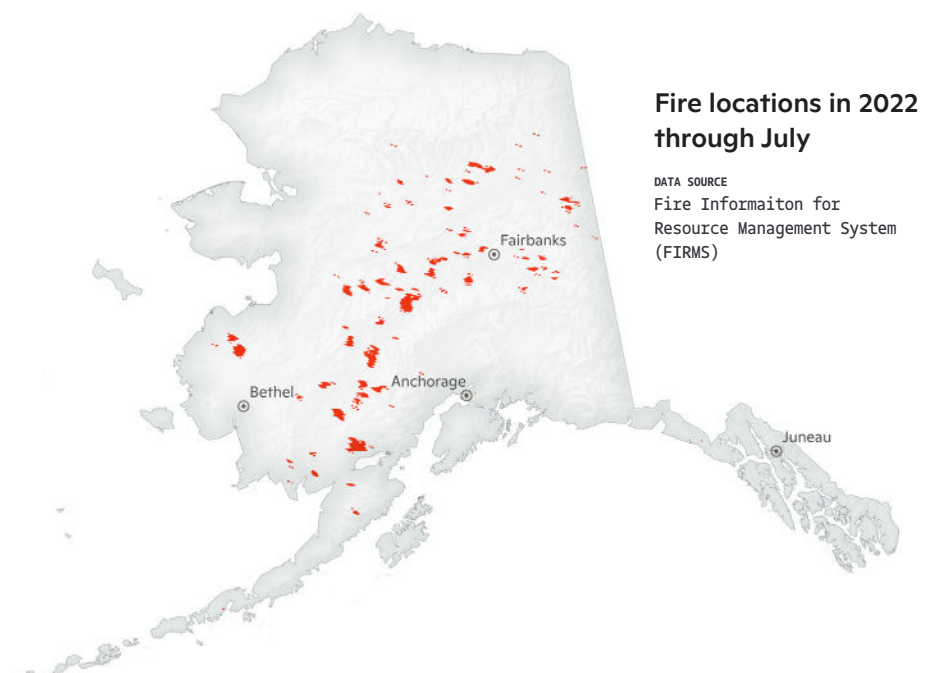
Southwestern Alaska, in particular, has been suffering. The season kicked off with an unseasonably early fire near Kwethluk that started in April. Currently, the East Fork Fire, which is burning near the Yup'ik village of St. Mary's, AK, is among the biggest tundra fires in Alaska's history. Just above Bristol Bay, the Lime Complex—consisting of 18 individual fires—has burned through nearly 865,000 acres. One of the longest lasting fires in the Lime Complex, the Upper Talarik fire, is burning close to the site of the controversial open-pit Pebble Mine.

② Seasonal predictions showed a low-fire season

For Dr. Brendan Rogers, who was in Fairbanks, AK for a research trip in May, the explosive start of the fire season contrasts strongly to conditions he saw in late spring.

“It was a relatively average spring in interior Alaska, with higher-than-normal snowpack. Walking around the forest was challenging because of remaining snow, slush, and flooded trails,” said Dr. Rogers.

Early predictions showed a 2022 season low in fire due to heavy winter snow. But



the weather shifted in the last ten days of May and early June. June temperatures in Anchorage were the second highest ever recorded. High heat and low humidity rapidly dried out vegetation and groundcover, creating a tinderbox of available fuel. This sudden flip from wet to dry unfolded similarly to conditions in 2004, which resulted in the state's worst fire season on record.

③ Climate change is accelerating fire feedback loops

The conditions for this wildfire season were facilitated by climate change, and the emissions that result from them will fuel further warming. The hot temperatures responsible for drying out the Alaskan landscape were brought on by a persistent high pressure system that prevents the formation of clouds—a weather pattern linked to warming-related fluctuations in the jet stream.

“With climate change, we tend to get more of these persistent ridges and troughs in the jet stream,” says Dr. Rogers. “This will cause a high pressure system like this one to just sit over an area. There is no rain; it dries everything out, warms everything up.”

The compounding effects of earlier snowmelt and declining precipitation have also made it easier for ground cover to dry out rapidly under a spell of hot weather. More frequent fires also burn through ground cover protecting permafrost, accelerating thaw that releases more carbon. According to the Alaska Center for Climate Assessment and Policy, the frequency of big fire seasons like this one are only increasing—a trend expected to continue apace with further climate change.

Additionally, this summer has been high in lightning strikes, which were linked to the ignition of most of the fires currently burning in Alaska. Higher temperatures result in more energy in the atmosphere, which increases the likelihood of lightning strikes. On just one day in

Permafrost Pathways installs first new carbon monitoring station

In early August, Woodwell's Dr. Kyle Arndt and Patrick Murphy installed a new eddy covariance flux tower in Churchill, Manitoba, Canada. This is the inaugural tower of the Permafrost Pathways project—a collaborative effort between Woodwell Climate Research Center, the Arctic Initiative at Harvard Kennedy School, and the Alaska Institute for Justice. The project aims to coordinate a pan-Arctic carbon monitoring network to fill data gaps that have hindered integration of permafrost thaw emissions and impacts into climate targets and adaptation governance.



MORE

Learn more at: permafrost.woodwellclimate.org

July over 7,180 lightning strikes were reported in Alaska and neighboring portions of Canada.

④ Communities are being affected hundreds of miles away

The destruction from these wildfires has forced rural and city residents alike to evacuate and escape the path of burning. Some residents of St. Mary's, AK have elected to stay long enough to help combat the fires, clearing brush around structures and cutting trees that could spread fire to town buildings if they alight.

But the impact of the fires is also being felt in towns not in the direct path of the flames. Smoke particulates at levels high enough to cause dangerously unhealthy air quality were carried as far north as Nome, AK on the Seward Peninsula.

“Even though a lot of these fires are remote, that doesn't preclude direct

human harm,” says Woodwell senior science policy advisor Dr. Peter Frumhoff.

Recent research has shown that combatting boreal forest fires, even remote ones, can be a cost effective way to prevent both these immediate health risks, as well as the dangers of ground subsidence, erosion, and loss of traditional ways of life posed by climate change in the region.

⑤ The season is not over yet

Mid-July rains began to slow the progression of active fires but, according to Dr. Frumhoff, despite the lull, it is important to keep in mind that the season is not over yet.

“The uncertainty of those early predictions also applies to the remainder of the fire season—we don't know how much more fire we'll see in Alaska over the next several weeks.”

Rebuilding Massachusetts' wetlands from the ground up

Four years into a transformative restoration, the Coonamessett River is a living laboratory for how to revive an ecosystem

Sarah Ruiz Science Writer

Dr. Christopher Neill, a senior scientist at Woodwell Climate Research Center, holds a confused snapping turtle at an arm's length, doing his best to keep the snapping end as far from him as possible. He moves it off the walking path to a sandy hill. Another turtle has already found a comfortable spot nearby and begun laying eggs.

"I guess with this lightly vegetated area, we've made great snapping turtle nesting habitat," Dr. Neil says, wiping off his hands.

The slope overlooks the older section of the Coonamessett River restoration project—a chaotic and vibrant wetland dotted with rushes, sedges, and shrubs. Swallows and osprey wheel overhead, the larger birds plunging down to the water occasionally when they spot a meal.

Two decades ago, this area was a cranberry bog. Cranberry plants grow well with their feet wet and many of the river valley's natural wetlands were converted for their cultivation. Native biodiversity was plowed under and flooded, and the original course of the river was diverted for better control of irrigation.

When the cranberry growing lease on the land ended in the early 2000s, a determined group of local residents, who would come to call themselves the Coonamessett River Trust, pushed the town of Falmouth, Massachusetts to return the land to its natural state—a

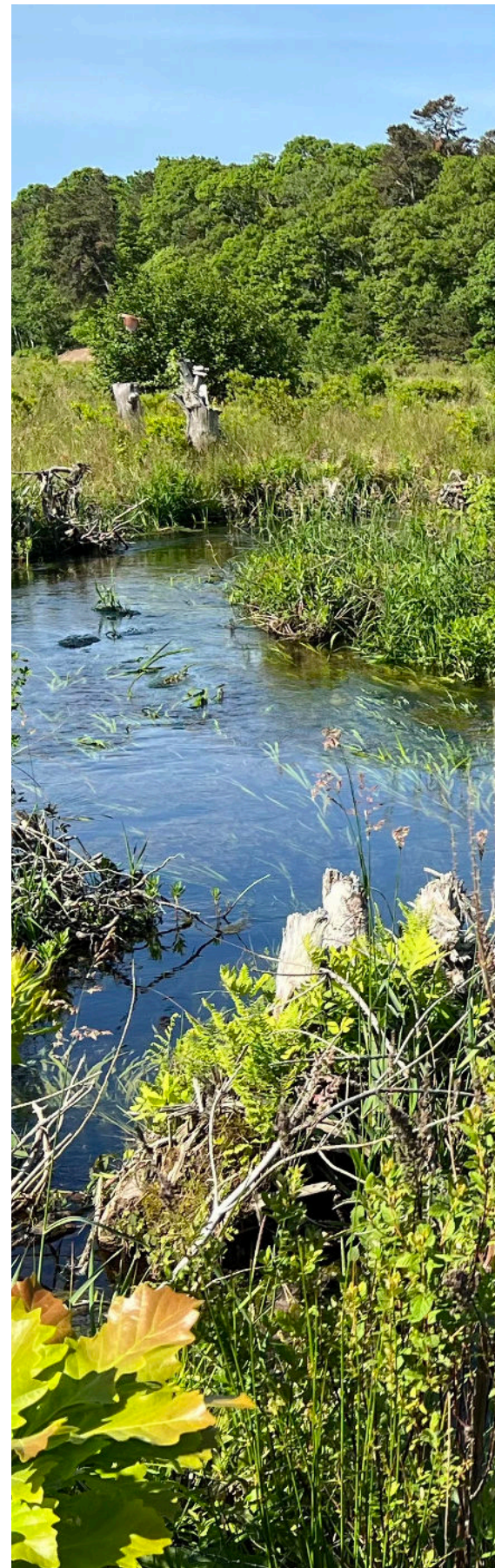
diverse natural wetland. Despite some opposition, the proposal was successful and work began on the restoration in 2017.

When the wetland was converted, it took with it ecosystem services it had been performing in the watershed for millennia. Wetlands are good at removing nitrogen. When groundwater interacts with plants and microbes, polluting nitrate is converted into plant biomass and harmless nitrogen gas. Here on Cape Cod, nitrates that leach out from homes and yards in fertilizers and wastewater typically get a free ride to the coast, causing algal growth to explode in estuaries. When these blooms die and decay, they use up oxygen in the water which can suffocate fish.

Additionally, many of the wetlands converted to cranberry bogs were originally Atlantic white cedar swamps, a unique ecosystem abundant in Sphagnum moss. This genus of moss forms peat as it dies and builds up in the soil. Over time, peat soils can sequester massive amounts of carbon.

The goal of restoration is to reinstate these natural processes. But getting an ecosystem back to a self-sustaining state can require a little tinkering—making adjustments to the landscape and water flow to encourage the flourishing of some species over others.

There can be trade-offs between sequestering carbon and building





biodiversity, though. Compared to grasses, trees offer more long-term carbon sequestration, but the shade they provide limits the number of species that can grow underneath them. A mosaic of open, grassy, meadow combined with more wooded spots allows for greater diversity. While the first section of the Coonamessett River restoration prioritized tree growth, project scientists designed the second phase with more intentionally varied topography for diversity—some higher, drier patches where trees can thrive, and some lower, boggy areas preventing tree saplings from out-competing the grass.

Researchers now come to the site frequently to continue monitoring how the wetland is changing over time—conducting water sampling, measuring river flow, and surveying biodiversity.

“I think we’ve shown that the naturalization process can work extremely well,” says Dr. Neill.

Counting on herring

Another crucial element of a successful restoration is keystone species—creatures

that have an outsized impact on the overall ecosystem. In the Coonamessett, that means the alewives and blueback herring (collectively called river herring) that used to overwhelm these waterways. They are a fish that, as Woodwell senior scientist Dr. Linda Deegan says with a grin “participates heavily in the food chain. Unfortunately for them, near the bottom.”

Because almost everything eats them, a healthy river isn’t possible without them. Though they spend much of the year out at sea getting snacked on by tuna, cod, striped bass, and whales, they make the journey each spring up rivers like the Coonamessett to spawn and offer another dining option for osprey, herons, and freshwater fish species.

Populations of river herring have suffered both from overfishing on the open ocean and degradation of freshwater habitat. Before the restoration, low bridges, culverts and water control structures for growing cranberries and the altered channel of the Coonamessett River and prevented herring from easily traveling up river far enough to spawn. Both

species of river herring were under consideration for the endangered species list, though they were never listed.

Herring populations have stayed steady recently, in part thanks in part to efforts like the Coonamessett restoration. Now, Dr. Deegan leads herring tagging efforts on the Coonamessett—one of the longest herring tagging operations in the northeast—to keep a close eye on fluctuating populations.

A researcher, usually Dr. Deegan herself, will catch the herring as it swims upriver to spawn, anesthetize them, and insert a tiny tag into their flank before sending them back on their way unharmed.

“When the fish passes through one of our antennae set up along the river, the antenna charges the tag and uses that to send a signal that registers the information in our data logger,” Dr. Deegan says. From this information we know what sections the herring have trouble migrating through, indicating the priority areas for restoration.

Volunteers also conduct fish counts as the herring make their way upriver between April and June each year. The hope is that, as the restoration grows in, it will ease the fish’s path to their spawning grounds and put them back on track towards the levels of abundance seen in the early 1900s. That abundance will in turn support species higher on the food chain.

The restoration’s successes have already garnered interest from across the community. Dr. Deegan leads elementary school groups through the process of tagging fish. Some older grades will later incorporate the data into their lesson plans, “adopting” tagged herring and following their journey through the river.

The adoption program and school visits have helped students recognize their shared responsibility for the health of the river. Dr. Deegan recalls a recent encounter with one 8th grader who returned to visit the restoration project. His 2nd-grade class had adopted herring and he was examining the river to see

if more fish were coming back now. He makes the trip over on his bike frequently to keep tabs on the herring. The restoration has created a multi-use space that encourages recreation and education in addition to conservation science.

From mudflat to wetland in under two years

Dr. Neill moves upriver to the footbridge where volunteers count herring in the spring. It overlooks the second phase of the restoration, completed in early 2020. Fewer trees have established themselves here, but it thrums with the diverse sounds of living things—from rustling grasses, to twittering birds and whining insects.

“This was a mudflat in the spring of 2020,” says Dr. Neill. “It ended up green and naturalized in two years.”

Though the effort of the restoration team created the right conditions for the land to flourish, much of the project’s success comes down to the sheer resilience of nature. For Dr. Neill, it’s a powerful proof of concept, especially when he thinks back to the objections raised at the outset of the project. Skeptics had doubted whether a restoration on this scale could be accomplished without falling prey to opportunistic invasive species like *Phragmites*—a common reed that can crowd out native plants.

“Nobody thought this would be nearly this successful. Now look at this. It’s got all this native vegetation, native grasses, blue flag Iris, sedges, rushes, and cattails. Very little *Phragmites* anywhere. Almost everything came in naturally, from what survived under the cranberry bog.”

The wetland that had persisted for thousands of years before the cranberry farmers, was still in the landscape. Buried deep in the soils, old seeds, dormant for at least a century, waited patiently. One quick turn of the soil during the restoration effort brought them up to the surface, and they needed no convincing to reclaim their place on the land again.



CLIMATE WEEK EVENT

Woodwell Climate is proud to partner with One Earth and The Explorers Club to bring you a special Climate Week event, *Nature in our Climate Budgets: Amazon to Arctic*. Join us for compelling conversation and audience Q&A with Tropics Program Director Dr. Mike Coe and Arctic Program Director and Permafrost Pathways Project Lead Dr. Sue Natali.

WHEN Wednesday, September 21 at 7 pm

HOW Livestream on The Explorers Club Facebook page or YouTube channel

In the news: highlights

Dr. Jen Francis was quoted in an *AP News* article on the jet stream’s impact on the heat waves affecting China, which contributed to widely-syndicated articles from outlets including *TIME*, *Fox News*, *ABC News*, *The Washington Post*, and *USA Today*. She was also quoted in a *Boston Globe* article on climate disasters.

Dr. Sue Natali was quoted on the impact of permafrost thaw on our climate budgets in a story from AGU’s *Eos*.

UMaine News published an article about newly-funded NSF research on methane sinks in Howland Forest, led in part by Kathleen Savage.

Dr. Jen Francis was quoted by *Reuters* in a widely-syndicated explainer article on what’s causing the recent US heat waves.

A *Yahoo!News* article about tsunami preparation on the US west coast included a quote from Dr. Anna Liljedahl about tsunami risk in areas with glaciers.

Alaska Beacon published an article on a pre-print study by Drs. Brendan Rogers and Sue Natali, and Stefano Potter, covering the 2022 Alaska fire season. The article was also published on KTOO.

Science Insider quoted Dr. Jon Sanderman on the recently-passed Inflation Reduction Act’s implications for soil carbon.

Dr. Jen Francis was quoted by the *Boston Globe* in an article about Massachusetts’ recent heat wave, and how a changing climate is changing how the jet stream flows. An article from *La Repubblica Green & Blue* also included a quote from Jen on the jet stream and heat waves globally (Italian).

Dr. Zach Zobel was featured on local Iowa news channel KCCI News 8, speaking about how climate change is influencing drought and heat.

BNN Bloomberg quoted Dr. Jen Francis on how the jet stream links heat waves and torrential rain in different parts of the country.

Dr. Zachary Zobel spoke to the *Boston Globe* about drought and rainfall in Massachusetts, and how we can expect climate change to impact current trends

Donations play an important role in securing the future of Woodwell Climate Research Center's work—and help safeguard the health of our planet for generations to come.

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