By Brian Payton

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Last Stand

Over nearly two decades, in a grove of old-growth forest on the North Shore, UBC's Lori Daniels has witnessed a doubling of the mortality rate of our trees

SIX KILOmetres north of Robson and Thurlow, Lori Daniels dodges saplings and roots with confident grace, dismissing huckleberry with a gentle wave of her hand. It's almost as if she's swimming. Twenty storeys up, the climax canopy of temperate rainforest brushes low grey cloud. She heads past giant Western red cedar, Western hemlock, and Douglas fir to the heart of her research, the findings of which were published last year in the journal *Science*, the implications of which will colour the way we see our forest—and our future.

She halts beside the enormous trunk of a fallen cedar, pulls out an increment borer (a kind of hand drill), and produces a sample core the size of a straw. Daniels exudes that mythic, West Coast, urban/wilderness thing marketed by MEC, the ability to flow between environments the way some Eastern bureaucrats shift between English and French. And despite having observed this particular patch of forest repeatedly over the course of 19 years, the doctor of biogeography retains the wide-eyed wonder of an intern, albeit one whose gloomy prognosis might send you scrambling

for a second opinion.

Daniels's native habitat could hardly be more unlike this grove: Manitoba's tallgrass prairie, where the native flora rarely tops a cornstalk. The daughter of a high-school physics teacher, she spent childhood summer vacations camping and exploring all manner of Canadian wilderness. On one such trip out West, she encountered UBC students engaged in scientific field research in Kluane National Park and thought, "This is for me." During her undergraduate science career at the University of Manitoba in the late 1980s, she spent summers at work on prairie restoration. It was during that time she developed a passionate interest in temperate rainforests; she and her friends founded the Rainforest Action Network some 2,000 kilometres from the coast.

"I couldn't fathom why they would want to clearcut a forest like this," she says, gesturing to the primeval grove around us. "I could see the economic gain, but I could also see the ecological consequences. I wanted to understand why our opinions were so far apart; the justification for the decisions being made. So I decided I would go and see if I could find out."

Daniels arrived at UBC in 1991 to pursue these questions in the form of a master's degree in forestry. As part of her thesis, she established a series of permanent research plots in the Capilano and Seymour watersheds that would become the focus of a long-term study of old-growth temperate rainforest. Here, her orange flags and numbered markers could remain undisturbed as the rain trickled into the reservoir and out our taps, as the seasons waxed and waned and the trees continued to grow, until reaching the ripe old age of, say, 600 or even 1,000 years before succumbing to natural causes, crashing to the forest floor, and serving as nurse logs for succeeding generations. That, at least, was the plan.

THE CAPILANO VALLEY WAS first tapped by the City of Vancouver with a water main across Burrard Inlet in 1889. Logging in the watershed sparked uproar almost from the start. The first commissioner of the Greater Vancouver Water District, the resolute Ernest Cleveland, stood firmly between local logging interests and the Capilano slopes, declaring, "They will log that watershed over my dead body." His words proved prophetic. Cleveland served as water commissioner for 26 years. In 1952, the year he died, his strict "no logging" policy was reconsidered. Logging resumed in 1958 and was still permitted when Daniels arrived on the scene in 1991, even though by then the GVRD's watersheds (Capilano, Seymour, and Coquitlam) were supplying half the drinking water in British Columbia.

With the PR promise of modern, scientifically managed "Forests Forever" ringing in British Columbians' ears, Daniels's academic adviser suggested she study Western red cedar, an iconic and valuable species that nonetheless remained poorly understood. Daniels happily took up the cause. She marched into the forest and established a series of 70-by-70-metre plots in the Capilano watershed, tagging all trees wider than 10 centimetres in diameter (some 1,300 trees of six species), reasonably assured they would remain undisturbed by loggers, hikers, mountain bikers, kids, and yahoos. They would stay where she put them.

As Daniels was settling in at UBC, her adopted province was riven with debate over cutting down old-growth trees in places like the Stein Valley, the Walbran Valley, and the Capilano watershed. While friends were getting arrested in the largest act of peaceful civil disobedience in Canadian history at Clayoquot Sound, Daniels was busy taking a close look at the old-growth trees just above Vancouver—closer, perhaps, than anyone had ever looked before.

By the time she was completing her master's, a seismic cultural shift was rumbling through British Columbia. Significant tracts of old-growth forest were being set aside in parks and protected places. The future of many of our oldest and most majestic trees, including the giants of Capilano, seemed secure at last. After 37 years, Cleveland's logging ban was finally reinstated in 1995, three years after Daniels began her study. The watershed was declared off-limits to

industry and the public, except on guided tours. Here, nature (and science) would be left to take its course. It was believed that these trees—hard fought for and won—would remain a precious, everlasting gift for our grandchildren's grandchildren. Daniels hoped that her work would add to the understanding of this living legacy.

In 1996, Daniels left to pursue a PhD in biogeography, focusing on the effects of climate change in the forests of South America. She returned to Vancouver for a working vacation in 1997 and repeated her survey. Then, after completing her postgraduate studies, she moved back to the area. In 2002, she checked in on her trees again. Her old hunch proved correct: no one had disturbed her research plots, although in some cases expanding bark had nearly engulfed her metal tags. What she couldn't have guessed was that her data would soon reveal a pattern that would undermine past assumptions of permanence and, indeed, cast doubt on the very survival of the forest.

THERE WAS NO CINEMATIC bolt of insight, only a growing pile of evidence. It was science, pure and simple. Over the years, Daniels's research has tracked numerous variables, including both rising temperatures and more frequent droughts in Vancouver's watersheds. As her data well deepened and trends began to surface, she noticed a significant change in the overall life cycle of her trees. More were dying than expected.

It wasn't until 2004 that Daniels got a glimpse of what her research might truly signify. While attending a gathering of her peers in California, she met colleagues conducting similar long-term studies of old-growth trees across western North America. One of them suggested her data be compiled to get a Google-eye view of what is happening in our forests.

The vital statistics of Daniels's 1,300 trees were then folded into a larger data set incorporating the lives of 58,700 trees scattered across the western half of the continent. From Arizona's ponderosa pines to California's giant redwoods, from Colorado's lodgepole pines to B.C.'s Western red cedars, a similar trend emerged. Of the forests studied, 87 percent showed increased mortality. Simply put, trees are dying faster than they're being replaced, and it's happening at all elevations. The death rate has doubled in just 29 years in interior forests, 25 years in coastal California, and—by far the most alarming—just 17 years in the temperate rainforests of the Pacific Northwest, the Capilano watershed included. We're not just talking about shortening the sunset years of geriatric trees. Saplings, trees in their prime and middle age, trees of all ages are being affected. Something—something widespread and insidious—is killing our forests.

For Daniels and her colleagues, there was no rush to judgment; rather, it became a process of elimination. This threat is unlike the dramatically obvious pine beetle plague, which has already killed half of British Columbia's merchantable pine trees (and will likely kill nearly 80 percent of them by 2013). Pollution and fire suppression could not provide the answer across the disparate regions and various forest types. What is consistent across the western half of North America? An average temperature increase of 1˚C.

"The message is clear," Daniels explains. "This is evidence of stress that is most likely linked to climate change." A climatic change that lies "beyond natural variation."

SOME OF THE TREES HAVE been alive since the height of the Aztec Empire, since Marco Polo met Kublai Khan, even since the First Crusade. Surely the trees of the Capilano watershed have endured dry spells before. Daniels is the first to admit that her study has taken place during a warm and dry phase that is part of a larger natural pattern.

In 1976-77, a switch took place in the way Pacific Ocean currents and the atmosphere interact off our coast, known as the Pacific Decadal Oscillation (PDO). Climatologists predict that we are due for a switch back to a cooler, wetter phase. Sound like the silver bullet for solving climate change on B.C.'s coast? Think again. If and when the switch occurs, Daniels says, it won't solve the problem—only buy us time before it inevitably reverts to a

warmer phase under what will most assuredly be increased CO_2 levels, higher temperatures, and a transformed global climate. On a graph, the long-term PDO pattern has distinct peaks and troughs. Think roller coaster. Now tilt the ground beneath that roller coaster on an upward pitch and you get a sense of the new heights we can expect on each leg of the coming ride.

"I don't want to leave you with the impression that all our forests are dying instantly and we don't have any time left," Daniels explains. "But this doubling of mortality is kind of like the straw that broke the camel's back. That's our cautionary message."

"Doubling of mortality"—it has an ominous ring. What does it mean in real terms? An increased death rate of one to two percent. If at first this seems innocuous, Daniels offers an analogy tailor-made for a Vancouver audience, one that draws its language from a topic we find irresistible: real estate investment, mortgages, the magic of compound interest. "Say we have 100 trees, and one percent are dying per year. At the end of a 50-year period, we would have only 60 trees remaining. If we double that to two percent, you're only going to have 36 trees remaining. If the PDO switches, the rate of loss might decrease. However, if it were to continue to increase, or maintain at the higher levels we've observed in this forest, what we'll see is trees of all sizes dying—small, medium, and large."

Since her copublication in *Science*—the first in the 50-year history of UBC's Department of Geography—Daniels has heard from numerous critics, including a man in Calgary who wrote to offer this bit of considered wisdom: "Trees die all the time. Get over it." Daniels's response speaks to the uninformed investor in all of us: Look to the long term. Look to the bottom line. "Think of the way a small change in mortgage rates can cause foreclosures and contribute to an economic crisis…"

DEPARTING DANIELS'S OLD-growth study plots brings a sense of déjà vu to anyone who toured Stanley Park after the storm of December 2006—the storm that broadsided Prospect Point, snapping or toppling 10,000 trees in our cherished urban oasis. Here on the North Shore, near the southern end of the watershed, a mature stand of second-growth hemlock was tossed like a super-sized order of fries. These trees were felled by the same storm, only there were no calls for cleanup, no salvage of wood for souvenir canoe paddles or planks of memorial flooring. Daniels uses the dramatic scene to punctuate her explanation of coastal weather systems, and that storm in particular—a storm most people assumed was a hurricane. Most people, it turns out, are wrong.

"Windstorms that blow down trees happen on a regular basis in coastal B.C.," Daniels explains. "And we've had some hurricane-force winds—for example, Hurricane Frieda in 1962. The climatologists I've spoken to told me that what we had in 2006 was unique. When we had big windstorms in the past, they were part of hurricane weather systems coming in off the Pacific. The windstorm at the end of 2006 was not a hurricane. It was simply a very, very strong winter storm. It's been suggested that this may be an indicator of the types of extreme weather conditions we might see in the future that are beyond the historic, natural variation."

Her reply to the cries of that tenacious but uninformed species, the climate-change denier? Temperatures have warmed since temperatures have been recorded. Human beings have pumped CO_2 into the air and we've changed the chemical composition of the atmosphere. "I have some personal friends who don't agree that climate change is taking place," she admits. "My response is always the same: 'How do you think the atmosphere works? How does CO_2 influence global temperatures?' Often, they come up with incorrect explanations that certainly wouldn't get a passing grade in my 100-level Geography class."

Even if climate change is the culprit, and half our temperate rainforest dies before today's high-school kids retire, won't other kinds of trees or even ecosystems replace them?

"We're still learning about the species within our forest," Daniels says. "We're still learning about their inherent value, and their value to us. If we had just cut down all the old-growth forests, we would have never learned about Taxol [a drug derived from the bark of the Pacific yew] and how important it is as a medication to fight breast cancer. There may be tens or hundreds more of those discoveries in these forests. I would hate to miss that opportunity for our generation, or for future generations."

SIMPLY PUT, TREES ARE DYING faster than they're being replaced. The death rate has doubled in just 17 years in the rainforests of the Pacific Northwest

What's more, Daniels explains, our forests have long served as significant "carbon sinks," covering for the extravagance of our industrial civilization—an ecological line of credit, if you will. Should present trends continue, these dying forests will cease absorbing and instead begin emitting CO_2. The profligate days of living beyond our means (and getting away with it) will end. Our ecological debt will have finally been called. And if you imagine this might harm only wild, genetically unmodified species, think again. What's affecting our old-growth forests will also affect fruit trees, annual crops, the food that ends up on our tables.

"In some ways, it's heartbreaking," Daniels says. "I've made my students cry, telling them these stories and trying to get them to understand how subtle, but significant, these impacts are. We chose not to log these trees—we chose to protect them in a watershed. And yet our impacts here are still pervasive.

"As dismaying as the results are," she adds, "I don't want people to just give up hope. We can turn it around." She points to past efforts to curb pollution and save the ozone layer—the switch to unleaded gasoline, the use of catalytic converters, the international treaty banning chlorofluorocarbons. Each of these changes met resistance but ultimately came to pass without destroying businesses or undermining economies. This time, she admits, we can't rely solely on technology to fix this problem. "We have to think about changing and modifying our behaviours."

THE SHORT DRIVE BACK TO the heart of the city leads through Stanley Park, where most of the storm damage has been cleared away and workers are busy with a new project, made possible through donated cash and labour. They're fitting braces and cables around the tottering Hollow Tree, Vancouver's famous (and long-dead) Western red cedar. When you're coming from old-growth Capilano, it at first appears as a metaphor for passing wilderness, human folly, and causes long lost. On second glance, though, it might also be seen as a symbol of determination.

Nineteen years after arriving at UBC with her questions and convictions about rainforest conservation, Dr. Lori Daniels now stands on the opposite side of the lectern—where the view is fresh and optimistic. From there, the associate professor of biogeography challenges her students to take responsibility, to make and sustain a change to reduce their CO_2 emissions—things like taking public transit, riding a bike, or packing a reusable coffee mug.

Seriously? Can we really believe these sorts of small, personal gestures will make even the slightest difference? Will shaving a tiny fraction off our mortgage rates today really pay off tomorrow? Individuals adjusting their ways of living will certainly have a cumulative effect, Daniels insists. After all, the sum total of individual deeds is what got us into this mess. It may be our only real hope for getting out. **VM**