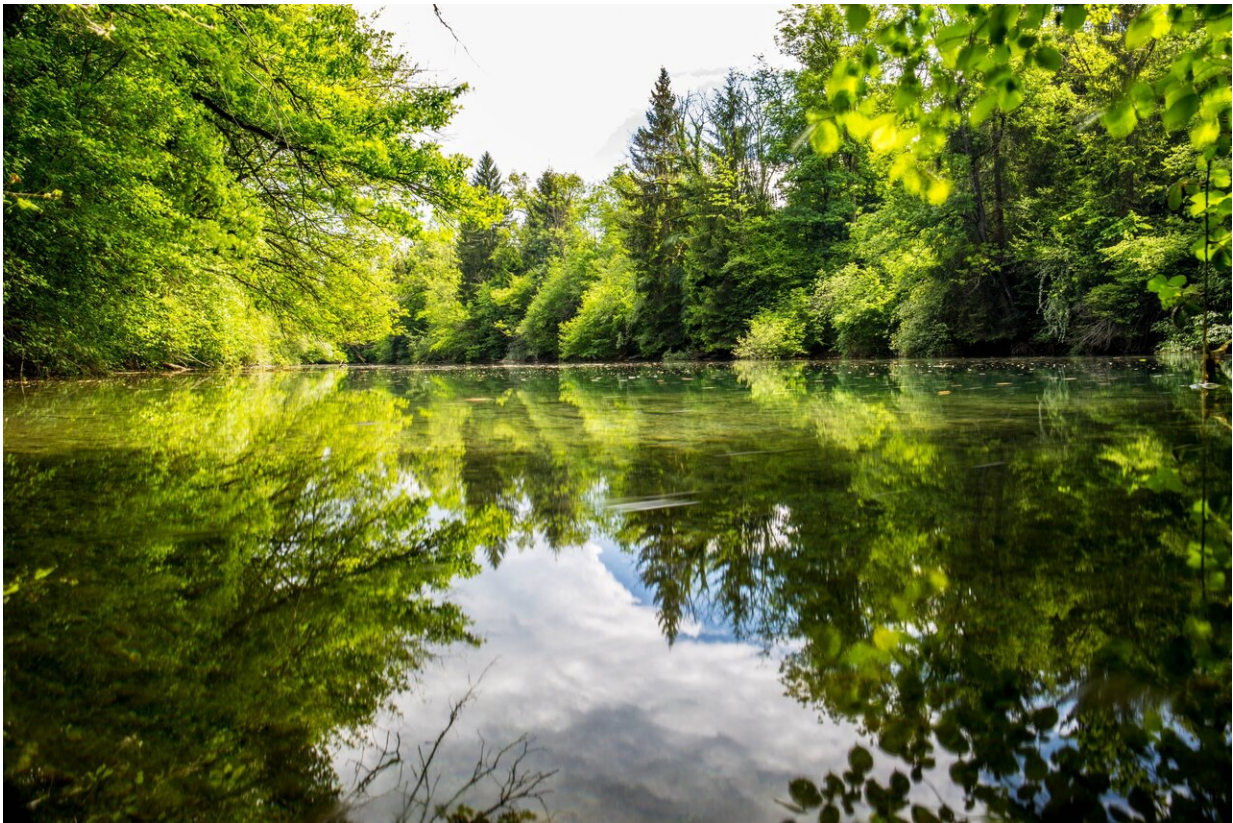# What is pond? Study provides first data-driven definition

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Credit: Unsplash/CC0 Public Domain

Nearly everyone can identify a pond, but what, exactly, distinguishes it from a lake or a wetland? A new study co-led by Cornell offers the first data-driven, functional definition of a pond and evidence of ponds'

distinct ecological function, which could have broad implications for science and policy.

"The lack of a universal pond definition causes a lot of confusion, from people wondering about the difference between a pond and a lake, to aquatic monitoring programs with different definitions across governmental agencies, even up to accurately modeling global carbon budgets," said Meredith Holgerson, assistant professor of ecology and evolutionary biology and co-first author of "A functional definition to distinguish ponds from lakes and wetlands," published June 21 in *Scientific Reports*.

"We wanted to evaluate how scientists and policymakers define ponds and examine whether ponds are functionally distinct from lakes and wetlands," Holgerson said.

Their conclusion: Ponds are small and shallow waterbodies, with a maximum surface area of five hectares, a maximum depth of 5 meters and less than 30% emergent vegetation.

There are hundreds of millions or even billions of ponds globally—more than 95% of the world's still waterbodies are small (under 10 hectares)—but the humble pond is understudied and has been largely left out of federal and state monitoring and protection programs. This is partly because their numbers make monitoring difficult but also because agencies fail to define them or distinguish them from lakes or wetlands. The neglect has implications for the accuracy of climate modeling, as ponds are high emitters of greenhouse gases, and their contribution to the global carbon budget is uncertain.

Holgerson and her team examined how scientists defined pond in more than 500 relevant scientific papers, coding it for different descriptors, like surface area or depth, and whether the descriptions were qualitative

or quantitative.

"We found that there wasn't one definition that researchers all cited, and the definitions were often qualitative, describing a pond as 'small,' for example," said Holgerson said.

The team also conducted a survey of state agencies in charge of waterbody monitoring and conservation. Half of the states had legislation that referenced ponds, but only one state (Michigan) defined ponds. Other states designated ponds as state waters or lumped them in with either lakes or wetlands.

The researchers found that ponds are not the same as lakes or wetlands, however. Further examination of the literature revealed that ponds have distinct ecological structures and function that make their categorization with either lakes or wetlands problematic.

Holgerson and her team plotted the relationships between surface area and various metrics of ecological structure or function. "We looked at parameters like gross primary production, respiration, chlorophyll levels, greenhouse gas emissions, diel temperature ranges, and the rate of gas exchange with the atmosphere," Holgerson said. "Nine out of the 10 ecosystem parameters related nonlinearly to surface area, suggesting that ponds really are acting differently."

They also examined how these ecosystem metrics related to depth and emergent vegetation—plants rooted in the bottom that extend to the surface—and again found nonlinear relationships. They used the thresholds for where waterbody functions began to change with surface area, depth, and emergent vegetation to arrive at their definition.

The distinct profile and characteristics of ponds means they shouldn't be held to the same monitoring standards as lakes or wetlands, Holgerson

said. "For example, ponds may have naturally higher nutrient concentrations and higher methane fluxes. We may need to develop unique water quality standards for pond monitoring."

More research is needed to hone the definition, particularly to better understand waterbodies at the boundaries between wetlands and ponds, and ponds and lakes, and how size, depth, vegetation—and other variables like how sheltered a waterbody is—impact the pond's functioning and its categorization.

"At the beginning of the study, we weren't sure if our research would allow us to propose a new definition that we felt confident about, but we think the numbers we offer are solid and a great jumping off point for further research," Holgerson said. "We do call for more research, especially to look at boundaries between wetlands, ponds, and lakes."

Holgerson hopes the new definition will also call attention to ponds as distinct, significant ecosystems that are worthy of study, monitoring, and protection. "Researching and monitoring ponds can help us figure out how these globally abundant waterbodies function. There's also an essential human element," Holgerson said. "So many people have connections to ponds—they have childhood stories of catching frogs or learning to fish in a nearby pond."

Provided by Cornell University