SCIENCECHRONICLES

Tracking mountain lions in the Charles M. Russell National Wildlife Refuge, Montana. Credit: Carmen Luna/USFWS

Working

Editor's Note

"Work is about a search for daily meaning as well as daily bread, for recognition as well as cash, for astonishment rather than torpor; in short, for a sort of life rather than a Monday through Friday sort of dying." — Studs Terkel.

The current debate over conservation is sometimes presented as a debate over its very soul. The merits of the various sides, and there are many more than two, will not be further explored here. But there is one area of agreement so fundamental that hardly anyone on either side ever mentions it, because it seems almost banal: conservation is a uniquely human endeavor, to be grandiose, but for many of us it is also both far simpler and far more powerful. It is a chosen career, a passion, a life's ambition, and a daily slog of the most mundane sort. We bear the costs of that labor (construing costs in narrow terms) and reap its rewards in the same way as any of the laborers whose stories the writer Studs Terkel captured in his oral history, *Working*. It is in that spirit that this issue of Science Chronicles focuses even more explicitly than usual on some of the people carrying out conservation, at its highest levels and as close to the ground as can be imagined.

The articles in this issue offer, I hope, a range of insights into how conservation works, including some from people who would never consider themselves conservationists. Consider, for example, the village headman in Jeff Opperman's article about dams on the Mekong River. His daily concerns do not explicitly include conservation, yet he will unquestionably reap the benefits and suffer the consequences of either its failure or its success. The scene in the headman's home, an encounter between two markedly different visions of conservation, is drama of the highest sort.

Matt Miller offers an example of a far different though perhaps more familiar drama, the drama that conservationists in the field see and feel every day. The unnerving contrast between routine problem-solving and often profound physical challenges and the highest stakes — the fate, perhaps, of an entire species — is rarely a part of public debates but it is the daily reality of conservation science.

The confrontation of the mundane and the exalted, so common in conservation careers and unusual elsewhere, is clear and compelling in Sally Palmer's moving appreciation of Dr. Elise Quarterman, a pioneer in both science and conservation. It is clear as well in the two profiles on offer here, of Walt Reid and TNC's Brian Richter. All these practitioners represent a spectrum of experience and perspective that I trust will be recognizable and hence useful in carrying out the work of conservation. As ever, your perspectives are most welcome as well. **SC**

Jonathan Adams (pangolin19@gmail.com) is a science writer and editor based in Maryland. Visit PangolinWords.com or follow him on Twitter.

The Mission(s) of *Science Chronicles*:

1. To bring you the latest and best thinking and debates in conservation and conservation science;
2. To keep you up to date on Conservancy science — announcements, publications, issues, arguments;
3. To have a bit of fun doing #1 and #2.

Director of Science Communications: Bob Lalasz

Editor & Submissions: Jonathan Adams

For Back Issues Visit the Conservation Gateway

To Manage Your Subscription Status Contact Nancy Kelley

Article

Shoot Out the Lights: The Science of Sustainable Hydropower and the Tragedy of the Wrong Dam

By Jeff Opperman, director of sustainable hydropower strategy, The Nature Conservancy

Mekong River, near Luang Prabang, Laos. Credit: Flickr user Jean-Marie Hullot via Creative Commons.

The old man apparently hadn't read my script.

It was our first night on the Mekong River and my family and I were spending the night in a remote village a few hundred kilometers upstream of Luang Prabang — the second biggest city in Laos, but really just a town with a population smaller than many suburbs in the U.S.

We had just finished dinner at the house of the village headman, our host for the night. The plates were pushed to the center of the table and the old man leaned back against the railing of the front porch where we sat. I'd finally gotten my nerve up to ask his thoughts on a massive hydropower dam that was planned to be built near his village; speech, especially speech about big controversial government decisions, is hardly free and easy in Laos.

But I was here to find out what people really thought about that dam, and dozens of others planned for the Mekong and its major tributaries. I figured I'd better get good at asking awkward questions.

I expected the headman to focus on the dam's impacts because it won't provide electricity to his village (the power will be sold to Thailand), but it will block the migration of the big fish that are an important source of food. To me, this one tiny village seemed the perfect illustration of a clash of national development goals versus local livelihoods, a human face to the statistics that quantify both the Mekong's bounty — it supports the largest freshwater fish harvest in the world, by far, providing the primary source of protein to tens of millions of people — and the threats to that bounty: nearly half of the river's fish harvest could be lost if the proposed dams are built.

But when I asked about the dam, the headman's response muddied the simple plot. "We need development," he said and then he made a circling gesture with his right hand, pointing out toward the absolute darkness that engulfed the village, "Roads, dams, schools, hospitals, we need all of it." The darkness that to me was a welcome respite from my well-lit world, an awesome tapestry of stars that we now so rarely see, to him that darkness was a reminder that the generator only provided two hours of electricity each night.

To the headman, dams didn't represent some epic contest of competing visions of sustainable development. Rather, he seemed to see dams as an indicator of the material progress that his country desperately needed because, to him, clearly the status quo wasn't cutting it.

To the headman, dams didn't represent some epic contest of competing visions of sustainable development. Rather, he seemed to see dams as an indicator of the material progress that his country desperately needed.

The rest of the trip I heard a lot of different perspectives and stories, but one thing was clear: dams defy simple answers and conclusions. Though the urge to fight dams resides deep in the DNA of environmental groups, this complexity has The Nature Conservancy seeking a broader vocabulary than just saying "no" to dams. Besides, the debate about whether dams should be built is a bit academic — lots of dams will get built, and there's a clear role for organizations that can find solutions for better outcomes.

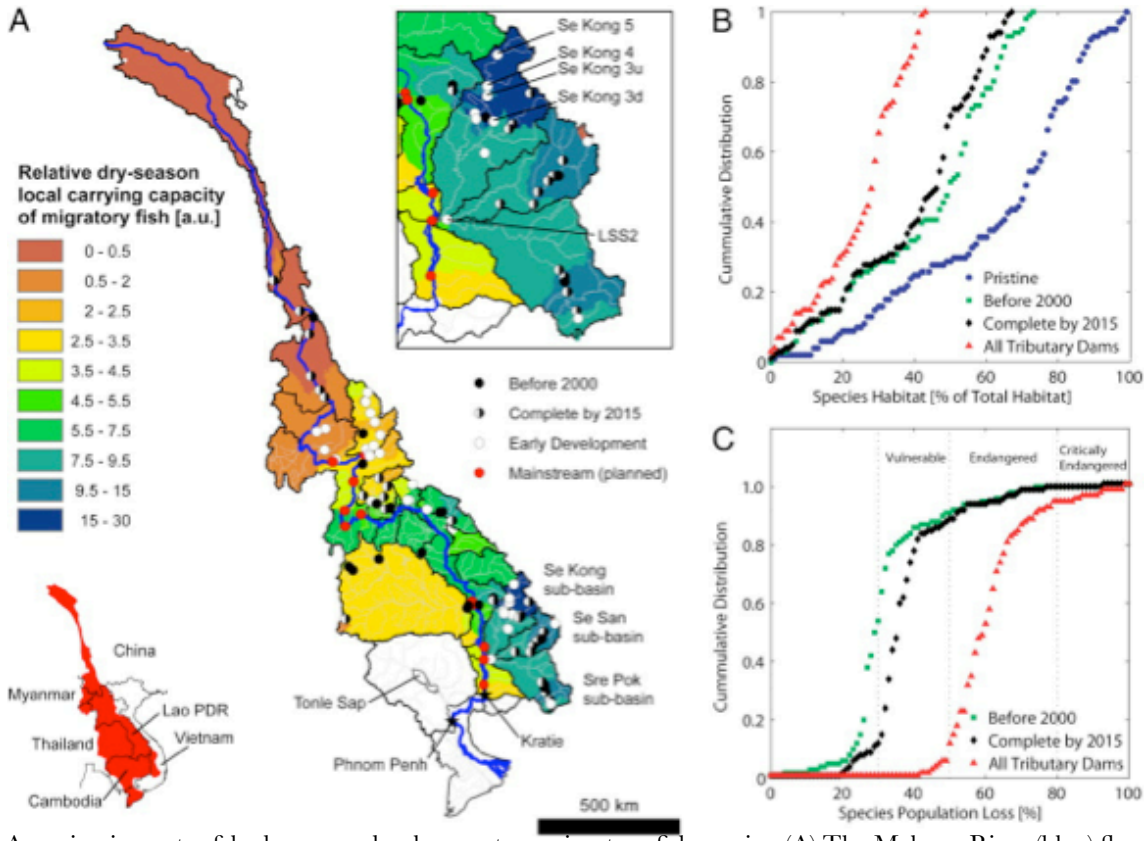
Science provides many of the nouns and adjectives for that broader vocabulary. For example, various analyses can help identify the spatial arrangements of dams that can accomplish an energy objective with the lowest impacts on other values. Working in several river basins in Latin America and Africa, Conservancy scientists are integrating a set of spatial tools to allow planners, developers and regulators the ability to quantitatively compare alternative hydropower development scenarios across economic, social and environmental outcomes.

The Mekong provides one of the clearest examples of how these analyses can identify promising solutions. Guy Ziv and colleagues (2012) studied 26 dams proposed for the Mekong's tributaries and modeled every possible alternative for building those dams. For each scenario they quantified the amount of energy produced and, using a fish population and migration model, they estimated the impact on biomass and species

viability of migratory fish species (the most important food species in the Mekong are migratory). The researchers found that building all 26 dams would reduce the biomass of migratory fish in the whole Mekong basin by nearly 20%. However, by foregoing a few dams, fish losses could be minimized to just 4%, while still producing 75% of the total available energy from tributary dams (note that mainstem dams are not part of this analysis, but even with mainstem dams, this type of analysis sheds some light on more balanced alternatives).

But the Mekong also reveals the limits of science to turn that broader vocabulary into action: verbs, in the form of government or corporate decisions, ultimately decide how hydropower is developed.

The vocabulary offered by science — by illuminating Lower Sesan 2's off-the-charts impacts relative to other options and highlighting alternative scenarios that achieve most of the energy target — gives greater richness to that opposition and, by speaking the language of alternatives, leavens it with pragmatism.



Assessing impacts of hydropower development on migratory fish species. (A) The Mekong River (blue) flows from China, through Myanmar, Lao PDR, Thailand, Cambodia, and Vietnam (bottom left map). The relative dry-season migratory fish habitat capacity (stationary solution of Eq. 1) highlights the importance of the Se Kong, Sre Pok, and Se San subbasins for maintaining the migratory fish population (Inset shows expanded view and the location of five key planned dams). Kratie (star) in Cambodia is the border between the wet-season floodplains and the upstream habitats. (B) The BCC of each migratory fish species for different basin development scenarios described in the text. (C) Predicted population decline of each species based on lost habitat in each scenario, relative to an estimated historical population size in a pristine river. From Ziv et al. PNAS 2012;109:5609-5614.

Last year, the Cambodian government approved the single most impactful dam out of the 26 Ziv studied, Lower Sesan 2, at a site on the Sesan River just downstream from the confluence of two of the Mekong's most important tributaries, thus cutting both of them off to migratory fish. This single dam by itself would reduce basinwide migratory fish biomass by nearly 10%, which is half the losses that would be caused by building all 26 tributary dams — for a relatively small amount of energy. The next most impactful dam has about 1/10 of Lower Sesan 2's impact. Unlike the dam I discussed with the headman, which will be thousands of kilometers upstream from the Mekong's floodplains, which are the engines of the system's productivity, Lower Sesan 2 is a wrench thrown directly into that engine.

Because it's impacts are so high relative to its energy benefits, Lower Sesan 2 is clearly one of those dams for which the word "no" is still relevant, but here the broader vocabulary offered by science — by illuminating Lower Sesan 2's off-the-charts impacts relative to other options and highlighting alternative scenarios that achieve most of the energy target — gives greater richness to that opposition and, by speaking the language of alternatives, leavens it with pragmatism.

However, as of yet, government officials aren't listening, and so currently this story offers a harsh lesson: science can illuminate more promising options, but decision makers can shoot out the lights. **SC**

References

Ziv G., E. Baran, S. Nam, I. Rodríguez-Iturbe, and S.A. Levin. 2012. Trading-off fish biodiversity, food security, and hydropower in the Mekong River Basin. Proc Natl Acad Sci USA 109:5609–5614.

Article
Every Cat Counts

By Matt Miller, senior science writer, The Nature Conservancy

A sign alerts motorists at Laguna Atascosa National Wildlife Refuge. Credit: Matt Miller/TNC.

In South Texas, every ocelot counts. Losing even one can have grave repercussions for the species' future.

The small, spotted cat – twice the size of your standard house cat – faces a precarious existence as it navigates ever-dwindling habitat, roads, and a border fence.

The ocelot population here is, at best, in the dozens. Can they really survive?

That's what I'm here to find out, spending time with U.S. Fish and Wildlife Service biologists working on public land and Nature Conservancy scientists working on private land. Together, their research and conservation efforts offer the best hope for the elusive cat along the border.

"A Fight with a Box of Thumb Tacks"

Hilary Swarts bursts from her office, a big smile on her face and radiating energy. She runs the ocelot research program for the U.S. Fish and Wildlife Service at Laguna Atascosa National Wildlife Refuge, a South Texas refuge that is a stronghold for the cats.

Today, she's going to show me prime ocelot habitat and the refuge's extensive research and monitoring program. "I just love to think about these cats," she says. "Some days I can't believe this is my job."

She looks too young for her resume — she's studied monkeys in Belize and Suriname, gorillas in Rwanda, island foxes on the Channel Islands. But this is perhaps a more vexing challenge.

In fact, despite her happy demeanor, I later learn she has been managing a bit of a crisis.

The radio collar of one of the refuge's ocelots has been emitting a "mortality signal" — a steady beep that means the collar is not moving. And it hasn't been moving for 8 hours.

It could mean the ocelot has merely lost the collar. Or it could mean it is dead.

She apologizes that she'll have to be checking her cell phone throughout the day to see if this ocelot has been killed, as assistants track down the collar in the brush by homing in on the signal. It is a young female, one of a pair of one-year-old ocelots confirmed on the refuge this year, the first evidence of successful breeding in several years.

It takes a lot of effort to find a human value for thornscrub. You can't live there, you can't farm there, you can't drill in it. But for ocelots? Ocelots love the thick stuff.

Every ocelot counts. If this one is dead, it would be a huge blow.

But in some ways, Swarts is used to dealing with bad news. The ocelot, after all, is clinging to a precarious existence here.

Ocelots are more commonly associated with tropical forest environments like the Amazon. But they once ranged as far north as Arkansas.

In the northern part of their range, ocelots thrive in thornscrub, the thick, dense forest cover that once dominated much of South Texas. The problem is, not much of that habitat is left.

Brush is pretty much incompatible with human use. Even conservationists acknowledge that it takes a lot of effort to find a human value for it. You can't live there, you can't farm there, you can't drill in it.

But for ocelots? Ocelots love the thick stuff.

"It's ugly getting through that stuff when we have to retrieve a radio collar or a camera trap," says Swarts. "Walking through that is like getting in a fight with a box of thumb tacks."

While the U.S. Fish & Wildlife Service, the Conservancy and other groups are actively restoring the habitat, it can take years for the brush to be fully established. Throughout much of the area, there are fragments of habitat often far apart from each other.

When ocelots move, they enter the fast-changing human realm of South Texas — a world of roads and speeding cars and tall fences.

"If land is undisturbed, ocelots will use it," says Robert Jess, Senior Refuge Manager of the South Texas Refuge Complex. "The problem is, a lot of that undisturbed land is disconnected. To get from one place to another, ocelots have to cross roads. And vehicle traffic is just plain horrible on cats."

Swarts remains hopeful. The Texas Department of Transportation, she says, is playing a cooperative role in examining how roads can be more wildlife friendly. They're currently implementing plans for wildlife crossings on a road improvement project adjacent to the refuge and removing sections of concrete barriers on the busy highway south of the refuge where a male ocelot was killed in November.

Still, ocelots face other challenges. One of the new ones is the Border Fence, the 30-foot-high division between the United States and Mexico. While the debate over whether the recently-completed fence is performing its intended purpose can get heated, most conservationists agree that it is effective at stopping wildlife movements and clearly has the potential to cut off pathways used by wide-roaming animals like ocelots.

While the debate over whether the border fence is performing its intended purpose can get heated, conservationists agree that it is effective at stopping wildlife movements and clearly has the potential to cut off pathways used by wide-roaming animals like ocelots.

"All refuges have issues to deal with," says Jess, who has worked on refuges across the country, from Florida to Alaska. "But the level of complexity here is just off the charts."

Monitoring an Elusive Cat

Swarts is leading a continuing, extensive effort to collect that data on ocelots and use that help direct land acquisition, habitat restoration, and other conservation efforts. But how to gain information on an elusive animal that spends much of its time in thick, thorny vegetation?

We first pull up to a live trap baited with a live pigeon (the ocelot's preferred prey are birds and wood rats). The pigeon is kept in a separate compartment and isn't harmed; in fact, Swarts is fond of these birds, kept in a spacious pen until taking their turns at decoys.

Any captured animals are radio collared and/or monitored with a GPS tracking device. This provides researchers with crucial data on their habitat use and movements.

Currently, there are four collared ocelots. Today, Swarts is hoping one of those animals isn't dead.

The ocelot program interns were currently tracking the female ocelot's collar to see its fate. Losing one now would mean the loss of a future breeding animal, important to the species. It would be the loss of data for the research effort.

And it would be the loss of an animal that ignited hope among conservationists and the public at large.

After our tour, Swarts excuses herself. She has to go see for herself. See if today would bring more bad news.

Hours later, I receive a text: "The intern's retrieved the little girl's collar. Just the collar. So all is well in Ocelot Land."

The ocelot had merely lost the collar on that thicky, thorny brush.

All is well. For now. But what does the future hold? **SC**

Profile
Walt Reid

By Marty Downs, associate director of science communications, The Nature Conservancy

Conservation science has changed a lot in the past two decades. Walt Reid, director of the Conservation and Science Program for the Packard Foundation, weighs in here with his thoughts on where we've been, where we are going, and what new science we need to get there. Reid also directed the Millennium Ecosystem Assessment (MA), an initiative designed to improve the management of the world's natural and managed ecosystems by helping to meet the needs of decision-makers and the public for peer-reviewed, policy-relevant scientific information. From 2001-2005, more than 1,360 experts worldwide worked on the MA and the report set a high bar for the growing role of social and decision science in modern conservation science.

Biggest problem facing conservation:

Walt Reid: Over longer time scales, the biggest problem is certainly climate change (and ocean acidification). But at shorter time scales, there are immediate threats that are much more pressing than climate change and where conservation science can play a very significant role. These threats include habitat loss, agricultural expansion, loss of marine habitat, and the overexploitation of fisheries.

Why demand-side approaches have a lot of potential:

We used to think almost entirely in terms of policy reform, government regulation… the supply side of conservation. But there are so many things happening now with demand side approaches. In so many parts of the world, actions taken by the private sector are having a greater conservation impact than actions taken by governments.

For example, several years ago companies in the Consumer Goods Forum, made up of most of the world's largest consumer products companies including Unilever, Wal-Mart, Kellogg's and General Mills, committed to removing deforestation from their supply chains by 2020. And we are seeing that translate now into actions on the ground in countries like Indonesia as companies demand traceable supply chains even for commodity products like palm oil and then require that the commodities are produced sustainably.

To make this work, there has to be self-interest from the private sector — whether that's about reputation (they don't want to see a Greenpeace banner down the side of their headquarters building) or they think they can reduce costs, ensure a more sustainable supply, or limit liability.

Of course, you end up with some big gaps where there are companies that can't be easily influenced by consumer demand or where there isn't a short- or medium- term economic rationale — the fossil fuel sector being an obvious example. But where there is self-interest, there is a lot of potential for movement.

"In the 1990s, we would never have imagined that we would see the abrupt turnaround on deforestation in Brazil that took place beginning in 2004."

Most overlooked issue:

Food production. We urgently need to figure out how to produce much more food with much less environmental impact. The projected growth in food demand, combined with growing bioenergy demand, will place extraordinary pressure on the environment. We're not producing food in a way that is sustainable. Unless we get agriculture right, then we aren't going to win on conservation.

Biggest fear:

Climate change keeps me up at night. I recently read a paper by Hal Harvey and Lynn Orr (A Trillion Tons, published in Daedalus in 2013) where they imagine what would happen if a hypothetical zero carbon energy source costing half the price of coal achieved mass global penetration within 20 years.

They find that even with that apparent "silver bullet" technology, emissions in 2050 would only be about 10% less than "'business as usual" — showing how unlikely it is that we'll be able to stay under 450 ppm carbon dioxide (the limit beyond which global average temperature increases are likely to exceed 2 degrees Celsius).

Most useful new science for conservation:

Over the last four decades, the basic science on the distribution and status of species and habitats was instrumental in motivating and guiding conservation action. There still is a need for better biological and natural science information. For example, there is an

urgent need to protect forests on peat soils in Indonesia from deforestation since these habitats can become a source of major greenhouse gas emissions, but we still don't have high resolution maps of those habitats.

But an even more pressing need now is for better information on how to actually make conservation work at scale and as part of broader development strategies. Some of the most interesting new work is the science that allows us to better understand human behavior and how to modify it. And much of that work is in a more applied form. Who are the best experts on influencing behaviors of a targeted audience? Advertisers. Political campaign strategists. We have a lot we can learn from them.

If you look back, conservation has evolved from a focus on the site to a focus on the system. When we focused on individual species or sites, we tended to rely mostly on natural science information. But for conservation to work, the whole system of resource management, laws, policies, rights, incentives and behaviors is involved and understanding that is inherently multi-disciplinary. It was hard enough just integrating economics and conservation biology, and it will be even harder to work in a more multidisciplinary setting.

Bright spots:

Two of the brightest spots of the last decade are the dramatic reduction in deforestation rates in the Brazilian Amazon and improved fisheries management in the OECD countries. In the 1990s, we would never have imagined that we would see the abrupt turnaround on deforestation in Brazil that took place beginning in 2004.

"In so many parts of the world, actions taken by the private sector are having a greater conservation impact than actions taken by governments."

There were many factors involved — public awareness in Brazil, a political change, international attention, consumer boycotts. But the conservation community played a critical role in documenting the problem, explaining the impacts, pressing the government for action, and helping to prioritize and protect many of the most important areas.

In OECD countries, there have been significant improvements in fisheries management in the past 15 years. Overharvesting of fisheries in the United States used to be the norm, but today overfishing has ended for almost all federally managed fisheries. Europe has now passed a law that should end overfishing.

Subsidies that promoted overcapacity have been reduced in many countries and rights-based management frameworks have been put in place that align economic incentives with sustainable fisheries management goals. Outside of the OECD countries, another success involved the spread (or re-establishment) of community-based management systems for coastal fisheries in many developing countries.

I'm also excited by the cases where it has been possible to create markets for previously un-marketed ecosystem services. In many places in Latin America, for instance, it has been possible to create markets for watershed protection, where downstream users will pay to protect upstream watersheds and secure their water supply. The carbon market provides an even larger-scale opportunity for ecosystem service conservation. Combined ecological, social, political and economic analysis can be really helpful in these situations.

Underutilized information:

I think about situations where we have information telling us that a conservation gain would also make sense economically over the long term, but where there are short-term costs and winners and losers that make the transition too difficult.

Reforming fisheries is one of those situations. We know that we can bring fisheries back from the brink and generate higher economic returns if we greatly reduce harvests for a period — but a lot of people are going to lose their livelihoods during that transition, creating a major political obstacle.

"Who are the best experts on influencing behaviors of a targeted audience? Advertisers. Political campaign strategists. We have a lot we can learn from them."

There are other situations — such as investing in ecotourism or wetland protection — where our research tells us that an investment now will yield significant social and economic returns in the long run. But having that information isn't sufficient to overcome the barriers. We don't know how to finance the transition.

Lessons from the Millennium Ecosystem Assessment:

One of the biggest lessons from the MA was the importance of trade-offs in how we manage natural and modified systems. Conservation has moved from a focus on species, to sites, to systems. When you're looking at a problem from a species perspective, you can say extinction is just unacceptable. But when viewing a problem from a system perspective, there really aren't any easy stopping rules or decision points. At a site level, you can still draw some hard lines. But at a system level, there's really nothing but complicated decisions and tradeoffs. SC

Author Interview
Brian Richter

By Bob Lalasz, director of science communications, The Nature Conservancy

Colorado River. Credit: Flickr user Wolfgang Staudt via Creative Commons.

Water shortages aren't just for California. They might be coming to your town — unless you push your leaders to get smart about managing water.

That's the message of Brian Richter's new book Chasing Water: A Guide for Moving from Scarcity to Stability (Island Press), Richter's guide to the causes of and solutions for water scarcity. Increasing demand for water and climate change, he says, are going to put mounting stress on water basins and water supplies — especially for cities — over the next two decades.

The answers, says Richter, chief scientist for water markets at The Nature Conservancy, lie in shifting water management decisions from technocrats to a stakeholder-driven process — even in places like Syria and China. He discussed his vision — and the nightmare scenarios we face if we don't take steps to manage our water better now — with Bob Lalasz:

Q: Why don't people understand how big the water problem is globally? What will it take?

BRIAN RICHTER: The problem is that water shortages are quite local in nature, so it's tough to grasp their potential impacts at a national or global scale. And like climate change, water scarcity is a slowly mounting crisis, building out of a gradual rise in water use — so our alarm bells don't go off until we finally run out of water, and the damage scarcity does to freshwater species and ecosystems (much of which takes place underwater) becomes apparent too late.

But people are starting to understand that water shortages can severely disrupt local and even regional economies. When Texas lost $12 billion statewide in 2011 due to drought and water shortages, its legislature quickly responded with funding for water projects. Similarly, China is now losing nearly $40 billion every year due to water shortages, and China's State Council is starting to take that seriously. Managing water from a crisis mode, though, seldom produces the most sustainable outcomes.

Q: Most places aren't yet experiencing water stress, but you say in Chasing Water that many are heading toward the verge — and many already at the verge support large urban populations. If we don't change the way we manage water, what might scarcity look like in these places over the next decade or two?

RICHTER: Let me paint an ugly but illustrative picture for you with the example of the Colorado River in the western United States.

If dry years persist in that region, or if water demands for cities and farms continue to grow, the water storage reservoirs and the river itself will continue to wither.

Then: When water levels in Lake Mead or Lake Powell drop to a certain point, we will no longer able to generate electricity from those dams. The water shortage will cause a massive electricity shortage.

People are starting to understand that water shortages can severely disrupt local and even regional economies.

Some of the biggest electricity users in that region are urban water delivery systems — the Central Arizona Project canal delivering water to Phoenix and Tucson, the California State Water Project delivering water to Los Angeles and San Diego — as well as huge groundwater pumps that irrigate farms. Water and electricity shortages in those states are beginning to force decisions of whether to keep the lights on, keep the grocery store stocked, or keep water flowing from our taps. Those decisions could easily become more common.

Q: So what's the first step?

RICHTER: For the Colorado River basin or any other water source that is being over-depleted, the highest priority is to substantially and permanently reduce current levels of consumptive water use.

As I explain in *Chasing Water*, managing water and managing money well are similar: you can increase your deposits or you can decrease expenditures. But because it can be very difficult or expensive to access more supplies of both money and water, reducing spending makes great sense.

Q: But wait. Aren't the pressures to override even the best water budgets and allocation plans almost irresistible?

RICHTER: The widespread over-drafting of groundwater aquifers or lakes (which lowers their water levels over time) and drying of rivers should be taken as evidence that

our governments are not managing our water accounts in a responsible and sustainable manner.

Local citizens and water users need to be made aware of these water problems, and we need to find ways to empower them with greater access and ability to participate in water planning and decision-making.

In the book I highlight places like Texas, where the water planning dialogue has been opened to local stakeholders. Their 50-year state water plan now calls for one-quarter of their water budget to be met with water conservation, and their legislature just authorized a sizable investment for that purpose.

But I do fear that their water demands are growing too fast to keep under control with water conservation alone, and they may not gain access to additional water supplies quickly enough, threatening to throw their water budgets dangerously out of balance.

Conserving water at larger scales could have great impact on blunting the risk of water scarcity. And urban and agriculture water needs can be reduced substantially without impacting our quality of life.

Q: Yet you are fierce that "smart" water conservation is the best way for a community to balance its water budget – better than solutions such as desalination, water storage, or even watershed management. Why is that?

RICHTER: Because water conservation — both in cities and on farms — is by far the most cost-effective way to balance a water budget. Reducing demand is usually 3-10x less expensive than water-supply options such as building reservoirs or importing water from distant places. Conserving water also avoids the ecological and social impacts usually associated with efforts to increase supply.

Conserving water at larger scales could have great impact on blunting the risk of water scarcity. And urban and agriculture water needs can be reduced substantially without impacting our quality of life.

Australian cities use half the water cities of the same size in the American West do, for instance. Many farmers — here in the United States, in Australia, and in many other countries such as Israel — have found highly cost-effective ways to reduce water consumption by 20% or more. The Aussies have also shown how state and federal subsidies for improving irrigation efficiencies can be used to get water consumption down to a sustainable level.

Q: But you also list in Chasing Water *a number of reasons why the deck is stacked against water conservation — including that it's easier to build pipelines than to change individual behaviors, and that conservation sends a message of scarcity that many communities don't want to advertise.*

In addition, agriculture —not urban consumption — accounts for up to 90% of water consumption in most basins. So why are you optimistic communities — especially urban communities — will even bother?

RICHTER: I'll suggest three reasons: (1) water shortages are spreading and intensifying in many regions of the world, making people more aware of the need to use less; (2) as governments become more comfortable with inviting stakeholders to participate in water planning, those stakeholders will see that conservation is the best deal available and hold their governments accountable for "doing the right thing"; and (3) as water becomes more expensive, people will use less.

As for urbanites, it's really important that everyone participate in water-conserving activities because we all need to do our share to resolve water problems and protect freshwater ecosystems. But they can also be advocates for urban-ag partnerships to save water. In my book and in many other writings, I make the case that because irrigated agriculture uses such an enormous volume of water, a little bit of improved irrigation efficiency can add up to a very large amount of water savings.

That's why city dwellers should encourage their water managers to form partnerships or water-saving agreements with farmers that share the same water source. Consumers can also help reduce the volume of water being used in agriculture by choosing foods that require less water to produce, or by wasting less food.

When people run out of water, they revolt. Syria is a case in point. A drought in that country — combined with the government's inability to manage water well — helped ignite the social unrest that threatens to overthrow the government.

Q: Your vision of the way water management decisions should be made is highly democratic — in large part, you say, because past technocratic schemes failed to include local stakeholders. But how can water planning be democratic in places like China or Yemen that have little or no tradition of democratic institutions or dynamics? And won't such schemes be outdone by the endemic corruption in a lot of these countries?

RICHTER: When people run out of water, they revolt. Syria is a case in point. A drought in that country — combined with the government's inability to manage water well — helped ignite the social unrest that threatens to overthrow the government. Water revolts may not lead to democratic reform or lessened corruption, but the people will demand that water is better managed in the future.

I'm putting my bets on local community leaders and activists everywhere to become the change agents demanding sustainability. But we have to ensure that they are well-informed about the basic fundamentals of water management.

Q: You close the book by looking at the water plan of the Murray-Darling River Basin in Australia, which endured a horrific 12-year-long drought that ended in 2009. What are they doing right in the Murray-Darling?

RICHTER: The Aussies have put into place some really important water reforms. First, they recognized two decades ago that over-allocation of water was placing both their economies and their freshwater ecosystems at risk. They decided to institute a limit or "cap" on the total volume of consumptive water use in the basin. That cap was lower than the existing levels of use, so they needed to figure out some way to reduce their use, permanently.

Since 2002, the Australian Commonwealth (federal) government has allocated nearly US $14 billion dollars to reduce the volume of water being used on farms, where more than 90% of the water is used. More than two-thirds of this money has been directed into a Sustainable

Rural Water Use and Infrastructure Program that helps farmers to install more efficient irrigation technologies like drip irrigation, or reduce water losses through infrastructure improvements such as concrete lining of earthen ditches. This program has been extremely well received, and farmers have lined up to take the government's help in saving water on their farms.

The remainder of this federal funding support was directed at buying water rights from willing sellers. Some farmers sold their water and got out of farming altogether. But many others switched to growing crops that used less water, thereby freeing up some water for sale.

Now that they are getting close to reducing water use to the cap levels, water trading is proving to be extremely beneficial. Australia has a very well-designed water market that enables those that need more water to access it from those willing to give some up, on a permanent or temporary basis. Both parties win: some get water, others get a new source of revenue.

Q: Chasing Water *presents a comprehensive vision of where you think we need to go with water management. It also feels like a manifesto, a summing up for you. What do you want it to accomplish, and with whom?*

RICHTER: 25 years of traipsing around the world witnessing bad water management and its horrific consequences could have caused me to throw up my hands in despair. But I have enjoyed the privilege of a good education, the insights gained from observation, and from the mentorship of really smart and visionary individuals. They have instilled in me a lifelong mantra: when you observe something wrong in the world, it is your moral duty to do something about it.

Only a very small fraction of the global population understands how the water cycle works, where their water comes from, or what we can do to prevent water shortages. Yet I have not been able to find educational material about water that is written at a simple, foundational level. Too often, water experts assume too much about their audiences. If this book proves to be useful, I'm going to do everything I can to help spread it around — getting it translated into multiple languages, and subsidizing its purchase by those that cannot afford to buy it. **SC**

In Memoriam
Dr. Elise Quarterman, 1911-2014

By Sally Palmer, director of science, Tennessee Chapter, The Nature Conservancy

Credit: Dr. Kim Cleary Sadler

I recently attended the celebration of life service for Dr. Elsie Quarterman, who died at the age of 103 on June 9, 2014. Like many of the parties hosted at the home she shared with loving niece and nephew Ann and Patrick Quarterman, this service was full of friends, food, and photographs — including this picture taken with me in November 2008 at her 98th birthday party. The only difference this time was our sadness at the physical absence of the guest of honor.

Dr. Quarterman was one of the greatest plant community ecologists in the Southeastern United States of her time, and the quintessential, original Nature Conservancy scientist. During her funeral service, Mack Prichard — a friend and retired Tennessee State Naturalist — walked up to the lectern with a copy of "Potential ecological/geological natural landmarks on the Interior Low Plateaus." This five-inch thick book, compiled by Dr. Quarterman and Richard Powell in 1978, was one of the first resources translated into the Conservancy's earliest MS-DOS database of biologically significant sites. I have our Chapter's copy of it on the bookshelf in my office.

Along with Mack and a few others, Dr. Quarterman began a movement to begin investing private and public money to acquire and protect many of the places in the book, including now-iconic Tennessee landscapes like Savage Gulf and Radnor Lake State Park, a natural oasis nested within urbanized Nashville. This core group of people created the foundation for The Nature Conservancy in Tennessee, and Dr.

Quarterman was one of our first Board of Trustee members. During her time on the board, we continued catalyzing the protection of many significant natural areas, including for the Tennessee coneflower, *Echinacea tennesseensis*. Dr. Quarterman and one of her students had re-discovered the flower in the early 1970s, and she not only helped it become one of the first Federally Listed Endangered plants, she also led the effort to conserve it, and she lived long enough to celebrate its official recovery.

As a young woman, Dr. Quarterman taught English, then biology, and during the late-1940s became a doctoral student of Dr. Henry J. Oosting at Duke University. In graduate school, she not only studied under Dr. Oosting, she also learned about mixed mesophytic forests from E. Lucy Braun, and Catherine Keever was a close friend and research associate. Dr. Quarterman earned her PhD in 1949 and returned to Vanderbilt University in Nashville, Tennessee to resume a long teaching and research career that included developing a particular expertise in a rare plant community type commonly known as cedar glades. She was the first woman Chair of any department at Vanderbilt when she led the Biology Department in 1964, and she was a devoted teacher and mentor to the many students in her academic family tree.

I am not one of those students. Dr. Quarterman was awarded *emerita* status at Vanderbilt the same year I started kindergarten. By the time I reached Vanderbilt in the early-1990s, she and her students had moved on, and the Biology Department was in the midst of consolidating "traditional" botanical and zoological studies with the newer field of molecular biology under one new department.

Dr. Quarterman was one of the greatest plant community ecologists in the Southeastern United States of her time, and the quintessential, original Nature Conservancy scientist.

My first introduction to Dr. Quarterman's work was when I was a field intern for The Nature Conservancy between my junior and senior year of college, and my summer job was to help execute a cedar glade monitoring plan at Chickamauga National Battlefield in northern Georgia. Rob Sutter, a Conservancy ecologist at the time, hired me and another intern to do the work and gave us copies of several papers written by Dr. Quarterman and her students.

Despite the name, cedar glades are not, in fact, covered with cedar trees. They are open limestone rock outcroppings that are home to over 30 endemic wildflowers that display a rotating riot of color and texture throughout the spring and summer. And, they are blazing hot in June and July, with temperatures surpassing the 100 degree F mark — perfect field sites for an intern. I fell in love with them anyway.

After that summer I decided to go to graduate school and study plant ecology and conservation biology. Because I was a master's student with the goal of getting out of school and working for The Nature Conservancy as fast as possible, I was

encouraged to continue studying something I already knew something about. It was at this point that I became a real student of not only Dr. Quarterman's work, but of her students' work as well, many of whom were active academics and natural resource professionals.

I finally had the honor of meeting Dr. Quarterman in the early 2000s in my first job as a "Botanist" with the Tennessee Chapter. We were dedicating our Flat Rock Cedar Glades and Barrens preserve, and we made sure to invite Dr. Quarterman to the ceremony. She was in her late-80s at this point, and still passionate about sharing her love of cedar glades with all those in attendance. This was one of only a few times I actually spent in a cedar glade with her, trailing behind at the back of the group.

Since that time, I've grown to know both Elsie (as she insisted I call her) and many of her students professionally through the launch of the Center for Cedar Glade Studies at Middle Tennessee State University, a collaborative initiative led by Dr. Kim Cleary Sadler. In these last few years, Kim has done an amazing job of both honoring and documenting Elsie's life and contributions. In May of 2008 at the age of 97, Elsie herself spoke at the dedication launching the annual Elsie Quarterman Cedar Glade Festival and shared personal recollections of her life in the field with her mentors and friends.

I imagined Elsie as a towering white oak tree in the forest with a wide strong canopy, and myself as a small dogwood tree under her shade nearby – blooming each year in honor and gratitude.

It was only during her funeral service that I learned how difficult it was for some of her students to call her "Elsie" — even long after they had graduated and in most cases become personal friends. They loved and held her in such esteem that calling her anything but "Dr. Quarterman" didn't feel right to them. I felt a small pang of shame for my casualness when I heard this, because after she instructed me to call her Elsie, I always did. I quickly decided that just as with my own grandmothers and great aunts, it was best to do as I was told, and I felt a little relief.

A small poster of Dr. Quarterman's academic family tree was displayed among the many photographs of her adventures with friends and family at the reception following the funeral. Despite the many ways I have followed behind her on the trail, my name is not on that tree. In a silly and selfish way, this made me feel sad. So instead, I imagined Elsie as a towering white oak tree in the forest with a wide strong canopy, and myself as a small dogwood tree under her shade nearby – blooming each year in honor and gratitude.

Enjoy Dr. Quarterman, in her own words, at the 2008 Elsie Quarterman Cedar Glade Festival dedication. And here is a lovely remembrance written by a family member. **SC**

Drinking from the Fire Hose

A quick and entirely subjective monthly roundup of interesting articles, websites and other experiences collected by your editor. Send your suggestions for future roundups to pangolin19@gmail.com.

1. The Serengeti Highway May be Dead. Amid all the dismal headlines about elephant poaching, here is a bit of good news from East Africa. "This is great victory for conservation in Tanzania and sends a strong message that future development cannot proceed in a business-as-usual manner," according to Festo Semanini, the Head of Programmes for BirdLife International's Tanzania Project Office.

2. Are fossil fuels a bad investment? According to Ambrose Evans Pritchard, writing in the Telegraph, "the fossil fuel complex of oil, gas and coal ... is where investors have been throwing the most good money after bad." Perhaps more of those dollars will be invested in wind, solar, and other renewables.

3. Nothing cooler than a tide pool. The "last child in the woods" story has been well told, but this is a interesting take on it, from Timothy Egan in the New York Times.

4. Benefit Corporations such as Seventh Generation, Patagonia and Bert's Bees commit to creating positive environmental and societal impacts. This article, by the chief of science and sustainability at the California Academy of Sciences, suggest a parallel for science museums to promote sustainability education and research.

5. On the other hand, some are declaring an end to the era of sustainability: "The time has come for us to collectively reexamine — and ultimately move past — the concept of sustainability." The idea is not bad per se, the authors claim, just no longer useful. A longer version of the argument is in the journal Society and Natural Resources.

6. Scariest quote in quite some time: "We don't know if it's going to rain again. It's prudent to act as if it won't." Felicia Marcus, chairwoman of the California's State Water Resources Control Board.

7. A dubious distinction: Indonesia has taken first place for the highest rate of deforestation in the world, owing to land clearing mostly for oil palm plantations and other agro-industrial land uses, according to a new study published in Nature Climate Change. **SC**

Announcements

July 31 Science Science Spotlight Webinar: Conservation and Unconventional Energy Development

The North America Region is hosting a webinar series to highlight some of the most exciting new TNC science. You (Conservancy scientists) guest-host each webinar and pick 2-3 speakers on the topic or geography of your choice. We (NAR Staff) provide the venue and handle all the Webex stuff, scheduling, and advertising, so you can focus on content.

Anne Trainor, a TNC NatureNet Fellow, will host the next Science Spotlight on July 31 at 2PM ET. Anne and Sharon Baruch-Mordo, a Spatial Scientist with TNC's Development by Design team, will present their work on keeping landscapes functional while also meeting energy needs. Register and get the call-in info here.

Want to host a webinar or suggest a topic? Please contact Brad McRae and visit our site to learn about upcoming webinars.
SC

New Conservancy Publications

Conservancy-affiliated authors highlighted in bold.

Please send new citations and the PDF (when possible) to: pkareiva@tnc.org and rlalasz@tnc.org. Please include "Chronicles Citation" in your subject line so we don't miss it.

Some references also contain a link to the paper's abstract and a downloadable PDF of the paper. When open source or permitted by journal publisher, these PDFs are being stored on the Conservation Gateway, which also is keeping a running list of Conservancy authored science publications since 2009.

Acreman, M.C. I.C. Overton, J. King, P.J. Wood, I.G. Cowx, M.J. Dunbar, **E. Kendy**, and W.J. Young. 2014. The changing role of ecohydrological science in guiding environmental flows. Hydrological Sciences Journal 59 (3-4):433-450. http://dx.doi.org/10.1080/02626667.2014.886019.

Aldous, A.R. and **L.B. Bach**. 2014. Hydro-ecology of groundwater-dependent ecosystems: applying basic science to groundwater management. Hydrological Sciences Journal 59 (3-4):530-544. http://dx.doi.org/10.1080/02626667.2014.889296.

Blankenship, K. L. Provencher, L. Frid, C. Daniel and J. Smith. 2013. Human Dimensions of State- and - Transition Simulation Model Applications to Support Decisions in Wildland Fire Management. P. 28-33 IN: Fox RL (Ed) (2012) Proceedings of 3rd Human Dimensions of Wildland Fire Conference, 17-19 April 2012, Seattle, WA. International Association of Wildland Fire. (CD-ROM) (Missoula, MT). Conference proceedings submitted to International Journal of Wildland Fire.

Blankenship, K., J. Smith, R. Swaty, A. Shlisky, J. Patton, S.Hagen. 2012. Modeling on the Grand Scale: LANDFIRE Lessons Learned. In: Kerns, B.K.; Shlisky, A.J.; Daniel, C.J., tech. eds. Proceedings of the First Landscape State-and-Transition Simulation Modeling Conference, June 14–16, 2011, Portland, Oregon. Gen. Tech. Rep. PNW-GTR-869. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 43–56.

Bowden, A.A. 2014. Towards a comprehensive strategy to recover river herring on the Atlantic seaboard: lessons from Pacific salmon. ICES Journal of Marine Science 71:666-671; 10.1093/icesjms/fst130.

Fleming, G.M.; J.M. Wunderle, **D.N. Ewert**, and J.J. O'Brien. 2014. Estimating plant biomass in early-successional subtropical vegetation using a visual obstruction technique. Applied Vegetation Science 17:356-366; 10.1111/avsc.12067.

Gillespie, N., A. Unthank, L. Campbell, P. Anderson, R. Gubernick, M. Weinhold, D. Cenderelli, B. Austin, D. McKinley, S. Wells, J. Rowan, C. Orvis, M. Hudy, **A. Bowden**, A. Singler, E. Fretz, **J. Levine**, and R. Kirn. 2014. Flood Effects on Road-Stream Crossing Infrastructure: Economic and Ecological Benefits of Stream Simulation Designs. Fisheries 39:62-76. http://dx.doi.org/10.1080/03632415.2013.874527.

Grossman, J.D., and K.J. Rice. 2014. Contemporary evolution of an invasive grass in response to elevated atmospheric CO2 at a Mojave Desert FACE site. Ecology Letters 17:710-716.

Kareiva, P. 2014. New Conservation: Setting the Record Straight and Finding Common Ground. Conservation Biology 28:634-636. http://dx.doi.org/10.1111/cobi.12295.

Kereseka, J. 2014. Successful Community Engagement and Implementation of a Conservation Plan in the Solomon Islands: A Local Perspective. Parks 20: 29-37

Lavoie, M., M.C. Mack, J.K. Hiers, S. Pokswinski, **A. Barnett,** and **L. Provencher.** 2014. Effects of Restoration Techniques on Soil Carbon and Nitrogen Dynamics in Florida Longleaf Pine (*Pinus palustris*) Sandhill Forests. Forests 5:498-517. http://dx.doi.org/10.3390/f5030498.

Magdaong, E.T. M. Fujii, H. Yamano, W.Y. Licuanan, A. Maypa, W.L. Campos, A.C. Alcala, **A.T. White**, D. Apistar, and R. Martinez. 2014. Long-term change in coral cover and the effectiveness of marine protected areas in the Philippines: a meta-analysis. Hydrobiologia 733:5-17; 10.1007/s10750-013-1720-5.

Marvier, M., and **P. Kareiva**. 2014.The evidence and values underlying 'new conservation'. Trends in Ecology and Evolution 29:131-132; 10.1016/j.tree.2014.01.005.

Moore, B.C., B.K. Cross, **E.M. Clegg**, B.P. Lanouette, M. Skinner, E. Preece, A. Child, P. Gantzer, E. Shallenberger, D. Christensen, and B. Nine. 2014. Hypolimnetic oxygenation in Twin Lakes, WA. Part I: Distribution and movement of trout. Lake and Reservoir Management 30:226-239; 10.1080/10402381.2014.908437.

Morrison, S.A. 2014. A bird in our hand: Weighing uncertainty about the past against uncertainty about the future in Channel Islands National Park. George Wright Forum 31: 77–93.

Moseley, R.K., and R.B. Mullen. 2014. The Nature Conservancy in Shangrila: Transnational conservation and its critiques. Pages 129-151 In Yeh, E.T., and C. Coggins, (eds.), Mapping Shangrila: Contested Landscapes in the Sino-Tibetan Borderlands. Seattle: University of Washington Press.

Nemec, K.T., C.R. Allen, S.D Danielson, and **C. Helzer.** 2014. AC.gricultural Ecosystems and Environment 183:11-20. 10.1016/j.agee.2013.10.024.

Putz, FE; P.A. Zuidema, T. Synnott, M. Pena-Claros, M.A. Pinard, D. Sheil, J.K. Vanclay, P. Sist, S. Gourlet-Fleury, J. Palmer, R. Zagt, and **B. Griscom.** 2014. A More Realistic Portrayal of Tropical Forestry: Response to Kormos and Zimmerman. Conservation Letters 7:145-146. 10.1111/conl.12044.
SC