Utah Forest News

Utah Forest Landowner Education Program Newsletter

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Mud Provides Window into Utah's Forest History

Answers to many questions about Utah's forest history are located in an unlikely source: mud. Dr. Andrea Brunelle, Paleoecologist and Assistant Professor in the Geography Department at the University of Utah, is uncovering the fascinating story of forest history in Utah and other western states by studying the sedimentary deposits of mud located beneath high elevation lakes surrounded by today's forests. By removing a cylindrical core of sedimentary deposits and putting it through intense analysis back in the lab, Brunelle can observe changes in forest types and disturbance events that took place thousands of years ago.

Photo: Dr. Andrea Brunelle

Mud at the bottom of Emerald Lake tells a detailed story about the forest history of the area.

Brunelle and her Ph.D student Jesse Morris are especially interested in pollen records, through which they can determine what species of trees occupied the area around each lake, what the forest density was, and what sort of fire and bark beetle activity took place. What they have been surprised to find, however, are actual pieces of the puzzle – such as a pine needle from a lake bed in the Big Hole of Montana that was 17,000 years old. There have been other interesting finds as well. According to Brunelle, "We found a bark beetle deep in the sediments of Baker Lake, Montana, and when I compared this 8,000 year old beetle to one that died a few weeks ago, they looked exactly like."

Brunelle describes herself as an applied paleoecologist, meaning that she studies the ecology of past

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environments, but instead of the classical approach of simply trying to understand the ecology of the past, she is asking applied questions and coming up with some astounding results.

In fact, she has uncovered clues to the answer of one of the most common questions asked by Utah forest landowners: what is the future of the spruce forests in places like the Wasatch Plateau that have been decimated by bark beetles since the 1980s? At first glance, the future looks bleak. Some foresters say that it could take 10,000 years for the spruce to return. Others say we are going to lose the spruce component altogether, and walking through these beetle-killed spruce forests, it is hard to disagree.

However, Brunelle and Morris are finding that according to the pollen record, the spruce forests around these lakes were even more severely affected by logging associated with settlement in the 1850's, and that today's spruce forests may recover more quickly from the 1980s beetle outbreak than they did from that event. This leads one to believe that, barring changes from climatic shifts, the spruce forests will recover within a period of 150 years, and although that may not help today's landowners, it is important to their grandchildren. However, as one forester put it, "In 150 years we will be seeing bark beetle problems again" because spruce beetles are likely the dominant disturbance agent in spruce dominated forests.

At this point Brunelle's work is all about calibration. These lakes surrounded by dead spruce and pine trees offer Brunelle a chance to determine how a beetle outbreak affects the pollen record. By using known events in forest history over the past 150 years such as logging and beetle outbreaks, and observing how the pollen count and type responded to these known events, she can recognize these events in the pollen record from thousands of years ago before historical records were available. She can even estimate tree density and determine which tree species were on the landscape.

Mud samples from the lake are collected in these tubes, usually in one-meter increments.

Part of the calibration process involves getting what Brunelle refers to as "comparative material." So when she first started seeing what appeared to be parts of beetles, she contacted Dr. Barbara Bentz, Research Entomologist at the Rocky Mountain Research Station in Logan. Bentz had the comparative material on hand and sent samples to Brunelle, who realized that she was seeing *Dendroctonus* species, the Latin name for bark beetles, meaning tree killer.

Now Brunelle is working with Bentz and Steve Munson, Regional Ecologist with the USDA Forest Service, as well as Dr. James Pitts, Research Assistant Professor in the Department of Biology at Utah State University, to answer questions associated with patterns of disturbance and vegetation. One of the big questions she is working on in pine forests is whether a record exists of large scale fires following bark beetle outbreaks. The work that has been done on this question has focused mainly on patterns in tree rings during the past few hundred years. So far the answer seems to be no. However, Brunelle and Morris want to know if the pattern is similar over the past several thousand years.

Photo: Dr. Andrea Brunelle

Researchers use a river raft with a hole in the floor to acquire mud samples.

The work can be fairly challenging. Many of the mountain lakes best suited for this work are remote and far away from roads. Despite an impressive grant record from such sources as the National Science Foundation and the Joint Fire Sciences Lab, the budget to conduct these studies is still under-funded. The principle costs are the equipment used in the field and the laboratory and accessing these remote locations. Sometimes Brunelle uses outfitters and horses to access lakes up to ten miles into the backcountry. Occasionally she uses a helicopter, and sometimes she, Morris, and other graduate students just have to carry the equipment themselves.

To date Brunelle has cored Blue Lake and Emerald Lake on the Wasatch Plateau, Purple Lake and Banana Lake on the Aquarius Plateau, Alpine Pond on the Markagunt Plateau, and Deep Creek Lake on Thousand Lakes Mountain in Utah, in addition to several other sites in surrounding western states. These lakes were selected because historically documented spruce beetle outbreaks have occurred around them, allowing for better calibration.

The equipment consists of a river raft with a hole in the floor through which a long cylindrical tube is lowered into the bottom of the lake and pushed down into the mud. A core sample of the deposits at the bottom of the lake is collected within the hollow tube. The crew pulls up and carefully removes tubes of mud that are two inches in diameter and are kept in increments one meter long. The entire cores are typically 3 to 5 meters long. They are then wrapped in cellophane and aluminum foil, packed in boxes, and transported back to shore.

Brunelle recalled with laughter the difficulty of sampling lakes on the Wasatch Plateau in particular, where they are working with long metal tubes sticking up in the air during lightning storms and trying to time their work between storms, alternately rowing back and forth to crouch in the forest in the rain as each storm settled upon them.

Back at the lab, each centimeter of the mud is meticulously examined under a microscope. One target of her search is what she called “macroscopic charcoal”, particles greater than 125 microns in

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size. This gives her clues about fire history in the watershed. She also sees twigs, needles, and portions of cones. Originally the bark beetles were a surprise for her to see; now she is doing studies that are specifically looking for them.

To read the "pollen signal" the mud is washed with an arsenal of strong acids, which wash away everything else but leave the pollen. Its strong protein coating makes it resistant to the acids. The amount and type of pollen is then measured and identified, and if possible correlated to the abundance of trees on the landscape at that time.

This research may also increase our understanding of the abundance of aspen forests in the West, although this too has its challenges. Brunelle points out that the protein coating on aspen pollen is not nearly as resilient as that of conifer species, and is more likely to be carried away by the acid wash treatment. For now her funding and focus is mostly centered on answering questions about the history of spruce and pine forests.

By using these techniques Brunelle can evaluate patterns back to the retreat of the glaciers ~12,000 years ago, when mastodons and mammoths roamed throughout the Intermountain West. She describes the forest history following the period of the glaciers as similar to alpine settings with open meadows, shrubs and a few trees. These meadows were eventually replaced by spruce and fir forests. The older lakes she has cored in Montana that are now surrounded by pine forests were originally surrounded by spruce.

When asked if there is any human record prior to the logging associated with settlement in the 1850's she can point directly to *Erodium cicutarium*, a geranium that arrived with the first Spanish horses that came into the country around 1800 AD. Could this be the record of Utah's first invasive weed?

Brunelle can also use these valuable insights from the past to look into the future. A particularly warm period in the earth's history is the early Holocene. Examining the sediments deposited during and after this period will provide clues as to how our forests might respond to our present warming climate.

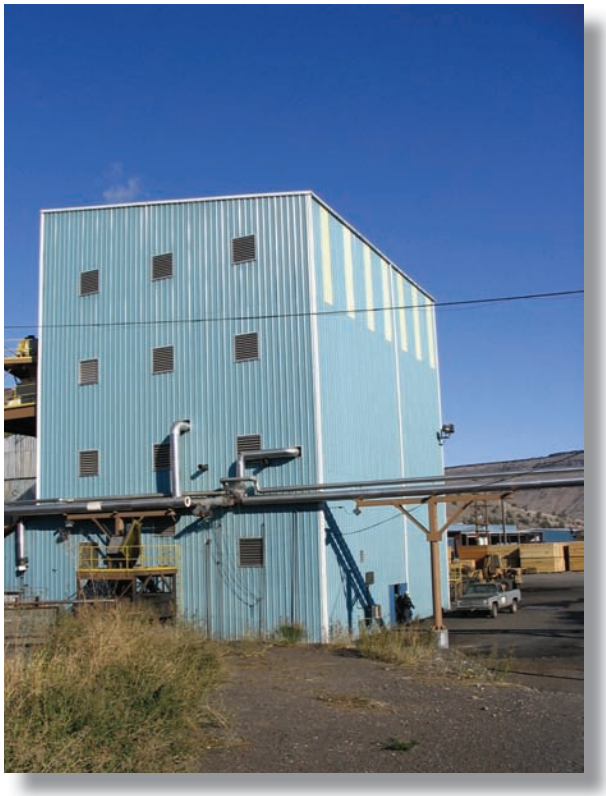
When asked about future work and funding priorities Brunelle gets wide eyed thinking about Fish Lake, southeast of Richfield, Utah. Because it formed in a protected area between two faults, known as a graben, and not by glacial processes, the record could go back 2 million years. This project would take a much larger boat, a bigger crew, and more substantial equipment and support, so it is yet a dream for Brunelle. Still, it is not often you see someone get really excited about "200 meters of mud."

by Darren McAvoy

Western Wood-to-Energy Projects Show Promise

Alternative energy and forest restoration are two hot topics in the West as concerns mount over the contribution of fossil fuels to global warming and unhealthy, dense forests grow increasingly susceptible to catastrophic fire. These problems may seem unrelated, but they have a common solution: the woody biomass found in overstocked forests can be used to produce heat and electricity.

While burning wood to create energy is hardly a new technology, meeting even a small proportion of an industrialized society's energy needs with woody biomass is a complicated endeavor. Fortunately, successful projects are emerging as examples of how large-scale wood-to-energy technology can work. One of these projects is occurring on the eastern side of the Cascades in Northern Oregon, on the Confederated Tribes of Warm Springs Reservation.



This cogeneration facility on the Warm Springs Reservation in Oregon uses woody biomass to produce heat and energy.

For years, tribal members observed declining forest health and increasing fire frequency on their reservation. This year, 12,000 acres burned on the reservation, which cost $12 million to fight. Although they had a sawmill on the reservation, it wasn't economically viable to thin these "sub-merchantable" stands. Utilizing the woody biomass in these forests for energy production emerged as a way to profitably remove unwanted materials and restore reservation forests to a healthier condition.

The Warm Springs Forest Product Industries (WSFPI) sawmill began a three phase project to construct a cogeneration facility which would utilize woody biomass from the reservation and surrounding areas. A cogeneration facility produces steam that can be used both for drying lumber onsite and to drive turbines that turn generators, creating electricity. The first phase of the WSFPI cogeneration project, which is completed, involved constructing a new boiler, which is currently sending steam to the sawmill's kiln. The steam is sent to the kiln in metal pipes, and the heat radiating from these pipes into the circulating air of the kiln raises the temperature inside. The second and third phases of the project, which should be complete by September 2009, will involve installing a second boiler and new power generation and ancillary equipment. WSFPI currently has a Power Purchase Agreement negotiated with an Oregon Utility and should be providing 15.8 MW of electricity to Oregon consumers soon. This amount of electricity is enough to power approximately 15,000 homes.

The cogeneration facility will require about 125,000 bone dry tons (BDT) of woody biomass a year. Wood from forest restoration activities on the reservation can meet some of this need, but not all, so other sources had to be identified before the wood-to-

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energy project could move forward. Half of the 125,000 BDT is expected to come from within the reservation, both from fuels reduction projects and from mill waste, such as sawdust, bark, and wood chips. Another source of fuel will be urban wood waste trucked in from Portland (i.e. construction materials, tree branches and stumps from city trees, and shipping pallets). A crucial step in meeting the fuel requirements of the biomass cogeneration facility came in January 2006, when the tribe signed a Memorandum of Understanding (MOU) with the US Forest Service and the Bureau of Land Management. The MOU committed 8,000 acres of public land and 80,000 BDT of biomass a year to the WSFPI cogeneration facility.

Emissions are an important issue when large quantities of woody biomass are burned. The facility at the WSFPI sawmill is equipped with the "best available emission control technology" and fully complies with state and federal emission standards. This results in far lower particulate and carbon emissions than would have occurred if these woody materials were burned in the open (either in slash piles or in prescribed and wildland fires). The ash that is produced is collected and sold to farmers and ranchers as fertilizer.

Biomass projects in Utah

Wood-to-energy projects on the scale of the WSFPI cogeneration facility do not currently exist in Utah. However, early efforts to utilize woody biomass for energy production are being discussed in the state. Last year, Governor Jon Huntsman established the Blue Ribbon Advisory Committee on Climate Change (BRAC) and charged the group with identifying steps the state could take to "mitigate the emission of greenhouse gases." Representatives from state government and industry, as well as environmental and community groups, participated in the committee and released a report in October 2007.

Steam is sent in pipes from the cogeneration facility to the kiln. The heat from the pipes circulates in the kiln to dry lumber.

The expense, risk, and difficulty of burning these slash piles in southern Utah could be avoided if a biomass facility were available nearby.

The BRAC report calls for expanded use of forest biomass for energy production in the state, but only classified it as a "medium priority." The report stressed the importance of locating biomass-fueled plants near forests to reduce transportation costs

and called for more research into how much woody biomass would be needed to produce a significant amount of power.

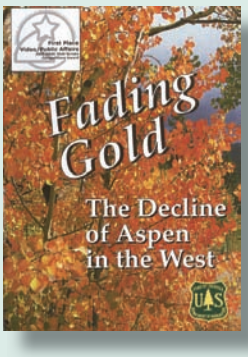
The growing number of neighboring states that are enacting Renewable Portfolio Standards (RPSs) is putting increasing pressure on Utah to diversify its energy sources. RPSs are state level policies that require a certain percentage of the state's energy to come from renewable sources by a target date. Although Utah has not enacted any RPSs within its borders, a large percentage of the energy produced here is sold out of state, particularly to California. The largest power generation facility in Utah, the Intermountain Power Project (IPP), is coal-fired and sells 75% of its power to California. Because California has enacted RPSs which require the state to acquire 20% of its energy from renewable sources by 2010, IPP is considering co-firing their plant with biomass, according to the BRAC report.

Utilization of woody biomass for energy production has yet to be adopted on a wide scale in the United States. However, the type of wood-to-energy projects described above are gaining increasing national support and attention. The USDA recently recommended that the 2007 Farm Bill (currently being debated in the Senate) set aside $150 million for research and development of wood-to-energy projects. With public concern mounting over global warming and declining forest health, it is likely that woody biomass will emerge as an important source of renewable energy in the coming decades.

by Olivia Salmon

Aspen DVD Available

Aspen decline is an important forestry issue in Utah and throughout the West. This 12 minute DVD describes the unique biology of aspen and how that is tied to its decline. To receive a free copy, contact Dale Bartos at 435-755-3560 or dbartos@fs.fed.us.



For more information regarding any of the information presented in this newsletter, please call Darren McAvoy at Utah State University, 435-797-0560, write to him at 5230 Old Main Hill, Logan, UT 84322-5230, or email darren.mcavoy@usu.edu.

The Utah State University Forestry Extension Web site, found at http://extension.usu.edu/forestry, is an excellent source of technical forestry information for woodland owners. Check the "What's New" section periodically for new postings.

State of Utah Division of Forestry, Fire and State Lands (DFF&SL) service foresters for your area can be contacted by calling 801-538-5555.

Ideas and written contributions to this newsletter are encouraged. Send your contributions or comments to the return address above or call 435-797-0560, or email darren.mcavoy@usu.edu.

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Utah Forest News

COMING EVENTS

Forest Biomass Short Course: January 7-18, 2008, Fort Collins, CO. This workshop will cover topics related to forest biomass utilization including forest conditions as they relate to biomass production, resource evaluation and characterization. For more info, visit http://welcome.warnercnr.colostate.edu/biomass-short-course.html.

Joint Meeting of Intermountain and Northern California Society of American Foresters: February 1-2, 2008, Reno, NV. Visit http://www.norcalsaf.org for more information.

Wildland Urban Interface Conference: March 4-6, Reno, NV. Visit http://www.iafc.org for more information.

In Ovid, Idaho, the Jensen Lumber Company uses their biomass waste to make wood pellets for home and commercial heating.