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Image: Petroglyph of hunters at Arches National Park, Utah. Credit: Flickr user C.G.P. Grey and a Creative Commons

Hunting for Answers

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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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Letters

Hunting: The Other Side of the Story

I read with great anticipation Mike Palmer's account of his trip into the Canadian Northwest Territories (in the July issue of *Science Chronicles*) to hunt Dall sheep and moose or anything else that was big and imposing and respectable among hunters to shoot, hoping that this would be an alternative viewpoint on the subject of hunting and why we do it and whether it is a positive activity for conservationists to practice or support. I came away thinking, "Wow, that sounded like it was a great camping/hiking/wildlife viewing trip — why should it have ended up with a magnificent animal dead? (even though that primary directive failed)." All the benefits of the experience were there without having to take an ecologically well-adapted and biologically extraordinary animal down.

Would wrestling it to the ground have made it more palatable to those of us who feel hunting, like religion and sports fanaticism, is based on location, custom and culture and mostly a masculine trait passed down from father to son without question? Probably not. Why not take a great, award winning photograph of the animal perched high in its mountainous realm if you seek a trophy or proof of the moment? Or why not just track it and observe it and respect its ability to inhabit this remaining fragment of the earth we have otherwise converted, degraded and only in fractions preserved?

A disclaimer for those who think I don't understand hunting culture — or religion — or sports fanaticism. I grew up in Texas. Enough said. I got more than my share of all three indoctrinated into my formative, combative psyche. I hunted rabbits, dove and quail, trapped and skinned possums and raccoons and nutria, and fished the rivers, lakes and streams of the state. It wasn't until my little Peruvian aunt asked me one day in bewilderment when I was 16, "Why do you have to shoot and kill those rabbits – why not just watch them and appreciate how they live in their own environment." I had no credible answer for her and that's the last time I killed anything directly. From that point on I could see firsthand that, like religion and sports fans, sons don't ask fathers why they do what they do or why they follow this team versus that team — they just do and that's that. Hardly scientific, I thought at an early age — and if you dig just a little below the surface of this blind following, you find that the fundamental rationale for such adherence to cultural norms is lacking in objectivity and even relevance nowadays.

Hunting does not cost less per pound of flesh brought home than commercially available meats — when you factor in the vehicles, the fuel, the clothing, the accessories and the guns/bows/traps etc. It, like religion, is comfortable for those sons of fathers who did this for their fathers and so on — it's more about getting out of doors away from school and work and home and bonding together with the masculine figure they are supposed to emulate but perhaps rarely see during a typical work week. That's fine — let's keep doing that and encourage more. But why need it culminate in the killing of a wild creature? Are we still so tribal and un-evolved that we can't separate the two activities?

I'm not a tree hugger by any means, but I don't buy the arguments that we need to cull the wild creatures since we have thrown their ecosystems out of balance. I respond with, "Then let's replace the predators and let them do so naturally." And "culling" the trophy-sized perfect males of the species is not exactly replicating a natural process of predation that would otherwise take down the young, the old and the sick or injured of a population — thereby making the population genetically stronger and more fit.

So TNC has to make the pitch that we are not hunting-averse since we don't want to piss off the hunters who have disposable income to spread around. And yes, they do support creation of new national parks, refuges and protected areas — but for what? To kill the animals attracted to them. In what world does the word "refuge" mean you can hang out there to escape urban sprawl, rest, refuel and reproduce, and get shot? Not any refuge I hope to depend upon in my lifetime. But are we kidding ourselves that this is a scientifically-based position for a world renowned conservation organization to espouse? Of course we are — just like we do so in our marketing the environment for the betterment of people.

People don't need any help surviving in this world — they're doing too well on their own. I'm speaking of the species — not subunits of the world population who really are struggling — largely through outstripping any sense of sustainability with their surrounding environment and impoverishment exacerbated by corrupt governance structures. But humans do not need help to survive in this world we now completely dominate. The natural world we trod upon and eat and poison and pollute and overuse and infest — that's the world The Nature Conservancy used to primarily care about and pitch to our membership, and the reason I embraced the organization in the first place 23 years ago.

So fundraising is down and our supporters are getting older and fewer in number. Let's revisit our expenditures and investments rather than retool what we fundamentally do and why we do it. And let's not kid ourselves that hunting is a necessary part of the natural world now — it's a recreational activity that makes men feel like proficient providers for their family and boys feel like their fathers.the "best available science" and absolutely certain that they were doing what was best for people and nature. Sound familiar? **SC**

— **James Moore**, Mojave Desert ecoregional ecologist, The Nature Conservancy in Nevada

Mike Palmer's Response

I appreciate the time James was willing to take in expressing another view on hunting. Obviously, this is a very nuanced issue that can lead to strong debate. It can also be difficult to relay views, thoughts and feeling through writing, so I will provide a brief response to James and others that share his views.

As stated, tradition is a strong foundation of hunting and it is something parents can and do share with their children, male and female. It can be an opportunity to teach children the value of being outdoors, learning where your food comes from and the importance of healthy ecosystems. Like any teaching, it takes compassion, patience and thoughtfulness to make lessons worthwhile for the next generation. Our current hunting "industry" and "culture" seem to lack these qualities — images of uneducated, macho, camouflaged hunters dominate our media. Thus part of the reason for writing my piece in the Chronicles.

My article put forth my own personal experience and perspective as both a hunter and a conservationist. It was not meant to represent TNC's stance on the matter of hunting, as James seemed to think. The largest point I wanted to make was the existence of many types of hunters in the world, even in conservation. You won't see us with TV shows, 4x4 trucks or hoards of weapons. Some of us just want to be outside in pursuit of our food, simplifying life and glimpsing a small piece of the struggles that those who walked before us faced. Also, harvesting animals in the northern wilderness is a sustainable, cheap alternative to meat raised in feedlots thousands of miles away — arguably an even more environmental choice than tofu! And I find it much more satisfying than buying something wrapped in plastic in the grocery store. Through my Chronicles piece I have been lucky to find others in TNC who share the same view. **SC**

— **Mike Palmer,** program officer, The Nature Conservancy in Canada

News Brief

The All Science Conference and You

Submit your proposal for a session, talk or poster by August 30th (new deadline)

The Nature Conservancy's much-anticipated All Science Conference convenes in December to explore both existing science and innovative new ways to advance conservation for both nature and people. It's an opportunity to discuss, debate and propel conservation science in the 21st century.

This 3-day conference, hosted by TNC Lead Scientist Heather Tallis and Chief Scientist Peter Kareiva with local host Scott Morrison, will feature plenary sessions by CEO and President Mark Tercek, and CEO and President of the Wildlife Conservation Society, Dr. Christian Samper. In addition, TNC and guest scientists/practitioners will hold sessions on innovations in field work and advances in conservation.

You can help shape the content of this conference by presenting a session, talk, poster or workshop. All attendees are required to present something, such as:

- **Open Sessions, Workshops and Training:** There will be a competitive selection process for session slots, and we are looking for all sessions to go beyond a collection of talks. Sessions will be chosen to create a diverse program of stimulating ideas. Proposals for workshops and trainings to be held before or after the conference are included in this "open session" category.

- **Talks and Posters:** These are intended to bring attention to specific scientific advances or challenges being faced across the Conservancy. Talks will be in a 'speed dating' format, in which one hour sessions of similar topics will be arranged where 6 speakers will each give a 5 minute talk, then all session attendees can mingle with all speakers for an additional 30 minutes to discuss.

Don't delay in submitting your proposal by August 30. Chosen sessions will be notified by the end of September. Any questions, please contact Lynne Eder.

Conference Details:

What: TNC's All Science Conference for Nature and People
When: December 10-12, 2013
Where: Santa Clara, California
Who: Conservation scientists and staff from across TNC, guest scientists/practitioners
Why: It's the must-attend event of the year

More details are available on CONNECT.

Article
Deer Overabundance and Ecosystem Degradation: A Call to Action

By Allen Pursell, Southern Indiana program director, The Nature Conservancy; Troy Weldy, director of ecological management, The Nature Conservancy in New York; and Mark White, forest ecologist, The Nature Conservancy in Minnesota and the Dakotas

Image: Deer at Valley Forge National Historical Park, Pennsylvania. The forest understory is nearly absent except for Japanese stiltgrass. Note the deer appears to be especially thin. Image: Ron Rathfon.

"I now suspect that just as a deer herd lives in mortal fear of its wolves, so does a mountain live in mortal fear of its deer." —Aldo Leopold, A Sand County Almanac, 1949

In August, 2012 The Bloomberg View published a staff editorial entitled *Deer Infestation Calls for Radical Free-Market Solution*. The *Wall Street Journal* then ran a story in November 2012 entitled *America Gone Wild*, noting the impact of overabundant deer. If business news organizations can talk freely about deer, TNC needs to speak openly as well. Aldo Leopold long ago warned us of the problems of a growing deer herd. Have we waited too long to heed his advice, or is there still time to reverse the damage done?

No native vertebrate species in the eastern United States has a more direct effect on habitat integrity than the white-tailed deer. There are no hard numbers, but in many states deer populations continue to rise well beyond historical norms. In many areas of the country deer have changed the composition and structure of forests by preferentially feeding on select plant species.

In northern Minnesota, TNC staff demonstrated that decades of overbrowsing led to recruitment failure for many tree species, a shift in subcanopy and canopy dominance towards non-preferred white spruce, and significantly lower forest productivity (White

2012). In New York, TNC scientists report that one-third of New York's forests are currently compromised as a result of excessive herbivory (see New York Forest Regeneration Study).

Findings similar to these have been documented across the country. U.S. Forest Service researchers have noted that even if areas with high deer densities were managed to reduce the impact of deer, there may be long-lasting legacy effects (Royo 2010). Webster (2005) found severe and lasting impacts at Smoky Mountain National Park to be so complete that some plants such as trilliums were unlikely to recolonize local areas on their own. Deer are also well-documented vectors for the dispersal of non-native exotic plants (Knight et al. 2009, Baiser et al. 2008, Williams and Ward 2006).

Indirect effects on wildlife have been reported as well, such as widespread declines of North American songbird populations (Chollet 2012). One study found forest songbirds that preferred nesting in the shrub and intermediate canopy layer declined in abundance and species richness as deer density increased (deCalesta 1994).

White-tailed deer likely impact every landscape east of the Mississippi River. The damage has been insidious — both slow moving and cumulative. Unfortunately, the harm is often overlooked, or worse, accepted as somehow "natural."

In our opinion, no other threat to forested habitats is greater at this point in time — not lack of fire, not habitat conversion, not climate change. Only invasive exotic insects and disease have been comparable in magnitude. We can argue about which threat is more significant than another, but no one who walks the eastern forests today can deny the impact of deer to forest condition.

"In our opinion, no other threat to forested habitats is greater at this point in time — not lack of fire, not habitat conversion, not climate change."

It is clearly true that fire suppression has had a widespread impact on successional trajectory and tree species composition. A natural fire return interval would be a great benefit to many eastern forests. Yet even where fire is present, excessive deer herbivory has been shown to depress tree species diversity or at least minimize the benefits of fire. In the words of a recent study on the interactions of fire, canopy gaps, and deer browsing: "… restoring disturbances without controlling browsing may be counterproductive" (Nuttle, 2013).

While we acknowledge that climate change is a long-term stressor that will lead to significant changes in eastern forest ecosystems, high deer populations have had a much greater negative impact currently and over the last several decades. At present there is little evidence of direct climate change impacts on eastern forests (Beckage et al. 2008, Woodall et al. 2009, Zhu et al. 2012, Rustad et al. 2012). With climate envelope and other modeling systems, we have a general understanding about likely range shifts and compositional changes in eastern forests over the next 50-100 years.

However, due to the many interacting factors such as atmospheric deposition (nitrogen, ozone), insect pests and pathogens, invasive plants, CO_2 enrichment, longer

growing seasons, and white-tailed deer populations, there is a high degree of uncertainty about the future condition and function of eastern forests in a changing climate (Frelich and Reich 2009, Rustad et al. 2013).

No such uncertainty exists regarding the negative impacts of high deer populations on eastern forests; the body of evidence is unequivocal. In this article, we present only a small fraction of the literature on deer impacts. Reducing the impact of deer herbivory is currently a key forest restoration strategy (White 2012, Nuttle et al. 2013) and likely will become more important in order to help maintain resilient, functioning forests in a warming climate (Galatowitsch et al.2009).

Engaging society to address the problem will be difficult, probably similar to our experience with wild pig eradication in California and Hawaii, but on a wider scale. Views on deer management are deeply entrenched, both among those who hunt and those who don't. People have strong opinions when it comes to deer. If The Nature Conservancy were to take an unambiguous position that deer densities must be lowered, we would certainly make enemies and possibly lose donors, but new alliances could emerge.

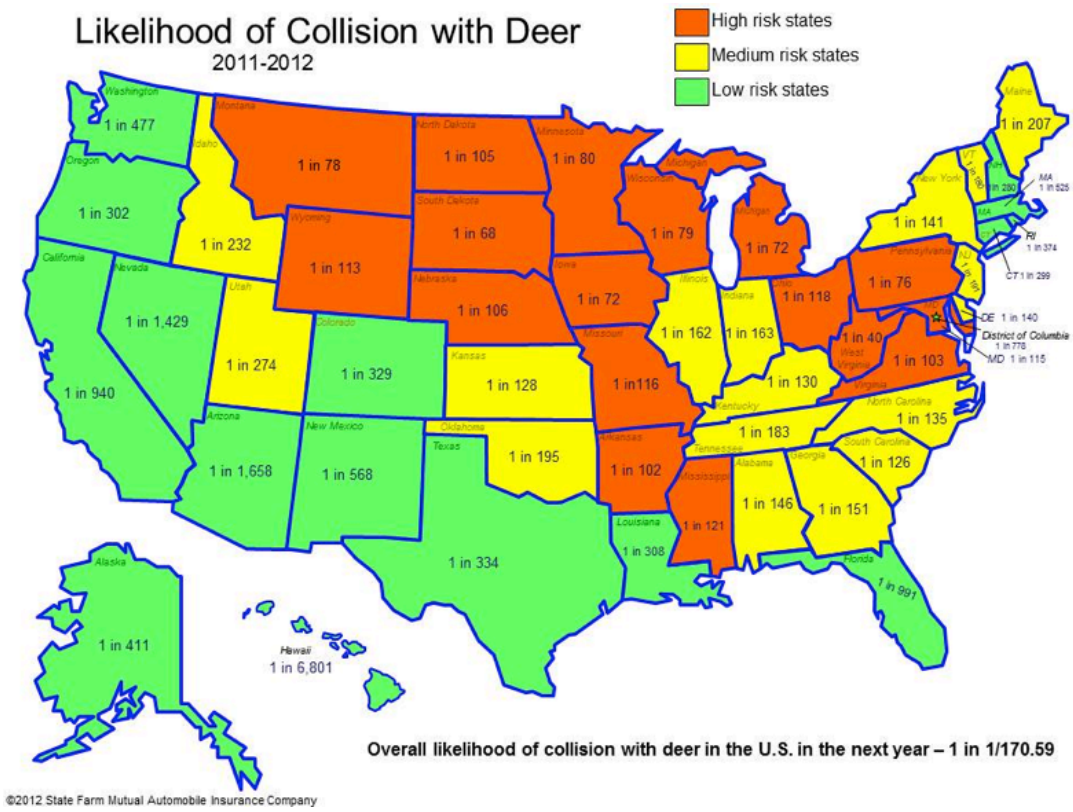
Natural Allies?

TNC can look to a number of non-traditional partners in an effort to influence policies that reduce deer numbers. Among these partners are hunters, auto insurance companies and the driving public, the public health sector, the timber industry, and agriculture. We provide a brief rationale for each of these below.

Hunters. Hunters spend billions of dollars each year in pursuit of white-tailed deer. The success of the Quality Deer Management Association (QDMA) in attracting members is evidence that many hunters, especially younger hunters, increasingly understand that deer must be managed in balance with their habitat. QDMA's philosophy revolves around "Healthy Habitat, Healthy Herd." Such hunters could be very helpful.

"Views on deer management are deeply entrenched, both among those who hunt and those who don't. People have strong opinions when it comes to deer."

Insurance Companies and the Driving Public: State Farm Insurance estimated that in the year ending June 30, 2012, there were 1.23 million deer-vehicle collisions in the U.S. The chance of a driver striking a deer during those 12 months was 1 in 171 nationwide, but as high as 1 in 40 in West Virginia. The cost is enormous with an average expense of $3,305 per collision, totaling over $4 billion nationwide (State Farm Mutual Automobile Insurance Co. 2012). In West Virginia there were an estimated 30,203 deer-vehicle collisions in 12 months — roughly $83 for every licensed driver in the state. Ask drivers whether they are concerned about deer on roadways, and most will say, "Yes!" At a public hearing, someone stood up and said, "I'm here because Indiana was once a great place to ride a motorcycle. Not anymore. There're too many deer." Insurance companies and public safety interests could make a big difference supporting deer reduction strategies.



Map 1: Likelihood of deer collision by state. By State Farm Insurance Co.

Public Health Sector: There is strong evidence that the rise and spread of tick-borne illness is associated with large numbers of deer as deer can be significant reservoirs of tick-vectored diseases (Allan 2010). The threat of contracting a tick-borne disease is prominent in the minds of many. The public health sector — both government and private — could be effective partners in managing for lower deer densities, with testimonials by individuals whose lives have been affected by tick-borne illnesses.

"The public health sector — both government and private — could be effective partners in managing for lower deer densities, with testimonials by individuals whose lives have been affected by tick-borne illnesses."

Timber Industry: Foresters have long held that deer browsing limits silvicultural options. Take the Central Hardwoods Region and Appalachians, where oak forests are not successfully regenerating. Deer browsing has led to an understory dominated by ferns — at the expense of valuable oak seedlings — across large areas of the Allegheny Plateau.

Agriculture: Given their economic motivation, farmers could be persuasive allies in deer management policy. In 1990, crop damage associated with deer topped $318 million nationwide (Fagerstone and Clary 1997). Perceptions of farmers toward deer and other wildlife reveal that many of them (40%) would oppose the creation of a wildlife sanctuary near their property because wildlife damage is so severe (Conover 1998). Most farmers (53%) in this same study attributed their problems to deer. Livestock producers are not immune either. Wild deer in at least two states are known to harbor bovine tuberculosis, a disease of great concern to cattle producers.

A Call to Action

Change is possible but it won't be easy or quick.

Deer management cannot be regulated at the federal level. As early as 1896 the Supreme Court ruled that states have "ownership" of their wildlife. As a result, each state has its own intricate rules. State regulations need not be standardized, but efforts at reform must be made state-by-state. This process will be slow as rules are generally promulgated by processes that ensure adequate evaluation by respective wildlife authorities and to allow for public review.

Nevertheless, some states are beginning to do the difficult work of changing policies to stabilize or reduce the number of deer. For example, Indiana recently enacted the first modern firearms season targeting female deer in the state's history.

It will be difficult to overcome traditional hunter concepts of proper deer management as it is counter-intuitive to most hunters that fewer game animals are desirable. Decades of effort, patience, and expense were invested to enhance populations to the point where hunting success is now commonplace. To suggest that populations be reduced and therefore increase the effort needed to harvest a deer understandably generates resistance. Success will take a carefully crafted and sustained public relations effort.

Like almost all conservation problems, deer management is a societal issue. If the deer population is to be reduced, it must be reduced slowly. Rules that lower the population drastically will almost certainly spur a backlash from hunters who can appeal to their respective legislatures to overturn regulations they regard as harsh. In an effort to lower the population of deer in Wisconsin the DNR liberalized hunting dramatically. The result was a hunter revolt. Gov. Scott Walker campaigned on a pledge to fix deer management. Once elected, he made good on that promise by appointing a deer trustee to evaluate his state's DNR. The trustee's final report noted that by failing to adequately communicate with hunters and involve them in determining solutions the DNR had lost credibility (Kroll 2012). A similar push back may be occurring in Pennsylvania.

"In some sense one of the greatest losses of all is that deer are no longer viewed as the majestic and even mystical animals of the forest that they were only a few decades ago."

We propose the following:

- Establish a working group, including representatives from TNC field offices, Central Science, and GR, to develop two products: 1) an organization-wide position statement on the deer issue; and 2) a toolkit for addressing deer overabundance state-by-state;

- Report these recommendations to staff and trustees;

- Reach out to traditional and non-traditional partners at the national level, including the Quality Deer Management Association; and

- Encourage operating units to use the toolkit to address specific state-level policies that have led to unnaturally abundant deer.

TNC's three primary conservation strategies are to 1) Protect and restore natural systems, 2) Use nature sustainably, and 3) Broaden support for conservation. A carefully crafted solution addressing the challenge of elevated deer populations will do all three.

In some sense one of the greatest losses of all is that deer are no longer viewed as the majestic and even mystical animals of the forest that they were only a few decades ago. To quote Bloomberg: "… it's hard to think of a more insidious threat to forests, farms and wildlife, not to mention human health and safety, than deer."

How different that is from the time of John Muir, who wrote, "Standing, lying down, walking, feeding, running even for its life, it [deer] is always invincibly graceful, and adds beauty and animation to every landscape — a charming animal and a great credit to nature." **SC**

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Bronson Griscom
Forests: A Climate Superpower on the Rise?

By Bronson Griscom, director of forest carbon science, The Nature Conservancy

We just topped 400 ppm of CO_2 in the atmosphere. That's a 40% increase since 1750, and a good bit above the 350 ppm boundary that has been identified for playing it safe (Hansen et al. 2008). There's another statistical threshold we just passed that hasn't raised the same warning alarms in the scientific community, but it makes me even more uncomfortable, on a gut level: over 50% of earth's ice-free land surface is now anthropogenic.

Image: Superheroes decorate a family Christmas tree. Image credit: Flickr user JD Hancock via a Creative Commons license.

In other words, there are more crops, pasture, plantations and strip malls than there are native forests (28%) and other natural ecosystems (19%) (Hooke et al. 2012). It's hard to say if we've yet crossed scientifically justified planetary boundaries. I'm just saying that it makes me nervous, and I don't want to learn the hard way. So, I am one who advocates for getting back to 350ppm for CO_2 and back to 50%+ for nature. I make the case here that forests are a big part of the solution.

Both of these problems, and their solutions, are linked. During the agricultural revolution, conversion of forests and other ecosystems to crops was the largest source of rising CO_2 concentrations. Despite the massive scale of fossil fuel emissions in the 21st century, emissions from forest destruction continue to play a significant role in climate change. The last IPCC report (2007) concluded that nearly 20% of greenhouse gas emissions come from tropical forest destruction alone. Likewise, efforts to Reduce Emissions from Deforestation and forest Degradation and enhance sequestration (REDD

+) in the tropics have been darlings of private and public green funding, since they offer a solution to both climate change and biodiversity loss.

Recently, however, there seems to be a growing sense of concern that REDD+ is a fading star as a solution to climate change. This may be due to both (i) the absence of a global climate deal that was anticipated to create global financing for REDD+, and (ii) a declining net contribution of forest loss to climate change, now down to about 10% (average of Pan et al. 2011, Baccini et al. 2012, and Harris et al. 2012).

I believe both of these concerns are unfounded. It should come as no surprise that a global climate deal has been hard to reach — it requires an unprecedented level of voluntary financial and legal commitment by most countries to address a slow moving (albeit massive) environmental threat. Sadly, I believe that the relentless escalation of climate change impacts that we are witnessing will make this commitment more palatable when the next opportunity for a deal rolls around in 2020 or soon thereafter.

As for the scale of forests' influence on our climate, net tropical deforestation emissions are not a good indicator of the forest climate opportunity. Let's review the basics of global climate flows. Natural processes account for the vast majority of gross flows of greenhouse gases, a whopping 96% according to the IPCC (Denman et al. 2007), with a disproportionate role played by forests. A lot of this is the breathing in and out of natural systems (like seasonal tree leaf off and leaf on), which are in equilibrium. And this balance of nature explains why nature dominates the gross carbon flux story, yet humans are entirely responsible for the net increase in CO_2. In fact, nature is counter-balancing the human impact, as earth's lands and oceans are absorbing about half of human carbon emissions (Denman et al. 2007). One third to one half of the sink is on land, and much of that land sink is forest. This represents an existing economic subsidy worth hundreds of billions of dollars in terms of climate mitigation (Canadell and Raupach 2008; Le Quéré et al., in review).

"As for the scale of forests' influence on our climate, net tropical deforestation emissions are not a good indicator of the forest climate opportunity."

The statistic that only about 10% of global CO_2 emissions are due to net tropical forest loss emissions is a red herring too often the focus of discussion within the forest climate community. This statistic conflates two more important statistics: 1) gross emission from destruction of tropical forests constitutes about 20% of global anthropogenic CO_2 emissions according to the three most recent studies (Pan et al. 2011; Baccini et al. 2012; and Harris et al. 2012), and 2) gross sequestration from tropical secondary forests already offsets over 15% of our CO_2 emissions, not to mention sequestration by temperate forests which are nearly as large (Fig. 1). Gross emissions tell us the scale of the opportunity for avoided emissions, and gross sequestration tells us the scale of the current offset from nature that could be enhanced.

Consider this: Despite increasing crop and timber demands to feed a growing human population, despite the impacts of climate change on forests, and despite deforestation emissions in the tropics that are on par with those from the global transportation sector, global forests are a net sink for atmospheric carbon.

This is because:

1) A large-scale re-growth of secondary forests in both temperate and tropical regions (Pan et. al. 2011; Canadell and Raupach 2008), and
2) Evidence of considerable net sequestration in "intact" tropical forests, which we have long assumed to be carbon neutral (Pan et al. 2011; Wright 2013).

In graphical form, here's what it looks like:

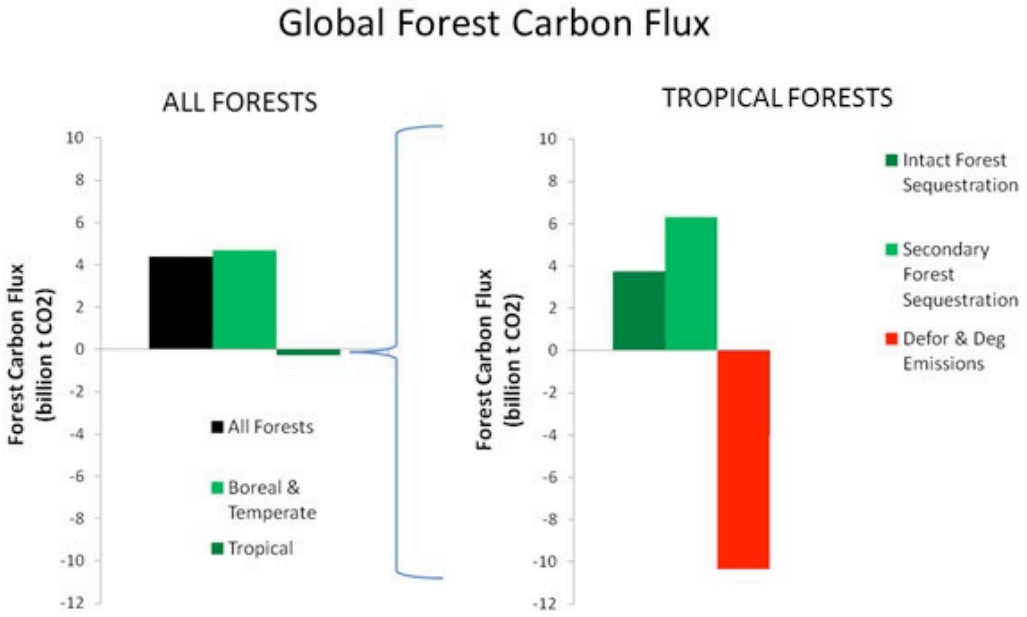

Figure 1: This is my graphical representation of the numbers presented in table form by Pan et. al. (2011). The nearly net zero emissions from tropical forests shown in the left-hand bar chart belie large tropical gross emissions from deforestation and forest degradation, which are offset by large sequestration by secondary and intact forests (bar chart on the right).

"Forests are already acting as a major solution to climate change, despite taking it on the chin from human activities."

So, nature is hard at work mitigating climate change, even if human society is not. Forests are already acting as a major solution to climate change, despite taking it on the chin from human activities. Not only are forest ecosystems a net sink, they also currently store twice the amount of carbon that is in the atmosphere (Canadell and Raupach 2008). This represents a large risk, because forest carbon is vulnerable to climate change. There is mounting evidence of this vulnerability, in particular due to drought and fire (Allen et al. 2010). Despite these threats, there is surprising evidence that the land-forest sink is increasing (Ballantyne et al. 2012).

Does this large role of forests in the greenhouse gas story translate to a large opportunity for an affordable forest solution to climate change? A recent UNEP report estimates that, based on least-cost scenarios, forests offer about 1/5 of the global

opportunities for reaching our goal of limiting climate change to 2ºC (UNEP 2012). This is based on emissions reductions opportunities by avoiding forest destruction. Others argue that the combined opportunity of avoided emissions and enhanced sequestration (e.g. planting forests and extending logging rotations) offers 1/3 of the global least cost climate mitigation opportunities (Sohngen and Mendelsohn 2003), and that sequestration mitigation opportunities are on par with avoided deforestation opportunities (Canadell and Raupach 2008).

To summarize, forests are a climate superpower with large opportunities for addressing climate change for 3 reasons:

1) **Forests store double the amount of carbon that sits in the atmosphere**. At the very least we'd better hold on to the remaining forests;

2) **Forests already play an important role in mitigating climate change**, with a net sequestration of 4 billion tons of CO2 per year, which seems to be growing (Ballantyne et al. 2012) despite large emissions from forest destruction in the tropics (Figure 1, Pan et al. 2011).

3) **Forests are a large part of the solution to climate change.** Forests can provide about 20-30% of global climate mitigation under least-cost scenarios (UNEP 2012; Sohngen and Mendelsohn 2003).

Considering all the other values of forests beyond carbon (water filtration, flood control, biodiversity, ozone absorption, timber production, etc.), we should go beyond the above least-cost studies concluding that forests are price-competitive machines for mitigating 20-30% of climate change. Under a dream scenario where tropical deforestation and degradation was halted, and a global program was launched to double forest sequestration through reforestation, low impact logging, and extended rotations, forests could offset over half of global human CO_2 emissions (my back of the envelope math based on Pan et al. 2011). This might just be possible if we can expect declining global farmland alongside increasing food production (Ausubel et al. 2013), and if we can convince the McDonalds Hamburglar to switch to cultured beef (Tuomisto and Teixeira 2013).

"Forests store double the amount of carbon that sits in the atmosphere. At the very least we'd better hold on to the remaining forests."

Of course I am also banking on break-out success of a variety of forest-climate strategies we (TNC) and our global partners are pioneering. All told, I'm optimistic that part of our solution to climate change will be bringing nature back to 51%, with forests as a rising global climate superpower. **SC**

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Coda Files
Building Caribbean Capacity to Assess the Human Dimension in Our Conservation Work

By Elianny Dominguez, marine conservation manager, The Nature Conservancy's Central Caribbean Program

Image: Elianny (left of sign) and her colleagues at the socioeconomic monitoring and assessment training in Papua New Guinea.

Editor's Note: Coda Global Fellow Elianny Dominguez recently spent time in Papua New Guinea to learn about best practices in socioeconomic assessments that she could bring back to her work in the Caribbean. This is an account of her experience.

"Every day I watched him go out into the ocean to fish our daily supper and every day he came back with a big smile on his face."

My adoptive family in Papua New Guinea was a wonderful mix of community ties and people being nurtured by nature. Yet as I spent more days on the island of Jeiwei, as a new member of their family, I could easily see the social challenges that lay ahead for them and for me.

I had come to Papua New Guinea from my home in the Dominican Republic to attend a TNC training workshop on developing socioeconomic assessments with conservation practitioners and community leaders from the Pacific Region. This was a unique opportunity provided by the Coda Global Fellows Program, which kindly supported my participation.

Back home in the Caribbean Operating Unit, we already had set forward our regional goal of enhancing the Caribbean Program's capacity to measure the impact of our conservation strategies on people. Having worked with fishing communities of Samaná Bay in the Dominican Republic over the last five years, I felt particularly drawn

to this regional goal. Thinking back on my conservation site, I could easily account for all the previous goals, projects and efforts that so many organizations have contributed to Samaná Bay and its struggling artisanal fishing sector. Regretfully, with no lasting results. I could attest to large-scale equipment and infrastructures donations, the development of participatory fishing strategies and implementation of community-based training programs that, through the last 20 years, had caused a couple of ripples that calmly soothed out in time.

But the questions in my mind kept on going and multiplying: Why have the artisanal fishermen of my country never ever progressed in their chosen profession of fishing? We have examples of farmers progressing on equipment, materials, working methods, etc… why not the fishermen? Who is deciding that a private marina for wealthy people should be constructed over fishing grounds that support local families with low household income? What criteria are being used? How can we participate and facilitate changes as an NGO?

Over my first few days in Papua New Guinea, I quickly settled down with my new family and our scheduled training hours. The SEM-Pasifika manual and its addendum on social vulnerability to climate change were the cornerstones of our workshop. Guided by our lead facilitator Annisah Sapul, we completed a series of worksheets that led up to a final design of a site-based socioeconomic assessment. I quickly drew information from our Dominican Republic marine conservation plans and strategies to focus my assessment on our priority site, Samaná Bay. I was keen on leveraging a socioeconomic baseline that would convey sound information to develop our first draft of social objectives.

As I continued on with the training and learned new perspectives and skills, I started to see how the human dimension could have a stronger voice within my own conservation work. Through a process of analyzing and choosing socioeconomic indicators, securing well-suited communication channels and drafting a couple of social objectives, I gained insight into new survey methods that could help me measure socioeconomic changes contributed by our conservation work to different aspects of people´s lives. This would be a crucial piece of the puzzle to raise awareness on how to strategize our current role in Samaná Bay and to encourage lasting changes. As I was living within a tribal fishing community at the time, it quickly came to my mind the thought of how hard I would be willing to work with my stakeholders in Samaná, to pursue this wonderful community life where a father or mother could go out into the sea, every single day, and feed the entire family free, healthy seafood… that seemed to me a splendid live portrait of human well-being.

“I gained insight into new survey methods that could help me measure socioeconomic changes contributed by our conservation work to different aspects of people´s lives.”

Yet I knew visions can dissipate very quickly. As we carried on with a climate calendar exercise with a nearby village, we heard about the ordeals of shifting wind patterns affecting their navigation, increased storms over their agriculture lands and bad weather conditions keeping villages out of reach. I already knew these were going to be the same climate challenges we would start facing soon in Samaná Bay, in addition to the economic repercussions of a rapidly changing world.

Back home now, I am all geared up. In March I began leading a team of enumerators to conduct our very first socioeconomic survey including: household surveys, focus groups with leaders and women; and an additional survey on specific areas of governance and the fishing sector. With this data I will re-design the marine and fishing strategies for our program to incorporate the social dimension.

I can honestly say I feel encouraged to look deeper into the social context of my stakeholders. I also feel motivated to start off the development of measurable social objectives that facilitate a much needed enduring change in the governance system at Samaná Bay, and help us position TNC as stakeholder fostering human well-being across all of nature´s landscapes.

The biggest outcome for me has been able to design projects that link our conservation work with people. I love that. **SC**

Article
Create Your Own Venue for Science Communications

By Dale Turner, conservation planner, The Nature Conservancy

Image: Ladybug-a-palooza. Image credit: Flickr user Jason Samfield via a Creative Commons license.

One of the challenges for Conservancy scientists has been finding the right venues to present our work. At times it seems like much of what we do is too applied, too localized, too interdisciplinary, too *something* to fit neatly into peer-reviewed journals or professional society meetings. But we're doing important stuff, and we know there's an audience that could learn from our successes and mistakes and external colleagues who could teach us useful things.

What to do? Create the right venue!

One of TNC's strengths is our ability to convene disparate partners to accomplish common goals. Apply those skills to this communications problem, and we have . . . a regional conference on conservation science and management.

Twice in the past decade, Conservancy staff in Arizona have played central roles in organizing conferences on Research and Management of the Madrean Archipelago. Also called the Sky Islands or the Apache Highlands, this highly-diverse region spans four states in the U.S. and Mexico. It's been a conservation priority for years (Marshall et al.

2006) and the focus of much research, but suffers from being split by an international boundary.

The conferences have provided a venue for academics, agency staff, and conservationists from both sides of the border to share their knowledge and plan new efforts. Building on a first conference held in 1994 with 100 oral and poster presentations, the second conference in 2004 had 160 presentations, and the third in 2012 had 190.

The 2012 conference lasted four days and had more than 300 participants. Fifteen Conservancy staff from Arizona and New Mexico were authors on sixteen presentations. Planning for symposia within the conference became an incentive to organize partners for new projects. With everyone strapped for funds, this regional gathering became an opportunity to stage other events that couldn't stand on their own. The halls were crawling with side meetings, both planned and spontaneous, including several with major funders. The enthusiasm of the crowd was obvious, the benefits immediate.

The long-term benefits are also tangible. Thanks to a partnership with the U.S. Forest Service Rocky Mountain Research Station, each of these conferences has resulted in a peer-reviewed volume of proceedings. Available on-line, these have become a significant resource for conservation and management of the region (Debano et al. 1995, Gottfried et al. 2005, Gottfried et al. 2013).

Articles from the 2012 conference with Conservancy authors are listed in New Conservancy Publications of this issue of *Science Chronicles*. A full list of abstracts and papers from the proceedings is available here. **SC**

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"The conferences have provided a venue for academics, agency staff, and conservationists from both sides of the border to share their knowledge and plan new efforts."

Resource Management in the Southwestern Deserts; 2012 May 1-5; Tucson, AZ. Proceedings. RMRS-P-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 593 p. www.fs.fed.us/rm/pubs/rmrs_p067.html

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15 Seconds of Fame
Dayna Gross

The Conservancy's conservation manager for the Silver Creek area in Idaho is a Jill-of-all-trades and a master of opposites, blending a love for art and science, of things big and small, of being active and sitting still. Meet Dayna.

Image: Dayna Gross and her children at Pettit Lake in Idaho.

MY JOB: I manage the Silver Creek preserve daily operations including volunteer and staff supervision, preserve upkeep and special projects, communications and public relations, plus I lead larger-scale projects such as easement acquisitions, collaborations, sustainable agriculture and land stewardship projects.

I love that every day is different and that I get to spend a lot of time outside. And, although I seem to spend less and less time with them every year, I really enjoy the interns. They are young and full of ideas and life and coming to Silver Creek is such an experience for them — it's nice to see how it shapes them. I keep in touch with many of them and that is one of my greatest achievements — helping form the next generation of conservationists.

I could do without cleaning the outhouses, which I do mostly to 'be part of the team.'

READING: Currently I have about 10 books sitting on my nightstand — all started and not finished. It's a reading funk — happens to me every few years. So, right now, I have found that what I enjoy most is reading the *Frog and Toad* books to my kids. Not so

much for them (although they do like them, too), but because I really enjoy the stories. They are simple and have great life, work and conservation messages. Sometimes taking a break from grown-up books and reading kids' books brings me back down to earth.

JOYS: Running, hiking, painting — anything that brings me outside. When I am not active, I really just enjoy sitting and watching — my kids, bugs, the garden. Oh, and taking care of our ridiculously large vegetable garden is also a great joy of mine.

TRENDING: The connection people are making with their food. Because the interest brings them to look at where the food is produced, how we use our resources, to think about issues coming down the pipeline with more people to feed, and how we protect natural areas when there is an immediate demand for more food and maybe agricultural lands. This connection — what we eat and where it comes from and how it is produced — really brings us directly to think about conservation. It's tangible and real, and that is really powerful.

BEST ADVICE: My high school art teacher used to tell us that no one is ever an expert. I have found that to be something I go back to over and over again because it frees me up to ask good questions without feeling intimidated and to dive into subjects I wouldn't normally be compelled to wonder about — for some reason it makes me feel like there is a level playing field.

BUILDING BLOCKS: My kids make me feel hopeful about the future of conservation and nature. After a long week of school or daycare, they 're-set' their attitudes and their brains during the weekends of spending time outside and doing nothing except collecting bugs, playing in the creek, and exploring. It rejuvenates them in a way that reinforces to me how important nature is in our lives and how much we need it.

SCIENCE MEETS ART: I have an undergraduate degree in landscape architecture and have spent many days in art studios and art classes. Someone once told me landscape architecture was the perfect nexus of art and science — and I can live in both worlds, so it made sense to me. For instance, since I was young, I have collected insects — not to learn their scientific traits so much but because I like looking very closely at things, especially the bits and pieces of bugs. I enjoy big landscapes, too, but in a more abstract way — I love wide-open spaces and the shades of different colors as the day goes by.

But when it comes down to it, I like to look and examine things very closely and I think that is where my interest in scientific illustration comes from. The combination of the two — liking to look up close, and appreciating the beauty of the big — has given me a different perspective on nature. The big things are great, but it's the little things that really keep everything working. **SC**

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

Blog Reel

Voices from the Conservancy's science blog, *Cool Green Science*. Interested in contributing? Contact Matt Miller.

"The ospreys were more popular than the Kardashians!"

— **Jeff DeQuattro** in *Farewell to Osprey Cam*

"It's a common question in conservation — why does one threatened or endangered species get lots of conservation attention, while others don't?"

— **James Fitzsimons** in *Science Video: Why Do We Value Some Species More Than Others?*

Image: A live camera broadcast the real-time activities of a nesting osprey family along the Gulf of Mexico.

"Without relationships, the best any conservation plan can be is an abstract aspiration."

— **Matt Miller** in *Sawmills and the Limits of Conservation Science*

"But how can resource managers hope to stop invasives in their tracks when simply keeping up with their numbers and locations is a challenge? Enter cloud computing."

— **Darci Palmquist** in *Cloud Computing: A Key Tool in the Fight Against Invasive Species*

"Katrina, Sandy, Andrew: iconic names…. and indelible examples of how nature can kill and destroy. But could *nature* actually help reduce our risk from… nature?"

— **Bob Lalasz** in *New Study: Coastal Nature Reduces Risk from Storm Impacts for 1.3 Million U.S. Residents*

Announcements

Science Innovation and Achievement Award

By Peter Kareiva and Bill Ginn

TNC has always been science-based, and many of TNC's most effective conservation strategies have come out of science advances. These include everything from environmental flows, to water funds, development by design, and coastal resilience. We are launching a new annual award to recognize scientists at TNC who exemplify science innovation. Candidates can be nominated by any senior manager within TNC and the nominating senior manager need not be a supervisor of the person they nominate. The criteria used to select the winner entail innovation, publication, and potential (or realized) impact.

The nomination should consist of a short letter (one page) that indicates why the science is so important, as well as a copy of candidate's resume and PDFs or links to one or two publications that report on the scientific foundations behind the contribution. The nominations will be reviewed by the Chief Scientist and the Chief Conservation Officer, who will jointly make the decision. A modest monetary award of $2,000 will accompany the recognition. Submissions due September 30. **SC**

Sept. 18 at 2PM ET: North America Region Science Spotlight Webinar

Submitted by Brad McRae

The North America Region is hosting a webinar series to highlight some of the most exciting new TNC science happening in the U.S., Canada and Caribbean.

The Sept 18 Science Spotlight will focus on **modeling and mapping landscape condition**. Randy Swaty will present LANDFIRE tools for collaborative learning and landscape-scale assessment. Ryan Haugo and Louis Provencher will talk about how they're applying LANDFIRE and other tools to identify restoration needs and restore large landscapes for the least amount of money. Register and get the call-in info here.

Know of science projects going on in our region that your colleagues should hear about? Please send your suggestions to Brad McRae and visit our site to learn about upcoming webinars. **SC**

December 10-12, 2013: All Science Conference for Nature and People Santa Clara, CA

Submitted by Ryan Surber

In December 2013, the Conservancy will convene conservation scientists, philanthropists, and environmental thought leaders to explore the existing science and explore innovative ways to select and design transformative conservation strategies, advance conservation efforts, and measure the effectiveness of investments in conservation. The 2013 All Science Conference for Nature and People will give us an opportunity to discuss, debate, and advance the science foundations of conservation in the 21st century.

This 3-day conference, hosted by TNC Lead Scientist Heather Tallis and Chief Scientist Peter Kareiva with local host Scott Morrison, will feature plenary sessions by CEO and President Mark Tercek, and CEO and President of the Wildlife Conservation Society, Dr. Christian Samper. In addition, TNC and guest scientists/practitioners will hold sessions on innovations in field work and advances in conservation. Please submit presentation proposals for consideration by the All Science conference committee. **SC**

SNAP: Call for Proposals

Submitted by Craig Groves

The Nature Conservancy's new scientific collaboration SNAP — Science for Nature and People — seeks proposals for working groups. These working groups will be funded by SNAP for up to 2 years to tackle important inquiries related to nature conservation efforts and issues of human prosperity (e.g., food, water, energy, housing, security). SNAP is already off and running with the launch of its first two working groups: 1) Coastal Defenses and 2) Western Amazonia.

We are seeking Requests for Proposals for additional working groups. This call for proposals is open to all TNC scientists in field programs, global priority teams, and Central Science, and we strongly encourage you and/or your staff to consider applying. Applications must be received by September 9, 2013 and should first be vetted with Craig Groves before submission.

Details on the proposal format and submission process are available on the new SNAP website. Contact Craig Groves with questions. **SC**

Take the Science Chronicles Survey

By Darci Palmquist

We're conducting a reader survey of *Science Chronicles* to find out what you like and don't like about it, what you find most useful and what you would like to see change.

Please take 5 minutes to fill out the survey! **SC**

New Conservancy Publications

Conservancy-affiliated authors highlighted in bold.

Please send new citations and the PDF (when possible) to: pkareiva@tnc.org and rlalasz@tnc.org. Please include "Chronicles Citation" in your subject line so we don't miss it.

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

Albert, D.M., and J.W. Schoen. 2013. Use of historical logging patterns to identify disproportionately logged ecosystems within temperate rainforests of southeastern Alaska. *Conservation Biology* 24: 774-784.

Game, E.T., E. Meijaard, D. Sheil and E. McDonald-Madden. 2013. Conservation in a wicked complex world; challenges and solutions. *Conservation Letters* doi: 10.1111/conl.12050.

Geselbracht, L., K. Freeman, E. Kelly, **D. Gordon**, and **A. Birch**. 2013. Retrospective analysis and sea level rise modeling of coastal habitat change in Charlotte Harbor to identify restoration and adaptation priorities. *Florida Scientist* 76: 328–355.

Gottfried, G.J., P.F. Ffolliott, **B.S. Gebow**, L.G. Eskew, and L.C. Collins, compilers. 2013. Merging science and management in a rapidly changing world: Biodiversity and management of the Madrean Archipelago III and 7th Conference on Research and Resource Management in the Southwestern Deserts; 2012 May 1-5; Tucson, AZ. Proceedings. RMRS-P-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 593 p. www.fs.fed.us/rm/pubs/rmrs_p067.html

The below papers were published in the proceedings:

Bodner, G.S., P. Warren, D. Gori, K. Sartor, and **S. Bassett**. 2013. Sustaining the Grassland Sea: Regional Perspectives on Identifying, Protecting and Restoring the Sky Island Region's Most Intact Grassland Valley Landscapes. Pp. 399-409.

Gebow, B., C. Stetson, D.A. Falk, and C. Dolan. 2013. FireScape: A Program for Whole-Mountain Fire Management in the Sky Island Region. Pp. 472-473.

Minckley, T.A., A. Brunelle, and **D. Turner**. 2013. Paleoenvironmental Framework for Understanding the Development, Stability, and State-Changes of Ciénegas in the American Deserts. Pp. 77-83.

Tiller, R., M. Hughes, and **G. Bodner**. 2013. Sacaton Riparian Grasslands of the Sky Islands: Mapping Distribution and Ecological Condition Using State-and-Transition Models in Upper Cienega Creek Watershed. Pp. 410-424.

Turner D.S., and A. Castellanos. 2013. Conference Summary: Biodiversity and Management of the Madrean Archipelago III: Closing Remarks and Notes From the Concluding Session. Pp. 1-2.

Van Devender, T.R., S. Avila-Villegas, M. Emerson, **D. Turner**, A.D. Flesch, and N.S. Deyo. 2013. Biodiversity in the Madrean Archipelago of Sonora, Mexico. Pp. 10-16.

Van Devender, T.R., E.F. Enderson, **D.S. Turner**, R.A. Villa, S.F. Hale, G.M. Ferguson, and C. Hedgcock. 2013. Comparison of Preliminary Herpetofaunas of the Sierras la Madera (Oposura) and Bacadéhuachi with the Mainland Sierra Madre Occidental in Sonora, Mexico. Pp. 110-116.

Graves, E.E., M. Holyoak, **T. Rodd Kelsey**, and R.J. Meese. 2013. Understanding the contribution of habitats and regional variation to long-term population trends in tricolored blackbirds. *Ecology and Evolution* doi: 10.1002/ece3.681.

Hamel, P.B, **D. Mehlman**, S.K. Herzog, K.V. Rosenberg, J. Jones. 2012. Passing the baton of action from research to conservation implementation for Cerulean Warbler (*Setophaga cerulea*). *Ornitologia Neotropical* 12/2012; 23(Supplement):367-378.

Lawler, J.J., A.S. Ruesch, J.D. Olden and **B.H. McRae**. 2013. Projected climate-driven faunal movement routes. *Ecology Letters* 16(8): 1014–1022. doi:10.1111/ele.12132.

Schoch, G.C., **D.M. Albert**, and **C.S. Shanley**. 2013. An estuarine habitat classification for a complex fjordal island archipelago. *Estuaries and Coasts* 10.1007/s12237-013-9622-3.

Schoen, S.K., M.L. Kissling, N.R. Hatch, **C.S. Shanley**, S.W. Stephensen, J.K. Jansen, N.T. Catterson, and S.A. Oehlers. 2013. Marine birds of Yakutat Bay, Alaska: evaluating summer distribution, abundance, and threats at sea. *Marine Ornithology* 41:55-61.