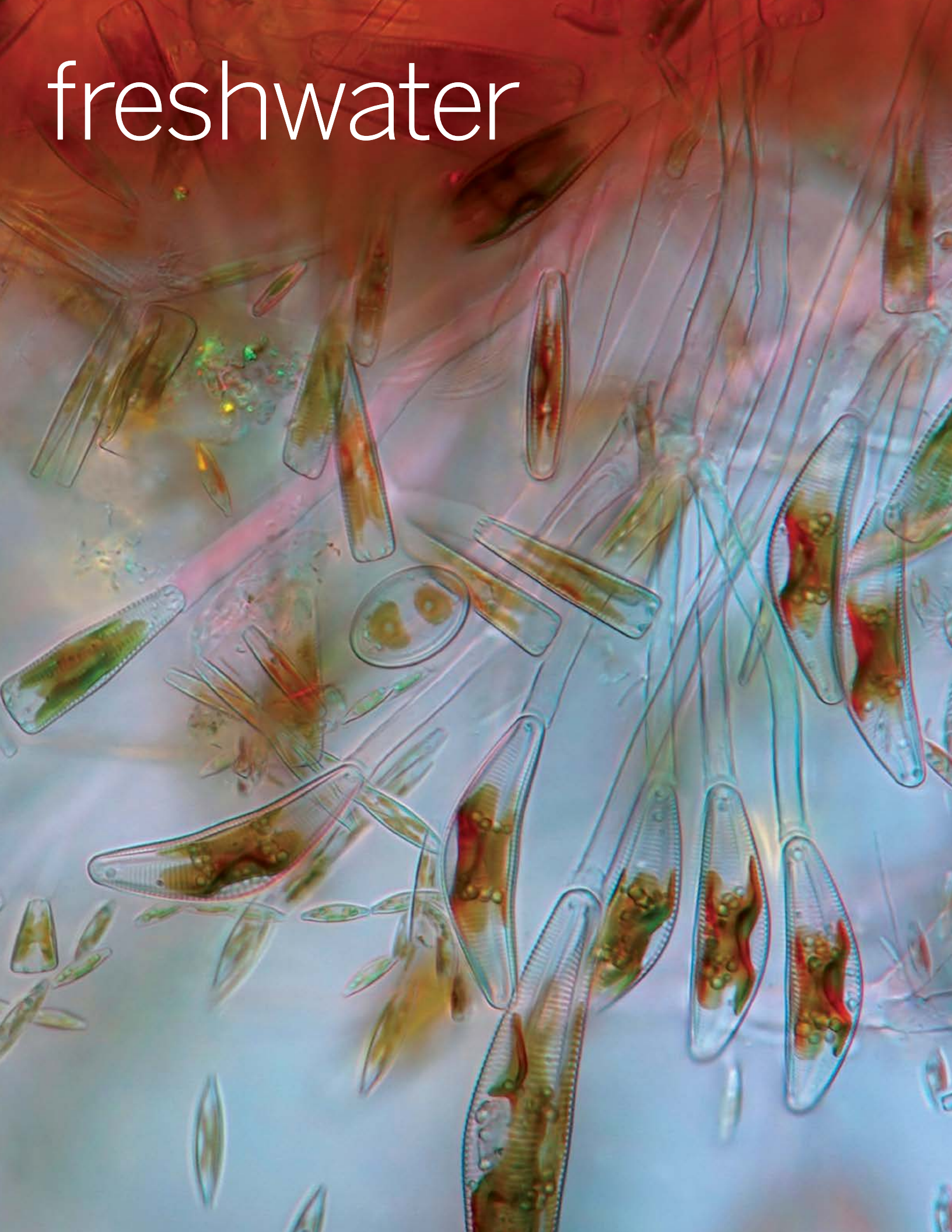


freshwater



contents



MARTY SHEPPARD

CATHY CHENEY / PORTLAND BUSINESS JOURNAL



08



12



DON JACOBSON

16



18

DEPARTMENTS

- 03 From the President
- 04 On the Fly
- 05 Sustainabilities
- 06 Profile
- 16 Blue Prints
- 18 Water Proof
- 20 From the Trust



20

FEATURES

Make Way for Beaver
page 8

A Blueprint for 21st Century Conservation
page 12

From the President



One doesn't need a polarized micrograph to see whether the traditional solutions that spurred change in the 20th century meet the challenges of the 21st.

The answer is clear: No.

But that's okay, because we can see an era shifting right before our eyes. Eras change when tools evolve to better meet current needs. We did not move from the Bronze Age to the Iron Age because we ran out of bronze. We shifted because steel was cheaper, stronger, and lighter. It simply worked better. Such a shift happened at the dawn of the environmental movement when we woke up to the fact that economic gains carried real environmental costs, and we needed to reestablish balance.

And conservation is shifting again. While we've spent the last 45 years working to develop and force the following of procedures, we can now focus on getting results on the ground — to ensure that all this environmental effort adds up. It'll take some work, but we have all the resources we need right at our fingertips to make this happen. We just need to engage them.

These tools and the framework of this approach, dubbed "quantified conservation," is unpacked in

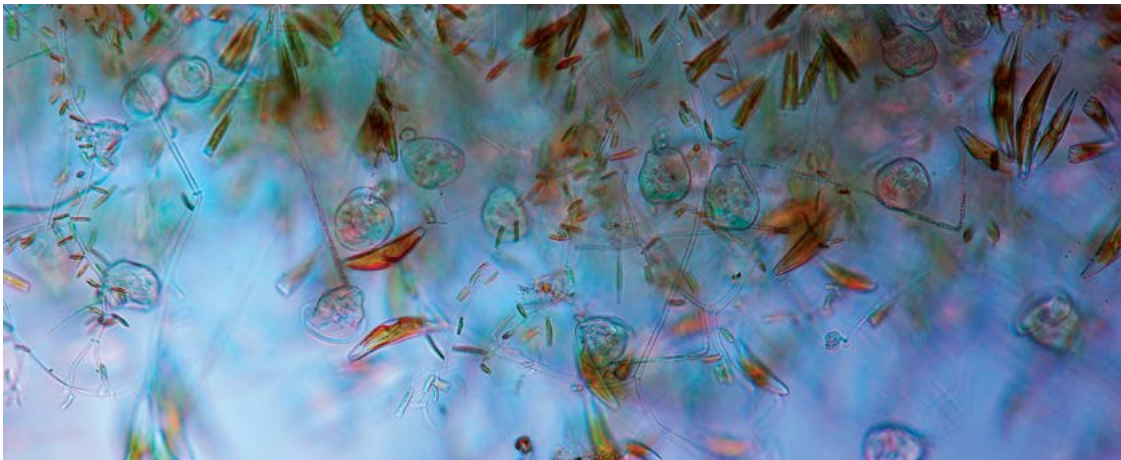
my new book "Quantified," and you can read an excerpt in the following pages of this issue.

I'm not the only one that's rethinking things, as this issue of "freshwater" clearly shows. Gregg Semler reimagined how energy could be produced from water already moving through pipes. Meg Lowman reinvented how to learn about the health of an entire forest by examining tree canopies. Three scientists asked how they could remake the misunderstood beaver by showing how the creatures can help restore rivers. And Echo challenged anglers to rethink "beauty shots" by only taking them underwater. Clear-eyed imagination is one of the biggest change agents out there.

So take in this issue — and then go out there and see things anew.

Yours in Conservation,

Joe S. Whitworth
President



↑ Polarized light micrograph of diatoms. Diatoms are a group of photosynthetic, single-celled algae. They form an important part of the plankton at the base of the marine and freshwater food chains.

— ABOVE AND FRONT COVER: MAREK MIS / SCIENCE PHOTO LIBRARY; BACK COVER: GERD GUENTHER / SCIENCE PHOTO LIBRARY



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Fish Need Water

Echo Fly Fishing launches campaign to reduce post-catch mortality

↑ A wild brown trout being released in northern Utah
— MATT GUYMONT

by Tyler Allen

Fish need water. Of course they do. Yet according to Echo Fly Fishing, there are times when this fact could use underlining.

The company's newly developed "Fish Need Water" initiative educates about best practices to minimize

"There are no ivory towers or high horses, only a deep love for both fish and fishing."



Tyler Allen is the Conservation Program Manager for Echo Fly Fishing Company. Based on Mount Hood, he owns and operates a stewardship-oriented fly fishing guide service, Henry Creek High Country Guides. He can be found at his cabin fixing things that aren't broken or traveling the Pacific Northwest with his fiancée, Lauren. For more information, visit www.FishNeedH2o.org.

post-catch mortality. Handling the fish only when necessary, minimizing the duration of the angling event, and keeping gills below the waterline can dramatically improve a fish's chance at survival. And at times like this, when water levels are already too low and stream temperatures are often too high, Echo says it's imperative to communicate the challenges faced by angled fish and the ways to mitigate the risk they face, especially when their lives are literally in our hands.

"We could have sat back and done nothing," said Echo Founder Tim Rajeff. "But we decided to do something."

As part of the Fish Need Water campaign, Echo has pledged to only post and publicize photos of fish that remain subsurface post-catch. Social media outlets have become sounding boards for a growing subset of anglers who see fly fishing as part and parcel to watershed stewardship. Whether a fish calls a freestone creek, sandy flat, or cement pond home, only wet gills will grace Echo's website, Instagram, Facebook, blog and catalog pages. Photos of fish above water posted by Echo in the past will remain as a testament to humans'

propensity to err. There are no ivory towers or high horses, only a deep love for both fish and fishing.

Post-catch fish mortality is influenced by several factors, the most impactful being air exposure, water temperature and duration of an angling event. In one study, angled rainbow trout survival rates dropped from 88% for fish allowed to remain below the water's surface to 62% for fish exposed to air for 30 seconds. After 60 seconds of exposure, rates plummet to 28%.

Rising water temperatures make current climatic trends particularly damning for Western fisheries. Salmonids, the image of stream health and vivacity, tend to thrive in a fairly narrow temperature range and undergo behavioral and physical changes when water exceeds that spread. And then there are dams, predators, poaching and disease that also hinder survival. With these challenges, Echo recognizes that when possible, we should do what we can to keep more fish alive.

Catch and release fishing has a history of being practiced in earnest only by "serious" anglers. Yet fishing culture has begun to shift toward a more conservation-oriented ethic, due in part to collapsing fisheries throughout the Pacific Rim. Now a significant proportion of anglers — many of whom chase the West Coast's anadromous species — are vowing to respect, care for, and release any wild fish that finds its way to human hands.

"Supporting our local fisheries isn't new," said Rajeff. "Grassroots efforts to only share photos of fish with their gills in the water are. This simple gesture will help protect a special resource we often take for granted. Fish need water." 🐟

A Real Flow of Energy

Turbines generate electricity from water in city pipes

Entrepreneur Gregg Semler has been pitched some really good ideas. That's how he knows what a home run looks like.

Semler heard about the idea of harvesting renewable energy from gravity-fed water pipes in a 2011 phone call. And for the last four years, he's been at the helm of a company making microhydro energy systems a reality under streets nationwide.

Lucid Energy's LucidPipe™ Power System enables industrial, municipal and agricultural facilities to produce clean, low-cost electricity from gravity-fed water pipelines and effluent streams.

"Hydropower isn't new, but we haven't seen anyone else who has a system that converts water in pipes to electricity the way we do it," said Semler. "It's really the first mass produced solution of its kind. Any pipe where water is running through it could be producing energy with this technology."

With spherical turbines, often compared to egg beaters, the LucidPipe™ Power System harnesses the untapped energy potential of moving water inside any free-flowing water pipe.

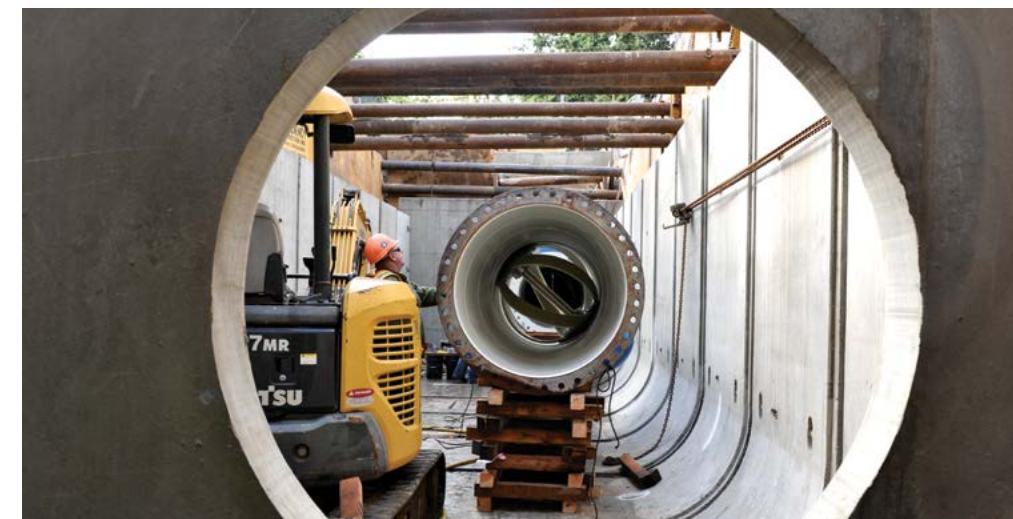
"We are recapturing energy that already exists and would otherwise be lost," said Semler.

The system is also not dependent on the weather, a detail setting the technology apart from other renewable energy sources.

"It doesn't rely on the sun shining or the wind blowing," said Semler. "This electricity is reliable and consistent and can be used on-site or fed to the grid to reduce energy costs. Managers of water pipelines can dramatically decrease the costs of delivering safe, clean drinking water."

That caught the attention of Portland, Oregon's Water Bureau. Last January, the Rose City began generating electricity — enough to power 150 homes per year — in one of its largest drinking water pipelines. Lucid Energy has a 20-year agreement to sell the power generated by water rushing through the city pipe. A portion of that revenue will come back to the city to offset the cost of running its water system.

"Water is the most important resource on the planet," said Semler. "But it's also one of the



most energy intensive. We're demonstrating the economics of our system."

Running the hot water faucet for five minutes uses about the same amount of energy as burning

"Water is the most important resource on the planet. But it's also one of the most energy intensive."

a 60-watt bulb for 14 hours, according to the Environmental Protection Agency.

The Portland project has given Lucid Energy a national soapbox. It is a proven, quintessential example of their technology at work. But Semler is already dreaming of going much further than home base. He says it's time the world of water got a big upgrade.

"Over the last 25 years, the U.S. has invested billions of dollars to ensure reliability of our electrical grid," said Semler. "The same is not true for water infrastructure. In many places, it's 100 years old and breaking down. We need to rebuild water infrastructure in the U.S., and we would like to see the LucidPipe™ system play a pivotal role in rebuilding this infrastructure to improve the sustainability and economics of water."

Lucid Energy now has its sights set on California, New York, Arizona and Texas — states where water prices are already high.

"The links between water and energy are resonating with people," said Semler. "Saving one means saving the other." 🌊

↑ LucidPipe™ Power System. The turbines have been compared to egg beaters.
— SHERRI KAVEN

LUCID ENERGY'S PORTLAND PROJECT BY THE NUMBERS

1st project of its kind in the U.S.

Water in pipes is used to spin four 42" turbines

1,100 megawatt hours per year, powering up to 150 homes

20-year power purchase agreement will generate \$2 million worth of renewable energy

Source: Lucid Energy

Q&A

with Meg Lowman ARBORNAUT. SCIENTIST. TRAILBLAZER.

Meg Lowman didn't grow up with the internet. She didn't grow up with apps for species identification, drones or satellite imagery. She grew up climbing trees. And that has made all the difference.

Nicknamed the "real-life Lorax" by National Geographic and "Einstein of the treetops" by Wall Street Journal, Meg Lowman pioneered the science of canopy ecology. For more than 30 years, she has designed hot air balloons and walkways for treetop exploration to solve mysteries in the world's forests, especially insect pests and ecosystem health. Today, she is Chief of Science and Sustainability at the California Academy of Sciences, and Meg sat down with us to talk about her work blazing a trail for canopy research and for women in science.

You've become one of the world's first "arbornauts." Explain what that means.

An astronaut studies outer space. Technically, an arbornaut studies the upper reaches of the forest, otherwise known as the canopy. It's a pretty new field, and there have been only 30 or 40 years of pretty intensive exploration of forest canopies. It is sometimes called the eighth continent of the world.

Soaring atop the canopies of French Guinea in a canopy inflatable sled, "trawling" for biodiversity in the treetops
— PHOTO PROVIDED BY MEG LOWMAN

How much of the world's canopy would you estimate we have explored?

Gosh. Probably 5%. It's pretty low, and the technology has been slow in coming. We don't quite have the budget of NASA. Arbornauts, or canopy scientists, have been operating with ropes and harnesses — pretty simple tools. Only lately are we starting to catch up with really amazing tools like LiDAR and probably drones as they emerge.

You mention that technology has been slow in coming, but that didn't really slow you down. You took off exploring these tree canopies by hot air balloons, cranes and walkways. In the early days, what were you thinking?

My mother still hates seeing pictures of me, and now I am a mom myself, so I have to forgive my children for whatever they do. It was amazing. It was like a dream come true. All of these techniques were really and truly allowing me to answer questions that I was passionate to answer. In some ways, I was really driven by the science more than the adventure. It's only looking back that I suddenly realize: Holy cow, I guess I was a bit of a risk taker ... more than I probably cared to admit.

What does a tree canopy tell us about the life of the forest below? How do you approach a canopy? What are you looking for?

For more than 100 years, foresters walked through forests and assessed the health either with binoculars or maybe by cutting a tree down. It would almost be like going to your doctor and he looks at your big toe and says, "Gosh you're perfectly healthy!" without ever looking at your

ears or your eyes or anything else. We've been looking for such a long time at this very small tunnel through the bottom of the forest without really knowing what was going on in the other 95%. So with canopy access came the ability to really look at the important parts of a tree. The canopy is where the flowers and fruits exist. It's where most of the foliage that's photosynthesizing exists. It's where all the active growth is going on for the most part. It's a hot spot for biodiversity as well as all sorts of processes. So with canopy access, all of those hot air balloons and cranes and ropes that we developed in the 1980s and 1990s, came the opportunity to really measure in greater detail the inner actions.

In areas where trees have suffered extreme water deficits, large trees are casualties more often than small ones. Why is that?

A couple reasons. Of course it varies with the types of trees and the habitat. Technically speaking, younger vegetation is a) more aggressive in its growth patterns and b) usually has shallower root systems. A lot of that water that comes from rain, especially heavy rains, is going to get taken right up at the top of the soil region, so those young trees benefit.

These amazing and enormous big trees are really important, but they're also vulnerable because they have a lot of other issues. For instance, the center of them is mostly hollow, which is a huge amount of dead carbon storage, which is really important. But when those things get wet, they are very vulnerable to falling over. Their roots systems go far and wide and are equally vulnerable to getting enough to support the entire canopy. We are losing some of those big trees, and unfortunately, we're not allowing trees to become those old growth stands as readily as we probably were 200 or 300 years ago. So this is something to show your children while you can. I'm really sad to admit that, but I do worry about the fate of having old growth stands left for kids to admire and for wildlife to reside.

If you could have any superpower what would it be?

I guess it would be to restore the world so that those old growth forests were still with us. Did you know we cut about 95% of our forests down, and we mainly have secondary forests? We don't really know what we're missing. We don't know what biodiversity used to be in those incredible New England forests 500 years ago. We can't know, because no one was keeping a notebook at the time. And of course my ultimate social justice wish would be that every child would have the opportunity to have a science class and get through the sixth grade. I tend to work in countries where there is a lack of education because they can't possibly harvest the crops, look after the family, and go to school at the same time. With a little more equity of

environmental education, we could probably turn a lot of the issues of the planet around.

Your field is not what I would characterize as crowded. There are not a lot of people doing this, and you had to blaze this trail alone in a lot of ways. Why did you do it? How did you do it, and who helped you along the way?

Gosh. What great questions. I do look and wonder what on Earth happened to me. My parents think I must have come from the milkman or something. They are definitely not scientists. I really did love playing outdoors. We didn't really have much else to do. I grew up before the internet, and we didn't even have a movie theater in my little hometown in upstate New York. So I think a lot of my inspiration did come from playing in nature.

I loved Rachel Carson when I read "Silent Spring." I loved hearing about Harriet Tubman feeling the moss on the north side of the tree trunk in the middle of the dark to free some of the slaves from the south to the north. It just blew my mind that she was such an amazing naturalist. Those were my role models. They were light years away from me, and I never met them in person nor did I have a California Academy of Sciences to go to after school. I really do think it was the nature play. And after that, I just really continued to gravitate toward forests.

Why is there such a dearth of female leadership in science?

I think it's the "leaky pipeline" as we call it. Some 50% of women are getting the PhDs in biology, which is really awesome. But somewhere between then and tenure, they are either following their husbands, taking time out to have children, or are simply deciding to do something different because they look at other women in those positions and realize they don't want to quite imitate the same level of challenge and pressure. We need somehow to simplify or streamline that challenging period of the decade after the PhD. I'm hosting a women in science summit at the Cal Academy in January, because one of the things the Academy wants to do is become a conversation hub — a convening place for issues. Women in science is certainly one of those issues. 🌱

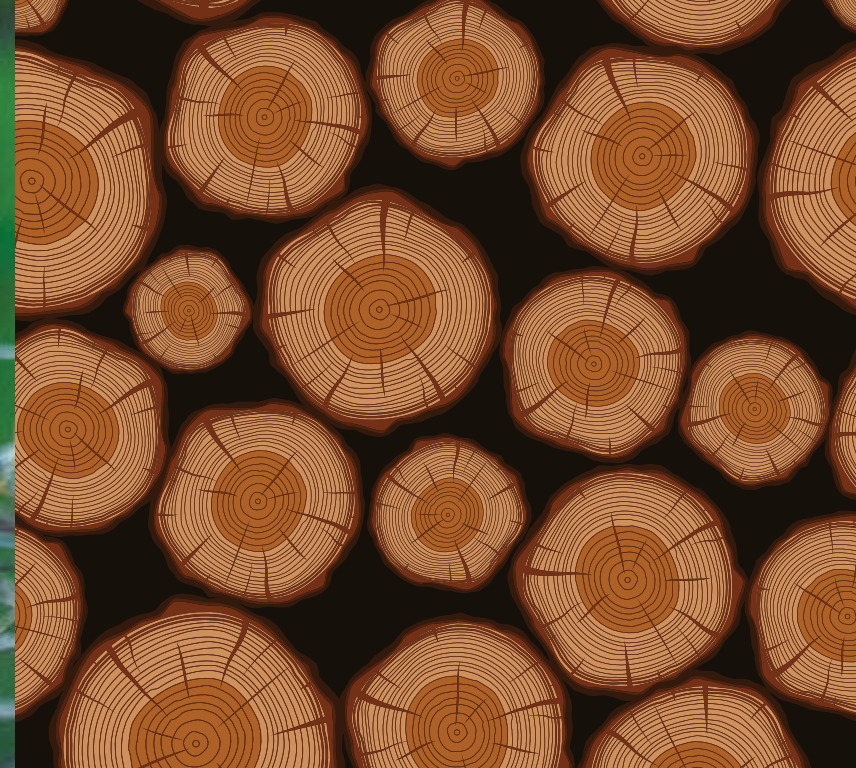
Meg Lowman dangling from a Great Kapok tree along the Amazon River in Peru
— PHOTO PROVIDED BY MEG LOWMAN



To hear more from Meg Lowman, download the freshwater Talk podcast on iTunes.



Listen to more freshwater Talk podcasts featuring lively discussions with global leaders about big issues facing our economy and environment. Visit www.thefreshwatertrust.org.



MAKE WAY FOR BEAVER

When a group of five scientists in the Pacific Northwest began advertising for workshops on the science of beaver restoration, they didn't anticipate a few things.

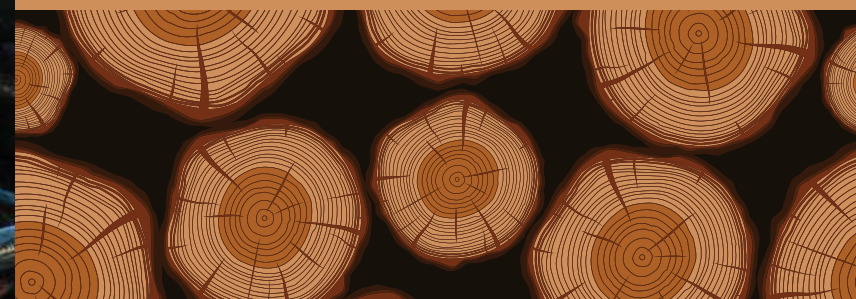
The workshops would be filled to capacity within a week. There was so much interest they needed to increase both the workshop size and the total number of workshops offered. There would be a waitlist, followed by phone calls and emails from people clamoring to get in.

It wasn't that the team was unprepared. This level of interest just wasn't expected.



A beaver working on a dam in Wyoming's Grand Teton National Park. The park has several wetlands created by beaver dams.

— CHASE DEKKER WILD-LIFE IMAGES /GETTY IMAGES



After all, the relationship between beaver and humans has been strained for centuries. Fur trappers nearly wiped out the population entirely in the 1800s. Then, when the creatures came back in thriving droves, they were deemed havoc-wreaking pests.

But name after name appeared on the workshop registrations in Oregon, Washington, Alaska and California.

Regulatory agency staff, nonprofits, tribal representatives, private landowners, members of the general public and others paid the \$50 fee for one-day intensives on the science behind how beaver restore streams.

“When wolves were reintroduced into Yellowstone, the effect cascaded throughout the entire ecosystem,” said Castro. “The similar, widespread effect can be seen with beaver.”

The ponds, pools and wetlands created by beaver dams expand both habitat complexity and area for birds, waterfowl, fish, aquatic invertebrates, mammals and amphibians.

While it was once common belief that fish could not pass through the dams, research now shows most native fish easily cross them.

“Large wood placement in streams was something that was pretty contentious 20 years ago,” said Castro. “There was huge concern about

Tahoe basin, concentrations of phosphorus entering Lake Tahoe increased downstream.

Wetland sponges created by beaver dams also hold water in the system longer.

“Beaver slow the flow of water, reducing flash flooding and erosion and giving it the opportunity to recharge into the ground,” said Michael Pollock, ecosystem analyst with the National Marine Fisheries Service and another author of the guidebook. “When water is stored, it can later come out at low flow times, which is of course invaluable in the West.”

Beaver and climate resilience

In a changing world that forecasts the dry season to only become drier and longer, these creatures can make a big impact.

“Everyone is wondering what the West’s landscape will look like without the snowpack,” said Lewallen. “We can use beaver to create more climate resilient systems.”

Moreover they’re quite affordable. Some might spend tens to hundreds of thousands of dollars on some stream restoration projects that could be done for a fraction of the cost using the techniques outlined in the beaver restoration guide.

“There are things that we did to the landscape in the last 50 or 100 years — like build dams or straighten streams — and now we are trying to find ways to offset some of those impacts,” said Kent Woodruff, a biologist with the U.S. Forest Service and an author of the guidebook. “A lot of people understand that putting a natural engineer back on the landscape makes a lot of sense for a lot of reasons.

Storing water for the future

Woodruff leads Washington State’s Methow Beaver Project, a collaborative group of partners working to improve water quantity and quality by reintroducing beavers into strategic locations of the Methow Valley Basin. Nearly 300 beavers have been relocated to 51 sites over the last seven years.

Their tag line? Storing water for the future. One beaver at a time.

“I recognize there are plenty of places where beaver are not appropriate,” said Woodruff. “But where there are compatibilities and when we can increase our tolerance, we as a society are going to benefit.”

The scientists say the growing interest in our country’s diminished water quality and quantity may be behind the growing interest in beaver restoration.

“We should always be worried about water, and beaver have an immediate impact on this scarce resource,” said Castro. “It’s the fundamental thing that we all need to survive. People are starting to see the value of beaver for more than just their pelts or more than just pests, but how we can work in concert with them to fix more rivers and streams.” 🌿

FREQUENTLY ASKED QUESTIONS ABOUT BEAVER

How many species of beaver are there?

There are two: the North American beaver and the Eurasian beaver.

Is it true that beaver are rodents?

They are the largest rodent in North America and second largest in the world. The first is the capybara. Adult beaver typically weigh 35 to 71 pounds and can grow to a total length of four feet.

What do they eat?

As herbivores, beaver consume a wide variety of plant species. They eat the leaves, twigs, and inner bark of most types of woody plants that grow near the water. In addition, they eat many different kinds of herbaceous plants, including grasses, sedges and aquatic species such as water lilies. Despite common myths, beaver do not eat fish.

What do they use to build dams?

Dams are often constructed from a variety of material, both natural and manmade. Tree trunks, branches, twigs, bark, leaves, earth, mud, stones, cornhusks, plastic, metal and other debris have been documented in the structures.

Why do beaver build dams?

Beaver build dams to raise water levels. Higher water levels provide the following benefits:

- Allows them to dive to safety from predators;
- Increases foraging area and provides safe and easy travel routes to and from feeding areas;
- Allows logs and branches to float within the pond;
- Ensures that the entrances to lodges and burrows remain underwater, so as to protect beaver from land-based predators such as coyotes and cougars; and
- In colder climates, keeps ponds at a sufficient depth to maintain liquid water under a sheet of ice during the winter months.

How big are the dams?

Dams can range in size from 20 inches to 930 yards long, as discovered in Alberta, Canada’s Wood Buffalo National Park.

How do beaver communicate?

They are highly social creatures that communicate through scent, vocal sounds, tail slapping and body movements. Tail slapping often serves as a warning signal.

“PEOPLE ARE STARTING TO SEE THE VALUE OF BEAVER FOR MORE THAN JUST THEIR PELTS OR MORE THAN JUST PESTS, BUT HOW WE CAN WORK IN CONCERT WITH THEM TO FIX MORE RIVERS AND STREAMS.”

“We knew there were a ton of people out there working with beaver to restore waterways,” said Janine Castro, a geomorphologist with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. “What we wanted to do was bring all these people together to synthesize knowledge on this topic and widely share science, information and management techniques.”

But the sharing of knowledge and best practices would live beyond the day-long events. Workshop discussions were captured in an official guidebook on beaver restoration, published this past June.

“The publication is meant to be an accessible resource for anyone using beaver to restore waterways,” said Greg Lewallen, a master’s student at Portland State University and the research assistant for the project. “With enough educational outreach, the perception of these animals will start to change. That’s why it’s critical we continue to spread the word about the large role that these animals play in ecosystems.”

Nature’s ecosystem engineers

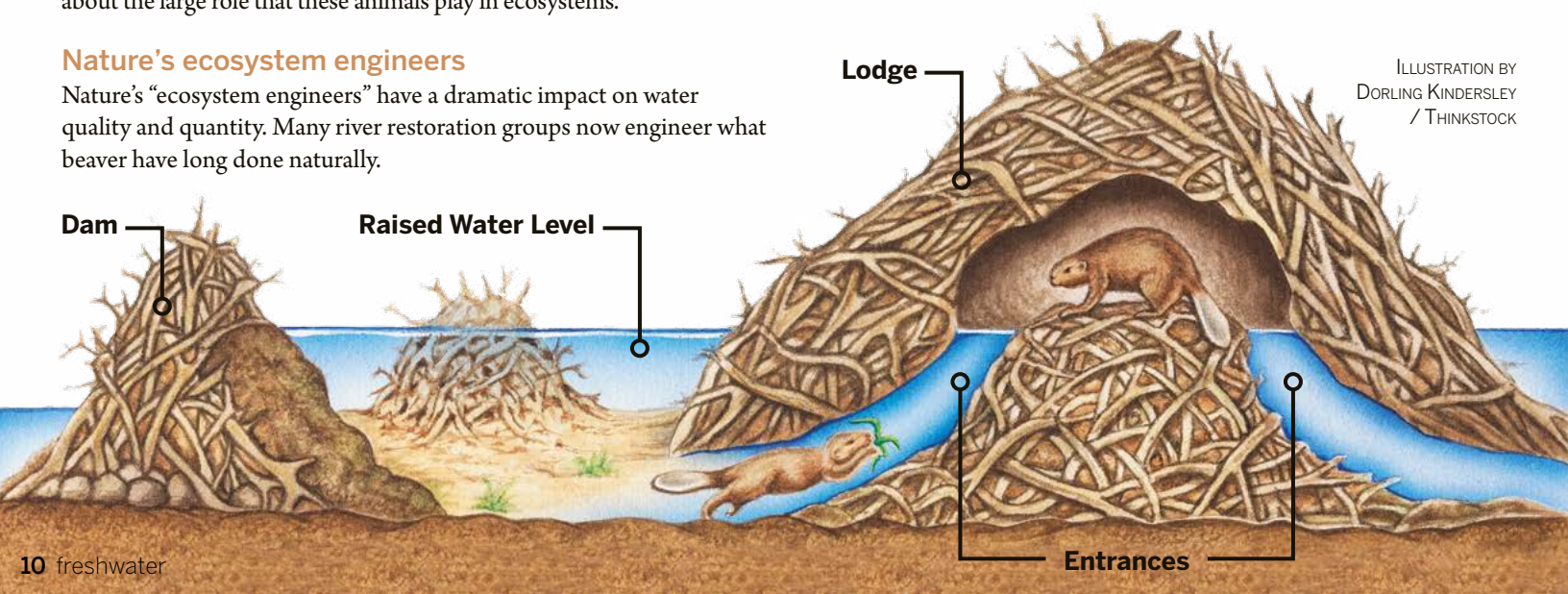
Nature’s “ecosystem engineers” have a dramatic impact on water quality and quantity. Many river restoration groups now engineer what beaver have long done naturally.

the risk, but education and outreach made a huge difference. Many landowners now realize this large wood has value. We’re hoping for the same thing with beaver.”

As the water overflows around the dams, natural floodplains are reconnected. New channels and wetlands are created. In Maine’s Acadia National Park, beaver contributed to an 89% increase in wetlands from 1944 to 1977. Studies have found similar results nationwide.

Increased presence of wetlands

As the “kidneys of the landscape,” the increased presence of wetlands often means a decreased presence of nutrients. The beaver restoration guide notes that ponds and wetlands created by dams can act as sinks for nutrients and toxins that would otherwise stimulate the growth of algae and other bacteria downstream. When beaver dams were removed from Taylor Creek in California’s Lake





A Blueprint for 21st Century Conservation

In September, Joe Whitworth, president of The Freshwater Trust, released his first book, “Quantified: Redefining Conservation for the Next Economy.” Published by Island Press, “Quantified” draws lessons from the world’s most tech-savvy, high-impact organizations to show how we can make real gains for the environment. The five principles of this approach, dubbed “quantified conservation,” will be familiar to any thriving entrepreneur: situational awareness, bold outcomes, innovation and technology, data and analytics and gain-focused investment. This no-nonsense strategy builds on the inspirational work begun in the 1970s, while recognizing that the next economy will demand new solutions.

Here, Whitworth shares the introduction of his newly published work and what inspired him to embark on the journey of memorializing “quantified conservation” and becoming an author.

Introduction

The seeds of my current work were first planted by my grandfather more than 40 years ago. A corn and bean farmer along Blackbird Creek in the Missouri River Basin, he used to say that no man has the right to take more from the land than what the land itself can withstand. Over decades, he learned that if he took care of the land, it would take care of him. In a fundamental way, he understood that commerce and environmental stewardship were forever entwined, that prosperity requires both a strong economy and a healthy environment.

As a young college graduate, I entered a world that sends a quite different message. Not only are the economy and the environment

seen as completely separate, but they are at war. The message is that you can have either a strong economy or a strong environment but not both. This view of the world has never sat well with me. And when I see evidence that both our economy and our environment are in decline, I’m reminded that Grandpa Whitworth had it right.

Yet despite my grandfather’s good intentions, Blackbird Creek has since been listed in violation of the Clean Water Act. In fact, its entire length suffers from agricultural runoff, including the stretch of creek that bordered my grandfather’s property. Like most farmers, my grandfather intended to do right by the land. Yet he was caught up in an economy that didn’t bother to connect the dots. Fertilizer was cheap. Conventional wisdom was to farm all the way down to the stream. And an ongoing need to pay off bank loans required him to keep increasing the number of bushels he produced. Unfortunately, my grandfather’s experience is still the rule, not the exception, in today’s world. It’s just the system.

A finite sandbox

Like my grandfather, most people do not fully understand or connect their actions to the impact they have on the environment. Producing cheap food requires lots of fertilizer and pesticides. And because we all enjoy cheap food, our nation’s rivers are literally choking from these nutrients. Take the Mississippi River, for example. The world’s fourth longest river, it has become so saturated with fertilizers from agricultural runoff that every year it creates an enormous water ghost covering as many as 8,000 square miles — the size of New Jersey — where the river drains into the Gulf of Mexico. Within that dead zone,

there’s not enough oxygen to sustain fish or other marine life. In their place are enormous quantities of toxic algae, leaving an ugly layer of scum to shadow the depths below.

We’re taking more from the land than it can withstand, and in the long term, that’s bad for the economy. With the world’s population projected to reach 10 billion by 2050, we’ll have more people to feed, clothe, house, and employ than in any time in human history. And then we’ll have to do it every year thereafter. That means we cannot undercut the resource base from which we draw. We have a limited sandbox in which to play. Our natural resources are finite. They are the basis of our prosperity; we can’t just use them up.

Yet that’s exactly what we’ve been doing. In the last 150 years since the Industrial Revolution, we’ve focused almost exclusively on growing our economy, extracting whatever we need to do so at the expense of the environment. And now we’re at a point where the environment is hurting — seriously hurting. Setting aside all romantic reasons for saving nature, the fact is, we cannot have a thriving economy without a resilient resource base underlying it. It just won’t work. We need basic systems operating properly, and right now, they are deeply compromised as a result of humans making a living on Earth.

We’re in a game of catch-up, and to restore the right balance, we must train a laser focus on achieving gains for the environment in the same way that we’ve obtained financial gains in the past. Simply put, we have to rebuild the health of the environment on whose services both our economy and our very existence depend. In my mind, this

“We have to rebuild the health of the environment on whose services both our economy and our very existence depend.”

is not a war where we must halt the evil economy in the name of a beautiful environment as foretold by eco-warrior legend. This is an obvious imperative.

Busywork or actual results?

Growing up in a small town in downstate Illinois, I was also influenced by my dad, a carpenter. I spent my summers as a grade-schooler earning a dollar a day running back and forth to the truck getting the right tool for the job at hand — a great way to understand the tools and learn the trade. The way it worked was pretty simple. People called my dad when they had a problem. We would show up on the job site, check out the situation — the gutter would be broken, the roof would be leaking, the floor would have fallen through — and if Dad did his job right, the problem would be fixed by the end of the day. But if we walked off that job site and the problem wasn’t fixed, we’d have to come back the next day and then the day after that until it was. Dad didn’t get paid unless and until he fixed the problem.

Being exposed to job site after job site all the way through high school, I learned that when there’s a problem, you fix it. Yet when I started working on water issues, I soon recognized that we weren’t getting the job done. Yes, we were raising money every year. Yes, we were staying busy. Yes, we were helping. But we weren’t actually fixing the problem.

When you're a carpenter, the first thing you do is size up a problem. Is it a leaky roof or a cracked foundation, and what tools do I need to fix it? Sizing up our 21st-century water problems, I eventually reached the conclusion that the tools we've been using aren't enough to solve the challenges we face. It's like trying to paint an entire house with a one-inch paintbrush when what you really need is a spray gun. In the same way, the tools we're using to protect the

We humans can do astounding things when we focus on challenging problems.”

environment aren't getting us where we need to be. Despite the hard work by a lot of uber-smart, totally dedicated, gifted people, the reality is that we're not achieving the gains we need for the environment. In fact, the environment continues to lose ground at a rapid pace.

Taking a quantum leap forward

I have written this book for the same reason that I work on water issues: I want to take my grandfather's good intentions about the environment and convert them into action while still allowing people like him to earn a decent living. And I want to harness my dad's fix-it work ethic to restore our rivers and streams within my lifetime. Unless we change the course we are on, we simply won't get it done.

There's an incredible array of tools available to us, but we have yet to seize them. Instead, we remain stuck in Conservation 1.0 — an unacceptable rate of innovation for smart folks living in the age of Google. Most of the major advances the environmental movement has made date back to the 1970s, when the Clean Water Act was passed and issues such as clean water and air drew national attention. True, there's been a tremendous amount of advocacy and litigation since then. But the improvements have been incremental. Perhaps we've moved on to Conservation 1.1 or 1.2, when what we really need is

a quantum leap forward. The bottom line is that the environmental movement hasn't been innovative, and we need to be innovative if we're to address the complex environmental problems in front of us.

To use an example that most environmentalists hate, consider the oil and gas industry. Historically, oil was extracted by drilling vertically. Vertically, vertically, vertically — for more than a century. But over time, the work the industry could get done diminished. The oil began to dry up, and the return on investment began to decline. Rather than throwing up their hands, oil and gas executives regrouped and innovated. They looked sideways at the issue and came up with a new way of getting at the oil that involves drilling horizontally rather than vertically. No matter how you feel about the substance of this example, you cannot argue with the form. Horizontal fracking opened up a whole new oil boom.

In the same way, we need to realize that the same old environmental playbook is no longer working and find a way to open up new possibilities. We've spent the last 45 years using the same old tools and strategies, even as the return on our investment has diminished. Yet drilling down harder on our problems using these same methods isn't going to work. We've got to wake up and realize that we're not getting at the issue and that we have to move sideways, at an angle, or in some other way. In short, we need to tackle our environmental problems from a different direction, and that requires a brand-new approach.

Whatever our role working on environmental issues, we must all have a meeting with ourselves and our organizations. We must take a hard look at where we're at, admit where things aren't working, and then revamp our approaches to get the results we want. And we must innovate and measure our results to make sure our chosen path is working.

“Quantified” is about doing exactly that. It's about changing our approach to conservation on a fundamental level. It's about widening the focus to bring about environmental gains alongside the financial ones that have been the central emphasis of our global economy. And it's about moving past the current “let's stop more bad things from happening” mentality to achieve lasting, quantifiable improvements for the environment. Although many of the examples in this book come from my field of focus, water, the principles of “quantified conservation” apply to environmentalists working on any issue. They also apply to the entire spectrum of players concerned about the environment, including government administrators, farmers and ranchers, business leaders, philanthropists, social investors, and anyone who cares about bringing about a more prosperous future.

We humans can do astounding things when we focus on challenging problems. Not all the obstacles may be known or the details written down, but we have the tools we need to start the journey. What is certain is that we cannot afford to stay stuck in an extraction-based past that treats our natural resources as limitless. We must forge ahead and create a conservation-based future that balances a prosperous economy with a thriving environment. And we can. By reading this book, I hope you will walk away with a strong set of organizing principles with which to evaluate our present crisis and build a more resilient future. 🌱

Q&A with Joe Whitworth

What inspired you to write “Quantified?”

Two things. First, I was interested in figuring out why as an organization, The Freshwater Trust had grown in an economic downturn, and especially when so many other groups had contracted. My hope was to find certain elements that made such growth and innovation replicable.

Second, I wanted to write a book focused on workable environmental solutions that reorganize how our economy and environment interact — as opposed to simply pointing out the problems we face as a society. I had this great idea to include a chapter in my book called “The Problem” that would just say: “See references in back for details.” My publisher didn't love that idea. But the fact of the matter is that the problem has already been written about at great lengths. It was time someone wrote about what we can do to take conservation to the next level and start getting the results we desperately need.

In two sentences, why should people read it?

People should read this book because it shines a spotlight on the fact that our traditional set of tools are completely outmoded. It also demonstrates that solutions are available if we have the guts to pursue them.

Who do you hope this book reaches?

I wrote this book to create space for the next generation of doers. For readers older than me, I hope they will see the imperative for them to allow the change to happen. For younger readers, I want them to see the opportunity they have to change the world ahead.

What are your expectations for this book?

I want this book to send up a flare for all those who understand that the way we approach conservation today is not working. I'm interested in reaching those who also believe technology, analytics and innovation will catalyze the next generation of environmental action. I hope that folks will read this and agree that we have to start thinking about and acting on conservation in a new way if we are going to fix our freshwater issues — and really many of the other environmental problems we face today.

What was the most difficult part of becoming a published author?

It's really the 30% more that you have to do after the manuscript is done. Editing. Bibliography. Graph



All proceeds from the sales of “Quantified” will go to help The Freshwater Trust fix more rivers.

captions. Heck, even finding an author photo was quite the to-do that I did not see coming.

What's your favorite story included in this book?

Probably the chapter called “Lessons from an Aussie Water Shock.” Nine thousand miles away from us here in the American West, Australians have been experiencing their own water crisis. Like the Colorado River, the 1,600-mile Murray-Darling River is critical to Australia's livelihood. But climbing temperatures and plummeting rainfall have been reducing water flows. Today, Australia is tackling its water problems head on and taking a quantified approach. We could take a page out of their book!

In one word, how do you want people to feel when they finish this book?

Optimistic.

What's next?

To me, this is more of a blueprint than a book. It sets up a breakpoint between the previous era and the next one. My intention is to start blazing the path, demonstrating the solutions I talk about in the book, and recruiting others interested in moving forward. Throughout the next year, I'll be sharing the ideas I write about in the book with others across the country, in offices, classrooms and town halls.

Want to purchase a copy of “Quantified” or read more about it? Visit www.islandpress.org/quantified.



BLUEPRINTS

➡ Clockwise from Top:
Triple Falls, one of the many majestic falls at Oregon's Columbia River Gorge National Scenic Area. The area includes more than 200,000 acres spanning southern Washington and northern Oregon.
— DON JACOBSON, JULY 2015 WINNER



South waterfront along Portland, Oregon's Willamette River. The Willamette is a major tributary of the Columbia River and divides the city between the east and west sides.
— WENDI QIU



Yellow-billed stork, also known as the wood stork or wood ibis, in Kuala Lumpur, Malaysia. The bird primarily exists in eastern Africa and is on postage stamps in several African countries.
— KURUPARAN



Friends enjoying Lower Lewis River Falls in Washington. The falls are approximately 43 feet high and 200 feet across.
— BRADLEY BOULTON, AUG. 2015 WINNER



⬅ Clockwise from Top:
The South Fork Crooked River snakes through Central Oregon.
— SCOTT WRIGHT, SEPT. 2015 WINNER

Stanley Lake in the Sawtooth National Forest, a more than 2 million acre protected area in Idaho and Utah. The forest is named after the Sawtooth Range of the Rocky Mountains.
— JESSE WRIGHT

Columbia Hills State Park in Washington. The park is known for sprawling grasslands, wildflowers, oak trees and basalt cliffs.
— KEVIN COWLEY, MAY 2015 WINNER

Fly fishing on the Metolius River, a tributary of the Deschutes River in central Oregon.
— TONIA TWIGGER



Metlako Falls, a major waterfall on Eagle Creek in the Columbia River Gorge National Scenic Area.
— CLIFFORD PAGUIO, JUNE 2015 WINNER



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Photo of the Month Contest

The Freshwater Trust and Pro Photo Supply partner on a monthly photo contest. Whether it's a beauty shot of your favorite water spot or an active photo of you recreating, submit your freshwater photos, and enter to win. Each month, a photo will be selected and featured on The Freshwater Trust's website for one month, highlighted as our Facebook cover photo, posted to Twitter, and eligible for inclusion in this Blue Prints photo section. The winning photographer will also win a \$25 gift card from Pro Photo Supply.

For more information and contest rules, see our Get Involved page at: www.thefreshwatertrust.org/get-involved.



The History of Drinking Water

Throughout the ages, humans have developed new technologies for improved water treatment, distribution and safety. These efforts also include protecting the source of the water in the natural environment. Keeping water clean and clear upstream reduces downstream costs of removing contaminants before water is delivered to the tap.

Circa 2000 B.C.

Sanskrit medical writings describe water treatment methods such as boiling water over fire, heating water under the sun, dipping heated iron into water, and filtering water through gravel and sand



Circa 1400 B.C.

Water clarifying apparatus depicted on tomb wall of Egyptian ruler

200 A.D.

Gravity-operated aqueducts provide a public water supply to more than 1 million people in Rome



1804

The first municipal water treatment plant opens in Paisley, Scotland, and uses slow sand filters

1974

The Safe Drinking Water Act passes, extending U.S. standards for safety to all community water systems with 25 or more customers



2001

New York City creates a watershed protection program to protect the source of the city's drinking water 100 miles away in the Catskill Mountains. San Antonio, Texas and Portland, Oregon have similar watershed protection programs.



2010

The UN General Assembly recognizes access to clean drinking water and sanitation as a human right



1853

Cholera epidemic in London ends after the physician John Snow identifies a neighborhood drinking water pump as the source of contamination

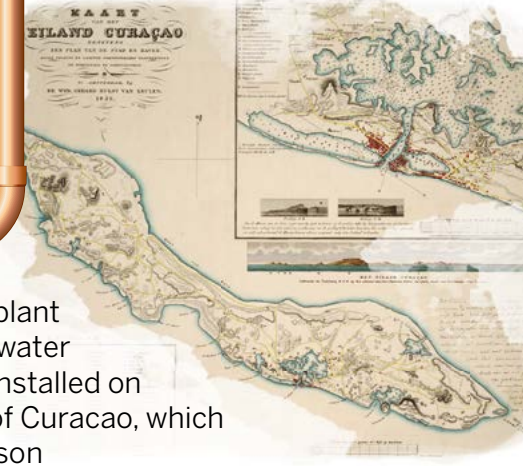
2010

Millennium Development Goal met five years ahead of schedule: More than 2.3 billion people gained access to improved drinking water sources



1928

First desalination plant for converting seawater to drinking water installed on Caribbean island of Curacao, which has a long dry season



Sources: *The Quest for Pure Water: The History of Water Purification from the Earliest Records to the Twentieth Century* / Moses Baker and Michael Taras
Historic Milestones in Drinking Water History / State of Alaska Division of Environmental Health
Watershed Protection / City of New York Department of Environmental Protection
Source Book of Alternative Technologies for Freshwater Augmentation in Latin America and the Caribbean / United Nations Environment Programme
www.un.org/waterforlifedecade/milestones.shtml

The Freshwater Trust® **UPDATES** →

Our website got a makeover. Noteworthy progress was made on water quality trading. The StreamBank® Monitoring App received new features. New funding and partnerships have helped expand work outside Oregon. We're pleased to share a look into what's happening on the ground and behind the scenes.

Medford project featured in Scientific American

In late July, Scientific American published an article featuring The Freshwater Trust's Medford, Oregon water quality trading program. Reporter Brian Bienkowski conducted several interviews with The Freshwater Trust's staff, including President Joe Whitworth and Senior Director of Ecosystem Services David Primozich. The final piece ran on Scientific American's features page and in Environmental Health News.

Foundations support projects in California and Idaho

Over the past year, The Freshwater Trust has cultivated noteworthy partnerships with foundations interested in supporting work outside Oregon. This spring, the Bullitt Foundation funded our efforts to develop water quality trading programs in Idaho's Boise River

watershed. The project funded by this \$35,000 award is being coordinated through our new Boise office. In addition, The Freshwater Trust secured its first grants from the Rockefeller Foundation (\$350,000) and the Gordon and Betty Moore Foundation (\$124,875) for new projects being launched in California. These awards will allow The Freshwater Trust to research how our innovative StreamBank® BasinScout™ methodology could help identify restoration opportunities and approaches, using data from the Salinas and Russian River watersheds.

Final Oregon water quality trading rule expected at end of 2015

Since the multistate release of the Joint Regional Recommendations in 2014, The Freshwater Trust's legal and policy team has been engaged in Oregon's Department of Environmental Quality rulemaking and update of its internal policies and guidance for water quality trading program development in Oregon. The Oregon rule is set to be finalized at the end of 2015 at the Oregon Environmental Quality Commission's December 2015 meeting. It is intended to provide clarity and certainty for stakeholders and permittees, and serve to support the establishment of additional credible and effective programs.

Steps taken toward creation of Idaho water quality trading program

The Freshwater Trust has been working with the cities of Boise, Caldwell, Meridian and Nampa in Idaho's Lower Boise River basin, as well as Amalgamated Sugar and Simplot, to complete the analyses needed to support water quality



trading programs in the basin. The cities will soon face new limits in their permits for phosphorus discharged from their wastewater treatment plants to the Lower Boise River or its tributaries. While a trading framework was developed in the early 2000s, it had not been used to meet regulatory compliance and needed updating – an effort currently being completed by Idaho Department of Environmental Quality. The Freshwater Trust completed a technical analysis of the Lower Boise River basin that will help support the updates of the trading framework. This includes selection and confirmation of applicable water quality models, assessment of how and where particular agricultural best management practices would be most effective, calculation of the water quality benefits that can be attributed to on-field conservation actions, and an assessment of hydrologic connectivity. Our data and analyses will provide a technical foundation that can be used for management decisions to improve water quality in the Lower Boise River.

Attorneys serve on task forces for noteworthy water bill

The Freshwater Trust participated in two task forces and a rule advisory group implementing SB 839, a 2013 Oregon Senate bill that established a funding program designed to target state investment in water supply projects that create economic, social and environmental benefits. This bill has been considered by some to be among the most significant water bills to pass the state Legislature in the past several decades.

New, three-year flow agreement signed with more than 70 agricultural producers in northeastern Oregon

After 10 years of successfully maintaining a minimum flow of 15 cubic feet per second (cfs) in the Lostine River, The Freshwater Trust negotiated a new three-year agreement with more than 70 local agricultural producers. This new agreement is to restore flow up to 25 cfs and reinvest restoration dollars into projects that increase irrigation efficiency and benefit fish and farms. A steering committee of local stakeholders will review project proposals, such as upgrading outdated diversion structures, lining leaky ditches, and improving sprinkler systems. Initial technical analysis is also underway on a proposal to consolidate and pipe two irrigation ditches that lose significant flows to seepage. The Freshwater Trust will work closely with project partners to estimate water savings and assess financial feasibility for this potentially transformative infrastructure upgrade.

Innovative irrigation alert program marks third year

This summer marked the third year of the innovative Fifteenmile Action to Stabilize Temperature (FAST) in north central Oregon. This program is a collaborative effort of The Freshwater Trust, the local watershed council and other conservation groups. When hot weather and low flow combine to create stream temperatures lethal to steelhead, an alert is sent by phone to all irrigators encouraging them to voluntarily reduce their stream diversions. In exchange, irrigators who sign up in advance receive



↑ From Top: Trevor Griffiths, habitat restoration project manager, evaluating riparian conditions on California's Russian River.

Kimberlee Myers, operations director and science & restoration team manager, with a solar pathfinder. The pathfinder is used for shade analysis.

Flow restoration funding provided by the Columbia Basin Water Transactions Program of National Fish & Wildlife Foundation and Bonneville Power Administration.

↓ Our field staff measure a spawned out steelhead carcass on Rudio Creek. Using our StreamBank® Monitoring App, staff are able to upload all the data remotely.





↑ The Freshwater Trust helped coordinate the delivery of locally sourced trees from private and public timberlands to the Salmon River. This "large wood," as it is often called in the restoration world, will be strategically placed in the river to improve critical spawning and rearing habitat for native fish. The large wood is carried to the project site by the Chinook helicopter.

compensation for their participation, in addition to reducing their liability under the Endangered Species Act in the event of a fish kill. Over the course of the last several months, the local FAST Coordinator has been in the field daily, working closely with farmers to document their diversion reductions and quantify instream response. At the time of this publication's printing, one alert lasting 14 days had been issued in 2015.

Quantifying flow restoration in Oregon's John Day Basin

In the John Day River basin, extensive monitoring is underway to quantify the impacts of a new flow restoration transaction in the Rock Creek watershed of central Oregon. Most of this watershed is controlled by a single landowner who manages the land both for agricultural production and conservation values. Water rights for more than 1,000 acres of irrigated land are being dedicated to instream use, improving streamflow conditions in more than 17 miles of high quality habitat for steelhead and Chinook. Ten measuring stations capture flow and temperature data every 15 minutes. The Freshwater Trust will also study the watershed's aquatic macroinvertebrates. Due to their short lifespans and limited mobility, these aquatic insects, crayfish, snails, clams and worms can provide valuable information about stream health more quickly than anadromous fish.

Leases in Upper Catherine Creek allow for better management and higher instream flows

In Upper Catherine Creek of northeastern Oregon, instream leases with 10 landowners guarantee legal

protection of streamflow in this critical wild salmon habitat. Upgrades to the irrigation diversion and delivery system for a lease high in the watershed are slated to be completed this summer, allowing better water management and higher instream flows in the hot season. Several miles downstream, near the city of Union, another landowner is experimenting with alternative crop types to increase fall grazing potential. A split-season instream lease allows irrigation from the creek for alfalfa production during the early summer when flows are higher, followed by establishment of a drought-tolerant forage crop in early July before irrigation shutoff. For the remainder of the summer, flows that would otherwise have been diverted for irrigation remained instream for the benefit of native fish.

Unique monitoring plan informs management and design at Rudio Creek Ranch in central Oregon

The Rudio Creek Ranch restoration project's primary goal is to restore two miles of habitat for federally-listed summer steelhead and spring Chinook. In collaboration with NOAA Restoration Center and other partners, The Freshwater Trust developed a monitoring plan that measures progress toward achieving specific project objectives and identifies maintenance needs. This plan has been highlighted as an example of how robust monitoring efforts can drive management decisions and inform future restoration design. In 2014, monitoring results helped inform maintenance decisions to continue riparian planting, weed treatment and modification of off-channel juvenile rearing habitat.

Restoration efforts continue on Salmon River and Still Creek

As part of the Sandy River Basin Partners, The Freshwater Trust continues its ongoing work to restore Salmon River and Still Creek, two high-priority sub-watersheds of the Sandy River basin. In collaboration with the U.S. Forest Service and the Bureau of Land Management, The Freshwater Trust will reactivate flow to six historic side channels, place approximately 46 large wood habitat structures and two large boulders, restore two alcoves, restore one secondary channel, and place additional large wood in side channels and on stream margins. These efforts are designed to restore juvenile rearing and adult holding and spawning habitat for federally listed coho, spring Chinook and winter steelhead.

South Fork Little Butte Creek project to help meet mitigation requirements

In southern Oregon, project work is underway on South Fork Little Butte Creek to restore juvenile winter rearing habitat for federally listed coho salmon. Large wood habitat structures will be placed at two project sites. These efforts will work to meet the Bureau of Reclamation's mitigation requirements set forth under the National Marine Fisheries Service 2012 "biological opinion." Biological opinions document NOAA Fisheries' assessment of how the actions of federal agencies affect species listed under the Endangered Species Act and their critical habitat.

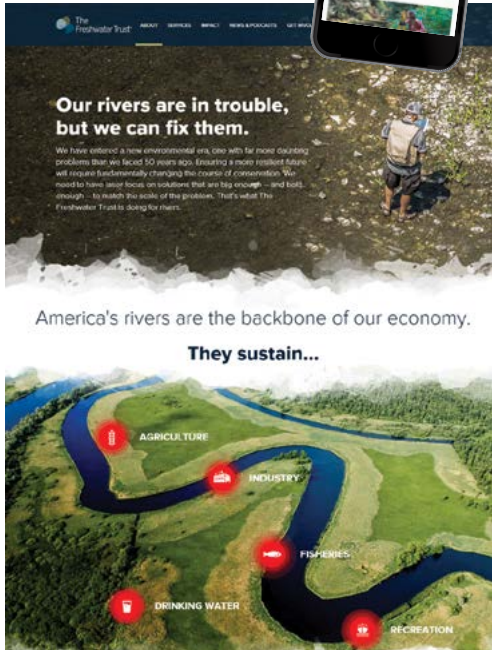
Three new features added to monitoring application

The Freshwater Trust has added three new features to our StreamBank® Monitoring application, allowing for the monitoring of salmon redds, streamside vegetation and streamside function. A redd is a spawning bed built by salmon and steelhead, most often in stream gravel. Redd counts allow staff and partners to monitor a waterway's fish use and distribution of redds over time. The second new feature of the application allows for the monitoring of revegetation progress on a project. A third feature allows for the assessment of streamside forest quality and identification of potential restoration sites.

Brand new website launched in September

The Freshwater Trust received an online makeover by launching a new website in September. After several months of deep digs into organizational storytelling, the site went live with new architecture, design and content. According to staff working on the project, while the science behind fixing rivers can be technical, The Freshwater Trust's work is compelling and deserves to be told to everyone in creative, understandable ways. 🌱

New web and mobile site design



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An All New Look

The Freshwater Trust's website received a full makeover this year. New stories, photos and news are now live. Check it out at www.thefreshwatertrust.org.

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