SCIENCECHRONICLES

Ghizo, Solomon Islands. Credit: USAID CTSP/James Morgan

Communicating

Editor's Note

When it comes to communicating effectively about science, perhaps what we need is more poetry.

This is in no way a slap at the varied and innovative efforts at communicating and sharing data described in this issue, from field guides to dashboards to apps. Each is important, and each reveals important insights about how to reach people in ways that matter and with information that they can use.

Yet, I get a nagging sense that something is missing more generally in the way we think about science and science education, and the role of science in both conservation and other parts of our public and private lives. The combined pressure of scientific specialization, rapid-fire communication channels, and looming (or worse) environmental crises seem to require a focus so vigilant it obscures the connections between science and all the other things we care about.

At a time like this, who has time for poetry?

In thinking about this I was reminded of a long-ago PBS series called *The Ascent of Man*, about how science has shaped civilization and humanity itself. There were several remarkable things about that series. First of all, it was 13 hours long. That is practically unimaginable now. How many tweets would that be?

The second remarkable thing about *The Ascent of Man* was its host and author, a Polish mathematician named Jacob Bronowski. He was hardly a dashing adventurer in the Attenborough model, with round glasses, bushy eyebrows, thick accent, and a gentle demeanor, but he had a mind that seemingly captured everything around him. He was as comfortable with Blake as he was with Newton.

The book that accompanied the series (and is largely a transcription of the TV scripts) was reissued a few years ago, and I expected it to feel dated. But Bronowski was a scientific humanist of a sort we rarely find nowadays, and as such his insights remains fresh four decades later (he died in 1974).

One image from the show remains clear in my memory. It is Bronowski in a marshy field near Auschwitz, where the ashes of millions were dumped, running his fingers through the mud. "When people believe that they have absolute knowledge, with no test in reality, this is how they behave. This is what men do when they aspire to the knowledge of gods. Science is a vey human form of knowledge... Every judgement in science stands on the edge of error, and is personal." Bronowski then quotes Oliver Cromwell: "I beseech you, believe it possible you may be mistaken."

This is not simply about science; it is about why science matters.

With this issue, Science Chronicles moves to a quarterly schedule, so look for the next issue in June. As ever, your comments are more than welcome. **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.

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Article

Identifying and Communicating the best Science to Diverse Audiences in the Coral Triangle

By Alan T. White, Senior Scientist, Indo-Pacific Division, and Alison Green, Senior Marine Scientist, Indo-Pacific Division and Global Marine Team The Nature Conservancy

Alotau, Papua New Guinea. Credit: USAID CTSP/Tory Read via Flickr and Creative Commons.

When we embarked on the Coral Triangle Support Partnership, a five-year USAID project supporting the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF), we knew there would be many challenges pertaining to the diversity of the region. A central part of our TNC marine work in the Coral Triangle countries has been and continues to be related to marine spatial planning, marine protected areas, and fisheries sustainability, all of which require good science to support improvements in design of implementation strategies that both protect and enhance the marine resources while benefitting people in meaningful ways. Scientists who live and work in the Coral Triangle region are well aware of the need to communicate their work to a diverse audience that includes senior policy makers, national and local practitioners, and a variety of resource-dependent users who have a limited understanding or interest in the science behind sustainable resource use and management.

One of the great opportunities of the Coral Triangle Support Partnership project was that it allowed us — alongside our NGO partners, World Wildlife Fund and Conservation International — to conduct historical research on the progress in the region and to identify gaps in the design and implementation of effective marine protected

areas (MPAs) and networks. Several substantial initial studies by local and international professionals, in consultation with many persons across the region, provided guidance for work ahead on MPAs under the umbrella of the CTI-CFF. Key findings from these initial research reports highlighted several important realities:

- We needed to really figure out how to design MPAs/networks to benefit people and nature — not only for biodiversity protection;
- We needed to make the messages about MPAs being an important tool for conservation and management in tropical marine ecosystems popular and understandable in relation to the resource use dependencies in the region;
- We needed to integrate essential considerations about the impacts of climate change on coral reefs in the design of MPAs/networks in simple and understandable ways; and,
- We needed to focus more on the issues of concern to primary stakeholders, e.g. fisheries management and livelihood, to engage a much wider range of stakeholders across the region.

A central part of our TNC marine work in the Coral Triangle countries has been and continues to be related to marine spatial planning, marine protected areas, and fisheries sustainability, all of which require good science to support improvements in design of implementation strategies that both protect and enhance the marine resources while benefitting

With these realities in mind and the project support in hand, we were able to develop design principles to achieve multiple objectives to benefit both people and nature. We did this by reviewing the scientific literature, doing new science where required, interacting with local users, and developing clear guidelines that can be used to achieve all three objectives (fisheries, biodiversity, and climate change adaptation) simultaneously. And because the audience for these materials is so varied, we were able to produce this information in four formats for different stakeholders:

- A set of six papers that provide the scientific basis and background for this approach was published in 2014 in a special issue of Coastal Management on MPAs in the Coral Triangle.
- A guide for field practitioners, that provides a succinct, graphic, and user-friendly synthesis of the best available scientific information for practitioners who may not have access to, or the time to review, the increasing amount of research literature regarding this issue co-authored with partner organization scientists and staff in the Coral Triangle (2013).
- A brief for policy makers, which is designed for use by government departments and senior government officials (2013).

- A guide for community based managers, which provides a series of flip charts and speaking notes to discuss these issues and implications for MPA design with local communities also co-authored with local partners (2013).

- Two definitive scientific papers: "Larval dispersal and movement patterns of coral reef fishes, and implications for marine reserve network design," published in Biological Reviews (2014) and "The intrinsic vulnerability to fishing of coral reef fishes and their differential recovery in fishery closures," in Fish Reviews and Fisheries (2014).

This information has been enthusiastically received and is already being used to design MPA networks in the Coral Triangle, Micronesia, and beyond. Information from the project has been used in:

- The regional marine gap analysis for the Coral Triangle Protected Area System (in press), done in collaboration with the University of Queensland, and,

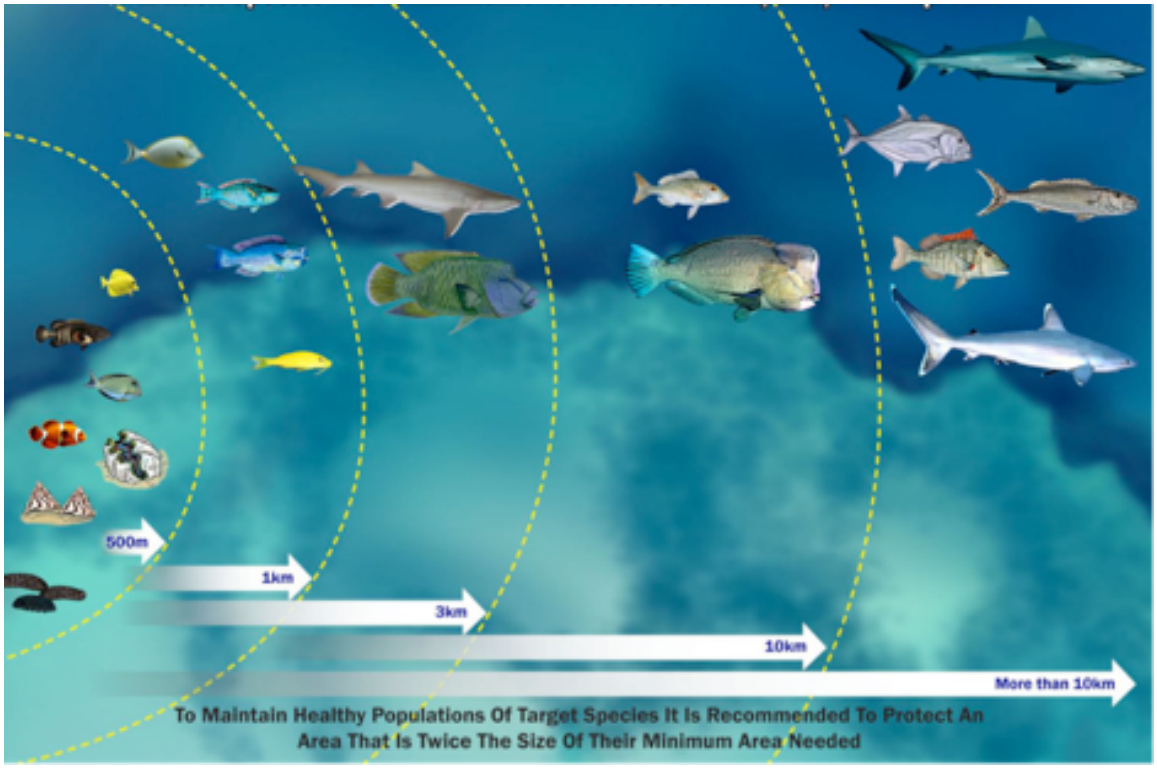
- Zoning many MPAs including Tun Mustapha Park (the largest MPA in Malaysia) and Savu Sea Marine National Park in Indonesia (the largest in the Coral Triangle).

Using images that people can relate to and understand immediately brings key messages to a much wider audience.

These documents are important by themselves and have already communicated essential information to many thousands of persons in the Coral Triangle countries. In addition, there are key take away lessons from this five-year process of generating these documents and how they are presented, for all who are trying to move conservation to a state of wider acceptance among diverse stakeholder audiences.

One lesson is that using images that people can relate to and understand immediately brings key messages to a much wider audience. An example is the use of the diagram below depicting the home-range movement of fish and thus showing the area required to effectively protect different species of fish from exploitation. This graphic has been very powerful for engaging stakeholders in MPA design processes and helps convince them about the size needed for their MPA/marine reserve.

Another key lesson was that such data collection, analysis, report writing and ultimately the scientific paper publications should not be done in isolation by a few scientists. The process offers many opportunities for learning and education when as many partners, colleagues, and stakeholders as possible are involved in developing and vetting the materials so that there is true ownership among those close to the problems and resources being managed. While the Coral Triangle is a large area covering



Different species have home ranges of different sizes, so they need different sized no-take areas.

six countries, authorship for the various publications cited includes scientists and policy makers from each of the six countries. And, getting to formal publication is important in the eyes of the local scientists and policy persons since this adds credibility to the scientific guidelines being communicated.

Data collection, analysis, report writing and ultimately the scientific paper publications should not be done in isolation by a few scientists.

A final but sometimes forgotten point is that this work would not have been as effective if the guiding impetus for the research and the publications did not come from the Coral Triangle stakeholders themselves. They were asking questions in the beginning of the project that we in TNC (and the other NGOs) could help answer, thus we embarked along this path. If these decisions and direction were only decided internally within our organization, the outcomes would be much less significant and acceptable to our many partners. **SC**

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Article

Gauging Conservation Dashboards

By Nick Salafsky, Foundations of Success

Credit: Flickr user Quimby via Creative Commons.

Many conservation organizations are starting to focus on management metrics displayed in "conservation dashboards." This phrase evokes images of senior managers sitting in their command center making subtle adjustments to organizational strategy and tactics based on the readouts from a panel of spinning and blinking gauges showing hectares of forest in the Amazon or the status of fish populations in the Coral Sea. Managers are charged with "moving the needle" on key gauges as a measurement of the outcome of their work.

If you think about your car's dashboard, however, moving the needle is really only half the story. What makes a gauge truly useful is not the needle itself, but rather the markings on the gauge that help you interpret what moving the needle actually means and then decide what actions you need to take as a result.

A fuel gauge, for example, literally measures the level of liquid in your car's gas tank. The needle moves as the tank empties. But to make sense of the needle's movements, the gauge converts them to a measurement of what fraction of your tank is filled (the markings of E ¼ ½ ¾ F beneath the needle plus the buzzer that sounds as you approach empty). You the driver then must convert these markings to an assessment of

how many kilometers or miles you have left to drive before you need to take action and refuel.

Or consider a tachometer that measures the rotations per minute (RPM) of the drive shaft in your engine (technically, it is measuring the electrical voltage generated by a magnet attached to the spinning drive shaft – the manufacturer has to invest in a special system to get the gauge measurement). But the observation that the needle moves from 4,000 RPM to 7,000 RPM is not that useful in and of itself. What's more important is the red line trigger point on the dial that warns you to immediately shift gears to avoid burning out the engine. Furthermore, if you have an automatic transmission, there is not much point in investing in a tachometer (even if it looks cool), because there are no decisions to make based on its readings. It is not only a waste of both the resources required to build it and premium space on the dashboard, but it may even distract the driver from focusing on other more important gauges.

The trick is to think about a limited set of meaningful indicators and thresholds for the viability ratings that will prompt conservation action where warranted.

Developing an effective automotive gauge thus starts with understanding what the critical management decision is, figuring out the best available and affordable indicator to provide information vital to this decision, and then presenting measurements based on this indicator to the driver along with sufficient context to guide appropriate action. Interestingly, as technology changes, we can improve how gauges help drivers make better decisions. For example, modern cars are replacing the traditional gas gauge with a digital readout of the distance you can drive before running out of gas. Computer technology has essentially enabled car manufacturers to bypass the analog needle measuring gas levels in the tank and present drivers with pure interpreted information to make the critical management decision about when to refuel.

So how does this link to conservation? Since the decisions facing a manager of a project site or program area differ from those facing the CEO of a large organization, it seems like different dashboards would be needed for each situation.

In general, project and program managers need to know how the things they care about (aka conservation targets) are doing. To this end, the Open Standards tool of Viability Analysis has all the elements for constructing a good gauge:

Gauge Element	Automotive Analogy	Viability Analysis	Specific Example
Information need for management	Distance before refueling is required	Key ecological attribute of focal target	Connectivity of toad populations in lakes
Actual measurement	Level of liquid remaining in tank	Indicator	Distance/barriers to toad source populations
Interpretative markings on gauge	E ¼ ½ ¾ F markings + buzzer near empty	Thresholds for Very Good, Good, Fair and Poor condition	Hop-ability ratings

As many *Open Standards* coaches and practitioners know, Viability Analysis is a bit of a black hole into which conservation teams can fall, never to emerge. I suspect that much of this problem stems from the fact that teams are trying to measure all possible variables rather than construct the cheapest set of gauges that will help them make good management decisions. The trick is to think about a limited set of meaningful indicators and thresholds for the viability ratings that will prompt conservation action where warranted. With this in mind, Foundations of Success is now working to compile a guide to the most useful attributes, indicators and thresholds for different types of conservation targets (a working draft is available here).

One of my favorite recent examples comes from a project team working with endangered toads in high mountain lakes. Here, one critical parameter is the ability of each lake to be colonized from adjacent source populations of toads. To this end, we developed a qualitative scale for each lake that assessed whether the distance to a source population was Easily Hop-able, Hop-able, Barely Hop-able, or Not Hop-able due to either distance or physical barriers. Although it sounds silly, this scale tells the managers much of what they need to know. If a given lake is not hop-able, then managers need to take action to ensure that proper connectivity is established. The key is to use the team's ecological knowledge to find the critical attributes, indicators, and interpretive markings with which to construct their gauge.

The key to an effective dashboard is to only collect and present data that can be interpreted and used for direct management action. Everything else is superfluous and a distraction – like tachometers on cars with automatic transmissions.

Another parameter of interest to project managers is the status of threats facing conservation targets. Conservation practitioners are coached to identify and prioritize threats and to then develop threat reduction objectives and indicators. I suspect that formulating these objectives and indicators would be easier if we extend the metaphor of the interpretive markings on the gauge to this problem. In many cases, it may be sufficient to assess whether a threat is declining, stable, mildly increasing, or substantially increasing in scope and/or severity. But there may also be some cases in which critical thresholds exist that will prompt management action. For example, if practitioners are dealing with a highly infectious disease or a rapidly spreading invasive species, then finding even one incidence of the disease or invasive species in their project area may represent a critical redline threshold that requires immediate management attention. Similar thresholds may also exist for indicators used to track conditions for project-level strategy implementation.

Jumping up to the level of an organizational dashboard, it seems that most of the management decisions being made at this level are about the allocation of scare time and treasure across different parts of the organization to take on different strategic approaches. As such, it seems useful to have gauges that show which projects and programs are on track and which are not functioning well and need either additional resources or management attention, or both. It is also vital to monitor current and

projected levels of key financial, human and other resources so that managers can ensure they are available within the organization as needed.

But it is hard to imagine much else that would be useful at the organizational level including (somewhat surprisingly) measures of the status of species, ecosystems, threats, or human stakeholder wellbeing. At best, these measures are needed for long-term strategic reprioritization efforts, not for day-to-day or even year-to-year management work. If you were the CEO of a large organization and you saw that deforestation in the Amazon increased by 10% in the last five years, or that the GDP of Indonesia went up 5%, what action would you take as a result? Whereas if you saw that your Amazon program was having trouble retaining key staff or meeting its agreed upon goals, these would presumably be actionable signals.

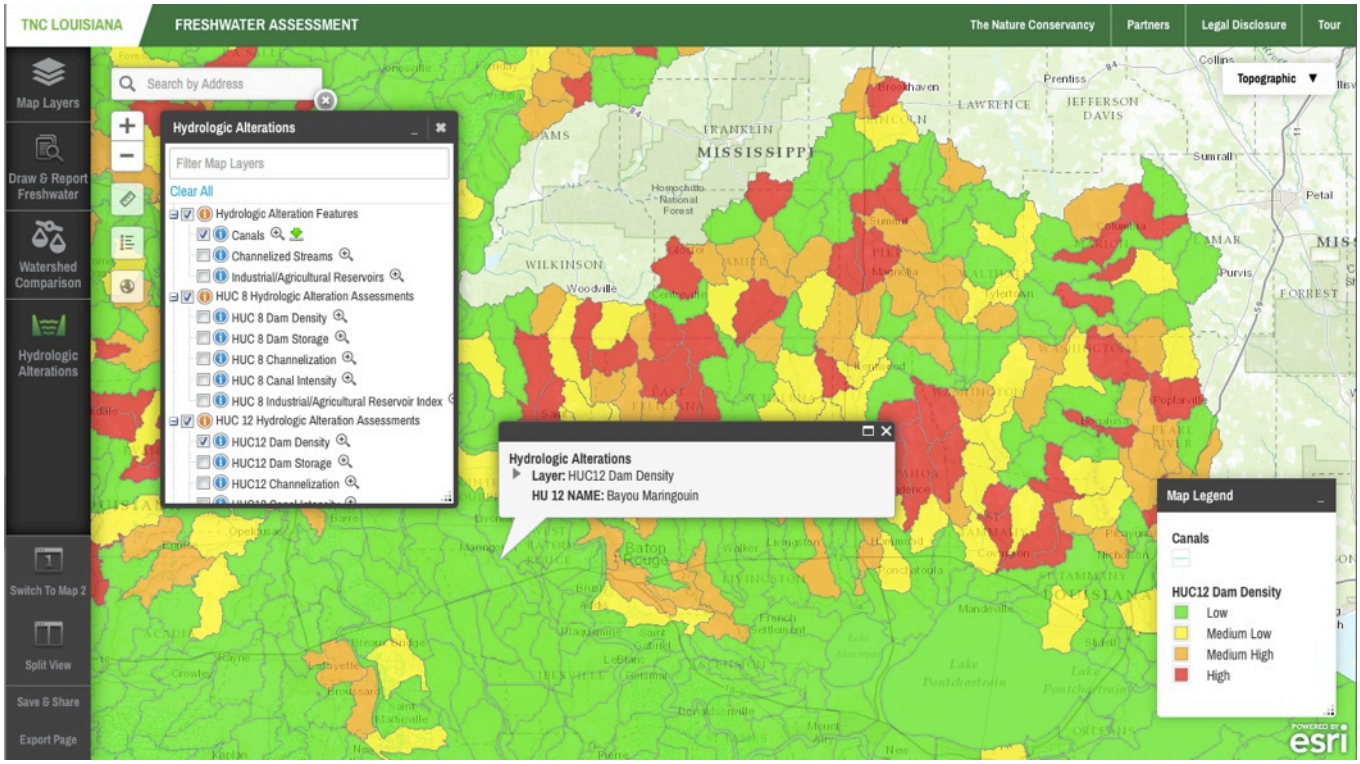
The key to an effective dashboard is to only collect and present data that can be interpreted and used for direct management action. Everything else is superfluous and a distraction – like tachometers on cars with automatic transmissions. The best dashboard is not the biggest and most complex one – it is the one that contains the minimum set of effective gauges needed to guide critical management decisions. **SC**

Thanks to Arlyne Johnson and Caroline Stem for helpful comments on a draft of this essay.

Article

The Freshwater Network – A Scalable Way to Use Science to Meet Global Challenges with Local Solutions

By Bryan Piazza, director, freshwater and marine science, The Nature Conservancy in Louisiana



A scientist stares intensely at her computer screen, hands clutching her aching head. She's tired, frustrated. Piles of full ring binders and manila folders stuffed with scientific reports and papers surround her in towering, wobbly piles. Maps are spread across tables, full of arrows, dots, and notes scribbled in black marker. A huge state-agency dataset she's downloaded stares back at her from the screen.

The scientist's task is to compile all of this information and paint a picture to inform her agency on a water development decision that will take place in an area where three threatened fish species reside. But the studies and datasets are so different, not only in subject matter, but also scope and scale. They are not compatible, at least not in their current form. How will she ever paint that picture? How will anyone understand that picture even if she paints it?

Have you ever been in this situation? I have. It's the old way of trying to bring scientific information into decision making. It was frustrating and often caused science to be excluded from the decisions that affected natural resources and the people who depended on them. Science was seen as too complicated and scary — inaccessible to normal people.

But what if this scene was different? What if this scientist didn't have to rely on that old, antiquated system? What if she could find everything she needed to paint that picture in one place – a comprehensive system with the easily accessible scientific information she needs to inform the agency decision with accessible and easy to understand tools to make her recommendation understandable and transparent? Well, now she can.

The Louisiana chapter has released the Freshwater Network (freshwaternetwork.org), a freely-available online network designed to provide a holistic, scientific view of water resources and to facilitate decision making. The network is intuitive for users and can be custom-built for individual geographic areas, like states, regions, or river systems. That means programs across TNC and partners can quickly, simply, and economically create their own site or app to answer their most important questions anywhere in the world with rigorous scientific information.

Louisiana – the First Statewide Assessment

The Freshwater Network began with a comprehensive statewide assessment of freshwater resources in Louisiana. We built the assessment on USGS watershed delineations and added a waterway dataset that contains over 580,000 waterways of all types (rivers, bayous, streams, canals, channelized streams, and reservoirs) for Louisiana. To that we added datasets on land cover, land use, conservation lands, wetlands, and more than 50 years of data on nutrients, pollutants, and fish communities. We're also building a statewide model that provides estimates on the water flow in all of our bayous, rivers, and streams so that we can look at past, present, and future projected uses of fresh water even down to very small scales as well as the interaction between surface flow and groundwater.

The Louisiana chapter has released the Freshwater Network, a freely-available online network designed to provide a holistic, scientific view of water resources and to facilitate decision making.

But we're not just compiling this information for viewing; we're building apps to use these data for decision making and informing statewide water policy development. For example, we are building an app with NRCS that will use nutrient information to help target conservation partnerships with agricultural producers to improve water quality through nutrient reduction. We're also building a flow app that will provide time-series surface flow estimates and generate flow metrics at multiple scales, and we're analyzing potential water sales from rivers and the effects of those sales on coastal salinity and commercial fisheries.

The Freshwater Network is important to Louisiana. Not only will it be used to inform conservation decisions, but it will help the state develop a statewide water management plan and a water code.

Membership has its Privileges

Our goal for the Freshwater Network was not only to provide a comprehensive look at Louisiana. It was to create a network of sites that are integrated to answer bigger questions and work on whole systems. So we created a system framework and program infrastructure that can be readily expanded into other places and that is fully compatible with the existing Coastal Resilience (CR) Network. We see real opportunity in expanding

the network across larger areas and whole systems so that TNC and our partners can facilitate larger scale conservation for a bigger impact in less time and at a lower cost.

For example, the network is currently expanding with the addition of a similar project in Mississippi, giving both TNC programs and our partners the opportunity to analyze watersheds that span across state lines as well as entire river systems, like the Pearl River, that starts in Mississippi and flows into the Gulf of Mexico in Louisiana. The Mississippi chapter has saved time and money by building on the technical infrastructure we developed in Louisiana and using apps that are already developed and cost-sharing the development of new apps, like the water flow app. As the network grows, the costs should decrease more, as cumulative cost reductions kick in. For example, any app within the CR or Freshwater Networks can be re-used or re-purposed for little to no cost, and as more apps get built that "library" of available science tools grows. Also, the annual maintenance and upgrade costs for the web platform become spread across more programs, both in the CR and Freshwater Networks.

A Model of One Conservancy Collaboration

Our goal for the Freshwater Network was not only to provide a comprehensive look at Louisiana. It was to create a network of sites that are integrated to answer bigger questions and work on whole systems.

Developing conservation science tools across programs and geographies is challenging. There are technical, financial, and programmatic factors to consider. But most importantly it takes dedication to partnership and working across programs to achieve our greater TNC global mission – a whole that is greater than the sum of its parts.

By working together with the Global Marine Team to create the CR 2.0 platform with freshwater geographies in mind and by linking this project with the Gulf of Mexico Resilience Decision Support Tool, we created a programmatic, financial, and technical model of One Conservancy collaboration so that multiple state chapters, whole systems, and regions can now use the platform to create apps and tools to meet their needs. We hope that these concrete steps toward achieving our larger mission will change the way we invest in and do science at TNC to achieve conservation results at greater scales and to explore the connectivity inherent among all natural, economic, and social systems. Partners can freely use the network, taking advantage of data and apps, or they can help the network grow by creating apps to answer their specific questions and meet their conservation missions. There are large conservation challenges to overcome and by increasing the scope at which TNC and the broader conservation community can investigate current status and trends and test future scenarios, we can all help make better decisions, confer a broader sense of stewardship, and design innovative solutions for nature and people. We can also turn that frustrated, tired scientist into a happy, effective scientist who is spending her time using the Freshwater Network and creating tools that paint clear pictures that anyone can understand. **SC**

Article

When to Say No

By Bill Ulfelder, executive director, The Nature Conservancy in New York.

Bristol Bay, Alaska, location of the proposed Pebble Mine. Credit: Todd Radenbaugh via Flikr and Creative Commons

As we begin a new year working with public and private partners on important issues like cleaning our coastal waters, restoring flows on Lake Ontario, using nature to promote climate change resilience, and developing an energy vision for New York, we bring a unique and essential approach to our work -- we are collaborative, non-confrontational and solutions-oriented.

This, combined with our great science, has produced a remarkable legacy of results. It's what we bring to land deals like the Heart of the Adirondacks, our water quality work on Long Island, and our efforts to make New York City more resilient in the face of climate change.

As Mark Tercek has said, "We are the organization that asks, 'How?'" How can we produce energy and protect wildlife? How can we farm and ensure that nature is not harmed? How do we find ways for both people and nature to thrive?

We applied this approach to hydrofracking in New York State. We did not take a position for or against. Our approach was to contribute science to the State, industry, environmental groups and the public, to aid in the decision-making -- providing a practical, scientifically credible voice in a debate fraught with emotion. We appreciate the consideration our science received in Governor Cuomo's decision.

But being the organization that asks "How?" means having the ability to say no when we need to. And the Conservancy can and does say no.

The proposed Pebble Mine in Alaska would simply be too damaging to the endemic salmon population and habitats to effectively minimize or mitigate them. After extensive research, the Conservancy believes that the risks are too great to allow mine development to proceed.

Closer to home we are working hard to get Plan 2014, which will manage the flows of Lake Ontario, adopted by both the U.S. and Canadian governments. The science is clear: With alterations in how we manage the dam that controls the water levels in the lake (which is the size of New Jersey) we can restore 64,000 acres of wetlands and meet the needs of hydropower and shipping. There are some who suggest we should change the plan to address the needs of a small group of property owners. We don't agree. The plan is a good one. And we're doing everything we can to get it adopted.

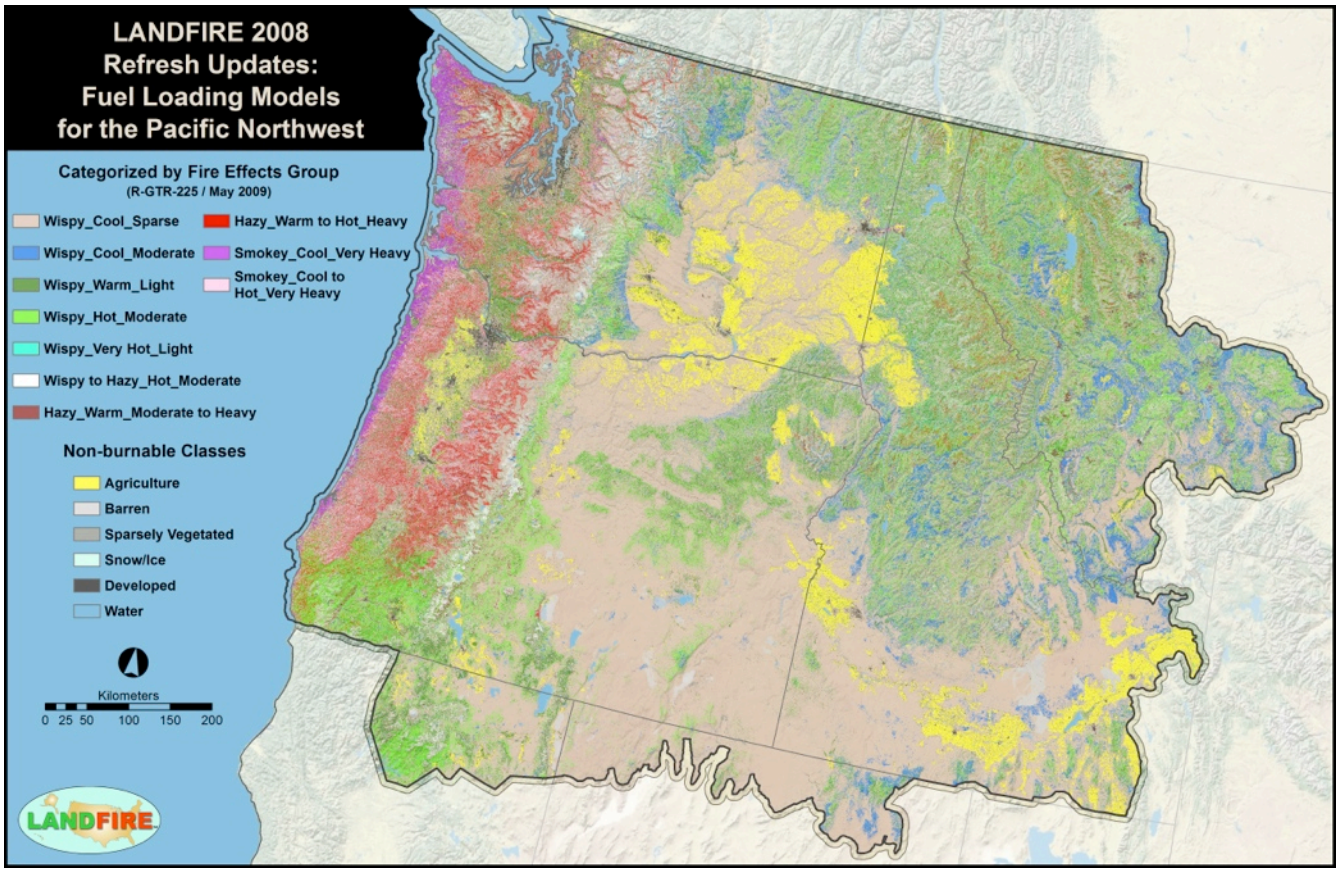
After Superstorm Sandy created a breach on Fire Island, many elected officials, the Army Corps of Engineers and others pushed to fill the breach because they feared an increased risk of flooding. But Conservancy scientists and partners saw that the breach had actually caused the water in Great South Bay to become cleaner by circulating it with the ocean and data showed the breach was not contributing to flooding. We said "No" to closing it and launched a concerted campaign to keep it open. The breach, now an inlet, continues to benefit the Bay through increased tourism, fishing and better water quality - a great outcome for people and nature.

But being the organization that asks "How?" means having the ability to say no when we need to. And the Conservancy can and does say no.

We don't often say no. Sometimes we have to. And ultimately it's what gives us legitimacy to ask, "How?" **SC**

Article
Data and Models: Pay Attention to What is Behind the Curtain

By Jim Smith, LANDFIRE Project Manager, The Nature Conservancy



Many are familiar with George E. P. Box's statement, "All models are wrong, but some are useful." That said, his seemingly cynical view doesn't stop us from using them every day, whether we know it or not. For instance, do you check the weather? Do you pay attention to economic forecasts? Did you know that your grocery store arrangement was modeled? Underneath all critical decisions are models, and behind every one of those models are data.

Models support the world of conservation as well, much like they do weather or economic forecasting. Restoration plans, environmental assessments and The Nature Conservancy's Portfolio are models. As is every map. But just as Dorothy uncovered the real Wizard in Oz, we must pay attention to what is behind the curtain (model) -- data.

Because all models depend on data, they must be in the appropriate scale and quality for the work at hand. What I believe (and fear) is that data are hidden so far behind the curtain that they are invisible, forgotten. No good policy, plan or project was created or monitored without good data. A nearly perfect model is nearly perfectly useless without the right kind of data used in the right way.

I am a member of the TNC LANDFIRE Team. We are in the data business, so that while this commentary may seem like a self-serving diatribe, my personal concern goes way beyond our program. LANDFIRE relies on the Gap Analysis Program, the Landsat Program, Forest Inventory and Analysis, Forest Health Technology Enterprise Team, the NRCS National Resource Inventory, Bureau of Land Management monitoring plots, and many other resources. Local data are absolutely vital to LANDFIRE. It is critical that we don't plan to create and use mission-critical models or systems without understanding and providing for their current and future data requirements.

Despite my obvious love of data (after all it is my life's work,) I also know that George Box's statement about models applies to data. That is, while all data ARE [in effect] wrong, some are useful. I know the value of models, and am a true worshiper of useful data. As strange as it may seem, I savor a rich data set (map, spreadsheet, etc.) like a piece of chocolate cake with chocolate chips and cream cheese frosting. To me, investigating a new data set is like opening a wrapped gift -- you never know what exciting things await.

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However, it is so important to remember that no data set is effective or efficient for every application. The bottom line is that users must take responsibility for making the decision about the data you use. Our responsibility as data producers is to tell you everything we know about our products, but we cannot -- indeed must not -- make decisions for you about which data sets are the "right" ones for your purposes.

Instead of 'Readin', Ritin' and Rithmetic', here are my "Three "Rs". Remember the importance of data: Respect the value of that data; Make the Right decisions about data; Pay attention to the data behind the model. **SC**

Article

Why Applied Science Can Often Be Truly Brilliant

By Heather Tallis, senior scientist, The Nature Conservancy

Bluestripe seaperch in Palau, where scientists are piloting a promising tool to reduce overfishing Credit: Tanaka Juuyou via Flickr and Creative Commons

I've had the chance to interact lately with university students in the natural sciences in Hong Kong, California and Georgia. These students are asking the same questions I did when I was a student. Can you do good science in an applied position (like mine)? Don't you have to compromise scientific rigor to do applied work? Isn't the best science done at universities?

So, to all students everywhere, I want to say one thing: People who do applied research are not less brilliant than those who sit in universities, or who do more basic research.

In fact, they can be even more brilliant.

I don't just say this because I sit at a conservation NGO. Before I came to The Nature Conservancy, I sat at Stanford University as a senior researcher for seven years.

In that position, I regularly interacted with people who had what many consider to be true brilliance. Incredibly smart, innovative people — but who had been taught to employ their brilliance in what can be a limited way.

Single Geniuses vs. Making Everyone a Bit of an Einstein

In the natural sciences today, there is the perception that scientific excellence lives in universities. You succeed in those universities by having thoughts that no one else has had, by establishing how you can do something that no one else can do.

This model of brilliance produces pinpoints of light, bright flashes for all to gaze at and be inspired by. We need these flashes, to be sure.

But the single-genius model is less helpful for fixing most environmental and social problems — the solutions to which often lie not in individual brilliance, but involve catalyzing and coordinating small innovative actions among thousands or even millions of people.

The light bulb was a great invention, but it didn't change the world until there was a power grid providing electricity to every house. Both the bulb and the grid were brilliant inventions, but we hear a lot more about Thomas Edison (the bulb) than we do about whoever invented the grid (the person is so not-famous I can't even figure out who it was).

The single-genius model is less helpful for fixing most environmental and social problems — the solutions to which often lie not in individual brilliance, but involve catalyzing and coordinating small innovative actions among thousands or even millions of people.

Here's an environmental example of the same situation from some of my colleagues. Fishery stock assessment and management is a classic realm of sophisticated, advanced science. Rigorous models have tens if not hundreds of parameters, and require Ph.D level scientists to run and interpret.

It's costly, too: The collection of data on stocks to inform these assessments can run in the hundreds of thousands to millions of dollars. The best assessments use large research vessels and whole teams of university professors and government scientists. These resource-heavy requirements are part of the reason that 95% of the world's fisheries regularly go un-assessed.

For example, Atlantis is arguably the world's best stock assessment model, and Beth Fulton, the CSIRO scientist in Australia who developed it, is truly brilliant. The model is a masterpiece of sophistication and complexity and it has had staggering success as far as these kinds of complex models go.

But it's been applied in 20 marine fisheries globally….of the 15,000+ fisheries that need to be assessed.

To get all fisheries globally on stable footing, we need an infusion of the applied kind of brilliance, too. Capacity limitations in many fisheries will mean they will crash before someone comes around who could apply a model like Atlantis to their management.

There's a small group of scientists taking a very different approach, in another version of what I see as true brilliance. Jeremy Prince (an academic), Noah Ideching (a Pew Fellow) and Steven Victor (an NGO scientist) are starting in Palau: small, yes, but promising.

Instead of requiring complex, integrated foodweb ecosystem models and large research vessels, they are piloting a method that requires a knife, a ruler and some fishermen. You can also just walk into a fish market and use it.

The trick here is that the science builds on existing data — reams of it, on the life history traits of different species and size at reproductive maturity. So Prince, Ideching, and Victor are relying on the brilliance of tens of point-of-light scientists who have come before and done the pure science to define how fish grow and when they become reproductively mature.

The equally brilliant and novel advance here is synthesizing that knowledge and applying it in an entirely different way that's simple and effective.

Basically, you cut open a fish, and measure its gonads.

Doing this across a decent sample size reveals how many fish being caught are in their reproductive prime, and can help fishermen to adjust the size of the fish they are keeping to keep more baby-makers in the water.

This method is the "grid" for fishery stock assessment. It takes the discoveries of top-notch scientists and uses the brains of other top-notch scientists to put them in the hands of thousands of fishermen.

In information technology, success is determined by how rapidly and extensively an innovation can spread, and brilliance in innovation is judged on how quickly a discovery can transform the lives of millions.

Now, this method is not going to get published in Nature. These scientists are unlikely to win a prize from a prestigious scientific society.

But I think they should. This is true brilliance. It's just a different kind from that which we normally celebrate.

NGO scientists are often the first to call each other out as second-rate. And yes, crappy science happens at NGOs, but it also happens at universities. And yes, brilliant science is done at universities, but it's also done at NGOs. We need to change the stereotypes in the natural sciences, which don't match the facts.

How Do We Change the Prejudice Against Applied Science?

Encourage the best students to do applied work, if they so choose.

Stop giving the impression that an applied career equals second-rate research and scientific death.

Move beyond the idea that complexity and uniqueness are the only top hallmarks of good science, and recognize elegance and relevance as equally important.

These are not insurmountable changes. Other top ranking fields do all of these things well — health, for example.

Leading researchers are acting doctors. They are learning through trials with real people who have real health problems. Leading scientists in the field are even more

deeply heralded if what they discover is translated into standard practice in hospitals that serve thousands — not a bonus we regularly bequeath to applied natural scientists.

The first Nobel Prize in medicine went to Emil Adolf von Behring for the development of a diphtheria vaccine; cutting edge medical research trained on the outcome of protecting all humans from an infectious disease. Many Nobel Prizes in medicine since then have elevated people whose research allowed widespread use of scientific novelty in saving the lives of millions. It doesn't get more applied than that.

The tech world gets it, too. In information technology, success is determined by how rapidly and extensively an innovation can spread, and brilliance in innovation is judged on how quickly a discovery can transform the lives of millions.

In the Massachusetts Institute of Technology's 2014 list of 35 Innovators under 35, arguably every advance is a version of applied science; discovering solutions to human problems or figuring out how to scale someone else's invention.

The people MIT notes as visionaries are developing nano-particles that improve drug delivery, imaging brain seizures to allow better treatment, replicating the sticky stuff made by carnivorous plants and using it to repel bacteria or other unwanted critters, making better batteries to reduce China's air pollution, and so on.

Applied science seems to sit comfortably at the pinnacle of excellence in many other fields. What's so special about the natural sciences, then? Nothing.

Closer afield, the Nobel Committee felt that the contributions of climate scientists in the regular IPCC reports had such important applications to the future of humanity that they awarded them the Nobel Peace Prize. The award was given "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change." In other words, applied science at its peak.

These kinds of translations from insight to uptake and impact don't happen on their own. Some scientists somewhere have to actually think about them, and formulate the advances that let the findings of prime intellect fall into the hands and lives of millions.

Applied science seems to sit comfortably at the pinnacle of excellence in many other fields. What's so special about the natural sciences, then? Nothing.

Applied science can be brilliant and rigorous, wherever it's done. Let's stop telling students — and ourselves — otherwise. **SC**

Drinking from the Fire Hose

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

1. The Collaboration for Environmental Evidence has teamed up with the Campbell Collaboration, an international research network that produces systematic reviews of the effects of social interventions in Crime & Justice, Education, International Development, and Social Welfare. The first results of the partnership are available, on whether decentralized forest management or payments for environmental services can serve both poverty alleviation and conservation. Bottom line: little cause for optimism just yet.

2. Africa will feed itself. At least that is hope of the Gates Foundation, which is making a big bet on agricultural innovation that will dramatically increase the productivity of Africa's farmers over the next 15 years. "By growing more varied and nutritious food and getting it to the people who need it at the right time, Africa can achieve food security by 2030. It will still import food when it makes sense to do so, but it will also export much more, eventually achieving a net positive trade balance. Famine will strike less often — and when it does, it will be African countries that take care of the response."

3. Celebrating women in science, the famous and forgotten. My favorite: Hedy Lamarr (*Tortilla Flat*, *Samson and Delilah*), who also invented frequency-hopping spread-spectrum technology that eventually revolutionized mobile communications.

4. Can science make you good? The quick answer — of course not — may be too quick, says Steven Shapin, Professor of the History of Science at Harvard. "The ideas and feelings informing the tendency to separate science from morality do not go back forever. Underwriting it is a sensibility close to the heart of the modern cultural order, brought into being by some of the most powerful modernity-making forces. There was a time—not long ago, in historical terms—when a different "of course" prevailed: of course science can make you good. It should, and it does."

5. Nanotechnology has revolutionized medicine. Can it do the same for farming, and by extension, conservation? That is the question for scientists investigating the potential for nanopesticides to significantly reduce the amount of toxins sprayed on fields. The research itself is fascinating — requiring the creation of nano-seized ecosystems — and the potential seems great, but will industry get ahead of science?

6. More to for bees to worry about: commercial populations can spread disease to their wild brethren. A new study in the Journal of Applied Ecology finds that many commercial beekeepers are creating ideal conditions for virulent diseases to emerge. "High densities within breeding facilities and in commercial pollination operations increase the contact rate between infected and uninfected conspecifics, thereby lowering the threshold for disease emergence." Here is the trailer for the documentary film The Vanishing of the Bees.

7. And finally, squid talk. **SC**

Announcement
Science for Nature & People (SNAP) Accepting Proposals for New Working Groups

By Cara Byington, senior communications specialist, The Nature Conservancy

Lake Kivu, Rwanda. A new SNAP Working Group will help Rwanda determine the value of non-market services. Credit: Flickr user Antonis Kyrou via Creative Commons.

SNAP (Science for Nature & People) announces a call for new projects and will be accepting proposals for new Working Groups until Monday, May 18, 2015.

The call comes at the same time SNAP announces the addition of seven new Working Groups to its portfolio — investigating science-based solutions to issues ranging from frameworks for better land-use decisions to how to create sustainable offshore aquaculture to reducing Chinese demand for ivory.

What is Science for Nature & People?

Sponsored by The Nature Conservancy, the Wildlife Conservation Society, and the National Center for Ecological Analysis and Synthesis (NCEAS), SNAP was created to tackle some of the thorniest dilemmas within the tangle of environmental degradation and human resource needs.

"The mission of SNAP places a priority on solving problems at the intersection of nature and human well-being," said Craig Groves, SNAP's Executive Director. "We are seeking ambitious proposals with the potential to generate clear outcomes that integrate the health, prosperity and productivity of both nature and people."

SNAP currently has more than 250 scientists — from more than 100 universities — volunteering their time to serve on its 19 Working Groups, whose inquiries encompass land-use tradeoffs, securing sufficient food and water for growing populations, and dealing with the impacts of climate change, among other severe regional and global challenges.

SNAP is a boundary institution — at the boundary between analysis and action. Successful Working Group proposals will help answer two overarching questions:

How can nature conservation broadly benefit human well-being while enhancing longer-term ecological resilience and sustainability?

"The mission of SNAP places a priority on solving problems at the intersection of nature and human well-being," said Craig Groves, SNAP's Executive Director. "We are seeking ambitious proposals with the potential to generate clear outcomes that integrate the health, prosperity and productivity of both nature and people."

How can economic development and humanitarian activities be conducted in a sustainable manner and what alternatives can be explored to achieve this sustainability?

Science for Nature & People Working Groups and New RFP

What differentiates SNAP is its emphasis on immediate implementation of its research findings. SNAP's 19 Working Groups include not just top-caliber scientists, but policymakers, bankers, engineers, corporate leaders, and others who can and will take up SNAP's findings and move them immediately into real-world applications.

The SNAP Request for Proposal (RFP) selection process prioritizes projects that tackle high-profile problems where the solutions have a clear pathway to implementation.

To apply, proposals should be uploaded as a PDF no later than 4pm PDT on Monday, 18 May 2015. Click here to download the full RFP.

SNAP was launched in 2013 and has been generously supported by Shirley and Harry Hagey, Steve and Roberta Denning, Seth Neiman, the Gordon and Betty Moore Foundation, Ward W. and Priscilla B. Woods, and the David and Lucile Packard Foundation.

Announcing Seven New Working Groups

In the last round of selections for the 2014 RFP process, seven new projects were added to SNAP's portfolio, bringing the total number of Working Groups to 19. The

methods for evaluating future drought risks that don't rely only on historic data. They will also work with existing pilot efforts on drought resiliency, and field test a suite of community preparedness and conservation actions that increase resilience to drought without harming the natural systems that both depend on.

Economics of the Chinese Ivory Trade

Reducing demand for ivory is seen as vital to eliminating pressure on increasingly threatened elephant populations. How to reduce such demand in China – whether by regulating the legal trade (which entails effectively combating the parallel illegal ivory trade) or instituting a permanent ban on all ivory trade – is the subject of debate because so little is known about the economic intricacies of the Chinese ivory trade. To help policymakers make informed decisions between regulation or a ban, this Working Group will assess the economics of the Chinese ivory trade, its impacts on human livelihoods in China and Africa, and provide policy recommendations to the Chinese government in time to inform China's 2016 National Congress Conference, which is a particularly important opportunity because it will guide Chinese policies at the next Conference of the Parties to CITES (CoP17) in October 2016.

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Fire Research Consensus

There is growing concern over how to best manage fire-prone landscapes in the face of an uncertain future climate, as well as an increasingly contentious scientific debate over how much high-severity fire should be considered "natural" in dry conifer forests across the Western U.S. Unfortunately, the debate has become a roadblock to practical action on fire management. To identify common ground among fire researchers, this Working Group will bring together representatives from both sides to address the core issues of the debate, review and synthesize available data, identify where consensus exists, focus on policy and management decisions based on that consensus, and develop a strategy for resolving issues that remain unsettled.

Natural Capital Accounting

Gross Domestic Product, the most common indicator of economic performance, does not include many non-marketed services. As a result, the contributions that ecosystem services (natural capital provided by healthy forests, rivers, and other habitats) contribute to a country's economy are not accounted for. Today, many groups, including NGOs, research institutions, the World Bank and governments are emphasizing the importance of a system for natural capital accounting that will more accurately assess a country's true wealth. This Working Group will focus on helping Rwanda, one of the World Bank's core implementing countries for natural capital accounting, determine the value of non-market services in two priority landscapes. The results of this work will directly support Rwanda's development planning process, as well as underpin the central role of natural capital in economic output. Beyond Rwanda, the results will give

impetus to efforts by global initiatives, such as the UN's Green Economy, and provide a pathway for other governments committed to including natural capital accounting in their goals for, and measures of, economic growth.

Sustainable Offshore Aquaculture

Aquaculture currently represents 50 percent of all fisheries products for direct human consumption. It's not a question of if or when aquaculture will take off, but more about how and where it will expand, and what people can do to help steer it towards more sustainable practices. This Working Group of industry representatives, scientists, and others will examine current best practices, analyze opportunities for sustainable expansion, as well as the economic and ecological impacts of potential aquaculture development scenarios, with a special focus on the emerging sector of open-ocean aquaculture, which currently has no best-practice guidance of any kind.

Water Sharing

Over-allocation of water for agricultural, municipal, and industrial use severely depletes stream flows across the American West, degrading ecosystems, and posing economic risk to all who depend on reliable water supplies. This Working Group is developing a novel approach to water sharing – using legal water transaction agreements that change water use or transfer or sell water rights – to eliminate zero-sum competition between users, and instead advance a multiple-benefit approach that restores stream flows, reduces economic risk associated with water shortages, and maintains agricultural economies. **SC**

New Conservancy Publications

Conservancy-affiliated authors highlighted in bold.

Please send new citations and the PDF (when possible) to: science_pubs@tnc.org.

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

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