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Team to study human effect on watershed

Research will chart carbon cycle in 565-square-mile Christina River basin

By *RACHEL KIPP - The News Journal*



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Stroud Water Research Center scientist Louis Kaplan checks a tube that protects a white oak seedling as colleague Anthony Aufdenkampe collects sediment samples from the banks of White Clay Creek near Avondale, Pa.



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Scientists at the Stroud Water Research Center in Chester County, Pa., and the University of Delaware will use a \$4.3 million grant from the National Science Foundation to study Christina River basin, part of a nationwide effort.

AVONDALE, Pa. -- The narrow creek that runs behind the Stroud Water Research Center has witnessed plenty of changes over the centuries.

Hundreds of years ago, early settlers cleared trees and vegetation to build their homes. Later, the area became a cow pasture. Today, as Stroud scientists restore the forest, the creek bank is dotted with skinny, pale green tubes that protect young trees from strong wind and harsh weather.

The changes can be seen in the soil that makes up the creek bed. Scraping aside leaves and other debris with a small shovel, Stroud scientist Anthony Aufdenkampe reveals a swath that looks like a layer cake -- two lighter stripes separated by a chocolate-colored center strip.

The dark strip of soil is actually the creek bank as it was hundreds of years ago, and the top layer is all of the sediment that has accumulated in the years since -- some of it naturally, but most of it due to human activity.

"The dark layer that was there pre-settlement had probably been there for thousands of years," said Louis Kaplan, a Stroud research scientist who stood in the ankle-deep creek

water next to Aufdenkampe. "And then we have a 300-year period when we have this huge amount of sediment on top of it."

Scientists at Stroud and the University of Delaware want to learn more about that sediment, how it got there and where the water may carry it next.

They also hope to learn how that journey affects the carbon cycle -- the exchange of carbon between the atmosphere and rivers and streams, oceans, soil, fossil fuels and living things.

They believe that changes in the cycle affect global climate change.

Using a \$4.3 million grant, the team will spend the next five years studying how their theories play out in the Christina River basin as part of a nationwide effort funded by the National Science Foundation.

"The first question we're trying to answer is how humans are affecting the carbon cycle in a watershed," Aufdenkampe said. "Specifically, how is human erosion affecting the carbon cycle?"

Six studies in U.S.

The Christina basin, a 565-square-mile area that includes the Brandywine, Red Clay, White Clay and Christina River watersheds, is one of six areas in the United States where scientists will study watersheds to learn more about the health of the Earth's "critical zone" -- the area that extends from the treetops to the bottom of the groundwater table.

"Carbon is really linked to climate change and a lot of the big questions about our future climate," Aufdenkampe said. "Questions like, 'How much oil are we going to burn?' That's not even a scientific question, that's social question."

The National Science Foundation project includes observatories in the Sierra Nevada range in California; the Rocky Mountains in Colorado; mountain and basin areas in Arizona and New Mexico; along the Susquehanna River in central Pennsylvania; and in the tropical forest in Puerto Rico. Each observatory is focused on a watershed -- where all of the creeks and streams within the system drain into a central waterway.

"You can put a gauge at the bottom of the watershed and use that to kind of integrate all the processes that are happening upstream," Kaplan said.

For example, efforts to improve water quality in White Clay Creek could be for naught if pollution were being dumped into the White Clay tributary that runs through the Stroud Research Center's backyard.

"You have to start somewhere, and when you look at the map and start thinking where should we start, the obvious answer is a watershed," said Kyungsoo Yoo, a plant and soil science professor at UD. "It's the union of the landscape."

Picture incomplete

The National Science Foundation decided to launch the observatory program at the urging of the earth science community. Scientists said there was a lack of research sites that brought together those studying water, the atmosphere, plants and minerals to collectively examine what was happening in the Earth's critical zone.

"Usually when you are doing research, you're only looking at one component and you don't know how it relates to others," said Enriqueta Barrera, a section head in the NSF's earth sciences division. "So you don't have a complete picture of what is happening."

For example, scientists at the observatory that encompasses parts of Arizona and New Mexico are studying how rocks and soil interact to create a filter at the surface of the Earth that helps clean and store water. Researchers at the observatory in California are looking at the impact of climate change on the rapid seasonal precipitation changes in the southern Sierra Nevada.

All of the information gathered by each of the six NSF-funded observatories will eventually appear online in public databases. Other scientists and the public will be invited to work on their own research projects at the sites, Barrera said.

At UD, the funding complements another project: the launch this week of the Delaware Environmental Institute, an effort to encourage partnerships among First State scientists. The institute sets up shop after three days of events on campus, including an opening ceremony on Friday.

"When you bring these groups together and people from these different disciplines are housed together, you get interaction that I think is much more effective in addressing some of these questions that are very important but very broad," said Don Sparks, director of the Environmental Institute and the lead researcher for the critical zone observatory project.

The Christina Basin is unique among the areas being studied in the NSF project because it is the only system that has experienced the brunt of human development in the long term, flowing through forests, farms, suburbs and cities.

Source of drinking water

The scientists are one of dozens of groups monitoring the health of the basin, which includes five counties and 60 cities and towns in Delaware, Pennsylvania and Maryland.

More than half of Delaware's population gets its drinking water from the river system.

Delaware's first European settlement was established near the confluence of the Christina and Delaware rivers. For centuries afterward, trees lining the banks of the basin's watersheds were cut down to make way for factories and farms. Before environmental regulations were written into state and federal law, raw sewage and industrial waste was dumped directly into the river system.

The Christina River is a tributary of the Delaware, which eventually flows into the Atlantic Ocean, so studying the Christina basin also allows researchers to examine how changes in the carbon cycle impact the coast and marine life.

"Ours has a human stamp on it," Kaplan said. "And we are explicitly using the human stamp to ask our question."

<http://www.delawareonline.com/article/20091019/NEWS/910190335/0/RSS0907/Team-to-study-human-effect-on-watershed>