

Bringing landscapes to the forefront at BLM

Alison Gillespie

In November 2010, US Interior Secretary Ken Salazar announced a new directorate for the National Landscape Conservation System (NLCS). Yet, despite the sweeping policy change, almost no one noticed – perhaps because, generally speaking, most people have never heard of the NLCS.

“This is the largest, least-known land system in the US”, admits Brian O’Donnell, Executive Director of the Conservation Lands Foundation (Durango, CO), which works to protect, restore, and expand the NLCS – a system comprising more than 10 million hectares of land administered by the federal Bureau of Land Management (BLM). Some people are familiar with a few of its sites, such as the National Monuments at Grand Staircase Escalante in Utah and Craters of the Moon in Idaho, but as a huge conglomeration of National Monuments, Conservation Areas, Wilderness Areas, and Wild and Scenic Rivers and Trails, the NLCS remains largely unknown.

Regardless of its low profile, the NLCS boasts some of the nation’s most unique landscape features, which explains why Salazar’s announcement was celebrated by so many environmental groups. “It’s really an important step in making this system thrive”, O’Donnell says. Salazar, he explains, has elevated the status of the NLCS and established a new directorate and a renewed emphasis on science and conservation. “I like to think of [NLCS] lands as the third leg of the US conservation system”, says Kevin Mack, from The Wilderness Society (Washington, DC). The other two legs, the National Park Service and the National Wildlife Refuge System, do a great job of showcasing remarkable locations to tourists. The NLCS, in



Missouri Breaks, a beautiful river landscape in Montana, forms part of the NLCS.

contrast, is what he calls a “self-willed experience” for anyone that tries to visit. By way of example, Mack begins to rhapsodize about the Missouri Breaks, a beautiful and remote river landscape that was once traversed by Lewis and Clark. Visitors who travel to the middle of Montana, where the Upper Missouri River Breaks National Monument (UMRBNM) is located, won’t find a large visitor center, accessible roads, or interpretive trail signs. Nothing here makes the visitor’s stay easy, which is typical of other sites in the NLCS.

Although that may discourage the average vacationing family in a minivan, it is ideal for those who want to conduct large-scale ecosystem research or long-term data collection in environmentally sensitive areas. “[The UMRBNM] is one of the last remaining ‘wild’ places, and you rarely see people”, says geologist Ray Rogers (Macalester College, St Paul, MN), who has been doing research there since 1990. “It’s an amazing kind of natural laboratory.”

“Many of these lands were designated for their scientific, ecological, cultural, or paleontological values”, according to Marietta Eaton, Science Coordinator for the NLCS (Washington, DC). “We want to understand [these lands] more clearly.” Assigned to facilitate science research within the system, Eaton also hosts a webpage devoted to marketing such

opportunities to scientists, which might surprise some who more often associate the BLM with grazing permits and minerals management.

Nevertheless, parts of the NLCS can prove daunting and dangerous, even to the most trail-hardened field scientist. Ironwood National Monument, for example, sits near the Mexican border in southern Arizona, where some of the most remote and biodiverse parts of the Sonoran Desert form a backdrop for the trafficking of illegal drugs and immigrants, making both science and stewardship especially challenging. “We only go out in groups, and the dangers are not just from things like snake bites or cactus needles”, says Lahsha Brown, from the Friends of Ironwood Forest (Tucson, AZ). Nevertheless, her organization has been able to tackle some tough restoration projects, including the removal of invasive buffelgrass (*Pennisetum ciliare*) from steep cliff sides. Other locations have proven to be security challenges of a different sort, as cultural treasures have been stolen for profit and damaged by vandalism. Just last November, graffiti, which officials say will cost more than \$10,000 to remove, was sprayed across ancient Native American rock art in the Red Rocks Canyon National Conservation Area in Nevada.

While the BLM hopes to encourage more volunteer stewardship at each of the NLCS locations, Brown is optimistic that the changes brought about by Salazar’s new directorate will eventually also translate into improved security, perhaps through increased funding and attention to such on-the-ground land-management problems. Even without more money, however, Brown says she’s already pleased to see a new enthusiasm among agency staff who had never before embraced a conservation mission at the BLM. Although initially created by then Secretary of the Interior Bruce Babbitt in 2000, the NLCS was mostly ignored during the George W Bush administration. “This is a 10-year-old system that feels like it’s in its second year”, Brown says. “You can see a new sparkle in the eyes of those working on it now.” ■

Himalayan glaciers, debris cover, and climate change

Jane Bradbury

New research suggests that debris cover – layers of pebbles and rocks more than a few centimeters thick – may be an important factor in the response of Himalayan alpine glaciers to climate change. “People have been talking about the effect of debris cover on glacial melting for a long time”, notes researcher Bodo Bookhagen (University of California Santa Barbara, CA), “but its effect throughout the Himalayas has not been investigated. Many Himalayan glaciers have a thick debris cover, which shields the ice from melting; our study shows that, because of variations in debris cover, Himalayan glaciers are not responding uniformly to climate change”.

Scientists often rely on measurements of retreats and advances as indicators of glacial responses to climate change but, for their study, Bookhagen and his colleagues used NASA satellite images – collected between 2000 and 2008 – to calculate the velocity of



Debris on a Himalayan glacial tongue.

more than 250 Himalayan glaciers. They then used the same images to map the debris-covered areas of those glaciers (*Nat Geosci* 2011; doi:10.1038/NGEO1068).

Overall, more than 65% of the glaciers examined by the researchers were retreating. However, in the Karakoram, where glaciers tend to be debris covered, 58% of the glaciers were stable or slowly advancing; in the western Himalaya and other regions where the proportion of debris-covered glaciers is relatively low, 79–86% of the glaciers were retreating. These results, says Bookhagen, emphasize the importance of looking at as many glaciers as possible when investigating the effects of climate

change. But, he warns, “satellite-based observations must always be validated by field observations”.

“This research is unique”, comments glacial hydrologist Eric Mattson (Nipissing University, North Bay, Canada), “in that a comparison of change of extent between debris-free and debris-covered glaciers situated in differing environments throughout the Trans-Himalaya has never been undertaken before. The implications of this research are actually positive. They indicate that debris-covered glaciers are responding to climatic change slower than debris-free glaciers, which means that [the former] will survive for longer.”

“What these researchers have done is valuable and recognizes the diversity of contexts in the High Asian cryosphere”, agrees glaciologist Kenneth Hewitt (Wilfrid Laurier University, Waterloo, Canada). But, he cautions, “although debris cover may be important for long-term ice storage and for local ecological and mountain community needs, it may be a relatively unimportant factor in terms of glacier health, dynamics, and climate response”. ■

Winter temperatures and spring budburst

Noreen Parks

An intricate interplay between cold and warm winter temperatures strongly determines the timing of spring budburst in Douglas-fir (*Pseudotsuga menziesii*) trees in North America, according to scientists with the US Forest Service Pacific Northwest Research Station (Portland, OR). Their research, reported in the December 2010 station publication *Science Findings*, sparked the development of a novel model that could help forest managers predict plant response to future climate conditions.

Botanists have long recognized that perennial temperate species need exposure to “chilling” winter temperatures, along with adequate warming, to trigger spring growth. As winters and springs have recently become warmer in mid-latitude regions of the

Northern Hemisphere, budburst in many species has taken place earlier in the year. “The timing of budburst is crucial, because if it occurs prematurely, subsequent frosts may kill new growth. And if it is much delayed, summer drought may reduce growth”, says research forester Connie Harrington (US Forest Service, Pacific Northwest Research Station).

To investigate the timing phenomenon, Harrington and colleagues conducted experiments that simulated a range of winter conditions for seedlings of more than 100 genetic varieties of western Douglas-fir. “We found that seedlings exposed to fewer hours of optimal chilling temperatures need more hours of warmth to satisfy their genetically determined budburst requirements, whereas with many hours of chilling, they required less warming time”, Harrington explains. The studies revealed that the plants respond to *both* warming

and chilling throughout winter and spring, rather than simply going dormant in the fall and then “waking up” the following spring.

The study data, along with research findings for other species, gave rise to a mathematical model, which indicated that many possible combinations of wintertime temperatures can initiate budburst. One implication, Harrington notes, is that “while moderately warmer winters will continue to trigger earlier budburst, much warmer winters could reverse this trend and eventually result in either later budburst than has occurred historically or even no budburst at all”.

The new paradigm may well apply to many plants with chilling requirements, the researchers believe, so planting non-local varieties of plants better adapted to a locale’s changing temperatures may be a viable management response to climate change. ■

Agave for biofuel

Mike Faden

As worldwide biofuel demand grows, there's increasing interest in *Agave* species, which could potentially be grown for biofuel with minimal environmental impact in semiarid regions that cannot support other crops. "One of the most interesting things about *Agave* as a potential biofuel feedstock is that *Agave* species have been grown commercially in many parts of the world for fiber – but these plantations were then abandoned due to the decline of the natural fiber market", explains Sarah Davis, bioenergy feedstocks analyst at the University of Illinois at Urbana-Champaign (Urbana, IL). These abandoned plantations could be reused to grow *Agave* for biofuel. "We really need biofuel options that don't require additional

land conversion to agriculture", Davis continues.

The area occupied by these plantations, formerly used to grow species such as sisal (*A sisalana*) and *A fourcroydes*, is considerable. According to UN Food and Agriculture Organization statistics, there is an opportunity to reinstate *Agave* agriculture on about 0.6 million hectares in Mexico, Africa, and elsewhere, Davis notes in a recent review (*Glob Change Biol Bioenergy* 2011; doi:10.1111/j.1757-1707.2010.01077.x).

Another *Agave* species, *A tequilana*, is used to make tequila in Mexico. Due to overproduction, farmers are currently suffering from reduced demand and falling prices. Only the sugar-rich stem bases are used to make tequila; the residues from this process, as well as other parts of the plant, could be used to produce

ethanol for biofuel, increasing the income from an existing crop.

Agave species can be highly productive, even in semiarid regions, because, like cacti, these succulents photosynthesize using the crassulacean acid metabolism pathway, which minimizes water loss. "*Agave* can grow in places where many food crops can't, which reduces potential competition with food crops", Davis says. Annual yields of commonly cultivated species can reach about 26 megagrams per hectare, even without irrigation – higher than yields from intensively managed corn crops in the US.

Still, Davis admits, more research is needed to determine the best *Agave* species for use as a biofuel. There are about 200 species, and the few that have been widely cultivated may not necessarily possess the best traits for biofuel production. ■

Haiti's highland forest frogs refound

Adrian Burton

In Haiti, there has been little to celebrate since the earthquake of January 2010, and for most Haitians the rediscovery of six forest frogs – nearly all unseen for 20 years – will bring scant relief. However, their finding provides hope that the nation's heavily degraded natural environment is not entirely doomed, and that if protected it might still be able to provide ecosystem services the country will need as it rebuilds.

The rediscovered frogs – the Hispaniolan ventriloquial frog (*Eleutherodactylus dolomedes*), Mozart's frog (*E amadeus*), the La Hotte glanded frog (*E glandulifer*), the Macaya breast-spot frog (*E thorectes*), the Hispaniolan crowned frog (*E corona*), all last seen in 1991, and the Macaya burrowing frog (*E parapelates*), last observed in 1996 – were recorded by scientists working with Conservation International and the Amphibian Specialist Group of the International Union for the Conservation of Nature during an



Macaya burrowing frog (*E parapelates*), hanging on in southern Haiti's highland rainforests.

expedition to the mountains of southern Haiti.

"Haiti has some of the worst deforestation problems in the world; only about 2% of its rainforests remain", says Robin Moore (Conservation International, Arlington, VA). "And with deforestation comes the loss of forest wildlife and other problems. We set out to determine the status of Haiti's 49 native amphibians, and to search for the long-unseen La Selle frog. We didn't find it, but we did find 25 other species, including these six species, which haven't been seen for years. Although the health of Haiti's frogs is nobody's primary concern today, these discoveries are important.

Healthy forests are essential for Haitians' livelihoods, food security, and fresh water. Our findings suggest that those remaining can still guarantee some of these services, if cared for."

Given Haiti's dire habitat loss, 10 critically endangered frog species are now being raised in captivity, in a collaboration between Pennsylvania State University (PSU), the Philadelphia Zoo, and the Audubon Society of Haiti. "These [species] could be reintroduced if the forests' health improves", explains Blair Hedges (PSU, University Park, PA).

Similar breeding projects are underway to save Central America's frogs from chytrid-based disease. "However, Central America has much more rainforest to return its frogs to", says Markus Gusset (Conservation Officer, World Association of Zoos and Aquariums, Gland, Switzerland). "In Haiti, these forests are at huge risk from continued woodcutting, despite being in national parks. If it doesn't stop, these Haitian frogs may have no home to return to. It's in the long-term interest of Haiti's people and frogs to protect these forests." ■

Is climate change imperiling pikas?

Virginia Gewin

Using records from 1898 to 2008, researchers have charted the changing distribution of the American pika (*Ochotona princeps*) within the Great Basin, the 200 000-square-mile region between the Sierra Nevada and Rocky Mountain ranges in the western US. Their findings (*Global Change Biol* 2011; doi:10.1111/j.1365-2486.2010.02389.x) indicate that four of 10 extirpations have occurred since 1999 and that the species' low-elevation boundary in this ecoregion is moving upslope at an average of 145 m per decade. "This habitat has not changed much physically for several decades; climate appears to be the game changer – responsible for quickening the pace and altering drivers of extinction in these areas after 1999", according to ecologist Erik Beever, now at the US Geological Survey (Bozeman, MT).

Pikas, small mammals that live in loose rock in mountainous areas throughout western North America, have become a poster child for cli-



The pika's (*Ochotona princeps*) distribution is being altered as a result of climate change.

mate change because of their sensitivity to both extreme heat and cold. Yet pikas were declined protection under the Endangered Species Act by the US Fish and Wildlife Service in February 2010 because enough suitable high-elevation habitat may exist to ensure their survival. To better understand the mechanisms driving local pika extinctions, Beever and colleagues identified 25 sites in the Great Basin with historical pika records and revisited those sites, documenting pika dynamics and quantifying thermal stress.

Connie Millar, an ecologist with the US Forest Service (Albany, CA),

agrees this is one of the most comprehensive studies designed to parse out the impact of climate on pikas. But while these sites offer interesting comparisons over time, she says many are atypical of "classic" pika habitat. Though Millar points out that the Great Basin is a marginal portion of the pika's broad western North American range, Beever maintains the region is important to study precisely because it represents the margins of their distribution – areas that can tell us the most about what factors determine a species' niche.

Shaye Wolf, Climate Science Director at the Center for Biological Diversity (Tucson, AZ), says the findings support their efforts to get the pika added to the federal endangered species list because of climate-change threats. However, Millar continues, "I don't think this is enough work to reopen the case for the whole species, but it does open up questions of viability and vulnerability in Great Basin populations – questions that should be addressed by, for example, seeing if the same trend holds true at a different set of sites in the region". ■

Tiny larvae signal big potential for MPAs

Pete Mooreside

Until recently, the long-distance dispersal of marine fish larvae from spawning sites within marine protected areas (MPAs) to unprotected regions had never been documented. Considering the sea's immensity relative to the minute size of larvae, it's easy to understand why evidence for such connectivity would be hard to come by. However, by relying on a novel technique combining genetic analyses and Bayesian statistics, scientists identified a handful of parent-offspring pairs of fish at protected and unprotected coral reefs off the Island of Hawaii (*PLoS ONE* 2010; doi:10.1371/journal.pone.0015715).

Marine biologist Mark Christie (Oregon State University, Corvallis, OR) and colleagues studied populations of the herbivorous yellow tang

(*Zebrasoma flavescens*) – a charismatic reef dweller that tends to stay close to home after post-larval settlement, usually not venturing farther than a kilometer. The yellow tang also happens to have a price on its head; this species alone is responsible for over \$1 million of the Big Island's annual commercial harvest of live fish destined for the saltwater aquarium trade. Given the potential for over-collection, several fishing-prohibited MPAs were established to help promote juvenile tang survival and thus better ensure the fishery's long-term viability. But did reefs within MPAs actually serve as population sources, effectively "seeding" nearby regions – protected or otherwise – with larvae?

After collecting fin tissue samples from >1000 unique adults and juveniles at nine reefs around the island, Christie and his team extracted DNA, determined genotypes, and performed probability analyses. The

nearly indisputable confirmation of four parent-offspring pairs, separated from one another by distances ranging from 15 to 184 km, was surprising in light of the study's relatively small sample size. "In any large population, it's challenging to directly document dispersal events. But to identify offspring that traveled over 180 kilometers as miniscule larvae, that was truly remarkable", says Christie. Furthermore, all offspring were discovered to the north of their parents, a finding that coincided with satellite observations of an oceanic eddy generating substantial northward currents. Overall, according to Christie, the study "demonstrates that MPAs can successfully seed areas at considerable distances outside of their borders, indicating that well-designed MPA networks may be useful not only for conservation purposes, but also for successful management of commercially exploited species". ■

US lowballs CO₂ damage costs

Janet Pelley

As the US Congress continues to resist capping greenhouse-gas emissions, a new measure of harm is grabbing attention. The “social cost of carbon” (SCC) has been pegged by the US Government at \$21 per ton of CO₂ emitted. But the true cost could be nearly three times that amount, according to a recent analysis by the Natural Resources Defense Council (NRDC).

Meeting secretly in 2009, federal officials used models that project future trends in climate change and economic growth to estimate the SCC, according to Frank Ackerman, an economist at Tufts University (Medford, MA). The SCC measures the detrimental effects stemming from CO₂ emissions – such as famine, illness, ecosystem decline, and property loss – in monetary terms.

“The discount rate is a critical

parameter that can radically change the SCC”, says Laurie Johnson, an economist with NRDC (Washington, DC). “Economists use discounts to compare values at different points in time – you’d probably prefer to have \$100 in 10 years [when it will be worth less]”, Ackerman explains. In climate policy, economists assume that \$1 spent today to prevent emissions is equal to only pennies in future benefits. This difference in current and future values is the discount rate. A high discount rate gives a low value to future benefits, while a low discount rate suggests that future benefits are worth more.

The federal experts used a discount rate of 3% to calculate the SCC. However, US Environmental Protection Agency guidelines recommend a discount rate of 1–3%, Johnson continues. When she ran the Government’s models with a discount rate of 2%, the SCC was \$62 per ton of CO₂. Johnson recom-

mends a discount rate of 1.4%, yielding an SCC of more than \$122 per ton of CO₂, because it puts greater value on the lives of future generations and is therefore more ethical. In fact, “many have argued that we need to use a discount rate close to zero in order to put a reasonable value on the lives of our future descendants”, adds Ackerman.

In the absence of an emissions cap, the SCC – when used in regulatory impact analyses – is a powerful means of revealing the economic benefits of cutting pollution, Johnson says. The SCC was used to calculate the benefits of lower CO₂ emissions arising from the new, more stringent fuel-efficiency standards for cars, Ackerman notes. “Our results suggest that regulatory impact analyses using the Government’s limited range of SCC estimates could substantially understate potential benefits of climate mitigation”, Johnson concludes. ■

World forest report offers hopeful, yet mixed results

Johanna Polsenberg

Released at the February 2011 launch of the International Year of Forests, the Food and Agriculture Organization (FAO) of the United Nations’ *State of the World’s Forests* report (www.fao.org/docrep/013/i2000e/i2000e00.htm) documents that forest cover expanded in China, Vietnam, the Philippines, and India between 2000–2010.

Speaking at a press conference, Eduardo Rojas-Briales, Assistant Director General of the FAO Forestry Department (Rome, Italy), reported that “China has increased its forest cover by 3 million hectares per year – no country has ever done anything like this before; it’s an enormous contribution”. According to the FAO, the overall rate of deforestation – though alarmingly high globally – has slowed. “As for forest-cover data”, Rojas-Briales continued, “from the 1990s to the past

decade, net deforestation decreased by 37%”.

“China is dominating the report’s outcome”, comments John O Niles, Director of the Tropical Forest Group (San Diego, CA). “It has done some amazing things, largely banning deforestation and [demonstrating] that rates of forest loss can be slowed. To a great extent, China was motivated by soil erosion and the recognition that the devastating Yangtze River floods in 1998 were due to deforestation”. Niles cautions, however, that the Chinese “are taking a very engineered approach, planting only a few species and using genetically modified trees. Furthermore, the numbers need to be looked at in context. China has essentially exported their impact to other countries”.

Over the past 10 years, continued forest losses were documented in Africa, South America, and Oceania, while Europe and North America showed little change. “In Africa, the problems are

strongly linked to poverty and population growth”, Rojas-Briales continued. “But the results for most of Latin America are disappointing; although the economic and social situation there is comparable to that in East Asia, it seems most of Latin America hasn’t taken advantage of the opportunities East Asia did to put in place strong land-use policies during the shift to urbanization and away from subsistence farming.” Niles stresses, however, that “Brazil’s rate of deforestation is way down, to some of the lowest levels since measurements started 40 years ago, which many view as one of the most important ecological developments of our time”.

“What we need during the International Year of Forests is to emphasize the connection between people and forests, and the benefits that can accrue when forests are managed by local people in sustainable and innovative ways”, concludes Rojas-Briales. ■