



**SKY  
ISLAND  
ALLIANCE**  
Protecting our Mountain Islands  
and Desert Seas

# Restoring Connections

Vol. 10 Issue 2 Summer 2007

Newsletter of the Sky Island Alliance

## Climate Change

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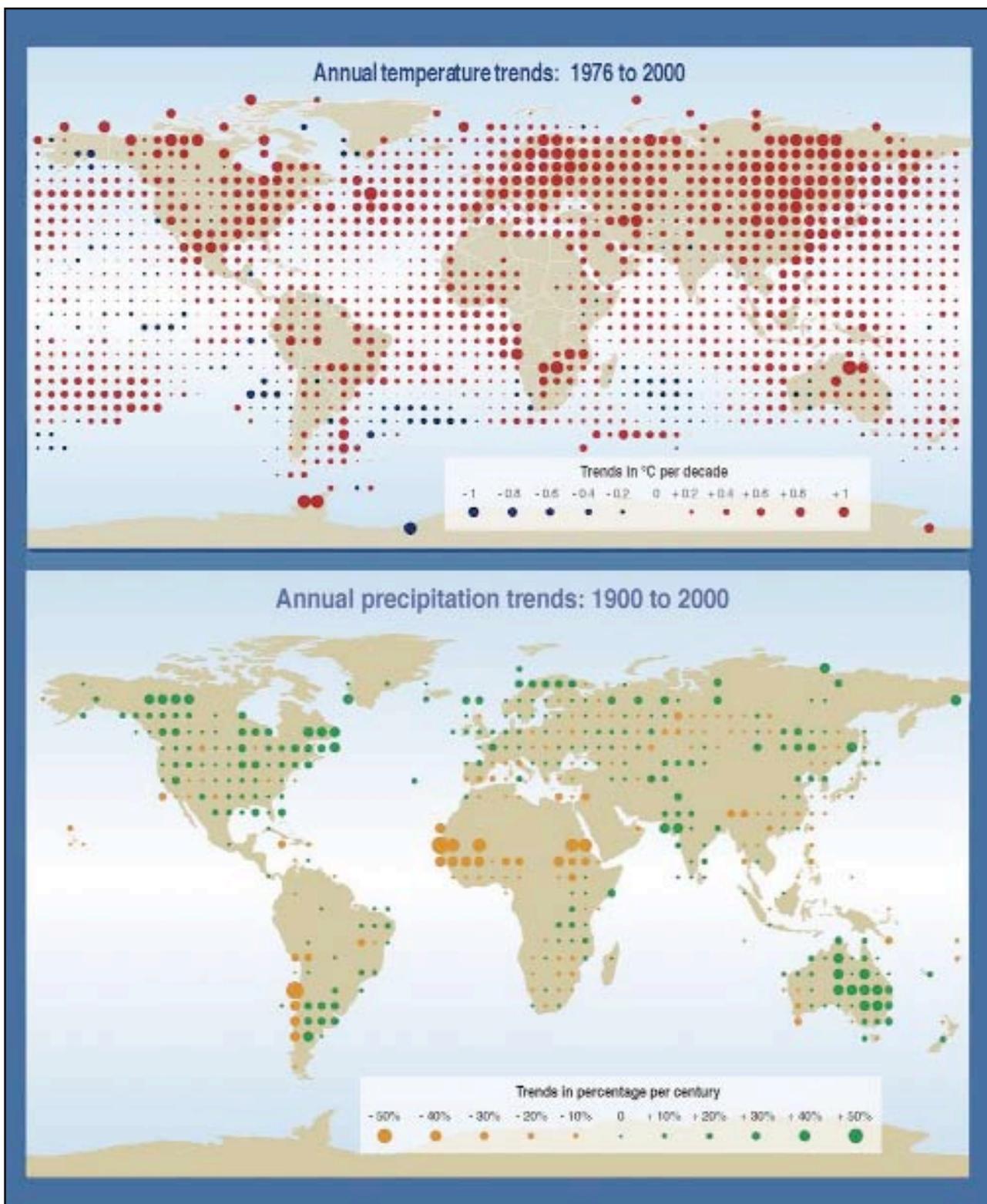
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Charts courtesy Intergovernmental Panel on Climate Change.

# From the Director's Desk

It is getting hotter, and drier.

When asked about the warming trend in the Sky Islands, most people I've spoken with use the technical term "scary" to describe the phenomena.

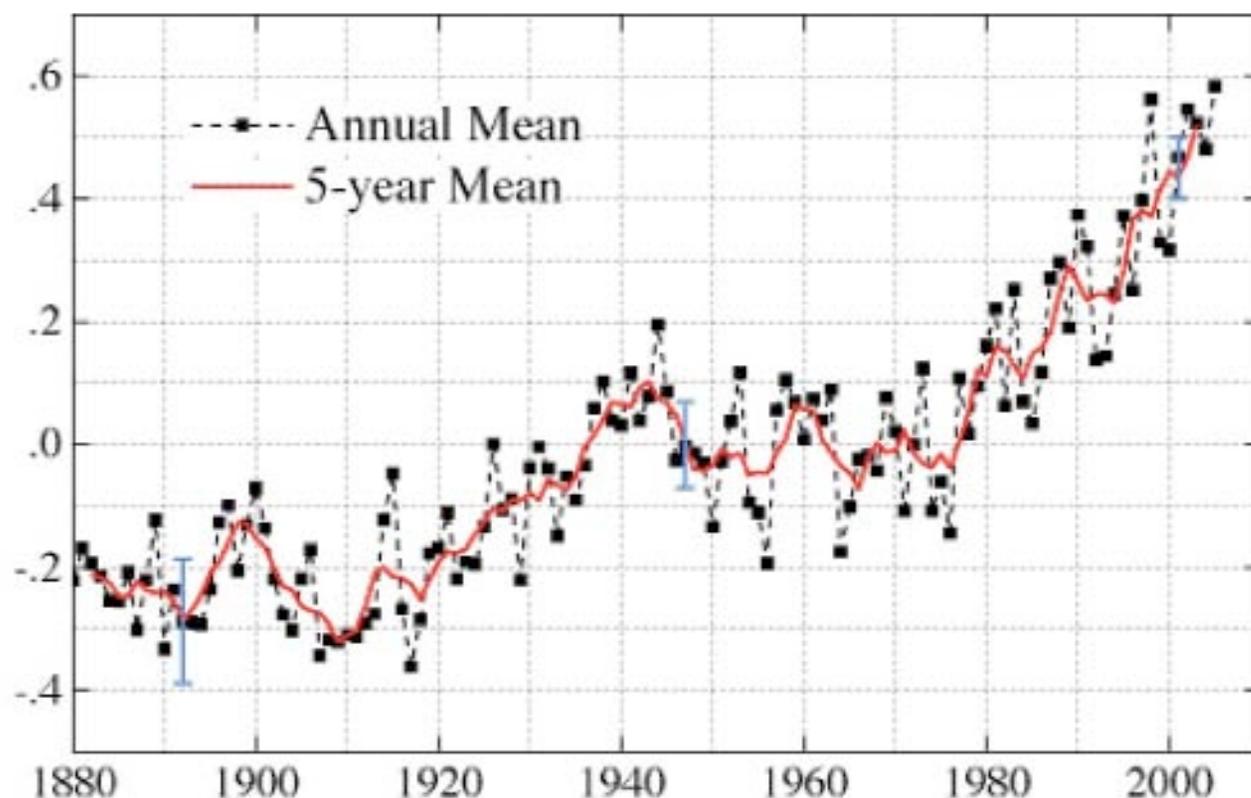
What do hotter temperatures mean for our natural heritage? Scientists are not optimistic. Spruce-fir forests are disappearing. Grasslands are converting to shrublands. Invasive exotic species are spreading. These things are happening now, and climate change is fueling their progression.

What is causing this warming? Smokestacks and tailpipes — mostly from the United States, China, Japan, and European Union, though China's contributions are largely linked back to the U.S. Carbon dioxide, nitrous oxide, and methane are being released into the air mainly by the energy, transportation, and industrial sectors of the world. If you look at a map of atmospheric greenhouse gas concentrations, you'll see a large plume floating west off Asia over the Pacific Ocean towards North America — globalization isn't restricted to trade and economic growth.

What this means is that the squirrels on Mt. Graham, the pronghorn in Sonoita Valley, and the Gila Chub in Redfield Canyon — along with many other geographically restricted critters — are going to have a hard go of it.

That's where you and I come in.

The Intergovernmental Panel of Climate Change ([www.ipcc.ch](http://www.ipcc.ch)) tells us that if we act fast, we can limit global temperature increases to 3 or 4 degrees Fahrenheit. If we don't, we'll likely see temps rise beyond 6 degrees by late century. The difference between a 3 degree rise and a 6 degree rise will have a huge effect on how our Sky Island ecosystems cope. The difference could be measured in the number of extirpated or extinct species.



Global Mean Temperature Change courtesy Intergovernmental Panel on Climate Change.

What do I mean by act fast? It's actually not all that complicated.

First, we **vote** for elected officials who vow to advocate for renewable energy, more efficient transportation modes, and better land-use planning. Needed solutions can be invented and designed in the free market, but their implementation will have to be, at least initially, regulated. That will require us to change our backward energy policies, and this will require good public servants. There is hope here — the U.S. Senate passed new fuel economy standards that will raise our mpgs by 40% last month.

Second, we tier our efforts to reduce greenhouse gases with our efforts to mitigate for climate change. If you thought wilderness protection, wildlife linkages, and natural disturbance regimes were important before climate change came on stage, consider how critical these land and wildlife conservation measures are now. Creating land reserves and connections between protected areas has never been more important. Conservation planning, from a landscape level, is our ticket to ensuring that our natural heritage has the best chance for adaptation and survival. While we hear

much about renewable energies and reducing greenhouse gases — appropriately so — we must also understand that conservation programs like those at Sky Island Alliance are just as important to meeting the challenges posed by climate change. Without resilient, intact ecological systems, our incredible assemblage of life here will suffer.

The path forward is daunting, but not impossible. A sea change in thinking is necessary, and its beginning is marked with the wave of climate awareness that has permeated mainstream society. North America has the ingenuity and skills to drastically reduce carbon emissions and protect our wells of biodiversity, like the Sky Islands. It just takes the will. There is an appropriate cliché to use — Think Globally, Act Locally. Within the pages of this edition of *Restoring Connections*, I hope you'll appreciate learning more about the warming phenomena, and what we can do as individuals to be a part of the solution.

Matt Skroch, Executive Director

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*Sky Island Alliance is a non-profit membership organization dedicated to the protection and restoration of the rich natural heritage of native species and habitats in the Sky Island region of the southwestern United States and northwestern Mexico. Sky Island Alliance works with volunteers, scientists, land owners, public officials and government agencies to establish protected areas, restore healthy landscapes and promote public appreciation of the region's unique biological diversity.*

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I am fortunate. Early this Spring I bought my first house. I knew I wanted it the instant I saw how large the backyard was — a blank slate where I could finally grow all the salsa and herb gardens and fruiting trees I wanted. I've been digging holes for plants and reading Brad Lancaster's *Rainwater Harvesting* ever since.

Two weeks ago I installed rain barrels and gutters... just in time. The next day was the summer's first Tucson-wide monsoon and I captured 100 gallons of water. The following Saturday (I'd purchased a rain gauge in the meantime) I got almost 2.25 inches of rain and my barrels were overflowing. By the next storm (1.25"), my barrels again overflowed but this time into some new swales I'd dug so my mature plants could get a nice drink. I have not seen saturating rains like this for a long, long time. I don't think my plants had either... the decades-old arboreal prickly pears and agaves, which pre-monsoon had looked like they were about to succumb, have found hope for yet another season.

Judy is my closest neighbor and she has lived next door since her parents built their house in 1948, which is the same year my house was built. She has photos she's promised to show me of my house, back when the prickly pears and the agaves were just pups, and when there was an arroyo running just beyond my midtown driveway. Judy and her brothers used to ride their horses down the arroyo to the Rillito. It was filled in after our neighborhood was incorporated into Tucson.

With the last two rains I have seen the arroyo regain a bit of its former glory, chugging as if it were Mississippi-wide, water flowing from curb to curb, maybe 60 feet across. After the afternoon showers, before dark, I have a front row seat to watch kids on bikes zipping again and again through the slowing waters. And after dark, I hear the larger "kids" double-dog-dare their truck engines not to stall out in the deeper spots as they slide through the slurry clay.

As I've been putting this issue together, my mind automatically leaps from global to *local* warming to the desert rat's worst fear: drought. I hope I'm not putting down roots too late. But I can't live without hope and thus I take breaks from work to dig a hole or build a berm or try to figure out how I can capture some of the water that flows alongside my curb. The more rainwater I harvest, the more I mourn for what gets away.

Lancaster has reminded me that we can make a difference in our environment by observing the lay of the land and then taking appropriate action. In this issue you will find scientists, activists, and motivated citizens who have something important to tell us about what they are observing. It is now up to us to take appropriate action — engaging ourselves and neighbors to get actively involved in the dialogue and repeatedly, if necessary, remind our elected representatives that we are watching and we have *Expectations*. That, hope, and a little sweat equity here and there, are how things begin to change. *Julie*

## Comings and Goings

We bid a fond farewell to Nicole Urban-Lopez, as Membership and Outreach Coordinator and Jennifer Shopland, as Conservation Associate. But it is only as staff that we say goodbye to them, as they both have assured us they will continue to be active participants with Sky Island Alliance.

Nicole joined SIA in September of 2005 as our first staff person dedicated to Membership and Outreach. She started our e-news, keeping everyone informed of the happenings at Sky Island Alliance. To introduce new people to SIA, she initiated a series of membership house parties. Then, when the Bush Administration renewed their attempts to undo the Roadless Rule, Nicole stepped up, organizing Arizona in the nation wide effort to defeat this attempt to fragment our precious roadless areas. These are just some of her contributions — thank you Nicole! She is now completing a Masters of Public Administration program at the Eller College of Management at the University of Arizona.

In February of 2006 Jennifer joined SIA and was integral in launching the Coronado Planning Partnership, the Science Advisory Panel and the Coronado Action Center. Sky Island Alliance's intentions to bring conservation and concerned public involvement into the planning process for the upcoming Coronado National Forest Plan is off to a great start thanks to the effort and expertise Jennifer brought to the program. She has taken a position with Statistical Research, Inc., a group of research consultants in archaeology, anthropology, and history. She is looking forward to learning more about the history and cultures of the Southwest.

As we wish great success and happiness to Nicole and Jennifer, we welcome in Louise Misztal as our new Conservation Associate. Louise has worked on and off with Sky Island Alliance for some time. In 2005, while interning with SIA, she completed her honors thesis on management of the Aravaipa Creek watershed. Her post-graduate field studies have taken her across the Sky Islands, and in between she has volunteered out in the field with Trevor. Louise will be working to complete Ecosystem Management Area reports and filling the shoes left empty in our GIS program when Cory Jones left SIA last year to take a full-time GIS position with Pima County.

## Next issue: Stories from the field!

We want to keep this newsletter filled with inspirational, informative material, and we'd like your help! Do you write poetry? Draw, sketch, paint or photograph? Like to address regional conservation issues? Review books or websites? Anything that related to the Sky Island region is fair game! You can respond to items in our recent newsletter, comment on your experiences as a volunteer or conference-goer, etc. Or give your favorite small-town restaurant a boost by writing a review and letting us promote it!

*Restoring Connections* is published three times a year; the deadline for our next newsletter is 15 September 2007. Material submitted after that date may be saved for subsequent issues.

Please email submissions to: [julie@skyislandalliance.org](mailto:julie@skyislandalliance.org), or mail them to Sky Island Alliance, PO Box 41165, Tucson, AZ 85717. Resolution of digital images should be at least 300 dpi if possible.



Coati by Sky Jacobs © 1995

## Join the Legacy Club!

Comprised of our monthly and quarterly donors, this program is an easy way to donate to SIA and helps us tremendously! By donating just \$10 a month, you can turn your yearly \$35 membership contribution into \$120. Or, by donating \$50 every quarter, your yearly contribution would total \$200! There are many different donation options through this program. If you are interested, please call Acasia at 520.624.7080 x10 or click on the Donate Now button at

[www.skyislandalliance.org](http://www.skyislandalliance.org)



Ft. Grant Overlook in the Pinalenos, facing the Galiuros *courtesy Tim Van Deventer.*

# Climate and the Changing Landscape

by Thomas Swetnam

In the past few years, the scientific community has gone from considering how climate change impacts might play out on the landscape to documenting how it has begun. At a climate and forests workshop back in February of 2004, we wondered whether some of the drastic changes we were seeing in southwestern forests were harbingers of global warming, or only a response to past land use practices, such as a century of livestock grazing, logging, and fire suppression. Research published in the scientific journals since then has confirmed many of our concerns that climate change has played an important role.

In late 2005, my colleagues identified high temperatures as one of the likely causes of the 2002-2003 massive die-off event of southwestern piñon and ponderosa pine trees.<sup>1</sup> Drought and bark beetle outbreaks certainly contributed as well. But the recent dieoff was apparently more extensive (about 3.5 million acres in Arizona and New Mexico) than the one which occurred during the 1950s drought, which was at least as dry as the current drought. Higher temperatures during the recent drought seems to have been a critical factor.

A much larger bark beetle outbreak — more than 20 million acres! — in British Columbia lodgepole pine forests was strongly linked to warming temperatures, adding further evidence that climate change impacts on ecosystems is beginning in western North America.<sup>2</sup> On another front, my colleagues and I reported in 2006 that increasing spring and summer temperatures were correlated with increasing numbers of large forest fires in the past few decades, with the evidence indicating that earlier snowmelt acts to dry out forest fuels, triggering synchronous, large forest fires throughout the West.<sup>3</sup>

Even as we better understand how global warming is changing the landscape, however, we are also recognizing additional complexities in the landscape response. A variety of other factors interact with warming temperature, including annual variability in the climate system and past land management practices.

Global warming interacts with other climate patterns, such as the long-term Pacific Decadal Oscillation and Atlantic Multidecadal Oscillation and the shorter-term

El Niño Southern Oscillation (commonly called El Niño). Beyond these climatic factors, there's a human component. Management practices, climate patterns and global warming all work together to affect the landscape in which we live.

To illustrate this complexity of how these various factors can interact, consider wildfire patterns in the Southwest. People have been fighting fires in western forests for more than a century, and permitting cattle and sheep to graze in forests for even longer. These management practices have changed the dynamics of fire on the landscape in some forests, as our research at the University of Arizona Laboratory of Tree-Ring Research has shown. Before Euro-American settlement, southwestern ponderosa pine forests supported frequent fires, generally of low severity. These surface fires burned along the forest floor with flame lengths of one to several feet in height, maintaining pine forests as open parks with little fuel accumulation in the understory.

Extensive livestock grazing and large-scale fire-fighting helped create conditions promoting modern-day fires that are often very severe. For example, in the Bullock and Aspen fires on Tucson's Mount Lemmon in 2002 and 2003, respectively, high severity burns completely killed even the canopy trees on roughly a third of the total burned area. Based on our knowledge of fire history reconstructed from fire-scarred trees and the ages of trees in these mountains, that proportion of high severity burn is probably anomalous over at least the past 300 years.

Along with forest management practices, climate variability influences wildfire regimes. Years of above-average rainfall, which occurs more often during El Niño events than during other years, encourage the growth of grasses. These fine fuels prime the landscape for more extensive burns during a subsequent dry year, which is more likely to occur during a La Niña event. We see the influence on forest fires of the fluctuations between these two related climate patterns at many scales, from the Southwest to western North America, and even extending to southern South America.

Yet another contributing factor in these dynamics is the recent spread of invasive grasses in many parts of the West. In the Southwest, introduced red brome and

African buffle grasses are increasing exponentially in the Sonoran Desert. These highly flammable grasses resprout prolifically following wildfires, which also kill many native desert plants, such as the iconic saguaro cactus. The exotic grasses appear now to be carrying fire into the woodlands and forests up slope, creating new corridors for fire spread through sensitive habitats and at-risk human communities.

As I mentioned earlier, warming temperatures are apparently now melting the snow packs earlier and desiccating forests more quickly than in earlier decades (before about 1980). This warming has probably contributed to the enormous fires we have seen in the Southwest in the recent decades — but forest changes due to land uses and exotic species, as described above, are likely also involved. However, this pattern of warming temperatures and increasing numbers of large forest fires also shows up in many Northern Rocky Mountain forests, where fire-fighting and other management practices have had relatively little effect on forest structures.

As you can see, climate change is rarely the only impetus behind the changes we're witnessing on the landscape. Yet it can make a critical contribution to the result, much like the straw that breaks the camel's back. That's why I have found myself compelled, like so many of my fellow scientists, to issue warnings about current and predicted climate change. We're moving into dangerous and generally uncharted territory as we continue to emit greenhouse gases that unequivocally will further warm the planet, resulting in severe ecosystem disruptions.

Some skeptics compare those of us who raise this alarm to Chicken Little, warning that the sky is falling. In reality, I suspect we're playing the role of Cassandra, the tragic prophetess of Greek mythology, portrayed by Shakespeare in his play *Troilus and Cressida*. Unlike Chicken Little's, the prophecies foreseen by Cassandra came true. In the Greek myth, Cassandra's curse was that no one believed her so she was unable to prevent the gloom and doom she foresaw. Still, we must temper our Cassandra-like warnings with the humility that comes from acknowledging the significant uncertainties that persist.

*continued next page*

# Climate and the Changing Landscape

*continued*

In modern times, people are now recognizing the truth that there are real dangers ahead if we don't take action to curb our greenhouse gas emissions. Therein lies the hope that we can prevent some of the worst consequences of climate change. This is also the time to think strategically and boldly about our stewardship responsibilities for the landscape and the people and wildlife that live on it.

It is still possible to mitigate coming impacts in some areas. In forests, we need to undertake judicious forest treatments, which will include landscape-scale forest thinning and prescribed burning in order to reduce the risk of severe, large-scale wildfires. In other ecosystems, we need to make similar efforts to increase native ecosystems' ability to adapt to global warming and the changes that come with it.

We have much work ahead, but it is essential work if we want to make the landscape we live in more resilient to climate change. My hope is that the information here and elsewhere will help people understand why it's important to undertake these important steps to reduce some of the risk to our landscape that is posed by rising temperatures. Recognizing the danger ahead can be a blessing if we have the foresight to take action to mitigate it.

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*Thomas W. Swetnam is professor of dendrochronology and watershed management and Director of the University of Arizona's Laboratory of Tree-Ring Research. Melanie Lenart also contributed to this perspective piece, which is a slightly edited version of a foreword that ran in Global Warming in the Southwest: Projections, Observations and Impacts, a University of Arizona publication available at: [geo.ispe.arizona.edu/climas/publications/pdfs/GWSouthwest.pdf](http://geo.ispe.arizona.edu/climas/publications/pdfs/GWSouthwest.pdf)*

# Recent Developments Leave Forest Planning in Flux

*by David Hodges, SIA Policy Director*

At the end of March, the 2005 Forest Planning Rule was vacated by a US District Court in California, with the presiding judge, Phyllis Hamilton finding that the Bush's administrations rule for land and resource management planning violated the basic laws ensuring that forest ecosystems have environmental safeguards.

Tim Preso, a lawyer who represented the environmental group Earthjustice, said, "basically, the importance of this decision is that the Bush administration had been trying to take all mandatory environmental protections out of forest planning process and this decision puts them back in."

This has had the effect of (at least temporarily) bringing Forest Plan revision, to a halt.

After considering several options, it first appeared the Forest Service had decided on utilizing the "2004 Interpretive Rule." This Rule was developed to give individual forests the latitude to move ahead with planning efforts, without waiting on the lengthy process that was playing out in developing a new (2005) planning rule.

The 2004 Interpretive Rule allows each forest to use either the 1982 Rule (which the existing Coronado Plan was done under) or the 2000 Planning Rule, which was finalized at the end of the Clinton Administration.

At this point, the Coronado NF made a decision to proceed under the 1982 planning rule, which means the final plan would have an Environmental Impact Statement, Standard and Guidelines, Management Indicator Species, and would retain current emphasis on retaining scenic values.

The Coronado has been working to remove all references to the 2005 rule from the document formerly known as the Comprehensive Evaluation Review (CER), and will be transforming the information into a Comprehensive Assessment. They hope to have a draft document out for public review by the end of August and still hope to have public meetings in the fall, to validate the needs for change and then focusing on desired conditions, and possibly objectives to achieve desired conditions. The desired conditions and objectives will be the backbone of the proposed revised plan.

According to the Coronado's revision team leader Jennifer Ruyle, "there are some very good examples of forests that have accomplished a lot

in periods of transition, and we will follow those examples. At this point we can continue to focus on analyses and interim products that add value to the final product. There is a lot of work that can be done that fits under any of the rules that have ever been promulgated, and that is what we intend to do."

I wish that I could say that it all ended there and we are moving forward with completing long overdue forest plan revisions. Unfortunately, the Forest Service nationally has decided on an attempt at resurrecting the 2005 Planning Rule. They are preparing a draft Environmental Impact Statement, which in theory would satisfy a major concern of the courts, and would open the door to returning to the 2005 rule. It is anyone's guess at this point, as to what happen next, beyond delay.

Here at SIA, and with the Coronado Planning Partnership, we have continued to develop organizing and campaign tools for when forest plan revision is reinitiated. The good news is we have a strategy in place we believe will work regardless of what planning process, plan revision is done under.

On that front we have continued to create reports for each of the 12 Ecosystem Management Areas on the Coronado National Forest, all of which will contain threats, assets, conservation targets, and management recommendations, as well as an analysis of both wilderness suitability and areas to be managed for roadless and semi-primitive recreation, and special management area proposals (and of course, maps).

Soon, we will be make drafts of these reports available to the public for review and suggestions.

We have continued developing the Sky Island Action Center website, which you can view at [www.skyislandaction.org/ActionCenter.html](http://www.skyislandaction.org/ActionCenter.html)

In addition to forest planning, we have been heavily involved in the Travel Management planning process that the Coronado is undergoing. We have completed our recommendations for the Santa Catalina and Nogales Ranger Districts and these are available for review at the above website. Thanks to all of you who have helped with that. We are now beginning to work on transportation recommendations for the Safford Ranger District.

If you have questions about any of this, or would like to get involved, please contact me at [dhodges@skyislandalliance.org](mailto:dhodges@skyislandalliance.org) or 520.624.7080 ext. 13.

# Five Miles & Twenty Years Later... Dave Bertelsen's Amazing Data Set

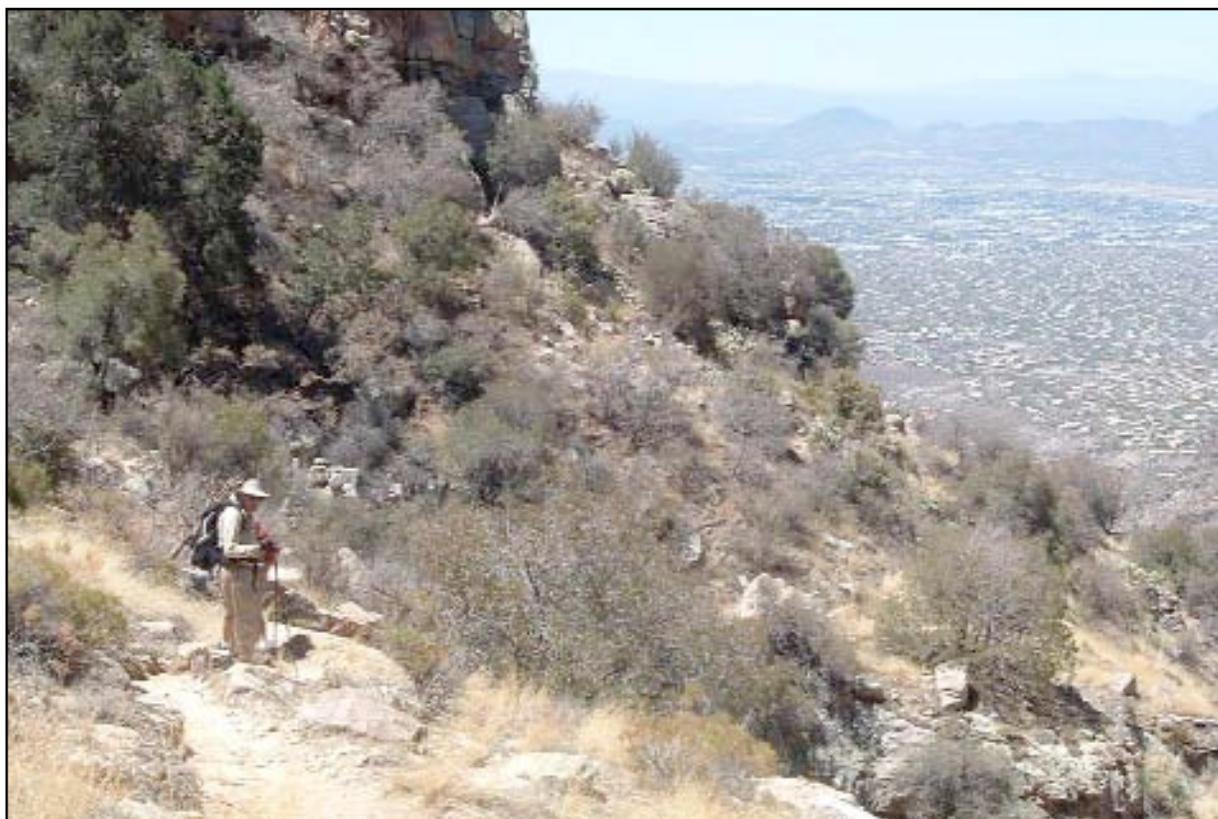
by Theresa M. Crimmins, from data collected  
by Dave Bertelsen

Week after week, month after month, for the past twenty-some-odd years, Dave Bertelsen has quietly and doggedly hiked the same trail in the Santa Catalina Mountains. The trail is a butt-kicker — the Finger Rock trail climbs over 4,000' in its five mile traverse from the north terminus of Alvernon Way to the peak of Mt. Kimball. But making this hike over 1,000 times in a 20-year stretch isn't Dave's only feat — every time he's hiked the trail since 1984, he's kept track of every single grass, cactus, shrub, flowering plant, and tree that he's seen in bloom within each of five, mile-long trail segments.

Unknowingly, Dave has collected an extremely valuable phenological record. Phenology refers to the seasonal timing of life cycle events such as leafing and flowering in plants and migration and egg-laying in animals. Phenological records of plant and animal life cycle events are strong indicators of ecosystem response to environmental change. Dave's meticulous documentation, resulting in more than 111,000 records of nearly 600 taxa of blooming plants over a 20-year period along an elevation gradient, is an incredibly rare and rich dataset. Typically, long-term studies focus on a few target species. Conversely, comprehensive studies such as floras aim to document all species in one location, but are generally short-term (1-2 years) in scope. Dave took the best of both approaches, documenting all species in bloom for an uncommonly long duration. The fact that Dave attributed his observations to mile-long segments, which roughly correlate to the different biotic communities found along the gradient, adds yet another welcome dimension to this dataset. The elevation gradient captured in this study is roughly equivalent to a latitudinal transect ranging from southern Arizona (desert communities) to southern Canada (conifer forests).

I was very lucky to have met Dave a few years ago at a meeting of local environmental organizations and to learn of his efforts. At the time, he was unsure that his meticulous recordkeeping held scientific merit. I have since had the pleasure and honor of working with Mike Crimmins, a climatologist with the University of Arizona, and Jeff Balmat, a geographer and physical science technician with the National Park Service to explore Dave's dataset and to demonstrate to him just what a gold mine his observations are!

Dave's remarkably rich Finger Rock record has allowed us to explore relationships between the plants observed in bloom and climatic variables as well as spatial and temporal shifts in flowering patterns. In initial analyses, we found that the number of plant



Plants observed in bloom in mile 5 of the Finger Rock/Mt. Kimball trail, Santa Catalina Mountains *courtesy Ben Wilder.*

species observed in bloom in the low elevations, primarily desert scrub and scrub grassland communities, was influenced mainly by the amount of precipitation in concurrent and preceding seasons. Wet winters yielded more species in flower in spring; wet summers encouraged more summer plants to bloom. In contrast, the number of species observed in bloom in the higher elevation communities was much more a function of temperature. In the woodland and conifer forest communities of the highest miles, the great majority of plants observed in bloom occurred in summer months. Warmer summer temperatures prompted more species to flower than cooler temperatures; this is a pattern that is consistent with plant communities in temperate and montane plant communities found at higher latitudes.

Because Dave recorded every plant species in bloom rather than just a few target species, we are also able to explore patterns and look for changes in the composition of the plant communities observed in the five miles. One pattern that stood out to us was that the list of plants Dave observed in flower in exceptionally dry years was very low, but that even moderately wet years yielded similar species lists to very wet years. Many recall the springs of 1993 and 1998, reported as “good” and “great” wildflower years in the Sonoran Desert, respectively; the carpets of poppies and lupines seen in bloom in these years were the result of wet winters. Within Finger Rock canyon, Dave observed many of the species in bloom in these outstanding years in a lot of “mediocre” (average rainfall) years too. The upshot: winters with only moderate precipitation can still induce flowering of many of the same species as very wet winters, just not in the same abundances as these notable years.

Another pattern observed at the highest elevations really jumped out. Over the 20-year study period, average summer (defined as July, August, and September) temperatures steadily increased. Interestingly, the number of plant species observed in bloom in the highest mile in the summer also steadily increased. In addition, a gradual shift in the

composition of species was observed over the course of the study. Together, these findings suggest that increasingly warmer average temperatures are producing conditions favorable for greater numbers of plants to flower in summer in forested communities. Dave's dataset is not alone in demonstrating what may be the effects of a warming trend. Many other long-term phenological records collected around the globe have documented changes in the timing of key events, suggesting increasing global temperatures as the driving force.

One key reason the Finger Rock dataset holds such value is that we have it *now*. Dave's dataset is providing us with a window into changes already taking place in the Catalina Mountains, changes we would not be able to detect probably for several more years, if monitoring was just getting started. However, there is a great need to have this kind of information in-hand *today*, to inform policy, planning, and legislation. Existing datasets can provide the basis for understanding the changes that may already be occurring.

This story is a premier example of a valuable but increasingly more common partnership between a dedicated volunteer collecting data and scientists analyzing it. Unpaid individuals contributing to scientific knowledge in this capacity fall under the general heading of “citizen scientist”, which runs the gamut from individuals participating in organized efforts such as Master Gardeners and Watershed Stewards to devoted, solitary data collectors such as Dave. The efforts of these committed individuals are a key contribution to furthering the scientific understanding of our ecological systems. Dave's Finger Rock dataset is far beyond what many scientists could dream of collecting; we have only scratched the surface of how it can be analyzed. We will continue to glean valuable information from this phenological gradient study for many years to come.



*Theresa M. Crimmins is adjunct faculty with the Office of Arid Lands Studies at the University of Arizona.*



Mt. Graham red squirrel *courtesy Claire Zugmeyer.*

Can anything be done? Besides more reports, meetings, and papers? Global warming can be a holocaust for certain species and require drastic measures. Combating the impacts of global warming is not very compatible with long bureaucratic meanderings and talking-head scientists. Given the controversy about telescopes vs. squirrels and the present administration's pressures on the Forest Service and US Fish & Wildlife Service, it appears little can be accomplished.

In a red squirrel-friendly world, the Forest Service or even the U.S. Fish & Wildlife Service would hire hunters to rid the Pinalenos of the invasive Abert's squirrel. This would be very helpful on an isolated peak (Blue Jay Peak) which was once red squirrel habitat and is now isolated from the rest of the population. Red squirrels could be transferred to this lost habitat. Arizona Game & Fish, unfortunately, has recently embarked on a different tack in handling Abert's — a two-year trial of changing hunting regulations to year-round with no bag limit, which carries a potentially fatal flaw if hunters can't tell the difference between the two squirrels.

In addition, the USFWS could re-start feeding programs. The last time, each feeding station became a favorite lunch counter for the northern goshawk and other predators. But, perhaps a predator-protected feeding station could be built. The last resort is to breed the Mt. Graham red squirrel in captivity — a hugely expensive proposition fraught with technical and legal obstacles.

There is some good news — the Forest Service gave the upper elevation burn areas of Mt. Graham a fifteen to twenty year jump-start at recovery. Most young seedlings resist insect attack, and this July the Forest Service planted spruce grown from seed collected within the same 500-foot elevation band as the burn areas.

In short, those who desire to keep this squirrel from extinction, might join the Native Americans and pray that no insect attacks the Douglas fir, the main remaining food source of the squirrel. They might pray that no further fires sweep over the still living habitat — no match is dropped or propane tank erupts in flames. They might pray that this does not happen for sixty to seventy years — the minimum for spruce, fir and other conifers to become mature donors of cones. Most of all, they might pray that humans, in all their fossil-fuel greed and incredible ignorance of nature, don't make too many more mistakes in land management on the Pinalenos.



*Peter Warshall's work centers on conservation and conservation-based development. He works on all socio-economic levels and with highly diverse people and ecosystems of the planet.*

## A Battered Squirrel faces Global Warming, too

by Peter Warshall

The Mt. Graham red squirrel still survives in the upper elevations of the Pinalenos, the tallest sky island. Its survival is quite remarkable given the number of blows it has had to endure. It lost one-third of its forest habitat to clear-cutting, road development, astronomical observatories, electronic relay stations, summer homes and other tree clearings. The clearcut forest has not yet returned to full production of conifer cones, the staple of the squirrel's diet. The eight-ounce squirrel lost more habitat and food to the Abert's squirrel, a chunkier, heavier squirrel, introduced by the Arizona Game and Fish Department for hunting. Most recently, it has lost most of its best habitat at the very top of the Pinalenos to insect attacks and severe forest fires.

As if these burdens were not enough, the squirrel is at the southernmost point of its range and needs cool, moist forest to shelter its food caches, hide from predators, and grow mushrooms and truffles. The squirrel is isolated on the top of the Pinalenos, and has nowhere to escape to in times of habitat loss or global warming.

All of these circumstances make the Mt. Graham red squirrel one of the most endangered mammals in North America, and a "red flag" for the future of the sky islands. All the thirty or so sky islands in the Madrean archipelago between the Mogollon rim and the Sierra Madre of Mexico sport a stack of biological communities. The stack resembles the kids' toy of concentric wooden rings of different colors that are placed on a central pole, the bottom being biggest and the topmost the smallest in diameter. As global heating occurs, the plants at the bottom survive better within the next rung up. The topmost plants go extinct or hide out in refuge locations such as the deep drainages on the north side of the Pinalenos, away from the sun. In a sense, the topmost community (the spruce-fir community) is literally being burned up into the sky.

It didn't take academic scientists to figure this out. I remember Gary Holy Bull, a Sioux medicine person, in 1992, leading a group of Native Americans to the top of Emerald Peak (behind the German telescope) to pray for the mountain. On the way down, he said: "The mountain is weak." 1992 was one year in one of the worst drought sequences in 700 years. The next year, bark beetles attacked storm-damaged trees. By 1996, a moth defoliated the Corkbark fir and Engelmann spruce in the area around the telescopes and up to High peak; and then, in 1999, an exotic aphid attacked the remaining spruce, sucking out the juice from its needles. The agencies responded slowly and, since the squirrel was endangered, were hesitant to spray the mountain top with pesticides to control the insect explosion. Thousands of trees perished. The squirrel population, even though inventoried by a controversial formula and census method, which artificially increases the overall number of this species, plummeted. Battered before, the newly opened forest now increased predation risk, reduced good locales to hoard food for the winter, eliminated significant fungi production (a major food), and increased fire risk that might destroy existing saplings or jump to viable forest.

The weakened forest did catch fire in 1996 (the Clark Peak Fire) and the USFWS estimated that, at least, fifteen red squirrels died as a result of efforts to control the fire and protect the telescopes. A human (never determined) was responsible for setting the fire. In 2004, lightning started the Nuttall Fire. (Actually this was the second fire called the Nuttall Fire. The first occurred in the last long drought period of the 1950s.) While many of the squirrels escaped being burnt, perhaps three dozen (everything is controversial on Mt. Graham) subsequently died from lack of food or ability to find a viable home range. The population went down to about 200 to 250 squirrels, if the survey method is to be believed.



Picacho del Diablo rising above the Sierra courtesy Horacio de la Cueva.

## Will the Sierra de San Pedro Mártir become a desert? by Horacio de la Cueva

*Editor's Note: Although the Sierra de San Pedro Mártir does not fall within our Sky Island Bioregion, I thought it would be interesting to include a perspective from a scientist in Mexico. Horacio very graciously agreed to write a "what if" scenario using his "sky island" on the Baja Peninsula.*

Controversy about global climate change lies on its causes, not in its presence. Independently of causes and solutions, climate change is here to stay. The planet we inhabit is an ever-changing dot in the universe. Our planet, as far as we can look into the past, has changed its climate regimes. But today we must suspect our species as both the harbinger and cause of the changing climate.

What will happen to sky islands over the next few decades as the climate changes, and the weather and environment behave in ways that might surprise us?

As sea islands will lose their lower ground to flooding as the oceans rise, the sky islands will also shrink as temperatures rise and warmer environments move upward, reducing the available habitat area and eliminating the coldest conditions. What does this all mean for habitats and species in sky islands?

I can't discuss every species in every sky island, but I think that the Sierra de San Pedro Mártir in the northwest corner of Mexico is as good an example as any.

The Sierra bisects in an almost N-S axis the northern section of the Baja California peninsula; its steep eastern escarpment limiting the Sonoran desert, while its western slope rises in discrete steps from the Pacific ocean. Both sides converge on the uppermost Sierra, where the Picacho del Diablo mountain reaches a height of 3,100 m (9,300 ft). The western slope is within the Mediterranean strip of North America. Mediterranean climates have dry summers and wet winters.

I will focus on the western slope. The habitat cline goes from sea level to mountain top. It can be classified as coastal sage scrub up to 400m, chaparral to 1,200m, followed by a strip of *Quercus* and Pinyon pine, and above 2,000m a mixed conifer forest, and a small strip above the tree line.

What will happen in the Sierra? Manuel Álvarez, a researcher from the 30-year-old Observatorio Astronómico Nacional in the Sierra, has observed during that period an increase of 4°C in the summer temperatures. The best accepted predictions for

climate change in the Sierra are that winter rains will diminish. We will not only have a dried habitat, we will also have a much drier atmosphere. This will most likely be a blessing to the Observatory as nights will be drier and with a more stable atmosphere, both favorable for astronomical observation. In the Sierra's dry atmosphere an increase in temperature is coupled with a decrease in precipitation.

As the atmosphere dries out and the relative humidity lowers in the Sierra, the differences between midday and evening temperatures will increase. At present a typical summer day in Vallecitos, a meadow 2,600m above sea level, goes from -4° to 30°C+. If the air becomes drier, nights will be cooler, and winter nights may go well below the -12°C recorded on our coldest nights. How many of these winter nights will push organisms beyond their temperature tolerance limits?

Dendrochronological studies carried out in the Sierra's forests during the last few years will give us a glimpse of the climate for the last 500 years. We might be able to find out if the old-growth forest has survived the climate extremes in rainfall they will be facing in the future.

With a reduction in winter rains and more extreme temperatures in the Sierra, many of its life forms will be pushed to their limits. For example, the Sierra harbours an endemic rainbow trout subspecies *Oncorhynchus mykiss nelsoni*. This small-sized, precocious fish tolerates both warm temperatures and the low oxygen concentrations of the Sierra, inhabiting the creeks in the La Grulla meadow about 1,800m above sea level. These adaptations make it a great candidate for providing genetic material to trout farms in Mexico. Will this genetic goldmine survive harsher weather and greater drought in the Sierra? As temperatures rise, oxygen concentration in the water will decrease; with drier winter air, water temperatures might lower. What will happen to the streams as water becomes more scarce?

As winter rains and the snowpack decrease in the Sierra, all the western slope will be drier. Several amphibian species and subspecies under different concern categories in the IUCN will be further

threatened, including the Western toad (*Bufo borea*), the California tree frog (*Pseudacris cadaverina*), and a subspecies of *Ensatina* salamander (*Ensatina eschscholtzii klauberi*).

With less water the endemic bighorn sheep, *Ovis canadensis cremnobates*, and its predator, the puma, *Puma concolor*, will slowly and irreversibly decrease in population size.

Two species of pinyon pine, *Pinus monophylla*, and *P. quadrifolia* currently belt the Sierra at the upper reaches of the chaparral. If water stress is not too high and winter temperatures remain tolerable for this species, we might see an upward migration of their population. We might also see a reduction in the lower part of their range if temperatures become too hot.

The stands of quaking aspen, *Populus tremuloides*, that pepper the Sierra and give it both a beautiful bright green foliage in the spring and an autumn flavour, are always associated with running water, sometimes above and sometimes below the ground surface. Will we lose these trembling lights too?

Although we think we have a good idea of bird species diversity in the Sierra, no one has spent enough time to look at population trends of any of the species; the California Condor is an exception, it is being reintroduced and followed constantly. As the forest receives less precipitation and water stress increases, all trees will be prone to insect infestation. Woodpecker species like the Northern flicker (*Colaptes cafer auratus*), Nuttall's woodpecker (*Picoides nuttallii*), and Hairy woodpecker (*P. vilosus*) might do very well for awhile as both their food base increases as well as the number of nesting sites in the hollows of dead trees. On the long run as the forest dies out and disappears, the woodpeckers will have the same fate.

The mixed conifer forests of the Sierra have the characteristics of an old-growth, unlogged forest. Most of the trees are old, but still productive. Many seedlings settle in the open spaces, but water stress and periodic fires kill many of these. Best estimates are that 1 out of every 1,000 seedlings ever reaches mature age.

*continued on page 13*



## Why Wilderness? *by Mike Quigley, SIA Wilderness Campaign Coordinator*

In early August, Congressman Raúl Grijalva introduced H.R. 3287, the Tumacacori Highlands Wilderness Act of 2007, into the United States House of Representatives. When passed, this legislation will designate Wilderness for the windswept peaks and breathtaking vistas of the Tumacacori Highlands — approximately 84,000 acres of wild Arizona northwest of Nogales.

This legislation builds on the public lands protection legacy and bipartisan work of Morris Udall, John McCain, and Barry Goldwater. Congressman Grijalva and his staff have worked collaboratively for more than four years with a diverse array of Arizonans to accommodate a range of interests in the proposal.

As a result, the legislation preserves the land, the functioning ecosystem, the intact habitat; and has the broad support of individuals and groups: conservationists, hunters, businesspeople, HOAs, scientists, church groups, and more.

Time was when America was mostly wilderness, when the “settled” places were small and surrounded by the wild. Time was when people feared the wilderness, when it was something to be tamed, beaten, converted. Time was when it seemed we’d never run short of wild places. That time is long gone.

Today, we know the values of wilderness: as a functioning ecosystem and a clean watershed; as intact habitat for magnificent creatures like jaguars and leopard frogs; as a natural classroom where we can learn how the world works; as a place for traditional hunting experiences; as a spiritual resource; as a natural escape from the bustle of town life for hikers, photographers, painters, birders, picnickers, equestrians, and many others. Today, the settled places sprawl across the maps and

the land has been largely converted — to subdivisions, parking lots, highways, and amusement areas. Today, it is wilderness that is surrounded — and in decreasing supply.

Fortunately, we have a means of preserving the wilderness we have left. In 1964, with the Wilderness Act, Congress created the National Wilderness Preservation System and with it a means for wild, intact public lands to be preserved with a special designation of “Wilderness”. Congress did this “...to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition...[and] to secure for the American people of present and future generations the benefits of an enduring resource of wilderness...” {Public Law 88-577; Section2(a); read the entire Act here: [www.wilderness.net/index.cfm?fuse=NWPS&sec=legisact](http://www.wilderness.net/index.cfm?fuse=NWPS&sec=legisact)}

Wilderness designation, in the most basic sense, provides wild places for wild things to be wild. Certainly, that’s needed. And it’s through Wilderness protection that we have places like Mt. Wrightson, Rincon Mountain, Pusch Ridge, Aravaipa Canyon, and Sycamore Canyon protected for the people of southern Arizona to enjoy — now, and for generations to come.

The Tumacacori Highlands Wilderness Act of 2007 takes a crucial step in protecting an irreplaceable natural resource that makes Arizona special. Within an hour’s drive of over a million people, the Tumacacori Highlands needs our vigilance and protection if it is to remain remarkable and special, if it is to remain an enduring resource of wilderness for future generations, if it is to continue to be Arizona as Arizona used to be.



# TUMACACORI HIGHLANDS



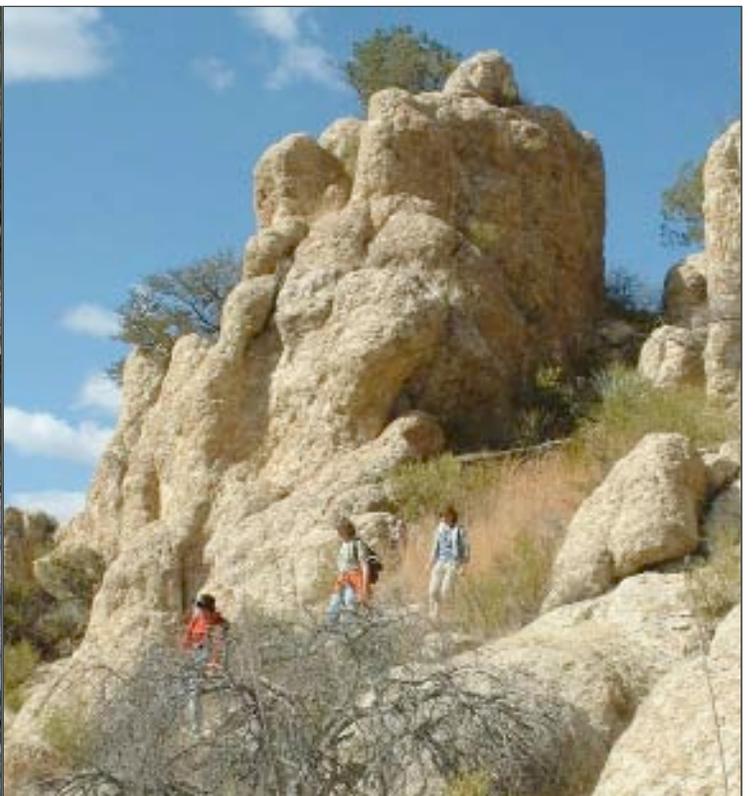
**Wilderness** is a designation for federally-managed public lands. The 1964 Wilderness Act is the original legislation, creating the National Wilderness Preservation System and defining the process of designating and managing wilderness areas. *Wilderness areas can only be designated by an Act of Congress.*

Lands qualifying for Wilderness designation are described by the 1964 Act as “where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.” Lands designated Wilderness are to be managed “for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness...” No roads or structures are to be built, and vehicles and other mechanical equipment are not to be used within the Wilderness boundaries.

Today, approximately 107 million acres of our national lands have Wilderness protection—and research shows that more than 12 million people visit these lands each year on their own or with a guide to hike, backpack, camp, climb mountains, ride horses, hunt, fish, ski, raft, canoe, take pictures, view wildlife and stargaze.

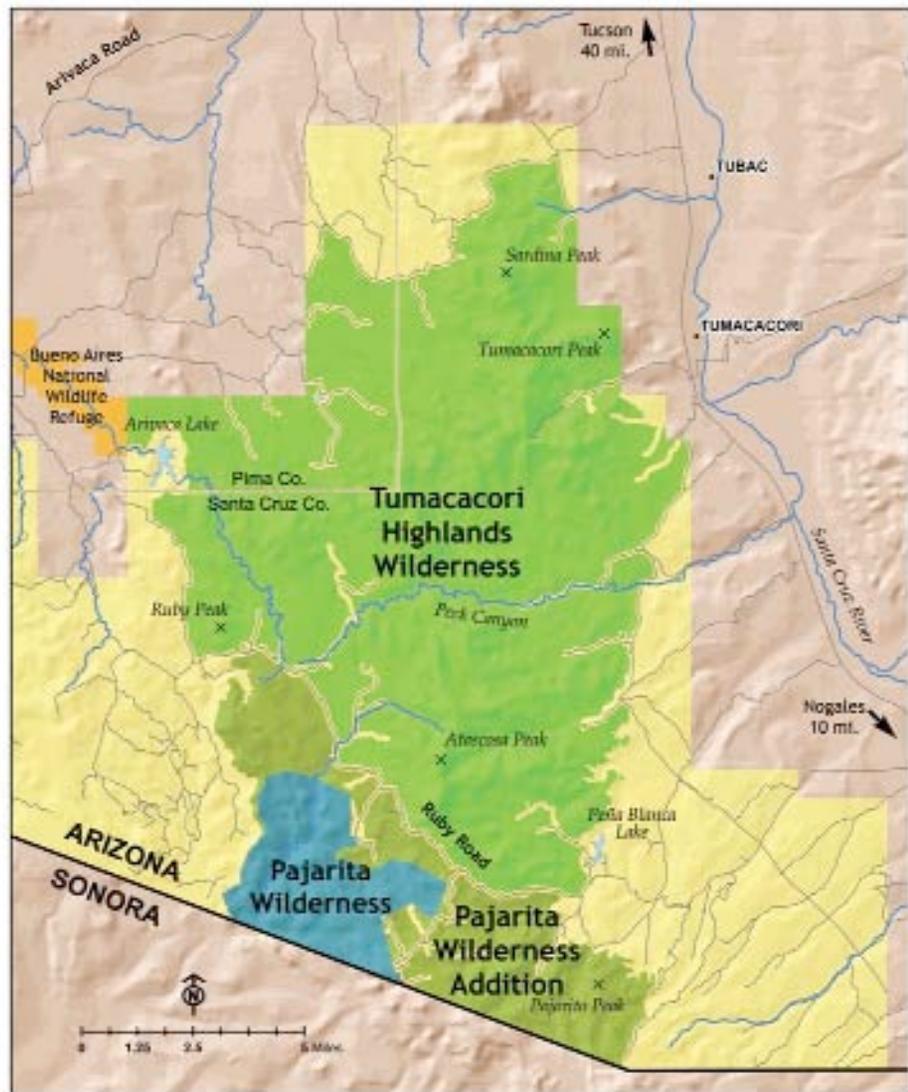
The major conservation and quiet-recreation benefits of Wilderness designation are the restrictions on motorized and mechanized use, and the *permanence* of statutory protections. Examples of popular Wilderness areas in southern Arizona include Pusch Ridge Wilderness in the Santa Catalina mountains (the Wilderness boundary extends to Tucson city limits), the Rincon Mountain Wilderness in the Rincon mountains, the Mount Wrightson Wilderness in the Santa Rita mountains, the Miller Peak Wilderness in the Huachuca mountains, and the Chiricahua Wilderness in the Chiricahua mountains—all on Coronado National Forest lands.

*So much more than a pretty place... it adds a wealth of wildness to our lives and places for wild things to roam...*



*Photos in this insert courtesy Sergio Avila, Trevor Hare, Mike Quigley, Jen Schmidt, Matt Skroch, and Michael Terrio.*

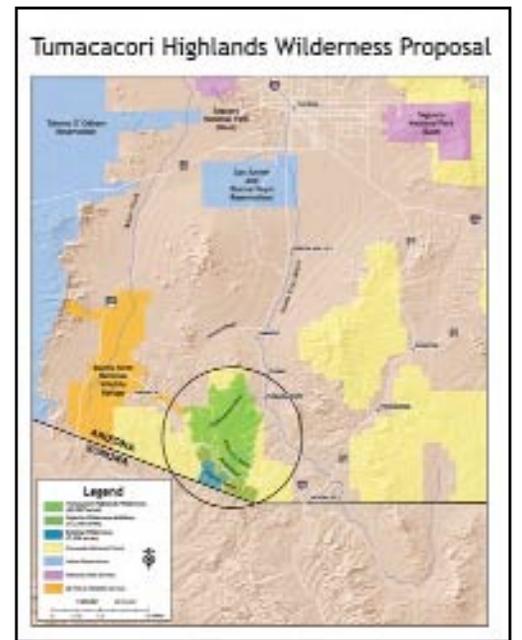
# Tumacacori Highlands Wilderness Proposal



Realizing the area's importance biologically and recreationally, local citizens began looking for ways to preserve it. Congressionally-designated Wilderness, with its statutory and historically-vetted protections, especially as a tool to prevent fragmentation and destruction of the land from new, often user-created and illegal, roads, emerged as the best way to assure preservation. *Core areas of native biodiversity, and their vigorous protection, are essential to maintaining native biodiversity on a larger scale.*

## The proposed Tumacacori Highlands Wilderness is...

... the largest remaining roadless area on Forest Service lands in Arizona that remains unprotected. Recognized as valuable intact core wildlife habitat in the RARE II (Roadless Area Review and Evaluation) process and from on-the-ground survey work by Sky Island Alliance staff, volunteers, and



collaborating groups, the area supports native biodiversity of game and nongame species, common and rare species, including whitetail deer, Coue's deer, javelina, mountain lion, Peregrine falcon, golden eagle, elegant trogon, five-striped sparrow, sonoran chub, Chiricahua leopard frog, and jaguar. The area is diverse in vegetation and view as well—predominantly rolling grassland hills and open-canopy oak, with sheer cliffs, deep canyons, and pine trees at the highest elevations. In short, the area is Arizona as Arizona used to be.

... approximately 84,000 acres in southern Arizona, entirely public lands within the Coronado National Forest, Nogales District. The area includes the Pajarito Mountains, Atascosa Mountains, Tumacacori Mountains, and important connecting valleys such as Bear Valley, Bartolo Canyon, Peck Canyon, Apache Pass, and others, and is roughly bounded by the international border and the existing Pajarita Wilderness on the south, Peña Blanca Lake and Wise Mesa on the east, Arivaca Lake on the west, and Red Springs Pass Road (also called the Hunters' Access Road) on the north. The proposed Wilderness is entirely within Arizona Congressional District 7, Mr. Grijalva's district, with the north side bordering Arizona Congressional District 8.

## Support for Tumacacori Highlands Wilderness is strong, broad and diverse.

Indeed, Wilderness and protection of Arizona's wild lands are issues that unite folks across political and recreational divides—Wilderness is common ground for Arizonans.

### Over 100 Local Businesses

### 4 Hunters and Sportsmen's Groups

Arizona Quail Alliance  
Arizona Wildlife Federation  
Backcountry Anglers and Hunters  
National Wildlife Federation

### 23 Local, Regional, and National Environmental Conservation Groups including...

Arizona League of Conservation Voters  
Arizona Native Plant Society  
Defenders of Wildlife  
Friends of the Buenos Aires National Wildlife Refuge  
Friends of the Santa Cruz River  
Green Valley Environmental Club  
Republicans for Environmental Protection  
Sierra Club-Rincon Group  
The Wilderness Society  
Tucson Audubon Society  
Tucson Herpetological Society  
Upper Gila Watershed Alliance

### 7 Local Homeowners Associations, representing 1300+ households in Green Valley

3 Local Hiking Clubs  
Green Valley Hiking Club  
Green Valley Environmental Club  
Huachuca Hiking Club

### Faith Groups

Arizona Ecumenical Council  
National Council of Churches

### Many Scientists and Academics

Over 80 natural resources & biology professors and graduate students  
Prescott College School of Environmental Studies

### Arizona Governors

Governor Janet Napolitano  
former Governor and Secretary of the Interior Bruce Babbitt.

And thousands of Arizona Citizens have written, emailed, or called their elected officials in support of the Tumacacori Highlands.

### There's a deep and diverse local support for Tumacacori Highlands Wilderness:

A poll (conducted by Behavior Research Center) of likely voters in Marana, Oro Valley, east Tucson, Green Valley, Sahuarita, and eastern Pima County, showed **"public support for the wilderness designation at 87 percent in favor, including 61 percent strongly in favor."**

Perhaps even more striking is the breadth of public support for Wilderness, the poll results showing **"support transcends every geographic region, is bipartisan, crosscultural (including 95 percent of Hispanics) and registers at 74 percent among off-road vehicle users."** Indeed, **"when informed that only six percent of land in Arizona is permanently protected as wilderness, three-quarters of likely voters opine that this is 'too little.'"**

### Support for Wilderness is political common ground:

Poll results show a strong majority of Republicans, a very strong majority of Democrats, and 86% of Independents support Wilderness.

## Let our elected officials know we want Wilderness for the Tumacacori Highlands!

**Make your voice heard! Tell Senators McCain and Kyl, and your Representative, that you want Wilderness designation for the Tumacacori Highlands.**

Personal letters or faxes to Members of Congress are an effective way to express your views and inform your elected officials. Visit [www.tumacacoriwild.org](http://www.tumacacoriwild.org) for contact information for Arizona's Congressional delegation.

Please send a copy of your letter or email to Sky Island Alliance, P.O. Box 41165, Tucson, AZ 85717. If you like, you can send us the original and we will have it hand-delivered in Washington, DC!

# Getting Involved

By M. Scott Johnson

My involvement with Global Warming did not begin this past January when I was selected to train with former Vice-President Al Gore. It dates back to the early 1980s. I had recently left my Humanities study at the Arizona State University. I was doing just what I thought every ex-philosophy student ought to do — write folk music and protest songs.

It was then I had my first encounter with climate change. I was dashing off to my “day job” in my run-down 1976 Dodge Colt. I stopped and got a paper, cup of coffee and drove off. I didn’t read the headline until I hit the next red light. It read: Scientist Suspect Earth Warming linked to Auto Emissions. At that moment the light changed. I stepped on the gas, looked in the rear mirror, and saw a black cloud of smoke pour out of my exhaust.

At that moment I realized two things I have never forgotten. I realized how intricately connected we are to this web of life through the air we breathe. I also realized how powerfully I could impact this web when not mindful of my actions.

These realizations found new words and deep meaning for me this last January when I spent three days with former Vice President Gore learning about Climate Change. Gore had set out to train 1000 people internationally to create a grassroots movement. I was privileged to be one.

The training was sobering. The facts are frightening. We have a massive challenge on our hands; one that will unleash unprecedented human commitment or mean drastic destructive change in our way of life. Still, in the midst of much darkness, I am more hopeful than I have been in 25 years of doing social change work. Why? People are waking up. They are frustrated. They are tired and want a change.



To raise awareness about Climate change and solutions, Defenders of Wildlife sponsored a live simulcast of the global LiveEarth concerts at O’Malley’s on 4th Ave. in Tucson. Speakers included Congresswoman Gabrielle Giffords, Supervisor Richard Elias and state Representative Steve Farley. Sky Island Alliance was one of the many conservation groups tabling the event. An estimated 1200 people attended throughout the evening. Photos courtesy Defenders of Wildlife.

I am predicting that over the next 15 years we are going to see unbelievable advances, not only in the environmental awareness of individuals, but in the government programs that protect and restore this Earth. While it may seem dismal right now, there is great opportunity in crisis.

In 1962, Rachel Carson wrote *A Silent Spring*. This watershed book not only awakened America to the dangers of pesticides, it helped us to understand the inter-connectedness of life. On the heels of this new awareness was born an undreamed of new environmental consciousness and the rudiments of unimagined laws we now take for granted: The Endangered Species Act, the National Environmental Protection Act and the Clean Air and Water acts. Mr. Gore is doing for our time what Rachel Carson did for the 1960s. On the heels of this we can now advance in people and in government a new Earth Ethic.

In the presentations I give I remind people that Global Warming is not the problem, it is the symptom. The larger challenge for our race is to remember what my “rear view mirror” experience won’t let me forget: life is a delicate weave and we are powerful change agents. I am intent on doing all I can to help further awaken myself and others to this. If we can take these remarkable powers and redirect them towards sustainability and living in balance with nature, I truly believe we can foster a peaceful and abundant future for the children of all life on this planet. Now that would be something to see in the rear view mirror!



M. Scott Johnson is a native Arizonan and the Senior Outreach Representative for Defenders of Wildlife. He is currently traveling around the state giving presentations on Climate Change and is available for speaking engagements. He can be reached at [sjohnson@defenders.org](mailto:sjohnson@defenders.org).

## Will the Sierra de San Pedro Mártir become a desert? continued from page 8

Under mediterranean climate — cool wet winters and dry summers — plant species have evolved to undergo decomposition and material recycling through periodic fires. We know how long, on average, it takes for the chaparral and the different stands in the mixed conifer forest to burn. Will the local effects of climate change break down the fire periodicity?

During the summer, lightning strikes set off natural fires in the Sierra — the strikes that hit a tree scar it and burn a small vegetation patch around it, ridding the forest floor of many seedlings and younger trees. Some of these fires grow in size and intensity, but fires don’t run very far or very hot in the Sierra unless there is enough dry biomass accumulated. Large forest fires, in the thousands of hectares, occur on 80-100 year cycles. As the air dries and water becomes more scarce, what might be the effects of lightning strikes? If the plant material is dry before it senesces and is struck by

lighting, we might see decoupling between fire frequency and size. Perhaps we will see more middle-sized fires that will change the patch-size characteristic of the Sierra. The Sierra is a mosaic of different-aged stands that both stops fires from spreading out of control and offers a variety of habitats to its animals. Perhaps the mosaics will reshape and become smaller, reducing continuous available habitat.

The evolutionary trend of periodic fires is being broken and this will change selection pressures in the Sierra. The eldest trees have undergone natural selection for several hundred years. Will they and their seedlings survive the new world we are now living? If selection pressures are similar to those in the past, the forest has a chance. If selection pressures are changing we can only hope for the best — that this magnificent forest will not shrivel. As the Sierra becomes a xeric habitat we can expect species from the lower lands to

move in. Can we expect an exotic plant invasion? Most likely, as these species are usually better competitors than the native flora.

As climate changes in our lifetime one thing is certain about Sierra de San Pedro Mártir, and perhaps many if not all the Sky Islands. We do not know enough. Enough about its natural history, its habitats, ecosystems, and species. How can we ameliorate change if we don’t understand completely how the system works, if we don’t know what is disappearing and at what rate, what is coming in, and what will be most critical to save. We are not ready for this new world.



Horacio de la Cueva is a research scientist at the Ensenada Center for Higher Education Scientific Research (CICESE). He can be reached at [cuevas@cicese.mx](mailto:cuevas@cicese.mx)



# Ten Things to Do

Save money and energy while “saving the world” from global warming

By Melanie Lenart

Earth's city lights courtesy NASA.

The world's production of greenhouse gases is projected to boost Southwest temperatures by another 3 degrees Fahrenheit or more by mid-century unless society's energy habits change, according to projections based on models used by the IPCC. That value would be over and above the urban heat island effect that occurs locally as cities expand.

The projected temperature rise would bring a host of predictable changes, such as a reduction in snow cover and an increase in heat waves, as well as the potential for widespread water shortages, large-scale wildfires and troublesome climate surprises. Greenhouse gas emissions are unequivocally behind the global warming observed for this past century, as Intergovernmental Panel on Climate Change (IPCC) experts confirmed this year.

**Drive less.** U.S. cars and trucks generate about half of the world's greenhouse gas emissions from vehicles, according to a 2006 Environmental Defense Fund report. Driving smaller cars or hybrids, walking or biking, using public transportation, and living closer to work all translate into fewer emissions. Even keeping tires full and lumping errands together for more efficient trips can help save gas.

**Use electricity sparingly.** Turn off lights that aren't in use, and replace conventional light bulbs with compact fluorescents. Unplugging appliances also contributes because most electronic devices continue to draw energy even when turned off. Attaching several devices to a surge protector will make it easier to shut things down.

**Consume wisely.** Recycling, buying fewer products, and using second-hand products reduce energy consumption because it reduces the emissions generated by the manufacturing industry. Buying local products, including food from farmers' markets, also helps by reducing emissions generated in transporting goods.

**Heat water less.** Water heaters account for about 13 percent of the energy Americans use in the home, according to the U.S. Department of Energy, which recommends lowering water heater thermostats at 120 degrees Fahrenheit. Washing clothes in cold water and installing low-flow shower heads can also help save energy. In the Southwest, heating water with the sun alone can work with a passive solar system. In summer, even conventional water heaters can be turned off if they're located in the outdoor sun.

**Reset the thermostat.** Turn down the thermostat in the winter and turn it up in summer. The comfort range would encompass setting the thermostat at 68 degrees or below in winter and 72 degrees or above in summer. Another idea is to heat or cool only the inhabited areas of the house by closing heating/cooling vents to rooms that are not currently in use. Fans can generate a cooling breeze while using less energy than air-conditioners or swamp coolers.

**Reconsider the swamp cooler.** Swamp coolers are typically two to four times more energy-friendly and thus economical than air-conditioners. Also, the

Emissions add up household by household, car by car, person by person. Thus, individual actions to conserve energy and reduce greenhouse gas emissions can make a difference in how much the temperature rises. This is especially true for Americans, who collectively produce about 23 percent of the world's greenhouse gas emissions from fossil fuels in a typical year, according to the 2006 International Energy Outlook published by the U.S. Department of Energy.

Fortunately, saving energy often means saving money. Fossil fuel emissions come from the burning of gas, oil, and coal to run cars, power homes and businesses, and heat and cool buildings. In Arizona, about 80 percent of emissions come about evenly from two main sources: electricity use and transportation. With that in mind, here are some ideas culled from various sources about how to apply this understanding for greater savings.

evaporative cooling of the air they treat can also cool the local environment, whereas air-conditioners cool the inside air by warming up the outside air. Swamp coolers generally do use more water, however. On an annual basis, swamp coolers account for up to 5 percent of a southwestern household's annual water use, according to a 2004 Southwest Energy Efficiency Project report ([www.swenergy.org/pubs/](http://www.swenergy.org/pubs/)). Both swamp coolers and air-conditioners increase water demand indirectly, because it takes water to generate electricity. To make a swamp cooler as water- and energy-efficient as possible, switch off the water pump in the evenings, and the cooler fans will move cool air through the house without using any water. Better yet, set it and forget it — thermostats are inexpensive and make operating swamp coolers a breeze.

**Let plants help out.** Plants help by taking up carbon dioxide, a major greenhouse gas, while moderating local temperatures through their own form of evaporative cooling. Taller species like trees can provide shade, perhaps even reducing home cooling costs if planted in the right location. By

*continued next page*

harvesting rainwater and recycling household “graywater” from bathtubs and washing machines, homeowners can create a cooler landscape featuring native plants without increasing their water bills.

**Get off junk mail lists.** The junk mail Americans receive every day uses about 1.5 trees per household, or up to 100 million trees a year, according to the Earthworks Group’s 1990 publication, *50 Simple Things You Can Do to Save the Earth*. The group recommends getting off junk mail lists by filling out a form at the Direct Marketing Association: [www.dmaconsumers.org/offmailinglist.html](http://www.dmaconsumers.org/offmailinglist.html). For \$1, which is payable online or through the mail, a person can be removed from many mailing lists for five years.

**Heat with sustainable wood chips.** Forest management practices can reduce the risk that a southwestern wildfire will reach into the treetops, which releases more carbon and kills more trees than a surface fire. Thinning out some trees can reduce the odds that a surface fire will explode into crown fires in some southwestern forests. The wood from trees thinned out of forests can heat homes, schools, and businesses or provide electricity when burned. The Show Low-based Forest Energy Corporation converts the small trees thinned out of Arizona’s White Mountain forests into high-energy pellets that burn clean enough to use even on smog-alert days.

**Buy energy credits** For about \$20 a month, the average American can buy enough renewable energy credits to account for their individual greenhouse gas emissions, according to the Cool It! campaign, a carbon offset project run by a coalition of four groups including the Sierra Club. NativeEnergy, a majority tribally owned company, runs a similar campaign to support the construction of new tribally owned renewable energy projects. In both cases, contributions provide crucial funding that tips the scales in favor of renewable energy, such as solar and wind-powered electrical plants. Carbon credits remain controversial, in part because there’s a risk of overcounting benefits. (The companies tend to give the offset purchaser full credit for any renewable energy generated; presumably the other parties paying the majority of the electrical cost also deserve some credit for using alternative energy.) But it doesn’t hurt to support renewable energy along with taking other steps.

For more ideas, see the Earthworks Group’s publication *50 Simple Things You Can Do to Save the Earth*. Although it was originally published in 1990, the small book and other related publications by the Berkeley, California-based group remain relevant. Another helpful book is *You Can Prevent Global Warming (and Save Money): 51 Easy Ways* by Jeffrey Langholz and Kelly Turner (2003, Andrew McMeel Publishing). A variety of websites also feature energy-saving ideas and suggestions to reduce greenhouse gases, including several supported by U.S. Department of Energy programs. Forest Energy Corporation’s website is [www.forestenergy.com/](http://www.forestenergy.com/). The Southwest Energy Efficiency Project report on new evaporative cooling systems is available at [www.swenergy.org](http://www.swenergy.org).

*Melanie Lenart, Ph.D., is a research associate with the University of Arizona Institute for the Study of Planet Earth (ISPE). The list and sources mentioned here do not imply policy recommendations or product endorsements by ISPE.*

Milky Way courtesy National Science Foundation.

## Under the Stars

by Michael S. Smith

On a pleasantly cool and quiet night, we parked under a mesquite tree in the high grasslands of southeast Arizona. We were well off the highway, the only sound being the occasional chirp of a nighthawk high overhead. Only a glow on the horizon showed us the lights of Tucson, Sierra Vista and Nogales. It was astronomical twilight, the Sun having set well north of Mt. Wrightson in the Santa Rita Mountains an hour earlier.

We were going to sleep under the stars.

I’m an amateur astronomer and own two telescopes, but there are times it is better to view through my 1X eyes. With no difficulty, I saw all the dim constellations of spring — Corona Borealis, Hercules, Libra, Serpens Caput, Corvus, Hydra, Crater, and even Lupus, far to the south. The constellations looked the way they were supposed to, not washed out by artificial lighting. The sky was full of stars, and when I lay down, I felt as if I were in a large bowl. I really was, and I felt part of the universe. Not many Americans have ever been under a truly dark sky.

Around 10, a large cloud appeared in the east. At least, it looked like a cloud. But it had been clear with no chance of rain. I’ve camped in plenty of places where I went to bed under a clear sky and awoke with rain on my face. But out here, if it is clear in the evening, it will be clear in the morning. We looked at the cloud a little more carefully. Yes, it was a cloud, but it wasn’t a few miles up in the atmosphere. It was a few hundred trillion miles away.

We were seeing the Milky Way rise.

How many of us today ever see the Milky Way, our island home in the universe? How many have ever seen the stars the way they are supposed to be seen — in darkness? The stars are as much our heritage as is the Grand Canyon, the black bear, the old growth forests, the Sky Islands surrounding us and water that can be drunk, unfiltered, from a lake. As long as we have that heritage, we connect to our forebears. And if we lose that heritage, what do we have left as a people?

I pondered all that as I watched the galaxy rise, saw Vega and Altair appear, and remembered Tanabata, that delightful Japanese holiday in July where people learn about the star crossed lovers that were separated by the river that astronomers call The Great Rift. Stars have meant something to people for thousands of years. The stories are different, the meaning changes, but mankind has always found significance among the stars.

We dozed for a while, awakening later in the night when the waning gibbous Moon rose over the Whetstones, a day from last quarter. We don’t often see this phenomenon because we don’t spend whole nights out among the stars. It’s worth doing. The Moon appeared flat on top and was orange, a consequence of the horizon haze allowing more red to be seen than usual.

But I didn’t think about atmospheric refraction and dust particles scattering light. I just looked. We saw the summer constellations — Scorpius, Ophiuchus, Serpens Cauda, Sagittarius, Corona Australis — dimmed by moonlight as the grasslands around us lit up with the glow. Neither of us said much, and when we spoke, we whispered. Physically, it seems impossible for sound to affect vision, yet loud talk or loud music does damage views, because we don’t just see, we experience, and the two are interlinked. We could have viewed the same stars from the highway, but it wouldn’t have been the same. The quiet seemed to make the stars and the Moon appear closer.

We awoke several times that night, each time noting the change in the Moon and watching new stars rise and old ones set as our Earth slowly turned. Morning twilight awoke us for good, and we watched the eastern sky gradually brighten and the Earth’s shadow slowly disappear into the western horizon. I can see the Earth’s shadow every evening and every morning from Tucson, but out there the shadow was far more impressive.

In my “must things to do” during my lifetime, sleeping under the stars was one of the earliest ones to get checked off. Occasionally, I still do it. Many times in Sky Island country, I’ve experienced the “outdoor triad,” wilderness, dark skies and total silence. On first glance it doesn’t appear to make much sense, but I think that by getting away from people in the outdoors and being alone with the stars I feel more connected to humanity.

# STUDY: Native Fish Conservation and Climate Variability in Southeastern Arizona

From an extended abstract by Douglas K. Duncan and Gregg M. Garfin

The conservation of native fish in southeastern Arizona has always been reliant on finding water that isn't "used," or that is not constrained by conflicts that make sites unavailable. Examples of conflicts that may render a site unsuitable or unusable for native fish are: sport fisheries; low-quality effluent; nonindigenous fish; and landowner, lessee, or permittee resistance.

In addition to conflicts listed above, the multiple impacts flowing from other human activities in southeastern Arizona also impact waters. Another issue impacting waters for native fish conservation is that other rare aquatic species in southeastern Arizona also need many of these waters. Some fish species are not compatible with other aquatic species in some sites. Climate variability, including drought, and climate change both have the potential to alter sites for conservation of native fishes in southeastern Arizona.

Here we consider southeastern Arizona that area east of the Tohono O'odham Nation and the lower-most (north) Santa Cruz River, and south of the Gila River. This area includes parts of the Rio Concepcion, Santa Cruz River, San Pedro River, Rio Yaqui, and Gila River Basins.

Depending on how they are included, split, or lumped, there are 21 species of native fish in southeastern Arizona. Of those 21 species, 16 still occur in the area, four are extirpated, and one is extinct. There are 13 species listed under the Endangered Species Act; nine are listed as endangered, four as threatened, and an additional species has been petitioned for listing.

There are a multitude of issues facing native fish in the study area. Threats that have been factors in the listing of fish and continue today include the standard litany: nonindigenous species, species' habitat loss, and reduction in habitat quality. Habitat destruction and the introduction of nonindigenous species are responsible for the decline of 98 percent of North American fishes listed as endangered, threatened, or of special concern (Williams et al. 1985). Impacts to habitat and impacts from nonindigenous species do not occur independently. Degradation of aquatic systems is a major factor in the invasion, establishment, and irruption of nonindigenous species (Aquatic Nuisance Species Task Force 1994).

Though the discussion here centers on native fish, it is likely that negative impacts could also occur to other native aquatic vertebrates. There are three native ranid frogs (*Rana* spp.) and a native salamander (*Ambystoma tigrinum stebbensi*) in southeastern Arizona. There are also several garter snakes (*Thamnophis* spp.). All are of conservation concern. The single greatest difference in how impacts to aquatic systems will impact native fish or herpetofauna, is that the herpetofauna are far more mobile than fish and at least have the potential to move between aquatic systems.

That southeastern Arizona and much of the American Southwest are in drought is well known. What is known with far less certainty is how long this drought might last. The predictions regarding how long the present drought might last was once discussed in terms of which phase of the Pacific Decadal Oscillation (PDO) was occurring. However, the relationship of the PDO to drought in our area is now less certain. One thing that is certain: historical climate records tell us that once a drought as severe as the present one exists, it is likely to continue for decades.

The information on how climate change might impact southeastern Arizona is less certain than current drought predictions. However, virtually all climate change scenarios predict that the American Southwest will get warmer during the 21st century (IPCC 2001). Precipitation predictions show a greater range of possibilities, depending on the model and emissions scenario (USGCRP 2001). To maintain the present water balance with warmer temperatures and all other biotic and abiotic factors constant, precipitation will need to increase to keep pace with the increased evaporation and transpiration caused by warmer temperatures. Key projections to keep in mind include:

Decreased snowpack — an increasing fraction of winter precipitation could fall as rain instead of snow, periods of snowpack accumulation could be shorter, and snowpacks could be smaller; ironically, due to changes in snow-precipitation characteristics, runoff may decrease even if total precipitation increases (Garfin, 2005);

Earlier snowmelt — increased minimum winter and spring temperatures could melt snowpacks sooner, causing peak water flows to occur that much sooner than the historical spring and summer peak flows (Stewart et al., 2004);

Enhanced hydrologic cycle — in a warmer world an enhanced hydrologic cycle is expected; flood extremes could be more common causing more large floods; droughts may be more intense, frequent, and longer-lasting.

Continuing drought and climate change, when added to the historical and continuing threats, will make native fish conservation in southeastern Arizona even more difficult. The impact to fish of site desiccation is obvious. There are many less obvious effects that could occur with drought and a warmer climate. A site with reduced streamflow, or a pond or pool with low water levels could become fishless due to reduced dissolved oxygen. We have seen this occur at three important natural Gila topminnow (*P. occidentalis*) sites (i.e. Sharp Spring, Redrock Canyon, Cienega Creek).

Drought and climate change will also impact watersheds and subsequently the water bodies in those watersheds. Drought, and especially long-term climate change will impact how ecosystems and watersheds function. These changes will cause a cascade of



Redrock Canyon, Cott Tank drainage, Patagonia Mountains courtesy Doug Duncan, USFWS.

ecosystem changes, which may be hard to predict and are likely to occur non-linearly.

As an example, drought and climate change will cause changes in fire regimes in all southeastern Arizona vegetation communities. The timing, frequency, extent, and destructiveness of wildfires is likely to increase and may also facilitate the invasion and increase of nonindigenous plants. These changed fire regimes will change vegetation communities, the hydrological cycle, and nutrient cycling in affected watersheds (Brown et al. 2004). Some regional analyses conservatively predict that acreage burned annually will double with climate change (MacKenzie et al. 2004). Such watershed impacts could cause enhanced scouring and sediment deposition, more extreme flooding (quicker and higher peak flows), and changes to water quality. Severe watershed impacts such as these, when added to reductions in extant aquatic habitats, will severely restrict sites available for the conservation of native fish and other aquatic vertebrates and make management of extant sites more difficult.

Many of the predictions about the impacts of climate change are based on modeling, but many predictions have already occurred. The tree die-offs and fires that have occurred in the Southwest early in this century show the impacts of the current drought.

The potential impacts from climate change and drought need to be addressed, while considering the potential duration of and uncertainty of their effects. The precautionary principle should be adhered to when planning for native fish conservation. While there may not necessarily be solutions to the problems presented by drought and climate change, there are things that can be done to minimize the impacts to native fishes and increase the resilience of fish habitat in southeastern Arizona.

After the fires of 2005, the Arizona Game and Fish Department and U.S. Fish and Wildlife Service began drafting a salvage protocol for native fish. This

*continued next page*

# Native Fish and Climate Change *continued*

protocol should be expanded to include any impacts to native fish, such as drought and climate change, invasion of nonindigenous species, and release of environmental contaminants.

We recommend the following actions:

- Natural resource managers should be informed about climate change;
- Constructive dialogue regarding native fish conservation needs and drought and climate change should occur now;
- Conservation planning should address climate change through adaptive management provisions;
- Important fish populations should be replicated across the landscape when possible;
- Important fish populations should be replicated in refuge populations;
- Genetic information will be crucial to determine important populations;
- Natural resource and land management agencies should begin work on identifying and creating potential refuge sites.

Regular and systematic monitoring of important aquatic sites and fish populations, and expanded monitoring programs are essential to enhancing drought preparedness for fish conservation. Also, research focused on specific impacts of climate change in southeastern Arizona would be incredibly useful to managers. Lastly, the uncertainty surrounding the timing and impacts of climate change requires flexibility and the need for adaptive management. Agencies do not have a good track record of effectively implementing adaptive management, but the conservation of native fish and other aquatic vertebrates requires it.

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\*Editor's apology: These references are in an abbreviated form.



Doug Duncan is a U.S. Fish & Wildlife Service biologist based in Tucson and Gregg Garfin is project manager for the Climate Assessment for the Southwest (CLIMAS) project at the University of Arizona.

## STUDY: Pygmy Owl Declining in Northern Mexico

### *Results reinforce need to protect Sonoran Desert pygmy owls under U.S. Endangered Species Act*

*From a press release based on a report by UA Senior Research Specialist Aaron Flesch*

Cactus ferruginous pygmy owl populations in northern Sonora, Mexico, have declined over the last seven years, according to a study released this past February by University of Arizona biologist Aaron Flesch. In 1997 pygmy owls in Arizona were listed as endangered by the U.S. Fish & Wildlife Service, yet despite conservation concerns driven by recent declines in Arizona, pygmy owls were removed from the endangered species list in 2006 for reasons unrelated to recovery. Flesch's findings run counter to assertions that pygmy owls are abundant across the border. Conservation groups had challenged this decision in court and have petitioned the U.S. Fish & Wildlife Service to list species as endangered.

"The pygmy owl's declining status in Mexico, combined with very small numbers in Arizona, shows clearly that the species should have continued to be protected under the Endangered Species Act," said Noah Greenwald, conservation biologist with the Center for Biological Diversity.

The study found that pygmy owls in northern Sonora have declined an average of 4.4 percent per year, or 26 percent overall since the year 2000, and concluded that "should this apparent decline continue, recovery strategies that rely on pygmy owls from northern Sonora and persistence of pygmy owls in the Sonoran Desert could be jeopardized."

"The status of the pygmy owl is clearly more precarious now than ever before," said Jenny Neeley, southwest representative of Defenders of Wildlife. "Without appropriate protections, the very existence of the pygmy owl in the region is in grave doubt."

Declines of pygmy owls were more severe in regions of northern Sonora with greater intensity of human land use, such as woodcutting and agricultural development. Evidence also suggests that nest success and other reproductive parameters were lower following winters with low rainfall.

Recent findings by the National Research Council indicate that drought in the Southwest may become more common due to global warming, raising a red flag.

"The combination of habitat destruction and global warming may be the nail in the coffin for the cactus ferruginous pygmy owl in the Sonoran Desert," said Greenwald. "The Bush administration's willingness to let the pygmy owl go extinct in Arizona is characteristic of its contempt for the nation's endangered species."



Cactus ferruginous pygmy owl courtesy Sky Jacobs.

Although ferruginous pygmy owls are found throughout much of lowland Mexico, recent genetic studies suggest a unique subspecies occurs in Arizona, Sonora and Sinaloa. Within this subspecies, U.S. Fish and Wildlife Service biologists have identified the Sonoran Desert population of pygmy owls as discrete population segment that could be listed under the Endangered Species Act. Combined with surveys of recently occupied sites in Arizona, Flesch's study indicates that the Sonoran Desert population of pygmy owls is declining on both sides of the international border.

"It is irresponsible to do anything other than take aggressive action to protect these amazing owls," said Sandy Bahr, conservation outreach director for the Sierra Club's Grand Canyon Chapter. "This research confirms that. We would all like to see the pygmy owls continue to inhabit and enrich the Sonoran Desert."

Although the study was released in February of 2007, monitoring continues at least for now. According to Flesch, abundance and territory occupancy in 2007 remained low and were roughly equivalent to that found in 2006. "However," he continues, "nest success rebounded from a near 5-year low in 2006 to levels that were among the highest I have observed. This observation combined with good monsoonal rain suggests the potential for high fledgling survival during summer 2007, which if combined with good conditions in winter 2007-08, could contribute to above average recruitment and increases in abundance and territory occupancy in 2008." Monitoring in 2008 depends on funding which has not yet been secured. Population monitoring in Sonora has been supported by federal and state governments and NGOs. In 2007, monitoring was sponsored by Defenders of Wildlife, T&E Inc., and the Center for Biological Diversity.

For questions about this study, contact Aaron Flesch at [flesch@ag.arizona.edu](mailto:flesch@ag.arizona.edu). To learn more about how the conservation organizations cited above are working to protect this species, contact Matt Clark (Defenders of Wildlife) at 520.623.9653, Noah Greenwald (Center for Biological Diversity) at 503.484.7495, Sandy Bahr (Sierra Club-Grand Canyon Chapter) at 602.253.8633, or Christina McVie (Tucson Audubon Society) at 520.622.5622.

# Wildlife linkages and climate change: ALIEN PLANET

by Janice Przybyl, SIA Wildlife Linkages Program

Conservation biologists have long viewed diminishing habitat and the loss of connectivity between habitat patches as the biggest threat to biological diversity on our planet. Our modern age — with its rabid population growth and the accompanying staggering spread of urban infrastructure — is precipitating rapid wildlife habitat degradation and fragmentation.

Conservation strategies that incorporate wildlife linkages can increase species' persistence and maintain biological diversity by facilitating movement between remaining habitat fragments. Wildlife corridors increase the probability that a given species or set of species will endure in an isolated habitat patch and in the overall region.

Species depend on landscape connectivity to meet an array of ecological needs: for daily movements to acquire resources such as food and water; for seasonal movements; for natal dispersal which promotes genetic exchange; for mate finding; for adjusting to environmental fluctuations such as drought; and for long-term species' persistence in response to global climate change.

In the scientific literature, "response to global climate change" has occupied that last slot on the list — almost as an afterthought. But now, more and more focus and research has been placed on how species will survive impending climatic changes. Mitigating

impacts from global climate change is becoming one of the driving motivations for maintaining landscape connectivity. The rationale stipulates that by maintaining a network of habitat patches interconnected by movement corridors, whole assemblages of flora and fauna can shift their geographic distributions along latitudinal or altitudinal gradients.

For example, as temperatures rise at the lower elevations of Sky Island deserts and grasslands, species will shift up-mountain to suitable climates or move northward. Will oak/woodland be found a thousand feet higher on some Sky Islands? Will Saguaro cacti guard the rim of the Grand Canyon as the Sonoran desert shifts? Will coatis range into the Rockies of Colorado?

Unfortunately, these scenarios are overly simplistic and underestimate the scale of ecological disruption due to climate change. Species evolve in the context of complex ecological interrelationships with other plants and animals. Ecosystems are dynamic conglomerates of biotic and abiotic (nonliving) components. The latter includes variables such as weather patterns, geology, topography, and soil type. An ecosystem can not translocate as a distinct unit and with all variables remaining intact.

Climate models created by Williams, *et al.*, predict that novel combinations of precipitation, temperature, seasonal variations, along with other variables, may create new climates that never before existed on Earth. The result may be a shuffling of species and the formation of new ecosystems as some species move up the latitudinal or elevation ladder, but others species stay put. Further analysis shows that, not only do new climates appear, but existing climates will disappear. Alpine species are at higher risk of extinction as suitable habitats vaporize from mountaintops.

If landscape connectivity is to succeed as a conservation strategy, movement corridors must link species to appropriate and viable habitats. However, in an era of rapidly morphing or vanishing ecosystems, linking suitable habitats may become implausible. If the rate of climate change is as rapid as current models postulate, species may lack the ability to migrate quickly enough to survive. Furthermore, when Williams's team tightened the parameters of their model, they discovered that existing climates could vanish off 14% to 84% of the earth's terrestrial surface. There may not be anywhere for species to go.

Does this mean that we dispense with the notion of wildlife linkages as a conservation tool? Definitely not.

We need to be cognizant that the dynamics of climate change may bring us a planet we did not imagine nor thought would arrive so soon. In any scenario of global climate change, the survival of Sky Island plant and animal species depends on their ability to move across the landscape in response to shifting or changing habitats. Down the mountain, up the mountain, across the river, we must ensure safe passage.

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Art from herondance.org

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- \$500 provides: **Digital camera purchase, setup and checkup\*** and 4 sets of photos (6 months)

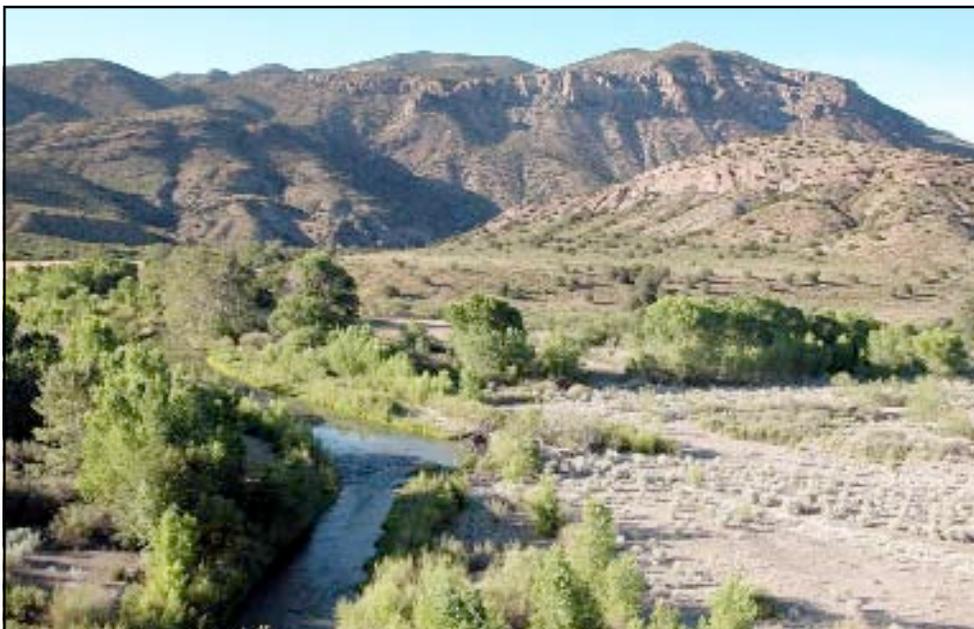
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\* Camera purchase, setup and checkups are conducted by Sky Island Alliance. All photos will retain Sky Island Alliance's copyright.



## Flowing into the Future

3RD ANNUAL  
Gila River Festival  
September 13–16, 2007  
Silver City & Gila Cliff  
Dwellings, New Mexico

[www.gilaconservation.org](http://www.gilaconservation.org)  
505.538.8078

Photo courtesy Nanda Currant.

As the last free-flowing river in New Mexico, the undammed Gila River vibrates with the pulses of seasonal fluctuations. These seasonal fluctuations — drought and flood — are what drive the diversity of life along its banks: more than 300 species of birds, several threatened and endangered species, and one of the most intact native fish communities in existence in the Lower Colorado River drainage.

This weekend celebration focus is on increasing the awareness of the natural and cultural history of the Gila River through talks, walks, stewardship projects and puppet theater. This year's event will also feature an evening campfire program with community storytellers, a star party, and an opportunity for families to camp at the river's headwaters. The theme for this year's festival, "Flowing Into the Future," emphasizes the role of flooding in maintaining the natural integrity of the river, and the cyclical nature to which the people living alongside it continue to adapt.

## Landscape Restoration Field Schedule:

Summer to  
Fall 2007

**17–19 August.** Peloncillo Mountains Riparian Inventory. Visit the beautiful and remote Peloncillos in a project to assess restoration potential of historic ciénegas and degraded streams. 3.5 hours from Tucson. Must RSVP and be able to leave Tucson at noon Friday.

**31 August–3 September.** Labor Day in the Chiricahua Mountains. Join the Sky Island Alliance as we revisit a favorite haunt! We will be hiking and having fun! Cool weather, slow cooking, hot fires and good friends! 2.5 hours from Tucson.

**14–16 September.** Huachuca Mountains Restoration Weekend. Come out and help revegetate a restoration area, search for a rare snake, and have fun in these amazing mountains! 2 hours from Tucson.

**5–6 October.** Sky Islands Inventory Weekend. We will be out there someplace doing what we do best — collecting data on the roads, illegal ATV trails, campsites, and other human impacts.

**13 October!** Volunteer and Supporter Appreciation Party! Mark it in your calendar and stay tuned for more information!

**26–28 October.** Tumacacori Highlands Wilderness Inventory Weekend. Join us we celebrate Wilderness and look at the wilderness boundary for the proposed Tumacacori Highlands Wilderness. 2 hours from Tucson.

**9–11 November.** Road Closure and Restoration Weekend. Help to close old roads and restore roadbeds and natural drainage! Within 3 hours of Tucson.

**30 November–2 December.** Peloncillo Mountains Riparian Restoration. Get yourself muddy and help us erect one-rock dams to protect a ciénega watershed! Must RSVP and be able to leave Tucson at noon Friday.

**14–16 December.** Road Closure and Restoration Weekend. Get your hands dirty and play a direct role in improving the ecological health of your public lands! Within 3 hours of Tucson.

Contact Trevor at [trevor@skyislandalliance.org](mailto:trevor@skyislandalliance.org) or 520 624-7080 x14.



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## WILDERNESS T-SHIRTS!!

"Wilderness has virtue  
unto itself and needs no  
extraneous justification."  
— E. O. Wilson



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- See pictures on our website at: [www.TumacacoriWild.org](http://www.TumacacoriWild.org)

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Quantity	Size
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_____	XL
_____	L
_____	M
_____	S

### Women's cut

Quantity	Size
_____	XL
_____	L
_____	M
_____	S
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More Sizes!



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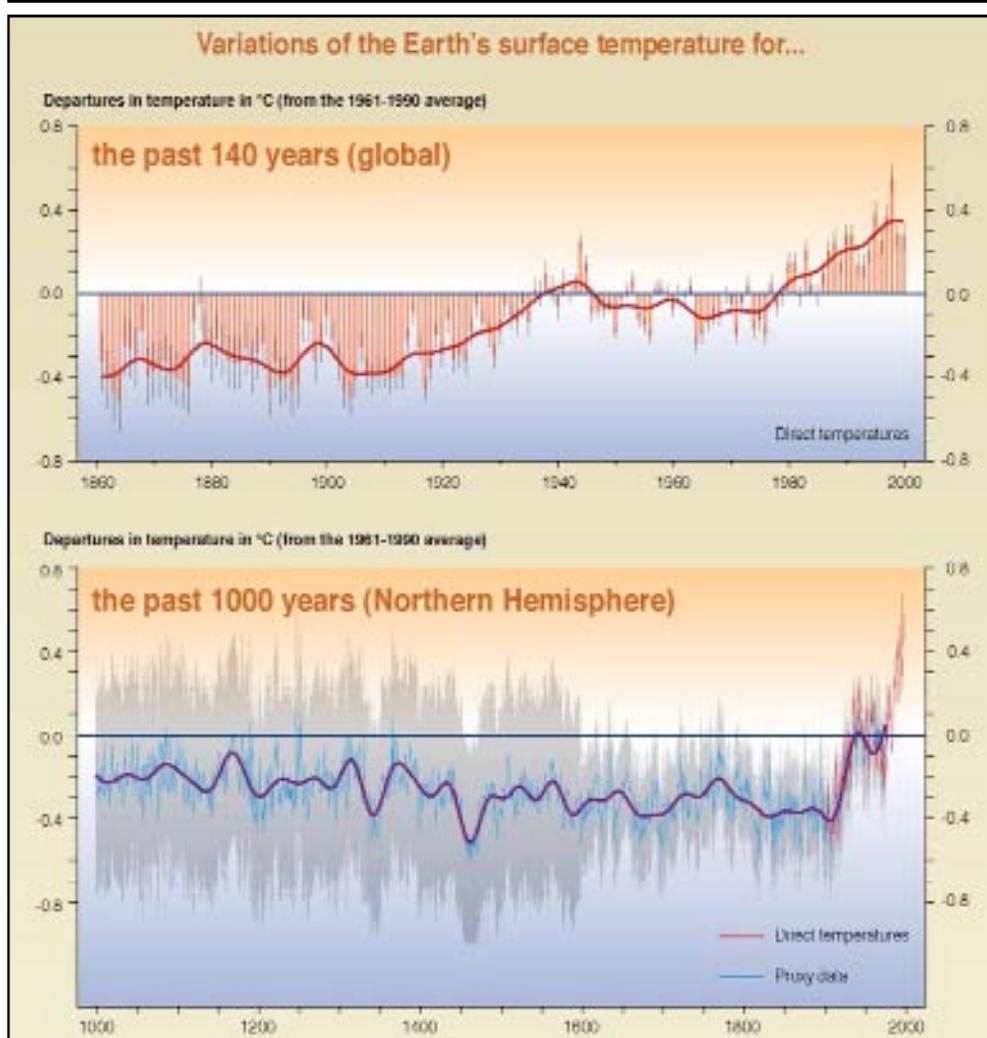


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## “Some impacts are already clear...”



Charts courtesy Intergovernmental Panel on Climate Change.

...They can be seen on Mt. Graham, with the near-elimination of the spruce-fir community there. We can anticipate loss in the near future of the Mt. Graham red squirrel, and possibly the long-tailed vole. At the same time, we've seen recent northward movement of Mexican opossum, yellow-nosed cotton rat, and possibly others.

The mountain-top communities are not the only ones at risk. Many grassland species depend on both a certain climate and relatively deep soils (not just plants — think kangaroo rat burrows). Thus they cannot shift up in elevation along steep mountain slopes. Grasslands are predicted to experience greater shrub encroachment, leading to declines in pronghorn and many bird species.

Our streams and rivers, already degraded, stand to suffer from both the declining precipitation and increased evaporation due to warming.

The desert is predicted to have grass encroachment, which brings a changed fire regime. This suggests the ultimate loss of saguaros and other desert shrubs and trees which cannot live with regular fire.

It may also be worth noting that the region has experienced dramatic changes in the past. Pollen cores from the Pleistocene Lake Cochise, now called Willcox Playa, show that it was surrounded by pine, spruce, and fir...

— Dale Turner, Conservation Planner  
The Nature Conservancy in Arizona