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Is Health an Ecosystem Service?

Editor's Note

By Bob Lalasz

"There's only so much me to go around, no matter how much I eat."

Bob Lalasz

There's only so much me to go around, no matter how much I eat. So with this issue I am handing editorial management of *Chronicles* over to Darci Palmquist, one of the two senior science writers in TNC's science communications shop. Darci has had a long, accomplished career at TNC — with our California program, as part of our digital marketing group and now with science communications — and has won great admiration wherever she has worked for her sensitive editing and ability to manage large projects.

Putting *Chronicles* together from conception to proofing is immensely satisfying but also time-consuming — it takes at least a week out of every month. And as my duties have expanded to include huge assignments such as overseeing the growth of the Science Impact Project, helping launch a science-only TNC blog, and developing a communications plan for the new Nature Matters initiative (more about those last two next month in *Chronicles*), it's become clear that keeping this publication at a high level will require more attention than I'll be able to give it. I'll still be helping steer *Chronicles*' editorial direction, a sort of benign (Darci hopes) overseer; so when things go wrong in these pages, you can still blame me. And I will still be writing here occasionally.

I'm grateful to the many dozens of scientists and TNC staffers who have written for *Chronicles* in the two and half years that I have served as its chief cook and bottle washer. As I said when I took over for Erik Meijaard in 2010, it is a very live microphone. I hope you agree, and that you all feel free to pick that mike up and shout or do karaoke whenever you feel so moved. **SC**

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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 Bob Lalasz

Managing Editor and Submissions Darci Palmquist

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Peter Kareiva
Global Health: Pay Attention

By Peter Kareiva, chief scientist, The Nature Conservancy

We conservationists have had a hard time tracking the lasting impact of our achievements beyond acres protected, and we all know that acres protected is not sufficient by itself as a measure of biodiversity health. Contrast that with global health. The most recent global health report — the Global Burden of Disease Study 2010 — is a compelling tale of astonishing accomplishments (Horton et al., 2012). In the last 40 years, global life expectancy for women has risen from 61 to 73 years, and for men from 56 to 68 years. Mortality from malaria is the one and only outlier in a remarkable record of falling death rates due to infectious diseases.

We might do well by asking ourselves why the health world has been able to document so much progress — even in some of the poorest and most strife-torn countries — while conservation has not. Global health programs are notoriously rigorous when it comes to evaluating effectiveness — randomized trials are the rule, measures are everywhere, and funding is based on outcomes. The difference in measures and evaluation in global health vs. measures and evaluation in conservation is akin to the difference between an iPad and a stone tablet. While it is unlikely that conservation could ever pragmatically apply randomized trials, we could do better with our non-experimental metrics.

Image: Mosquito. Image credit: Flickr user live w mcs via a Creative Commons license.

Conservation has a fondness for scorecards with green, yellow and red grades. Global health uses DALYS (the years lost to disability, illness or early death). We should work hard to abandon color-coded scoring and settle on quantitative measures that, however imperfect, allow us to track trends and change. The DALYS approach used in the Global Burden of Disease Study was initially hugely controversial, and still has its critics — but is does provide the health world with a powerful way of recording its achievements. So yes, conservation has a lot to learn from global health programs.

But we need to pay attention to global health for additional reasons beyond its laudable commitment to measures and evaluation. For the first time ever, major depressive disorders have made the top 10 list of global health problems (as measured by DALYS). And the top 10 risk factors include inactivity and obesity. I hypothesize that an effective, cost-effective and practical prescription for a large portion of today's and tomorrow's global health problems is nature. I cannot point to solid data supporting my hypothesis — but I bet in 10 years there will be compelling evidence that time in nature can help repair mental health and mute depression.

Who among us has not felt physically, emotionally and mentally better after a prolonged hike or backpacking trip? When we talk about wild places and the intrinsic value of biodiversity or species, I suspect it is often code for the personal ways we each have of drawing on nature's restorative and healing powers. This is not hocus-pocus new age stuff — millions of years of evolution as hunter gatherers, prey and predators has to have left its mark on our hard-wiring.

"The difference in measures and evaluation in global health vs. measures and evaluation in conservation is akin to the difference between an iPad and a stone tablet."

There is no more basic do-good activity in the world than taking care of human health. Before there can be education, there has to be health. Rights and equity cannot be enjoyed if someone is afflicted with debilitating poor health. As infectious diseases wane, our emerging health problems could well put a premium on the nature prescription. Wait and see — the data will be there in 10 years. Our challenge is to make the nature prescription available to everyone, not just a lucky few with the time and money to go to distant wild places.

Pay attention to global health. **SC**

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Eddie Game
Steps to Better Metrology

By Eddie Game, conservation planning specialist, The Nature Conservancy

Image: Life in miniature. Image credit: Flickr user Shelly S via a Creative Commons license.

Be honest, did you glance at the title and read it as "meteorology"? Or saw metrology but assumed (quite plausibly) that I had misspelled meteorology? Given the recent weather, you can be forgiven.

Metrology is the science of measurement — a task that a great many of us at TNC do with surprising frequency. (Witness the effort demonstrated in the November 2012 issue of *Chronicles* alone to measure resilience.) Think of some of the things that we might measure in a conservation planning effort; disturbance, viability, condition, connectivity, intactness, risk, cost, biodiversity, threat, opportunity, service, etc. But despite the fact that assigning numbers to things is an everyday Conservancy activity, we violate basic rules of metrology almost as frequently. Before you skip a few pages on the reasonable premise that this is just Eddie banging on about planning again, consider that at the very least I'm hoping to license you to add another expertise to your resume.

Natural vs. Constructed Scales

In conservation, our main purpose for measuring things is to compare them — generally to make decisions about which activities we should prioritize and where. Sometimes the things we want to measure have *natural scales* — these are the easy ones. Natural scales are obvious and pre-existing ways to measure something — stream flow

in volume (m^3/second), populations by number of individuals, cost in dollars. Natural scales are great because they are relatively objective; two people should be able to measure the same thing and get the same number.

Frequently, however, we want to measure things — such as resilience or disturbance — that do not have natural scales. In these cases, we need to use *constructed scales*.

We can construct a scale to measure anything. This is where many conservation scientists demonstrate their skill as metrologists. For instance, we might assess the disturbance to different areas or habitats in a region on a scale of 1-7, or alignment of a strategy or geography with TNC's expertise on a scale of 1-4. Constructed scales can even be simple linguistic interpretations (e.g., threat classified as "high," "medium," or "low") that are subsequently related to numerical values (e.g., high = 3, medium = 2, low = 1). The basic premise of constructed scales is that the measurement reflects underlying empirical relationships in the thing we are measuring.

Constructed scales allow us to measure things for which there are neither natural scales nor established data. They also allow us to integrate data on a number of variables and from a variety of sources — including in many cases, a good degree of expert judgement. These strengths make constructed scales really useful in conservation.

The Potential Issue with Constructed Scales

But the scores assigned to things on constructed scales are essentially arbitrary — there is no objective reason why a relatively undisturbed habitat should be given a score of 4 rather than 5, for example. What these constructed scales typically represent is a set of ordinal numbers. They tell us that a score of 2 is better than a score of 1 and worse than a score of 3.

"The basic premise of constructed scales is that the measurement reflects underlying empirical relationships in the thing we are measuring ... Constructed scales allow us to measure things for which there are neither natural scales nor established data."

If we restrict our interpretation of such scales to simple ordinal representations between alternatives (e.g., alternative X is better than alternative Y for things Z), then the arbitrary nature of the numbers is not problematic. However, because ordinal numbers do not tell us how much better 2 is than 1, constructed ordinal scales become an issue when we try to perform any arithmetic on them, such as adding scores together or taking the mean across a number of scores. Performing this sort of math on an ordinal scale assumes a strict relationship between the numbers (that 4 is twice as good as 2) that the constructed scale might never have possessed.

Yet we perform math on our constructed scales all the time. Take the Conservation Action Planning (CAP) workbook or the software Miradi. To help compare target viability (amongst other things), both tools combine measurements of size, condition and landscape context using the following scale: Very Good = 4, Good = 3.5, Fair = 2.5 and Poor = 1. The overall rank is given by the arithmetic mean of these three categories.

To illustrate the problem with doing this, consider two habitats, A and B. Habitat A receives three scores of *Fair*, whereas Habitat B receives two scores of *Good* and one of

Poor. Taking the arithmetic mean, Habitat B (score of 8) would be ranked above Habitat A (score of 7.5). But if we adjusted our choice of scale such that *Good* was worth 3 rather than 3.5, Habitat A (score of 7.5) would now be ranked above Habitat B (score of 7). As Wolman (2006) eloquently puts it in an article on measurement theory: the "truth or falsity of results derived from measurements should not depend on a fortuitous choice of scale."

The above example shows how easily basic rules of metrology can be violated and the results rendered somewhat arbitrary. We should improve our science related to measurement, especially as measurement is so often the place where our great science meets actual management decisions. Here are some very simple ways to improve your measurement practices:

- Recognize that you are effectively a metrologist and take pride in your expertise.
- Be aware of the type of scale something is being measured on, what the numbers mean, and what sort of math you can admissibly perform on them.
- To check whether the math you are doing is reasonable for that scale, go back to the underlying data and ask if "4" is unambiguously (in other words everyone would agree) twice as good as "2."
- Where possible, use natural scales. Even if data in the logical natural scale doesn't exist (say for population numbers), ask experts to give you estimates in the natural scale rather than a constructed scale.
- If you need to construct a scale and measure things on it, do so in a way that preserves interval relationships. This might require using a more resolved scale, say 0 – 100 rather than 1 – 4.
- If things need to be combined, normalize rather than convert to constructed scales. Converting to a constructed scale usually just loses information.
- Consider multiplication rather than addition. Multiplying has the interpretation of weighting one thing by another thing and can avoid some of the issues of meaningfulness that come with adding or averaging.

So update your CV's. And keep measuring. **SC**

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Article
Have We Hit Peak Farmland?

By Craig Leisher, senior social scientist, The Nature Conservancy

Image: Crops with Mt. Adams in the distance, Oregon. Image credit: Flickr user pfly via a Creative Commons license.

I want to believe. Who in conservation doesn't? What if we really have hit peak farmland globally, as a new study by Rockefeller University researchers argues (Ausubel et al. 2013)? Considering that land conversion is the biggest threat globally to terrestrial biodiversity, hitting peak farmland would be better news for conservation than finding a flock of passenger pigeons living next to the Gates Foundation headquarters.

Yet I have several niggles about the study that make me click my heels together three times because I am not sure it's real. Beef consumption, intensification of agriculture, and tropical deforestation make we wonder if the new study is right. As people become wealthier, they eat more meat. There are exceptions such as India, but it's generally true. Fortunately, the global demand curve for meat flattens out after about US$10,000 in per capita income, but most countries are well below this level (Figure 1).

Producing a pound of meat takes a lot of other food. A broiler chicken gains 1 pound for every 1.7 pounds it eats, giving it a feed conversion ratio of 1.7:1. A pig has a 3.0:1 feed conversion ration, and a cow has a 10.4:1 ratio (Tolkamp et al. 2010). But these ratios are a bit misleading, because a 1-pound weight gain does not equal 1 pound of marketable meat. For a cow, it takes approximately 33 pounds of feed to produce 1 pound of marketable meat, because edible meat equals approximately 30-35% of a cow's live weight (civ-viande.org). Granted, cattle are often raised in rangelands that are

unsuitable for agriculture, but that is rarely the case with other farmed animals, and 30% of the grain produced in 2011 was used as animal food (USDA).

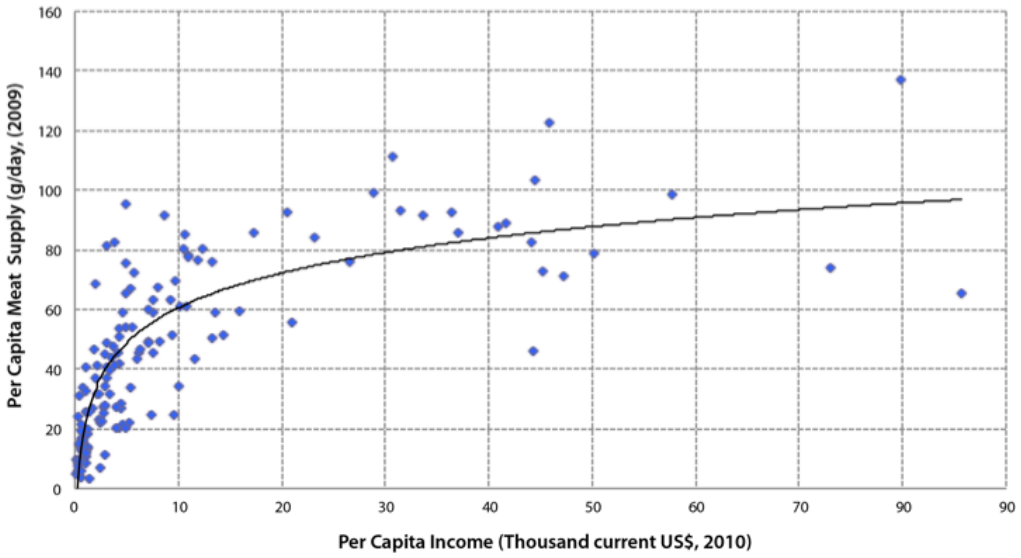

Figure 1: Global Demand Curve for Meat Per Capita Income (as per UNEP GEAS using FAO and World Bank data).

The Peak Farmland co-authors note that beef consumption is a potential confounding wild card. Yet beef consumption is predictable once the income elasticity of demand is known. In China, for example, income elasticity of demand for beef is high — 1.56 — meaning that demand for beef increases 15.6% for each 10% increase in average income (Masuda & Goldsmith 2010). The average person in China currently consumes about 12% as much beef as the average American (FAOStats). If China's GDP per capita grows at only half the rate of the last decade, beef consumption will still triple between 2010 and 2030 (Masuda & Goldsmith 2010). And we are doing our part: By the end of 2013, there will be 2,000 McDonalds restaurants in China (China.org.cn).

"To borrow a line from University of Minnesota's Jonathan Foley, for global agriculture, 'the elephant in the room is not an elephant but a cow.' Thus, my first beef with the Peak Farmland study is that there is no beef in the study — i.e., no consideration of how growing beef consumption will impact farmland."

China is not alone on the beef issue. Mexico and Indonesia are also projected to have increases in beef consumption. To borrow a line from University of Minnesota's Jonathan Foley, for global agriculture, "the elephant in the room is not an elephant but a cow." Thus, my first beef with the Peak Farmland study is that there is no beef in the study — i.e., no consideration of how growing beef consumption will impact farmland.

My second niggle is with the idea that intensification of agriculture on existing lands is sufficient to feed the 2060 world population. The co-authors make the point that the contest-winning farmers in Iowa produced 18 tones of corn per hectare in 2010 compared to the US average of 10 tones/ha and the global average of 5 tones/ha, and intensifying corn production on existing land could negate the need for new farmland. Yet if the 16 most important food and feed crops were brought to within 95% of their current potential yields, this would increase production by only about 58%, or about half the increase needed to meet the projected world food demand (Foley et al. 2011).

Moreover, Fargione et al. (2010) show that exponential extrapolations of yield increase as used in the study (e.g., 1.7% per year) result in poor predictions because trends in yield increases may be linear rather than exponential. There is also the problem that, in recent years, increases in yields for wheat and rice have stagnated in more than 30% of global crop areas (Ray et al. 2013). In short, it seems overly optimistic to assume that intensification of agriculture on existing lands can meet future food needs.

Finally, agricultural expansion in tropical forests is likely to continue to be one of the biggest global threats to biodiversity conservation whether we are past peak farmland or not. The forces driving the expansion of soybean and sugarcane areas in Brazil, palm oil in Indonesia, and small-scale agriculture in sub-Saharan Africa are likely to continue even if global farmland decreases in aggregate.

I very much hope the Peak Farmland co-authors are right, and we are over the hump. But the study gives me the feeling that we are not in Kansas anymore, but are in a different and better world where I would like to live but don't yet. **SC**

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Feature Article
Is Biodiversity Loss Making Us Sick?

By Marilyn Jordan, senior conservation scientist, The Nature Conservancy on Long Island

Image: Red, itchy eyes. Image credit: Flickr user parrchristy via a Creative Commons license.

Biodiversity is rapidly declining, we know this. But so what? Unless you're a conservationist, ecologist or environmental scientist, biodiversity is an abstract concept with little relevance to people's everyday lives and health. Until now. Earlier this year, a groundbreaking study out of Finland became the first to provide evidence of a link between biodiversity loss and human inflammatory diseases (Hanski et al. 2012). The researchers' "biodiversity hypothesis" — the idea that environmental biodiversity is linked to both microbial diversity and human health — has far-reaching implications for biodiversity protection and for improving public health. Could it even transform the conservation movement? We'll get to that. But first, some background.

A Version of "Eating Dirt"

Perhaps you have heard of the "hygiene hypothesis," colloquially known as "let them eat dirt." Essentially, the hypothesis says that humans developed a dependence on a variety of commensal microbes with which we co-evolved (Rook 2010). Exposure to these microbial "old friends" remains essential for training the developing immune system of babies and toddlers to distinguish between dangerous pathogens and harmless microbes, and is still important in adulthood (Rook 2010).

According to the hygiene hypothesis, the increasing incidence of allergies (asthma, hay fever, atopic eczema) and autoimmune diseases (e.g. type 1 diabetes, inflammatory bowel disease, multiple sclerosis, depression) over the last few decades is largely due to limited exposure to microorganisms (bacteria, fungi, viruses and possibly protozoans). Antibiotic use, exposure to antibacterial soaps, high socioeconomic status, small family size, early birth order and more all tend to reduce exposure to indigenous microbiota

and contribute to allergic diseases. So the absence of good microbial species can make us sick.

The focus of the hygiene hypothesis was on microbial exposure only in the home, food, drinking water and from animals — until Finnish researchers von Hertzen, Hanski and Haahtela expanded the hygiene/microbial deprivation hypothesis to a biodiversity hypothesis (von Hertzen et al. 2012). They proposed that *environmental biodiversity* is linked to both microbial diversity and human health. Their hypothesis links two seemingly unrelated trends: Rapid growth of urban populations (UNDP 2009) which have limited exposure to biodiversity, and a skyrocketing increase in the incidence of allergies and other chronic inflammatory diseases in urban areas (Fig. 1). Their data were published this spring and will likely lead to an explosion of new research (Hanski et al. 2012). If their findings are replicated by others it could lead to major changes in thinking about biodiversity and disease.

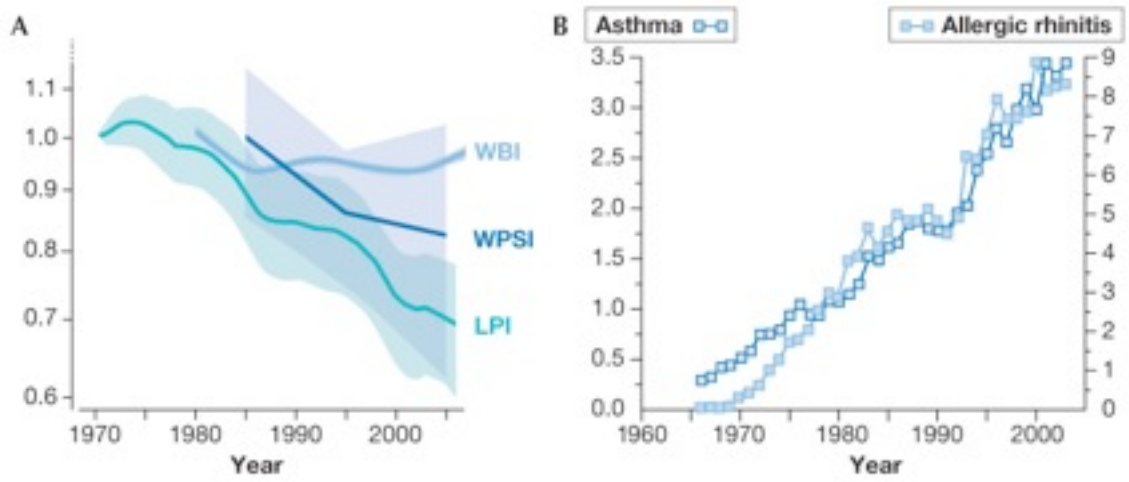

Figure 1: Two global megatrends in biodiversity and public health. (A) Declining biodiversity since 1970 as measured by three indices. LPI, Living Planet Index; WBI, World Bird Index; WPSI, Waterbird Population Status Index (Butchart et al. 2010). (B) Increasing trends in the prevalence of inflammatory diseases. Asthma and allergic rhinitis among military conscripts from 1966 to 2003 (Latvala et al. 2005) are shown as an example.

"Their hypothesis links two seemingly unrelated trends: Rapid growth of urban populations (UNDP 2009) which have limited exposure to biodiversity, and a skyrocketing increase in the incidence of allergies and other chronic inflammatory diseases in urban areas."

The Negative Correlation of Wild Native Flowering Plants and Atopy

What Hanski and colleagues did was to relate the atopy (allergic disposition as measured by the level of IgE antibodies) of adolescents in eastern Finland to microbial diversity on their skin, and to the environmental biodiversity of their yards and surrounding land use types. Atopic individuals had significantly lower generic diversity of gammaproteobacteria on their skin and were more likely to live in built areas or near large water bodies rather than in forested or agricultural lands. (Gammaproteobacteria are a diverse class of bacteria found in dust, soil, ambient air and on pollen grains but are particularly dominant in vegetation.)

Interestingly, they also found that species richness of just one group of plants — wild native flowering plants — was significantly correlated with atopy. Adolescents who lived in homes with a greater diversity of native flowering plants in their yards had a lower incidence of atopy. No association between plant diversity and gammaproteobacteria was found, though Hanski told me such a link may be found in future studies.

These observations were supported by in vitro measurements of IL-10, a key anti-inflammatory signaling molecule released by immune system cells. IL-10 in blood cells was positively correlated with the abundance of the gammaproteobacterial genus *Acinetobacter* in healthy individuals. Hanski thinks that low diversity of gammaproteobacteria is much more likely to be a cause of allergic disease rather than the reverse, based on previous immunological and experimental studies.

Reasons and mechanisms for the link to flowering plants are unclear (see diagram 1), for bacterial diversity on plants has not yet been studied. A diverse plant community may support a diverse microbial community, which directly benefits people. However the amount and diversity of pollen may also play a role or high diversity of flowering plants may simply indicate a more natural state of residents' yards. In the Finnish study area, many yards were not carefully managed so vegetation in parts of the yards is similar to natural areas, Hanski explained to me.

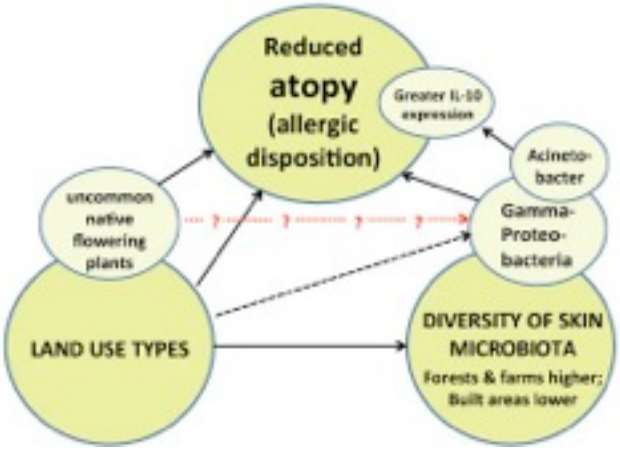

Diagram 1: Adapted by M. Jordan from Hanski et al. 2012. Hanski et al. 2012. Legend at left.

Diagram 1 legend: Associations among environmental diversity, skin microbiota and atopy. Solid arrows indicate P<0.015 to <0.0009; dashed arrow P=0.059. IL-10 is a key anti-inflammatory cytokine (immune system signaling molecule).

Hanski thinks that the general effects they observed are probably universal but details may differ in other biogeographic regions. Plant diversity in Finland is low, and the largest town in the study area was Joensuu, population 73,000. Similar research is clearly needed from other regions that differ in population sizes, environmental conditions, plant diversity, and factors known to be related to health (diet, pollution levels, chemical exposure, etc.) to test and extend their findings.

One challenge to replicating their research is locating appropriate human populations. Most Finnish study subjects lived where they were born and grew up, which is important since it is exposure to microbes and allergens early in life that is most protective. Hanski and his colleagues plan to study populations in Russia, on the other side of the border with Finland. People in eastern Finland and adjacent Russia are genetically similar, but the Russians are less affluent and have much lower rates of asthma, allergies and type 1 diabetes.

Results of the Finnish research raise many questions ripe for research, including:

- Will the findings of Hanski et al. be replicated in other biogeographic regions and cultures, and in large cities, towns and suburbs?
- If so, by what mechanisms is plant diversity linked to reduced human immune diseases? Is it through direct causality or indirectly through other factors shared in common?
- Do novel no-analogue ecosystems dominated by relatively few species of spontaneous and cultivated nonnative plants support fewer genera and species of microbes beneficial to people compared with more diverse and/or mostly native plant assemblages?
- How much nature in cities is enough for all aspects of human physical and mental health, and how should it be distributed? Close proximity to green space is important, but do all urban residents utilize these areas?

Inevitably there will be a search for easy substitutes for biodiversity. Could we solve the inflammatory disease problem by sprinkling good bacteria on our potted houseplants, swallowing probiotics, and kissing the dog? Even if immune-stimulating treatments are developed, we will still need natural green places near where we live for many reasons, including relieving stress, encouraging physical activity, making social contacts and improving air quality, all of which contribute to physical and mental health (Maas et al. 2009).

Protection from chronic inflammatory disorders may turn out to be another reason for preserving not just green places, but the biodiversity of all life forms on earth. Yet more than 80% of people in the U.S. live in urban areas and the rest of the world is quickly catching up (UNDP 2009). As cities grow there is less room for natural environments. Von Hertzen and Hanski (2011) fear dire consequences for public health (and economies) if large numbers of people develop immune disorders requiring long lasting medical treatment as a result of microbe-poor environments.

"Could we solve the inflammatory disease problem by sprinkling good bacteria on our potted houseplants, swallowing probiotics, and kissing the dog?"

What should we in The Nature Conservancy do? At first I think we should pay attention to this emerging area of research and investigate opportunities to be involved in interdisciplinary efforts to replicate Hanski's findings. Do we have databases that

could be of use for biodiversity/health researchers? Could some of our preserves be good study areas? The Urban Homogenization Project would be a good place to start.

If the findings of Hanski et al. are found to be generally applicable in many biogeographic areas, it could transform conservation efforts. Biodiversity and conserving nature would be much more relevant to people, especially in urban areas. At this point, TNC should become actively involved. We should incorporate and monitor microbial diversity in our work at key sites (e.g. Parker 2010), and explore the possible benefits to immune system health provided by our urban and suburban preserves.

Our new strategy of establishing urban conservation initiatives could include efforts to link biodiversity of green spaces with all aspects of human health, not just immunological health. Since socioeconomically disadvantaged urban populations typically have the least exposure to natural areas and have poorer health, we should consider collaborative efforts with advocates for public health and environmental justice.

As Stevens pointed out in *Science Chronicles* (2011), urban dwellers know "… there's something they want that they can't get from soccer fields and manicured city parks." Who knew reduced incidence of allergic diseases might be one of those previously unidentified benefits? **SC**

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Chris Helzer
Why Don't You Call Me Anymore?

By Chris Helzer, program director, The Nature Conservancy in Eastern Nebraska

Image: Death Valley phone booths. Image credit: Flickr user Ian Joyce via a Creative Commons license.

Innovation in conservation happens best when smart creative people interact with each other and build upon each others' ideas and experiences. During my 15 years with the Conservancy, I feel like that kind of collaboration has diminished over time. Sure, we're getting bigger, and communication is more difficult in large organizations than small, but the problem is due to more than just organizational size. We're just not very good at finding and talking to each other.

I worry that we're relying too much on vehicles such as *Science Chronicles*, listservs, and CONNECT to share information. Those communication efforts tend to feature the voices of a select few — despite the best efforts of editors and moderators to broaden participation. There is a lot of great conservation work going on in TNC's operating units around the world that doesn't get much attention, and a lot of great conservation ideas that don't get widely shared.

What we need is a way to reach out and grab stories and ideas from people who have good ones but don't have the opportunity or personality to share them. We don't need to invent new ways to do this — we just need to reinvest in, and maybe tweak, things we've done before.

Here are three examples of staffing positions that I have seen facilitate communication very effectively in the past:

Conservation Audit Teams

The Conservation Audit program we had for several years was, I thought, the most effective conservation strategy the Conservancy has ever had. I'm dead serious about that. I hosted an audit and was on the peer review team for several others, and found them to be extraordinarily valuable. The process forced the staff of a program being audited to take a hard look at its work. Even more important, the audit brought in peers from other programs to contribute ideas and constructive criticism. That process was invaluable to both the host site and the volunteer audit team members. Over time, Tim Reed — who ran the audit program — became an important asset himself.

I would venture to guess that no one knew the details of what TNC was doing around the world better than Tim did. I could call or email Tim and mention something I was doing, and he would invariably give me the name of someone else in TNC doing or thinking about something very similar. Searching CONNECT profiles doesn't begin to compare with that. I don't know why the audit program was discontinued, but it certainly wasn't because of any discontent from those it served in the field.

Regional Scientists

I'm in Nebraska. Over the 15 years I've worked for TNC, Nebraska has been in the Great Plains Division, the Midwest Region, the Central U.S. Region, and other subdivisions of the Conservancy. I think we're currently in the Central Division of the North American Region, but don't quote me on that. Regardless, we've had various versions of science positions that have worked at that inter-operating unit level. Before the last (or next-to-last? — I've lost track) reorganization, Joe Fargione filled that role for us. When he was here, Joe was learning the details of conservation programs within operating units, communicating regularly with OU science staff to discuss and coordinate projects, and even traveling out to advise and learn from staff in the field. Just as he was getting to the point where we could call him and get the kind of feedback we could get from Tim Reed, his position shifted to the new North American Region.

Science Writers

"Regardless of the exact staff positions and job titles, what's important is that supervisors buy into the communication function and ensure that it's an integral part of the way employees are evaluated."

A good science writer is one that actively pursues stories like a badger following a ground squirrel. Asking questions of one person leads to other contacts, and pretty soon, they're driving around in a truck with a land steward in Illinois, learning the intimate details of prairie restoration. (You know, just like a badger...)

In the old days, we had a few writers like this that would call us now and then, looking for information on a particular story, but also nosing around for any other good potential story ideas. Just like the other two examples, they began to know the behind-the-scenes work of the Conservancy well enough to become hubs of information for Conservancy staff — in addition to being valuable pipelines carrying stories about TNC's work to our supporters, partners and the public.

We still have science writers, but I don't hear from them very often. I don't know if that's because they're focusing on broader issues than I'm working on, or if there are just not enough writers to cover all the things we're working on in the field.

In all three of these examples, facilitating intra-staff communication within TNC is only a portion of their job. We don't necessarily have to hire people just to help us talk to each other — we can try to build that function into other roles we need. The three examples I give are just that — examples — and I'm sure others exist. Regardless of the exact staff positions and job titles, what's important is that supervisors buy into the communication function and ensure that it's an integral part of the way employees are evaluated. **SC**

Clarification

By Jon Fisher, spatial scientist, The Nature Conservancy

It was pointed out to me that I gave the impression during my talk at ScienceFest (http://www.conservationgateway.org/Pages/scifest-fisher.aspx) that our Ecoregional Assessments (ERAs) were a waste of time and money. This was not my intent, so I wanted to clarify this point. I did not find evidence that the priority areas from our ERAs had a significant influence on our land acquisitions, and I do think that represents a missed opportunity. Moving forward, we do need to think about how to improve the rate of implementation of our planning efforts. However, that should not be taken to mean that conducting ERAs were a waste of time and money.

Here are some reasons why:

- *Even if ERAs didn't influence land acquisition, they still serve other functions*. For example, they can be important in building partnerships, they can guide policy work, and the ERAs often have influence on people outside of TNC (e.g. SWAPs, government agencies, other nonprofits).

- *The lack of influence of the ERAs on acquisitions does not necessarily indicate a flaw in the plan.* It could mean there's a problem with implementation by the states, or that there IS a problem with the plan (e.g. it may not have sufficiently considered implementation), or a combination of the two. I am not attempting to cast blame on anyone, just to note that our plans may not be implemented in the way we had envisioned they would be.

- *Land acquisitions are only one of TNC's strategies, and are decreasingly important over time*. I only studied the effect of the priority areas on land acquisition at TNC, rather than all of the impacts of ERAs on TNC work.

- *I characterized ERAs as "expensive" during my talk*. While their overall cost was high, the term "expensive" may be unfair in terms of how much data and value they generated.

I believe that the published paper (http://bit.ly/VgxadQ) that the talk was based on did a better job of making my conclusions clear than I did in person. I am hopeful that this work is useful in opening a discussion of how TNC can work on narrowing the gap between planning and implementation, which is a challenging and pervasive problem in conservation. SC

15 Seconds of Fame
Darran Crabtree

What's it take to run conservation for central and western New York, a region that contains 2 of the 5 Great Lakes? A passion for "all things wet, slimy, unloved and undervalued" seems to help. Meet Darran.

READING: As a rule I don't read about science and nature for pleasure (I live that stuff). So my bedtime reading is usually fiction. I often read what others recommend; I recently finished *The Brief Wondrous Life of Oscar Wao* by Junot Diaz. I can't say it was my favorite book, but it had all these footnotes about the U.S.'s relationship with the Dominican Republic during the 20th century. Fascinating and totally not taught in my schools.

Image: Darran piloting new boat and setting trapnets to determine if cisco are still using Irondequoit Bay (on Lake Ontario near Rochester, NY) as a spawning area (they aren't, as it turns out).

LISTENING & WATCHING: I've been getting amped up on "Queens of the Stone Age" lately. Watching various things including *Dexter* and *Supernatural*.

MYSTERIES OF THE DEEP: I'm partial to animals, the zoological elements of nature. It was an invertebrate zoology course that really blew my mind over the complexities and details of the things living right under our noses. Take freshwater mussels. They have a parasitic stage where they've evolved to squirt their larvae onto fish that carry the eggs downstream. I love the "mysteries of the deep" even if the deep is just a few inches!

CHALLENGES: The science is good on how human population growth is causing pressure on habitats, but how do we address that? What intrigues me right now is how we crack that nut. TNC is small potatoes compared to state and federal agencies, and those budgets need to be linked more to conservation. Business should be doing more. For engineers and developers, it should be second nature to consider how a project harms or benefits the environment. The biggest challenge we have in the next 10-20 years is breaking down those barriers.

IRKSOME: I think what pisses me off the most about conservation is something we are trying to become better at — that is, in order to raise funds we have to show how "we" (fill in any conservation group) are the best for the job. But as the challenges increase in scope and scale, we are going to have to become more comfortable with and better able to articulate how we are part (and maybe not even the biggest part) of creating a positive change.

Let's leave the egos at the door and solve some problems together.

THIS OLD HOUSE: I like old things. I have an old house and I've tried to populate it with historical furniture, knick-knacks, etc. I go antiquing.

I can't believe I've become that guy. How did this happen to me? I grew up in a modern architectural home outside New York City, where everything was white and museum-like. And I loved it. But I bought an old farmhouse — the lay of the land drew me to it — and I'm trying to do something genuine with it. The land is near a secluded part of French Creek, which is the river I used to work on when I moved here.

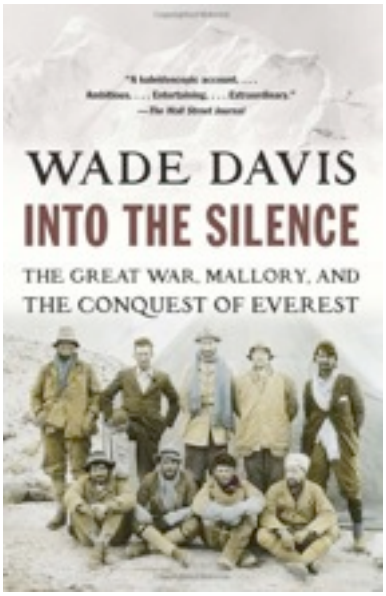
2012 HIGHLIGHT: This year I got back out into the field! We secured some funding to investigate how to best restore cisco (a native prey fish that is doing poorly in the Great Lakes). Over the past month I spent a lot of time on a boat wearing a cool orange-and-black survival suit and netting fish. Things haven't worked out exactly like we planned, but when does it?! SC

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

Book Review
What it Takes to Get to the Top

Into the Silence: The Great War, Mallory, and the Conquest of Everest. **By Wade Davis. Vintage, 2012. 688 pages.**

Reviewed by Tim Boucher, senior conservation geographer, The Nature Conservancy



Extreme cold, hunger and hardship… venturing into the total unknown… to a blank spot on top of the world.

Because it is there.

George Mallory said it first and it has been echoed by high-altitude climbers ever since: this is why we climb these mountains. But Mallory was different. I had read a smattering about Mallory, including the short piece in *National Geographic* about the discovery of his body — perfectly preserved by the cold and the high altitude. Mallory shared the traits of climbers described decades later by Jon Krakauer, writing of the 1996 disaster on Mount Everest in *Into Thin Air* and *The Climb* — the compelling rebuttal to Krakauer's book by Anatoli Boukreev. The latter in particular gets at the spirit of a true climber — supreme fitness and stamina, climbing for the pure joy of it, the adrenalin rush of danger survived.

These physical and mental traits made Mallory the supreme climber of his generation, a veritable mountain goat who explored new routes in the Alps while a student at Cambridge. But fate threw him and his generation into the madness of World War I, which the author describes in several chapters of excruciating, gut-wrenching detail. Hard as it is to read, this background is key to understanding the motives of Mallory and others of his generation who explored the most remote places in the world. They had lived with death; they were intimate with the worst that could happen. They charged through life with determination fueled by desperation to outrun the stink of death and return to life.

Several chapters — alternating between brilliant description and tedium — describe the long expedition to find the mountain, followed by the search for a way up. The journey was a string of ordeals. One of the most remarkable characters is Major E.O. Wheeler, a geographer who mapped and measured the mountain using a photo survey method he had developed. A year after this 1921 survey, Mallory returned to Everest, reaching 26,980 feet; his third attempt on the summit resulted in the deaths of seven

sherpas in an avalanche. Still, he returned in 1924, climbed to 800 feet below the summit, and was never seen alive again.

No one knows if he reached the summit before falling to his death. At times, reading the book is a bit like climbing Everest; endless preparation, countless small steps, the 600+ pages a distant summit that never grows closer. It is exhaustive and exhausting, but provides a much-needed challenge for our limited attention spans. **SC**

Science Short
Parasites, Poverty and Biodiversity

Bonds, M.H., A.P. Dobson, and D.C. Keenan. 2012. Disease ecology, biodiversity, and the latitudinal gradient in income. *PLoS Biol* 10(12): e1001456. doi:10.1371/journal.pbio.1001456

Conservationists lamenting the diminished focus on biodiversity in an increasingly ecosystem-service dominated field can take succor from this study by Matthew Bonds and colleagues published in *PLoS Biology*. The interesting take-home, which is actually a side event in the paper, is that the loss of biodiversity (species richness of plants, mammals, and birds) increases the burden of vector-borne parasitic diseases amongst a country's human population, which in turn increases poverty. The study's principal focus was on disentangling the relationship between disease and poverty at a macro scale. Are countries poor because they have lots of disease? Or do they have lots of disease because they're poor? These relationships cannot be explored with straightforward regression models because causality is likely to flow both ways. To circumvent this bias, the authors use a multi-layered but elegant modeling approach that makes use of additional variables that are correlated with one of disease or poverty but independent of the other — which is where they bring in biodiversity.

Links between ecosystem degradation and disease burden have been demonstrated before, but this is one of the first studies to clearly link biodiversity (in its species richness sense) to human health. The precise mechanism of this link is not entirely clear; one hypothesis is that biodiversity puts downward pressure on parasites and non-human hosts. Important questions about the biodiversity effect on disease remain to be explored — for example, how does the effect differ between rural and urban populations, and what does this mean in a rapidly urbanizing world? The authors are reserved about the possible policy implications of their findings, even though they rightly stress the importance of the question for policy. Even with mounting evidence of a causal link between environmental degradation and human health, the nagging question for policy is whether an ecosystem approach to public health is as expedient or cost effective as other alternatives. I suspect that in terms of direct actions it probably wouldn't, but it does contribute very significantly to the bundle of benefits that healthy, biodiverse ecosystems provide a country. SC

— **Eddie Game**, conservation planning specialist, The Nature Conservancy

Science Short
A Coral Reef Lemonade Stand

Jupiter, S.D., R. Weeks, A. P. Jenkins, D. P. Egli & A. Cakacaka. 2012. Effects of a single intensive harvest event on fish populations inside a customary marine closure. *Coral Reefs* 31(2):321-334.

What is the coral reef equivalent of taking lemons and making lemonade? In the case of locally managed marine area (LMMA) monitoring, this article may just be the answer. One of our sister NGOs (Wildlife Conservation Society) was conducting a before-after-control-impact (BACI) study of LMMAs and larger district managed marine protected areas in Fiji, when the villagers of Kia Island opened their LMMA for fishing — initially to fulfill a specific community fundraising need — that then became a bit of a gold-rush. Instead of despairing and dropping a data point from the larger study, the NGO researchers adapted the sample design to create a BACI-within-a-BACI. While the authors admit the imperfections of this opportunistic approach, the study provides a strikingly sensitive quantitative panoramic view of what happens when a human community needs to dip into their natural bank account.

As for the results, I think that they are best summarized in this quote from the discussion: "Our study demonstrates that a single intensive harvest event can quickly remove almost all positive effects of protection on fish biomass and subsequent reproductive output in a marine protected area." Because this was a study of biological and not socioeconomic response, the authors speculate very minimally on whether the original intended community harvest for fundraising for church and school fees (the goal which was attained during the very first day) would have had the same impact as the subsequent harvest reaped in the ensuing open period (5 weeks @ 6 days a week, fishing in shifts for all 24 hours).

I think the study says almost as much for what it leaves unsaid. **SC**

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

Announcements

Science Peer Review Help Desk

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**

NatureNet Fellowships

Meeting the world's demands for food, water and energy without exacerbating climate change and degrading natural systems is the challenge of our generation. To do it, we need a new brand of science — one that blends economics, business, engineering, technology & communications with conservation.

That's why the Conservancy has established the NatureNet Science Fellows Program in partnership with six of the world's leading universities — Columbia, Cornell, Princeton, Stanford, the University of Pennsylvania, and Yale — to create a reservoir of new interdisciplinary science talent that will carry out the new work of conservation.

Ideal candidates are outstanding early-career scientists who seek to improve and expand their research skills while directing their efforts toward problems at the interface of conservation, business and technology. Fellows' research programs — designed in collaboration with mentors based at one of the six universities and at the Conservancy — will fall into one of three thematic research areas for 2013: agriculture, water or energy.

Questions? Contact Lynne Eder, director of operations for Central Science, at leder@tnc.org. More information can be found at nature.org/fellows. **SC**

ScienceFest: Recaps

You loved it the first time around, now go back for a second helping.

Held in late November, ScienceFest was a two-day series of short science talks and debates by Conservancy and partner scientists. Focused on cutting-edge science in the service of of conservation, the 15-minute presentations were followed by short discussions.

A few must-watch videos:

- Dick Cameron: Energy, Climate & Transportation in California
- Evan Girvetz: A Rainier, but Drier, Future?
- Jensen Montambault: The Easement Bubble
- Steph Wear: The Secret to Coral Reef Conservation

And so much more. View all the videos on Conservation Gateway. **SC**

New Conservancy Publications

Conservancy-affiliated authors highlighted in bold.

Please send new citations and the PDF (when possible) to: pkareiva@tnc.org, dpalmquist@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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Opperman, J. J. 2012. A conceptual model for floodplains in the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 10.

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Palmer, S. 2013. Linking conservation priorities to wetland and stream mitigation decisions: A watershed planning approach for the Stones River Watershed, Tennessee. *National Wetlands Newsletter* 35(1).

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Rubbo, M.J., L.K. Belden, S.I. Storrs, J.J. Cole, and **J.M. Kiesecker**. 2012. Species loss in the brown world: are heterotrophic systems inherently stable? *Aquatic Sciences* 74:397-404.

Salick, Jan, and **R. Moseley**. 2012. *Khawa Karpo: Tibetan Traditional Knowledge and Biodiversity Conservation*. St. Louis, Missouri, USA: Missouri Botanical Garden Press.

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