SCIENCECHRONICLES

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Image: Sunflower, Union Street, Gowanus Canal, Brooklyn, New York. Image credit: brainware 3000/Flickr through a Creative Commons license.

After the End of Nature, Etc.

Editor's Note

By Bob Lalasz

There's been a lot of to-and-fro recently over the Anthropocene (i.e., the "Age of Man" for those of you who have yet to hear the term) and how conservation can address its challenges. What's been almost ignored, though, is the question of whether we — not just conservation, but humankind in general — have the baseline scientific understanding required to manage Earth's ecosystems effectively. Are we actually ready to be "global gardeners"?

I've read only one article — on the website YaleE360, by Paul J. Crutzen and Christian Schwagerl — that addresses this question. Well, now make that two: Rob McDonald's essay "After the End of Nature," the centerpiece of this issue of *Chronicles*, which casts a skeptical eye at the world's track record of nature management thus far. Rob's argument isn't reactionary: as he puts it, he "rejects the fundamental pessimism of some 'deep' ecologists who argue that the biosphere's exquisitely balanced processes of self-regulation could never be equaled by wise human management." But he rejects blithe optimism about our ability to "get good at being gods." Like Crutzen and Schwagerl, Rob sees considerable gaps in our scientific arsenal to be global gardeners, and he calls for a quick and massive response to close those gaps. Values will alway underpin the discussion of how to work in the Anthropocene. But discussing the science needed to do that work seems like a necessary evolution of the conversation.

Here's the itinerary for Matt Miller, our newest senior science writer in the Conservancy's Science Communications shop, for his first three weeks on the job:

- California's Mojave Desert, to report on how Conservancy scientists Dick Cameron, Sophie Parker and John Randall were ground-truthing aerial maps of the desert ecosystem to confirm where renewable energy instillations could be sited without destroying important habitat;
- The Apalachicola River in Florida, to see how Conservancy scientist Steve Herrington developed a way (using a couple hundred dollars worth of materials from Home Depot) to allow Alabama shad to migrate past locks to their spawning grounds — which could mean a boon for sport fishers throughout the southeastern United States; and
- Green Bay, Wisconsin, to learn how Conservancy scientists are harvesting the otoliths of northern pike caught in Lake Michigan and tracing the mineral signatures in those otoliths back to determine which streams must be protected as spawning grounds for the pike.

This kind of reporting is now standard operation procedure for TNC Science Communications, and you should take advantage of it. Matt and Darci Palmquist, our other senior science writer, have over a decade of reporting experience between them, and are ready to cover your great science stories in the field. Email me and let's get you "in the papers." **SC**

Bob Lalasz (rlalasz@tnc.org) is director of science communications for the Conservancy.

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.

Editor & Submissions Bob Lalasz

Knee-High, Corn, July Peter Kareiva

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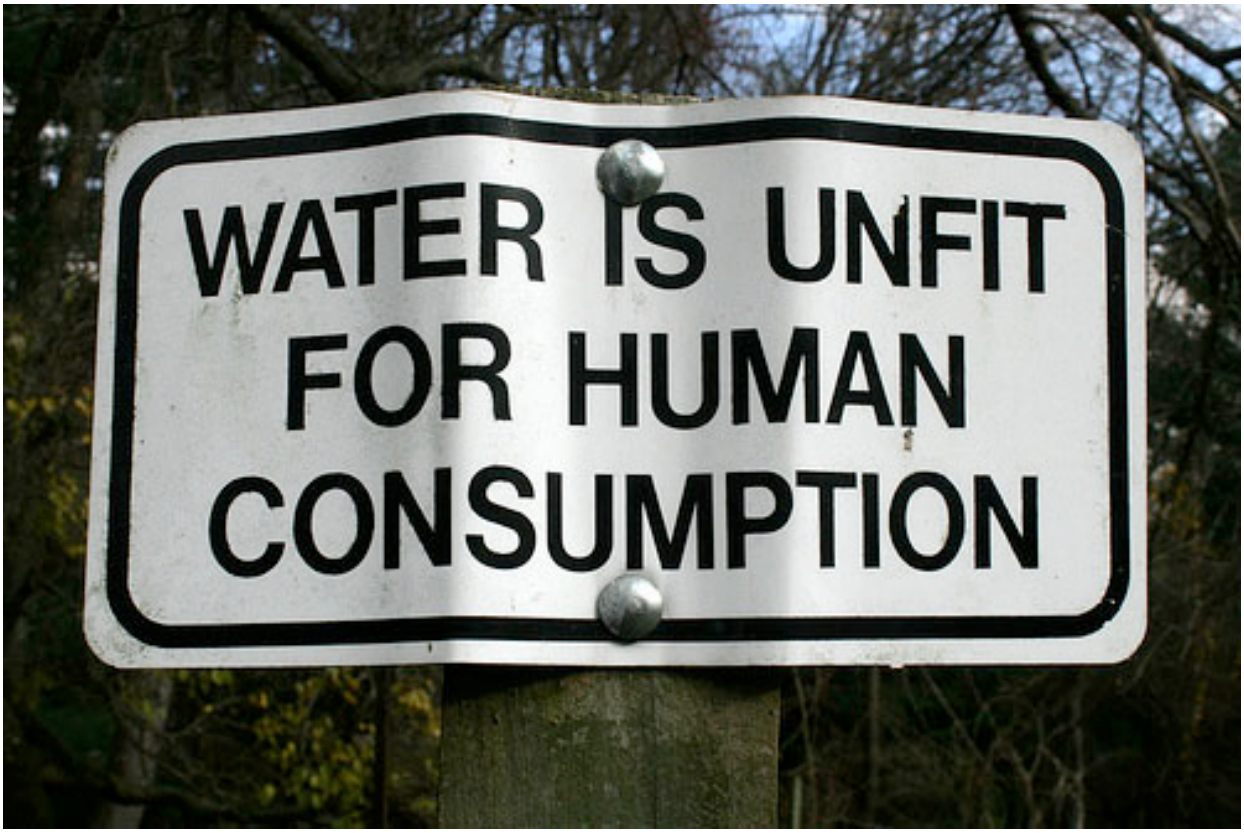
Straight, No Chaser
Human Health and Conservation

By Jonathan Higgins, senior aquatic ecologist, Global Freshwater Program, The Nature Conservancy



Our work improves human health. We should measure and communicate that impact.

'Straight, No Chaser' is an irregular (if not downright odd) column written exclusively for *Chronicles*.

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On Earth Day, I was on a panel discussion in Chicago after a screening of the film "Living Downstream," a documentary based on a book of the same name by Sandra Steingraber that addresses the links among environmental contaminants and risks to human health. Like me, Steingraber is a Ph.D ecologist who grew up in the Midwest. Like me, she is surviving cancer. She was adopted, yet many of her family members have the same or similar types of cancer as she does. She believes that her and their cancers were induced through exposure to commonly used agricultural chemicals that are pervasive environmental contaminants in the places where they lived and worked. Sandra has become a leading authority on environmental contaminants and their links to cancer, and has by default become the modern Rachel Carson, one of her idols.

The film is impressive and moving. So I wondered after seeing it: How could I contribute to activities that might lower these kinds of health risks?

And then I thought: Am I already doing it? Doesn't the work of The Nature Conservancy already contribute to lowering health risks? And shouldn't we be talking about these benefits more forcefully?

The Conservancy, of course, sees benefits to people as the new future for conservation. We are focusing on ecosystem services and socioeconomic sustainability. Most of our new strategies seem intended, whether on purpose or not, to benefit the extremes of the socioeconomic spectrum — mega-corporations and the poor (although there is currently little evidence to support whether what we do actually provides those benefits), along with nature.

Human health, on the other hand, knows no geopolitical or socioeconomic boundaries, and often has clear connections to environmental health. Yes, many risks to human health and access to health care are indeed closely linked to socioeconomic status. But many illnesses such as cancer do not recognize these boundaries, and they affect millions if not billions worldwide. I am talking about more than just protecting habitats that contain potential sources of new drugs. Is conservation lowering the risk to human health by dealing with the sources of illness? And could we do even more?

Evaluating if and how our work benefits human health — and then touting those benefits when they exist — make tremendous sense. If we can identify such benefits, it would greatly expand the scope of our measured impact (when we actually start measuring it) and the base of our support. I certainly don't want to start a paper tiger of false pretense in TNC about the benefits of our work — and I'm not suggesting that we create a global health priority to go along with all our other priorities. But I am suggesting we investigate (with reputable partners that have expertise in human health) which health gains conservation is and might be contributing to and then figure out how to scale these interventions for the greater good of people and conservation.

"I am talking about more than just protecting habitats that contain potential sources of new drugs. Is conservation lowering the risk to human health by dealing with the sources of illness? And could we do even more?"

Possible Benefits

Here are just three of the areas in which I think conservation has a great opportunity to measure and communicate the impacts our work has on human health:

- *Diarrhea* from waterborne disease is one of the most common sources of infant mortality in the world. *Cancer* is pervasive, and many of its risk factors are linked to environmental contaminants. Poorly managed landscapes and water systems are responsible for a large source of these illnesses, among many others. Globally, more than 1 billion people lack access to clean water, and many of them are in developed countries, living with excessively contaminated water supplies that water treatment (when available) does not always make safe for consumption. Can we document the contributions that best management practices (BMP) for landscapes and water systems make to reduced incidence of waterborne illness or even cancer? We already expect that our work to fence cattle out of streams (part of our water funds efforts) reduces

risk of waterborne illness; and we are establishing monitoring to confirm this expectation.

• *Atrazine* is an herbicide widely used in agriculture and lawn care, and a common contaminant in drinking water sources. In her film, Dr. Steingraber stated there are stronger links of risks to human health to Atrazine than there were to PCBs when they were banned in the United States. Atrazine is banned in Europe, and the U.S. EPA has defined an allowable threshold for Atrazine concentrations in municipal water supplies based on risks to human health. I am not suggesting here that we rally to ban Atrazine — that's not our role as an organization. But conservation is already helping to reduce the input of Atrazine and other agricultural chemicals into some of our water supplies, through policies and agricultural best management practices that reduce surface runoff and in-stream loadings of sediments and nutrients. The U.S. Department of Agriculture reported in 2010 that, for the Upper Mississippi River Basin, models based on field monitoring of individual farms suggest that agricultural BMP implementation has reduced Atrazine in-stream loads by 51% as well as generally reducing pesticide loss from fields to surface water, resulting in a 51% reduction in edge-of-field pesticide risk for aquatic ecosystems and a 48% reduction in edge-of-field pesticide risk for humans (for all pesticides combined).

• *Extremely low water flows in rivers* resulting from extensive water consumption and flow management for a variety of purposes can result in increased concentrations of contaminants — such as agricultural chemicals and sewage — in rivers that people use as water sources. Pollution levels can become so high that the water cannot be adequately treated, making it dangerous for any human use. Such low flows can also result in salt-water intrusion from oceans, making water unhealthy to drink and unsuitable for a variety of other uses, such as irrigation. Our work to protect watershed sources of water, to appropriately manage dam outflows, and to help farmers to irrigate more efficiently all results in higher low flows that can avoid these situations and make water supplies safer for people. We should be monitoring and estimating our impact to human health in these situations as well.

"It is time to stop being esoteric about benefits to people, and step up and show how and why our work really matters to people where it counts — to someone who has had a child or friend die in their arms from an avoidable illness, or a cancer patient who has gone through hell and back."

The Conservancy's marketing touches on some of these benefits to human well-being, but we should get straight to the point if we can. For instance, in North America alone, 600,000 people die of cancer every year. To what extent can we lower the risk of cancer through our work in the Mississippi River Basin? To what extent are we lowering risk from waterborne illnesses through water funds and our flow management and agricultural irrigation practices? Does our work in terrestrial and marine conservation offer similar direct health benefits? What are they and who receives them?

It is time to stop being esoteric about benefits to people, and step up and show how and why our work really matters to people where it counts — to someone who has had a child or friend die in their arms from an avoidable illness, or a cancer patient who has gone through hell and back. Believe me. I have been there. **SC**

Essay
After the End of Nature

By Rob McDonald, senior scientist for sustainable land use, The Nature Conservancy

Above: Coral reef at Palmyra Atoll National Wildlife Refuge. Image credit: Jim Maragos/ U.S. Fish and Wildlife Service/USFWS Pacific/Flickr.

The tropical sun rises early over Palmyra Atoll, shining light on a beautiful coral reef, a sliver of an island, and little else. Palmyra is 1,000 miles south of from the nearest major airport and city, a little speck of land in the middle of the Pacific Ocean. Signs of military activity from World War II remain — an airfield, some old buildings — but most days there are less than two dozen people on the whole island, scientific researchers there to study.

Palmyra Atoll's remoteness was what led The Nature Conservancy and the U.S. Fish and Wildlife Service to protect it in 2000, for it has one of the most ecologically intact coral reef ecosystems in the world, with a diversity of fishes and corals that have been lost from reefs with more human activity. And yet even here, human actions have put coral reefs in danger of being destroyed. Climate change will warm ocean waters, killing many of Palmyra's corals, and trash from all over the world washes up on its beaches. Decisions by people in Beijing or New York to drive to work will affect how many greenhouse gases are emitted, which will control the severity of climate change, which in turn will determine the fate of Palmyra.

From climate change to deforestation to water flows to soil erosion, the impacts of human actions are now having global impact. Some scientists are calling this new era of human domination "the Anthropocene." In a recent front-page article, the Washington Post even revived Kenneth Boulding's famous description of "Spaceship Earth," a craft whose life-support system we must maintain if we want to survive.

Many environmentalists feel regret about the thoroughgoing way people have domesticated the natural world to suit our interests. Bill McKibben has even movingly written about "the end of nature" — at least, if "nature" is conceived as something separate and apart from people. But a recent flood of books and articles have a response to McKibben: get over it. Whether intentionally or not, these authors argue, humans are managing many of the major ecological processes on the planet.

From this point of view, what we feel morally about past human actions is irrelevant to the future. McKibben and his ilk (including me!) may mourn the disappearance of wild nature, places that are "no man's garden" (to use Daniel Botkin's term); while others may be indifferent to its loss.

Many of the thinkers of the Anthropocene have focused on a very important practical question: Given that we are already managing the planet's natural systems, how can we make the domestication of nature smarter — both in the sense of increased productivity and enhanced sustainability?

Or, as Stewart Brand put is: "We are as gods and might as well get good at it."

I spend most of my professional life as a conservation scientist working to answer pieces of this practical question, and I believe answering it is key to our civilization continuing to thrive. Our domestication of the Earth's surface is almost certain to increase as global population and economies continue to grow and consume more resources. But in the rush to embrace better management of the planet as the new paradigm of environmentalism, we shouldn't fail to ask a more basic question: Do we actually know enough about how nature works to actively manage many ecosystem processes — or even improve them? There's a gradient of human control over ecosystems, from the heavily managed lawn of my apartment building to the bits of relatively wild nature like Palmyra. Even if humans are impacting every point on the Earth's surface, our degree of management varies greatly. If we are masters of the planet, can we manage or replace everything natural?

"Do we actually know enough about how nature works to actively manage many ecosystem processes — or even improve them?"

To put it another way, humans depend on nature for a lot of things that allow them to survive and prosper. These benefits from nature are called by ecologists, rather dryly, "ecosystem services." Some of these are tangible goods that come off managed lands, like the food we all eat. But less managed lands can be important too. Many cities depend on forests to maintain the quality of water that runs off into their reservoir, either by filtering out pollutants or by preventing erosion. If the forest wasn't there the city could build a treatment plant to increase water quality, but at much greater financial

cost. Ecosystem services can be more intangible, like the role that wild pollinators play in pollinating some food crops. In places where wild pollinators are gone, humans have stepped in as "bee wranglers" who drive around in trucks full of bee hives, providing pollination to those farmers that can pay for it. If we are planetary gardeners, do we have the technical skill to replace or actively manage all the world's ecosystem services?

In asking that question, I should add that I reject the fundamental pessimism of some "deep" ecologists who argue that the biosphere's exquisitely balanced processes of self-regulation could never be equaled by wise human management (or, more darkly, that human management can never be wise). I see no reason to believe that, if scientists can discover the bizarre world of particle physics and general relativity, that they cannot also discover how to sustainably manage ecosystems.

But our track record of such management thus far is not terribly encouraging.

Bumbling Gods

About a decade ago, thousands of the world's ecologists and natural resource managers came together to work on the Millennium Ecosystem Assessment. Published in 2005, the Assessment sought to quantify humanity's dependence on ecosystem services and the trends in those ecosystem services over time. Out of 24 major ecosystem services that were examined, only nine were being used sustainably or were at least being maintained over time.

Most of these success stories were for what are called "provisioning services," like crop and livestock production. There are strong economic incentives to manage the landscape for these services, because they often produce tangible goods that can be sold at market. While this management may not necessarily be sustainable over the long term (people tend to discount how their actions affect others, especially future generations), there is at least an economic incentive to maintain provisioning ecosystem services. Moreover, humanity has had two millennia of practice in agriculture, so it should be reassuring we have gotten better at it over time. Particularly in the last century, with the so-called Green Revolution, humanity's ability to produce food from the land has greatly increased. Our proven technical ability to feed 7 billion people (setting aside the political obstacles to overcoming global hunger) is one of humanity's greatest technological achievements.

"If we are as gods upon this Earth, then we are peculiarly bumbling gods. Perhaps we are like the classical Roman gods, blessed with power but (for now at least) full of ignorance."

That finding, however, still leaves 15 of 24 major planetary ecosystem services that were being degraded over time. Most of these are common resources, like fisheries or clean freshwater. While there are clearly examples of these kinds of common resources being sustainably used, they are in the aggregate still declining globally.

And even for those ecosystem services for which we are managing nature adequately, we are still dependent on other "regulating" services to maintain production. Without the world's existing stock of topsoil, it would be very hard for

farmers to maintain sufficient food production to feed 7 billion people. Chemical fertilizers that allow us to add the big three nutrients (nitrogen, phosphorus, and potassium) have played a crucial role in increasing global food output, but we still need natural soil.

(Above: Rainfall runoff following fertilizer applications on farm fields can cause nutrient loss, potentially polluting waterways. Image credit: pennstatelive/Flickr.)

One unintended consequence of our widespread use of chemical fertilizers is that much of it ends up in waterways. Some fraction of applied nutrients like phosphorus and nitrogen end up in plants, but much of it washes down into rivers and lakes, eventually moving downstream into estuaries. Fertilizer is relatively cheap now, and most farmers are not considered legally responsible for runoff from their property, so there is little incentive to limit excess nutrient runoff. Once nitrogen and phosphorus make their way into freshwater or marine ecosystems, they cause a massive growth of algae and other primary producers. This reduces the amount of oxygen dissolved in the water, leading to large-scale dead zones (hypoxia), where many fish species will die. Many major estuaries now have dead zones (including one at the outlet of the Mississippi that is often bigger than the state of Massachusetts). These dead zones have dramatically reduced the ecosystem services these estuaries can provide to humanity.

The basic techniques to reduce excess nutrient runoff (less fertilizer application, and then riparian buffer strips or other wetland areas that can slow the flow of water to rivers and filter excess nutrients) are well understood, but there has been little substantial progress made in stopping the slow expansion of dead zones. There are challenges at many levels that must be overcome. Scientifically, the world needs cheap

yet precise ways to apply just the right amount of fertilizer at times when it is needed by the plants but when rainfall is unlikely to wash it to the sea. While such technology exists, it is far too expensive for many of the world's farmers. Economically and politically, farmers need incentives to limit excess nutrient runoff. This has proved a hard policy task, because there are many individual actors that each contribute to the slow degradation of a common societal resource. Designing and implementing an efficient policy program to support changes in farmer practices that reduce runoff remains a challenge for humanity.

Phosphorus is actually an interesting example of a slowly emerging environmental challenge that humanity must solve. Unlike nitrogen, which we can obtain from the air, and potassium, which is abundant, the supplies of mineable phosphorus globally are limited. The United States' supply of phosphorus, mostly from a large mine near Tampa, FL, may only satisfy our domestic requirements for a few more decades. Globally, there is perhaps a century of phosphorus supply remaining at current use rates. As this resource gets scarce, its price will increase and make new extraction of sources of phosphorus economically viable. It will also provide an economic incentive to farmers to minimize any waste in their application of phosphorus, much of which is now not absorbed by crops but washed down into streams and lakes.

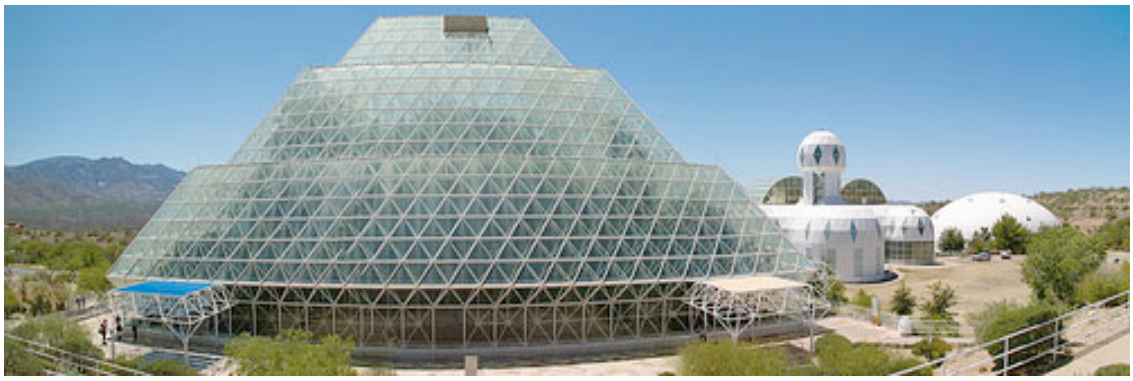
It is also worthwhile to remember than in our quest to solve one environmental problem, we sometimes accidentally create another. In 1928, Thomas Midgley, Jr., and his research team finally stumbled upon a chemical refrigerant they had spent years looking for — one that could replace some dangerous chemicals currently in use in that industry which killed or maimed many workers. Even better, the chemical was so non-reactive that Midgley famously inhaled the gas at a demonstration, to prove it wasn't dangerous. Midgley's chemical, Freon, went on the market a few years later, introducing a new class of chemicals to the world, chlorofluorocarbons (CFCs). The rest is history. It took decades before scientists realized that CFCs could remove the Earth's ozone layer, essential for life's persistence, through a chemical reaction in the stratosphere.

"The chemical was so non-reactive that Midgley famously inhaled the gas at a demonstration, to prove it wasn't dangerous. Midgley's chemical, Freon, went on the market a few years later, introducing a new class of chemicals to the world, chlorofluorocarbons (CFCs). The rest is history."

If we are as gods upon this Earth, then we are peculiarly bumbling gods. Perhaps we are like the classical Roman gods, blessed with power but (for now at least) full of ignorance.

Reverse Engineering a Flying Spaceship

On September 26, 1991, eight people shut the door inside a huge, 3-acre enclosure, complete with replicas of a working rainforest and coral reefs. The goal of Biosphere 2 was simple: see if people could maintain a self-sufficient, enclosed ecosystem for any length of time. Biosphere 1, in case you're wondering, is the Earth itself. The base was initially well stocked with the plants and animals that people would need to survive. Nothing, not even air, was to go in or out. For 2 years, the people inside Biosphere 2 were to be self-sufficient.



(Above: Biosphere 2 panorama. Image credit: PurpleGecko/Flickr.)

The mission was ultimately a failure for a complex set of reasons, about which whole books have been written. For one thing, the crew never managed to produce enough food, lost a great deal of weight, and eventually had to be fed supplemental food from outside Biosphere 2. A few invasive plants and animals exploded in population, causing more problems. "I didn't expect the cockroaches," said Jen Molnar, currently the director of the Conservancy Sustainability Science Team, who worked as a lab tech in Biosphere 2 several years later when the facility was transitioning to being a traditional scientific research site. "They were so thick they would cover the wooden walkways and you couldn't walk without stepping on them."

The biggest issue from the standpoint of human health was the wild swings in carbon dioxide and oxygen levels in the atmosphere. Big chunks of soil had been imported whole into the site, and the organic matter within them was decaying, releasing carbon dioxide. At the same time oxygen was being slowly absorbed into Biosphere 2's concrete walls, an event that seemed obvious in hindsight but was not expected by the engineers planning the mission — unlike Biosphere 2, most normal buildings intentionally allow external air in for ventilation, so this phenomenon is not something that is usually a problem. Even when Molnar worked at Biosphere 2 years later, workers had to sign a waiver acknowledging they knew about the abnormally high carbon dioxide levels. "I asked how high the levels got and the woman hiring me just laughed and shrugged," said Molnar.

"Instead of being the proud commander of Spaceship Earth, we are more like Chewbacca in Star Wars, pounding the walls of the ship in hopes it will continue to go."

In many ways, Biosphere 2 is an imperfect example of human's capacity to manage the Earth. There were some disastrous personality clashes during the project, and an odd "survivalist" mentality that permeated the whole mission. Some of those involved saw the world as quickly heading toward an ecological catastrophe, and wanted to create something like Noah's Ark, an encapsulation of complete ecosystems. Moreover, it has been 20 years, and ecosystem science has advanced significantly. It would be extremely interesting to create Biosphere 3, as a rigorous scientific and engineering experiment to fully sustain humans in a totally contained space for a set period of time. Such an experiment could provide lessons for ecosystem science as well as for space programs like NASA that might someday have to set up long-term bases on another planet.

Apart from the specific problems of the Biosphere 2 mission, which were legion, the overall conclusion is clear: humans are very far from being able to fully replace, or even maintain, everything they need from the natural world. For all of humanity's knowledge about nature, and for our enormous increase in the power we can exert over the natural world, we can still only at best partially manage and maintain Spaceship Earth. Instead of being the proud commander of Spaceship Earth, we are more like Chewbacca in Star Wars, pounding the walls of the ship in hopes it will continue to go. It's not enough for those who write about the Anthropocene to say to humanity "get over it" and accept the mantle of global stewardship. In the Anthropocene, the real challenge for the world's scientists is: get working, and quickly fill in our considerable gaps in knowledge and practice. We have to get much, much better at managing and maintaining the only spaceship we've got, if we hope to continue on our species' voyage. **SC**

Have a response to Rob's piece you want to share? Send it to rlalasz@tnc.org and we'll publish it in next month's issue.

From the Field

Message from the Mojave: Shaping the Desert Energy Boom

By Matt Miller, senior science writer, The Nature Conservancy

Above: Wind farm in the Mojave Desert. Image credit: Matt Miller/TNC

Editor's note: This article first appeared on Cool Green Science. If you want TNC's Science Communication shop to report on your science fieldwork, email Bob Lalasz, Matt Miller or Darci Palmquist.

I stand before hundreds of giant pinwheels, each churning rapidly.

The whirring they make sounds oddly like the chirping of birds, albeit endlessly repetitive, surprisingly grating ones.

A wind farm: coming soon to a desert near you.

I'm in the Mojave Desert with Conservancy ecologists and conservation planners. They're checking real-life desert conditions against aerial maps to help determine where solar and wind development can be built without destroying pristine habitat.

Their task is urgent if they are to keep up with the pace of wind and solar development here.

When this Conservancy team visited the desert a year ago, this wind farm didn't exist.

"This whole area looks completely different from the last time I was here," said Conservancy ecologist Sophie Parker. "I can't believe the impact."

The interest in renewables has created a boom in the desert. Several years ago, development applications began springing up, in part fueled by the idea of the "empty desert," that seductive myth of a barren land just waiting for a productive human use.

But the desert is also home to endangered species, critical habitat and migration corridors.

At this point, renewable energy development could proceed in two ways: It could spread hodge-podge across the landscape, inevitably mired in lawsuits and controversy. Or, it could be guided by sound, comprehensive plans that avoid ecologically sensitive areas and important wildlife habitat.

And that's where the Conservancy comes in: No organization has the conservation planning expertise that the Conservancy does. Beginning with ecoregional plans and proceeding with the latest maps providing a comprehensive picture of land uses, the Conservancy has generated the information land managers need to make the best decisions.

Parker and other Conservancy ecologists began by supplying federal agencies like the Bureau of Land Management as well as utilities with comprehensive, well-researched maps that show where endangered species live, where wildlife move and migrate and where unique native plant communities grow.

"Stories about wind energy in the desert generally have one narrative: That of environmentalists pitted against each other, of those who love desert tortoises fighting those who want to combat climate change. Data change that narrative."

These maps are being used to inform plans that will guide energy development to less sensitive parts of the desert.

Conservancy planner Dick Cameron and others just published a paper in the journal PLoS ONE that describes just how wind and solar development could occur without loss of biodiversity.

The paper "found there to be sufficient area to meet renewable energy goals without developing on lands of relatively high conservation value."

Now, the Conservancy is involved in a joint state/federal effort called the Desert Renewable Energy Conservation Plan, again contributing conservation expertise to help an overall energy planning effort — providing the information needed to direct renewable energy in places where it does the least damage to the desert.

These maps are extraordinarily sophisticated, but they're not fail-proof. Cameron says that some people search hard to find errors in the maps.

"If someone knows that an area shown on the map as ecologically sensitive is actually a parking lot, they question the whole map," he says.

That's why testing the maps on the ground is so important. Throughout the day, the Conservancy ecologists take photos throughout the area, marking them on digital maps to later check against existing data for accuracy.

"It can seem pretty abstract," says Cameron. "But when you get out on the ground, you can attach a real photo to a map."

Stories about wind energy in the desert generally have one narrative: That of environmentalists pitted against each other, of those who love desert tortoises fighting those who want to combat climate change.

Data change that narrative.

"Clean energy can and should be a win-win," says Cameron. "With comprehensive planning, you could avoid the conflict that is so often emphasized in the media. But to have a comprehensive plan that protects ecosystems and meets the needs of energy developers, you need data. The Conservancy has taken the lead in compiling those data to support our conservation goals. We're able to play a unique role in shaping where wind and solar development goes, due to our science-based approach." **SC**

Drinking from the Fire Hose

A quick monthly roundup of interesting articles, websites and other experiences collected by your editor. Send your suggestions for future roundups to rlalasz@tnc.org.

1) How Our Disinterest in "The Environment" Signals the End of Nature (Motherboard.vice.com): Everybody's writing about the Anthropocene now, and the conversation is spinning off into scary, fascinating directions. Christopher Mims, one of the more pugnacious and provocative journalists covering science and the environment, argues here that "nature separate from people" is quickly giving way to "nature as cyborg." As we further degrade nature, Mims says, we will have to "devote an ever-increasing percentage of our inventive capacity to merely staying alive," meaning the line between nature and technology will blur to invisibility.

2) Scientists Map "Facebook for Birds" (Cosmic Log): The ultimate justification for anything is that it's natural, and here it is for Facebook: Birds of the same species tend to form affiliate groups that resemble the social network that ate everything. Using radio transponders, Oxford University researchers observed millions of interactions of great tits at 67 feeders in woods near Oxford — and the map of these meet-ups looks just like a map of a typical Facebook network's interactions. (Sadly, "individuals with no connections have been removed from the network" map, note the researchers. Bias!)

3) Who's Responsible for Climate Change? Not Ecologists, Right? (ConservationBytes): Corey Bradshaw might be the best conservation science blogger out there — he's fearless, with a great nose for issues and a beguiling tendency to go for jugulars. Check out this takedown of excessive ecologist hobnobbing with an interview of Kevin Anderson, deputy director of the Tyndall Centre for Climate Change Research. Anderson — are you sitting down? — still attends conferences all over the globe despite not having flown in *eight years*. (Boat. Train. And he doesn't go to a lot of them.)

4) Biodiversity Loss and Its Impact on Humanity (Nature): The "nature versus people" debate often comes down to biodiversity vs. ecosystem services — but doesn't rich biodiversity underpin many ecosystem services? This meta-analysis gives a qualified "yes" in many cases, although stronger for ecological function than e.s.. Money quote: "The impacts of diversity loss on ecological processes might be sufficiently large to rival the impacts of many other global drivers of environmental change — such as climate change."

5) **I Point to TED Talks and I Point to Kim Kardashian. That is All (Download the Universe):** Backlash comes to everyone and everything, and that moment has arrived for TED talks, those 18-minute bites of intellectual goodness that you can't stop watching once you start, like a box of bon-bons for smarties. Carl Zimmer says phooey: While TED talks are built on the basic notion of a science talk, they leave out the Q&A afterwards. So they've basically become sales pitches for ideas, not ideas. OK, just let me watch the one by the publisher of *Maxim* and then I promise I'll stop. **SC**

Viewpoint
Lowering the Risk: Ethical Practices When Doing Research with People

By Supin Wongbusarakum, senior social scientist, The Nature Conservancy; Craig Leisher, senior social science advisor, The Nature Conservancy; and Christopher E. Gregg, associate professor of geology, East Tennessee State University

Measuring the social impacts of conservation projects provides information essential for effective conservation, and making those measurements often involves obtaining information from people. But how do we ensure that our research involving human subjects[1] adheres to ethical principles? Below we offer some guidance on best practices to ensure (a) that our studies are ethical and (b) to prevent or minimize different types of risks for both the human subjects and conservation organizations.

Historically, abusive biomedical experiments like those revealed by the Nuremberg War Crime Trials in 1945-46 and the 1932-1972 Tuskegee Syphilis experiments resulted in serious efforts to develop ethical standards for research involving human subjects. In the United States, for example, researchers working with human subjects are guided by the *Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research* (NIH 1979). Australia has a national statement on ethical conduct in human research (Australian Government 2009).

The Nature Conservancy is not involved in biomedical research, but rather in social and behavioral research in which the risk to human subjects is relatively low. Nevertheless, these types of research also have sets of rules and regulations for reviewing and inspecting their processes and procedures. Additionally, in many places in the world where customary and traditional ways of leadership are maintained, researchers must often go through a local village council or leaders prior to conducting any study. In the United States, federally funded projects require approval by an Institutional Review Board (IRB) that screens proposed human-subject research to assess the risks it poses to subjects, ensuring that it either meets ethical standards and has sufficient safeguards or meets criteria for exemption from U.S. Department of Health and Human Services regulations.[2] Many journals only publish research that has received IRB approval.

"A researcher needs to protect subjects from any harm that may result from participating in the research. Doing so requires learning what is harmful; therefore, it is important to have basic knowledge of the community and its social dynamics."

Even if a specific project is not regulated by an IRB, however, there are ethical issues that we should be concerned with whenever we work and do research with people. The following three ethical principles based on the Belmont report are therefore recommended for adoption within the Conservancy.

Principle #1: Respect for Persons. People should participate in the research on a voluntary basis and be given information in a manner and context that allows them to

make an informed decision about participating in a research project. This information may include the purposes of the study, how the study will be conducted, how long the interview/survey will last, and how the study results will be used. It also includes a statement offering the subject the opportunity to ask questions and noting that the subject can withdraw at any time from the research. For a researcher, respect for persons means obtaining the free, prior and informed consent (FPIC) of subjects. (See this 2010 Oxfam report for more on FPIC and how to do it.)

For several recent Central Science household surveys, the FPIC approach involved meeting with appropriate local leaders to explain the research and ask for their formal written permission to conduct the study. Another approach would be to secure written or verbal consent from each individual being asked to participate in the study. Also, anytime a person under 18 years of age is involved in research, consent to participate must be obtained from their parent or guardian and the youth.

Principle #2: Beneficence. This principle has two elements: 1) do no harm to the people we study; and 2) maximize possible benefits and minimize potential harm. A researcher needs to protect subjects from any harm that may result from participating in the research. Doing so requires learning what is harmful; therefore, it is important to have basic knowledge of the community and its social dynamics.

Consider possible harm at every step of the research, including the study objectives; collecting, handling and storing data; and how research results are communicated. In particular, protecting data confidentiality is critical. To remain covered by the U.S. federal exemption, TNC must ensure that subjects cannot be identified through the information obtained and that the information collected will not lead to disclosures that could reasonably place subjects at risk of criminal or civil liability or damage their financial standing, employability or reputations. Risks and benefits of research may affect the individual subjects, the families of the individual subjects, and society at large (or special groups of subjects in society).

Principle #3: Justice. The selection of research subjects needs to be scrutinized in order to determine whether some classes are being systematically selected simply because of their easy availability, their compromised position, or their manipulability, rather than for reasons directly related to the problem being studied. Finally, research should not unduly involve persons from groups unlikely to be among the beneficiaries of subsequent applications of the research.

By following these principles, we can take important steps toward maintaining our high ethical standards, averting potential harm to those involved in our studies, and protecting TNC against reputational, organizational, legal and possibly financial risks. **SC**

References and Resources

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[1] A"human subject" is a living individual about whom an investigator obtains either (1) data through interaction or intervention with the individual, or (2) identifiable private information (HHS 2004).

[2] The regulations pertaining to the protection of human subjects published by HHS are located at 45 C.F.R. Part 46. The regulations basically require that institutions that receive federal funding for research on humans set up and operate institutional review boards. Subpart A of that regulation, "The Basic HHS Policy for Protection of Human Research Subjects," applies to "all research involving human subjects conducted, supported or otherwise subject to regulation by any federal department or agency" (Subpart A, Section 46.101). However, Paragraph (b) of the regulations allow for exceptions to the policy. Paragraph (b) states:

(b) Unless otherwise required by department or agency heads, research activities in which the only involvement of human subjects will be in one or more of the following categories are exempt from this policy:

The exception that applies to TNC is located at Section 46.101 (b)(2) which states:

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:

(i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Appreciation
Elinor Ostrom, 1933-2012

By Craig Leisher, senior social science advisor, The Nature Conservancy

When Elinor Ostrom became the first women to win the Nobel Prize in Economics in 2009, some economists sniped that she was not a real economist. They were factually right but in practice wrong, for she was as much an economist as anything. And conservation could have claimed her as well. Her work has massive implications for the way we should approach conservation and natural resource use.

For 40 years until her death on June 12 at age 78, she studied the economic, social and ecological factors that drive how people use local natural resources — drawing on economics, but also notions of power and rule-making drawn from political science, and using fieldwork much like an anthropologist.

Ostrom's ground-breaking publication was *Governing the Commons* (1990). She had two core ideas in the book. The first is that the tragedy of the commons — the idea that renewable resources held in common would inevitably be overexploited — wasn't inevitable and in fact may not be that common. From fisheries to forestry, Ostrom found examples of communities that organized themselves to manage their common-pool resources in a sustainable way.

The book's second core idea was that communities that successfully manage common-pool resources share a number of characteristics:

- Clearly defined resource boundaries,

"Her thinking gives us a pragmatic way to catalyze local and sustainable management of renewable natural resources via knowledge, cooperation and enlightened self-interest."

Left: Elinor Ostrom at the press conference after her acceptance of the 2009 Nobel Prize in Economics.

Credit: Holger Motzkau/Wikipedia/Wikimedia Commons

- An open process of decision-making about resource use,
- Local resource rules respected by external authorities,
- Community monitoring of compliance,
- Graduated sanctions, and
- Low-cost conflict resolution mechanisms.

Ostrom then suggested people everywhere use these characteristics as "design principles" for engendering community stewardship of shared natural resources.

In July 2009, Ostrom published a paper in *Science* that probably clinched the Nobel Prize for her — and should be known to everyone in conservation. The paper itself is short and actually not that clear. The genius is that it builds on her design principles by highlighting 10 success factors for community management of natural resources, including able local leadership, moderate territorial size, and local autonomy to design and enforce resource-use rules.

Ostrom's design principles and success factors should be in every conservationist's toolbox. These are the secrets to lasting conservation impacts in the 95.1% of the globe that is not in a protected area.

In April 2012, *Time* magazine named Ostrom one of the 100 most influential people in the world. I hope she becomes even more recognized in the years ahead. Her thinking gives us a pragmatic way to catalyze local and sustainable management of renewable natural resources via knowledge, cooperation and enlightened self-interest.

Ostrom's thinking is based on her decades of social science work. It's optimistic in believing that many communities can avoid the tragedy of the commons, and it's pragmatic in saying which factors matter for success.

It's also innovative in suggesting that fostering local success factors can help communities sustain renewable natural resources indefinitely.

Does science-based, optimistic, pragmatic and innovative sound familiar?

It should, because it's what makes The Nature Conservancy great. And it's why we should all carry a piece of Elinor Ostrom into every conservation context. **SC**

Science Shorts

Give a Little, Get a Little

White, C., C. Costello, B.E. Kendall, and C.J. Brown. 2012. The value of coordinated management of interacting ecosystem services. *Ecology Letters* 15:509–519.

The conservation world can look pretty discombobulated when viewed through a lens of multiple stakeholders vying for a piece of the public's attention, funding and political will. But the authors of this study encourage us to think again! Conservation may actually be on top of its game. Game theory, that is. Using a tidy heuristic model and the rather more disorderly empirical ecosystem-based management of northern California marine systems, this study applied Nash's Equilibrium from economic theory to illustrate how coordinated management can stifle the real needs of those with softer voices and simplify ecosystem processes to borderline ludicrous — in an effort to be inclusive and thus efficient. "In both models, and across all ecosystems evaluated, coordinated management never produced a 'win-win' solution, even though society as a whole always gained." If you think compromise is hard and its results messy and unsatisfactory, you might just be on the right track. **SC**

— **Jensen Reitz Montambault**, applied conservation scientist, Central Science, The Nature Conservancy

Complex, with an Aftertaste of Sustainability

Cichelli, A., A. Raggi, and C. Pattara. 2012. Life cycle assessment and carbon footprint in the wine-supply chain. *Environmental Management* 49:1247-58.

Can you save the environment while relaxing with friends over a cup of vino? Science's answer to this question is a resounding "maybe." It all depends on the way you look at how a bottle of wine is produced and what you are most worried about in the environment.

A recent study follows the (some might argue delightful) path of a bottle of wine in south-central Italy through its growing, harvest, vinting, bottling and shipping process.

The questions bubble up like proverbial Champagne: What really goes into sustainable packaging? Is it better to have lightweight bottles so you spend less fuel to ship them? Or very standard bottles to make it easier to recycle them, which saves other fuel and production costs?

And what about organic agriculture? When farmers use fewer chemicals, they might use more machines, which contribute to pollution in their own way.

This study wasn't meant to make us crazy second-guessing our sustainable living choices. But it is a strong advocate for reason over dogma.

If we focus on one issue and one issue alone, we could really miss the conservation boat. The wine study gives the example of climate change and popular carbon footprint calculator. If we totally focus on reducing carbon, farmers don't get credit for some of the good environmental practices they usually do, like mulching with spent vines, because the carbon calculator considers that business-as-usual, not a fresh effort.

We also might miss critical parts of sustainable living that aren't carbon-related, but are important in their own right. Pesticides can sicken us and the ecosystem. Incautious use of freshwater in agriculture could be a disaster for us all.

So, the end message from this study is: calculate your carbon footprint, but cut yourself a little slack. Just as our lives have many, many facets so does the environment and a too-rigid approach might confound instead of solve all our problems. Cheers! **SC**

— **Jensen Reitz Montambault**, applied conservation scientist, Central Science, The Nature Conservancy

Announcements

Science Peer Review Help Desk & Quantitative Support

By Jon Fisher

Most of us working in science can sometimes use input from our peers, but find it a pain to chase people down to get their review. The good news is that there's a service to do it for you: the TNC Science Peer Review Help Desk!

- Have a paper you are working on that you want reviewed with no writing workshop in sight?
- Need help with the statistics or analysis of your data?
- Need feedback on a monitoring plan or protocol?
- Have a cool new science method or tool you want to use but need a sounding board?
- Been asked to write up the science for your programs business plan and want feedback?

If you answered "yes" to any of the above questions or find yourself in a similar situation to those described, then send your work to the Science Peer Review Help Desk. The help desk is designed for any and all science at TNC. Your submission can be "half baked" – i.e. just beginning – or nearly done. No matter the stage, you will receive thoughtful feedback from a set of peer reviewers.

Some examples of potential submissions:

- Monitoring plans
- Science that will inform a business plan
- New science methodologies
- Social science methods or approaches
- Draft funding proposals
- Draft papers to be submitted for peer-review
- Potentially high impact science analyses with policy implications

How does it work?

1. Send your submission to the help desk manager (Jon Fisher) at tncsciencehelpdesk@gmail.com, and specify what kind of review you're looking for (and/or what kind of quantitative support you need)
2. Jon will send your submission to 2-3 expert reviewers within TNC (it usually takes a week to get reviewers signed up)
3. Reviewers will have up to 3 weeks to provide a review
4. Jon will then send all reviews back to you
5. Reviewers have the option to remain anonymous
6. For large file size submissions please use Accellion or another file transfer service. **SC**

Measures Demystified! (A Course)

By Jensen Reitz Montambault

A new self-paced, online training curriculum on measures, "Measures Demystified" is now available on www.conservationtraining.org. This curriculum updates and expands the existing on-line course, "Monitoring Our Conservation Work," including three new modules that merge the process of conservation planning and measures authored by Terri Schulz of the TNC-Colorado and featuring the process of creating measures for our Mongolia program.

The curriculum is free and open to the public and provides students with the opportunity to explore, at their own pace, the process of considering the audience and conservation context for monitoring programs, as well as reviewing the fundamentals of articulating program logic and experimental design for cost effective data collection, which we collectively refer to as "measures."

There are six major focus areas, or modules, of the Measures Demystified course. Students can take just one module or all six. Go to www.conservationtraining.org to enroll in the course today! **SC**

Nature Brains: A Science Blog for TNC

By Bob Lalasz

My team (Science Communications) is working with the digital folks at WO to establish a science-only blog for TNC geared for science media and bloggers and the general audience interested in science — audiences the Conservancy has never gone after before. Called "Nature Brains," the blog will include reviews of new research, interviews with our scientists and others, reporting from the field, photography by our scientists, natural history reports, opinion pieces, surveys of the state of sub-disciplines, book reviews and more. It will be a lot of fun, so if you're interested in contributing to it, either regularly or occasionally, let me know at rlalasz@tnc.org. **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/or 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.

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