

grow

Wisconsin's Magazine for the Life Sciences • Spring 2011

food & agriculture • environment • energy • health

CRAFTED *with* CARE

The rise of
Wisconsin's artisan
cheese market



College of Agricultural & Life Sciences
UNIVERSITY OF WISCONSIN-MADISON

THE BEETLES ARE COMING • REDUCING KIDS' SUMMER WEIGHT GAIN • BIOFUEL FOR FRESHMEN





grow

Wisconsin's Magazine for the Life Sciences

16 Crafted with Care

Wisconsin's artisan cheese renaissance is the work of many hands, including close cooperation between the state, CALS, businesses and nonprofits. Here's the story behind the miracle.

By Michelle Wildgen

22 A Bug in the System

The mountain pine beetle is not an invasive species, but milder weather is making it act like one. The beetle is laying waste to conifer forests from Alaska to Arizona—and now scientists in Wisconsin are on the lookout.

By Bob Mitchell BS'76

28 Taking It Outside

Kids are packing on pounds during a season once associated with outdoor activity and exercise. The reasons why point to a perfect storm of environmental factors leading to weight gain.

By Madeline Fisher

Departments

4 In Vivo

Interim Dean William F. Tracy

5 On Henry Mall

Freshmen pan for microbes for biofuel development

Unveiling a better culture for stem cells

Funding gives students *hands-on time* with cows

Why Teri Balser was named *Professor of the Year*

New initiative aims to *recruit more hunters*

KnowHow: Identifying people by their DNA

12 Field Notes

Alaska: Thawing ice and soil offer insight into climate change.

14 Living Science

Horticulture professor *Jiming Jiang*

34 Working Life

The Grow Dozen: Alumni making a difference in *forestry and related industries*

38 Back List

Five things everyone should know about *bedbugs*

39 Final Exam

On the cover: The rise of Wisconsin's artisan cheese market is a business and culinary success story.

Cheese provided by Alp and Dell Cheese Store and Emmi-Roth Käse USA, Monroe, Wisconsin

YOU CAN FEEL AT HOME HERE: The new Wisconsin Institutes for Discovery combines cutting-edge research facilities with an array of programs for the public, including presentations by CALS faculty.

Interim Dean William F. Tracy

An Opportunity to Serve



CALS has given a great deal to me since I arrived here as an assistant professor in 1984. In the past 27 years, I have had opportunities to build a productive research program on the breeding and genetics of sweet corn, to teach and advise many hundreds of bright students and to forge relationships with people across Wisconsin and around the world. Throughout my career, my experiences in CALS have helped shape not just the work I do, but also the way in which I do it.

So it was with some sense of indebtedness that this fall I accepted Provost Paul DeLuca's invitation to serve as CALS' interim dean. I am humbled to serve our college during this transition, and I will dedicate myself fully to ensuring its continued success.

The good news is that the college is in outstanding condition. Our faculty are world-renowned for their expertise and produc-

As interim dean, I will work to make CALS even stronger in all of our missions.

tivity—this past year, we earned more in federal and private research funding than in any year in the college's history. We continue to graduate students with the knowledge and skills to make a difference in their careers, and our alumni continue to dazzle us with their leadership and accomplishments. We also enjoy strong partnerships with agricultural and scientific industries in the state and play an important role in helping ensure that these businesses remain a vibrant part of our state's economy.

In these times, however, to hold steady is to fall behind. As interim dean, I will work to make CALS even stronger in all of our missions. And although both the state and federal budgets will be constrained by economic factors beyond our control, I believe that progress is attainable. During the next several months, the CALS community will be engaged in critical conversations about how to increase the efficiency and impact of our activities—and because I know this community, I know those conversations will be productive.

The faculty, staff, students and alumni who devote their lives to making CALS a special place deserve a great dean. My top priority will be to put CALS in the strongest position possible to recruit and hire the best scholar and leader to assume this role permanently. In the meantime, you can rest assured that CALS will not pause. We have too much momentum to carry us any direction but forward.

Editor

Joan Fischer

WritersNicole Miller MS'06,
Bob Mitchell BS'76**Editorial Assistants**Rebecca Bock, Charlie Pope,
Christa Seidl**Design**

Diane Doering

Marketing

Sevie Kenyon BS'80 MS'06

PhotographyAll photographs by Wolfgang
Hoffmann BS'75 MS'79, except as
noted.**CALS ADMINISTRATION**

William F. Tracy, Interim Dean
Birl Lowery, Senior Associate Dean
Rick Lindroth, Associate Dean for Research
John Shutske, Associate Dean for Extension and Outreach
Daniel Schaefer, Interim Associate Dean for Instruction
Michael Penn, Interim Assistant Dean for External Relations

INTERACTING WITH CALS**Alumni:**

Office of External Relations,
1450 Linden Drive, Madison,
WI 53706
Phone: (608) 262-1251
Email: alumni@cals.wisc.edu
www.cals.wisc.edu/alumni/

Prospective students:

CALS Undergraduate Programs and Services, 1450 Linden Drive, Madison, WI 53706
Phone: (608) 262-3003
Email: undergrads@cals.wisc.edu
www.cals.wisc.edu/students/

Business contacts:

Office of Corporate Relations,
455 Science Drive, Suite 230,
Madison, WI 53711
Phone: (608) 263-2840
Email: inquiries@ocr.wisc.edu
www.ocr.wisc.edu

To make a gift to CALS:

Brian Hettiger, UW Foundation,
P.O. Box 8860, Madison, WI 53708
Phone: (608) 265-5893
Email: Brian.Hettiger@supportuw.org
www.supportuw.org

To contact the magazine:

Grow Editor, 136 Agricultural Hall,
1450 Linden Drive, Madison, WI
53706
Email: grow@cals.wisc.edu
www.cals.wisc.edu/grow/



**College of Agricultural
and Life Sciences**

UNIVERSITY OF WISCONSIN-MADISON

fsc logo here-FPO
FSC_B_L_Green
don't print keyline

On Henry Mall

News from around the college

O Bioneers

A new course in bioenergy gets freshmen involved in real-life research challenges

It wasn't exactly panning for gold, but a lesson in "bioprospecting," as it's called, had students scour the campus looking for something just as valuable: invisible forms of life that could one day be key in developing a sustainable alternative to oil.

"Instead of going out and looking for precious metals, we're looking for precious microbes," says John Greenler, director of education and outreach at the Great Lakes Bioenergy Research Center and lead instructor of the university's first bioenergy course for freshmen, held this past fall semester.

"Out in the environment there are a lot of microorganisms that are really good at breaking down fibrous plant material," Greenler notes—a vexing but essential step in producing biofuel.

"We're hoping to figure out how those microbes do that and then utilize that process to make biofuels—essentially, capture energy for our transportation needs the same way the microbes capture energy as a source of food," Greenler says.

"Bioenergy: Sustainability, Opportunities and Challenges" debuted as a First-Year Interest Group (FIG) program open to 20 freshmen, and it was snapped up quickly during registration. As the bioprospecting lab shows, the course was designed to have students work on real-world problems researchers face in a new and rapidly growing field.

That includes the frustrations. Student Michael Polkoff reports that the prospecting material chosen by his group—pond scum—came up negative for microbes that produce cellulose-busting enzymes.

"While the results are depressing for the work we put into this—especially going barefoot into a freezing, sludgy drainage pond—it's part of doing scientific research," says Polkoff. "Sometimes you get results, other times you don't. More importantly, we learned how research is done."



The course has galvanized Polkoff's interest in bioenergy. "Before I took this class I was only a little curious with the concept of bioenergy," he says. "Now I feel involved with bioenergy research and the possibility of using it to solve many environmental, political, and economic problems."

The course is offered through a partnership between the Great Lakes Bioenergy Research Center and the Wisconsin Bioenergy Initiative. Students visit the UW campus labs of some of the nation's foremost researchers, and one field trip took them to CALS' Arlington Research Station to study bioenergy field plots.

The FIG program, which clusters three courses linked by a common theme—the bioenergy course was paired with introductory chemistry and environmental studies—targets low income, minority, "first in family to college students," says Greenler. "Overall, about 30 percent of students in the FIG program are minorities."

—JOAN FISCHER

Hot on the trail of cellulose-busting microbes.

Taking Out the Guesswork

Researchers have created a safer culture for embryonic stem cells



Kiessling in lab with research assistant Joseph Klim.

Growing human embryonic stem cells in the lab is no small feat. Culturing the finicky, shape-shifting cells is labor intensive and, in some ways, more art than exact science.

But a team of researchers led by Laura Kiessling, a UW professor of biochemistry and chemistry, has developed a culture system that promises a more uniform and, for cells destined for therapy, safer product. The system is inexpensive and takes much of the guesswork out of culturing the all-purpose cells. “It’s a technology that anyone can use,” says Kiessling. “It’s very simple.”

At present, human embryonic stem cells are cultured mostly for use in research settings. And while culture systems have improved over time, scientists still use lab dishes coated with mouse cells or mouse proteins to grow batches of human cells. Doing so, however, increases the chances of contamination by animal pathogens such as viruses, a serious concern for cells that might be used in therapy.

“The disadvantages of the culture systems commonly used now are that they are undefined—you don’t really know what your cells are in contact with—and there is no uniformity, which means there is batch-to-batch variability,” Kiessling explains. “The system we’ve developed is fully defined and inexpensive.”

Instead of mouse cells or proteins, Kiessling’s new culture system utilizes synthetic, chemically made protein fragments. The system can culture cells in their undifferentiated states for up to three months and possibly longer. It also works for induced pluripotent stem cells, the adult cells genetically reprogrammed to behave like embryonic stem cells.

Cells maintained in the system were subsequently tested to see if they could differentiate into desired cell types, and performed just as well as cells grown in commercially available cell culture systems, Kiessling says.

The first clinical trials involving human embryonic stem cells are underway. As more tests in human patients are initiated, confidence in the safety of those cells will be a top concern, notes Kiessling.

—TERRY DEVITT

Berry Good Science

It was a yummy connection to a science badge. Nearly 50 Girl Scouts from southern Wisconsin extracted DNA from strawberries during two “Biochemistry in the Kitchen” workshops led by graduate students and postdoctoral fellows with the Integrated Program in Biochemistry’s Student-Faculty Liaison Committee. The scouts used salt water and dishwashing detergent to extract DNA from mashed-up strawberries, and then added rubbing alcohol to make its spaghetti-like strands visible. As a keepsake, the girls got to bring their results home in test tubes.



Cows, Up Close and Personal

Special funding allows students more hands-on learning about animals

The students are nervous. The cows, not so much. But only because they don't know what's coming. They're lined up in stalls in the Old Dairy Barn—10 Holsteins on one side, 10 Jerseys on the other—where, during the next few hours, they will undergo artificial insemination (AI) by small teams of undergrads who each have a particular cow in their care.

Professor John Parrish and two TAs direct students as they prep for the procedure, which starts by pulling plastic straws filled with bull semen out of frozen storage, thawing them in warm water, and loading them into long syringes called AI guns. The students don long plastic gloves; AI is a two-armed operation. One hand will pilot the AI gun up the cow's vagina, through the cervix, and into the uterus. The other hand, inserted far up the cow's rectum, presses along the rectal wall to help manipulate the gun into place.

"No, I've never done this before," laughs student Brandee Roberts while heeding Parrish's call to "lube up" an arm. She grew up in Milwaukee with the goal of becoming an obstetrician, and finds working with cows and pigs in Parrish's Reproductive Physiology class highly relevant to her future. Her teammate Carissa Levash grew up on a dairy farm but says her father handled all the breeding. She wants to work in dairy industry sales. Their teammate Ty Hildebrandt, on the other hand, was raised in dairy and wields the AI gun like a pro. In a class made up mostly of city kids (and 80 percent women), most teams have one experienced member to offer additional guidance. Gamely the trio marches over to Cow No. 15, a gentle Jersey they've named Betsy.

This year the students have gotten to know their cows particularly well. While Animal Science/Dairy Science 434 has long offered students the opportunity to perform AI, that was their only hands-on work with the cows. Now, special funding through the new Madison Initiative for Undergraduates (MIU), which uses a supplemental tuition charge to improve undergrad education and expand financial aid, has enabled the students to do a whole lot more.

Students are in charge of syncing their cow's reproductive cycle to be ready for AI on a particular date. They administer injections to bring their cow into heat and then concoct and inject the best hormonal cocktail to ensure their cow will ovulate some 12 to 18 hours after insemination. They'll track their cow to see if she goes into heat again or gets



pregnant, using ultrasound to help make the final determination.

Previously all of that work—which is part and parcel of modern cattle breeding and key to understanding reproductive physiology—would have been done by teaching assistants. But an additional TA funded through MIU meant the hands-on work could fall to the students themselves, with the TAs serving as coordinators and coaches.

The students are thrilled. "Most other pre-vet undergrads that I know at other schools don't have these opportunities," says Erin Harris.

Over at Betsy's stall, Roberts, Levash, and Hildebrandt take turns inseminating. Apparently it's not so simple. "Can you feel the cervix? Do you think you're in yet?" Parrish coaches. "You can feel the gun tip when it's in the vagina and in the uterus, but not while it's in the cervix!" Betsy remains remarkably unperturbed, all things considered.

The students seem pleased with their efforts. Parrish expects only six or seven cows will conceive—it takes a lot of practice to become proficient—but for him, that's not the main measure of success. "The students keep thinking it's just to get the cow pregnant," he says. "But I don't care so much about that. What I care about is how much they're learning about reproduction."

—JOAN FISCHER

[Editor's Note/Epilogue: Betsy got pregnant.]

Team Betsy, left to right:
Ty Hildebrandt, Carissa
Levash and Brandee
Roberts.

Challenging Their Brains

Teri Balser's teaching style awakens curiosity and encourages big picture thinking



PHOTO BY BRYCE RICHTER / UW COMMUNICATIONS

Former student Jillian Dynowski introduced Teri Balser at the Professor of the Year awards ceremony with these words:

“**Professor Balser** has an amazing ability to connect with all of her students and focus on the big picture. The focus was never on rote memorization. Instead, students were encouraged to ask questions and challenge their brains so as to encourage a deeper appreciation for the subject and to build their own thinking skills.”

CALS soil scientist Teresa Balser remembers the “aha moment” when she first decided to change her teaching style—a departure that, more than anything, led to her recently being named U.S. Professor of the Year, an award that recognizes excellence in undergraduate teaching. The honor was bestowed by the Council for the Advancement and Support of Education and The Carnegie Foundation for the Advancement of Teaching.

A couple of years into her assistant professorship, Balser realized her soil biology lectures were designed for the small percentage of students following in her footsteps: aspiring academics who love learning for learning's sake. “So I reframed the material,” says Balser, who studies soil microbes’ contribution to global carbon dioxide emissions. “Instead of saying, ‘I’m going to teach you this because I love it,’ I started saying, ‘I’m going to teach you this because you need to learn it, and here’s why.’”

To revamp her course, Balser turned to an obvious but often overlooked resource for advice: her own students. She conducted what she calls a “mid-course correction” survey, soliciting feedback on what was and wasn’t working for them. She also dug into pedagogical literature, searching for ways to ramp up student engagement in the classroom.

What emerged was an approach known as active learning. Compared to the typical lecture-and-quiz format found in most college classrooms, active learning is about getting students involved—having them answer questions, participate in small-group discussions, interact with guest lecturers and work on hands-on projects. To this day, Balser continues to survey her students on a regular basis and to test out new teaching techniques, including cutting-edge educational technologies.

Balser’s enthusiasm for biology education reaches far beyond her own classrooms. She’s one of the founders of a new national education research group in biology. And on campus, Balser is director of the Institute for Cross-College Biology Education (ICBE), which serves as the administrative home of the university’s biology major. With about 6,000 undergraduates in 31 biology-related major programs, it is the largest, most complex area of study on campus.

One of Balser’s main goals at ICBE is to help modernize the university’s Introduction to Biology course, a critical educational portal crossed by more than 4,500 aspiring scientists each year. “The way

Code Orange

Alarmed by a drop in hunting, researchers investigate how to better market the sport to new audiences

PHOTO BY TIMOTHY J. KAMKE

They don't do it for the mounted heads, they do it to spend time in nature.

That's the verdict of a survey asking more than 340 Wisconsin hunters why they pursue their sport. The survey was conducted by CALS life sciences communication professor Bret Shaw and doctoral student Beth Ryan as part of a research initiative aimed at informing hunter recruitment and retention efforts. The initiative, called the Hunters Network of Wisconsin, is a partnership between the Wisconsin Department of Natural Resources, UW-Extension and UW-Madison.

Although hunters in Wisconsin are some 700,000 strong, their numbers are declining (the number of gun deer hunting licenses sold decreased by 6.5 percent over the last 10 years, for example). The drop is raising concerns about long-term consequences both for the economy—hunters spend nearly \$1.4 billion in the state and contribute more than \$197 million in state and local taxes—and for natural resource management, since hunters help keep wildlife populations in check. Hunting is also responsible for more than 25,000 jobs.

Survey findings can be key in recruiting newcomers to the sport, notes Shaw—a necessary step for hunting to expand its reach beyond current hunters and their children. “Spending time outdoors and connecting with nature are major motivators for Wisconsin hunters,” says Shaw. “This finding is important because it demonstrates that, in Wisconsin, hunting seems to be an important way to connect our increasingly urban society to the natural world. It also highlights the potential mental and physical benefits of hunting, including being outside, exercise, and stress reduction.”



That's certainly been the experience of Madison resident Mike Carlson, a lifelong outdoor enthusiast who only recently took to hunting when a friend pulled him into it. “I can't think of another sport that requires you to be out in nature and be so quiet and still and in tune with things around you,” he says. “It's opened my eyes to a lot of new experiences out there.”

Carlson doesn't have kids yet, but he can easily picture teaching them to hunt when he does. And spreading out to new adopters and their kids is exactly the kind of expansion Wisconsin hunting will need.

Survey results are available at www.huntersnetwork.org.

—JOAN FISCHER

Teach your children, and beyond—the Wisconsin Hunters Network aims to bring new audiences to the sport.

we teach biology has got to catch up with the way scientists do research. Students need to understand how chemistry, math, physics and engineering are all relevant to biological research,” says Balser. “But the way we teach them now, all of those subjects are taught separately, in different boxes.”

The overhauled biology course, as Balser and several key biology faculty imagine it, will feature a mix of labs, lectures, computer projects and—of course—active learning techniques.

—NICOLE MILLER MS'06

classAct

Alejandra Huerta

Farm Workers' Daughter



Alejandra Huerta's parents may be forgiven for their distress when Huerta announced she was pursuing a career in agriculture. As native Mexicans who spent their lives picking crops around Salinas, California, they had hoped that a good education would be their children's ticket to a better life.

"What? You went to college for four years and now you're going back to the fields?" was their reaction, Huerta recalls with a laugh. "I explained that I'm doing something very different. My job is not to pick. I think about the work I do."

But convincing her parents that a career in science was right for her was nothing compared to the doubt Huerta had to overcome in herself.

She had always loved science, but in her first foray at a university, she fell behind in the science course sequence and her grades were disappointing. By contrast, the Spanish and Portuguese department wooed her with opportunities to study abroad. With some misgivings, she switched majors.

Living abroad gave her confidence. "I was like, I can do anything. I've lived here, I survived, I've nailed the language," Huerta recalls. "That's when I said, 'I'm going back to the sciences.'"

Now a second-year Ph.D. student in plant pathology, Huerta's research in Caitilyn Allen's lab focuses on the bacterial plant pathogen *Ralstonia*, which causes disease in tomatoes, potatoes, tobacco and other valuable crops.

Last spring Huerta was awarded a three-year research fellowship from the National Science Foundation. The coveted honor includes a \$30,000 annual stipend and a \$10,500 cost-of-education allowance.

Huerta plans to stay in academia, but she also wants to help farm worker children back in Salinas. She'd like to develop an intensive science program for elementary school students.

"We don't grow up thinking about biology or chemistry, so when we see it in high school it's a completely different language. That's why a lot of us struggle with it," she says. "Sometimes we're the first ones in our families taking that course. The only people we can really ask for help are our teachers, but sometimes we're just so afraid—'Oh my gosh, he's going to think we're dumb or something'—that we don't do it."

LAUNCHED, the **Global Health Initiative's Incubator Series**, biweekly talks featuring two researchers from different disciplines offering their perspectives on a health problem, with plenty of time for discussion. The series is held at the Wisconsin Institutes for Discovery. CALS researchers will participate regularly (plant pathologist Caitilyn Allen kicked off the series paired with flu expert Yoshihiro Kawaoka for a talk on infectious disease). Upcoming talks include promoting gender equality and empowering women (featuring Samer Alatur) and eradicating extreme poverty and hunger (with Ian Coxhead). Details at <http://ghi.wisc.edu>.

APPOINTED to CALS administration: soil science professor **Birl Lowery**, now senior associate dean, and entomology professor **Rick Lindroth**, now associate dean for research.

GROUND BROKEN for the **Wisconsin Energy Institute**, located at 1552 University Ave. (site of the old University Health Building). Primary occupants will be the Great Lakes Bioenergy Research Center (GLBRC) and the Wisconsin Bioenergy Initiative (WBI), which focus on converting plant biomass into ethanol and other clean, renewable motor fuels. Space will also be created to promote development of other renewable technologies.

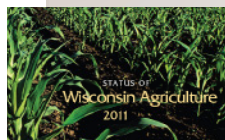


AWARDED to *Grow* magazine, two first-place honors in a regional competition sponsored by the Council for Advancement and Support of Education (CASE). The "Fixing Our Food" feature package (Spring 2010), written by **Nicole Miller** and **Michael Penn**, won gold in the Best

Feature Series category. And Penn took a gold in Best Feature Writing for "Invisible Hands" (Summer 2009), a story about foreign workers in Wisconsin's dairy industry.

HONORED by The Wildlife Society for his lifetime achievements, **Stanley Temple**, Beers-Bascom Professor Emeritus in Conservation in the Department of Forest and Wildlife Ecology and the Nelson Institute for Environmental Studies.

Number Crunching 25 YEARS of "STATUS OF WISCONSIN AGRICULTURE" reports.

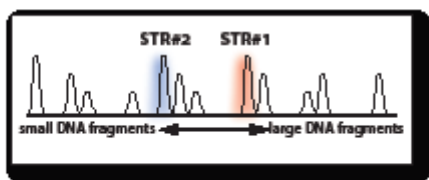
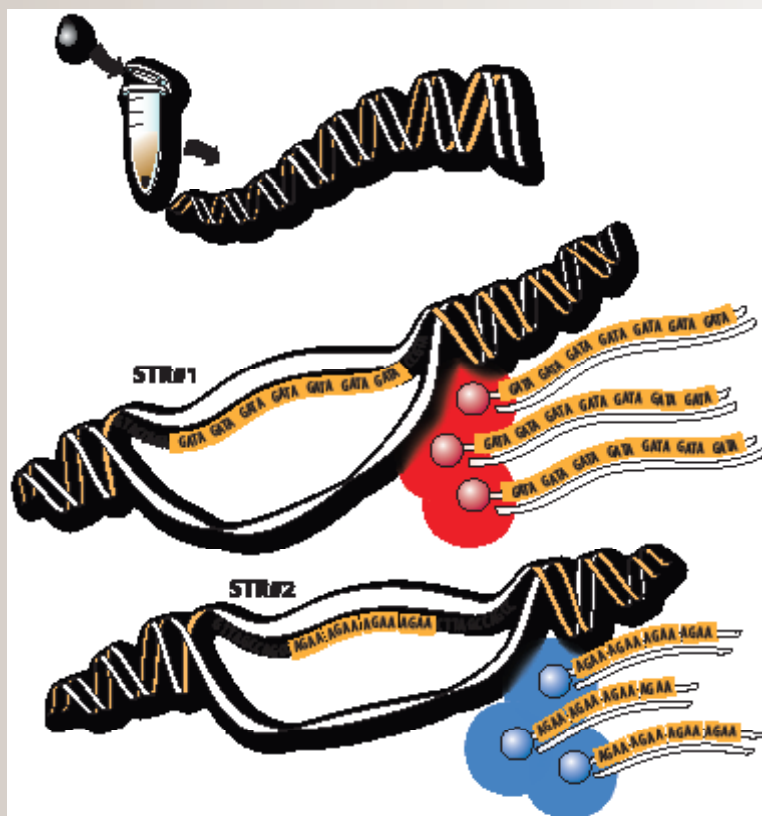


What began as a one-time report—or so its authors thought—has become an institution. Early each year, the *Status of Wisconsin Agriculture*, prepared by the Department of Agricultural and Applied Economics, provides an

overview of the current financial environment in Wisconsin farming; a market analysis of current conditions and a forecast of the coming year; and special articles on a topic of interest (this year, articles focus on a recent survey of Wisconsin dairy farmers). You can download the report at www.aae.wisc.edu/pubs/status/

how DNA profiling works

EVEN THOUGH 99.9 PERCENT OF HUMAN DNA is exactly the same in all people, a single droplet of blood or stray eyelash collected at a crime scene still carries all the genetic information needed to convict a criminal. Back at the lab, forensic scientists simply probe the remaining 0.1 percent of the genome—3 million nucleotide bases—for telltale variations. This process, known as DNA profiling or genetic fingerprinting, reveals a suite of variations in the genetic code that, taken together, constitute an individual's unique DNA profile. Here's how it works:



STR Region #	# Repeats Crime Scene Sample	# Repeats Suspect #1	# Repeats Suspect #2
1	7	8	7
2	4	11	4
3	14	13	14
4	11	18	11
5	8	7	8
⋮	⋮	⋮	⋮

1. Collect a sample and extract its DNA.

Scientists only need a tiny amount of DNA—around 100 micrograms—to construct a DNA profile from a crime scene sample. That's so little, a few cells from saliva on a straw will do.

2. Amplify the telltale regions. Scientists use a powerful technique called Polymerase Chain Reaction (PCR) to make millions of copies of the sample's telltale DNA regions. In particular, they home in on regions known as Short Tandem Repeats, or STRs, which are composed of short units of DNA—just four or five bases long—that are repeated numerous times in a row. What makes these regions telltale is that the number of repeats they contain varies widely from person to person. In criminal investigations, 13 such STR regions, all located in the non-coding DNA between our genes, are analyzed for the number of repeated units they contain.

3. Count the repeats. During PCR, fluorescent dyes are attached to all the STR copies that get made—one type of dye for each STR region—so that all of the DNA copies from a given region can be distinguished from the others in the mix. Scientists run the mixture through a capillary electrophoresis machine, which separates the various DNA fragments by size. From there, it's a fairly easy thing to calculate the length of each STR region, and, therefore, the number of repetitive units at each site.

4. Look for a match. To convict a suspect, his or her STR repeats must match those in the crime scene sample—at all 13 STR regions. According to the FBI, when all 13 STR sites match perfectly, it's virtually guaranteed you've got your culprit; the odds of fingering the wrong person are about one in 1 billion. A single STR mismatch, however, is enough to exonerate a suspect and spur investigators to search CODIS, the nation's database of DNA profiles, in hopes of solving the crime.

ALASKA



When the Deep Freeze Thaws

After four decades studying some of the planet's coldest soils, James Bockheim has gained a formidable vocabulary to describe the interplay between ice and soil. Analyzing a core of permafrost—the permanently frozen soils found near the Earth's poles and on some mountaintops—he points out vein ice threading the length of the core. He speaks of cryoturbation, the mixing of soil layers caused by freezing and thawing ice, and notes the formation of lens ice, puck-like discs that form above the permafrost layers.

These features make permafrost samples beautiful, often resembling the mixed batters of a marbled cake. But they also have important implications for the planet's climate, says Bockheim, a CALS professor of soil science. Although permafrost and other cold soils make up only 16 percent of all soil, they hold 50 percent of all soil carbon, making Arctic soils a deep freezer for vast stores of the greenhouse gas. But many researchers fear that as global warming thaws permafrost layers, that carbon will be released into the atmosphere, exacerbating changes in climate.

Last spring, that question took Bockheim and postdoctoral researcher Jenny Kao-Kniffin to Barrow, Alaska, which at 320 miles north of the Arctic Circle is the United States' northernmost city. It's a region that already feels acute pressure from climate change. According to Bockheim, temperatures around Barrow have risen by as much as 2 degrees Celsius during the past 20 to 30 years, nearly four times the rate of warming for the planet as a whole. Thawing soils have put houses, roads and even the Alaskan oil pipeline at risk of collapse. But the changes in Barrow have implications that reach far beyond the Arctic, says Bockheim.

In Barrow, Bockheim and Kao-Kniffin are trying to glimpse into the future of polar soils by learning from their past. Working with a team of international scientists, they have been digging into the soils of former lake basins, which drained anywhere between 50 and 8,000 years ago, to get a view of how different soils have developed over time. Once emptied of water, Bockheim explains, the basins fill with grasses, sedges and willows, attracting animal life and creating changes in soil composition. Older beds contain more carbon, for instance, and they also harbor more ice, due to repeated seasons of snow and rain trickling into upper layers of soil.

The scientists' interest is not only in the soil itself,



PHOTO BY CHRISTINE MLOT

but also in the microbes that call it home—specifically, how those resident microbes metabolize sources of carbon in the soil. One of the main concerns about the warming Arctic soils is that as once-frozen organic matter thaws, resident microbes will start churning out carbon, releasing potentially large quantities back into the atmosphere. But it's also possible that the soil nutrients won't be suitable to support the microbial community.

"We know the rate of carbon sequestration in these lakes, but we don't know anything about decomposition rates and the different forms of carbon that exist," says Bockheim, whose study of polar soils began with a trip to Antarctica in 1969.

Kao-Kniffin, a microbiologist who recently became an assistant professor at Cornell University, is now in the process of characterizing the microbial community that lives in the Alaskan soils. She will analyze fatty acids and DNA of the soil microbes to get a clearer picture of their metabolic function, using stable isotope tracers to follow the path of carbon through the system.

"The lab component is easy," says Kao-Kniffin, compared to the physical ordeal of drilling and collecting cores from the Alaskan tundra. Once samples were collected, the scientists returned to a small Quonset hut backdropped by the frozen Arctic Ocean to measure and prepare them for lab analysis. At one point, as newly thawed soil samples dried in an oven, a whiff of a mushroom-like aroma wafted through the hut, a sign of the fungi and other microbes in the soil. It was a small reminder of the suspended life harbored within those frozen soils—and the potential consequences once that life is awakened.

—REPORTING BY CHRISTINE MLOT

Left: Jim Bockheim and Jenny Kao-Kniffin work with the "Big Beaver," a 6-foot drill for cutting into the frozen earth. It gets hauled on its own sledge, built in a traditional Arctic style; the drill's Briggs & Stratton engine sits on another.

Right (top and center photos): In each core, dark brown layers of organic material alternate with gray layers of mineral. Sometimes the cores come out looking like cardboard mailing tubes; other times they hold dark and light swirls. It's a result of what Bockheim (center photo, right, with Kao-Kniffin and the University of Cincinnati's Kenneth Hinkel) calls cryoturbation, as freezing and thawing ice mix the layers.

Right (bottom photo): A core chunk back at the lab in Madison.



PHOTO BY CHRISTINE MLOT

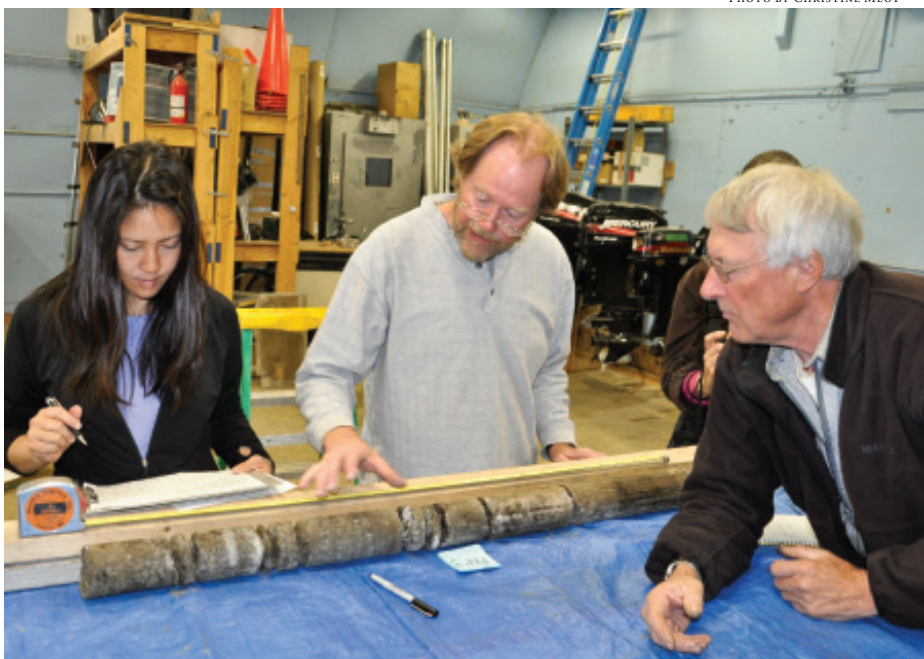


PHOTO COURTESY JENNY KAO-KNIFFIN



PHOTO BY WOLFGANG HOFFMANN

Missing Piece

Jiming Jiang is unlocking the secrets of the centromere, an overlooked region of DNA that holds the key to chromosome engineering—and a new, possibly safer approach to gene therapy

HORTICULTURE professor Jiming Jiang studies centromeres, large regions of DNA that help match up and then separate pairs of chromosomes during cell division. Long ignored by most genome scientists, centromeres now appear to be key in creating artificial chromosomes—complete, self-replicating packages of genetic material that could revolutionize crop improvement in plants and gene therapy in humans.

What is a centromere?

Humans have about 30,000 genes carried by our 46 chromosomes. Each chromosome has one centromere, a stretch of DNA that ensures the accurate transmission of the chromosomes—our genetic material—into daughter cells during cell division.

You can actually see the centromere under the microscope—it looks like a constriction on the chromosome. It's an extremely complex structure. There's a lot of protein involved, and the centromere's DNA—how to describe it? It's junk DNA, basically. It doesn't have genes, just a lot of repetitive junk DNA.

When did scientists discover the centromere is full of junk DNA? When they sequenced the human genome?

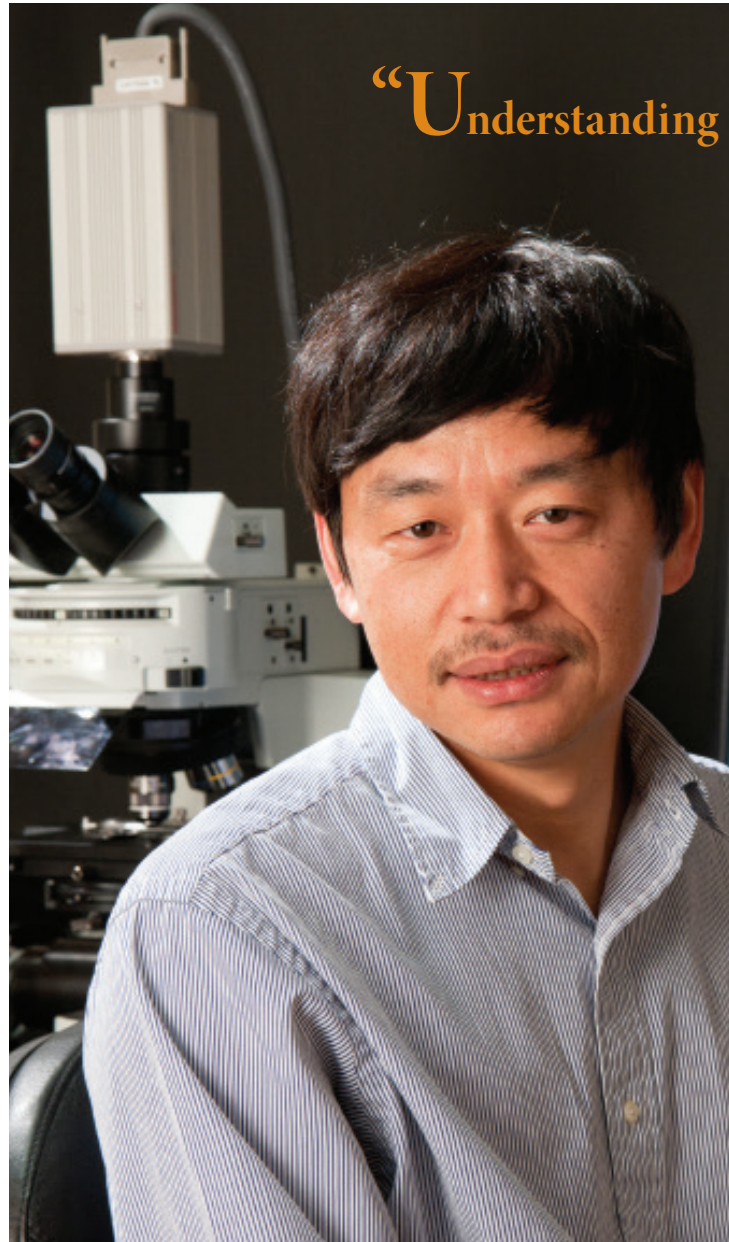
Scientists say that the human genome has been sequenced, that the mouse genome has been sequenced, but people don't realize that none of the centromeres have been sequenced. They just don't count it. And most scientists don't care because there are no genes [in those regions]. Plus, it's almost impossible to sequence centromeres with current technology—they are too long and contain too much repetitive DNA.

But rice is a different story. The centromere on rice chromosome 8 is not particularly repetitive, so my team was able to sequence it back in 2004. We were the first team to sequence a centromere from a multicellular species, and, surprisingly, we found genes in it!

How did this rice centromere end up with genes in it?

Let me try to explain what we think is going on in this strange case. In the scientific community, people are starting to believe that centromeres originate somewhere. They don't just exist, right? And when a new centromere emerges—a neo-centromere—it may look like a regular piece of DNA, with genes in it. Over time, however, as it evolves, the centromere accumulates junk DNA for whatever reason.

So, the rice centromere that we sequenced, we believe, is somewhere in the middle of this evolu-



tionary process. It's like a caveman. It is starting to accumulate some repetitive, junk DNA, but it still has some genes in it.

It's interesting to consider that centromeres can evolve.

With funding from the NSF, we are now trying to understand the evolution of this rice centromere over

the structure, function and evolution of centromeres in plants will definitely help on the human side.”

the past 10 million years. To get at this question, we’re sequencing this centromere in five different species of wild rice, which diverged from cultivated rice between 1 million and 10 million years ago. We’ll be able to see what kinds of changes happened over that time—how the genes moved away, how the junk DNA accumulated.

This work will help us figure out the minimum requirements needed to make a centromere. There are a lot of things we don’t know right now, but if we can figure out the answers, this work will ultimately help us design artificial chromosomes. That’s the long-term goal.

What is an artificial chromosome?

It’s a chromosome that’s made from scratch in the lab. It can have one or more genes on it, and it needs a centromere, so it gets replicated and divided up during cell division just like a regular chromosome.

How do you envision artificial chromosomes being used?

I definitely want to see artificial chromosome technology used in agriculture someday. Right now plant biotechnologists add one gene at a time [to plants]. When they made Bt corn, for instance, they put a Bt gene into corn, and that was that. The big argument in favor of the artificial chromosome is

that it has a large capacity to carry genes—you can put as many genes on the chromosome as you want. You can put entire pathways.


Let’s say a crop plant doesn’t make vitamin B12, but you’d like it to. To make vitamin B12 you need something like 10 genes. It would be almost impossible to [engineer this plant] with current technology, but with an artificial chromosome it should be possible to do a manipulation like that.

Does your rice research have any implications for human health?

Centromeres exist on all eukaryotic chromosomes, so understanding the structure, function and evolution of centromeres in plants will definitely help on the human side.

In humans, artificial chromosomes are seen as a promising way to deliver genes for gene therapy. Let’s say you have a patient who’s colorblind, and they need a single gene to correct the problem. The basic theory of gene therapy is to put the needed gene into the affected tissue, so that the gene can produce the protein that’s needed to correct the problem.

Currently, doctors use a virus-based vector, which inserts the gene randomly in the genome. It’s already known, however, that this process can actually cause cancer, because sometimes the new gene will insert into the middle of an existing gene that regulates cell division or the cell cycle.

But artificial chromosomes carry genes independently. They don’t integrate into the genome, and they don’t interfere with existing chromosomes. So you can express the gene you need, without interfering with the other 30,000 genes that you have. [Human gene therapy] is really the main drive behind artificial chromosome research, and understanding the centromere—how it behaves, how it functions—is the most important part of this effort. 

Wisconsin's artisan cheese
renaissance may be a miracle,
but it's no accident. Government,
academia and nonprofits all
have had a hand in the
market's delectable bloom.

CRAFTED *with* CARE

By Michelle Wildgen





Cheese curds are oddly soothing. This is evident on a recent morning inside the CALS Babcock Hall Dairy Plant, where a few hundred pounds of springy ivory cheese curds are being stirred and drained of whey inside a long gleaming vat.

Within a few hours, those curds will be transformed into juustoleipa (joost-oh-LEEP-ah), or “juusto” for short, a firm, baked Finnish cheese with a browned exterior speckled with creamy white. A barely cooled corner piece is a satisfying blend of fresh, sweet dairy flavor inside and savory caramelization outside—rather like the bubbly cheese part of a pizza without all that pesky pizza.

For now, however, the curds are still curds. Periodically, Babcock’s master cheesemaker Gary Grossen pauses from his constant circuit around the cheese production area to scatter a handful of salt or to cup a few curds in his palm, thoughtfully testing their texture. The cheese curds go from creamy and moist to drier, lighter, with a good portion of finer-grained curds to the egg-sized clumps. The constant motion inside the vat is rhythmic, even mesmerizing.

But for Jay Noble, who is visiting Babcock that day, the morning’s observation is all business. He had traveled from Noble View Creamery, his 400-cow dairy farm in Racine County, to observe Grossen at work. A sixth-generation dairy farmer—“Born with a pitchfork in my hand,” he says—Noble is curious about expanding into specialty cheese, such as Hispanic-style cheeses or possibly juustoleipa.

Noble’s reasons for considering specialty cheese echo a common refrain. In the face of volatile milk markets and dwindling prospects for passing a dairy farm to the next generation, cheesemaking offers a dairy farmer the chance to set his or her own prices and carve out a more stable niche in a growing market. Twenty years ago, a dairy farmer might

Looks like pizza, tastes like heaven, especially with a bit of jam: Brunkow Cheese’s Karl Geissbuhler wields a tray of freshly baked juustoleipa.



**“Artisan cheesemaking
is part of our
unique heritage,” Monsen says.**

have seen little cheesemaking opportunity in a Wisconsin landscape composed mainly of struggling commodity cheese manufacturers, all being squeezed out by far larger and ever-growing companies, while California threatened to snatch Wisconsin’s dairy industry mantle.

“Artisan cheesemaking is part of our unique heritage,” says Norm Monsen, senior agriculture markets consultant with the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP). “In the 1980s or 1990s, we were getting a little bit away from the lessons of our heritage. Since the early 2000s, there’s really been an effort and drive to get those lessons back.”

Today you’ll still find plenty of commodity cheddars and mozzarellas—but you’ll also find a wealth of specialty cheese, be it the savory, golden Pleasant Ridge Reserve from Uplands Cheese, fresh, tangy Fantôme goat cheeses, or Bleu Mont’s bold cave-aged originals. There are crumbly, well-aged artisan cheddars, smoky blues, sticky, green-veined Gorgonzolas and a slumping, velvety sheep’s milk Brie. The list goes on and on.

Clearly, the state’s specialty cheese numbers have exploded. Ten years ago Wisconsin had six artisan cheesemakers, whereas today that number is a little

above 30, according to Jeanne Carpenter, communications director of the Dairy Business Innovation Center (DBIC). In 2009, the most recent year for which figures are available, Wisconsin produced 477 million pounds of specialty cheese, 18 percent of its total cheese production. That’s a 40-million-pound leap over 2008 figures, courtesy of both newly minted cheesemakers and existing manufacturers who’ve adopted specialty items.

The most successful of Wisconsin’s artisan cheese producers are winning international awards and commanding top dollar in a market increasingly willing, even delighted, to expand its culinary repertoire. “People are beginning to appreciate different flavors in cheese beyond traditional cheddars, Muensters, and Monterey Jack. They want more intense flavors,” notes Mark Johnson, interim director of the CALS Center for Dairy Research. The shift into artisan cheese is so marked, and so needed, that Johnson is willing to call it a “salvation” for the small cheesemaker.

He’s not the only one to view it this way. The growth of the artisan cheese industry has resulted from a coordinated and ongoing effort involving not only the cheesemakers themselves but government, academia and nonprofits.

**Back then, they all were artisans:
Cheesemakers taking part in a short
course at the University of Wisconsin’s
new dairy school, ca. 1901. They pose
with some tools of their trade and fruits
of their labor (probably Muenster, Swiss
and brick).**

Wisconsin’s artisan cheese renaissance may be a happy miracle to a cheese lover, but it’s no accident.

Before the 1990s, a hopeful cheese artisan had little to guide her. “Now, if you want to become an artisan cheesemaker in Wisconsin, it’s like there is a handbook to do it,” says DBIC’s Jeanne Carpenter. “Whereas there was a handbook before, but it was in French.”

The CALS Center for Dairy Research (CDR) has been offering courses in cheese technology for years, but as John Jaeggi, the cheese industry and applications coordinator there, points out, “Originally it was just us with cheese help, but we didn’t bring the full package.”

Now, by design, the artisan dairy players are several and closely entwined. CDR provides a number of educational programs to the dairy industry, be it classes for the Wisconsin Master Cheesemaker program, numerous short courses, or more individualized research. The Center also works directly with new and established manufacturers on product development and troubleshooting, often calling on the CALS food science department down the hall for basic science to complement the applied science of dairy production.

The Babcock Hall Dairy Plant, once known solely as a source for tasty ice cream, now employs Gary Grossen, a master cheesemaker in brick, Muenster and cheddar—and No. 2 in the world in Gouda, the sole American in an otherwise Dutch top three. Grossen not only makes Babcock Hall’s cheese and provides income, but serves as a resource to industry members like Jay Noble and a mentor to apprentices logging the required 240 hours with a certified cheesemaker to obtain a license.

Outside of the university, DATCP regulates the dairy industry, placing food safety and quality as its No. 1 goal.

As a government agency, DATCP also tends to be a first point of contact for dairy industry members, and therefore its role includes connecting a cheesemaker or dairy crafter facing a challenge with the necessary resources to help resolve it. “If they need some great assistance for developing a new product, they should go to CDR—but they may not know that,” Norm Monsen notes.

Cheese manufacturers have the opportunity to meet with the regulators and food safety inspectors from DATCP—a chance to build relationships and ask questions before breaking ground on a facility, thus avoiding any unpleasant surprises at inspection time. It’s a state of affairs that Jeanne Carpenter, who used to work for DATCP, calls “a total 180 from 2003 or 2004, when I first started there.”

The Dairy Business Innovation Center (DBIC), too, connects resources and dairy crafters and provides business support, be it through business plans, sourcing or financial guidance. And the Wisconsin Milk Marketing Board (WMMB) works the public relations angle, keeping Wisconsin cheese in the sights of magazines, chefs, home cooks and retailers.

WMMB played a key role in another early part of this initiative—the creation, in 1994, of the aforementioned Wisconsin Master Cheesemaker program, which is funded by dairy farmers represented through WMMB and administered by CDR. The program, comprised of a rigorous series of courses and a three-year apprenticeship, is open only to a cheesemaker who has amassed 10 years of licensed cheesemaking experience and five years making a particular type. The goal was to recognize and publicize—both in the industry and the marketplace—the state’s cheesemaking expertise.

Babcock’s master cheesemaker Gary Grossen testing pH levels in some Gouda.

By 2004, each of these entities—CDR, DATCP, DBIC and WMMB—had taken up its own tasks in growing and supporting the specialty cheese industry. They work together and with the industry, and that cooperative spirit either has filtered down or else reflected a unique characteristic the industry already had. For while Wisconsin dairy is justifiably known for its infrastructure, its other great strength is that cheesemakers—veterans and novices—work together and share ideas.

“Now, everyone talks,” says Mark Johnson, describing the cheesemaker culture. “The openness, the camaraderie is there. They are competitors, but I think they try to help each other out. Especially the smaller artisan cheesemakers are talking this way, but that camaraderie is all over Wisconsin.”

Heather Porter Engwall, director of national product communication for WMMB, concurs. “I can’t think of one cheese that’s been created by only one person,” she says.

Certainly that’s true of juustoleipa. In the winter of 2001, Jim Path, then a researcher with CDR, was hunting down intriguing new specialty cheeses to share with the state’s small cheesemakers. But when he received a call from a county agent in Hurley urging him to travel to northern Wisconsin to taste “squeaky cheese,” Path was reluctant to go. “Squeaky” sounded like plain old cheese curds to him, plus, it was winter on the Upper Peninsula. So he put off his trip until summer.

But the cheese, which was being made in homes and farmstead kitchens and sold neighbor to neighbor, turned out to be a unique one. It was made without a starter culture, it softened with heat but did not melt, and it was baked and browned in an oven. More research revealed the Finnish name of juustoleipa. Path traveled to Finland and found that juusto was quite popular, eaten warm with coffee or cloudberry jam, and even boasting its own section in Finnish supermarkets. “It’s not the cheddar of Finland,” Path says, “but



maybe the Monterey Jack or colby of Finland.”

The Finland visit demonstrated that a genuine market could exist for juusto—but that wasn’t the only reason the cheese had grabbed Path’s attention. Juusto was not only singular in appearance and flavor, it was nearly indestructible, impervious to extended refrigeration and even freezing. Best of all? For once, a small cheese manufacturer might find its size an asset. A small factory,

Erickson estimates, sales might have averaged about 500 pounds per week; today, an average month’s output from March to September might be 1,000-1,500 pounds, while during juusto’s peak season around the holidays he might sell 2,500-3,500 pounds per month.

CDR also spotlighted juustoleipa in a 2002 fresh cheese seminar. Among the cheesemakers who took note was Steve Bahl, then-owner of Fennimore Cheese. Here juusto got a boost from that

“We take pride
in seeing
Wisconsin cheesemakers
stand out,” says Johnson.

Path points out, will have a small vat and can likely obtain one pizza oven and try out a little batch at lower risk. But for a big factory to economically make juustoleipa, the batches and the risk must be far larger, and the necessary new equipment is more like four or five ovens. Path assumed the larger manufacturers were likely to hold off until the market was proven, and in the meantime, he hoped, the little guy would wedge a foot firmly in the door.

But first, juusto required a few introductions. Path had tweaked his recipe and procedures to fit the industry and asked Babcock Hall Dairy Plant’s then-cheesemaker to try it out. He then brought the idea to Bass Lake Cheese’s Scott Erickson, who had also encountered juusto through the Master Cheesemaker program (he is certified in cheddar, colby, Monterey Jack, Muenster and chevre).

Erickson liked its versatility and felt juusto could cross over into the Hispanic market, so he and Path developed a technique at CDR that improved the shelf life and safety while retaining the traditional characteristics. Early on,

surprisingly cooperative spirit among the state’s specialty cheesemakers: Bahl asked Karl Geissbuhler at Brunkow Cheese if he’d be interested in partnering on juusto, with Brunkow making the cheese and Fennimore baking, packaging and marketing it. As the cheese built a following, Brunkow began to manufacture and sell juusto on its own. Bahl, who died in 2010, sold Fennimore to Carr Valley, where Sid Cook, master cheesemaker in cheddar, fontina and mixed milk cheese, kept the cheese in rotation, too.

Every juusto devotee agrees on the most effective form of marketing. The buttery, caramelizing fragrance of juusto being warmed on a griddle—at the farmers’ market, in the store, or at the trade show—seems to do the trick every time.

But each manufacturer has found a way to distinguish its offering, and has watched the numbers rise. Erickson stayed with traditional juustoleipa—very soft, sweet, high in lactose and very low in salt—and also offers ostbrod, a Swedish-style version made with goat’s milk. Grossen’s juusto is baked a deep,



dark brown with only an occasional spot of ivory. Cook felt the Finnish name was a hindrance to sales, so he christened it “bread cheese,” trademarked the name, offered it in plain and garlic, and saw Carr Valley’s production rise from one vat of bread cheese every two or three months to two or three vats per week. And Brunkow’s Geissbuhler went with the hybrid name of “Brun-uusto,” added such flavorings as bacon, jalapeno and garlic, and has gone from 200- and 300-pound batches to 3,000-4,000 pounds per week.

Today, seven Wisconsin cheese companies sell juusto, and five of them produce it. This spring, the cheese reaches an important milestone: Erickson will be the first Wisconsin master cheesemaker to be certified in juustoleipa.

Juustoleipa may be a perfect example of CDR’s distribution of ideas, but the flow of information goes in both directions. “The ideas work both ways,” explains CDR’s John Jaeggi. “We either come up with ideas and push them out, or the idea is from the outside but they don’t know how to get it going.”

Jaeggi’s cheese industry and applications team works directly with the food industry in its many forms: established cheesemakers, restaurant chains, food service companies, culture manufacturers and others. They might tweak a recipe to meet a manufacturer’s goals for melt, or confront a blue cheese lacking



Stirring the curds at Brunkow:
This steamy, swirling cheese bath is the most mesmerizing part of the process.

sufficient blue-colored mold or blue flavor—precisely the type of endeavor in which access to the CALS staff of top food scientists proves invaluable.

CDR also lends support through product development, depending on how much a cheesemaker wants or needs. However romantic the life of a dairy artisan may sound, beneath the veneer is a demanding business. Scott Rankin, chair of the food science department, explains it thusly: “To go from dairy farming to dairy manufacturing is like going from driving a car to building a car. It is a very complex culture to navigate.”

For this reason, the would-be cheesemaker must commence less with a dream than with a business plan, and perhaps training from DBIC in obtaining financing, sourcing equipment or building a facility. And the future artisan has some education ahead of her. Courses include CDR’s core curriculum and its changing selection of short courses, such as cheese and dairy technology or Marianne Smukowski’s classes in food safety geared especially for farmsteads. In sensory courses, students can learn to evaluate good and bad cheeses firsthand, so that “when we say something has gone rancid, acid, buttery, they know what we’re talking about,” says Mark Johnson.

And when it comes to the nuts and bolts of product development and troubleshooting, three or four artisans each year might finally begin to work

with Jaeggi’s cheese industry and applications program.

That process, which can take two or three years, begins with a sit-down at which artisan and CDR staff sample a cheese they hope to use as inspiration. Next, they set up a cheese trial, using specific milk if needed.

The researchers design four to 12 recipes, using different combinations of procedure and ripening. They make the cheeses, age them out, and finally gather to taste with the cheesemaker and narrow down the recipes that meet the cheesemaker’s intention. Then they repeat the manufacture again, at which point the cheesemaker decides if this is the cheese he wants to make and market. Many artisans then work with incubator plants, who make the new cheese during times of open production capacity.

Dean Sommer, a cheese and food technologist on Jaeggi’s team, sums it up: “What sets the CDR apart from any other group in the U.S. is this: we can essentially provide the whole technical package.” After Jaeggi’s group makes the cheese, after the sensory group evaluates it, and after the analytical group tests for information such as composition and microbiology, “We’ll go with the people to their plants, elbow to elbow, any time of the day or night, and make cheese with them side by side. That gives them a tremendous comfort level. Because you can talk about it, you can tell them till you’re blue in the face,” says Sommer, “but when you have to do it on your own, that first or second time, it’s like—” He mimics a terrified scream.

Wisconsin may be producing more than 600 kinds of cheese, but there’s room for plenty more, say those close to the field.


WMMB’s Heather Porter Engwall hopes for more raw milk cheeses that

fit the state’s strict regulations but still rival their European counterparts. CDR also hopes for more funding for sheep’s and goat’s milk dairy; currently they are funded by a dairy check-off program that is overwhelmingly from cow’s milk. Another future trend, Carpenter and Sommer believe, is bloomy rind cheese. Wisconsin produces very few, the minimal presence of French immigrants showing in a correspondingly tiny number of traditional Bries and Camemberts.

That opportunity illustrates another issue for CDR. “You’ve got to have the curing room for that,” says Gary Grosen. “It’s like making blue. You have to be careful with blue mold- and smear-type cheeses.” A volatile bloomy rind mold could contaminate every other cheese in CDR’s small facility.

But if CDR’s fundraising efforts go as hoped, a facility expansion might help them serve the dairy industry in a number of new and expanded ways. The Babcock Hall facility is 60 years old, says Rankin; there are major infrastructure issues and the rooms are grossly undersized. Rankin has hopes for a new facility in the next three to five years. Without it, he says, “We can’t keep providing the scale, number and caliber of programs.” The Wisconsin Cheese Makers Association recently announced a \$500,000 gift toward that project.

For the dairy industry to remain healthy, growth in new and diverse directions is crucial, as is a balance of plants of all sizes. Smaller artisans pop up, closed factories return to life. As both grow into larger entities, the next wave of new ones must sprout. “Anything we can do to augment or help that in any way is a positive,” says Sommer.

Mark Johnson concurs: “We work with so many folks, and are so proud of them. I don’t know how much we’ve helped them, but we take pride in seeing Wisconsin cheesemakers stand out. And we know every one of them.” 

A Bug in the System

BY BOB MITCHELL BS'76



A beetle-ravaged hillside in Greater Yellowstone.

PHOTO BY BOB MITCHELL

Climate change is fueling the biggest outbreak ever of tree-killing bark beetles.

The insects are decimating conifer forests from Alaska to Arizona—and raising concerns that they could reach the Upper Midwest.

There's no place to pull off on this stretch of the serpentine road leading up Wyoming's Signal Mountain, so Phil Townsend just stops the car in the middle of his lane. He hops out and darts across the road to get a closer look at a towering lodgepole pine. It's a substantial tree, fatter than a telephone pole and 80 feet tall, with full, lofty branches full of needles—but Townsend has already written it off.

"This tree is dead," says the CALS forest ecologist. "It just doesn't know it yet."

Townsend points to the dozens of tubes of yellow pitch sticking out from the tree's trunk. Each one, he explains, marks the point of attack of a mountain pine beetle.

As the beetle bored in, the tree exuded resin in an attempt to trap it, but the effort failed. The pitch tubes are gritty with fresh sawdust, but otherwise empty. The beetles tunneled through the sticky wax and are now chewing into the phloem, the tree's nutrient pipeline, creating galleries where they'll deposit their eggs.

"This is a fresh attack," he explains. "They will eat the phloem and girdle the tree. This tree is not going to succeed."

Townsend climbs back in the car and heads to the summit to get a clear

view of the sea of conifers that blanket the hillsides in this part of Grand Teton National Park. A typical sightseer at the mountaintop lookout would describe the forest as green and healthy, but Townsend points out various spots that show a subtle yellow sheen. "Next year those trees will all be red. The year after that, they'll be gray."

This color pattern has become all too familiar to those who live, work or play in the vast forests of the mountainous West. From Arizona to Alaska, matchhead-sized beetles are turning conifers from green to rusty red to driftwood gray. Trees in the Jackson Valley, which runs along the base of the Tetons south of Yellowstone National Park, are among the latest casualties.

Back in Madison, CALS forest entomologist Ken Raffa offers a grand assessment. And the picture is grim. "We're talking about dozens of millions of acres across the West where it's almost 100 percent mortality," he says. "We're talking about transformations of entire ecosystems."

Changes in climate, Raffa says, are enabling this swathe of destruction. Warmer summers and milder winters have boosted beetle populations at a time when drought stress, fire suppression and other management practices have left forests ripe for attack. As a result, what used to be intermittent, isolated flare-ups of native beetles have exploded into the largest known insect outbreak in North American history.

"As conditions have gotten warmer, the outbreaks have gotten more frequent and more large-scale. The outbreaks are normal, but the size of the current outbreak is unprecedented," Raffa says.

"The enormity is such that it has transformed lodgepole pine in British Columbia from a carbon sink to a



KEN RAFFA

carbon source. So it's taking something that's normally sequestering carbon and turned it into something that's releasing carbon," he says. "That has implications for global carbon cycles and global warming."

RAFFA HAS A GOOD perspective on what's normal and what's not about the mountain pine beetle and its close relatives. He has been studying the insects since his grad student days in the 1970s, and he has continued that line of research at Wisconsin. Those studies inform his work related to some of the Badger State's problem beetles—in particular the fir engraver, a serious pest in red pine plantations.

Most of his work focuses on the thresholds—the tipping points at which an endemic, low-level population surges to the point where it can successfully infest a stand of healthy trees, or an entire forest, or—as is now the case—a major forest ecosystem. While the infestations he's studying can be epic in size, his approach is to think small.

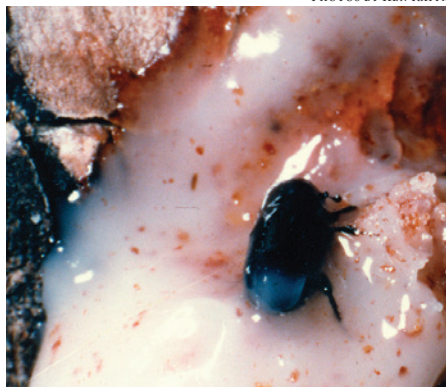
"The critical features that drive whether or not these large-scale out-



PHOTO BY ALEX MITCHELL-MORTON



PHOTOS BY KEN RAFFA



Trees under attack: Each tube of yellow pitch marks a beetle's point of entry, Phil Townsend notes. Trees exude resin to fend off the attack—and sometimes the tree wins (bottom right photo is close-up of beetle stuck in resin).

breaks can occur are happening at the scale of the individual beetles confronting biochemicals at the point where they enter the tree," he explains. "Those fine-scale processes ultimately determine if outbreaks can take place."

Bark beetles have been killing conifers in western North America for at least 38 million years. Fossilized wood from the region shows evidence of *Dendroctonus* (the name means "tree killer") beetle galleries. But the attacks usually have been few, far between and short-lived. Beetle populations would burgeon when trees were under stress, kill off the oldest, biggest trees, and then die back when that food source was gone.

Outbreaks were less common because trees that evolved with the beetles are very good at defending themselves. As a lodgepole pine oozes sticky resin to block the beetle's path, it is also killing its own tissue at the attack site and flooding the area with heavy doses of insecticidal chemicals. This leaves the beetle trapped in a toxic environment with nothing to eat. Raffa calls it a "scorched earth strategy."

"Trees are vicious," he says. "That's why an outbreak occurs in only one area maybe every 30 years. Most of the time, things are weighted very much against the beetle."

The only way the beetles can defeat a healthy tree is through a swift mass attack. The first ones to the tree sound the charge by releasing chemical attractants that draw hundreds or thousands more, enough to deplete the resin and weaken the tree before it can bring its defenses up to speed. The bigger the beetle population, the better the odds of success.

This is where warmer weather gives the beetle a leg up. Higher temperatures boost beetle numbers by speeding up the life cycle and reducing overwinter mortality. The minus-40-degree cold snaps needed to freeze beetle larvae have become rare occurrences. Warmer temperatures have also allowed beetles to thrive in places that used to be inhospitably cold.

"What we're seeing now is the mountain pine beetle getting into higher latitudes and higher elevations," says Raffa.

As it makes itself at home farther up in the mountains, the beetle has devastated one of the Rockies' longest-living conifers, the white bark pine. It's what's known as a naïve species, explains Monica Turner, a UW-Madison landscape ecologist who studies the Yellowstone National Park ecosystem. Because it evolved at higher elevations where cold temperatures used to suppress bee-

tle populations, the tree didn't develop the same level of ability to defend itself.

"Now it's being hammered by the mountain pine beetle. I think we could lose this forest type, or see it very much reduced," Turner says.

And that could bring a cascade of impacts, she adds. Grizzly bears, for example, fatten up on white bark seeds before hibernation. Losing this food source could force them to move down slope where they're more likely to encounter people.

The beetle's move into more northern latitudes opens up what some have called the "doomsday scenario," in which the beetle takes a right turn in Canada and make its way across the boreal forest to the Midwest. The worries began when mountain pine beetles crossed the Rocky Mountains from British Columbia into northern Alberta.

"This is frightening, because lodgepole pine is a sister species to jack pine, and the two hybridize in Alberta," Raffa says. Mountain pine beetles have been killing hybrid lodgepole/jack pine forest in Alberta, and in 2010, for the first time, have successfully reproduced in jack pine, a dominant species in the forest that stretches across Canada. "For the first time ever, the mountain pine beetle is physically connected with Wisconsin's forest," he says.

What are the chances of the beetle making it to Wisconsin? "The short answer is that nobody knows," says Raffa. But he hopes to get some answers through collaborative research with UW-Madison microbiologist Cameron Currie.

CAMERON CURRIE studies partnerships between insects and microorganisms, and he's learned a lot about how insects employ microbes in the struggle against predators, competitors and prey. His earliest studies focused on species of ants that cultivate fungus to feed their young. The ants, Currie discovered, carry

antibiotic-producing bacteria that protect their fungus crop from predators. He sees parallels between this system and that of the tree-killing beetles.

Mountain pine beetles also employ fungi, both to help break down tree tissue and to provide a food source for beetle larvae and adults. Currie suspects that bacteria also play a role in the beetle system. If so, he says, they may help the beetle adapt to a new host tree species.

“Microbes have a much faster turnover rate than beetles, so they evolve and adapt much faster,” he points out. “If it is the microbes that mediate the defenses of the hosts, it may be only a matter of time before the microbes adapt in a way that they are able to overcome the defenses of jack pine.”

Knowledge and methodology developed in Currie’s ant work is helping address that question. For example, Aaron Adams, a postdoctoral fellow in Ken Raffa’s lab, is conducting a series of experiments to see how well the mountain pine beetle’s microbial firepower matches up with the jack pine’s biochemical defenses.

“I am looking at how the differences in the chemical defense from one tree species to another affects the ability of the beetle’s microbial associates—both fungi and bacteria—to survive and grow,” he says.

Adams is culturing fungi and bacteria from the beetle galleries in the presence of defensive chemicals from both lodgepole and jack pine. “I’m growing fungi from the beetle in the presence of lodgepole pine monoterpenes, which are a major component in the tree’s chemical defense, and in the presence of jack pine monoterpenes. I want to see if jack pine chemistry has the same ability to inhibit growth of the fungi,” Adams says. He’s taking a similar tack with bacteria collected from the beetles, seeing if they have the ability to convert these chemicals to a less toxic form.

AUDIO ASSAULT

Confusing beetles with their own language might be an effective way to control them.

Richard Hofstetter MS’96 is taking what you might call a double-talking Dr. Doolittle approach to controlling bark beetles.

For the past five years or so, Hofstetter, a professor of entomology at Northern Arizona University, has been listening in on bark beetle conversation—acoustic signals the insects use to communicate. And as he has learned the beetles’ language, he has found ways to use it against them.

The research began with an effort to simply bombard the beetles with a variety of loud and discordant sounds—everything from heavy metal to Rush Limbaugh played backwards. But Hofstetter’s team didn’t have a lot of success until they focused on the beetles’ own sounds, and began to decode which signals were associated with various behaviors.

“Playing sound alone is not going to work,” he explains. “You have to play biologically relevant sounds, such as their own signals or the sounds of a competitor or predator. By knowing their communication signals, we can interfere and divert behaviors or cause adverse behavior.”

Some of this involves messing with the insects’ love lives. A well-timed broadcast of a male beetle’s mating call can really spoil a mating pair’s intimate moments.

“We have seen the female leave her partner and tunnel directly to the speaker, where she sits and waits for ‘something’ to happen,” he says. “The male tunneled the opposite way.” They got even more dramatic results by playing a male beetle’s aggression call: the male mated with the female, then killed her.

Now that Hofstetter has a pretty good idea of how to use the technology to disrupt the beetles inside the tree, he’s hoping he can use it to discourage them from attacking the tree in the first place. He’s also looking for applications beyond the bark beetles. He is collaborating with a Michigan State University scientist to see if the acoustic approach could be used to manage the emerald ash borer, an invasive species that is threatening the survival of ash trees in many states, including Wisconsin.

He’s also taking a genomic approach, examining DNA sequences extracted from bacteria associated with the beetle to learn what traits they carry and what role they might be playing in the tree attack.

As they probe this microbial system, the researchers hope to also get information about its strengths and weaknesses, which could help forest managers better predict whether a beetle attack will succeed or fail. They may also find some ways to harness these microbes’ abilities for bioremediation or energy production.

Canadian pulp mills are already using bacteria to break down monoterpenes in wastewater. Adams thinks the beetle galleries may contain strains that do this more efficiently. Currie, who is affiliated with the Great Lakes Bioenergy Research Center, hopes the beetle research will yield organisms that can help solve the puzzle of how to efficiently convert cellulosic plant material to ethanol. “We are looking at the possibility that within the bark beetle system there are microbes that help us break down plant cell walls,” he says.

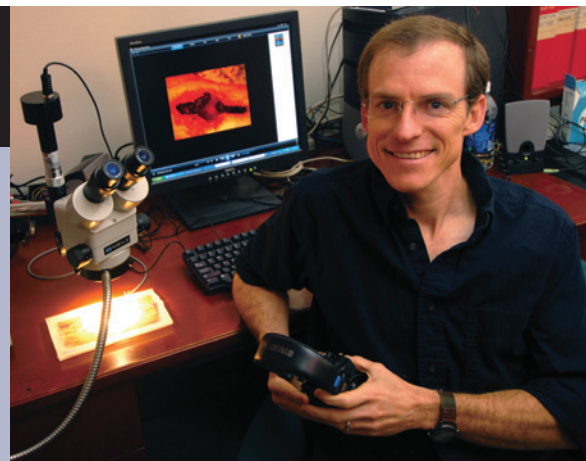


PHOTO BY JOSH BIGGS



PHOTO BY ALEX MITCHELL-MORTON

Townsend usually gets nose to bark with his subjects—but sometimes cameras and a spotting scope help him collect data from remote hillsides.

when they are disturbed.”

Research by Jake Griffin, another of Turner’s students, suggests that the trees that survive the beetle attack, along with other vegetation, are quick to take up the nitrogen. But that might change if forest managers opt to bring in loggers to remove the beetle-killed trees.

“Will the amount of nitrate lost from the system increase if you come in

with heavy equipment and

cut out the remaining trees, along with [performing] the other operations that disturb the soils?” Turner asks. Griffin’s research will help answer this question.

THE IMPACTS OF THE mountain pine beetle do not stop at the edge of the forest. The insects are changing the face of the landscape across the West and beyond—and that’s the scale at which Phil Townsend wants to look at them. For this he needs a tool that lets him step back to get the widest view possible. He’s studying the beetle infestations from space.

“Our work is not tree-based or stand-based. We’re looking over a much larger area. We’re studying how an insect outbreak affects forest characteristics—forest composition, water quality, carbon sequestration,” Townsend explains. “We use satellite remote sensing to develop models of mountain pine beetle infestations.”

One advantage of satellite data is that it has been collected since the 1970s, long before the current beetle outbreak. This lets Townsend’s team track the beetles back through time.

“We can go back to 40 years’ worth of data to look at patterns of how the damage spreads,” he explains. “For instance, we’ve learned that mountain pine beetle infestation usually starts at

THE IDEA THAT anything good could come from the mountain pine beetle is a hard sell in the West. Most people there see the beetle as nothing but trouble, and one of the biggest worries is fire. In an area that’s already coping with years of drought, it seems like a no-brainer that millions of acres of trees killed by beetles are a conflagration waiting to happen. But it’s not that simple, says Monica Turner, who has been conducting research about fires in the Yellowstone area for many years.

“Throughout the West, a lot of people assume that when beetles come through and kill many of the trees in the forest, it will increase the risk of subsequent fires. But if you look in the literature, there is not a whole lot of evidence to support it,” Turner says. “It is a lot of anecdotes and people making assumptions.”

In fact, beetle outbreaks may actually decrease the chance of the most dangerous types of wildfire, according to research by Martin Simard, one of Turner’s former grad students. Simard compared the amount of fuel available in undisturbed stands with that in stands that had undergone recent beetle attacks and others that had been attacked 25 years ago. He found that the beetle-attacked forests had significantly less fuel in the canopy.

“This is important,” says Turner, “be-

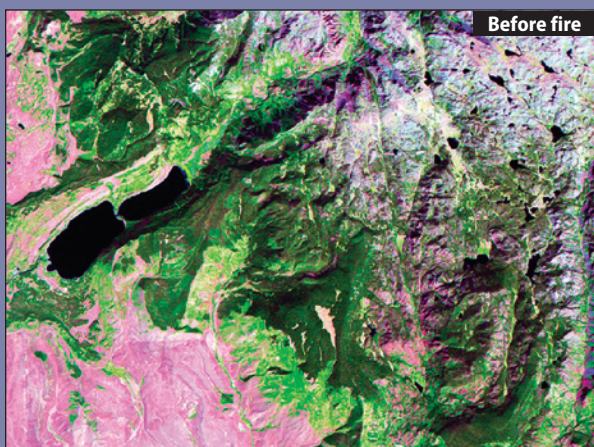
cause the active crown fires in the Rocky Mountains, in the lodgepole pine, are carried primarily through the crown, not in the big logs on the ground. The green needles have resins in them that are very flammable and the tree crowns are close together, so the fires can go right through them.

“When you take all of those kinds of changes in the fuels and you run them in a model that simulates fire behavior, you find that the likelihood of a severe crown fire always goes down after the beetles, and it stays down for at least 25 to 35 years,” Turner says.

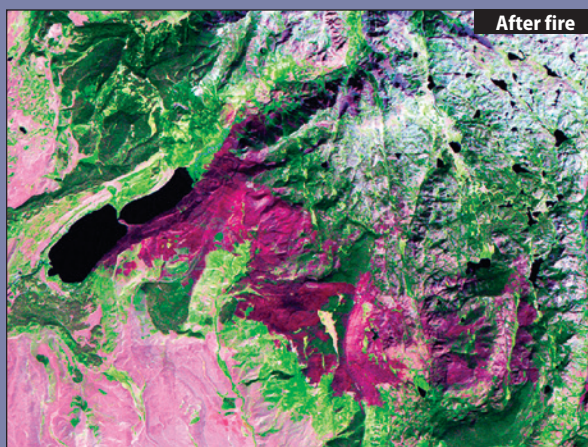
“There is an increased risk in what we call passive crown fires—what fire-fighters call torching—where a single tree will light up. But you never get an increase in the risk of severe crown fire. Those are the most dangerous, the ones that threaten people’s houses and things of that nature.”

Another big worry following a major tree kill, either from beetles or fire, is the potential for losing nutrients—especially nitrates—from the system.

“It can be a problem if nitrates get into streams and ground water,” Turner says. “It happens in a lot of the eastern forests. But what we are finding in Yellowstone is that the forests seem to have pretty effective mechanisms for conserving their nitrogen. We are not finding evidence that they ‘leak’



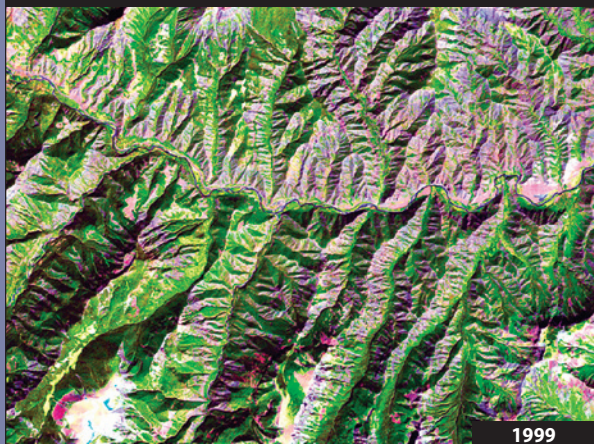
Before fire



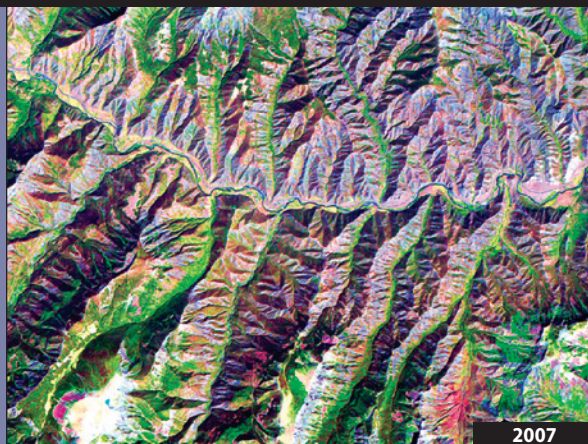
After fire

Landsat images taken before (far left) and after (left) a severe crown fire in Greater Yellowstone. The false-color images show the undisturbed forest (deep green), the burned areas (purple), and other features such as lakes (black), scrubland (pinkish), and rocky/snowy mountain tops (white and light blue).

THE FOREST BEFORE AND AFTER



1999



2007

The effects of bark beetle outbreaks are less striking than those of fire because beetles only kill some of the big trees and spare the understory vegetation and the soil. In this pair of Landsat images taken before (1999, far left) and after (2007, left) a beetle outbreak, the forest in the lower half of the image (south of the river) has been severely attacked (purple). Each image is approximately 20 km wide.

mid-slope. It quickly fills in the valleys and then moves upslope. It's like a front marching up the mountainside. This reflects the mountain pine beetles' mass attack strategy. They storm the trees."

Before Townsend can make sense of what he sees from space, he has to know what's happening on the ground. So he starts in the woods, marking off a plot, counting the trees and noting their stage of attack. Later he plugs that data into a computer model that compares the area's damage to its infrared signature. By analyzing data from dozens of plots across Greater Yellowstone, Townsend has assembled a library of signatures for different types and levels of disturbance.

"We're not just trying to map wheth-


er a stand is dead or has been attacked," he says. "We're trying to map the actual percentage of the forest that is damaged, because ultimately we convert this into carbon, nitrogen—all sorts of different things. We're trying to quantify the effects of this outbreak on the dynamics of the whole system."

Collecting data in the woods poses some interesting logistics. Beetle outbreaks often occur in remote places, accessible only by foot or horseback. Getting there can be fun, but it takes a lot of time, so Townsend has worked up a shortcut. Using cameras and a spotting scope, he can measure damage on a remote hillside from the side of a road.

But while hiking into the woods

takes time and effort, it yields more than raw data. Getting nose to bark with a lodgepole pine can offer a perspective that you can't get from a satellite. The day after his trip up Signal Mountain, walking through a different forest a few miles to the east, Townsend stops and points to a wad of pitch on yet another big lodgepole pine.

"This tree was successful," he says. "You can see where the beetle bored in and the pitch came out, and it actually knocked the beetle out. Here's the beetle stuck in the pitch. This tree defended itself. It may be one of the few trees that actually does succeed."

"Sometimes the tree does win," he adds with a smile. "That's neat to see." 

The GardenFit summer program promotes better eating habits and exercise.



taking it **OUTSIDE**

By Madeline Fisher

*Children are packing on pounds during a season once
associated with outdoor activity and exercise.*

*Addressing that problem means confronting a number of factors
that are contributing to poor health in our children.*

It's a scene that for many parents is frustratingly familiar:

Outside blooms a perfect summer day, while inside kids drape themselves on furniture, calling out occasionally for snacks or to announce, "I'm bored!" The languor is broken only by trips to the cupboard or refrigerator. And then there is the bewitching power of "screen time," a force few kids can resist. "TV, texting, Internet chatting, video gaming," says physician Alexandra Adams, a professor of family medicine with the UW-Madison School of Medicine and Public Health (SMPH). "You name it, they're doing it."

As a childhood obesity expert, Adams knows another fact about today's kids of summer: Many of them are at serious risk of packing on pounds. The children she treats at her practice in the UW Pediatric Fitness Clinic already struggle with weight gain and low fitness levels, and now 90 percent of them are coming back 5 to 10 pounds heavier after the three-month summer break, she says, without an associated increase in height. For young kids and teens, it's a devastating amount to gain, especially since statistics say those excess pounds may never come off again. And her patients are hardly alone. According to the American Heart Association, one in three American children are now overweight or obese, putting them squarely on the path to adult obesity and at risk for adult diseases, including diabetes, heart disease, arthritis and kidney stones.

"We have kids in our clinic who are type 2 diabetics and hypertensive and on cholesterol medication in their early teens. They look like mini-adults," Adams says. "They're physiologically much older in their bodies than they should be. And that's tragic."

These troubling trends have led doctors, nutritionists and health advocates to introduce a multitude of anti-obesity programs, including the national "Let's Move!" campaign started by First Lady Michelle Obama last year. Educational initiatives, healthier school lunch programs, and kid-tailored fitness regimens are all being tried. But amid these carefully orchestrated interventions, a team of CALS and SMPH researchers is now wondering if we've missed an obvious part of the

prescription, especially for children in summer.

With kids staying indoors in record numbers, what if we just got them to go outside?

This doesn't mean shuttling them to weekly soccer games or other activities by car; kids today get plenty of that, says Sam Dennis, a CALS landscape architect who specializes in children's environments and collaborates frequently with Adams. What Dennis has in mind are the outdoor experiences children used to have in the past—the type that 50- and 60-something adults describe when asked to explain how they played as children.

"They'll say, 'We didn't have any equipment and we didn't have organized teams. We would just go out into the woods and build forts or

make mud pies,'" says Dennis, who collects these accounts to inform his design of children's play spaces. "And they get very caught up and animated in telling stories of how they played in nature as kids."

These children of 40 and 50 years ago not only played outside more; they were also only one-third as likely to be overweight as their counterparts today. Being outside obviously removes kids from the indoor temptations of snacking and screen time. Plus, research shows that kids who spend more time outdoors are also more likely to be physically active, Dennis says.

Yet like many seemingly simple solutions, this one, too, has a catch. Earlier generations of kids played outdoors and were slimmer for it not because they were somehow healthier



PHOTOS BY RICK OLIVO

The Bad River Indian Reservation playground does away with big plastic structures and instead offers natural materials for imaginative, culturally relevant play. Kids help plant and shape a willow lodge (photos above) and play in a ricing canoe (right).



or more capable of making good choices than children are today—even though some grownups like to think so.

“It’s not that we were so much smarter,” says SMPH physician and pediatrics professor Aaron Carrel, with a smile. Kids have always been kids. The difference was the environment.

“**Obesogenic**” is what the Centers for Disease Control and Prevention calls the American landscape today, meaning it promotes unhealthy eating, a sedentary lifestyle, too many calories—and extra pounds. The more fattening aspects of our surroundings are easy to spot: a fast food hamburger and super-sized fries, for example. But what makes obesity so hard to prevent nowadays is that many things that foster weight gain have become part of our everyday lives, says Carrel. We take elevators instead of stairs, we drive instead of walk, we lift our garage doors with the press of a button. As a result, we probably expend 100 to 300 fewer calories each day than people did 30 years ago, while also taking in 100 to 300 more. And those added calories ... well, they add up.

“No one gets obese in a day,” says Carrel. “It’s really this few hundred calories every day that makes a difference over a week, a month, a year, and [causes] the systemic accumulation of weight and obesity.”

The same math applies to kids, of course, which is why Carrel co-founded the UW Pediatric Fitness Clinic a decade ago to help overweight children be more active in their daily lives. Through its own interventions and in collaboration with area schools, the clinic has produced dramatic results: Kids routinely trim body fat, improve their fitness and lower their risk for diabetes.

Until summer, that is. Carrel noticed the same alarming trend as Adams. When children came in for check-ups in September, their fitness levels had

“There is no more ‘free range’ childhood,” says Dennis.

plunged and they were padded once more with fat. “All the gains they made during the school year were lost,” he says. It told him and Adams that “things really have changed. The summer environment doesn’t always encourage physical activity.”

Dennis agrees, noting that what’s really vanishing is the free, outdoor play of the past, when the only rule was to be home by suppertime and kids would spend hours exploring tangles of woods, splashing through creeks, hunting for snakes under rocks—and, beneficially, exerting themselves, producing vitamin D and connecting with nature. But that kind of play is rare today. “There is no more ‘free range’ childhood,” Dennis says.

In his 2005 book, *Last Child in the Woods*, journalist Richard Louv discusses the loss of nature play at length, citing the rise of organized activities and video games as top reasons for its demise. But he and Dennis also point to parents. Fearing children will get abducted, injured or even just dirty, parents today keep a close eye on kids and restrict where they go. Even Dennis finds himself doing it. “My mom never knew where I was,” he says. “But I know where my kids are. I’m guilty of it, too.”

Sending children back out to wander the neighborhood obviously isn’t an answer to the childhood obesity crisis—most parents wouldn’t allow it. “So what I’m trying to do,” Dennis says, “is design settings that are like nature, but in very controlled situations like day care settings, or schools, or afterschool programs.” The idea, in other words, is to create environments that will keep kids engaged and active outdoors, even as they’re being supervised.

Working with Adams and tribal members, for example, Dennis designed a playground on the Bad River Indian Reservation in northern Wisconsin that replaced “bright, plastic play equipment” with such natural elements as



More elements at Bad River: Preserving trees for play and an environmental sensory wall that includes deer antlers, acorns and pine cones, and stones from Lake Superior.



Sam Dennis' play areas at Montessori Children's House in Madison encourage kids to sit on rocks and run through bushes (photo opposite).

collections of boulders and culturally relevant features like a willow lodge and ricing canoe. He helped restore an overgrown and underused children's park on Madison's west side so that today it beckons kids with grassy paths and piles of dead branches for building forts, along with a previously designed council ring.

But when Adams resolved a few years ago to change the summer environment specifically for overweight kids, it was Dennis' work with the Madison nonprofit, Community GroundWorks, that caught her eye. For years, Dennis and Community GroundWorks education director, Nathan Larson, had been using another natural setting—the garden—to lure kids outdoors, engage them in meaningful physical fitness and teach them about healthy foods. After a series of meetings, Adams, Dennis, Larson and CALS nutritional sciences professor Dale Schoeller devised an intervention based on the Community GroundWorks model. Led by Schoeller's graduate student Sarah Jacquart, the GardenFit program would test whether gardening could help kids at risk for

obesity stave off those critical summertime pounds.

There are many reasons to think that gardening might work. For one, although gardening is “not basic training, by any means,” says Schoeller, “it’s very easy to work moderate exercise and play into a gardening project.” Moreover, many studies indicate that kids who grow fruits and vegetables themselves are more likely to try them and eat them. Not that veggies somehow magically prevent obesity, Schoeller says. But when people eat larger portions of bulky, low-calorie foods, they tend to consume fewer high-calorie items such as snack foods. “It’s harder to eat excess calories with fruits and vegetables,” he says. “You fill up, plain and simple.”

But these immediate benefits aren't the only ones. Getting kids outside gives them the opportunity to connect and identify with the outdoors, say Larson and Dennis. And if they develop that affinity, chances are they will carry it into adulthood, where it translates into higher levels of physical activity and “a lot of positive, enduring health outcomes,” Dennis says. “So, there are

profound consequences for quality of life, I think.”

This is why the Community GroundWorks programs never focus solely on producing food or putting kids to work, Larson explains. Instead, children are free to roam within the gardens, giving them a sense of what past generations experienced “being out in the wilds of the neighborhood.” He recalls, for example, watching two girls lost in a tangle of raspberry canes on the property, completely engrossed in the pleasure of eating berries even though cars drove by on a road not 10 feet away.

“I think it’s important to realize that a lot of it is the experience,” Larson says. “The garden is a place where children develop a different relationship to food and a different relationship to spending time outside—a higher level of comfort and enjoyment.”

All the lofty goals in the world mean nothing, however, if kids won't cooperate, as the team soon learned when GardenFit launched two summers ago at Troy Gardens (which are run by Community GroundWorks) on Madison's north side. Starting a new research project is always complicated, Adams relates, especially when children are involved. “But I think you never have a real sense until you get kids with their hands in the dirt, saying ‘This is boring,’” she says with a laugh.

Jacquart had her hands full, in other words, as she faced a small group of 11- to 13-year-olds who were selected for GardenFit because they were on the cusp of becoming overweight. “Day to day, there was a lot of complaining,” she says. “It’s too hot, it’s too hard, I want to sit down.” Forget gardening, in fact—just being outside for three hours a day was an adjustment, she says. The kids would forget to put on bug spray or sunscreen. Or they would wear white

“We need to allow healthy options to be our default,” says Carrel.

shoes and then grumble when they got soiled.

But Jacquart quickly acquired a new talent—unexpected for a science graduate student—for motivating middle schoolers. Aided by the Community GroundWorks staff, she interspersed water fights and other play amid strenuous tasks like weeding and spreading wood chips. She frequently reminded the young gardeners about the produce they were growing for local food pantries and the skills they were developing. And two days a week, she and the kids fixed healthy lunches of veggie burritos, whole wheat pasta with pesto, pita pocket sandwiches and spring rolls—all bursting with vegetables they had grown themselves. The meals quickly became everyone’s favorite activity by far.

“It was really good. I loved the days we ate out there,” says Jacquart. “You know, fresh from the garden. We’d pick the vegetables right before we were going to prepare them, so that was very cool, I think.”

The grouching continued, but by the end of GardenFit last summer, the kids seemed to agree it had all been very cool. “The feedback we got from them is that they really liked participating, they enjoyed trying new foods and growing them, they got a real sense of accomplishment from working in the garden,” Jacquart says. “They would do it again.”

There was just one thing: The program, on average, failed to prevent weight gain. Some of last year’s GardenFit kids lost weight, she says. But others gained 7 to 10 pounds.

Having spent every day with them for eight weeks, Jacquart heard plenty about the fattening food they were eating on their own time: tacos at the mall, chips at home, bagels and cream cheese at the community center where they spent their early mornings. In the end, she suspects this intake of extra calories swamped out the program’s effects. Even

then, the results surprised her. “I mean, we did hard work out there. I came home every day sweaty and covered in dirt and I lost weight over the summer,” she says. “But I also didn’t eat those foods. I ate my normal diet.”

Adams and Schoeller are less surprised; what the findings tell them is that many more children need to be enrolled beyond the six who participated the first summer and the 10 who gardened the second. Collecting data from more kids will make it statistically easier to detect the program’s effects, Schoeller says. It will also help the researchers determine the “dose” of gardening that’s needed to counteract any factors that predispose the kids to weight gain, such as their genetics, as well as their lives at home, adds Adams.

“If they garden for three hours a day and then go home and eat junk food,” she says, “then clearly three hours isn’t a big enough dose.” The team will run a third season of GardenFit this summer and is hoping eventually to conduct a much bigger trial.

But the GardenFit results convey a larger message about the complexities of battling a health condition that has also become an environmental problem. When obesity stems not just from the summertime play environment, but also from the food environment, the school environment, and the built environment of streets and cities, just how do you fight it?

“On all fronts” seems to be the answer, which is why a group of CALS and SMPH researchers has embarked on a much larger effort. Working with the Bruce-Guadalupe Community School, a Latino charter school affiliated with the United Community Center in Milwaukee, a team that includes Carrel, Dennis and Schoeller will examine the lives and surroundings of 350 students in painstaking detail: what they eat, where they play and how they get to school, as

well as their levels of body fat, muscular strength and endurance, and the amount of energy they expend.

Based on what it learns, the team then hopes to offer the community ideas for reshaping school and neighborhood settings so that they naturally encourage behaviors like walking, playing outside and eating nutritious food, says Carrel—rather than constantly asking kids to choose these healthy options over less healthy but more enticing ones. Not that parents and doctors should stop teaching children to make wise choices, he adds. “But I think we need to change the environment a little bit to allow healthy options to be our default.”

As he contemplates the potential of this approach, Dennis recalls the sabbatical break he spent in Costa Rica with his wife and three kids last fall. In the rural town where the family stayed, the electricity went out with nearly every rainstorm (not to mention one hurricane). Not that this really mattered. The house had no television and Dennis’ kids had left their video games in Madison. The only screen time they got was a periodic e-mail exchange with friends back home and an occasional movie rental over the computer.

So, naturally, Dennis’ kids got bored. And then, in what might seem like a minor miracle to some parents, they went outside to play—climbing trees, running around and making their own fun, just like all the other kids in the neighborhood. 🌱



The Grow Dozen



Thomas Albrecht



James Birkemeier



Sean Burrows



Richard Hilliker



Paul Huggett



Darren Marsh

Thomas Albrecht BS'76 Forest Science

• Albrecht, a forester for the Department of Natural Resources in Shawano County for more than 30 years, oversees forest management on public lands and helps private landowners practice sustainable forestry. His duties include ensuring that trees are harvested sustainably and that areas are reforested. He also diagnoses tree diseases and fights forest fires. What fuels his passion? "The belief that every tree in every forest matters," he says. Albrecht is a board member of the Wisconsin Agricultural and Life Sciences Alumni Association (WAALSA).

James Birkemeier BS'76 Forest Science

• Low-impact logging, use of solar-heated kilns for wood-drying, and harvesting only diseased or windblown trees are central to business at Timbergreen Farm, which produces hardwood flooring and handmade wood products that are sold directly to customers. Proprietor Jim Birkemeier has long trained other Wisconsin woodlot owners in sustainable timber management. Now he's taking his message around the world—stops include Ecuador and New Zealand—to help forest owners there earn a fair income and protect the remaining rainforests, he says.

Sean Burrows MS'02 Biometry PhD'02

Forestry • Burrows serves as the chief technology officer and chief software architect of Ascend Analytics, a company that provides risk management models for energy companies. Such work may seem a far cry from forestry, but not according to Burrows, who minored in statistics and says his doctoral work

using spatiotemporal statistical techniques in forests was good preparation for the work he does now. "Much of today's forestry involves statistics," says Burrows. "If you know how to use statistics, you have a broad ability to analyze and understand data, whether it's in academic forestry or in the private sector."

Richard Hilliker PhD'68 Forestry

• Hilliker spent much of his career as manager of land and water resources with Consolidated Papers, Inc. (CPI) and president of Wisconsin River Power Co., a hydroelectric company owned by CPI, Alliant Energy, and Integrys Energy. His duties included managing the federal relicensing of seven hydroelectric facilities on the Wisconsin River and planning for the eventual disposition of CPI timberlands in Wisconsin and Minnesota. Now nominally "retired," he owns and runs two businesses, one a private consulting firm specializing in land management and real estate sales and the other, growing and wholesaling Christmas trees.

Paul Huggett BS'87 Horticulture

• Huggett owns Paul's Turf and Tree Nursery, Inc., which offers a mix of 200-400 acres of sod production, a 100-acre deciduous and evergreen tree nursery, and 200-400 acres of grain crops in rotation. "I am very blessed with good employees who allow me the freedom to run my business and not work it," says Huggett, who in the mid-'90s took over a family business that began as a mint farm in 1955. "Variety creates the greatest job satisfaction." Huggett is current

past president of the Wisconsin Nursery Association Board and has held board positions with the Wisconsin Sod Producers Association (including a term as president) and the Wisconsin Turfgrass Association Board.

Darren Marsh BS'87 Forest Science

• Dane County Parks Director Darren Marsh oversees more than 12,000 acres of parks and natural resource areas with some 1.25 million visitors each year. What you might not know: Dane County Parks was one of the first park programs in the nation to develop a dog exercise program ("Dog Parks," 1994) and has a nationally recognized disc golf course at Token Creek Park. "I have a great job," Marsh acknowledges. "I help people with special events ranging from large bike races, marathons, and music events to family reunions and youth activities. I really enjoy opportunities to restore and manage natural resource areas that include wetlands, prairies, and forests."

Margaret Milligan BS'05 Forest Science, Recreation Resources Management

• Milligan (formerly Grosenick) oversees the timber/forestry program in Idaho's Salmon-Challis National Forest, managing 1.8 million acres. She and her team use a variety of treatments to manage the forested public land, including prescribed burning, pre-commercial thinning, commercial timber sales, watershed restoration and wildlife habitat enhancement projects. "My favorite part of my job is working in some of the most beautiful places in this country and being responsible for ensuring that they are managed properly," she says.

12

Alumni who are making a difference in forestry and related industries



Margaret Milligan



Chad Morgan



Howard Nelson



Tara Talbot



Brenda Wasielewski



Shahla Werner

Chad Morgan BS'91 Forest Science MS'93 Forestry • Morgan is a log marketing supervisor with Potlatch Land and Lumber, where he markets pulpwood, bolts, saw logs, and biomass harvested from 320,000 acres in Minnesota and Wisconsin. "The industry has gone through many changes, especially during the last 10 years," says Morgan. "The name on the door has changed at many of the places that I've worked, often due to a changing global economy." Over the course of Morgan's career, those names have included Sappi Fine Paper, StoraEnso, and NewPage. While rolling with the changes Morgan remains firmly rooted in the northwestern woods of Wisconsin, which he came to know and love while growing up spending time at his parents' cabin.

Howard Nelson PhD'04 Forestry, Wildlife Ecology • Nelson spent five years as CEO of the Asa Wright Nature Center in Trinidad and Tobago, where he was responsible for managing research and ecotourism on 1,300 acres of secondary tropical forest. Now he's developing a regional master's degree program in biodiversity conservation to help countries implement their national action plans in keeping with the Convention on Biodiversity. Four universities—the University of the West Indies, the University of

Belize, the University of Guyana, and the Anton de Kom University of Suriname—will offer the degree.

Tara Talbot BS'96 Soil Science • Talbot serves as marketing and environmental communications coordinator for Glen Oak Lumber & Milling, a national hardwood millwork manufacturer headquartered in Montello. Much of her work involves meeting the challenges of a rapidly changing wood fiber market, she says. Glen Oak has implemented a zero-waste policy on wood fiber delivered to their facilities and now redirects all of their former waste into bagged animal bedding, industrial biofuel or heating their facilities. "With the economic collapse of the housing market and subsequently, the wood products industry, our diversified product lines have been a great asset," Talbot says. "Five years ago, I never would have thought that sawdust/residuals could become such a valuable and diversified product line."

Brenda Wasielewski BS'98 Forest Science • As a fire management officer for the Colorado State Forest Service, Wasielewski helps local governments prepare for and respond to wildland fires. Her zone covers approximately one-third of the state. She responds to wildland fires on request if they become

too complex for local jurisdictions to handle, but much of her job, she says, is to help those local governments prepare before fire occurs. Her experience at CALS gave her a higher expectation of foresters than some of her colleagues, she notes. "While we commonly joke that 'We're just a bunch of foresters, we can't change government,' I argue that foresters are on the front line of influencing landowners, implementing government policy, and spending taxpayer dollars effectively."

Shahla Werner MS'99, PhD'04 Entomology • Werner is director of the Madison-based John Muir Chapter of the Sierra Club. The work is very different from her previous position as a forest entomologist with the Pennsylvania Department of Conservation & Natural Resources—and from her doctoral research on ground beetle biodiversity—but she relishes the opportunities her job offers for meaningful change. "My most satisfying moments are when I can tell we've made a key difference on things that matter," she says.

Baker's Dozen

Catch up with **Richard Hofstetter**, who's getting attention for his startling work using music to ward off pine beetle attacks. More on page 25.

About the Dozen

These 12 alumni represent the depth and breadth of CALS graduates' accomplishments. Selections for the list are made by the Grow staff and are intended to reflect a sample of alumni stories. It is not a ranking or a comprehensive list. To read more about CALS alumni, go to www.cals.wisc.edu/alumni/

Next issue: Working Globally

Know someone who should be in the Grow Dozen? Email us at grow@cals.wisc.edu

Catch up with ...

Darrel Feucht BS'85 Agricultural Mechanization & Management

IT'S THE WISCONSIN IDEA GONE GLOBAL. That's one way to describe Colonel Darrel Feucht's pending mission in Afghanistan. The Fall River resident, a loan services facilities manager in civilian life, is leading a newly formed 58-member National Guard team that includes agronomists, hydrologists, forest scientists and a veterinarian. The goal of their 11-month tour? To help restore Afghanistan's farmland and provide a viable alternative to growing poppies for the drug trade. • Wisconsin's first Agribusiness Development Team (ADT) will get some help from CALS before their tour starts in late 2011. The group is taking a short course Feucht calls "101 Extreme," a 40-hour

crash course in farming practices they'll need in Afghanistan. And CALS International Studies will serve as a "reachback" resource for Feucht's team to call upon for assistance while in country. • Feucht's group, headed for the volatile eastern province of Kunar, will build upon an effort that since 2007 has involved dozens of National Guard ADT teams from other states (they have been going over in waves over the past three years). Their work has included everything from training farmers in the use of trellises in grape production to building root cellars, slaughterhouses and wind turbines.



● **What kind of agricultural efforts will you build upon?**

One thing that's really gained momentum are demonstration farms. ADT teams demonstrate growing particular crops at different stages of the growth cycle and invite farmers in to show how you can do things from start to finish. It's more efficient to teach a group of people the same thing at one time. It also means less time for soldiers to be traveling on the road. It's more secure for our people.

● **What kinds of crops will you be working on?**

Winter wheat is becoming a popular crop. Pomegranate is a huge crop in that region. One of the construction projects is a pomegranate juice production facility. Beekeeping is popular, too, and is part of the demonstration farm as well.

● **Why is this kind of help needed?**

Many years ago, Afghanistan was one of the major crop-producing countries in the region. They have the wherewithal to produce because of their rich soils and irrigation. The challenge is that a lot of the canal work and irrigation systems have been neglected or destroyed over the last few decades because of the wars. What looks to us like a

vast wasteland has great potential when you work on these irrigation systems. That's why we're taking a couple of civil engineers with us.

● **What's the state of farming compared to our own?**

It's been described to me many times as 1900s Wisconsin. There's almost no machinery, you till with an ox. It's very basic farming.

● **Are you excited?**

I am apprehensively excited. To me, "excited" is if someone said you were going to spend a year in Hawaii. It's still a dangerous country. There's a risk in where we're going. We try to mitigate and minimize that risk to keep everybody safe. I think it is a tremendous opportunity for the state of Wisconsin, the University of Wisconsin, and the College of Ag and Life Sciences.

And I'm looking forward to it. I'm glad I was picked to do this, and we will do the best we can. My No. 1 focus is that of the 58 people who go over, 58 come back and we're all safe and healthy.



CLOSE ENCOUNTERS WITH CHICKS, AND MORE: Science Expeditions take place April 2, with the new Wisconsin Institutes for Discovery as the main venue. 📺

CELEBRATE “Peace Corps and Africa: Fifty Years,” to be held on the UW-Madison campus March 24-26. The event brings together former volunteers, musicians, artists, storytellers, and Peace Corps founders and leaders to celebrate and debate the legacy of the Peace Corps in Africa and beyond. To register, visit: africa.wisc.edu/peacecorps.

NOMINATE candidates for three honors bestowed by CALS: The **Honorary Recognition Award**, the **Distinguished Service Award** and the **Distinguished Alumni Award**. Nomination forms are available at: cals.wisc.edu/honorary/ and are due by April 22.

ATTEND Alumni Weekend April 28–May 1, featuring family-friendly events, “Year of the Arts” presentations, and, new this year, a traditional Wisconsin fish fry. Visit: uwalumni.com/alumniweekend or call (888) WIS-ALUM for more information.

📺 For links to more information, go to: www.cals.wisc.edu/grow/

GATHER in Madison with alumni from around the world July 26–28 for an **International Convocation** exploring world issues and celebrating Wisconsin’s leadership as a global university. Highlights include a 10th anniversary celebration of Olbrich Gardens’ Thai Pavilion; a three-day conference at the new Wisconsin Institutes for Discovery; and a closing-night gala at the new Union South, recognizing distinguished international alumni. More info and registration at: uwalumni.com/international.

MAKE chili rellenos. If freshmen can do it, so can you—at least when you have horticulture professor **Jim Nienhuis** giving you **step-by-step instructions** about how to best roast, peel, stuff and fry this spicy, cheesy treat. Nienhuis gave his cooking demo to a First-Year Interest Group (FIG) as part of their study of the culture of food. You can follow along at http://www.youtube.com/watch?v=WaZ1BsMe_2c.

BABY ON BOARD

At age two and a half, K.C. Kniffin knows something you might not know about the Arctic Circle: The snow there is not good for packing snowballs. He also knows how much fun it is to breeze across the tundra on a snowmobile, or “snow-nobile,” as he prefers to call it.

Not many preschoolers from the Lower 48 get to become Arctic explorers, but K.C. got his chance courtesy of Moms on the Go, a CALS fund that covers some travel and childcare expenses for researchers out in the field. In K.C.’s case, the fund covered airfare for his father, Kevin Kniffin—the husband of microbiologist Jenny Kao-Kniffin—when she was doing postdoctoral research in Barrow, Alaska with CALS soil scientist Jim Bockheim. (For more on that research, see Field Notes, p. 12.)

Kniffin provided childcare for K.C., often playing with him in the snow just a few yards from where mom was doing research. The intent of the fund is to spare families the pain of extended separation and parents the usual load of worry and guilt about leaving their children behind. Instead, families get to flourish in each other’s company in exciting (if often challenging) new surroundings.

According to Jenny Kao-Kniffin, it’s a win-win for everyone. “My son helped us work longer hours with less stress,” she says. “Barrow is in a very remote location and resources are scarce. Having my son with me was the best form of entertainment for the entire research team. It’s amazing how everyone’s mood improved when my son was present.”

Not every kid gets to see whale bones:

Jenny Kao-Kniffin with K.C. and the research team.



PHOTO BY CARSTEN MUELLER

Kao-Kniffin, now an assistant professor at Cornell, puts Moms on the Go in the context of other progressive developments at CALS that support women in the workplace.

“The Microbial Sciences Building also has a lactation room and creative conversational areas. It was a great place to meet an amazing collection of women scientists that prove you don’t have to choose between your family and your career,” she says.

The UW Foundation maintains more than 6,000 gift funds that provide critical resources for the educational and research activities of the college. To help support Moms on the Go, visit <http://www.supportuw.org/giving?seq=12457>.

Five things everyone should know about . . .

Bedbugs

By Phillip Pellitteri



1 | They plagued the Neanderthals. Bedbugs have been a problem for humans since prehistory, and it is speculated that they originated from caves that our ancestors shared with bats. They were widespread in the United States but seemed to disappear during the early 1940s when DDT was used indoors for treatment. There were no records of bedbugs in North America before the early colonists. During the last 10 years there has been a major resurgence. The biggest factor is their high level of resistance to pesticides used for indoor pest control.

2 | You won't like their relatives, either. Bedbugs are a family of true bugs (Cimicidae) and are related to stink bugs, assassin bugs and other insects in the order Hemiptera. There are 15 species of these wingless, blood-feeding parasites in North America, with a majority associated with specific species of birds or bats. There are two species that feed and breed on humans—the human bedbug *Cimex lectularis* and the tropical bedbug *Cimex hemipterus*. Biologically, bedbugs can be thought of as indoor mosquitoes without the disease issues.

3 | They travel because we do. Widespread travel has allowed bedbugs to “hitchhike” and become reestablished throughout the world. Bedbugs first started to appear in motels, hotels and youth hostels. Infestations then appeared in multifamily dwellings. Now we hear about infestations in subway benches, hospitals, movie theaters, libraries and retail stores. Bedbugs must be brought into homes by people. The two most common sources are infested items such as used furniture, or they are brought into a home on baggage that has become infested.

4 | And now for the good news. Bedbugs are the only blood-feeding insect that has not been associated with any human diseases. More than 30 percent of people bitten do not show reactions to the bites. Bites often look like mosquito bites or hives and are clustered in areas on the arms, neck or back. They can be very itchy, but there can be a delayed reaction of 12 to 24 hours or more before you see a reaction.

5 | You'll still want to get rid of them. Bedbug control requires experience and it is strongly suggested that you seek professional help. Early treatment before populations become high is important. Bedbugs can be killed by heating them above ca. 112 degrees Fahrenheit. Putting clothes into a drier for 15 minutes under medium heat will kill bedbugs. Cold is effective, but requires hours of exposure around 0 degrees. Drying dusts have been used in void spaces to desiccate these insects. Pesticides often require multiple and very thorough treatments to be successful. Treatments are very expensive, which leads to people delaying starting them.

Phillip Pellitteri is a distinguished faculty associate in the CALS Department of Entomology. He runs the Insect Diagnostic Lab, which was established to identify insects and insect-damaged plant material from around the state and recommend controls to both county extension offices and commercial concerns. He also teaches in the Master Gardener program.

Take the FINAL EXAM!

Fill out your answers online. Ace our quiz and we'll enter you in a drawing for a gift box of Babcock Hall cheese. Go to: www.cals.wisc.edu/grow/ for more details.

Wildlife Ecology

1. In addition to the reduction in large predator populations, which of the following most likely accounts for the increase in deer populations in Wisconsin relative to the time before European settlement of the region?

- a. large areas of the landscape have been converted to earlier successional habitats that deer prefer
- b. there has been an increase in average annual precipitation leading to more rapid plant growth
- c. aggressive disease control efforts by wildlife managers have greatly reduced mortality of adult deer
- d. deer have fewer competitors because other large herbivores that used to occur here are now extinct

Bacteriology

2. What is the foodborne bacterial pathogen that produces heat-stable enterotoxins that cause vomiting in humans?

- a. *Campylobacter jejuni*
- b. *Staphylococcus aureus*
- c. *Salmonella*
- d. *Clostridium perfringens*

Biofuels

3. What is the most abundant organic compound on Earth?

- a. cellulose
- b. sucrose (table sugar)
- c. starch
- d. DNA

Horticulture

4. Which one is the most accurate ranking for the world's most important food crops?

- a. #1 Potato; #2 Rice; #3 Wheat; #4 Cassava
- b. #1 Rice; #2 Wheat; #3 Cassava; #4 Potato
- c. #1 Wheat; #2 Potato; #3 Cassava; #4 Rice
- d. #1 Rice; #2 Wheat; #3 Potato; #4 Cassava

Agronomy

5. Energy flow is an important functional component of ecosystems. Circle the one answer below that most accurately describes energy flow.

- a. energy flow is a cycle: sun > producers > consumers > producers > consumers
- b. energy flow is a cycle: sun > producers > consumers > environment > producers
- c. energy flow is in one direction: sun > producers > consumers > environment
- d. energy flow is in one direction: sun > producers > consumers
- e. none of the above

LAST ISSUE: Answers were 1: B, 2: B, 3: D, 4: D, 5: C. Congratulations to UW-Hospital and Clinics employee Lindsay Kneisler BS'06, who was randomly selected from the three people who correctly answered our Final Exam. She wins a gift certificate to Babcock Hall.

College of Agricultural and Life Sciences
University of Wisconsin-Madison
136 Agricultural Hall, 1450 Linden Drive
Madison, WI 53706

Nonprofit Org.
U.S. Postage
PAID
Madison, WI
Permit No. 658



SPRING IS HIGH

And nowhere can you better experience it than at Allen Centennial Gardens, run by the CALS Department of Horticulture as an outdoor teaching lab. Stroll through 2.5 acres of various types of gardens, and consider volunteering or attending an event there. For more cool science, visit us at www.cals.wisc.edu/grow/.