SCIENCECHRONICLES

August 2012

Image: Bleak upland eagle (Colombia). Image credit: Enrique Lara/ Flickr through a Creative Commons license.

Science for Water Funds

Editor's Note

By Bob Lalasz

This issue of *Science Chronicles* marks the publication's modest turn back to…science and scientists, of all things. Let me explain.

Since its debut nearly a decade ago, *Chronicles* has been one of the few places — and, at many times, the only place — for Conservancy staff to broach and freely discuss difficult issues about the direction of TNC and conservation. *Chronicles* bore this burden — happily, I might add — in large part because TNC simply didn't have a robust, user-generated forum for such exchanges. Now we do: CONNECT, the new Conservancy intranet. With such a responsive, online publishing platform available for the entire Conservancy — a place where you can read, contribute, comment and share instantly — it makes little sense for *Chronicles* to carry the weight of thorny TNC debate.

Which is not to say that we will avoid difficult topics — just that we'll address them going forward with science foremost in mind. I've solicited about a dozen TNC scientists and others to contribute regular columns to *Chronicles,* a mix of field and Central Science, U.S. and international. Their pieces, along with a monthly column by Peter Kareiva, will form the spine of Chronicles going forward. Their brief is to be provocative and useful, in our usual spirit — no boring conference reports or happy talk. (I'm especially excited about a new column by Tara Schnaible and Dan Majka on best design and usability practices for scientists; see page 13 for their debut.) We'll also step up our focus on TNC science with looks at new Conservancy research as well as reporting from the field and (when an issue warrants it) feature articles, like Heather Tallis and Adrian Vogl's excellent piece in this issue on science that can help prioritize water fund investments for maximized ROI. (Don't worry: We'll keep the book review issues as general as they are.)

So: scientists and science. (After all, it is *Science Chronicles.*) As always, I'm happy to receive your submissions, but those are the two guardrails going. There's so much good science going on at this place, and there's been so much enthusiasm from the columnists I've solicited, I don't see any problems, other than keeping the issues short.

Regular *Chronicles* readers know that I was a big fan of Jonah Lehrer, the *New Yorker* science writer and $50,000-a-pop speaker whose career went down in flames last week when he admitted he'd made up quotes by Bob Dylan for his new book *Imagine: How Creativity Works*. (Making up Dylan quotes: the jokes just write themselves, don't they?) The journalist who uncovered Lehrer's Dylan imitations has now tweeted that he has found a passel of additional literary crimes in Lehrer's work, so more revelations are on the way. The usual zeitgeist finger-pointing has ensued: ambition run amok, our shortcut culture, the rise of TED talks as pre-digested intellectualism. But where was *science* in all this? I'll write about that next month. **SC**

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

The Mission(s) of *Science Chronicles*:

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

Editor & Submissions Bob Lalasz

Waiting for Taijuan Walker Peter Kareiva

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Peter Kareiva
Are There Too Many People on the Planet?

By Peter Kareiva, chief scientist, The Nature Conservancy

Image: Festival of Colors, Salem, Utah, 2012. Image credit: Thomas Hawk/Flickr through a Creative Commons license.

Discuss this article on the Conservation Gateway.

Before you read any further, please answer the question in the headline. Even better, send me an e-mail at pkareiva@tnc.org giving me your answer and why you answered the question, however you did.

Finished? Now read on. I am guessing that a lot of you answered yes. Now let's think this through:

- We now have 7 billion on the planet. Were 5 billion too many people?
- Were 3 billion people too many?
- Were 1 billion people too many?
- Were 1 *million* people too many?

How would you make those decisions? I doubt any real science comes into play. Yet at a recent meeting of the Society for Conservation Biology, I was in a conversation with several colleagues when one person suddenly said "there are too many people on the planet" — and everyone nodded in agreement. This statement and the group's certainty of its truth offer a revealing window into conservation.

Here is what I bet goes on when asked this question — and I want to say up front that I think this way myself. I do not like long lines and traffic jams. I do not like that I have to drive 60 minutes to get to a decent natural area, and that when I get to the Cascades for my hike, I am likely to run into dozens of others on the same trail. I do not like how built up our coastline has become and how hard it is to get access to beaches. And so on.

In other words, I do not like the impact of the "too many people" on my personal happiness. Rarely do we admit that this is the basis of our concerns about human population. Instead, we couch them in terms of "exceeding the Earth's carrying capacity" or "causing the extinction of species."

For example, one common mantra is that we are already using up the equivalent of 1.5 Earths — so how could we add even more people? But that refrain is based on an ecological footprint calculation that is deeply flawed and has been widely critiqued in the literature (see van Kooten and Bulte 2000, Fiala 2008). The simplest way to expose the fallacy of ecological footprint calculation is to emphasize that simply by planting one-half of the United States' area with eucalyptus, we could change the current total human footprint from 1.5 Earths to only one Earth.

The other mantra is that an excess of people is causing the extinction crisis. I certainly agree that people are, sadly, causing extinctions, but I am not convinced it is a "number of people" per se. The most spectacular and massive extinctions of megafauna were associated with human populations of less than 1 million — the so-called "Pleistocene overkill" when humans entered North America from Asia. During that period, the world lost mammoths, giant sloths, saber-toothed tigers, the dire wolf, giant beavers and numerous other awesome species that would today inspire and enthrall us if they still existed. It did not take 7 billion people for this to happen. In fact, these extinctions occurred at extremely low population densities (Alroy 2001).

"The question of 'are there too many people' is the wrong one for conservationists to ask. The right questions are: What quality of life do we want all people on the planet to share? And how can we achieve that quality of life while preserving as many species and ecosystems as possible?"

And when we so easily jump to the conclusion there are too many people on the planet, what solutions does it suggest? Who should be eliminated? Who should not be allowed to have children? And who gets to decide? Is it really that there are too many people on the planet? Or is it more about the kind of settlements and economies we have built?

Lastly, the whole notion of too many people neglects the studies that show large numbers of people, especially concentrations of people in cities, are engines for innovation and cultural advances (Bettencourt et al. 2007). For example, new patents and inventions overwhelmingly come from cities — and the larger the city, the more patents and inventions are produced.

Given all this, I still think there are probably too many people on the planet. But I am a little embarrassed by that sentiment — I know there is no clear analysis behind that conclusion and that it is to some extent a reflection of the fact I occasionally like to get

away from people. More importantly, the question of "are there too many people" is the wrong one for conservationists to ask. The right questions are: What quality of life do we want all people on the planet to share? And how can we achieve that quality of life while preserving as many species and ecosystems as possible?

Conservation of nature has a lot to contribute to answering those questions and to enhancing that quality of life. So don't automatically nod in agreement when a colleague says: *"The problem is there are too many people on the planet."* People can be the solution as well as the problem. **SC**

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Eddie Game
China is the Greenest Government: The Importance of Counterfactuals

By Eddie Game, conservation planning specialist, The Nature Conservancy

Above: Beijing in sun and smog (photos taken about a week apart). Image credit: Ulrich Thumult/Flickr through a Creative Commons license.

Discuss this article on the Conservation Gateway.

"You know, TNC and other conservation groups should get together and give the Chinese government an award for the One Child Policy."

Well that's one way to break a moment of Peking-duck-induced reverie. I heard TNC's China Director, Shuang Zhang, make this pronouncement recently over dinner in Beijing.

The One Child Policy (mandating that Chinese couples each have no more than one child) has reflected the Chinese government's recognition of two factors: 1) its country's finite natural resources, and 2) that living more sustainably is good for economic prosperity (an idea that still seems anathema to Western macro-economic policies). But has the policy qualified China as a "green" country? I had been in Beijing a few days and was yet to see the sky through the smog.

The answer rests on the counterfactual. What would the world look like if China hadn't implemented the One Child Policy?

Well, to start with, China would have a lot more people today — somewhere between 100 and 400 million more.[1] (Exactly how many more is hard to say because it depends on assumptions about the background trend in birth rate. 400 million assumes that birth rates remained close to 1970s levels, while 100 million assumes they would have fallen steadily anyway. Certainly by the time the policy was introduced in 1979, Chinese birth rates were already on their way down due to aggressive government campaigns advocating later marriage and wider birth spacing.)

If we assume that the One Child Policy has led to a moderately conservative 200 million fewer people today, what does that figure mean in terms of avoided environmental impact? Let's focus just on the impact of not feeding those extra people (arguably, the Chinese government's key motivation for the policy). Landshare.org calculates that feeding a typical person in the UK each year requires 0.36 hectares of land. A typical Chinese person has a more modest diet than a UK resident, with fewer total calories and far less red meat — and so requires something closer to 0.23 hectares per year. Assuming those extra 200 million didn't trigger massive improvement in the efficiency of agriculture and food distribution, feeding China with them today would require a massive 46 million hectares of additional farm land.

Just take that in for a second. That is more land than the entire state of California. Or, for non-U.S. folks, a land mass nearly the size of Spain.

The point is not that governments around the world should be trying to forcefully control birth rates, but that I can't think of any other government that has asked so much of it citizens in service of the environment. Even giving the Chinese people credit for epic stores of Confucian tolerance, the One Child Policy has required massive sacrifice of personal rights for societal gain. Let's be honest. Stand aside Norway; China is the greenest government.

"It's hard to overestimate how our ignorance of counterfactuals biases our judgments, especially regarding environmental issues."

Can't picture a portrait of Deng Xiaoping gracing TNC's DC foyer?

The view of China as green beyond all others jars with colloquial references to pollution in its cities and rivers. It also rubs against professional opinion; the Yale Environmental Performance Index ranks China 116th in the world in terms of environmental policy. Why?

It's hard to overestimate how our ignorance of counterfactuals biases our judgments, especially regarding environmental issues. The value of any action or intervention should be judged not on what the outcome looks like, but how different the outcome would have been in its absence.

For example, Australia has made some pretty impressive commitments to national park establishment. What would have happened in their absence? Arguably, not a great deal different. Many of the areas were subject to very little exploitation anyway, and Australian governments have shown themselves willing to open national parks to resource extraction when the reward is high enough. This doesn't mean that establishing national parks is not a valuable contribution to conserving natural heritage and something that Australians should be proud of (I, an Australian, am). But when we target our conservation investment and effort, we should always think about the counterfactual.

Counterfactuals will inevitably take the gloss off some of our trophies (like finding out the other competitors were disqualified), but the good news is that they can also help turn what appears to be a mediocre conservation success into a substantial one. For example, some of our water fund work is only likely to hold the current ground with regard to catchment degradation — but when considering what would have happened in their absence, this might be considered a roaring success. Hopefully next time you fly through the Beijing smog, all you'll see is green. **SC**

[1] Hvistendahl, M. 2010. *Science* 329:1458-1461.

Feature Article
Standardized Science for Secure Water

By Heather Tallis and Adrian Vogl, Natural Capital Project, Stanford University

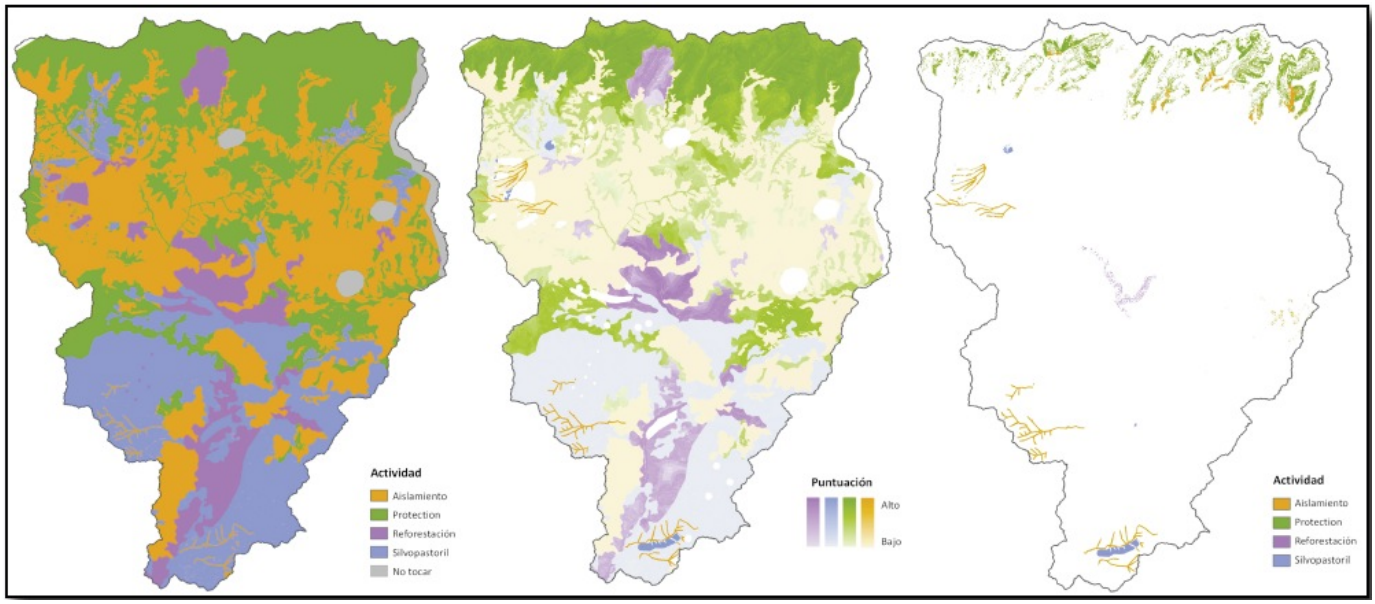


Figure 1 (above): Example of an water fund investment portfolio created with RIOS. The left image shows where each activity is feasible, based on information provided by stakeholders. The next image shows the integrated ROI scores for the fund's activities, and the final image is the investment portfolio that was selected based on ROI and the fund's budget.

Water funds are taking off like a wildfire in Latin America. But like a wildfire, they run the risk of burning too hot and too fast to help the ecology (and the people) in the system. The rapid expansion of water funds in latitudes south has presented some challenges for The Nature Conservancy and its partners, which are trying to make the most of a potentially great tool for bringing nature's value into the real economy.

These challenges hinge around four tough questions:

- How can water funds get the biggest return on investment for both ecosystems and people?
- What science can be brought into play fast enough and with small enough data and capacity requirements to be useful?
- Can one scientific approach work for all funds, or do we have to start over each time?
- And above all else, do water funds actually work?

Luckily, there has been a lot of experience in developing and investing in water funds in Latin America. The Natural Capital Project (NatCap) and the Latin America Water Funds Platform (a partnership among TNC, the Inter-American Development Bank, GEF and FEMSA) are collecting lessons learned and best practices from across the region to answer these questions and turn that experience into a standardized, science-based approach to designing water fund investments.

Standardizing approaches to water fund portfolio design

The first two questions prospective water fund investors usually ask are 1) how should we spend the fund's money? and 2) what are we going to get for it? In a recent workshop in the Dominican Republic, a group of practitioners and scientists found that their experiences aligned around the need to be able to answer these investment questions with a rigorous yet flexible return-on-investment approach.

From there, the Platform and NatCap decided jointly to develop a tool that would do just that. Tentatively named RIOS (short for Resource Investment Optimization System), this tool will standardize water fund investment design and provide water fund managers with answers to three core questions: (1) What set of protection and restoration actions will give the biggest return on investment? (2) What will that return on investment be? and (3) How much better is that return than what we would have achieved without the tool?

How does it work?

RIOS uses biophysical data (i.e. topography, soils and land uses) and simple representations of demand (i.e. where are the people that depend on the resource?) to identify places where activities like protection or restoration are likely to give the biggest returns for water fund objectives. Water funds are usually trying to get a lot for their money, including improvements in terrestrial and/or freshwater biodiversity as well as a long list of water-related benefits. While the current iteration of RIOS can't help with that entire list, it can identify the best places to invest for some of the most desired water benefits: water quality purification (nutrients and sediments), reservoir maintenance, flood mitigation and groundwater recharge.

Discuss this article on the Conservation Gateway.

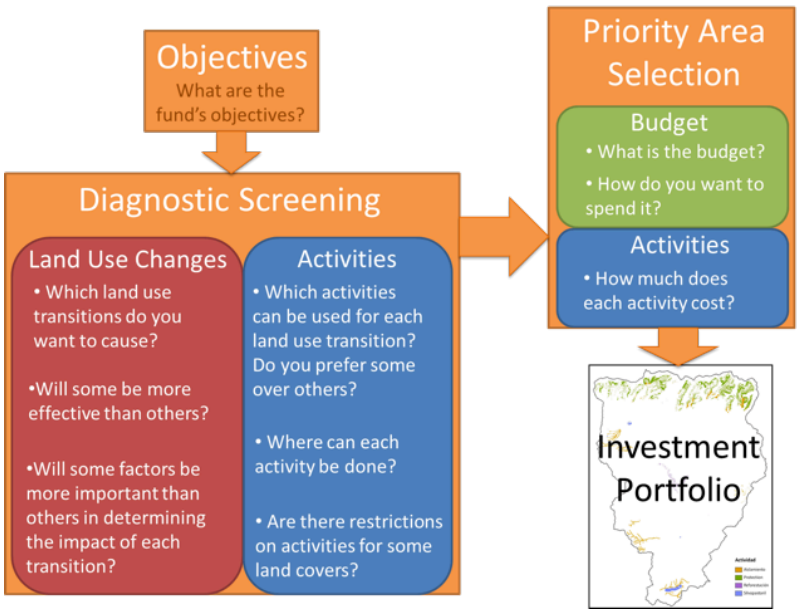


Figure 2: *User's view of RIOS. The tool connects 5 core components to create investment portfolios. Each question in the diagram is answered through a data input provided by the user.*

For each of these benefits, RIOS uses a relative ranking approach to identify the areas of highest potential returns. The tool also considers important information about social conditions that will affect implementation of investments, such as stakeholder preferences, legal limitations on where activities can occur, locations of security concerns and so on. Together, these relative returns show where investments will be both beneficial and feasible.

Using data provided by the user on activity costs and budget levels, RIOS calculates a relative return on investment (ROI) for each activity. Investment areas are chosen based on ROI until the fund's money runs out. In the end, water fund investors are given an "investment portfolio," a map that shows where and in what activity they should invest (see Figure 1).

RIOS was first tested at a workshop in Mexico in April 2012. We produced a portfolio for the Monterrey fund in northern Mexico during the workshop and got feedback from fund developers from across Latin America.

This approach still doesn't answer the question of precisely what the fund will get for investing in that portfolio of sites. As with many conservation strategies, we simply don't have the data to answer that question rigorously. The uncertainty stems is in part because the answer will change for each fund, depending on the starting state of the watershed, the technologies used to deliver water to users in different sectors, the laws regulating water access and fees and so on. So what can we do?

"We have very little evidence thus far, in terms of cold, hard data, from existing water funds on whether investments in watershed management do in fact lead to system-scale changes in hydrology and user-level improvements in benefits. We are, however, finally well poised to start generating these data."

First, we can do more monitoring. But that will take time to show results. In the meantime, investors need to have some sense that their money will indeed provide some return. So RIOS uses the InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) suite of models to estimate how much return the fund can expect towards each objective. These models estimate the actual change in ecosystem services and their values if the portfolio were implemented as designed. If the fund has a quantitative goal, like reducing water pollution by 10%, the tool will show whether the budget they are proposing is big enough to meet that goal. These estimates of returns that can be tested over time as monitoring data reveal what real returns accrue. This part of the tool will be tested in Lima, Peru in August, where we will see if the tool is flexible enough to develop portfolios and estimate returns for funds in Mexico, Peru, Panama, Colombia and Brazil.

Or course, using RIOS will take time and money, and many water funds have made it thus far without it. We think it's important to include a way to ask just how much better off fund investors will be if they use this new tool. While we continue to ask for funds to help us monitor and study ecosystem service returns on the ground, we need something today. So we use the same InVEST models to estimate returns from more "business-as-usual" portfolios (those that haven't been optimized through a RIOS-

guided design). RIOS compares estimates from the "designed" portfolio to the business-as-usual one, to give a sense of how much the science improves investment returns.

Generalized, flexible tool for a regional approach

From concept to design, RIOS was created with the vision of improving returns from conservation investments, presenting scientific information in a way that is useful for managers, and being flexible enough to be applied in many different environmental, social, and legal contexts. None of this is very helpful if there isn't anyone to use RIOS. Luckily, the enabling conditions being developed by the Water Funds Platform gives us a real opportunity to take what has been one-off, site-based work on water funds to the continental scale.

Of course, there is still the question of whether or not any of this actually works, for biodiversity or people. We have very little evidence thus far, in terms of cold, hard data, from existing water funds on whether investments in watershed management do in fact lead to system-scale changes in hydrology and user-level improvements in benefits. We are, however, finally well poised to start generating these data. NatCap is contributing to another effort being led by TNC to standardize biodiversity and ecosystem service monitoring across water funds. Funding is in place for several monitoring programs to start on the ground this year, giving us a chance in the coming years to start learning whether in the end, nature and people are better off. **SC**

Design and Usability for Scientists
Great Surveys by Design

By Tara Schnaible and Dan Majka, The Nature Conservancy

Surveys are an excellent substitute for spending hours interviewing dozens of people. However, you can ruin that effort (and collect junk data) by crafting questions that unintentionally bias, bore or just plain confuse your survey-taker. A bad survey is worse than spending hours on the phone collecting information and can lead to bad decisions. A good survey is designed like a good scientific study.

Here are ways to instantly improve your survey questions and the results you're gathering.

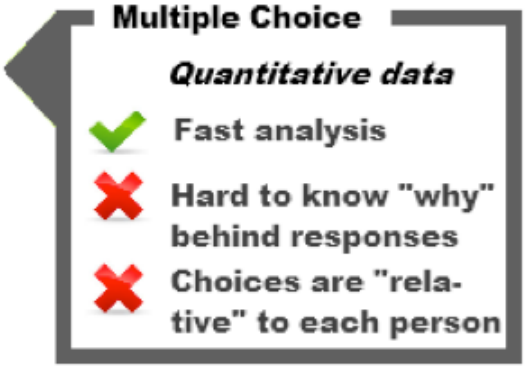
Work Backwards

Think about results first. What question are you trying to answer? Imagine 40 survey responses and trying to make sense of them: how will you be able to distinguish the answers from one another? The right survey is the one that gives you the information to answer the question you're asking.

*Example: Each question below addresses different kinds of information, but you have to know what data is important for **your** purposes.*

A. What was your opinion of the column about surveys in the recent *Science Chronicles?**

1. I loved it, best thing ever — I am changing my name to "Survey."
2. It was helpful and I might use its insights in my work.
3. Neutral — didn't do anything for me either way.
4. It was not helpful and I love my surveys.
5. I hated it. In fact, I might track down those hack authors and teach them a thing or two.



"Design and Usability for Scientists" is a new Chronicles column to help you learn the best practices of communicating visually with your audiences — everything from Powerpoints to website design to table and graphs to fonts and colors. Tara Schnaible is a usability analyst at the Conservancy, while Dan Majka is a GIS analyst with the Conservancy's Arizona program.

B. What was your opinion of the column about surveys in the recent *Science Chronicles?*

Please enter your comments here:

C. What was your opinion of the column about surveys in the recent *Science Chronicles?*

1. Very useful.
2. Somewhat useful.
3. Neutral.
4. Somewhat detrimental.
5. Very detrimental.

Please explain your response (required):

_____

*Note: The choices in Question A are funny and unorthodox. Don't attempt humor in surveys: **e-communications are misinterpreted >50% of the time.** Humor biases survey results.

Each type of question gives *different* quantitative information, qualitative information, and ways to analyze. A good filter for potential questions is to imagine the way people might answer them — and then to try to derive what clear actions can be taken based on their responses.

Finally, test your survey with a few people. It will identify if your questions are clear — and show you potential answers you might not have anticipated.

Helpful Tip

Make questions required — otherwise expect people to skip questions. Be warned: They might write dummy responses to get around required questions.

Thinking is hard.

People are doing you a favor by filling out your survey — return the favor by making the survey easier to complete.

Use simple language with fewer words, and reduce the use of passive voice. These tactics reduce your respondents' thinking load.

Limit the number of questions on one page. This approach makes your survey seem less intimidating.

Break up your wall of text. Use images, bullets and spaces to break up text-heavy questions or illustrate complex concepts in questions. You can add pictures to most survey programs. (Here are some free resources for pictures.)

The Future is Unpredictable (and 'I can't remember what I ate for breakfast last month')

Most people don't remember (well) what happens over time. This phenomenon is called a consistency memory bias. They likely guess (at best) when predicting how they will act in the future.

Example: If I'm asked, "Will I write about surveys in the future?" the eager beaver in me thinks, "Yes, of course I will!" Based on my past, I'd be wrong. (This is my first article about surveys.)

As Bill Cosby said: "The past is a ghost, the future is a dream and all we ever have is now."

Therefore: It is best to ask in surveys about very recent and specific events.

Don't Bias People

Leading questions give people ideas about how they should answer your question. A leading question looks like this: "Did you like my column about surveys?" Embedded within the question is the answer you want from the person. (FYI, the correct answer to this question is "Yes.")

Your questions should always be neutral and the answers should provide a range of emotions/states from which to choose.

Helpful Tip

Offer a prize.
This could nearly double the number of responses you get for your survey.

Takeaway

- **Think about responses — then create questions.**
- **Reduce thinking load.**
- **Ask questions about specific and recent events.**
- **Don't suggest the answer in the question.** SC

From the Field
The Answer in a Fish's Ear

By Matt Miller, senior science writer, The Nature Conservancy

Above: University of Wisconsin grad student Dan Oele with an adult northern pike.

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.

Can examining a fish's ear lead to more effective conservation?

That question is being answered in Green Bay, Wisconsin, where Nature Conservancy scientists and partners are examining the ear stones of northern pike to help figure out where the fish spawn.

I'm here checking northern pike traps with Nicole Van Helden, the director of conservation in the Green Bay watershed, and Dane Oele, a University of Wisconsin graduate student studying pike.

Northern pike are large, toothy fish that typically live in lakes, where they hunt smaller fish in weed beds and shallow bays. In Green Bay, the largest bay in Lake Michigan, pike are the top predator; each spring, many pike migrate from lakes to rivers, streams and even ditches to spawn.

Conservationists in this area focus on restore blocked or degraded streams and ditches for spawning pike. But if a stream is restored, will pike actually return?

At times, restoring wildlife habitat seems like the Field of Dreams: Build it, and the wildlife will come. That may not be the case for pike.

There is some evidence that, at birth, pike may imprint on the chemicals of a specific stream — what biologists call natal homing. They use the scent of these stream chemicals when they return to spawn.

"If pike have natal homing, it totally changes where we work," says Nicole Van Helden. "Just doing lots of restoration is not going to be enough to restore pike populations. If fish return to the same spot they were born, they may simply ignore restored streams. We need to focus our efforts on where our work will have the most benefit in this watershed."

Pike don't talk, but their ears may tell conservationists what they need to hear.

In the ear is a small "stone" composed of calcium carbonate known as the otolith. The otolith, found in all vertebrates, help fish with balance and sound detection.

Otoliths have annual growth rings, like trees, and accumulate trace chemicals from the surrounding water column as they form. Many streams have a specific — and unique — combination of chemicals, and this chemical profile shows up in the otolith when fish move from one chemically distinct water body to another.

As such, researchers can determine where pike spent different years of their lives – and if they return to the streams where they were born, or if they use different streams.

"If pike have natal homing, it totally changes where we work," says Nicole Van Helden. "Just doing lots of restoration is not going to be enough to restore pike populations...We need to focus our efforts on where our work will have the most benefit in this watershed."

"Conservationists working on stream restoration used to make best guesses on which streams would be best for pike," says Van Helden. "By examining otoliths, we can gain a much clearer picture of where pike move."

From Stream to Lab

To examine otoliths, researchers first have to catch pike — an often cold, wet and muddy process. For random sampling, researchers go electrofishing — sending voltage into the water that disorients fish and brings them to the surface—in Green Bay. They also set funnel traps that capture pike in small streams and roadside ditches, and determine if pike are successfully spawning in those small streams by capturing newly hatched pike a few weeks after the adults have returned to the bay.

"I'm running all over the place, checking the lay of the land and figuring out where pike are — and where the could be," says graduate student Dan Oele. "I'm spending a lot of time in streams. And I'm collecting pike from as many different types of places as

possible. Pike have rows and rows of sharp teeth, and even have teeth in their gill rakers. I've gotten poked a few times."

It's the kind of work many people envision when they picture field biology. But once the otolith is collected, it's a different picture.

Otoliths are smaller than a penny. To analyze each annual ring, researchers must cut them with a special saw with a one millimeter diamond blade. The micro-thin section is then sanded with ultra-fine sandpaper in a spotlessly clean work area.

The otolith ring is then scanned with a laser sensor that analyzes the chemical composition.

The laser cuts a path from the otolith's center to the edge, and analyzes the chemicals. Thus, scientists can compare the different life stages of the fish chemically and determine if the fish has migrated to the same place that it was born, or if it utilized different habitats.

Microanalysis like this is helping conservationists determine fish populations and fish migration patterns around the world.

A Future for Pike

In places like outdoors-obsessed Green Bay, pike are a popular gamefish. They're also a top predator in the Great Lakes, so protecting them protects a whole host of other species in the ecosystem.

The area around Green Bay has almost as many streams and water channels as it does Packers fans. The area are hundreds of road culverts, each potentially blocking pike from spawning. There are seemingly endless streams that could be restored.

Microanalysis will help conservationists determine where conservation can have the most impact — making your investment in organizations like the Conservancy go farther and achieve more lasting results.

Additional research is being conducted to identify the best places to improve fish habitat for a variety of migrating fish species in the Great Lakes.

"In some areas, simply changing one roadside culvert might open up miles and miles of habitat for pike," says Van Helden. "But we have to know if pike are going to use such habitat if it's opened up. The research being conducted now is an important component of determining where we work. It means that we will be restoring streams based on evidence, not guesses." **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) Post-Normal Science: Deadlines (Climate Etc.): Is climate science unlike other science? Steven Mosher, who was at the heart of leaking the Climategate emails, says yes — but before you excommunicate me for even daring to give him some web traffic, read his argument, based on the definition of "post-normal science" first advanced by Jerome Ravetz, and how it explains the extreme tribalism associated with climate science...and how very difficult it will be to push the reset button.

2) Kick Your Kids Out(side) for Their Own Good (Environmental News Network): If you don't want your children to end up like Mr. Magoo (do people remember who Mr. Magoo is anymore?), they need to spend more time outside, according to a new study in the journal *Investigative Opthalmology and Visual Science.* Researchers looked at more than 7,000 children of varying ages and found that the kids who spent more time outside at ages 8 and 9 were half as likely to be near-sighted by age 15 as those who spent more time inside, where you only look at screens and...well, other screens.

3) Bird Alerts by Birdeez: Tired of scanning all of eBird's listings to find out whether a Kirtland's warbler or Little Stint has touched down near you? Here's a service that breaks out those listings within 30 miles of you by degree of rarity and tells you exactly where you can go to see them. You can select any of the 970 species on the American Birding Association's list or just get all the birds reported. I love their slogan: "Why wonder when you can know for sure with Bird Alerts by Birdeez?"

4) Net-casting spider hunt filmed in wild (BBC Nature News): These Central American spiders hold with their forelegs a net of webbing that looks like a cat's cradle, and fling it on any suspecting passerby — in this case, a cricket about as big as the spider. The real treat here is to watch the ecstatic reaction of scientist George McGavin, who watches the capture in real time and then the footage. Pure geekery.

5) An ant that protects herself with...um...butt foam (Myrmecos.net): Need I say more? OK: that foam is venom. And there are LOTS of photos.

6) Coral Reefs: The Living Dead, or a Comeback Kid? (Cool Green Science): Roger Bradbury's *New York Times* op-ed last month that termed coral reefs "zombie ecosystems," accused reef conservationists of bad faith, and called for funds going to reef protection to be diverted to research into developing manmade surrogates...well, it predictably stirred the coral reef science community into a froth. In case you missed it, here's the response of Steph Wear, TNC's director of coral reef strategy, to Bradbury's fatalism. Money quote: "Abandoning hope for coral reefs not only is reckless and dangerous for those who depend on these amazing ecosystems — it is one of the most unscientific things a conservationist today could do." **SC**

Article

Mapping Impacts, Threats and Strategies for Adaptation: The Yale Mapping Framework

By Craig Groves, director, conservation methods, Central Science Team, The Nature Conservancy and member of the Yale Science Panel on Adaptation

Nearly three years ago, The Nature Conservancy held a Climate Clinic in which 20 project teams from around the globe assessed the likely impacts of climate change on natural systems and biodiversity and proposed changes in project goals and strategies to abate and mitigate these impacts. At that point, most conservation organizations had focused the bulk of their efforts on emissions reduction such as "cap and trade" legislation in the United States, only to see those efforts ultimately fail. With mitigation of emissions unlikely at the federal level in the United States, most institutions have turned to placing greater attention on adaptation strategies. But what *are* the most effective approaches to adaptation?

In late 2009, several important papers on adaptation were published, including Nicole Heller and Erika Zavaleta's review in *Biological Conservation* of 22 years worth of adaptation recommendations. Most recommendations before this lacked the specifics on who, how and under what conditions they might be implemented. Heller and Zavaleta identified several important gaps in adapation, including the need for a "practical adaptation planning process."

At the same time, three major foundations that fund biodiversity conservation projects (Kresge, Doris Duke, and Wilburforce) were noticing both an increase in funds requested for undertaking a variety of adaptation actions, but also that the proposals contained a confusing mix of approaches. They decided to assemble a panel of respected scientists and natural resource managers from across the agency, academic and non-governmental communities to synthesize and advance the best overall planning approaches for adaptation in landscape conservation. The resulting effort is referred to as the Yale Mapping Framework (so named because the panel is led by Dr. Os Schmitz of Yale University) — an integration of climate adaptation and landscape conservation planning (see www.databasin.org/yale for details on the framework).

"Conservancy practitioners and scientists should find much to like and use in applying the framework and its methods and data to help advance adaptation in our own landscape and seascape projects."

At the heart of the framework are six adaptation approaches that can each be applied at three different levels of ecological analysis (landscapes; ecosystems; and species and populations). The adaptation approaches include:

- Protecting current patterns of biodiversity;
- Protecting future patterns through projections of impacts and species/ecosystem responses;

- Maintaining ecological process and function;
- Maintaining and restoring connectivity;
- Protecting climate refugia, and
- Protecting the ecological stage (compliments of TNC's Mark Anderson and colleagues work among others).

The real strength of the framework lies in the approaches, tools and databases it provides to help planners and scientists determine the appropriate methods and available data for applying any one of the basic approaches to one or more of the ecological levels of analysis. It's relatively easy on the DataBasin website to "drill down" to learn about the available models and methods for any given approach and level as well as to learn about the assumptions, strengths and weaknesses of those models and methods. A separate page of the website provides extensive information on biological, cultural and abiotic datasets available for applying these basic approaches.

Beyond the development of the framework itself, the Yale project has provided several grants to "test" different aspects of the framework and strengthen it. Details on the grantees' projects and preliminary results are provided on the DataBasin website and have been the subject of symposia at the 2012 NatureServe and SCB annual meetings.

Discuss this article on the Conservation Gateway.

The target audience for the framework's use is landscape planners and scientists in agencies and conservation organizations in North America. The framework's orientation is largely terrestrial with some application to freshwater and coastal marine systems; the emphasis is on geospatial analyses. Beyond these limitations, Conservancy practitioners and scientists should find much to like and use in applying the framework and its methods and data to help advance adaptation in our own landscape and seascape projects. **SC**

Science Short
Most Scientists are (Drumroll) Human

Fawcett, T.W., and A.D. Higginson. 2012. Heavy use of equations impedes communication among biologists. *PNAS* 109(29):11735-11739.

Carter, R.M., D.L. Bowling, C. Reeck, and S.A. Huettel. 2012. A distinct role of the temporal-parietal junction in predicting socially guided decisions. *Science* 337(6090): 109-111.

Do your eyes glaze over at the sight of the first Greek symbol in a publication — or do you perk up and read on, relieved to be in familiar territory? These two articles on how people process information based on how it is presented and its source may shed some light on the challenge faced by that subset of humans we call conservation scientists.

Mathematical equations are a shorthand language for explaining patterns and are particularly beloved by theoreticians and modelers. Shorthand is great; it is efficient. Except, the author of the *PNAS* piece conclude, you still have to explain what it means if you want folks outside you immediate field to give your thoughts due attention. Otherwise, theory people cite theory people while empiricists and practitioners talk among themselves, which can limit our ability to grow an interdisciplinary field of science.

On the other hand, the report in *Science* shows that very different parts of the brain are activated when you think you are responding to a strategy devised by another person compared to when you know your opponent is a computer. Taking that logic a step further, it could be possible that "nature brains" respond differently to mathematical theory than field data and it really is a cognitive leap to switch from one to another. That's not, of course, to say we shouldn't try; just that we should recognize our feelings of discomfort at trying could be natural. **SC**

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

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.

Cross, M.S., E.S. Zavaleta, D. Bachelet, M.L. Brooks, C.A.F. Enquist, E. Fleishman, L. Graumlich, **C.R. Groves** et al. 2012. The Adaptation for Conservation Targets (ACT) framework: A tool for incorporating climate change into natural resource management. *Environmental Management* 50(3):341-51.

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Gordon, D.R., C.A. Gantz, C.L. Jerde, W.L. Chadderton, R.P. Keller, and P.D. Champion. 2012. Weed risk assessment for aquatic plants: Modification of a New Zealand system for the United States. *PLOS ONE* 7(7): e40031. doi:10.1371/journal.pone.0040031

Kroeger, T. 2012. The quest for the "optimal" payment for environmental services program: Ambition meets reality, with useful lessons. *Forest Policy and Economics*, doi:10.1016/j.forpol.2012.06.007.

Mangubhai, S., M.V. Erdman, **J.R. Wilson**, C.L. Huffard, F. Ballamu, N.I. Hidayat, **C. Hitipeuw**, M.E. Lazuardi, **Muhajir**, D. Pada, G. Purba, C. Rotinsulu, **L. Rumetna**, K. Sumolang, and **W. Wen**. In press. Papuan Bird's Head Seascape: Emerging threats and challenges in the global center of marine biodiversity. *Marine Pollution Bulletin.* http://www.sciencedirect.com/science/article/pii/S0025326X12003451

Martin, E.H., C. Kelleher and T. Wagener. 2012. Has urbanization changed ecological streamflow characteristics in Maine (USA)? *Hydrological Sciences Journal* 57(6):1-18.

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Thieme, M.L., J. Rudulph, **J. Higgins**, and J.A. Takats. In press. Protected areas and freshwater conservation: A survey of protected area managers in the Tennessee and Cumberland River Basins, USA. *Journal of Environmental Management.*