OREGON STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

OREGON'S AGRICULTURAL PROGRESS

Invaders from the Pacific

also:

Sage-grouse conservation
Summer Ag Institute
Canola in the valley
21st-century barley
... and more

Oregon State UNIVERSITY

OREGON'S
AGRICULTURAL PROGRESS

Winter 2013, Vol. 59, No. 1, Oregon State University

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Front cover photo: Hitch-hiking invertebrates from the tsunami-launched dock. Photo by Lynn Ketchum
Contents photo: Evening barley harvest. Photo by Lynn Ketchum
Back cover photo: The Chandler family welcomes the Summer Ag Institute. Photo by Peg Herring

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Discovery and collaboration

Agricultural research requires a lot of hands, and minds. That was evident last summer, when a Japanese dock set loose by the tsunami arrived on an Oregon beach with a load of potentially harmful invasive species. OSU researchers from the Coastal Oregon Marine Experiment Station were at the site within hours, working fast to collect and identify the hitch-hikers pictured on our cover.

With branch experiment stations across the state, OSU researchers are close to the action, whenever and wherever the unexpected happens. In this issue of *Oregon's Agricultural Progress*, we explore how unexpected discoveries come from many people thinking about a problem from many angles. Ranchers, land managers, and conservationists in eastern Oregon are discovering how to improve rangeland for the benefit of wildlife and cattle. Barley breeders, growers, brewers, and food scientists are testing new varieties of the world's oldest grain. And, a network of Facebook friends has become an instant, international corps of taxonomic discovery.

Oregon's Agricultural Experiment Station is where discoveries happen. It is where decision-makers turn for the information they need to make critical public policy. And it is where teachers come to discover how agricultural research can inspire the next generation of thinkers, doers, and discoverers.

Peg Herring

OSU hunts for 'zombie' flies

Ramesh Sagili was walking on Oregon State University's campus early one morning in July 2012 when he stumbled upon two dead bees under a streetlamp. Sagili, an Extension honeybee specialist, took the bees back to his lab. Four days later seven maggots crawled out of the neck of one of the bees. Three weeks after that, one of the maggots matured into an *Apocephalus borealis*, a zombie fly, so called because it is suspected of causing bees to exhibit a disoriented behavior at night.

OSU Arthropod Collection photo

Sagili's finding became Oregon's first documented case of a zombie fly infecting a honeybee. It comes amid rising concern about the health of honeybees, which have been hit by a mysterious phenomenon called colony collapse disorder in which adult honeybees disappear from a hive, either entirely or in large numbers.

Sagili doubts that the small, brownish-red fly is playing a role in the widespread die-off of the already beleaguered bees, which are crucial pollinators for some Oregon crops. "It's a stretch to say the fly is correlated to colony collapse disorder," he said. "At this point, I don't think it's a threat. I don't think it's at the level where it can depopulate hives in large numbers."

To see how prevalent the zombie fly is, Sagili has placed traps by hives at several locations on campus and is encouraging commercial and hobby beekeepers to do the same near their colonies.

Earlier in 2012, researchers in California became the first to document that the fly, which is native to North America, attacks honeybees. The fly, which lays eggs inside the bees and is smaller than a fruit fly, is also known to parasitize bumblebees.

Sagili hypothesizes that although honeybees are widely studied, it's possible that scientists just never saw the parasite because they usually preserve their collected bees in alcohol, which would kill the larvae and keep them from popping out.

– *Tiffany Woods*

OSU-trained taste testers evaluate experimental wines

Thirteen taste testers nuzzle their noses into glasses of Pinot noir in a classroom. They swirl, sniff, and sip. As they roll the wine in their mouths, they try to pin down exactly what it is they're tasting and smelling. Was that black pepper? Maybe forest floor? Or the sulfuric whiff of a struck match?

The evaluators were some of the 60 Oregon winemakers and vineyard managers whom Oregon State University trained in 2012 in an effort to help the state's wine industry better understand how what it's doing in its vineyards and tanks affects the final product.

The unpaid volunteers learned to use a sensory method called free-choice profiling that allows them to use their own vocabulary to describe the color, aroma, taste, and "mouthfeel" of wines.

They'll gather several times a year for refresher trainings and to evaluate experimental wines made by OSU and Oregon's wine industry. Last summer, they evaluated Pinot noir made from an OSU research trial at Stoller Family Estate's vineyard in Dayton.

Lynn Ketchum photo

In the study, Patty Skinkis, a viticulturist with the OSU Extension Service, and her crew snipped off different amounts of grape clusters at various times, altering the yields. Their goal was to determine how much fruit should be left on a vine and when it should be thinned to produce the highest-quality wine. The testers tasted five wines made from the different thinning methods.

James Osborne, an Extension enologist who trained them, is now analyzing the ballots to see if differences were detected. Ultimately, after evaluating wines over a number of seasons, he hopes to correlate the results with how the fruit was thinned.

"You really need to have a tasting panel so you can find out if these practices really are beneficial to the wine," said winemaker Dick Erath, whose foundation donated $25,000 to the training. "It's amazing how just little things can change how wines appear and smell. That all comes out in a sensory panel."

– *Tiffany Woods*

A new animal sciences teaching facility means no more crowded labs (or lines for the bathroom)

For years, animal science students at Oregon State University were shoehorned into Room 203, a stuffy, narrow lab in Withycombe Hall, where elbow-to-elbow they examined reproductive systems from livestock. On hot days, the smell drifted into a neighboring room. To study an actual live animal, they were shuttled in a van to OSU's various research farms, some of which are several miles off campus. And if they were women and needed a restroom, they sometimes waited in line to use the limited stalls in the west wing of their 60-year-old building.

But life just got better thanks to the new $3.5 million, 17,000-square-foot James E. Oldfield Animal Teaching Facility, which was built in response to increasing student numbers and a need for modern infrastructure.

Its main attraction is a large arena where livestock and equipment can be brought in for hands-on learning. There's also a convenient walk-in freezer and refrigerator for storing animal organs. Formerly, such specimens had to be carted from the basement and wheeled across the main entrance of Withycombe Hall, which also houses OSU's theatre complex and the university's wine- and cheese-making facilities.

Heated by geothermal energy, the new building also features a conference room and teleconferencing technology. Two classrooms have large garage doors that open into the arena, and the lab classroom is five times the size of the room formerly used in Withycombe. Additionally, the new teaching facility has seven bathroom stalls for women, who make up about 90 percent of the nearly 500 undergraduate majors in the department.

Sheep graze by the new $3.5 million James E. Oldfield Animal Teaching Facility on OSU's campus. Heated by geothermal energy, the building is used mainly for teaching and it's equipped with conference rooms, laboratories, and a livestock arena.

The Oldfield building comes amid increasing student enrollment. This fall, twice as many undergraduates were majoring in either animal or rangeland sciences as there were 10 years ago, said John Killefer, who is the head of OSU's animal and rangeland sciences department. In addition to building new facilities, the department plans to hire six faculty members, using donations and university funding.

The development is taking place at the same time that OSU is restructuring some of its livestock centers on and around campus because of budget cuts and a re-evaluation of how many animals it actually needs for research and teaching. At its dairy operations, for example, the university has sold approximately 200 of its 300 cows but is keeping its Jerseys as it focuses on grass- and forage-fed milk production.

The Oldfield facility will eventually be surrounded by three other structures: a building to house animals and research; a facility to store commodities like hay and grain; and a place for a farm machinery shop, the agricultural education program, and a computer data center.

Excluding the data center, the total cost for all the buildings is pegged at $8 million, with financing split evenly between bonds and gifts from donors, Killefer said. Funding for the Oldfield building came from donations raised by OSU's capital campaign as well as matching bonds from the state.

- *Tiffany Woods*

PACIFIC INVA

On March 11, 2011, a massive earthquake struck off the coast of Honshu, Japan, creating a tsunami that, in turn, launched a flotilla of debris across the Pacific Ocean. Riding the debris was a small invasion of sea creatures.

By Mark Floyd

Photos by Lynn Ketchum

A year after the tsunami, with images still vivid of 10,000 people drowned and villages contaminated with radioactivity, a forward-thinking assembly of Oregonians grappled with what to do about the tons of debris anticipated to arrive on Oregon's shoreline later that year.

There were physical oceanographers from Oregon State University to predict where the currents would deposit the debris. The Coast Guard talked about navigational safety; community leaders and the waste management industry outlined plans for cleaning the beaches. There were emergency planners, political staff members, education and outreach specialists, park rangers, fishermen, surfers, and beachcombers.

There were not, however, any biologists in that conversation. No one gave that angle much of a thought.

Tourists flock to the beached Japanese dock that landed on Oregon shores with a payload of potentially invasive species.

Jessica Miller was in her office at OSU's Hatfield Marine Science Center late on the afternoon of June 4, 2012, when she heard a buzz in the hallway. Apparently, something had washed ashore at Agate Beach, just a few miles north, and it was big.

Curious, she and her husband decided to swing by the beach on their way home. It would be daylight for another couple of hours. "When I got there, I was dumbfounded. It was huge," said Miller, on first seeing the 66-foot cement dock that had just completed its 5,000-mile journey from Japan. "And then I noticed it was covered with brown algae and big pink barnacles. These creatures weren't from around here. These were Japanese flora and fauna."

When she got home, Miller, an ecologist in OSU's Department of Fisheries and Wildlife, called her OSU colleague, John Chapman who studies invasive aquatic species. They made plans to meet at the marooned dock first thing in the morning.

When Chapman saw the enormous dock covered with living plants and animals, his first thought was, this isn't supposed to happen. "We invasion ecologists predicted that the tsunami debris would be covered with open-ocean species and that any near-shore Japanese species would be gone by now, after 451 days at sea," said Chapman. "The open ocean isn't a place where near-shore species are supposed to survive. This is changing the way we have to think about invasive species."

That morning, plans were already in place to completely scrape the Japanese dock before the hitchhiking organisms could escape on the next high tides. Miller and Chapman gathered as many samples as they could, stuffing them in buckets and bags, then taking steps to preserve the specimens for later study.

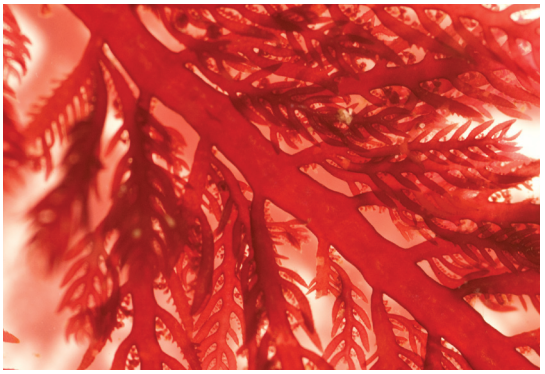
Precisely identifying all the organisms has turned out to be surprisingly complex. The large pink barnacles were clearly from Japan, but the algae, limpets, and anemones on the dock were similar to some North American west coast species. Over the next several weeks, Miller, Chapman, and OSU botanist Gayle Hansen worked with a dozen taxonomists in the United States, Japan, Russia, and Canada to identify what was on the dock and which species might pose a risk of establishing in Oregon waters.

"To date, we have identified 92 unique species from the dock, of which as many as 10 species are known to be invaders in other parts of the world," Miller said. "Invasive species do more than just take up residence; they result in ecological or economic damage. And we found some that have the potential to be invasive in Oregon." The brown algae that Miller first saw that June night turned out to be *Undaria pinnatifida*, a known invader that can spread rapidly when it gets established. "That's one I worry about," she said, noting that the specimens on the dock were reproductive.

OSU marine ecologist Jessica Miller examines one of hundreds of organisms hitch-hiking on the Japanese dock that was set loose following the 2011 earthquake and tsunami disaster. This northern Pacific sea star has become invasive in other parts of the Pacific.

The researchers also worry about what other creatures may have already "jumped ship" before the dock hit the beach. And more tsunami debris is heading our way.

Chapman and Miller hope to secure funding to survey coastal waters over



Above: Nearly 100 species have been identified so far from samples collected from the Japanese dock. They include at least four species of barnacle (top), a filamentous red alga, (middle), and masses of encrusting coastal invertebrates (bottom).
Bottom: The spectacle continued for tourists who watched authorities dismantle and remove the wayward dock.

the next few years to determine if any of the Japanese organisms become established. The researchers are using a 2010 "rapid assessment" of nearby estuaries as a baseline to know what species were in the estuaries before the dock arrived. But there are no such inventories of near-shore coastal organisms. "Most of the time—but not always—we can identify new invaders in our estuaries if they become abundant and if they are conspicuous," Chapman said. "Tiny things, including new diseases and parasites, are harder to recognize, even when they invade while we are watching."

Because the dock was harboring what seemed to be multiple generations of some species that may have successfully bred while onboard their long journey, Chapman guessed that the chance of some of the invaders establishing in Oregon waters is fairly high. Predicting which ones, he says, is all but impossible. "The fact that there were multiple generations indicates they may have been establishing more or less permanent populations while at sea," Chapman said. "That was unexpected. And it would seem to indicate that this winter's new debris—if it comes—could be as biologically dangerous as ever."

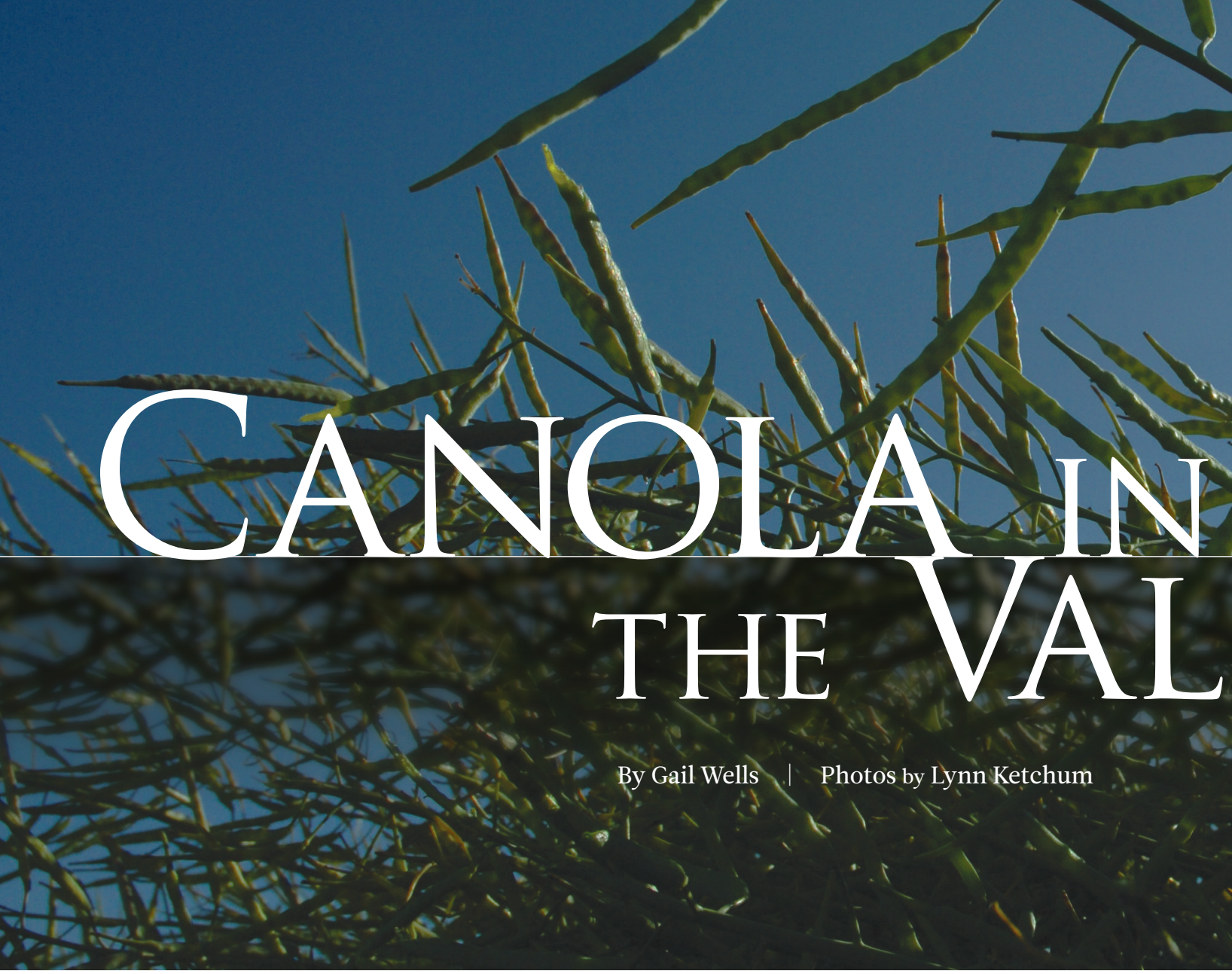
The dock landing reflects classic principles of invasion biology, according to Sam Chan, an OSU Extension Sea Grant specialist. "Pathways to invasion are important and the movement of a large coastal structure by tsunami is a new pathway for transporting a large, nearly intact community of organisms across oceans," said Chan, former director of the Oregon Invasive Species Council. "You would have assumed that organisms have been moving across the oceans for thousands of years, but in reality, this is the first time we've witnessed it."

So, will this invasion succeed?

"You would have assumed that organisms have been moving across the oceans for thousands of years, but in reality, this is the first time we've witnessed it."

"Successful invasion is made by repeated 'hits' onto the right habitat," Chan said. "It's called 'propagule pressure and habitat suitability.'"

The tsunami and its drifting debris were unwanted tragedies, Chapman said, but there is a silver lining. "The debris provide one of the greatest opportunities to test fundamental ideas of propagule pressure," he said. "How many invaders does it take to invade? How long can invaders survive as they disperse? Does time matter? What kinds of invaders fail? Scientists over the world have searched for these answers for decades and centuries. This massive, unwanted experiment may answer some of these questions if we give ourselves a chance to look." | **OAP**



Canola in the Val

By Gail Wells | Photos by Lynn Ketchum

Some scientists might relish seeing their research at the center of a vigorous policy dispute, but Carol Mallory-Smith is not one of them. "I try to stick to the science and stay out of the spotlight," she says.

Mallory-Smith is a weed scientist with Oregon State University's crop and soil science department. She is fascinated with how plants hybridize, how they spread their genes and cross-pollinate.

Such study might suggest tranquil scenes of birds and bees and a gentle breeze. But, no. Mallory-Smith's interest in cross-pollination has led her to investigate the flow of genes between genetically modified crops and their conventional counterparts. And that has propelled her into one of today's hottest environmental controversies.

"I didn't intend to get into these political issues," she says. But as a scientist at a public land grant university, her work is used by policymakers to shed light on such heated public debates.

Mallory-Smith is a careful and precise speaker, neither overstating the science nor backing away from its implications. In a situation where feelings run high, she is regarded as an unbiased spokesperson for the research—a straight shooter, neither a demonizer nor a booster of genetic modification.

But sometimes the grenades of controversy hit uncomfortably close to home. Currently, research by Mallory-Smith and her OSU colleagues has become Exhibit A in an agricultural tempest raging in OSU's backyard. The dispute is pitting specialty vegetable and vegetable-seed farmers in Oregon's Willamette Valley against grass-seed farmers who want to grow

LEY

Above: Carol Mallory-Smith, an Oregon State University weed scientist, studies cross-pollination between plants such as canola and broccoli.

canola, a rotation crop that can yield a profit as a source of both food and fuel.

Canola is a member of the sprawling Brassica family, which includes good-for-you vegetables like cabbage, cauliflower, kale, and broccoli. Canola can cross-pollinate with some of these crops and with their weedy wild relatives. That worries some vegetable-seed growers who must assure the genetic purity of their seeds. And because the Oregon Department of Agriculture makes no distinction between genetically modified and conventional canola (both are legal crops) the valley's organic farmers worry that they won't be able to sell their products as organic if they're cross-pollinated with genetically modified canola.

The Oregon Department of Agriculture permits canola to be grown in three areas east of the Cascades, and, since 2009, in small patches on the valley's fringe. At the moment, no canola is grown in the heart of the valley except by special research permit. The state's restrictions on canola date from 2005, when OSU scientists, including Mallory-Smith, reported many scientific unknowns and potentially high risk of allowing canola into a neighborhood of high-value specialty seed farms.

The state is now proposing a changed rule that would allow limited acreage in the valley to be planted in canola under specific conditions. Although this is only a proposed rule, to be decided in 2013, it worries specialty seed farmers. Canola is "an aggressive and persistent weed that can and will outcross"

with related Brassicas, says Nick Tichinin, a Polk County farmer whose company, Universal Seed Co., supplies vegetable seed to a worldwide market of vegetable producers and home gardeners. "We're introducing a new pest into a currently closed system."

The Willamette Valley is a great place to grow seeds—wet, mild winters encourage plant growth while dry, warm summers help set seed. One of just a handful of places in the world with a similar climate, the valley produces much of the world's Brassica seeds, accounting for $25 million annually. Unlike canola, specialty seed crops are painstakingly bred and tended, says Tichinin. "We are part of a unique, little-known, essential, and now jeopardized, worldwide seed supply chain."

Bringing a rampant Brassica like canola into the valley, says Tichinin, would risk contaminating their crops—an entire seed lot will be rejected if a tiny proportion is not the true variety. And contamination with engineered genes could drive organic growers out of business, he says.

On the other side of the debate are the grass-seed farmers, who are looking for a good rotation crop. "Canola is fantastic for rotation," says Kathy Hadley, a Polk County farmer and member of the Willamette Valley Oilseed Association. "It does all the things a rotation crop is supposed to do: utilizes different nutrients in the soil, reduces disease pressure on your main crop, and allows you to use a different chemical regime to control weeds. It has a taproot that breaks up the soil pan and provides a good soil structure for no-till agriculture."

In a situation where feelings run high, Mallory-Smith is regarded as an unbiased spokesperson for the research—a straight shooter.

And, unlike most other rotation crops, canola is profitable. It can be made into both a food-grade oil for cooking and fuel for biodiesel. Oregon law requires that diesel fuel contain 5 percent biodiesel. And governor John Kitzhaber's 2012 energy plan calls for replacing 20 percent of Oregon's fleet vehicles with cars and trucks that run on alternative fuels, including biodiesel.

Is Oregon's agricultural Eden big enough for both canola fields and specialty-seed operations? How can science shed light on this heated debate?

"The biology of the plant makes a big difference," says Mallory-Smith. "Is it cross-pollinated or self-pollinated? If cross-pollinated, is the pollen carried by wind or insects? And if a cross occurs, how viable are the hybrid offspring?"

Mallory-Smith and her OSU colleagues are working on questions like these. When the precautionary no-canola boundary was established in 2005, the Oregon Department of Agriculture (ODA) relied on the scientific advice of OSU researchers. Preparing to revisit the issue in 2010, ODA commissioned a full study from a team headed by Russ Karow, head of OSU's crop and soil science department.

In addition to reviewing existing studies on canola, the team, which included Mallory-Smith, conducted field trials in the valley under a special research permit. These trials included plantings on Kathy Hadley's farm in 2008 and 2009.

Pests and diseases common to many Brassica varieties were present in the trials. And the researchers found that canola seeds stay viable in the soil for two or three years, raising the risk that canola

Left: Canola is being successfully tested in eastern Oregon. In this Hermiston field, a swather cuts the seed crop in advance of the combine.

Above: Canola seed produces an oil that can be used for fuel or for cooking.
Below: Honeybees, such as this one pollinating organic broccoli in the Willamette Valley, could be a vector for cross-pollination between vegetable-seed crops and canola.

could become a weed in subsequent crops or along roadsides and waterways.

As with many scientific studies, the team noted that the research "resulted in as many questions as answers." Confirming the presence of insects and diseases led to the question of how these might spread from field to field and how long pests might persist. Confirming that the seed could stay viable for years led to the question of how farmers or regulators might control maverick canola plants along roadsides and field edges. And because plants have to flower at the same time to cross-pollinate, the researchers questioned if using plants with mismatched flowering cycles might limit cross-pollination.

"Given the potential risk," the researchers concluded, "precaution suggests not allowing canola production at this time." ODA opted to keep the 2009 precautionary rule, but reopened the case in 2012.

The researchers continued their work. In a report released in 2012, Mallory-Smith and OSU colleagues James Myers and Michael Quinn addressed additional risks posed by genetically engineered canola. They researched pollen movement and concluded that pollen from a large field of canola could overwhelm a small planting of, say, Siberian kale, which is highly compatible with canola.

They looked at studies from other researchers on transport of seed by humans, birds, rodents, and insects, and concluded that canola could become a persistent weed problem in a subsequent crop, in areas adjacent to fields, and along roadsides. And they cited a Canadian analysis of canola seed that had been certified as non-transgenic, but found that 24 of the 25 tested lots contained transgenic seeds.

Caution, the researchers conclude, is still the watchword. "This study provides strong evidence that it will be difficult to prevent the introduction of transgenic canola into an area even if there [were] a provision to only allow conventional canola production in the Willamette Valley."

The canola debate moved to the state capitol in September of this year, when farmers on both sides made their case. Science can do much to shed light on such controversial issues, but science cannot make the decision. That is the responsibility of the policymaker.

It is not easy to stand by and watch warring factions argue about your work. But having contributed the best science she can, Mallory-Smith stresses that the outcome is not up to her. "The decision-makers are listening to the science, and they understand the science," she says. "They have to make a regulatory decision based on what they see as the greater good." | **OAP**

Overlooking agricultural fields near Cove, Oregon, rancher Jason Beck and science teacher Orissa Burghard examine details of an invasive weed, St. Johns wort, during the week-long OSU Summer Ag Institute.

Lynn Ketchum photo

Q

How can kids learn where food comes from?

A

Teach the teachers.

By Peg Herring

There's a romance about how farms are portrayed in children's books. They often include: two cows, two chickens, two pigs, two horses; a red barn; a red rooster; and an apple tree full of red fruit.

This storybook image of a farm might have been on the minds of some teachers as they pulled their rollerbags into the hotel that would serve as their home base for the next week. They were part of the Summer Ag Institute, a graduate-level, continuing education course that teaches teachers about agriculture in Oregon.

Imagine summer camp: sharing a bunkroom, getting up at dawn, and heading out for a day of adventure. Learning by doing, these teachers will spend a week experiencing the diversity of agriculture in Oregon, so they can be more effective in teaching their students where food comes from.

"My kids know that food comes from a farm, not from a store," said Matthew Cook, a teacher at Franklin School in Corvallis. "But they don't know what happens on the farm and all it takes to produce the good food that ends up at the store." Food comes from a farm. That's the beginning of the story, not the end.

Despite its storybook image, farming is serious business. Oregon agriculture generates $29 billion annually, which is 10 percent of the state's economy and creates more than a quarter million jobs. Agricultural exports account for 60 percent of shipping that passes through the Port of Portland. Far from the image of corn and soybean agribusiness, Oregon farmers produce more than 230 major crops, from grass-fed beef to Pacific oysters, fresh milk to fine wine. No state has more diversity in its agriculture than Oregon.

Who knew?

Not enough people know about Oregon's agriculture, according to Greg Thompson, who heads the agricultural education department at Oregon State University. The Summer Ag Institute began in 1989 to help teachers understand agriculture as a subject worth exploring in their classrooms. Since then, more than 500 teachers have completed the week-long program and earned OSU graduate credits through Thompson's department.

Teachers have a choice of two sessions of the Summer Ag Institute, one on either side of the Cascades. The eastside experience, based in Union, includes Columbia Basin wheat ranches, timber operations, seed farms, and cattle

ranches. The westside experience, based in Corvallis, showcases the Willamette Valley's cornucopia of fruit, nuts, vegetables, micro-breweries, and Christmas trees.

The program gets teachers outdoors in the field, testing, tasting, and learning about agriculture first-hand. As educators, these teachers understand that people generally remember 10 percent of what they read and 90 percent of what they do when they experience something hands-on. So, you can bet, everyone remembers the fistulated cow.

Exploring with your hands the interior ecosystem of a cow's chambered stomach is a typical hands-on experience for the Summer Ag Institute. OSU animal sciences research farms maintain a few so-called fistulated cows, each fitted with something like a porthole window that allows researchers to dip their hands directly into the cow's partly digested breakfast. For scientists, it's a way to study the chemical and biological fermentation that allows a 600-pound animal to make muscle out of grass.

"It feels like a warm, wet carpet," said teacher Maggie Smart, elbow-deep in the side of a cow. As the rumen squeezes around her gloved arm, the gas produced from fermentation emits an unforgettable lesson in microbiology from the fistula into her face.

Cattle ranching is Oregon's second-largest agricultural industry, and one that Tim DelCurto knows well. An OSU beef cattle researcher at Oregon's agricultural branch station in Union, DelCurto organizes the Union-based Summer Ag Institute. A highlight of the eastside program is the field trip to the Chandler Ranch, a seventh-generation cattle ranch near Baker City.

Above and right: For their own continuing education, teachers immerse themselves in issues and practices within Oregon's vast agricultural industries. Teacher to teacher, Toby Koehn shares lessons he's learned as manager of the Cove School farm, a K-12 enterprise that includes a greenhouse, livestock, and a large garden space.

Lynn Ketchum photo

Oregon farmers produce more than 230 major crops, from grass-fed beef to Pacific oysters, fresh milk to fine wine. No state has more diversity in its agriculture than Oregon.

Lynn Ketchum photo

About 98 percent of Oregon farms are family owned or operated, and more than 1,100 have been continuously operated by the same family for more than a century. The Chandler ranch has been in the family for 150 years. In the shady yard of the Chandler's home, patriarch Charles regaled the teachers with stories about his great-grandfather's arrival in Oregon as a wagon train leader in 1862. Charles, a 1941 graduate of Oregon's Agricultural College (now OSU) recounted the contributions each generation has made to building a successful family business, including the recent transition made by his grandson Dwayne (a 1994 OSU grad) to digitize genetic records that track each breeding line of their world-famous Herefords.

"Every farmer I met was a college graduate," said Portland teacher Brad Kendrick. "It's a complex industry that requires knowledge in husbandry, genetics, economics, marketing, mechanical engineering, accounting and finance, even regulatory law. I teach my kids to solve problems, and that's what farmers do."

Kendrick was impressed with Jane and Terry Puckett, who grow cherries near Cove, and their commitment to farm laborers. The teachers toured housing that the Pucketts had built for workers who come to their farm for just three or four weeks a year. "Our own house would not pass government inspection," Terry said, "but our farm workers' housing does, and must." He said that some of the workers have been coming to their farm each year for decades. "The goal of all these workers is the same," he told the teachers, "and that's to educate their kids."

"What I learned from these farmers is that to be successful in agriculture demands an education," said Stacie Phillips who teaches in Silver Falls. "My kids' families work on farms in the valley. I'm not going to let them say, 'I don't need to know this because all I'm going to do is work on a farm.' Now I can tell them that they need to know all this and more if they want to be successful working on a farm."

Deep into soil, OSU instructor James Cassidy invites teachers inside a soil pit near Tangent to experience where agriculture begins.

The teachers nibbled their way through a week of touring orchards, berry fields, dairy processors, and wineries. They sheared sheep, tested soil, and built hydroponics systems for their classrooms. And they each stayed overnight with a farm family, lending a hand with the chores and often talking late into the night about the challenges of teaching and farming.

"I realized how much we (teachers and farmers) have in common," said Joel Magili of Amity. "Learning is like food, absolutely necessary but sometimes overlooked as an enterprise," he said. "Teachers and farmers both manage the growth and productivity of society's most valuable resources. Teachers, like farmers, never have all the resources we need, so we improvise, invent, adapt to produce the best outcome possible. Students are our annual crop that we nurture in a system that we hope is healthy and sustaining."

In teaching, as in agriculture, the next few years will see a large turnover as the majority of experienced professionals will retire. As new farmers find their way in a complex industry, new teachers will inspire the next generation of learners. Together, they will build a healthy, sustainable, knowledge-based environment in Oregon. | **OAP**

Greater Sage-Grouse

Centrocercus urophasianus

GOOD FOR THE BIRD, GOOD FOR THE HERD

A ranching community works together toward rangeland conservation.

By Peg Herring

Illustration by Erik Simmons

In the chilly light of an early April morning, bubbling sounds fill the air above Oregon's high desert. A dozen sage-grouse roosters strut and puff across an open patch of short-cropped grasses, their tail feathers spread in spikey fans. Each bird looks like a dancing feather pillow, two yellow air sacs ballooning from their ample fluffy bosoms. They swish their wings and gurgle their air sacs, creating a bubbling pop.

Greater sage-grouse cut the rug in flamboyant courting rituals each spring in open areas of the sagebrush grassland across eleven Western states. The birds depend on sagebrush and the grasses growing among these shrubs to provide food and a safe haven to raise their young.

Ranchers depend on this sagebrush country, too. Four southeast Oregon counties contribute 80 percent of the state's $535 million beef cattle industry. Those same Oregon counties—Baker, Malheur, Harney, and Lake—contain some of the nation's last, best sage-grouse habitat.

But this ecosystem, on which ranchers and wildlife both depend, is not healthy. Precipitous declines in sage-grouse numbers is just one symptom. The U.S. Department of Interior estimates that sage-grouse have experienced a 90 percent decline in their numbers and a 50 percent decline in their habitat over the last century. As a result, the greater sage-grouse is now a candidate for listing under the Endangered Species Act. It's easy to see another showdown brewing between a resource-based industry and an endangered bird. (Think: the Northwest timber industry and spotted owls.) But look again. Ranchers in southeast Oregon are working with land managers and conservation groups to develop immediate plans to protect sage-grouse, improve habitat, and ultimately restore health to the sagebrush grasslands for the benefit of *both* wildlife and ranch life.

"The decline of the sage-grouse is an ecosystem problem, not a species problem," says Chad Boyd, a rangeland scientist with the U.S. Department of Agriculture in Burns. "The decline of sage-grouse is a symptom of an ecosystem that is not functioning as well as it could. And we can't fix the ecosystem problem by fixing one symptom at a time."

Much of the original sagebrush grassland was transformed generations ago into the West's iconic amber fields of grain. Where sagebrush rangelands have persisted, in southeast Oregon and parts of the Snake River Plain and Great Basin, the ecosystem has been hard hit by previous decades of unmanaged grazing and altered fire patterns. In lowland areas, large swaths of cheatgrass, medusahead, and other noxious weeds have increased soil erosion, reduced rainfall infiltration, and displaced native plants.

Farther upland, western juniper has spread across the landscape, sucking up surface water and crowding out sagebrush, native grasses, and small plants. In places, juniper has become a dense woodland with no value for sage-grouse and little value for cattle or other wildlife, from mule deer to vesper sparrows.

Another symptom of an ecosystem out of balance is the change in the

Tony Svejcar photo

region's wildfires. Encroaching juniper in the uplands has elbowed out undergrowth, making wildfire less frequent but more intense. In lower elevations, large swaths of invasive cheatgrass have fueled ever bigger, more frequent fires. There, annual weeds lead a fast life: sprout early, grow fast, set seeds, and wither to dry stems by midsummer, ready to burn. This cheatgrass-wildfire cycle has increased the frequency of wildfire in low elevation sagebrush communities from the historic 30 to 100 years to a vicious cycle of 1 to 5 years.

The U.S. Department of Interior estimates that sage-grouse have experienced a 90 percent decline in their numbers and a 50 percent decline in their habitat over the last century.

The 2012 fires across southeast Oregon, the most extensive fires in the state for almost 150 years, burned more than 870 square miles south of Burns. Although the fire cleared out some juniper in higher elevations, it left much of the lowlands scorched, killing hundreds of cattle and incinerating grazing land and sage-grouse habitat.

Left: Perennial bunch grasses, sagebrush, and a mix of succulent native plants characterize a healthy rangeland condition, which is critical to conserving sage-grouse and to sustaining ranch life in eastern Oregon.
Above right: The Miller Homestead Fire, near Burns, Oregon, was part of a series of fires that scorched more than 870 square miles of rangeland in southeast Oregon in 2012.

Juniper, cheatgrass, and out-of-control wildfire are bad for people, livestock, and ultimately bad for sage-grouse, too.

The loss of sage-grouse habitat is far from just an Oregon problem. Historically, the birds numbered in the millions and ranged across most of the northern plains of the U.S. and southern Canada. Today just a few hundred thousand remain. In 2010, the U.S. Fish and Wildlife Service ruled that the sage-grouse was worthy of protection under the Endangered Species Act. But the ESA waiting list was backlogged with more than 250 other species waiting to be considered. So federal officials announced they would delay final consideration of the greater sage-grouse until 2015.

Devon Jones photo

Listing under the ESA is seen by many people as a last-resort, emergency-room action. Citing "environmental and economic trainwrecks" from the past, former U.S. Secretary of Interior Bruce Babbit said, "the only effective way to protect endangered species is to plan ahead and protect the ecosystem upon which they depend."

The delayed decision on the sage-grouse listing gave agencies and landowners the time to develop conservation plans that could possibly preclude listing *if* they could demonstrate that the plans they draw up are effective. Rather than wait for the big stick of the Endangered Species Act, a group of ranchers in Harney County are developing strategies to protect habitat on both public and private lands, and in turn, sustain their ranches.

Harney County is the ninth largest county in the nation, larger than several eastern states. Its 71,000 cattle outnumber its people nearly ten to one. As head of the Harney County office of Oregon State University Extension, Dustin Johnson knows most of those people on a first-name basis. So when it came to bringing together a potentially contentious group of ranchers, resource managers, and environmental groups, Johnson had the relationships to do it.

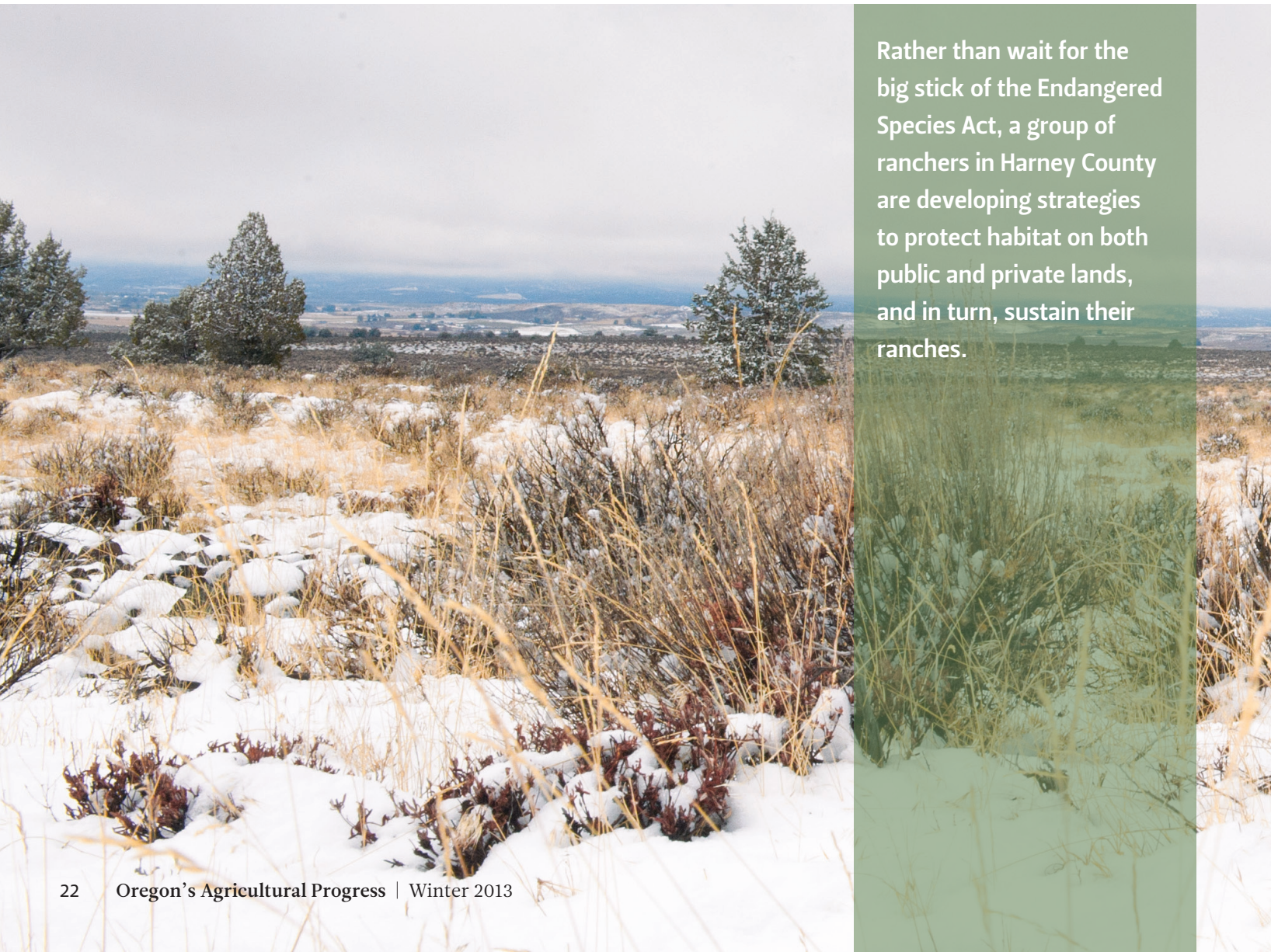
"They wanted information about 'Candidate (species) Conservation Agreements with Assurances'," Johnson said. So-called CCAAs are voluntary agreements that private landowners make with the U.S. Fish & Wildlife Service *before* a candidate species is listed. CCAAs outline specific management practices and

conservation measures the landowner agrees to undertake to conserve the species and its habitat on private land. The last "A" —Assurances—distinguishes these plans from conservation plans developed for public lands. Candidate Conservation Agreements with Assurances assure that the landowner will not be held to any higher standard if the species is listed under the ESA as long as the landowner continues to meet the terms of the original agreement.

Johnson, a tall, lanky redhead with a calm demeanor, laid out the details of the agreements to the Harney County community. He explained that regional CCAAs have been successfully negotiated in Idaho for the greater sage-grouse and in Colorado for the Gunnison sage-grouse; a statewide CCAA is under development in Wyoming. By the end of the meeting, Johnson said that agency representatives and landowners were talking about working together on a Harney County CCAA to conserve the species and sustain ranching operations. "If enough landowners are interested in developing these agreements, their conservation efforts could preclude the need to list the greater sage-grouse," he said.

The clock is ticking. Each landowner must enroll through a certificate of inclusion *before* any listing is announced. Community engagement is most important now, according to rancher Tom Sharp, who quickly saw the advantage of CCAAs. As chair of the Harney County Sage-Grouse CCAA Steering Committee, Sharp is working to help his neighbors organize their individual efforts into a comprehensive plan.

"Ranchers and environmentalists came to realize that they wanted the same thing," Sharp said. "Juniper and weeds hurt sage-grouse and cattle grazing. By approaching the problem as a land management problem, not a species problem, we could develop plans that would benefit grazing *and* sage-grouse. And ranchers *are* land managers, so the approach made sense. Cattle across the



Rather than wait for the big stick of the Endangered Species Act, a group of ranchers in Harney County are developing strategies to protect habitat on both public and private lands, and in turn, sustain their ranches.

West stand to benefit from rangeland improvements. What's good for the bird is good for the herd."

The committee has met monthly for a year. Supported by state and federal funds managed by the Harney Soil and Water Conservation District, their goal is to achieve sage-grouse conservation through sustainable ranching: managing grazing, controlling weeds, and removing juniper. Tactics to protect sage-grouse include moving cattle at critical times away from leks and nesting areas and removing fences and trees where predators could perch.

In Harney County, where more than three-quarters of the land is state- or federally owned, most cattle ranchers rely on grazing public lands for part of the year. They move their herds from winter pastures to summer range, often onto allotments they lease from the Bureau of Land Management or the U.S. Forest Service. Sage-grouse, too, move across the landscape, using a mix of public and private land for mating, nesting, or wintering.

So, Johnson and Sharp are working with public land agencies to make sure the conservation plans and monitoring methods are consistent across a landscape of many ownerships and managements. Johnson developed inventory and monitoring guidelines for landowners based on criteria he developed for the BLM that focused on the overall health of the ecosystem over time. "The best single indicator of overall ecosystem health is the condition of the rangeland bunchgrasses," Johnson said. Healthy bunchgrasses, moderately grazed, can reduce fire hazard and weed invasion and increase available water.

"Private landholders and government agencies are sometimes like oil and water, but we've done a good job with the

Eastern Oregon rancher Tom Sharp (left) and Dustin Johnson, the county leader for Oregon State University Extension Service in Harney County, survey sage-grouse habitat near Burns, Oregon.

Lynn Ketchum photo

CCAA," Sharp said. "Extension was instrumental in bringing all groups together. When you have relationships and trust already in place, it's easier to come to some agreement because people are already talking and working together."

And much of the science that will be used to develop conservation plans comes out of the Eastern Oregon Agricultural Research Center, a dusty collection of low-slung buildings on the outskirts of Burns, where OSU researchers share work with USDA scientists in the Agricultural Research Service. Some of

Kevin S. Abel, BLM photo

OSU / EESC photo

Oregon Dept. of Transportation photo

Top and right: Helo 782 drops a load of water on the Long Draw Fire in southeastern Oregon, which burned across US 95 repeatedly during the course of the July 2012 fire.

Above: Despite decades of unmanaged grazing, rangelands in southeast Oregon contain more than 700 known mating grounds for sage-grouse. Conservation plans aim to protect those areas and restore others to create more resilient rangelands for both wildlife and ranching.

Above: OSU graduate students participate in a sage-grouse study at the Hart Mountain National Wildlife Refuge near Lakeview, Oregon.

that work goes back 75 years, when scientists fenced a series of exclosures on the Northern Great Basin Experimental Range west of Burns to compare grazed and ungrazed rangeland.

Production of grasses and shrubs was similar in both grazed and ungrazed areas. But the ungrazed plots accumulated three times the amount of dead grass and had built up a huge fuel load by the 1990s when the ARS researchers burned both sides of the exclosures. Years following the burn, when the researchers inventoried these sites, they found the ungrazed areas had lower abundance of perennial grass and higher abundance of annual grass than the grazed areas. Apparently, the accumulated grasses in ungrazed areas burned hot enough to kill the perennial grasses, which opened the ground to cheatgrass invasion.

"Conservation is *not* fencing off land and never touching it," said ARS scientist Boyd. "When you eliminate the small disturbance, the larger ones accumulate and become more threatening."

Other studies suggest similar advantages of moderately grazed land to sustaining habitat critical to sage-grouse. A 2004 interagency report concluded that, beyond the open areas for mating displays, sage-grouse prefer to nest under a protective canopy of grasses (at 7 or more inches tall) and sagebrush (at 15 to 30 inches tall). They need a supply of small plants and associated insects when their chicks are young, and they need access to succulent streamside plants through the dry season. The researchers concluded that "these conditions can be enhanced by light to moderate grazing early in the season."

A report produced by Oregon Department of Fish and Wildlife concurs that light to moderate levels of grazing can have a positive impact on sage-grouse habitat. So it's not surprising that some of the best remaining sage-grouse habitat is in southeast Oregon, home to Oregon's cattle industry, where more than 700 leks are known and mapped, according to the ODFW report.

The report's author, wildlife biologist Christian Hagen, sees additional advantages to conserving sage-grouse habitat. "Because sage-grouse require many different habitats for mating, nesting, feeding, and wintering across extensive home ranges, they really occupy habitat that's home to a whole host of other species like elk, mule deer, pronghorn, and a lot of neotropical migrant songbirds, too."

But habitat is not static. Fires, drought, and floods can all affect the condition of rangelands. Big disturbances, like the 2012 fires, hurt ranchers and wildlife and open more land to weedy invasion.

The approach the Harney County ranchers are taking is community-based: keep the plant community functional, keep the ranching community functional, over the long haul. This kind of large-scale adaptive management could become a new model for the scientific management of sage-grouse. It also has the potential to create a new model for rallying unconventional allies in efforts to recover endangered species. Whereas some past efforts have been delayed and politicized by conflict and court battles, the future may involve more people working collaboratively—rather than at loggerheads—to come up with solutions.

And when the conversation comes to community, common ground is easy to find in Harney County. "Ranchers are land managers," Sharp said. "If we can find a land-management approach to conserving sage-grouse, we have a community of people who understand how to do this." | **OAP**

"Private landholders and government agencies are sometimes like oil and water, but we've done a good job with the CCAA,... Extension was instrumental in bringing all groups together."

Lynn Ketchum photo

Brian Sidlauskas curates Oregon State University's Ichthyology Collection, adding specimens from around the world to a collection that exceeds 2,000 fish species.

Fish on Facebook

What do you do when you're racing to identify 5,000 fish in six days? Ask your Facebook friends for help.

By Tiffany Woods

Brian Sidlauskas had just six days to identify more than 5,000 fish. He had caught them during a scientific jungle expedition in the South American country of Guyana. But the Guyanese government required detailed identifications before the Oregon State University biologist could ship them to the United States for further studies.

He had just spent the previous two weeks on the Cuyuni River, cooking over a propane stove, bathing in the muddy water, and pickling fish in formaldehyde by headlamp as he worked well into the night.

His aim was to see what was swimming in a 125-mile stretch of the river where fish had never before been cataloged. Mining is clouding the troubled water with sediment, and he wanted a snapshot of the river's health before it is further damaged.

Back in Guyana's capital, sweating and exhausted, Sidlauskas worked feverishly in a cramped, hot lab to identify the specimens. His plane would depart in a week. He was short-staffed. The clock was ticking. How was he going to identify *all* of them in time?

Devin Bloom, a graduate student, had an idea: Why not post pictures of the fish on Facebook and ask experts around the world to help identify them? Sidlauskas signed into his Facebook page and uploaded 114 photos (many of the 5,000 fish were the same species). He labeled (or "tagged" in Facebook-speak) the photos with the names of people who were authorities on the fish. These die-hard fish heads were then notified of the photos via their own Facebook pages.

The next morning, when he opened up his Facebook page, it was flooded with responses, and a little humor, too. An anchovy was identified as "pizza topping." Within 24 hours, about 10 people had accurately nailed down most of the fish. About half a dozen were species that had never before been seen and named by scientists.

Now back at OSU, rested and showered, Sidlauskas has had time to reflect on his experience with the social networking site. It's revolutionizing the speed of the identification process, he says. It can take hours for Sidlauskas to wade through scientific literature to name an unfamiliar fish. If he posts a photo of it on Facebook, he says, he can have an answer in minutes. "The idea has caught on," he adds. "I'm getting more requests from people who want me to identify fish."

When the folks at Facebook learned about Sidlauskas, they asked him to be part of their campaign that features high-profile public figures to celebrate the site's milestone achievement of 1 billion users. "It's the only time in my life I'll ever be compared to Alicia Keys," he says, referring to the Grammy Award-winning singer in the promotion. "For better or worse, I seem to be becoming a public figure for science. I've now got about 1,900 followers on Facebook who theoretically hear what I say. I hope that will get more people interested in science."

Right now, however, Sidlauskas is using Facebook to entice his followers to adopt a lapful of kittens he's fostering. Lab coats aside, Facebook can show the world that scientists are people, too, he says. "We've got friends. We foster kittens. We go out on Friday night and have fish and chips," he says. "If people see that scientists are human, they may more easily relate to science."

Sidlauskas hopes to use Facebook again for a possible trip to Suriname. "If that trip comes together," he says, "you better believe I'll take photos of the fish and post them to Facebook." | **OAP**

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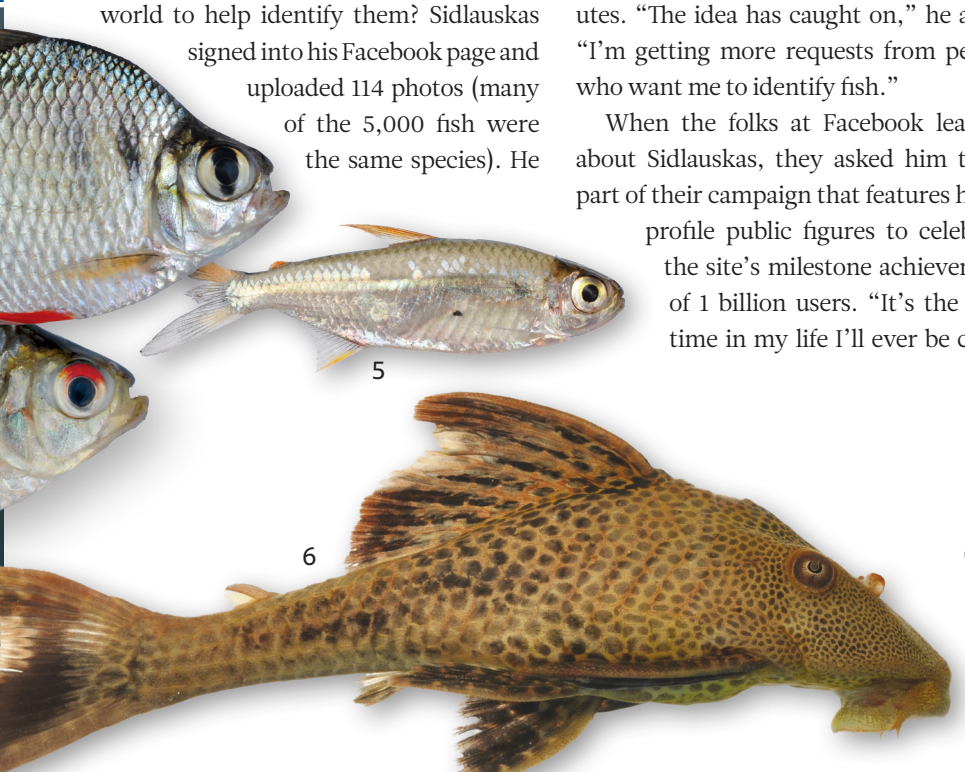

Lower left fish:

1. *Colomesus asellus*
2. *Phractocephalus hemioliopterus*
3. *Tetragonopterus chalceus*
4. *Moenkhausia oligolepis*
5. *Moenkhausia lepidura*
6. *Hypostomus hemiurus*

Photos by Whit Bronaugh

Check out Brian's fish, and kittens, on Facebook.

www.facebook.com/brian.sidlauskas

Bringing Barley

Tiffany Woods photo

Back

OSU is on a mission to bring the underappreciated grain back to Oregon by developing new varieties for beer, food, and livestock feed.

By Tiffany Woods

Under a blue sky in a field near Corvallis, a combine spits nearly a ton of barley seeds into a bin on the back of a flatbed Ford. Pat Hayes plunges his hand into the golden kernels. This is the first time he has harvested this variety, named Alba, on such a large scale. Hayes, the head of Oregon State University's barley breeding program, made the genetic cross that gave rise to Alba 15 years ago. He has been evaluating it in the field since. He's hoping that the high-yielding grain will be a hit in beer, food, and livestock feed.

Alba is just one of about 10,000 experimental barley varieties Hayes is growing and analyzing. He's working hard to get a little respect for the grain and keep consumers robust and regular. Hayes touts barley as a way for farmers to diversify their crops and cash in on a growing interest in microbrews and whole-grain diets.

Barley is one of the world's oldest cultivated crops. More than 10,000 years ago someone in the Middle East ate it, didn't die, and consequently started growing it. Its genus name comes from the word hordearii, or barley men, in reference to the Roman gladiators who grew burly eating barley. Today, however, barley is barely acknowledged even though it was the world's fourth most-produced cereal in terms of metric tons in 2010, grown mainly for animal feed. Barley is thought of as a gummy gruel for orphans in a Dickens novel, unless you're in Tibet, where the dietary staple is a dumpling called tsampa, a mix of barley flour, tea, and yak butter.

Honey-colored fields of barley used to be a more common sight in Oregon. The state's output peaked at 21.9 million bushels in 1957, according to the U.S. Department of Agriculture. In 2011, the state's farmers harvested just 2.4 million bushels, earning gross sales of $10.6 million, according to a report from the OSU Extension Service, the lowest production since 1909. That same year, barley made up only 2.5 percent of all grains harvested in Oregon in terms of bushels, and it ranked 47th in gross sales among the state's agricultural commodities.

At OSU's Hyslop Farm near Corvallis, 10 acres of barley heads chatter in the breeze. With clipboards in hand, Hayes and his team are evaluating these thousands of different genetic crosses to see how well they resist disease, tolerate the cold, and perform in the kitchen and brewery. They're also taking note of their yields, growing some of them organically, and seeing how much water and nitrogen they need.

After all the measuring, weighing, malting, and milling; the poking and prodding in the lab; cold winters, soggy roots, fungal infections, insect bites; after enduring all this for years, only a handful of these varieties will make it to market. Consider that over the past 26 years, Hayes has released just 12 new varieties and germplasms. It's not for a lack of trying: barley breeding just takes time when you're hand-pollinating the flowers and waiting through at least one season to see if the desired traits show up.

But Hayes is working on speeding up the process. He's using a technique called doubled haploid production. "By 2013, all of our new plantings here will be doubled haploids," he says, scanning the field at Hyslop. The technique involves regenerating plants from pollen in a petri dish,

Lynn Ketchum photo

Lynn Ketchum photo

Above: It takes 15 years or more to develop a new variety of barley for the marketplace. OSU barley breeder Pat Hayes examines some of the results harvested from field trials at OSU's Hyslop Farm near Corvallis. **Above right:** Long hair-like awns and rows of plump seed characterize barley. Two-row barley is used in English-style ales, and six-row barley is more common in American-style lagers.

Hayes is trying to develop barley that reflects the terroir—or soil and climate—of Oregon, much like wine grapes.

Lynn Ketchum photo

Above: Sometimes, because of high humidity, combining doesn't start until late afternoon. Combine operator Clayton Jones works into the night harvesting the barley variety "Alba" on the Hunton farm near Eugene, Oregon.
Below: Part of OSU graduate student Brigid Meints' research material on colored food barley, these envelopes contain unusual genetic stocks that combine the characteristics of hooded barley (without awns) and naked barley (with loose hulls).

Lynn Ketchum photo

and creating genetically pure lines of barley in just one generation, as opposed to the six to eight years required through traditional inbreeding. The plant will produce the same barley year after year. Hayes emphasizes that this faster technique is not genetic engineering; no DNA is added, removed, or modified.

Breeding new barley varieties, however, accounts for less than half of OSU's work with the grain. For every new variety released, Hayes' team publishes about 12 journal articles on their other research, which involves studying some of barley's 30,000 genes. They're trying to identify genes that allow barley to withstand low temperatures, resist disease, and survive with little water and nitrogen. They're looking for genes responsible for malting quality, nutritional properties, and flowering time. They've partnered on this research with countries that include Australia, Germany, Japan, Scotland, and Uruguay.

Walking among the rows at OSU's farm, Hayes points out his barleys as if they were students in his plant genetics class. They're under so much pressure to achieve. If they don't, they'll never graduate from his program. There's Streaker, a "naked," or hull-less, food barley that resists stripe rust and was named after the campus exhibitionists of the 1970s. It's expected to graduate in 2013. Unfortunately, it's a bit bronzed around the arse by a fungus called scald, the common cold of barley that eats away at yield and seed size. Next is Verdant, from the Class of 2010. It's a high-yielder meant for livestock forage because it doesn't have sandpapery awns—or beards as they say—that could hurt animals' mouths. Then there's

Maja, which is getting chewed up by scald, but two shots of fungicide should clear it up, Hayes says. Alba is the tall beauty queen, the teacher's latest pet. The screensaver image on Hayes' computer shows his wife smiling in front of a field of it. "The woman of my life and the barley of my life," he says. On down the line is Charles, a variety from Idaho that has lamentably failed its midterm at OSU. The stunted plant is falling over and ravaged by disease. "You would want fungicide fed into it intravenously," Hayes says, adding that it's an agronomic disaster in the Willamette Valley, although it does well in drier climates.

Getting barley into beer steins is one of Hayes' priorities. The grain is, after all, an essential ingredient in most beers. Traditionally, big brewers have wanted bland barley and relied on hops and malting for flavor, Hayes says. But barley is getting more attention thanks to an increase in small craft brewers and demand from consumers, says Zach Christensen, an OSU graduate and McMinnville farmer who grows and malts barley that he later sells to brewers.

"Craft brewers want to be able to create something that is unique, different, and good so they can tell that story as part of their marketing," says Christensen, who grows some of Hayes' barley. "Consumers are looking for a locavore story and to have a beer they feel good about."

With that in mind, Hayes is trying to develop barley that reflects the terroir—or soil and climate—of Oregon, much like wine grapes. Additionally, he and OSU researcher Alfonso Cuesta-Marcos are seeing if genes influence the flavor of barley. They're also breeding barleys that have desirable malting qualities. To be a malting barley, the grain has to be low in beta-glucan, a soluble fiber that impedes filtration during brewing and post-fermentation. OSU's work has caught the attention of California's Sierra Nevada Brewing Co. and Wisconsin's New Glarus Brewing Co. The brewers plan to make beer from 50 to 100 exotic varieties of barley from around the world grown in 2012 by OSU. Then they'll analyze how the beer tastes.

In addition to putting the bar back in barley, Hayes is trying to put barley back into people's diets—sans beer bottles. He sees potential in barley because it contains beta-glucan, which has been shown to reduce cholesterol. Its low glycemic index and high fiber content make it a healthy choice for those with diabetes or who want to shed some pounds, he says. So Hayes is developing new types of barley for food, including ones crossed with multicolored barley from Mongolia, Nepal, and Tibet. He's hoping they'll have a unique aroma and flavor and will appeal to consumers looking for novel, nutritious grains.

To help tempt consumers, OSU's Andrew Ross is developing some ambitious recipes. Ross is a cereal, or as he says, surreal, scientist who studies what goes on inside bread with all its proteins, starches, and enzymes. He's pushing the limits with barley, replacing up to half the wheat flour in bread recipes with barley flour. His repertoire includes baguettes, pita breads, sourdoughs, focaccia, and even pretzels that have been served in the OSU president's box at football games. Ross also makes a door-stopping rosette loaf, a real fiber bomb that's not for the faint-hearted. "Don't drop them on your toe," he warns.

Ross makes a door-stopping rosette, a real fiber bomb that's not for the faint-hearted. "Don't drop them on your toe," he warns.

Above: Scott Fisk and Natalie Graham, OSU graduate students, study barley samples in the Oregon State University barley project greenhouse.

Lynn Ketchum photo

Above: New varieties of barley offer opportunities and challenges to food chemist Andrew Ross, right.
Below: Among the new barley products Ross is testing are tortillas, which receive rave reviews from OSU Extension educator Ana Lu Fonseca.

Making bread from barley is not without its challenges. You can't use just any old barley. Unlike beer barley, it has to be high in beta-glucan. Barley flour sucks up water like a herd of thirsty camels, so bakers usually need to add more liquid. And dough made with all barley flour hardly rises because it doesn't trap the gas produced by yeast like wheat gluten does.

Farmer Tom Hunton is excited about barley's rising future. "It's the new super food," says the co-owner of Camas Country Mill. He grabs a bag of his cracked barley cereal off the shelf at his stone gristmill near Eugene. The cereal is made from a variety called Tamalpais, but he's eager to replace it with Hayes' soon-to-be-released multicolored Streaker because it yields more and he anticipates that it will turn out to be more nutritious once it's analyzed in the lab.

Hunton says he's growing barley, including some of Hayes' varieties, for the first time in at least three decades. He had stopped because it didn't pencil out; grass seed and wheat were more profitable. "I've been drinking Pat's Kool-Aid," he says of his reason for taking it up again.

Back at OSU's barley field, the combine is almost finished pouring the Alba seeds into the bin. Hayes feels like a composer hearing the public debut of his music. He wants it to be good. He rolls a handful of kernels in his palm. The golden grains trickle between his fingers. They're big, blond, and bountiful. Hayes couldn't be happier. His years of hard work in the field and lab have paid off.

"It's nice to grow them and do research on them," he says, "but at the end of the day it's nice to see them in a bin." | **OAP**

Lynn Ketchum photo

More information on OSU's barley breeding program is at:

www.barleyworld.org

Flower power

Girls rule if you're a hop. Only female plants produce the pine cone-looking flowers pictured here that give beer its flavor, aroma, and bitter bite. "Females do all the work," says Oregon State University's hops breeder, Shaun Townsend. Almost 1,500 of these lovely ladies are spiraling skyward at OSU's hop field near Corvallis.

It's here that the hops doc is shaking up the gene pool, hoping to create varieties that will knock the socks off microbrewers who are in search of unique-smelling hops beyond the classic citrus. He sprinkles their young flowers with pollen, nurtures their offspring, then keeps the ones that resist diseases, boast high yields, and have desirable fragrances. "It's a numbers game," he says. "Out of 4,000 seedlings in the greenhouse each year, we end up with maybe a dozen we'd brew beer with, and less than five would be of interest to the market."

But the market is going to have to wait. OSU's hops breeding program only started in 2010 with a grant from Indie Hops, and it'll take more than a decade of testing in the field and lab before one of its hops ends up in a pint glass, Townsend says.

Lynn Ketchum photo

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Four generations of Chandlers welcome the Summer Ag Institute to their ranch in Baker County, where their family has been ranching since 1862.

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