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GDP, Happiness and Natural Capital

Editor's Note

By Bob Lalasz

The career of hotshot science writer Jonah Lehrer today lies in smithereens, obliterated by his own lies, plagiarism, willful misreading of studies and sundry other crimes against science and journalism. What lesson should scientists take from his implosion? That journalists are out for themselves and usually screw up the science? That would be comfortable. Try this one instead: The culture of science still stinks when it comes to the media and the public. Got your attention? Let me explain.

But first, let's review the bidding in case you've missed the story. Three months ago, at the tender age of 31, Lehrer had it all, as far as journalism goes. A new staff job at *The New Yorker*. A new chart-topping book (immodestly titled *Imagine: How Creativity Works*) to go with his two other bestsellers. A speaking career at $50,000 a pop. And, underlying it all, a reputation as a meticulous, endlessly inventive science writer with a knack for uncovering path-breaking new studies on neuroscience that often easily translated into nuggets of self-help. He was Malcolm Gladwell with serious science cred. His ceiling was unlimited.

Today, Lehrer is jobless and disgraced, *Imagine* has been pulled from shelves and e-stores by its publisher, and he is finished as a journalist. His fall started in late June, when he was caught recycling some of his own pieces and passing them off as new — not a hanging offense in the literary world, but many speculated it was smoke from a bigger fire. They were right. Last month, Lehrer resigned from *The New Yorker* just before Michael Moynihan of *Tablet Magazine* revealed that Lehrer had studded *Imagine* with made-up quotes from Bob Dylan to buttress his argument about Dylan's creative process — and that he then made up a series of stories about his obscure sources for the quotes, maintaining to Moynihan that they were genuine right up to the moment of his resignation. Journalists on Twitter erupted in schadenfreude overdrive. Discoveries of other literary misconduct by Lehrer are still being announced by the hour, it seems, tumbling out of the clown car that was once his body of work.

I admit it: I was had, along with tens of thousands of others. I was a junkie of his "Frontal Cortex" blog for Wired.com, for which Lehrer combed through obscure journals to find fascinating studies that he'd turn into long posts that hit cultural and personal nerves — with titles like "Does Thinking About God Improve Our Self-Control?" "Are Emotions Prophetic?" and "Does Preschool Matter?" He had a singular talent for synthesizing and framing science and making it relevant — or, so it seemed.

As it turns out, Lehrer distorted just about every piece of science he touched, according to NYU journalism professor Charles Seife, whom Wired.com hired to pore nearly 20 of Lehrer's posts for misdeeds. (You can read about Seife's findings here.)

Seife found that Lehrer reflexively twisted findings to fit his Big Idea theses and ignored studies that contradicted them. He copied press releases wholesale — an unbelievable practice for any

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journalist with integrity. He got narratives, facts, data, you name it... wrong. Lehrer wasn't just sloppy, though: He was an intellectual Bernie Madoff, scamming his audiences by turning single studies into sound-bite concepts too good to be true. But someone like that is bound to get caught out quickly, isn't he?

And there's where science comes in…or didn't, in this case. Lehrer was blogging and writing and speaking to big audiences about science for five years. His first bestseller — *Proust Was a Neuroscientist* — appeared in 2007. Yet it took a Dylan junkie, not a scientist, to out Lehrer as a fraud. Huh?

It turns out that many, many scientists were on to Lehrer's game, according to several prominent science writers who've written about the scandal since Moynihan's revelations. It was a running joke among them at conferences. Yet almost none of them made an issue out of it to Lehrer or to any of his editors. They grumbled, or grimaced, watched Lehrer distort or dismiss their work or the work of their colleagues…and then turned back to whatever they were doing.

You can already guess the reasons, because you've heard them all before, and maybe use them yourself. Maybe it's because only the science world, the peer-reviewed world, truly matters; not the world out there. Or maybe it was because Lehrer was part of "the media," and they always distort; so it didn't matter. Or it was in a magazine, or a newspaper, and they're never going to publish a letter to an editor; so why bother. Or maybe...the scientists just couldn't be bothered.

Whatever the rationalization, the attitude behind it is an unaffordable luxury, especially in these days of science under siege. Let me be clear: Jonah Lehrer is a pathological liar, an enemy of science; his mess is his own, and he has gotten what he deserved. But every scientist who said nothing when they read one of Lehrer's falsehoods is his accomplice; and so is any scientist who says nothing when she encounters a marketing or media distortion of her work or work with which she's familiar. Science is a public act, especially in the applied sciences; there's far too much at stake for you to consider it any other way. And part of your job as a scientist is to defend the integrity of science, wherever it is under attack. The Internet affords us tools of astonishing reach with which to do so — for free. It is inexcusable not to use them.

When I was running editorial for nature.org and Cool Green Science a few years ago, we ran a blog post by TNC freshwater scientist Paulo Petry about how Paulo had found the first intact specimens of a particular species of wood-eating catfish in the Amazon. We added that a protozoan in the gut of the fish aided the fish's digestion of the wood (logs that fell to the bottom of the river). Of course, we shopped the story to media, and of course they simplified it into: "Wood-eating catfish discovered in Amazon!"

A young scientist at Washington University in St. Louis — a specialist in wood-eating catfish — emailed me, asking for us to help correct some of the distortions. Paulo had not discovered the species, and the protozoan didn't digest the wood, he maintained. I sort of blew him off. He emailed again, and made clear he would not be denied. Now I understood: *This was science, and his professional life.* There was nothing more important to him. Not to mention that he was correct. So with Paulo's help, we altered the blog post, and we got some of the media reports changed, too. It wasn't easy, but it happened.

So what's your wood-eating catfish? Make sure you defend the hell out of it.

To continue the scold theme, I haven't been getting a lot of submissions recently for our running list of new Conservancy publications. If you've had something accepted by a journal, or you have a new report coming out, please email me and let me know about it. Science Communications can help with publicizing your work, and every paper we publish helps build the brand of TNC Science...but far more so if interested parties can find them all in one place. **SC**

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Peter Kareiva
Conservation in a World of Senior Citizens

By Peter Kareiva, chief scientist, The Nature Conservancy

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Discuss this article on the Conservation Gateway.

In your opinion, what's the most significant and certain global trend that is not on conservation's radar, but should be? The coming phosphate scarcity? The gradual deterioration of the world's soils? Or perhaps the smartphone revolution that we have failed to harness in support of conservation?

Here's my candidate: the demographic statistic called potential support ratio (PSR), which measures the ratio of a) the number of people ages 15 to 64 in a given population to b) the number of people age 65 or over in that population. Currently, the global PSR is 8.4, but it is expected to fall to 2.5 by 2050 and to 1.2 in 2100. Remarkably, there is very little uncertainty surrounding this prediction — the 80% prediction intervals are 2.2 to 2.8 for 2050, and 0.7 to 1.8 for 2100. Moreover, the trend cuts across virtually all countries, developing and developed.

PSR is meant, of course, to measure a society's ratio of productive workers to retirees. But why should conservationists start thinking about a world that will be at least three times older than it is now (as measured by PSR) in less than 40 years? Because, in that future world, the most profound national issues will be healthcare and

social services, as well as providing infrastructure and cities that serve an aging population. Just as we now couch conservation in terms of today's global challenges (food, energy and water), in 2050 we will need to couch conservation in terms of that era's global challenges — one of which will be an unprecedentedly older population.

One advantage of an aging population is that people over age 60 tend to drive less, fly less, consume less and consequently tread less heavily on the planet — all trends that point towards lower greenhouse gas emissions. But what other features of an aging population can we take advantage of in service of conservation, and what type of conservation will an aging population most care about?

Two things strike me. First, we will need to switch our conservation stories from what I would call "nature adventures" (swimming with the sharks, hiking across rugged and dangerous landscapes) to "walks in nature." We would shift our emphasis from conservation in far away and exotic locations to conservation in our own backyards.

Second, the elderly are uniquely susceptible to heat stress, and therefore anything conservation can offer to urban design that would reduce temperature spikes in cities will be a boon to an aging population. Thus, tree-lined streets, expansive urban parks and restored urban streams and rivers will be the hallmarks of cities that appeal to an older population. I have not been able to find data on this — but I hypothesize (based on my parents' behavior as they aged) that the elderly will favor cities designed for walking (as opposed to driving). In Europe, where populations are older, modal splits of transportation to work heavily favor walking, cycling and public transportation, whereas U.S. cities favor cars. Peter Calthorpe gave a talk last year at the California Academy of Sciences in which he said that 52% of Swedes walk and bike to work, as opposed to 11% in the United States. The difference is cultural, but it is also driven by the demands of demographics.

"If we don't cultivate 20-somethings to have an affinity for nature now, they won't suddenly be receptive to it (or us) when they're 60-somethings in 2050."

So maybe this aging world will be a blessing for nature. I can imagine a world where greenhouse gas emissions have fallen substantially due to changes in individual behavior, a world with greener and more walkable cities containing restored nature and urban parks, and a world where conservation is embraced as a global ethic thanks to the wisdom of elders. But conservation had better start preparing now for that embrace, and not simply assume that it will happen because we deserve it. If we don't cultivate 20-somethings to have an affinity for nature now, they won't suddenly be receptive to it (or us) when they're 60-somethings in 2050. **SC**

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Joe Fargione
Climate Change and Conflict: Is There Any Correlation?

By Joe Fargione, lead scientist, North America Region, The Nature Conservancy

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Discuss this article on the Conservation Gateway.

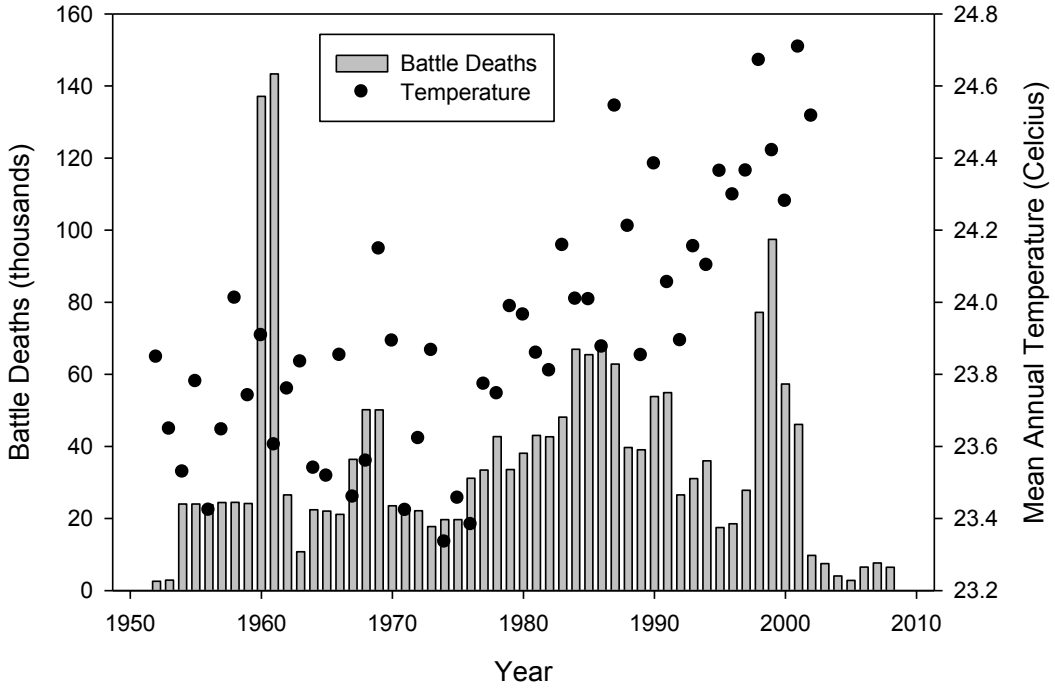
Will climate change lead to a future with more war? One popular hypothesis among advocates for action to curb climate change is that, if climate change creates or exacerbates resource scarcity for food and water (e.g., via crop failure and low rainfall), and resource scarcity creates conflict, then climate change could lead to increased conflict. But what is the evidence that past changes in climate have created resource scarcity and that such scarcity contributed to war? And how does the resource scarcity factor compare in importance to political drivers of war?

The question is complicated. For example, you have to specify what kind of war/conflict you are talking about (e.g., interstate war, civil war, or inter-communal violence) and use consistent criteria for what counts as war (e.g., thresholds for death counts and criteria to exclude one-sided massacres and pogroms). But there is a growing body of literature on this topic, and the surprising answer appears to be that the effect of past

climate change on conflict ranges from undetectable to small, and even when present sometimes goes in the opposite direction than you might predict.

Let's look at some specific examples from the literature. Although some research argued that increasing temperatures are correlated with increased war in Africa (Burke, 2009), this assertion is contradicted by subsequent analysis and by recent events (Buhaug, 2010). For example, although the first decade of this millennium was one of the hottest on record for Africa, average annual battle deaths were down 38-68% from any of the four previous decades (through 2008, the last year for which battle deaths data are available; see Figure 1). Clearly, whatever factors led to declines in violence are much stronger than the effects of increased temperature.

Figure 1: Battle deaths in Africa (in thousands) and mean annual temperature on the continent, 1950-2008



Sources: Data from Climate Wizard (http://climatewizardcustom.org/) and PRIO Battle Deaths Dataset (http://www.prio.no/CSCW/Datasets/Armed-Conflict/Battle-Deaths/The-Battle-Deaths-Dataset-version-30/)

A recent special issue in *The Journal of Peace Research* provides more detailed case studies of the relationship between climate and conflict. Researchers are turning toward lower-intensity conflict to test for the effects of climate change on violent conflict. As they define it, low-intensity conflict includes riots, protests and inter-communal conflict, such as between farmers and herders. Such conflict is more frequent, allowing a larger sample size and more rigorous statistics. Such conflict is also potentially more easily triggered by climate, since, for example, subsistence farmers and herders are among the

most exposed to the effects of climate change. But one recent study of low-intensity conflict in Africa found that it tended to be higher in *wetter* years (Hendrix and Salehyan, 2012). The causal mechanism is unclear, but these results suggest it is not as simple as climate change -> resource scarcity -> increased conflict.

Of course, lack of past correlation doesn't mean that there won't be problems in the future. Rapid climate change could bolt past thresholds of resilience, threatening food security and triggering natural disasters that spur an unsustainable wave of migration from rural to urban areas.

However, political factors are still likely to determine the prevalence of war. The surprising news here is that war deaths (along with pretty much every other form of violence) have been decreasing globally since the end of World War II. But don't take my word for it. The data are exhaustively compiled in Steven Pinker's 2011 book *The Better Angels of Our Nature: Why Violence Has Declined* (Pinker, 2011).

The forces that Pinker has identified as likely causes for the declines in war will still be in effect as the climate changes. Democracies tend to stick around once they are created, and are much less likely to be involved in interstate wars than are other forms of government. Weak democracies are still prone to civil war, but several factors have reduced deaths from civil wars. Peacekeepers have proven to be effective in reducing the probability of civil war. Increasing economic co-dependency and the economic benefits of trade, which are disrupted during civil wars, can provide incentives for citizens to avoid conflict. And one of the biggest predictors of civil war is past civil war. As more countries gain distance from their conflicted pasts, the likelihood that old rivalries will resurface decreases. Even the influx of rural residents to urban areas should ultimately decrease inter-communal conflict, as the diversity and proximity of cultures in the urban milieu promotes increased understanding and tolerance among ethnic groups. In other words, climate change is likely to make a lot people suffer, but not necessarily by increasing war.

"While the literature around climate change and war has not reached a consensus, it tends to find either no effect or a very weak effect. Attempts to spur action on climate change by linking it to violent conflict are treading on pretty thin ice."

What does all this mean for conservation? The conservation movement is desperate to get climate change back in the public conversation, following the build-up and crash of media coverage around Copenhagen. Consequently, you will see climate change linked to a variety of issues that the public cares more about, such as crop production, natural disasters and national security. Highlighting such consequences of climate change in an effort to raise awareness is all well and good. But if such linkages are not backed up by sound science, they will backfire. While the literature around climate change and war has not reached a consensus, it tends to find either no effect or a very weak effect. Attempts to spur action on climate change by linking it to violent conflict are treading on pretty thin ice. **SC**

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Feature Article
GDP 2.0: The Inclusive Wealth Index and Beyond

By Heather Tallis, lead scientist, Natural Capital Project, Stanford University

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In the United States, we're reminded every July to think about our independence and what our founding fathers had in mind for us: Life, liberty and the pursuit of GDP. No wait: that's not right. But gross domestic product (GDP) is what we and other countries still use to measure how countries are doing and how well off — or, presumably, how happy — we are as citizens.

However, many academics, policymakers and even finance leaders have grown increasingly skeptical about whether GDP does even an adequate job of measuring human happiness — or a country's wealth. And the reasons for skepticism have mounted in recent years. For example, measures of income like GDP can actually look good in times of great distress. Moody's estimated that the Gulf of Mexico region lost $1.2 billion in output in the year 2010 after the Deepwater Horizon oil spill. But GDP didn't budge. While the shrimp industry crashed, tourism plummeted, livelihoods disappeared and miles of marsh were polluted, lots of money was being spent on clean

up and recovery. All that spending is classified as income, and since GDP is an income account, all that expenditure offset the lost outputs from fishing, tourism and other industries. In reality, it's not likely that many people — environmentalists or not — would agree that the country was hardly impacted by the spill.

Another problem with GDP is that it is a measure of current income. It tells us how well a country is doing this year, but doesn't give us a very good idea of what's coming next. Take, for example, the ongoing global financial crisis. GDP growth in Ireland, Greece and Spain (among other countries) hovered around 5% from 2000 to 2007, when it unexpectedly plummeted into the red. Part of that high growth was built on large borrowing that could not be sustained over the long term. Similarly, aggressive harvesting of fish, timber and other natural resources can lead to large current income but be unsustainable because those practices deplete the natural capital these industries depend on.

This is where nature comes into the picture. A major reason to reform economic accounting is to be more inclusive of the many things that a robust environment contributes to human well being: jobs, education, food, water, energy, peaceful walks, spiritual moments…the list goes on. But while GDP captures the value of a new car purchase, it does a poor job as conventionally measured of capturing the values of clean air and clean water, of conserving species and natural habitat, of good health, or of living close to family and friends. In fact, much of what is conventionally thought of as contributing to quality of life is either partly or completely unaccounted for by measures of GDP.

Many countries have recognized the limitations of GDP and are ready to advance towards metrics that do a better job of accounting for economic, social and environmental components of the human condition in a more complete way. Former French president Nicolas Sarkozy commissioned an influential report on GDP alternatives. The World Bank is leading an effort to green national accounts (Wealth Accounting and Valuation of Ecosystem Services, otherwise known as WAVES). And even the financial sector has come out in support of an alternative to GDP in its Natural Capital Declaration.

"As long as we use GDP as our major metric of wealth, we will stay a long ways off from happiness and the sustainable management of natural capital needed to keep us in smiles."

So everyone agrees we can do better. But getting to better is not exactly straightforward, which highlights another reason why GDP has hung around for so long: we know how to calculate it. Ideas for alternatives exist, like "inclusive wealth" — so named because it accounts for all major forms of capital (e.g., social capital, human capital, manufactured capital, natural capital) and it considers the ability of those capital stocks to provide goods and services into the future. The concept of inclusive wealth has been around in the economics community for a couple of decades, and was popularized recently by two economics gurus (Joseph Stiglitz and Amartya Sen) in a 2010 book called *Mismeasuring Our Lives: Why GDP Doesn't Add Up*. But even with all this talk, actually measuring inclusive wealth has proven difficult.

The Inclusive Wealth Index: Stunning Departures from Historic GDP Trends

The good news: We are starting to see the light at the end of the tunnel. The first Inclusive Wealth Report was released at Rio +20, put together by the UN (specifically, UN University International Human Dimensions Program, UN Environment Programme) with support from the UN-Water Decade and the Natural Capital Project. The report takes a first stab at calculating an Inclusive Wealth Index (IWI) for 20 countries. Their formulation of the index takes into account human capital (education and jobs); manufactured capital (assets like tools, machines, buildings); and for the first time, natural capital.

One of the big difficulties in implementing this index comes from the desire to calculate the monetary value of goods and services provided by natural capital. Many of these goods and services are public goods — meaning they are not traded in markets. So we cannot easily track the value of these goods to society with market values, and it thus becomes quite challenging to reflect their value in a way that's easy to combine into one number, like GDP. So the authors of the IWI stuck to natural capital stocks that generate goods traded in markets — accounting for fossil fuels, minerals, forests, agriculture and fisheries — an approach that leaves out much of the value of natural capital.

Even with this very conservative accounting of natural capital, the differences between patterns in GDP and the IWI in the last 19 years are stunning. Between 1990 and 2008, China's GDP grew 422%, while its IWI only grew 45%, showing the large tradeoff China has made in natural capital to achieve its more commonly reported income growth. Even the United States did not fare as well in IWI (13% growth) as it did according to GDP (37% growth).

The Long Work Ahead to Account for More Natural Capital

Given the starkly different picture of national wealth that the IWI gives, even with a very conservative representation of natural capital, it seems worthwhile to try to go further. The Natural Capital Project's contribution to the report was to try out a way to include in inclusive wealth calculations those natural capital stocks that support *regulating ecosystem services* — services such as drinking-water-quality regulation, flood mitigation, climate regulation, and erosion control, among others.

"Given the starkly different picture of national wealth that the IWI gives, even with a very conservative representation of natural capital, it seems worthwhile to try to go further."

Working with TNC in the Northern Andes-Southern Central America program, we used ecosystem service estimation models in the freely available InVEST software to map out four regulating services at the national scale for Ecuador and Colombia. We were only able to get to present value estimates for one service: climate regulation through carbon sequestration. In Colombia, the carbon stocks in the country in 2000 had a present value of USD$376.8 billion to $3.885 trillion, depending on the price of carbon we used. The low-end estimate is based on the price the World Bank pays per ton ($20/metric ton C), and the upper end is based on the 95th percentile of reported social cost of

carbon estimates ($205/metric ton C). Ecuador, being a much smaller country, has a smaller standing stock of carbon that in 2000 had a present value of USD$74.5 billion to $772.8 billion, again depending on carbon prices.

We tried to apply the same approach, with different InVEST models, to water quality regulation (nitrogen and sediment retention). We were able to estimate the amount of service provided at the national scale (e.g. in 2000, Colombia enjoyed retention of 24.5 billion tons of sediment), but we weren't able to translate those into net present value estimates for saved drinking water treatment costs or saved reservoir dredge costs because economic data on operation of treatment facilities and reservoirs were not freely available.

Perhaps the IWI report will be enough of an eye opener for countries to see the value in taking the leap. We need countries to commit to regular collection and reporting of these kinds of data to make a better metric possible. It wouldn't be the first time governments made such a leap. No one was collecting all the data we needed when GDP started. In fact, it was the lack of data available to help guide the United States through the Great Depression that led to the creation of the first income accounts.

Discuss this article on the Conservation Gateway.

In health, you are what you eat. In wealth, you are what you measure. And what we measure has a huge influence on what we pay attention to and act on. GDP (along with percent unemployed) is still the kingpin of economic measures, from the media to policy circles to dinner conversation. As long as we use GDP as our major metric of wealth, we will stay a long ways off from happiness and the sustainable management of natural capital needed to keep us in smiles. **SC**

Jensen Montambault

Conservation's Smoking Gun: Who Bears the Cost of Making Us 'Evidence-Based'?

By Jensen Montambault, applied conservation scientist, Central Science, The Nature Conservancy

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Discuss this article on the Conservation Gateway.

Today, it's hard to think about medicine being practiced on anything but evidence (except on the TV show "House").

But as late as 40 years ago, medicine still relied as much on tradition and myth as it did on randomized and quasi-randomized controlled trials or massive cohort studies accessible in peer-reviewed publications and technical reports and strained through a methodological sieve. It took a 1972 monograph by the Scottish doctor Archie Cochrane to spur a widespread movement in medicine toward the scientific method. Cochrane — whose name now adorns a huge database of systematic medical reviews, a center in Oxford and an international research NGO — dedicated his life to making medicine evidence-based after seeing countless interventions during the Spanish Civil War and World War II that had no data to back them.

Today, a typical Cochrane Collaboration review might use the outcomes of 18 trials of pre- and neonatal care to recommend a best-practices package of the interventions with evidence showing they reduce infant and maternal mortality…and with detailed, summarized results free and open to the public.

Imagine a menu like this for oyster reef restoration, sustainable fisheries, conservation easements — pick your conservation flavor! Restoration managers in California declared these kinds of published synthetic reviews the single most useful and available tool for choosing an intervention — even better than web databases or calling up a friend/expert (Seavy and Howell 2010).[1]

Such utility was the dream of Collaboration for Environmental Evidence (CEE) founders when they launched CEE in 2003. It's hard to find fault with their logic, which linked directly to the widely lauded medical model (Pullin and Knight 2001). But the application of the medical review model to conservation has not quite panned out as hoped. While the Cochrane Collaboration boasts more than 5,000 completed reviews, CEE has only 44 completed reviews, with an additional three by sister org Conservation Evidence (CE). Admittedly, the Cochrane Collaboration began in 1993, so it had a little head start. However, the low numbers for conservation naturally raise the question: Why isn't this taking off?

The Lack of An Institutional Base and the 'Evidence Myth Trap'

First, the political and other institutional structures that provide a solid base for action in the U.K. medical world, Cochrane's home turf, are absent for global conservation (Segan et al. 2011). Cochrane searches global evidence, but the problems it tries to solve are relatively uniform, unlike conservation's.

Second, the Cochrane project relies on reliable published medical trials. You can quibble about the definition of "reliable" (and the medical-evidence community more than quibbles; see the recent argument about Cochrane reviews and the evaluation of mass deworming policies in developing countries), but rates of publication of biomedical research are way higher than in conservation-related fields.[2] Publication rates for conservation and applied ecology are slower than even sister fields such as taxonomy, behavior and evolution and genetics (Kareiva et al 2002). There is simply less evidence to draw from.

But we are also caught in an evidence myth trap. When I talked to one of the CE founders last December, he told me the best thing TNC could do was convince staff to write up results related to their pre-identified themes. This presents a very different cost/benefit structure, in my mind, than harvesting themes from already published research or organizing scientists around conservation topics of TNC interest. In addition, the published price of CEE reviews is between US$30,000-$300,000, which might help explain the low number of synthetic reviews available in conservation. Despite the enthusiasm of the 50 scientists and managers that attended the meta-analysis session at the last TNC all-science meeting, it seems unlikely that a single program will bear that cost for the good of the order. This challenge isn't about a culture of valuing evidence; it's a question of who is championing what evidence and why.

"This challenge isn't about a culture of valuing evidence; it's a question of who is championing what evidence and why."

A perhaps more tractable model is that proposed by the Global Environment Facility: special funding windows for "contributing to global conservation [by] …test[ing] and evaluat[ing] the hypotheses embedded in project interventions" (Ferraro 2012). Several conservation programs/organizations could collaborate to test a common intervention in need of evidence — say, upstream conservation to improve downstream ecosystem services.

Conservation may never be as standardized and coordinated as Western medicine, but it may not have to be. More rapid turn-around, open access and conservation-friendly journals accompanied by funding initiatives that promote interagency cooperation and learning might be enough to reasonably intertwine our daily work and the value of science. **SC**

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Notes

[1]Although a different survey in Australia found the use and availability of evidence is highly variable among managers of different types of conservation areas (Cook et al 2010).

[2]Using data from the National Research Council's "A Data-based Assessment of Research-Doctorate Programs in the United States" (accessed on 16 August 2012), biomedical fields were Biology/Integrative Biology/Integrated Biomedical Science, Immunology and Infectious Disease, Nursing, Pharmocology, Toxicology, & Environmental Health, and Public Health, and conservation fields were Forestry and Forest Sciences, Agriculture and Resource Economics, Ecology and Evolutionary Biology. Data compared using Welch's ANOVA for unequal variances; $p < 0.001$ in JMP 10.0.

Jon Fisher
The Case Against Flying So Much

By Jon Fisher, spatial scientist, Sustainable Science Team, The Nature Conservancy

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Discuss this article on the Conservation Gateway.

How is it possible that a vegan, car-free, green-living fanatic could have a bigger carbon footprint than the average American? It's pretty simple: for people who travel a lot — whether for work, pleasure or both — flying can outweigh everything else we do to live green.

Like many science staff at TNC, sometimes I'm a bit self-righteous about green living and I get frustrated when friends and family (and co-workers) seem to not "get it." But recently I've been trying to objectively look at my overall environmental impact, and I've realized that some of the things I obsess over make less of a difference than the things I have given myself a "free pass" to do in the past — especially travel.

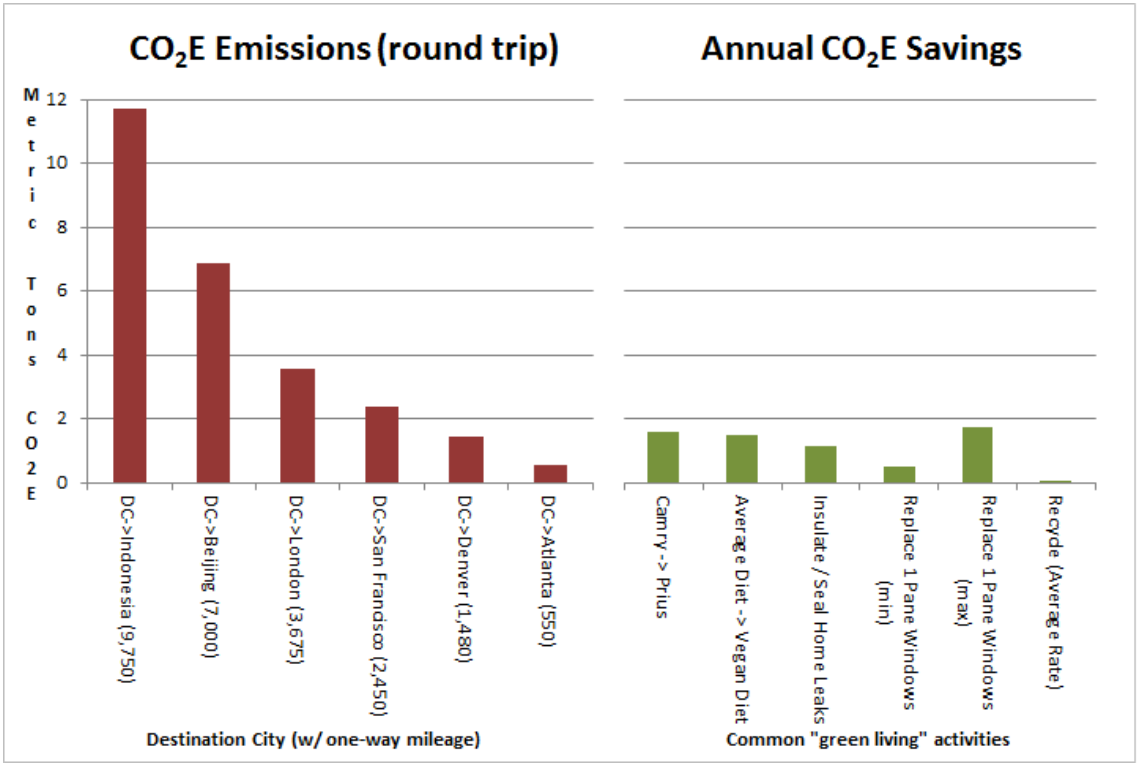
For example, a few years ago I attended a conference in Borneo (Indonesia) for work, learning about our projects there and conducting a few days of technical training for local staff. Afterwards, I calculated the emissions for that trip's flights — a total carbon footprint of 11.7 metric tons of CO_2 equivalent,[1] more than the total household energy

use (electricity, gas, etc.) of the average American family for a whole year![2] While I am hopeful that the trip ultimately led to enough of an improvement in conservation that the flight was worth it, it's still a pretty scary number.

Which led me to a disturbing realization: all of my efforts to shrink my carbon footprint — from eating vegan/organic/local foods to installing energy-efficient appliances in my home and commuting by bike — are all counteracted if I fly often. Simply staying close to home can have a bigger impact than all those activities, at least in terms of carbon footprint.

This chart comparing the carbon emissions of flight travel to various "green" activities illustrates my point:

Figure 1: Emissions Comparison of Round-Trip Flights with Common 'Green-Living' Activities[3]



"All of my efforts to shrink my carbon footprint — from eating vegan/organic/local foods to installing energy-efficient appliances in my home and commuting by bike — are all counteracted if I fly often."

As you can see, doing something like cutting out one cross-country flight can reduce your carbon footprint more than eating vegan for a whole year. And while doing some basic insulating at home has about the same impact as replacing old single-pane windows with new Energy-Star ones (and costs way less), you'd do even better to skip a single long flight (or long car trip, especially if driving alone) per year.

Note that, while the average impact each of us has through recycling is quite small, the total impact of recycling is still impressive: almost 16 million tons of CO2 are saved each year in the United States through recycling, not to mention less landfill waste and less resource use.

So what does this mean for TNC science staff? First, don't take this analysis as a license to stop doing all the little things that help reduce your carbon footprint. Many of the common "green" actions we take have other environmental benefits besides reducing carbon emissions — for instance, carrying a tote bag to the grocery store reduces plastic, eating a vegan diet saves water over meat-and-dairy intensive diets, etc.[4]

But if, like me, you've been giving Hummer drivers dirty looks while flying on a regular basis, take a moment to think about how you can reduce both the frequency and distance of your travel. For me, it was a wake-up call to calculate my carbon footprint from flying in terms of the average annual Hummer emissions (6.5 metric tons)...and then visualize towing a few Hummers behind me on my bike everywhere I go.[5]

There's no question that travel is often a necessary part of being a Conservancy scientist: we don't want to paralyze ourselves, stifle collaboration or just end up feeling guilty. But I also think it's highly likely that some of our travel has a higher cost than benefit, and that we should be approaching that scientifically, as befits us.

On the cost side we have carbon footprint, actual costs to TNC of the trip (flight, hotel, food, taxis, registration fees, salary cost during the trip, etc.), actual costs to the employee (e.g. child or pet care), and some qualitative costs that are harder to estimate (opportunity cost of not doing your normal job while traveling, decreased productivity due to sleep loss / stress, strain on personal relationships when leaving a family at home, etc.). The benefits are mostly in the hard to estimate category for scientists; we rarely can say "we now have a grant we couldn't have received without me traveling." But we can start to think about how much we value benefits of learning, creating and strengthening professional relationships, opportunities to collaborate, practice presenting our work, and other benefits. The critical final question is: how many of those benefits can we achieve at a much lower cost through other means? Just as many companies forced to reduce the amount of pollution they emit often ended up saving money, I wonder if TNC Science might be surprised at the unexpected benefits if we dialed back our travel.

"There's no question that travel is often a necessary part of being a Conservancy scientist: we don't want to paralyze ourselves, stifle collaboration, or just end up feeling guilty. But I also think it's highly likely that some of our travel has a higher cost than benefit, and that we should be approaching that scientifically, as befits us."

I don't have all the answers, but I'm hopeful we can get creative about how to do better as a division in cutting back on travel. Here are some ideas to get us started, and I'd love to hear more ideas from others:

- We need to use technology better (Skype, WebEx, Nefsis, Google+ "hangouts," Connect, etc.) to meet some of the needs we usually fill by traveling. There is no single technology to completely replace in-person meetings, but by combining them we can get pretty far. TIS has put together a guide to some of the options (https://connect.tnc.org/Departments/TechnologyInformationSystems/TechnologiesInfrastructure/Documents/Green%20Meeting%20Decision%20Matrix.pdf), and is currently working on researching additional options. Contact Joe Pilkington (jpilkington@tnc.org) with tech suggestions or ideas.

• TNC's science culture currently encourages a lot of travel. What can we do to encourage innovation in doing our jobs with less travel? Can we learn tips from the upcoming TNC virtual marketing conference?

• For conferences that alternate location (e.g. Society of Conservation Biology biannual meetings), staff should be encouraged to attend when they're close, not when they're somewhere cool and exotic (but far and expensive).

• Should TNC Science buy carbon offsets (ideally, through our own TNC offset program) to help encourage us to account for the environmental cost and work harder to avoid travel? This tactic would add some administrative burden, but helps to make the true costs more explicit.

• Should TNC Science consider more often hiring local short-term help rather than assuming the only / best solution is to fly ourselves all over the world? I hear a lot about people who fly a long way to do something (field work, a short interview or discussion, etc.) for which we could probably find competent local help. Again, if we include the total cost, this route may look like a better option. **SC**

Notes

[1]Calculations of carbon footprint from http://carbonfund.org/offset/individuals (which in turn is based on http://www.epa.gov/climateleadership/documents/resources/commute_travel_product.pdf). I used the actual flight pattern which included three layovers; a direct flight from DC to Balikpapan would have been slightly less (9.5 metric tons CO2E). Note that CO2E (or CO2 equivalent) indicates that factors including radiative forcing and other greenhouse gases like methane have been accounted for, so that their actual impact is measured in how much pure CO2 would be emitted to have the same impact. In this case, the emissions were multiplied by 2.7 to account for radiative forcing (as per IPCC recommendations). These estimates are the footprint per coach passenger of a typical plane for the distance flown assuming a completely full flight. They do not account for energy used in producing the aircraft or support infrastructure.

[2]See the "home energy use" section on http://www.epa.gov/cleanenergy/energy-resources/refs.html

[3]Chart calculations: See footnote 1 above for details of the calculations. As noted above, I used actual flight patterns I have taken (including layovers where the cheapest flight from DC uses them), and including radiative forcing.

The impact of switching from the average American diet to a vegan one (or from a "red meat" diet to the average one) was calculated in http://pge.uchicago.edu/workshop/documents/martin1.pdf. The average American diet gets 28% of calories from animal sources, of which 54% comes from meat (roughly 60% red meat and 40% chicken and fish). The efficiency of the Camry (28 mpg combined, http://www.fueleconomy.gov/feg/bymodel/2012_Toyota_Camry.shtml) and Prius (50 mpg combined, http://www.fueleconomy.gov/feg/bymodel/2012_Toyota_Prius.shtml) were plugged into the vehicle emissions equation on http://www.epa.gov/cleanenergy/energy-resources/refs.html to generate the projected annual emissions of each vehicle.

The emissions savings from insulation and sealing drafts came from the EPA's estimate that homeowners can save up to 10% on total energy costs through such activities (http://www.energystar.gov/index.cfm?c=home_sealing.hm_improvement_methodology) combined with the EPA's estimates of average annual home energy use (see citation #2); the actual impact will vary substantially by home/region, but I didn't have data on the range of values in the Unite States. The range of emissions savings from replacing single pane with energy star windows (shown as error bars around a mean value) came from http://www.energystar.gov/index.cfm?c=windows_doors.pr_benefits. Note that for windows, a range of emissions is presented as it varies by region, and that if replacing double-pane windows, the savings are much lower.)

The emissions savings from recycling used the figures from http://www.popularmechanics.com/science/environment/recycling/4291576 to calculate the total amount of CO2 emissions avoided by recycling aluminum, glass, newsprint and #1 plastics in the United States (other less commonly recycled materials were not considered). That figure was then divided by the 2010 U.S. population to get the average amount of CO2 emissions avoided by recycling per American.

[4]How much water can you save by cutting back on animal products? Replacing a single hamburger with a soy burger saves 579 gallons (http://pge.uchicago.edu/workshop/documents/martin1.pdf), which has about the impact of using no water at home (not counting food/fiber, but including everything else) for more than eight days (based on daily usage from http://www.drinktap.org/consumerdnn/Home/WaterInformation/Conservation/WaterUseStatistics/tabid/85/Default.aspx)! Replacing a half gallon of cow's milk with soy milk saves 398 gallons or almost six days of water (555 gallons H20 per ½ gallon cow's milk vs 157 gallons H20 per ½ gallon soy milk).

[5]See the "passenger vehicle" section of http://www.epa.gov/cleanenergy/energy-resources/refs.html for the basic equation used to calculate emissions. The MPG of the most recent Hummer (16 mpg) came from http://www.fueleconomy.gov/feg/Find.do?action=sbs&id=29370. Using this equation and mpg rating, and assuming the hummer is driven the average number of miles for a year, the hummer's annual emissions are an estimated 6.5 metric tons of CO2E. The average annual emissions for an average car in the United States are 5.1 metric tons of CO2E. To compare myself to a Hummer driver, I calculated the carbon footprint of all of my flights for this year through August, assumed my monthly emissions rate would be the same for the last 4 months, and came up with 19.3 metric tons of CO2E (about three Hummers worth).

15 Seconds of Fame
Mike Palmer

Mike Palmer is conservation program officer (CPO) for the Conservancy's office in Yellowknife, Canada — or, as he describes it, "the lone employee posted in the Arctic." Last year, he orchestrated the Thelon expedition with Sanjayan, Richard Jeo and youth of the Dene First Nation into a remote and sacred wilderness.

OH CANADA: When I first moved here, the Northwest Territories (NWT) seemed extremely remote, but just like anything, you get used to it. Yellowknife is a capital city with Walmart, McDonalds and Pizza Hut — if you want it. I live down in "Old Town" where floating houseboats, off-grid shacks and bush planes are more common. The best thing about living here is the access to true wilderness and the opportunity to explore it. It allows people to thoroughly test themselves and push limits related to an older way of life, when people still hunted their food and didn't stare at an iCrap device all day.

SUMMER VACATION: An Arctic summer is something amazing to behold. I spend most of my free time outside in endless daylight, 80-degree temps and lots of bugs! Paddling vast lakes and rivers is the best way to explore. Most southerners don't realize how much water exists in the Arctic.

READING: I just finished *The Legend of John Hornby* by George Whalley. I have a thing for reading old journals of Arctic explorers and trappers. The strength and tenacity of these men is astounding. It boggles my mind to think of what they did — before GPS, satellite phones and bug nets.

Interview by Darci Palmquist. Know someone we should feature in this column? Please email her with comments or suggestions.

Image: Mike on a moose hunt. Temperature: -30 Celsius.

Discuss this article on the Conservation Gateway.

CATCHING: Ice fishing season starts in late November and lasts well into April. Around Christmas, I set up my canvas wall tent on a remote lake about an hour out of town by snowmobile. It has a small wood stove, a table and a bed. I use a hand auger to drill holes, drop in a line, and wait…and wait. You need patience and a very positive attitude.

The fish move extremely slow in the cold weather and rarely eat. My most memorable catch was a 20 lb. lake trout through a 6-inch diameter hole. I ended up taking off my parka, fleece and shirt so I could reach my bare arm and shoulder down into the water-filled hole and squeeze the fish up through the ice. It was big. The last few years I've acquired a license to set a gill net. That has increased my efficiency quite a bit and is the best way to secure local, healthy, sustainable protein.

T**HELON YOUTH**: When I learned that the people of the Lutsel K'e First Nation community had always wanted to get youth into their most sacred place — the Upper Thelon River, a place also under threat from uranium mining — Richard Jeo and I talked about the idea of an expedition. The only access to the area is by float plane carrying canoes. Soon after, my life became full of logistics dealing with chartered bush planes, folding canoes, dehydrated food and wrangling youth. It was intense.

My favorite part was knowing we were providing an opportunity to youth they would never get otherwise — an opportunity that would immediately impact our conservation gains. The kids were so open and honest about what they had learned, urged on by being immersed in this incredible landscape. They all talked about how much healthy lands and waters mean to them.

I am still in touch with the kids that live in the NWT and they've been telling their friends how tough they are for completing the trip. Now all the other Lutsel K'e kids want to be tough too.

TRENDING SCIENCE: Since getting into conservation, I've always been fascinated with the idea of overpopulation of humans on the planet. Every single conservation and environmental issue we face deals with too damn many people. We could burn, pave and kill whatever we wanted if there just weren't so many people doing it. I find it interesting to watch how TNC addresses this taboo issue as we evolve as an organization. **SC**

From the Field
Secrets of Willet Migration Revealed

By Darci Palmquist, senior science writer, The Nature Conservancy

Above: Joe Smith, a conservation ecologist for the Conservancy, is conducting a three-year study on willet migration using the birds that have returned from their wintering grounds to nest at TNC's Gandys Beach Preserve in New Jersey. Photo credit: Erika Nortemann/TNC.

Olympic athletes are impressive, no doubt. But when it comes to athletic prowess, few creatures compare to migratory birds like the eastern willet.

A large shorebird with distinctive white racing stripes and a unique penchant for nesting in salt marshes, the willet flies at speeds up to 57 MPH to cross the Atlantic Ocean in just 3 days. Leaving its nesting grounds at the Delaware Bayshores by early August, willets cover some 3,500 miles before eventually settling down for the winter in …where?

The secret location of willets' wintering grounds had been a mystery — until now. Conservancy ecologist Joe Smith studied willet migration for the past 3 years and discovered that the eastern willet winters in estuaries on the northern coast of South America, mostly in Brazil and Suriname.

His discovery comes with the aid of new geolocator tags that rely on hours of sunlight to pinpoint latitude and longitude. Geolocators are lightweight, small and

cheap — allowing scientists to track more types of birds, like willets, that were considered too small for the bulkier satellite tags traditionally used.

Such advances in technology are ushering in a new era of bird studies and giving scientists deeper insight into the full annual life cycle of migratory animals, a burgeoning field known as "migratory connectivity." It goes beyond discovering where birds like willets winter to answering more complicated questions about how they migrate — such as how many miles they travel per day and how many places they stop. Migratory connectivity even uses advanced analysis of birds' chemical makeup to understand what the habitat conditions are like at their wintering grounds.

"It's a golden age for tracking migration," enthuses Smith. "We're learning that it's a big world, yet it's a small world for these birds because they use very discrete places."

And these advances in science can mean better conservation for birds like the willet.

(See a photo slideshow of Smith catching willets as part of his research.)

An Overlooked Species of Scientific Research

Very few studies have been conducted on eastern willets, with only one significant research project in the 1970s. Smith's study will provide the richest collection of data about the migration of this species to date.

In addition to the geolocator tags, Smith's team collects feather and blood samples that are then analyzed for mercury and carbon and nitrogen isotopes by experts at the Biodiversity Research Institute (BRI) and Smithsonian Migratory Bird Center. Together they're piecing together a more complete picture of the annual life cycle of an eastern willet.

"'It's a golden age for tracking migration,' enthuses Smith. 'We're learning that it's a big world, yet it's a small world for these birds because they use very discrete places.'"

The birds' primary wintering area in Brazil happens to be a shorebird hotspot — it has the largest tract of intact mangrove forest in the Western Hemisphere and is sparsely populated. It's not a big surprise that the willets spend their winter here, where the mangroves are lush and the food is plentiful.

What is a surprise is the other discovery that Smith's team has made: willets are picking up mercury pollution at potentially harmful levels at these seemingly pristine wintering grounds.

"We know this because of the feather samples," explains Smith. "Feathers retain a signature of the habitat conditions where they were grown. When the birds arrive here to nest, we can get a really good sense of what their winter habitat conditions were like from feather samples."

Mercury & Migration Don't Mix

The cause of mercury pollution at such a pristine place could be nearby gold mining, a well-documented source of methylmercury in the Brazilian Amazon (methylmercury is the organic form of mercury that can be harmful to people and wildlife). It's also possible that the source-point is further away, since mercury released into the atmosphere can travel long distances before being deposited in an ecosystem and undergoing methylation.

But what the mercury means for willets is still unclear.

"We know that mercury in loons creates asymmetrical wings, so we're looking out for that in our birds," says Smith.

Wing asymmetry spells trouble for long-distance migrators like willets, says Dave Evers of the Biodiversity Research Institute. He's been researching the effects of mercury on wildlife for years and first discovered the problem of wing asymmetry in loons. More recently, he's documented mercury's impact on insect-eating songbirds.

"If you have perfect symmetry, you'll have an easier time flying," he explains. "Controlled studies of starlings in wind tunnels have shown that a 5% difference in wing symmetry can cause a 20% increase in energy output during flight."

Shorebirds could be particularly vulnerable to mercury for two reasons: 1) wet areas, such as the estuaries where willets live year-round, typically exhibit the highest methylation; and 2) mercury is stored in the muscles—when migrating birds burn through their fat stores, they then rely on muscle energy that could release more mercury into their systems.

"My concern is for birds like willets that migrate long distances and build up mercury in their bodies without having time to get rid of it," says Evers.

Rising Seas, Raising Questions

Smith's 3-year study is just concluding—next there will be many months of analyzing and interpreting the rich storehouse of data collected. Further analysis will reveal if the willets exhibit asymmetrical wings or high levels of mercury.

And there will be other mysteries to explore, including the million-dollar climate change question: what will happen as rising sea levels transform the estuarine habitat that willets rely on?

"Willets are the only shorebird to nest in salt marshes," says Smith. "Given that all the habitat they use is only inches above the current sea level, even the most conservative predictions of sea-level rise will affect them."

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.

Another concern is habitat destruction from human development. Shrimp farming is growing rapidly in Brazil, taking down huge chunks of mangroves with it.

"Shrimp farming isn't prevalent here yet, but this very pristine place could be threatened in the future," says Smith. "Shrimp farming seems to be creeping westward along the coast and Brazil recently passed a law that makes it easier to develop protected areas."

Smith is optimistic that the questions can be answered and solutions found. He sees a silver lining in the fact that the birds' wintering area in Brazil is mostly populated by subsistence communities.

"Activities like industrial shrimp farming displace people who live subsistence lifestyles, as well as the wildlife and the ecosystems," he explains. "The birds don't have a voice, but the people do. My hope is that the people living here can be allies for conservation in the area." **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) A Good Housekeeping Seal for Science (Slate): Replication failure is epidemic in science — a recent review by biotech giant Amgen of 53 pathbreaking cancer studies failed to replicate the results of *47 of them*. One solution: The Reproducibility Initiative, which takes your study and, if it can replicate the results, gives you a big fat badge to put next to it on the journal's website. The goal: "Shift the culture of science from rewarding originality to things that are actually true."

2) Assuming We Develop the Capability, Should We Bring Back Extinct Species? (The Atlantic): It's a question we'll face shortly, says Rebecca J. Rosen — so what are the consequences? Would they all automatically be invasives? Should we tweak them genetically to improve their fitness...or their ability to live among people without eating them, like the California grizzly bear?

3) Argentinian Politicians Unveil Plan to Shoot Seagulls That Attack Whales (The Guardian): Seagulls, whose population off Patagonia has exploded over the last decade because of the proliferation of garbage there, have taken to attacking southern right whales as they surface for air, opening wounds that the gulls then mine for blubber and flesh. The provincial government approved a 100-day cull, worried the gull attacks will drive away the booming whale-watching tourist trade.

4) **A New Goal for Nature: Healthy, But Not Pristine (Scientific American)**: A member of the project to develop the new Ocean Health Index talks about the stiff resistance within conservation circles they faced to creating a measure of nature that was about its relationship with humanity, not its relationship to a reference state.

5) Rachel Carson Didn't Kill Millions of Africans (Slate): Did you know that some free-enterprise groups maintain Rachel Carson's opposition to pesticide ended up discouraging the use of DDT in Africa? Michael Crichton famously wrote that Carson "killed more people than Hitler." Author William Souder debunks.

6) **The Great Steelhead Rescue (Outside)**: TNC's Jeff Opperman finds river monsters in the stream behind his house...and they become a pretext for meditating on nature in the Anthropocene. But not before he tries to rescue them.

7) **This gorgeous world map depicts all of Earth's hurricanes since 1851 (io9.com)** By position and intensity.

8) Journey North: A Global Study of Wildlife Migration and Seasonal Change: Citizen science on migration for the K-12 set. iPhone app to report observations.

9) **Fox that discovers it's on a trampoline (Tumblr):** Except it's not doing it right. 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.

Craine, J.M., T.W. Ocheltree, J.B. Nippert, E.G. Towne, A.M. Skibbe, S.W. Kembel, and J.E. Fargione. 2012. Global diversity of drought tolerance and grassland climate-change resilience. *Nature Climate Change* 2(9).

Rau, G.H., **E.L. Mcleod**, and O. Hoegh-Guldberg. 2012. The need for new ocean conservation strategies in a high-carbon dioxide world. *Nature Climate Change* 2(9).

Withey, J.C., J. J. Lawler, S. Polasky, A.J. Plantinga, E.J. Nelson, **P. Kareiva** et al. 2012. Maximising return on conservation investment in the coterminous USA. *Ecology Letters* doi: 10.1111/j.1461-0248.2012.01847.x.