The New York Times

CLIMATE
Westchester Weekly Desk; SECT14WC
In a Marsh, Sifting the Past And Seeing the Future
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1072 words
6 November 2005
The New York Times
Late Edition - Final
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English

Piermont -- TWICE a day the tides flood Piermont Marsh, leaving layer after layer of thick, dark mud. At low tide one day in early autumn, Dorothy Peteet was ankle deep in it, squelching through the 15-foot-tall reeds, thick as bristles on a toothbrush, that now predominate. Finally, the shroud of reeds opened onto a patch of low, fine salt-marsh grass, which grows in swirls like cowlicks. Swirls like this used to cover much of the marsh's 270 acres along the Hudson River here in Rockland County.

The past that concerns Dr. Peteet is even more distant. In the mud under the marsh, it has left behind a record that, if carefully read, can help ecologists and climatologists anticipate what is to come.

Dr. Peteet, a research scientist at the Columbia University Lamont-Doherty Earth Observatory not far away in Palisades, started studying the Piermont Marsh because of a toothache. She was home sick one day in 2000 and watched an Audubon video that her husband had brought home. According to the video, the marsh formed after 1850 as a result of a pier built north of it.

''I just sat straight up and said, 'That's impossible!' '' said Dr. Peteet, who has studied wetlands for more than 25 years.

She and her research team at Lamont set to work disproving the assertion. That summer they started coring, or extracting, thin columns of mud -- which extends as deep as 46 feet -- to study the pollen, seeds, charcoal and sediment stored under the marsh like a 6,000-year-old ecological library. The findings allowed them to reconstruct the history of local forests and climate.

The first analysis, conducted by Dr. Peteet and Dee Pederson, a former research assistant in her lab, was published this summer in the journal Quaternary Research. In the top 8 feet -- 1,500 years' worth -- they found evidence of European settlement, the Little Ice Age and a 500-year drought.

The drought is especially interesting, she explained, because natural records of such phenomena for this time period are few, and because they reveal how dramatically our climate can swing even without the influence of large human populations.

''I've cored a lot around the world, and this is one of the most interesting places,'' she said. ''There's something very special about Piermont.''

That something is the sheer quantity of sulfurous mud. For some unknown reason, Piermont accumulates more than other marshes or lakes. What it means is that one meter of Piermont mud records 400 to 500 years, compared with 1,000 years per meter in other wetlands. The record it provides is stretched out, clearer and easier to interpret, the scientists say.

In the lab, Dr. Peteet and her team, which is financed by NASA's Geographic Information Systems group, remove seeds, which are used for radiocarbon dating, from small samples of the mud. Then they measure charcoal and minerals and dissolve the rest, leaving a gritty residue in the bottom of a vial: the hardy pollen that was blown in or washed in from the ancient forest.

''The thing I like about pollen is you can get a picture,'' said Dr. Pederson, who now works in Georgia studying soil for the federal Department of Agriculture. ''You can actually visualize what it looked like. When you're out there, you can pretend it's not 2005.''

The first foot and a half or so records the arrival and spread of Europeans from about 1700 to today. As forests were cleared for agriculture and industry, almost every type of tree pollen declined. At the same time, ragweed, which thrives in disturbed ecosystems, took over. From the 1400's to 1800's, the Hudson Valley was in the Little Ice Age, a cooler and wetter time when hemlock, spruce and beech thrived.

The most dramatic findings come from 800 to 1300, a time known in Europe as the Medieval Warm Period, which was marked by severe prolonged drought in what is today the western United States.

Until recently, there were almost no well-dated cores from this time in the eastern part of the country. But Piermont's thick layers provide one of the best. Pollen from pine, hickory and sweet gum suggest warmer, drier conditions, but the most telling evidence is lots of little fragments of charcoal. Where there's charcoal, there's fire, and where there's fire, it is probably very dry, according to Dr. Peteet.

While charcoal has been found in cores from the Chesapeake Bay region as well, it remains bold to infer that there must have been a major drought. ''The charcoal, it's hard to interpret,'' said James Clark, a scientist at Duke University who studies how climate change affects forests. American Indians in the area may have burned the forests regularly, he pointed out.

But cores from other marshes, some of which sit in a refrigerated vault at Lamont awaiting analysis, may help support Dr. Peteet's conclusion. Reconstructions of past climate -- whether from 1,000 or 11,000 years ago -- are more than ancient history. They provide a window onto the future, a baseline from which human effects on climate may be understood.

''It gives us some sense of what scale of background variability we're superimposing modern greenhouse warming on top of,'' Dr. Clark said. ''It's not nearly as large as what we're experiencing now. So getting some sense of what the background is just confirms what a dramatic impact we're having.''

Humanity's current effect on climate through greenhouse gases, a grand experiment unprecedented in natural history, could amplify a drought like the 500-year one from Medieval times that Dr. Peteet postulates. ''The chances are, you're going to have droughts now that are bigger even, or at least as big as, what you had in the past,'' she said.

''It doesn't portend well for New York City,'' she added, looking south from Piermont to where millions of people depend entirely on rainfall for their

water needs.

Photos: Dr. Dorothy Peteet, in the grasses of Piermont Marsh in Rockland County. The mud under the surface has left behind a record that helps her and her team predict the future climate. (Photographs by Samir S. **Patel** for The New York Times)

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