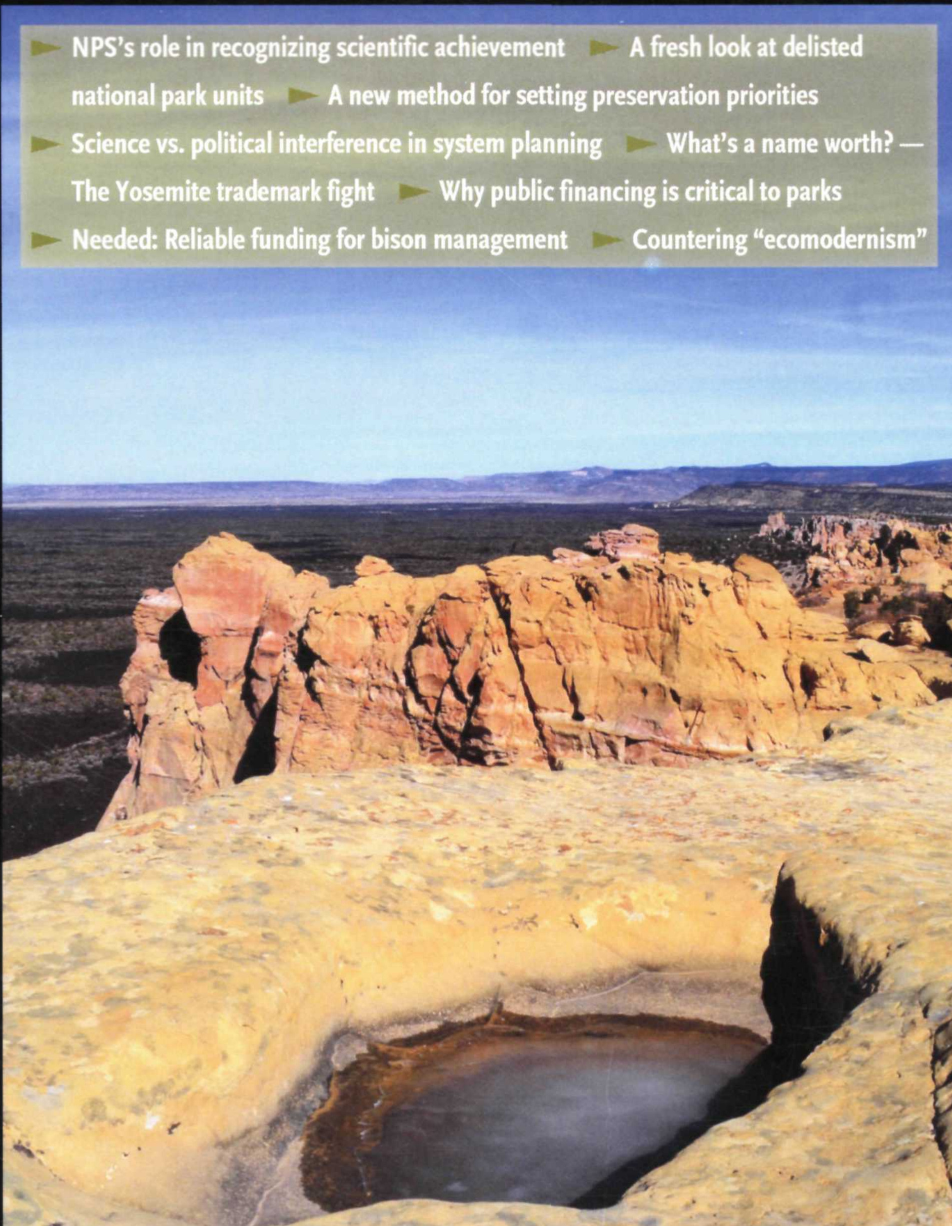

The George Wright Forum

The GWS Journal of Parks, Protected Areas & Cultural Sites
volume 33 number 1 • 2016

GEORGE
WRIGHT
SOCIETY

Mission

The George Wright Society promotes protected area stewardship by bringing practitioners together to share their expertise.

Our Goal

The Society strives to be the premier organization connecting people, places, knowledge, and ideas to foster excellence in natural and cultural resource management, research, protection, and interpretation in parks and equivalent reserves.

ISSN 0732-4715. Editorial and manuscript submission guidelines may be found at www.georgewright.org/forum. Text paper is made of 50% recycled fibers. Printed by Book Concern Printers, Hancock, Michigan.

The George Wright Society is a member of IUCN (International Union for Conservation of Nature) and US/ICOMOS (International Council on Monuments and Sites—U.S. Committee).

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(contents continued overleaf)

On the cover: Big Thicket National Preserve in Texas is one of a number of sites that was recommended for inclusion in the national park system by theme studies done under the auspices of a little-known 1972 plan called *Part Two of the National Park System Plan: Natural History*. See the article by Craig L. Shafer in this issue. Photo by Larry Rana, US Department of Agriculture.

SOCIETY NEWS, NOTES & MAIL

Call for nominations, 2016 GWS Board of Directors election

Each year, two seats on the Board of Directors come up for election. This year, the seats are held by David Parsons and Barrett Kennedy, both of whom are reaching the end of their second three-year term on the Board and are therefore unable to run again. We are now accepting nominations of GWS members who would like run for these open seats. The term of office runs from January 1, 2017, through December 31, 2019. Nominations are open through July 1, 2016.

The nomination procedure is as follows: members nominate candidates for possible inclusion on the ballot by sending the candidate's name to the Board's nominating committee. The committee then, in its discretion, determines the composition of the ballot from the field of potential candidates. Among the criteria the nominating committee considers when determining which potential candidates to include on the ballot are his/her skills and experience (and how those might complement the skills and experience of current Board members), the goal of adding to and/or maintaining the diversity on the Board, and the goal of maintaining a balance between various resource perspectives on the Board. It also is possible for members to place candidates directly on the ballot through petition; for details, contact the GWS office.

To be eligible, both the nominator and the potential candidate must be GWS members in good standing (it is permissible to nominate one's self). Potential candidates must be willing to travel to in-person Board meetings, which usually occur once a year; take part in Board conference calls, which occur several times per year; help prepare for and carry out the biennial conferences; and serve on Board committees and do other work associated with the Society. Travel costs and per diem to the annual Board meeting are paid for by the Society; otherwise there is no remuneration.

To propose someone for possible candidacy, send his or her name and complete contact details to: Nominating Committee, George Wright Society, P.O. Box 65, Hancock, MI 49930-0065 USA, or via email to info@georgewright.org. All potential candidates will be contacted by the nominating committee to get background information before the final ballot is determined. Again, the deadline for nominations is July 1, 2016.

GWS2015 Proceedings published; GWS2017 Call for Proposals coming shortly

In April we published *Engagement, Education, and Expectations: The Future of Parks and Protected Areas,* the Proceedings of the 2015 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites." Edited by Samantha Weber, it's a 203-page volume containing 49 papers from the conference last year in Oakland. It is published as an e-book in PDF format. The entire volume is available to download as a single file, or you can download individual papers, at no charge.

www.georgewright.org/proceedings2015

There is no hard-copy version (although of course you can print all or part of it as you wish). The book is copyrighted by the GWS, but you can share the contents freely so long as the purpose is non-commercial.

Now, please mark your calendars for the next GWS Conference. We will be meeting April 2–7, 2017, at the Norfolk Marriott Waterside in Norfolk, Virginia. GWS2017 will continue a series of meetings, extending back more than 30 years, where people gather to do some critical thinking about the future of parks, protected areas, and cultural sites. Make plans to join us! GWS members will automatically receive a Conference Announcement and Call for Proposals from us toward the end of June.

Latest Park Break paper explores park's social science research needs

The latest addition to our Park Break Perspectives series was published in March. "Great Sand Dunes National Park and Preserve: A Social Science Needs Assessment" is co-authored by Kaitlin Burroughs, North Carolina State University; Janae Davis, University of South Carolina; Tian Guo, North Carolina State University; Peter J. Mkumbo, Clemson University; Ojetunde Ojewola, University of Missouri; Aleksandra N. Pitt, Colorado State University; Robert Powell, Clemson University; Ryan Sharp, Kansas State University; Geoffrey Riungu, Clemson University; and Rose I. Verbos, University of Utah.

The paper originated in a Park Break session held in October 2015 hosted by the National Park Service Social Science Program and Great Sand Dunes. This session, the first-ever Park Break to focus on social science, filled a gap in the park's knowledge base by identifying management topics to which social science research could contribute. Through analysis of interviews with park staff and focus groups with community stakeholders, the Park Break team identified research needs in three areas: park visitors and experiences; relevance, diversity, and inclusion; and natural resources.

You can download the paper at **www.georgewright.org/perspectives.**

The series is a set of web-based research papers and essays produced by graduate students who have taken part on the GWS's Park Break program. The papers were developed in consultation with faculty members, park scientists, and other park professionals. Park Break Perspectives offers fresh looks at perennial and emerging issues through the eyes of up-and-coming scholars—the next generation of park leaders.

Worth and Value in 21st-Century Parks: The Critical Role of Public Financing

Duncan Morrow

The fundamental difference between the American model of the "public park or pleasuring ground" from its European antecedent, the royal hunting preserve, lies in the simple fact that access is not limited to the privileged.

It should be our lasting goal to keep it that way, even as we provide for the perpetuation of these special places that collectively represent the national heritage of a great nation.

When any significant share of our populace thinks the value of the Malheur National Wildlife Refuge lies in what we can personally consume, rather than what can broaden our lives and represent the diversity of our inheritance, we have exposed these people too little, not too much.

Our national refuges and national forests have different missions from that of the national parks, yet our missions complement one another. It is essential to remember that if our refuges and our forests are in jeopardy, our parks soon will follow. It really is a divide-and-conquer strategy.

This is my view of how and why those parks should be sustained. It has implications for other land managers, too, even as it addresses the worth and worthiness of parks.

The parks shoulder competing worries: Park funding is nowhere near matching park needs. Meanwhile, the profile of public users fails to match that of the American public itself.

The George Wright Forum, vol. 33, no. 1 pp. 5–9 (2016).

ISSN 0732-4715. Please direct all permissions requests to info@georgewright.org.

The parks see too few of the youth, the minorities and, yes, the immigrants in our midst. They are the core of the future tax base of America—the ones who can benefit from parks today and provide benefit to parks tomorrow.

I believe in public largesse; donors large and small who give of time, tools, money, and property are wonderful. Realistically, however, voluntary support is notoriously unstable. Personal priorities change as the givers encounter competing needs. A giver dies and her heirs may not care about her cause. His beloved cousin develops cancer and he redirects his giving to oncology research. Parks need reliable, continuing support. Congress, alone, has the power to make that happen.

To a lesser extent, I believe in a user-pays model that encourages those who most directly benefit to shoulder a disproportionate share of direct management costs. Ultimately, however, I believe no prospective park visitor should be turned away because of costs—and rising fees have a concurrently rising tendency to deflect more and more of the public, especially those we already underserve. Cost has no place as a barrier to access or appreciation.

That model does belong with the special services—lodging, restaurants, boat ramps, horse rides—that are useful, yet not part of the core value and experience of a park. Stephen Mather himself saw that government could not, and should not, compete with private business models for such services and facilities. Concession services were born of that vision.

We wring our hands over a visiting population that does not reflect the youth and diversity of America. We can excuse some of the imbalance simply because young Americans of any background have more pressures on their time and money. They're busy working two jobs—per household and often per person—paying off student loans, raising families, keeping roofs overhead and more on budgets that are likely smaller than those of the people who have more experience and more free time.

But fees have a pernicious impact on that smaller income of a budding career. They impose an additional barrier on precisely those who can best learn from the values parks represent—those who can use parks to strengthen their identity as equal participants in a uniquely shared partnership with their government.

Fees speak. They say parks belong to those who can pay—if you can't afford it, it isn't for you.

The irony, of course, is that the fees we do charge cannot touch the needs we have. They simulate the worth of a commodity without supporting the costs of an experience.

Total entrance and users fee revenues across our national park system account for a small share of the Park Service's total budget. We're trading a sliver of park operating budgets so that we can exclude the people who stand to learn the most from them.

Never has America been more in need of her parks. Our schools are raising their emphasis on science, technology, engineering, and mathematics (STEM) curricula and testing. Meanwhile, old-fashioned history, art appreciation, even physical education fall aside as our youth lose connection with the continuum of contemplation and consideration, human history and governance.

Our parks are ideal classrooms and laboratories for teaching the glorious, untidy progress of our people, their management, and their values. I'm old enough to remember civics classes. Our parks have become the civics classrooms of the 21st century. Civics is the foundation of an active, informed populace. Our citizenry deserves those lessons.

Access, unfettered, is our opportunity to expose our own people to the genius of Thomas Edison, the determination of César Chávez, the courage of Lewis and Clark, the steadfastness of homesteaders, the compassion of Emma Lazarus, the vision of John Muir, and the commitment of warriors in service to our freedoms.

Entry, without barriers, opens the vistas of great mountain parks, the pounding waters of our seashores, the lush landscapes of the Everglades, the silent expanse of the Mojave, and the stunning geology of places as disparate as Wind Cave, Craters of the Moon, and Canyonlands—each with an earned place in the growth and development of a system that treasures the many faces of our human and natural history.

Fees alienate our citizenry from their legacy.

They limit who can benefit by experiencing firsthand the natural and historical heritage that make America unique. Fees are a minimal barrier to most who reach remote Yellowstone or the great parks of Alaska, but the majority of our park areas actually lie within easy reach of urban populations, for whom an admission fee must often be balanced against child-care costs or household expenses. Even the remote parks have neighbors—neighbors who too often cannot see for themselves the memorable features and lasting lessons that can be found within.

The touchstones of America we save and share make our parks transcend ephemeral visits to theme parks, movie houses, or baseball games. Their mere existence inspires even those who may never climb Denali, hike the Appalachian Trail, visit the Statue of Liberty, or ponder the meaning of war while walking a historic battleground.

Vanderbilt Mansion, Manzanar, and Antietam each teach. Remote Devils Postpile and Isle Royale instruct in ways that parallel the lessons of the accessible Mount Rainier and Delaware Water Gap.

Fees sufficient to maintain parks at a reasonable base standard only work when large visitor numbers are coupled with high fees. The attractive values of most parks are too subtle to attract both. Worthy? Unquestionably. Exciting? Parks are not for an adrenaline rush, even though some will give that, too.

Even the most spectacular and popular parks, Yosemite and Great Smoky Mountains, for example, might be able to approach self-supporting income, but these are not compact amusement parks where the marginally fit can reach every attractive or edifying feature with a short walk or a tram ride, where $80 brings a family a day or two of non-stop fun, where the interaction is driven by mercantile management, not a drive for exposure to a heritage or a thirst for learning about a legacy.

Parks are not commodities to be bought by those who can afford the experience. In 1837, when landscape artist George Catlin first proposed the idea of a grand public park, a concept was born that would take flower in our earliest parks in the latter half of the 19th century. We recognized as a nation that certain places exemplified grandeur and others embraced unmatched natural assets of biology and geology.

Our drive to set aside hallowed battlegrounds and places associated with our most revered leaders evolved into an effort to represent the broad scope of American history through physical pieces maintained for successive generations who had not lived those experiences, but could call them up at the places we chose to represent the multiple realities of a many-faceted history.

The inventory, I might add, does not yet fully reflect the most notable of those facets. The legacy is incomplete. Each day, we re-assess the meaning and value of aspects of the forces that shaped our land and her people. I expect that job will never be complete.

I would extend to interpretive programs the same freedom from price that I would grant the parks themselves. It is through those programs that we open the park resource to the public's understanding. Moreover, interpretation shifts the experience itself from voyeurism to participation—precisely the interaction so craved by our electronic generation.

A nation that finds resources to prop up governments in some places and chop them down in others also has the resources to better protect and present this sampling of what makes the United States special among the community of nations.

We can afford it. We have been choosing, politically, not to do so.

The impulse to preserve the best places is fully appropriate, no matter how shabbily our government chooses to treat them—and it is Congress that holds the purse strings. Not only do the parks not get what they need, they are restricted and directed on how to use what they get. Shabby is unjust for the best of America.

The park deficits are huge when compared to a single household budget, of course. But we could fully fund every shortfall, every unmet need, without denting any of our government's largest programs. The question is not "Can we do it?" The question is "When will we do it?"

Park history is littered with fits and starts at providing necessary support. We had the CCC of the 1930s to thank for much essential infrastructure. Mission 66 let us regain our footing in the years following World War II and Korea. The centennial of the Civil War, bicentennial of America's revolution, key anniversaries of parks like Yellowstone and the Statue of Liberty have spurred selective investment. It's time to commit ourselves to making our parks whole, then keeping them that way for the public they serve—and honor.

We don't pay for access to our right to vote and we shouldn't pay for access to our right to understand. That some may decline makes that access no less important for those who accept.

Simple citizenship makes us stakeholders in the special places that have been set aside as the exemplars and benchmarks of a great country.

Don't sell our parks—whole or by increments.

Save our parks for our people. Let them in. Let them learn. Let them return. For free!

Over a 41-year career with the National Park Service, all of it in the Washington office, **Duncan Morrow** spent 28 years talking to reporters and another 13 in which speech-writing was his primary duty. He worked with 12 of the 18 directors the Park Service has ever had, and knew well two of those who left before his career began. His job mostly meant articulating official and personal views of others; here, he has the pleasure of speaking for himself.

Letter from Woodstock

Rolf Diamant

What's In a Name? A Lot More than Money

It has been an uneven beginning for the centennial of the National Park Service (NPS). The year started with a "find your adventure" Rose Bowl parade that was reported to be all about the 2016 centennial, but wasn't. Then there was the distressing news coming out of eastern Oregon about the occupation of the Malheur National Wildlife Refuge. As much as we might choose not to think about it, it could have just as well have been a national park headquarters that was seized—John Day Fossil Beds National Monument is only a few hours away. And lest we dismiss the occupiers as an isolated fringe group of armed extremists, many, more mainstream, conservative think tanks, commentators, and legislators unfortunately echo their rhetoric advocating local takeover of federal public lands. We don't have to look further than the pages of *The George Wright Forum*, where invited centennial essayist Holly Fretwell of the Property and Environment Research Center recently called for the franchising of some national parks.[1]

Another unwelcome distraction from the 2016 centennial has come from Yosemite National Park and an unusual tug of war over trademarks associated with a new concessions contract and the disgruntled outgoing concessioner, Delaware North Corporation (DNC). I'll focus much of this 13th Letter from Woodstock on one particularly disquieting consequence—the unfortunate renaming of many of Yosemite's most iconic places. This story starts with a dispute between DNC and NPS over the monetary value of DNC's "intangible property" that includes customer databases, website names, and, most importantly, trademarks. DNC began quietly building up its cache of Yosemite trademarks, registered with the United

The George Wright Forum, vol. 33, no. 1, pp. 10–14 (2016).

ISSN 0732-4715. Please direct all permissions requests to info@georgewright.org.

States Patent and Trade Office (USPTO) including those of iconic hotels and recreation areas (many listed on the National Register for Historic Places) such as "The Ahwahnee," "Wawona," "Yosemite Lodge," "Badger Pass," and "Curry Village." Though there are concession-operated visitor facilities at all these places, the locations are part of the national park and owned by the United States. It can only be inferred that all this trademarking activity was intended to discourage competition for a concessions contract worth an estimated $2 billion.

Having failed at this stratagem—a new 15-year concessions contract has been awarded to a rival concession company, Aramark—DNC was determined at least to make NPS and Aramark pay dearly, suing NPS and asking approximately $44 million from Aramark for continued use of these trademarked names. (Curiously, DNC was still trying to register Yosemite trademarks as late as last September, three months after the new concessions contract had been awarded.) NPS, on the other hand, pegs the worth of the trademarks at only $1.6 million, a small fraction of the asking amount. Responding to DNC's lawsuit, NPS argues that the value of each name is overwhelmingly associated with Yosemite National Park rather than a concession and has petitioned USPTO to reverse itself and cancel the trademarks. Furthermore, according to NPS, DNC's "improper and wildly inflated valuation" of the trademarks demonstrates a lack of "good faith and fair dealing"— and constitutes a material breach of DNC's original contract—therefore voiding any requirement for the new concessioner to acquire DNC's trademarks.

As this issue moves towards adjudication in the US Court of Federal Claims, it has also become a *cause célèbre* in the court of public opinion. People have been howling with indignation that these well-known Yosemite place names are not held in the public domain and are quite possibly at risk of being permanently lost. An opinion piece in the *Washington Post* calls the trademarks "a weird kind of 'cultural appropriation.'"[2] Much of this popular condemnation, including on-line petitions, has so far been directed at DNC.

Legal arguments aside, this does, however, beg the question: why did previous concession agreements not specifically address this thorny question of intellectual property and establish an intentional process for retiring or transferring these trademarks to the government? This point has commentators on intellectual property issues scratching their heads. "The National Park Service would be well served exercising some basic due diligence from time to time," suggests David Lizerbram, "like any large entity should, and monitor the USPTO for filings related to their valuable brand names."[3] (Interestingly, there was due diligence at Great Smoky Mountains National Park, where NPS trademarked the name of the iconic LeConte Lodge five years ago and now licenses the mark to its concessioner.) "By failing to restrict the concessioner's right to file for registration or even outline an intellectual property approval process in its contracts with vendors," Rachel Schwartz and Carla Sereny conclude that Yosemite Park "effectively buried its head in the sand and engendered the current trademark dispute."[4]

"This could only happen," sums up columnist Jeff Jardine, writing in the *Modesto Bee*, "because the park service got sloppy and failed to secure name ownership when it had the chance."[5]

Dan Rogers, however, in a post entitled “Selling Yosemite,” suggests there is another injured party in this dispute—the most important party of all—the public. “Regardless of whether the National Park Service is to blame for entering a contract that failed to protect Yosemite’s intellectual property or Delaware North is guilty of corporate greed,” writes Rogers, “for anyone whose breath has been taken away by El Capitan or felt the mist of Nevada Falls on a hot summer day, their heart is breaking….”[6] Public heartbreak was further exacerbated when NPS made the startling announcement that all the contested names would be renamed. This decision was purportedly made “to ensure a smooth transition for Yosemite visitors” when Aramark took over, rebuffing an offer by DNC for continued free use of the trademarks pending resolution of the case in court. To add insult to injury, the new names are for the most part distressingly lame. When asked who came up with the names, Yosemite park spokesperson Scott Gediman admits in an interview with the *Fresno Bee*, “it was the attorneys, mostly.”

In his commentary, Dan Rogers questions “the short-term benefit of renaming *The Ahwahnee* the ‘Majestic Yosemite Hotel’ or in booking summer reservations at the ‘Big Trees Lodge’ instead of the *Wawona* hotel.” In Rogers’s view, “the rebranding feels cheap, as if a treasure is being converted into a theme park.” According to environmental author Kenneth Brower, son of David Brower, several long time Yosemite observers have even suggested that this might be intentional. In their view, writes Brower in a National Geographic essay, “conversion of the lyrical ‘Ahwahnee’ into the comically portentous ‘Majestic Yosemite Hotel’ can only be calculated to offend.”[7] Whether or not this is the case, the renaming appears to be an attempt by NPS and its lawyers to embarrass DNC, undermine the value of the trademarks and maneuver their way around a painfully difficult contractual problem, in part of their own making. The renaming, however, may have deeper and more lasting costs than just putting up new signs. Regardless of intent, the changes are profoundly disconcerting. When these names change, writes Dan Rogers “so too does our perception of the Valley itself. The innocence and hope that Yosemite represents, that so many have worked so hard to preserve, is lost forever.”

This letter is difficult for me to write, as I believe that overall the NPS concessions program is highly professional, well managed and has made great strides in recent years encouraging park concessioners to more closely align their practices and services with NPS environmental goals. Instead of celebrating this accomplishment as part of the centennial, we find ourselves distracted by this unexpected custody battle. In the long run a reasonable agreement may yet be reached. I have a sinking feeling, however, that government lawyers, NPS, and Aramark ultimately may be content to live with these unfortunate new names if they have to, and are preparing the public to begrudgingly accept that outcome as well. One indication of this will be whether Yosemite National Park actually trademarks its new nomenclature. Perhaps, by the time this column comes out, or in the foreseeable future, this all may be a mute point if there is indeed a favorable judgment or a settlement is reached that restores the cherished historic names.

We can only hope.

I want to conclude this letter on a more upbeat centennial-related note, looking to an event much closer to home. The Vermont House of Representatives recently designated a day to honor the National Park Service centennial and invited NPS representatives and their partners from across the state to be recognized on the floor of the statehouse. Many Americans may not associate a small northeastern state like Vermont with an active NPS presence. The House resolution celebrates not only the centennial and the state's two national parks, Marsh-Billings-Rockefeller National Historical Park and Appalachian National Scenic Trail—but also recognizes NPS assistance with the Lake Champlain National Heritage Partnership, Missisquoi and Trout National Wild and Scenic Rivers, and more than 60 RTCA[8] community based recreation projects. The resolution also cites Vermont's 18 national historic landmarks, 12 national natural landmarks, 800 National Register properties, tens of millions of dollars in Land and Water Conservation Fund and Historic Preservation Fund grants awarded Vermont cities and towns and hundreds of millions of dollars in private historic preservation investments through the Historic Preservation Tax Credit Program—all administered by NPS.

Addressing colleagues on the floor of the House, Representative Alison Clarkson pointed out "Park Service programs reach into every corner of our state, helping preserve and protect natural and cultural resources and recreational opportunities for all Vermonters." Clarkson further noted that the statehouse itself is one of Vermont's earliest national historic landmarks, "so all of us have a hand in the preservation mission of the National Park Service."

The resolution was adopted by unanimous consent, and NPS representatives and partners seated behind the House Speaker's podium were asked to rise for a sustained standing ovation by legislators.

No single event could have better illustrated the often elusive promise of "One NPS."[9] This is exactly what I had in mind when I said in a previous letter that the national park

The National Park Service centennial was recognized recently in the Vermont House of Representatives. Photos courtesy of NPS.

system will truly function as a system, “when we recognize it, promote it, and use it to its full potential.”[10]

Endnotes

1. Holly Fretwell, “The NPS Franchise: A Better Way to Protect Our Heritage,” *The George Wright Forum,* vol. 32, no. 2 (2015), pp. 114–122.
2. Online at https://www.washingtonpost.com/news/volokh-conspiracy/wp/2016/02/01/a-sad-little-trademark-tale-with-a-dash-of-cultural-appropriation-thrown-in-for-good-measure/.
3. Online at http://lizerbramlaw.com/2016/01/26/about-the-national-park-service-yosemite-lawsuit/.
4. Online at http://www.insidecounsel.com/2016/03/09/the-battle-for-yosemite-national-parks-marks-lesso.
5. Online at http://www.modbee.com/news/local/news-columns-blogs/jeff-jardine/article55364745.html.
6. Online at http://www.yosemiteip.com/blog/?author=5115997be4b0b8b2ffe1d5e4.
7. Online at http://news.nationalgeographic.com/2016/01/160125-yosemite-names-ahwahnee-wawona-national-park/.
8. Projects were undertaken in partnership with NPS’s Rivers, Trails, and Conservation Assistance (RTCA) Program.
9. The “One NPS” principle focuses on engaging the entire NPS in coordinated conservation, education, economic, and recreation efforts. See the NPS Urban Agenda, online at http://www.nps.gov/subjects/urban/activate-one-nps.htm.
10. Rolf Diamant, “When Will We Really Have a System of National Parks?”, *The George Wright Forum,* vol. 31, no. 3 (2014), pp. 236–239.

❦ The Heart of the Matter

New essential reading on parks, protected areas, and cultural sites

***Keeping the Wild: Against the Domestication of Earth (2014),* and *Protecting the Wild: Parks and Wilderness, the Foundation for Conservation (2015),* both edited by George Wuerthner, Eileen Crist, and Tom Butler. Washington, DC: Island Press.**

Reviewed by David Harmon

Over the past few years, the conservation community has been roiled by a debate over whether our planet's supposed entry into a new geological era—one utterly dominated by human impacts—calls for abandonment of traditional protected area goals. So it is that the term "Anthropocene" has expanded from its technical origins (the current meaning of the term dates back to the 1980s, although it was coined earlier) to become the watchword for a very well-organized and stoutly financed group of self-described "ecomodernists." They contend that we should not worry much about human-caused extinctions and the spread of invasive species, that "nature" itself is over and we should just get over it, leaving us free to "love our monsters" and, without apology or self-reproach, hurry up and get good at being the gods of creation that we have made ourselves into. Through their policy and publicity center, a think tank called the Breakthrough Institute, they are doing their best to challenge the core assumptions of practical conservation.

Although it seems to have cooled down somewhat in recent months, the debate ran white-hot for awhile. To the most passionate defenders of protected area conservation as it has been developed over the past century and half, the Anthropocene-boosters are nothing but a bunch of heretical surrender monkeys, bought off by the corporate donor class, content to repose in a warm bath of ignorant hubris, and totally undeserving of the mantle of "environmentalist," which they insist upon claiming.

I'm exaggerating for effect, of course. To their credit, most of the contributors to the companion volumes *Keeping the Wild* and *Protecting the Wild* are not content to simply indulge themselves in such lazy invective. They realize that ecomodernist critiques of environmentalism deserve serious responses, and they deliver them. But there's a parallel problem: it's hard to separate the truth-value of the critiques from the revolutionary claims of those who level them. As Paul Kingsnorth, writing in *Keeping the Wild,* puts it, the ecomodernists are "keen to continue to define themselves as radicals, and as environmentalists, while acting and talking in a way that makes it clear that they are precisely the opposite." In short, he says, they "do not come rejuvenate environmentalism; they come to bury it."

The George Wright Forum, vol. 33, no. 1, pp. 15–17 (2016).

ISSN 0732-4715. Please direct all permissions requests to info@georgewright.org.

So the argument over the Anthropocene is nearly as much about who controls the mantle of environmentalism as it is about disagreements over goals and tactics. The two books under review here cover both aspects exhaustively. Each volume is edited by a trio of indefatigable conservationists who have long-held ties to the Foundation for Deep Ecology: George Wuerthner, Eileen Crist, and Tom Butler. All were key contributors to the now-defunct journal *Wild Earth,* and those of us who fondly remember that publication (its heyday was the 1990s) will recognize its editorial legacy in these two books.

The first to appear, *Keeping the Wild,* is an unbashed counterattack on the Anthropocene promoters and the human-centered values they champion. There are chapters from old and respected hands who have fought many a pitched battle, both on the ground and on the page: names like Dave Foreman, Roderick Frazier Nash, David Ehrenfeld (whose book *The Arrogance of Humanism* was a landmark when it came out in the late 1970s), Michael Soulé (a recent keynoter at the GWS conference), Terry Tempest Williams. All of them, as you'd expect, make effective arguments for the continuing value of wilderness preservation and the intrinsic value of nature.

But the chapter I want to call out here, titled "Resistance," is by Lisi Krall, a professor of economics. It's an elegy for the Wyoming she knew growing up, a time when the state "was infinite and wild" and she could smell the sagebrush, endless sagebrush, riding in the back of her father's pickup on a rainy June morning. That Wyoming has been replaced by one where a different, more ominous kind of truck—the white ones you seem to see everywhere nowadays in fracking country, the ones belonging to Halliburton and kindred companies—are on every back road, no matter how obscure, relentlessly searching for commodities to take out of the land. It makes her sick at heart. The basic question, she says, is not whether humans should manipulate nature; we always have, and have had to. Rather, it's whether we should allow ourselves to throw out all pretense of a land-ethic so that we can utterly "colonize the forms and rhythms of the natural world." For her, "the answer to this question is a thousand times no." The other authors in *Keeping the Wild* join her in that insistent chorus.

The companion volume, *Protecting the Wild,* came out last year. It's thesis is stated in the subtitle, "Parks and Wilderness, the Foundation for Conservation." And the case is made, fairly thoroughly if not exhaustively. While both books contain chapters that look beyond the United States, *Protecting the Wild* is significantly more internationalist, with chapters on protected areas in Latin America, Africa, the Carpathians, Mongolia, and Australia. That adds ecumenical value to the defense—despite many problems, it is in fact true that at least some protected areas are working reasonably well under all kinds of economic situations and under all kinds of governments.

Some of the most inspirational chapters come at the beginning, in a section on "bold thinking." Readers of this journal will already have seen a version of Harvey Locke's "Nature Needs Half" argument (a well-developed call that came long before the attention being paid to the idea in E.O. Wilson's new book *Half-Earth*). His essay is joined by a plea headlined by Reed Noss for conservationists to fight for whatever protected area targets are dictated by the best science, not just those that we think our socially palatable. These chapters are buoying and effective. Unfortunately, the afterword to the book has now taken on a poignant pall because its author, Doug Tompkins, who founded the North Face clothing line and went on to work for years in Patagonia creating one of the world's largest private protected areas, died in a paddling accident in December 2015.

Overall, *Protecting the Wild* is a wide-ranging summary of the current arguments for standard protected areas. It does not, however, delve much into alternative models, such as community-based conservation, so it cannot stand as a complete overview of the current state of play in protected areas as a whole. Nonetheless, together these two books are a formidable response to the purveyors of a conservation ideology that favors instrumental over intrinsic values.

You may be wondering: haven't we had this big brawling argument before? Indeed we have, back in the day when Muir and Pinchot were gathering their very different sets of apostles unto their sides.

Just so we don't lose track of the real meaning of the term being argued over today, keep in mind that the relevant professional bodies, the International Commission on Stratigraphy and the International Union of Geological Sciences, have not yet decided whether to declare the end of the current geological epoch, the Holocene, in favor of the Anthropocene. Even if they do (and a recent high-profile article in *Science* suggested that it would be justified), the debate over the implications for conservation practice is far from over.

Bison Conservation in Northern Great Plains National Parks and the Need for Reliable Funding

Daniel S. Licht

Introduction

Badlands, Theodore Roosevelt, and Wind Cave national parks, located in the Northern Great Plains region of the United States, have played a crucial role in restoring the American bison (*Bison bison*) from the brink of extinction. Thanks in part to these parks, the global bison population now numbers in the hundreds of thousands (Gates et al. 2010). Yet in spite of the significant numerical recovery of the species, bison remain a species of conservation concern in part because of genetic issues (Dratch and Gogan 2008). The National Park Service (NPS) has called for heightened bison management in its vision document *A Call to Action* (National Park Service 2011) and the Department of the Interior has an explicit goal of conserving bison herds of 1,000 or more animals (US Department of the Interior 2008).

Bison were restored to Wind Cave in 1913, Theodore Roosevelt in 1956, and Badlands in 1963. Bison thrived in all three units. Due to the absence of apex predators, the parks conducted recurrent culling operations to keep the herds at desired population levels. Culling generally consisted of rounding up bison and live-transferring surplus animals to other entities. Collectively, the three parks have provided approximately 10,000 live bison to at least 50 American Indian tribes, eight state parks and zoos, nonprofit organizations, and several federal entities. A goal of the transfers was that the recipients of the surplussed bison would use the animals to start new herds or augment existing ones. Assuming 16% annual population growth, the distributed bison could have grown to over 100,000 animals in just 16 years, i.e., the lifespan of a bison. However, such growth was not realized as recipients harvested many of the bison.

Prior to 2010 the three parks funded the culling operations using an arrangement known as *cost recovery*. Under cost recovery the recipients of surplus bison shared the costs of the culling operations. The use of cost recovery within the agency goes at least as far back as the

The George Wright Forum, vol. 33, no. 1, pp. 18–28 (2016).

ISSN 0732-4715. Please direct all permissions requests to info@georgewright.org.

1930s at Yellowstone National Park (Anonymous 1932). Culling expenses at Badlands, Theodore Roosevelt, and Wind Cave typically include helicopters to push bison into processing facilities, veterinary services and supplies, overtime for staff, and other roundup-associated costs. In 2009, the cost of the roundup and cull at Wind Cave was about $50,000 with 96 animals being surplussed (Roddy et al. 2009). The cost recovery model generally allowed the parks to conduct strategic, efficacious, and scientifically defensible bison culls.

However, in 2010 the parks were ordered by the NPS national office to cease using cost recovery. I could not find any written record justifying or explaining the change in policy. Parks were provided no explanation other than the claim that there had been a solicitor's opinion saying cost recovery was illegal; however, no official solicitor's opinion appears to exist and subsequent to the change in policy two former solicitors expressed surprise that the practice had been discontinued, and they reiterated that the practice was in fact legal (Brian Kenner, pers. comm., October 2013). A 2015 investigative article in the *Rapid City* (South Dakota) *Journal* indicates that lobbying of Washington, D.C., officials by a tribal organization was instrumental in the change in policy (Tupper 2015). The same article states that as of 2015 park staff were still unsure as to why the policy was changed, a consequence of the contradictory information and the lack of written documentation. More importantly from the perspective of bison management, no replacement funding or authority was provided.

Subsequently, the parks have tried a variety of low-cost methods to cull surplus bison. For example, in 2013 Wind Cave tried to lure bison into a corral using bait distributed from a pickup truck, a method that could lead to increased habituation and injuries to visitors (some animals were enticed into the corral, but the number was deemed insufficient to conduct a culling operation). At Badlands, park staff used vehicles to push bison into a corral where the animals were held for an extended period of time as the park waited for more bison to walk within herding distance of the corrals: the confined animals broke through a fence and onto private property. The few culls that have occurred since 2010 were funded using sources that cannot be relied on in the future. For example, Theodore Roosevelt conducted a bison cull using funds received for a feral horse (*Equus ferus*) study and Badlands used Recreational Fee Program funds—a funding source that might be inappropriate for routine bison management activities. The new policy has also affected population goals; Theodore Roosevelt attempted to cull the herd well below the long-term average size out of fear that funds would not be available in future years.

Fortunately, 2010–2014 was a period of above-average precipitation in the Northern Great Plains. That, along with the low stocking rates the parks had circa 2010 has precluded bison overabundance and range damage. However, the herds continue to grow and drought is an inevitable occurrence in the Great Plains. I modeled pre-2010 and likely post-2010 culling scenarios to identify potential impacts to bison genetics and herd and ecosystem health as a result of the changes in policy.

Methods

To better understand, document, and predict the possible impacts of unreliable funding on bison demographics and genetics, I modeled each of the park herds under several culling scenarios using the software program VORTEX, version 10.0.7.3 (Lacy 2000; Lacy and Pollak 2014). I parameterized the model to maintain herd sizes at the current park goals. Badlands strives to keep its herd around 700 animals (Pyne et al. 2010). Wind Cave manages for a herd of about 425 bison (National Park Service 2006). Theodore Roosevelt has North Unit and South Unit herds that it attempts to keep at around 200 and 350 bison, respectively (National Park Service 2015). I assumed the four herds could increase to up to three times the targeted size with no ill effect on bison or ecosystem health. At three times the targeted herd size the model started imposing density-dependent reductions in survival and recruitment under the assumption that range degradation was beginning.

Baseline reproduction rates were derived from the bison roundups at the parks (Millspaugh et al. 2005). I parameterized age-specific mortality rates with the mid-points of the values reported by Millspaugh et al. (2005) and Pyne et al. (2010); those values were also derived from the park's bison roundups.

For each of the four herds I seeded the model with the respective allele frequencies from Halbert (2003). To account for differential male breeding success by age, all males ages 9–11 were assumed to be in the breeding pool, with declining inclusion for younger and older males. To account for disproportionate breeding success associated with dominance, all males in the initial population and all males born during the simulation were randomly assigned a dominance score that they kept throughout their life. A male's reproductive success within a year was a probabilistic factor of their age and dominance score. The output reasonably approximated the reported male breeding success rates reported by Berger and Cunningham (1994) for the Badlands herd. I did not alter female reproductive success by dominance as there is no evidence for that based on the Badlands study (Berger and Cunningham 1994). I did not enable inbreeding depression in the model due to a lack of evidence that the herds were impaired (Licht, in prep.).

For each of the four herds I modeled five culling scenarios. Two scenarios consisted of annual culls and are comparable with pre-2010 practices. The three other scenarios assumed multiple years between culls and are comparable with what has transpired post-2010 and will likely continue into the future in the absence of adequate and reliable funding and/or culling authority. I excluded calves from all culls as the parks typically do not cull that cohort. The five modeled scenarios were:

1. *Cull Yearlings Annually.* In this scenario a cull occurred annually, comprised only of yearlings, split evenly between the sexes. The cull reduced the herd to the respective population target. This scenario mimics what Wind Cave routinely did prior to 2010 (National Park Service 2006).
2. *Cull Yearlings + Adults Annually.* In this scenario a cull occurred annually, comprised of 50% yearlings, 25% 2.5-year-olds, and 25% older adults, split evenly between the sexes. The cull reduced the herd to the respective population target. The multi-cohort cull is similar to what Badlands and Theodore Roosevelt historically conducted, although the frequency of culls varied from nearly annually at Badlands to every few years at Theodore Roosevelt.

3. *Cull Every Fourth Year.* In this scenario a cull occurred every fourth year. To keep the long-term average herd size near the target level, the cull reduced the herd to 74% of the target population. Under this scenario the cull was comprised of 25% yearlings, 25% 2.5-year-olds, and 50% adults, split evenly between the sexes. This cull approximates the frequency of culling that could happen post-2010, although rigorous adherence to quadrennial schedule is unlikely.
4. *Cull Every Fourth Year from an Accessible Subpopulation.* In this scenario a cull occurred every fourth year using the same basic assumptions as scenario #3. However, this scenario also assumed two subpopulations within the park, only one of which could be culled. This mimics a situation whereby there are insufficient funds to use helicopters to push distant herds into the corrals. The scenario assumed that 33% of animals aged 2–5 from the unharvested (and oversaturated) subpopulation dispersed into the harvested subpopulation and 2% dispersed the other direction.
5. *Cull at a 0.25 Probability.* In this scenario culls occurred probabilistically in 25% of the years. When culls occurred the herd was reduced to about 47% of the target level. The more severe cull was necessary to minimize the risk of exceeding the carrying capacity in subsequent years as an unknown number of years could go by before the next cull. However, a competing goal was to keep the minimum population as large as possible to better conserve genetic diversity.

The population goals established by the parks are generally viewed as conservative, i.e., well below the potential forage-based carrying capacity at the sites. For example, the Badlands goal of 700 bison is reportedly based on drought conditions (Pyne et al. 2010). The Theodore Roosevelt South Unit goal is based in large part on indicator plants sensitive to elk (*Cervus canadensis*) herbivory (Westfall et al. 1993) and is considered conservative for bison (National Park Service 2015). The Wind Cave bison management plan (National Park Service 2006) acknowledges that its population targets are conservative. The use of conservative targets is deliberate as smaller populations of bison are easier to manage, require less funding, and provide a buffer for herd growth should funding for culls not be available in future years. However, under such a strategy the herds are not realizing their full conservation potential. I determined the ecological carrying capacity for each site using standard range management methods. For each site I summed the annual plant productivity, i.e., forage production (Natural Resources Conservation Service 2014). I assumed that half of the annual plant growth was needed by the plants for growth and maintenance and should not be consumed. I assumed that 15% of the balance would be lost to insects, rodents, weather damage, or decay, or was unpalatable or otherwise unavailable to ungulates. Ungulate consumption rates are typically reported as oven-dried rates so I reduced the air-dried forage values by 10%. At Theodore Roosevelt South Unit I assumed the presence of 360 elk and 100 feral horses. At Wind Cave I assumed the presence of 300 elk. Depending on the site I also assumed lesser amounts of deer (*Odocoileus* spp.) and pronghorn antelope (*Antilocapra americana*) and bighorn sheep (*Ovis canadensis*). I allocated forage to these species using the weight and intake values in Westfall et al. (1993). After accounting for these species the remaining forage was considered available for bison. I assumed a typical bison weighed 1,000 pounds (Licht, in prep.) and consumed the equivalent of 22 pounds of oven-dried forage daily (Feist 2000) for 365 days. To get the bison carrying capacity, I divided the remaining plant mass by the bison forage needs. To illustrate the conservation benefits of maintaining larger bison herds, I ran the VORTEX model across a range of herd sizes, using the allele frequencies of the Theodore Roosevelt South Unit herd and an assumed cull of all cohorts every fourth year.

Results

The two annual culls showed the least variability in late-summer (post-calving) herd size over time, with the variability about 5% of the herd size (Table 1). In contrast, the random-year culling scenario had the greatest variability in post-calving herd size, with a standard deviation about equal to the population goal for the herd. The random-year culling scenario was the only scenario to exceed the density-dependent threshold (i.e., three times the target level); it exceeded the threshold in 10.8% of the years for the small Theodore Roosevelt North Unit herd and 4.9% of the years for the large Badlands herd (Figure 1).

The two annual culls removed the fewest number of animals per cull on average and with the least variability (Table 1). The three multi-year culls had the largest number of animals removed per cull. The random-year cull showed the most variability, with some of the culls removing more bison than the population goal for the site.

Gene diversity (heterozygosity) was best conserved by the two annual culls (Table 1). For example, the annual yearling-only cull lost only 3.32% of its gene diversity over 100 years

Figure 1. Three iterations of simulated bison herd size assuming a 0.25 probability of a cull in a given year. The desired population size is 500 bison; culls reduce the herd to 200 bison.

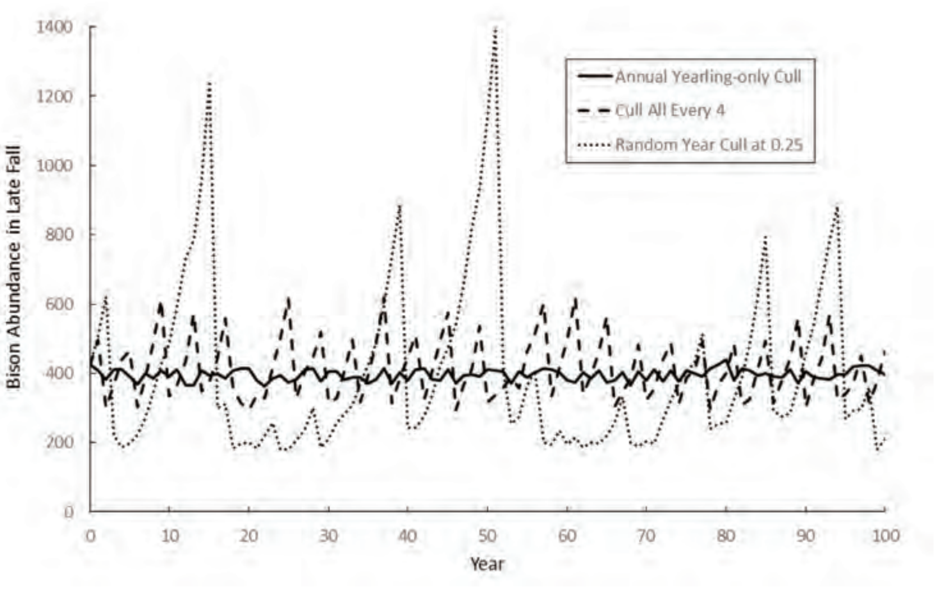


Table 1. 100-year simulations of the demographics and genetics of the four herds under the five culling scenarios.

Result by Scenario	Badlands NP	Theodore Roosevelt NP, North Unit	Theodore Roosevelt NP, South Unit	Wind Cave NP
Mean Post-cull Population	700	200	350	425
Post-calving Population and SD				
Annual Yearling Cull	810 ± 46	233 ± 14	411 ± 18	493 ± 25
Annual All Cohort Cull	830 ± 34	235 ± 12	415 ± 20	504 ± 26
Cull All Every Fourth Year	843 ± 193	235 ± 53	418 ± 95	506 ± 117
Cull Subpopulation Every Fourth Year	806 ± 181	238 ± 61	402 ± 84	470 ± 97
Cull Random Years P=0.25	780 ± 570	278 ± 210	398 ± 298	535 ± 430
Number Harvested Per Cull and SD				
Annual Yearling Cull	116 ± 40	34 ± 13	59 ± 23	67 ± 25
Annual All Cohort Cull	129 ± 40	34 ± 12	64 ± 19	77 ± 21
Cull All Every Fourth Year	550 ± 126	147 ± 38	267 ± 66	320 ± 88
Cull Subpopulation Every Fourth Year	412 ± 67	135 ± 38	230 ± 49	275 ± 48
Cull Random Years P=0.25	429 ± 501	157 ± 180	220 ± 277	272 ± 346
Heterozygosity Yr 100 and % Decline				
Annual Yearling Cull	0.547 (–2.34%)	0.464 (–7.07%)	0.536 (–4.15%)	0.615 (–3.32%)
Annual All Cohort Cull	0.545 (–2.71%)	0.448 (–10.27%)	0.525 (–6.17%)	0.606 (–4.69%)
Cull All Every Fourth Year	0.536 (–4.37%)	0.423 (–15.21%)	0.508 (–9.22%)	0.588 (–7.54%)
Cull Subpopulation Every Fourth Year	0.528 (–5.87%)	0.411 (–17.59%)	0.502 (–10.26%)	0.580 (–8.79%)
Cull Random Years P=0.25	0.528 (–5.73%)	0.401 (–19.77%)	0.500 (–10.57%)	0.575 (–9.60%)
Alleles / Loci Yr 100 and % Decline				
Annual Yearling Cull	4.20 (–6.25%)	3.04 (–12.14%)	3.84 (–8.35%)	4.42 (–7.53%)
Annual All Cohort Cull	4.09 (–8.71%)	2.93 (–15.32%)	3.73 (–10.98%)	4.34 (–9.01%)
Cull All Every Fourth Year	3.96 (–11.61%)	2.78 (–19.65%)	3.57 (–14.80%)	4.16 (–12.97%)
Cull Subpopulation Every Fourth Year	3.85 (–14.06%)	2.69 (–22.48%)	3.45 (–17.86%)	4.03 (–15.51%)
Cull Random Years P=0.25	3.90 (–12.95%)	2.66 (–23.12%)	3.48 (–17.14%)	4.02 (–15.90%)

at Wind Cave; in contrast, the quadrennial all-cohort cull reduced gene diversity 7.54%, the cull of a subpopulation quadrennially reduced it to 8.79%, and the random-year cull reduced it 9.60%. The simulations showed a similar change in allele richness over time, with the annual culls better conserving alleles than the culls separated by multiple years (Table 1).

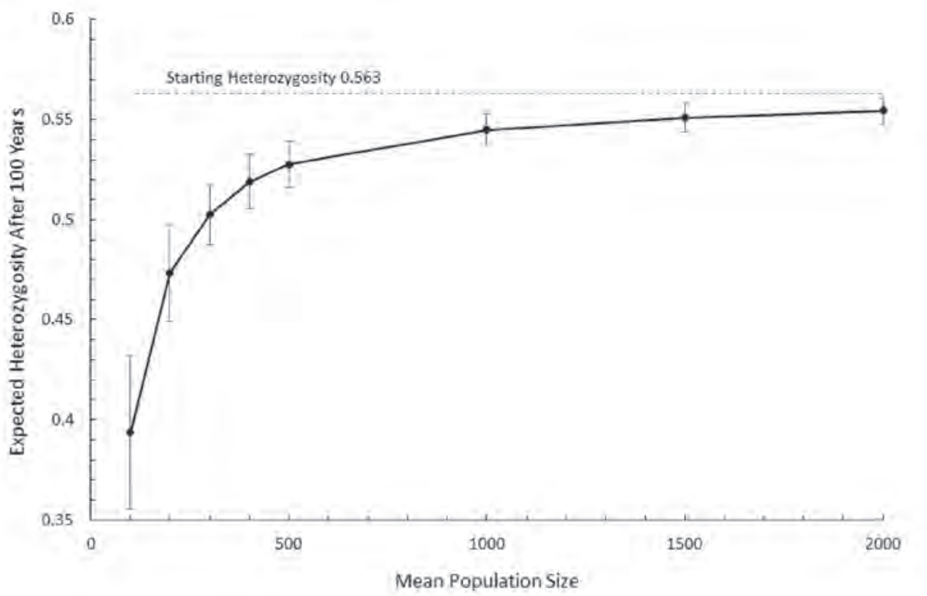
The conservation of heterozygosity and allele richness improves with increasing herd size, assuming other variables remain the same (Table 1; Figure 2). Assuming a starting gene diversity of 0.563 and a cull every fourth year, a herd of 2,000 animals would conserve about 98% of the original heterozygosity after 100 years, whereas a herd of 100 animals conserves only about 70% (Figure 2).

The analysis of a forage-based carrying capacity for the sites indicates that the parks could support substantially more bison than their current population goals (Table 2). If bison were allowed to consume about 25–30% of annual plant productivity, the parks would support about three times as many bison as they currently do.

Discussion

Bison conservation at NPS units in the Northern Great Plains has been a great success by many measures, including the conservation and recovery of an imperiled species (Coder 1975), conservation of the bison genome (Halbert 2003), restoration of an ecological process (Wallace and Dyer 1995), and enhanced visitor experiences (Vequist and Licht 2013).

Figure 2. Conservation of expected heterozygosity under varying herd sizes. Simulations start at 0.563 heterozygosity using allele frequencies from the Theodore Roosevelt South Unit herd. Assumes a cull every fourth year from all yearling and adult cohorts.



Scenario	Potential Ecological Carrying Capacity				
	Current Population Goal	Modeled Allocation to Bison in Normal Year	Unfavorable (i.e., Drought) Year	Normal Precipitation Year	Favorable (i.e., Wet) Year
Badlands NP	700	30%	1,188	2,162	2,776
Theodore Roosevelt NP, North Unit	200	28%	NA	994	NA
Theodore Roosevelt NP, South Unit	350	25%	NA	1,644	NA
Wind Cave NP	425	26%	821	1,332	1,831

Table 2. Current population goals and potential herd sizes (includes calves) based on forage productivity.

However, some of those successes are now jeopardized due to unreliable funding for bison roundups.

Under the current management paradigm it's likely that bison culls will occur less frequently, more haphazardly, and in a piecemeal fashion. As a result, bison population levels could deviate greatly from park-established targets. In the random-year cull simulations, the herds often exceeded the level at which the model assumed range degradation and density-dependent changes to vital rates. In the subpopulation scenario, the unharvested subpopulation would also have exceeded the carrying capacity in that portion of the park were it not for the high rate of dispersal assumed in the model.

In reality, range impairment levels may not be reached at the rates modeled here as there would be increased motivation within the agency to implement a cull once range degradation was imminent. Furthermore, the model assumed that carrying capacity was exceeded at three times the herd goals, yet the carrying capacity analysis conducted here—plant productivity data from the US Department of Agriculture's Natural Resources Conservation Service—suggests that the parks might be able to support at least that many animals or more with no impairment. Nevertheless, the simulations illustrate the risks that parks now confront in the absence of a dependable funding mechanism to cull bison.

An argument can be made that large swings in bison abundance—as simulated in the multi-year culling scenarios—better mimic natural patterns and processes. However, historical variability in bison abundance was likely a response to regional weather patterns and landscape-level disturbances (e.g., fire). Under the status quo, variability in bison abundance is primarily due to fiscal, logistical, and staffing factors, and not environmental conditions. Ideally, parks would have dependable funding, or a suitable culling authority, that would allow managers to cull herds in a way that best meets conservation goals and mimics natural processes. Ecologically, the ideal scenario for bison management would be one where the size of the herd would essentially "follow the rain," i.e., during periods of favorable precipitation the population would grow and during years of drought the herd would be reduced.

If the parks had reliable funding for culls they could manage for larger herds to the betterment of the bison genome. The model demonstrated that gene diversity is efficiently conserved once a herd reaches about 1,000 animals. Such results are consistent with the recommendations made by Gross and Wang (2005), Dratch and Gogan (2008), and Derr et al. (2011), and with Department of the Interior goals (US Department of the Interior 2008). Reliable funding would also allow parks to implement annual culls of yearlings, which are the most effective strategy for conserving genetic diversity. Yearling culls reduce the likelihood of removing a dam and her offspring and lengthen the intergenerational time of the herd. An annual cull of all cohorts is also effective, and has the additional benefit of a more natural sex-age structure. Conversely, the multi-year culling strategies lose genetic diversity at about twice the rate of annual culling. However, the greater loss of genetic diversity under the multi-year culls could be mitigated for by maintaining larger herd sizes. For example, the Theodore Roosevelt South Unit herd had a 100-year heterozygosity of 0.525 under an annual cull of all cohorts; the same amount of gene diversity could be retained under a quadrennial all-cohort cull if the long-term population goal were increased from 350 to 450.

The current conservative stocking rates at the parks are due in part to unreliable funding, yet they are sometimes justified as conserving biological diversity. However, unnaturally low grazing levels can retard the conservation of black-tailed prairie dogs (*Cynomys ludovicianus*), black-footed ferrets (*Mustela nigripes*), swift fox (*Vulpes velox*), and burrowing owl (*Athene cunicularia*), among other grazing-dependent species. Although present in some of the parks evaluated in this study, these species are not realizing their full potential in part because of the inability to effectively manage bison populations, demonstrating the cascading effect of unreliable funding for bison management.

This study focused on the risks to bison genetics and ecosystem health as a consequence of unreliable funding. However, the absence of reliable funding also raises animal welfare and human safety concerns. For example, in 2014 Badlands confined an excessively large number of bison to their holding pasture for an extended period of time in hope of collecting more animals. During confinement a calf was born and subsequently trampled and fatally injured. Wind Cave had five bison mortalities in 2014, well above the long-term average; the deaths might have been due to the excessively long period of bison confinement that year, as the park used horseback riders to push bison into corrals versus using the more expedient helicopters. As roundups are spread out over longer periods, and more bison are processed per roundup, there are more stresses on infrastructure, park funds, and worker safety.

Some risks of not having reliable funding for bison management include:

1. Loss of genetic diversity.
2. Potential to exceed the ecological carrying capacity.
3. Difficulty in finding recipients of surplus animals due to uncertainties in culls.
4. Diverting funds from other programs or using inappropriate funding sources for culls.
5. Use of capture methods that conflict with policy or have harmful consequences.
6. Increased risk to staff safety and infrastructure due to larger culls.
7. Increased cost per cull.

8. Loss of data collection opportunities, resulting in less refined management.

To better manage bison, the parks need a reliable and adequate funding mechanism and/or enhanced authorities to remove surplus bison. Bison are a valuable commodity, with a herd of 1,000 capable of generating upward of $250,000 annually on the open market (Licht 2014). Although NPS bison should not be managed as a commodity, the unique values of the animal makes them conducive for innovative funding mechanisms, such as is done for micro-organisms at Yellowstone National Park. Bison conservation has been successful for the past 100 years at NPS units in the Northern Great Plains. It seems reasonable to assume that the agency intends to manage bison for at least another 100 years, so a reliable culling program is warranted. If the three Northern Great Plains parks had reliable funding and culling authorities they could manage their herds in ways that better conserve the species and meets department and agency bison conservation goals. Each year that goes by puts the ecosystems at risk and decreases the genetic diversity of the herds. The clock is ticking.

Acknowledgments

I thank Blake McCann for reviewing an early draft of the manuscript. The views expressed herein do not necessarily represent the views of US Department of the Interior.

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The Rise, Fall, and Legacy of *Part Two of the National Park System Plan: Natural History*

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This review and essay will trace the history and use of a little-known National Park Service (NPS) document entitled *Part Two of the National Park System Plan: Natural History* (NPS 1972). (Part One of the plan, also published in 1972, covered historic sites.) *Part Two*'s purpose was to guide the growth of the natural area component of the US national park system in a systematic fashion. The author was one of three NPS professional staff in the 1970s who were responsible for *Part Two,* which encountered political opposition before the decade ended. This discussion focuses on just one park selection criterion, representation, as required by Secretary of the Interior Franklin K. Lane in his famous "Lane Letter," written in 1918 to the first NPS director, Stephen Mather, and which stands as the first statement of standards for which areas should qualify for national park status (NPS 1970: 71). Much of the information in the present paper is taken from two earlier publications by the author (Shafer 1999, 2004), which are longer and broader discussions. Some key points, references, illustrations, and tables from these papers are repeated here along with added or updated information.

Themes and a system plan

Systematic reserve planning is an ideal. When new park opportunities are taken as they arise, this approach is called "ad hoc." For example, there may be no "system plan" or the ranking of potential new sites using selection factors. To avoid ad hoc growth of the national park system, beginning in the late 1950s NPS began discussions of potential additions around the concept of themes. Themes were a way to organize natural and cultural phenomena into categories. For geology, examples of themes include such things as aeolian landforms and Jurassic fossils. For ecology, themes might include wetlands and prairies. By 1960, some early

The George Wright Forum, vol. 33, no. 1, pp. 29–46 (2016).

ISSN 0732-4715. Please direct all permissions requests to info@georgewright.org.

themes were developed by NPS geologists and The Nature Conservancy (Masland 1960; Seaton 1960). By October 1965, the secretary of the interior's Advisory Board on National Parks, Historic Sites, Buildings and Monuments approved the concept of using themes in planning (NPS 1965). Later, in April 1966, the Advisory Board endorsed a specific list of themes (NPS 1966a: 84) (Figure 1). The thinking behind theme creation was provided in NPS 1966b:

> … natural history [is] polydimensional and difficult to resolve into a generally acceptable rational system of categories of a nature that would be useful for evaluation and selection of representative natural areas. The only apparently reasonable alternative is a system of themes.… These themes involve not only entities and processes but also the aspects from which they are viewed. By their very nature, themes intersect and overlap. Because of this, no single area is characterized solely by a single theme, although a single theme may be of overwhelming importance.

These themes, both ecological and geological, sought to capture the same thing that some conservation biologists are proposing today: "conserving nature's stage" (Lawler et al. 2015: 618). This illustrates that the need to preserve geological diversity has been a late recognition for some biologists. For example, IUCN changed their definition of "natural area" and replaced it with the broader concept of "conservation of nature" (Dudley et al. 2014) to accommodate geology.

The notion that a "system plan" should guide the growth of the US national park system, based on natural feature gaps, was also mentioned in the 1960s (Masland 1960; Seaton 1960). One champion of a system plan, Secretary of the Interior Stewart L. Udall, said in 1963 that the national park system should be "rounded out" in the following three decades (Udall 1963: 181). During FY1962, NPS began asking Congress for funds to implement such a plan.

A system plan for natural areas, based on themes and natural regions (i.e., physiographic provinces modified from Fenneman 1928; Figure 2), was developed in draft by January 1967. Other countries were moving in a similar direction. Drawing from *Part Two*, Canada developed a park system plan in 1970 that was approved in 1971 (Parks Canada 1971, 1977). By FY1971, NPS was being funded to implement a National Natural Landmarks (NNL) Program, which, as we shall see, was used as a tool to guide the systematic growth of the national park system.

In June 1969, Secretary of the Interior Walter Hickel promulgated the following policy: "There are serious gaps and inadequacies which must be remedied while opportunities still exist…. You should continue your studies to identify gaps in the System and recommend to me areas that would fill them" (NPS 1972, preface). *Part Two* was finished in 1970, although not published until 1972. It was endorsed by the Advisory Board that same year as "valuable guidelines for the further evolution of the National Park System Plan and a useful framework within which to present plans and priorities to the Bureau of the Budget and the Committees of the Congress for expansion of the National Park System" (*Federal Register*, August 15,

GEOLOGICAL AND ECOLOGICAL CATEGORIES

Theme I. Landforms of the Present

Subthemes:
1. Plains, plateaus and mesas
2. Cuestas and hogbacks
3. Mountain systems
4. The works of volcanism
5. Hot water phenomena
6. Sculpture of the land
7. Eolian landforms
8. River systems and lakes
9. The works of glaciers
10. Seashores, lakeshores, and islands
11. Coral islands, reefs, and atolls
12. Phenomena associated with earthquakes
13. Caves and springs
14. Meteor impact sites

Theme II. The Geologic History of the Earth

Subthemes:
1. The morning of life (Precambrian Period)
2. The age of primitive invertebrates (Cambrian, Ordovician, and Early Silurian Periods)
3. The rise of vertebrates and the first forests (Late Silurian and Devonian Periods)
4. The great development of land life and changes in marine life (Mississippian, Pennsylvanian, Permian, and Triassic Periods)
5. The age of reptiles (Permian, Triassic, Jurassic, and Cretaceous Periods)
6. The emerging dominance of mammals (Tertiary Period: Paleocene and Eocene Epochs)
7. The golden age of mammals (Tertiary Period: Oligocene, Miocene, and Pliocene Epochs; Quaternary Period: Pleistocene Epochs)
8. The age of man (Quaternary Period: Pleistocene and Recent Epochs)

Theme III. Land Communities of Plants and Animals

Subthemes:
1. Tundra
2. Boreal forests
3. Pacific forest
4. Dry coniferous forest and woodland
5. Eastern deciduous forest
6. Grassland (steppe)
7. Chaparral
8. Deserts
9. Tropical region
   a. Lowland rain forest
   b. Summer-deciduous forest
   c. Woodland and scrub formations
   d. Swamp and mangrove formations
   e. Savanna
   f. Montane rain forest
   g. Alpine vegetation
10. Special land communities of plants and animals
11. Land plants or animals of special interest

Theme IV. Aquatic Ecosystems

Subthemes:
1. Marine environments
   a. Exposed coastline with rocky substrate
   b. Exposed coastline with unconsolidated sediment
   c. Coral reefs
   d. Protected coastline with rocky substrate
   e. Protected coastline with unconsolidated sediment
   f. Lagoons
   g. Tidal salt marshes
   h. Mangrove swamps
   i. Areas with extensive kelp beds
2. Habitats of marine species of special interest
3. Estuaries
4. Streams
   a. Rapidly flowing streams
   b. Slow meandering streams
   c. Deltas (both at seashore and at lakeshore)
   d. Springs
   e. Thermal waters
5. Underground waters with distinctive animal life
6. Lakes and ponds
   a. Large deep lakes
   b. Large shallow lakes
   c. Lakes of complex shapes
   d. Crater lakes
   e. Kettle lakes and potholes
   f. Oxbow lakes
   g. Dune lakes
   h. Sphagnum-bog lakes
   i. Saline lakes
   j. Lakes fed by thermal streams
   k. Tundra lakes and ponds
   l. Swamps and marshy areas
   m. Sinkhole lakes
   n. Unusually productive lakes
   o. Lakes of low productivity and high clarity
7. Habitats of fresh water aquatic species of special interest

Figure 1. The natural region themes. This version represents a slight expansion on the 1966 themes.

1970). The coupling of themes with natural regions may seem like everyday thinking today, but it was a major innovation at that time (Shafer 1999).

As just noted, *Part Two* was published in 1972 (Figure 3). Its official purpose was to identify the best new natural areas for potential addition to the system. Its unofficial but critical co-purpose was to fend off inappropriate potential additions being pushed by Congress, or what Everhart (1972: 137) called congressional "dead cats." Using *Part Two* to evaluate new additions was adopted as official agency policy in 1975 (NPS 1975). Importantly, *Part Two* only identified *gaps* in theme representation if they occurred in an identified *natural*

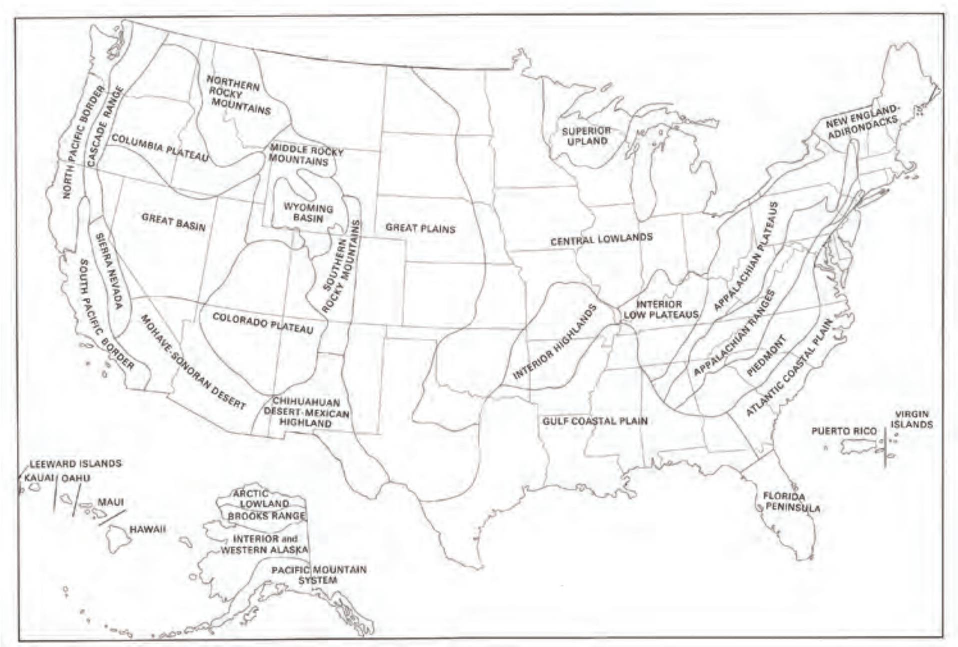

Figure 2. Fenneman's (1928) physiographic provinces were modified slightly by NPS. NPS called these provinces "natural regions."

region. It did not identify specific *sites* to fill those gaps. That step would be the role of subsequent natural region theme studies.

Natural region theme studies

As a result of the *Part Two* and the NPS responsibility to continue to administer the NNL Program, the Park Service commissioned 70 natural area inventories between 1968 and 1986 to identify potential NNLs. The early studies—e.g., an inventory of one theme, like limestone caverns and springs over the entire country—were a learning experience, while the studies that followed were different and much more costly (i.e., an inventory of all themes within one physiographic province). These later studies, called "natural region theme studies," described a particular physiographic province, developed a classification scheme for its geological or ecological features (or both), and then described and prioritized those sites that best represented each theme and subtheme. Typically they were conducted by the best university plant ecologists and geomorphologists knowledgeable about a particular natural region in the country. This theme approach was a very coarse method to sort or categorize natural features. These ecological themes were the primary component of what The Nature Conservancy (TNC) called "elements of ecological diversity (Jenkins 1978) but lacked the "fine filter" that their State Heritage Programs used to capture, for example, the presence of rare and endemic

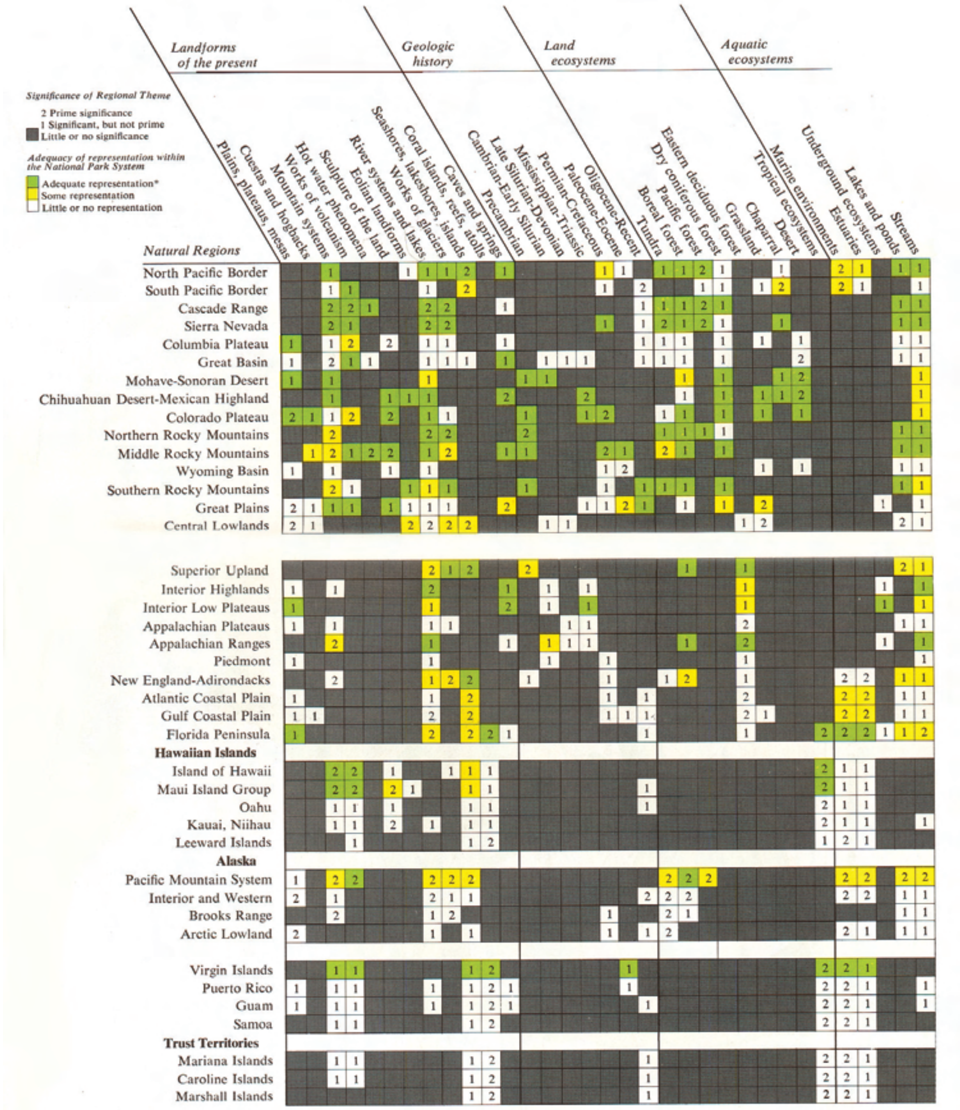

Figure 3. A chart from *Part Two* (NPS 1972).

species. Study teams were given the freedom to use the themes or develop their own refined natural feature classification scheme for geological and ecological features.

One can argue that a *process* approach for the classification of geology is better than a *features* approach (Spicer 1987). Regardless, more than half a century after the first geological themes were developed in the 1960s, modern conservation biologists are now beginning to appreciate the importance of preserving what is now called "geodiversity" (Comer et al. 2015; Hjort et al. 2015), the term itself surfacing around 1999 and used in NPS starting around 2005 (Gray 2005).

New park recommendations

In a separate letter of transmittal (which was not part from the theme study itself), the NPS-contracted natural region theme study team was asked to recommend a few potential new units to add to the national park system. The team was asked first and foremost to consider whether the sites would fill *gaps* in representation in the national park system or whether they were *unique*. Information about *threats* to their integrity was welcome. The selection criteria the teams used would, decades later, come to be known as "complementarity," "representativeness," "irreplaceability," and "vulnerability" (e.g., Margules and Pressey 2000). The early recommendations were too broad—some teams recommended 50 or more sites—but with more guidance NPS got what it wanted: a list of one to four sites. These theme studies represented a public investment of around $2 million. They identified approximately 3,000 potential sites that are currently part of an NPS electronic database, and many were added to the National Registry of National Natural Landmarks, which today totals 597.

Congressional support for federal land inventories

The Public Land Law Review Commission was created in September 1964 and its report, *One Third of the Nation's Land* (Aspinall 1970), was completed in June 1970. It consisted of "policy guidelines for the retention and management or disposition of Federal lands…" (p. iii). The report consisted of 137 recommendations. One recommendation (no. 78) said agencies should identify and protect "unique" natural areas on federal land. Another (no. 27) recommended that Congress assist in the creation of a natural-area system for scientific and educational purposes. In the text, it endorsed inventories of US Forest Service and Bureau of Land Management (BLM) property for sites that qualify as national parks and monuments. But such enthusiasm for new natural areas and national parks was short-lived. By 1975, the Ford administration was opposing legislation to authorize most new units of the national park system (Duddleson 1975). However, not every member of Congress agreed with this "no new parks" policy.

Section 8

Some in Congress wanted to afford NPS the opportunity to freely offer new park recommendations without being muzzled by political and budgetary considerations. This opportunity became law in 1976. Section 8, a 1976 amendment to the General Authorities Act of 1970 (84 Stat. 825), stated:

> The Secretary of the Interior is directed to investigate, study and continually monitor the welfare of areas whose resources exhibit qualities of national significance and which may have potential for inclusion in the National Park System.... [T]he Secretary shall transmit ... comprehensive reports on each of those areas upon

> which studies have been completed. *On the same date … the Secretary shall transmit a listing … of not less than twelve such areas which appear to be of national significance and which may have potential for inclusion in the National Park System* (emphasis added).

The new park recommendations sent to Congress from 1977 to 1980 did rely heavily on those of the contracted theme study scientists. One private conservation organization gave the 1978 recommendations visibility (NPCA 1978). Of the sites sent to Congress from 1977 to 1980 primarily for their natural values, 11 were recommended as potential parks by the theme studies and 4 were NNLs that appeared on the Section 8 "threatened and damaged list," a related Section 8 requirement that directed the secretary of the interior to:

> transmit annually [to Congress] ... a complete and current list of all areas included on the Registry of Natural Landmarks ... which areas exhibit known or anticipated damage or threats to the integrity of their resources, along with notations as to the nature and severity of such damage or threats.

Some of these potential new park sites were not unknown to NPS; some were even already on one version or another of an agency priority list. Examples include Channel Islands, Valles Caldera, a Great Basin national park, a prairie national park, and Congaree Swamp. Such priority lists go back to at least 1960, when Masland named about 70 sites that had been identified by NPS as worthy of further examination as potential new parks (Masland 1960).

More funding to allow studies of new parks and for supporting the NNL Program arrived in 1978. The National Parks and Recreation Act of that year (92 Stat. 3467) amended Section 8 to allow up to $1 million annually for studying and monitoring potential new national parks, and $1.5 million annually for monitoring NNLs. An earlier draft of this amendment required that the National Park System Plan be updated annually, but the requirement was subsequently struck out. Then, in 1980, Congress amended Section 8 again (94 Stat 1133), requiring that the "list of 12" submissions include an analysis of the condition of previously submitted sites based on careful monitoring.

Political opposition to park additions and park system planning

With fiscal conservatives gaining ascendancy in Congress as the 1970s came to a close, having a national park system plan became a political liability. But not all members of Congress saw things that way. Some, such as Keith Sebelius (R) of Kansas, wanted to update *Part Two*. NPS did so and the product was at the printing press, literally, until NPS Director Russell Dickinson (who served in that role from 1980 to 1985) was forced by political appointees in the Reagan administration to stop its publication. NPS then had to convince these appointees who were opposed to having a plan to expand the national park system that no such plan existed. The plan and its data were forced to go into hiding.

To be certain that NPS would not be involved in studies for new parks, some members of Congress arranged the following: funding for new area studies was slashed; the staff of six professionals in the NPS Washington Office of New Area Studies was reduced to two; and a gentlemen's agreement was struck between the Department of the Interior and Congress that, after 1981, NPS would no longer need to submit to Congress the annual "list of 12 potential new parks" required by the 1976 Section 8 mandate. Congress essentially eviscerated any activity NPS might conduct for planning new parks.

In fact, even the NNL Program narrowly escaped abolishment in 1980. The Heritage Foundation, a think tank with close ties to the Reagan administration, placed it on their list of unfavored programs, essentially a "hit list" of programs to get rid of. The issue of park system expansion remained a sensitive one throughout most of the Reagan administration (1981–1989). For example, within months of Secretary of the Interior James Watt's appointment in 1981, there was a moratorium on park acquisitions using the Land and Water Conservation Fund and a policy of no new park additions. After Donald Hodel became the new secretary of the interior in 1985, he vowed to send legislation to Congress to end the "list of 12" aspect of Section 8. *Part Two* and its recommendations derived from the natural region theme studies were relegated to being occasionally pulled out of the drawer to answer questions such as Congressional requests for new parks.

By 1986, the Sierra Club asked NPS to revise *Part Two*. NPS wanted to do so but the views of the Sagebrush Rebellion and its supporters (Davis 2001) prevailed. Instead, NPS produced *Natural History in the National Park System and on the National Registry of Natural Landmarks* (NPS 1990). The booklet said it was "not a strategy, plan, or proposal for expanding the National Park System" (NPS 1990: 1). All the useful maps in *Part Two* were missing. The 1990 document was thus of little use for park system planning.

During 1983, a series of meetings of nongovernmental organizations (NGOs) took place to discuss the future of the system. The only product, a 15-page typed document entitled "Toward a Premier National Park System" (The Wilderness Society et al. 1983), recommended that *Part One* and *Part Two* be updated, that the NPS new areas study program be restarted, and the NNL Program be invigorated. Five years later, this meeting probably generated the nine-volume study by NPCA entitled *Investing in Park Futures—The National Park System Plan: A Blueprint for Tomorrow*. Volume 8 of the study (NPCA 1988) recommended a long list of areas for addition to the system, including many identified in NPS-sponsored theme studies and Section 8 reports. Additional report recommendations also included revising *Part One* and *Part Two* and continuing to comply with the Section 8 mandate of providing Congress with a "list of 12" potential new parks each year.

A moratorium was placed on the NNL Program in 1989 until various "program improvements" could be made. The moratorium was lifted in 1999 after a busy decade of work (Shafer 2000). However, the NNL Program budget was cut in half while NPS Director Fran Mainella was in office (2001–2006). One criticism by program opponents was the perception that NNL status was the first step towards national park creation. This fear stemmed in part from an unfortunate statement in an NGO publication which described NNLs as "ladies in waiting" (NPCA 1988: I-15)—that is, future units of the national park system. Some private property rights groups spread fear that NNLs were the first step towards government land acquisition (see Shafer 2003). The facts indicate that that fear was overblown. Of the eight NNLs containing private land that resulted in federal acquisition, only one (Congaree River Swamp) involved the federal government exercising its right of eminent domain.

The Vail Agenda (NPS 1992), the results of an October 1991 symposium in Vail, Colorado, which sought to review NPS responsibilities with input from 500 outside invited participants, called for the plan's resurrection. Again, not every member of Congress wanted Section 8 to disappear. So it was amended again by the National Parks Omnibus Management Act of 1998 (112 Stat. 3497). This amendment directed NPS to continue to provide Congress with a list of areas for potential addition to the national park system but with a new twist of adding congressional oversight. From then on, Congress would have to *first approve* any site before NPS could expend funds on it for a "new area study." In earlier days, NPS expended funds for "suitability and feasibility" studies on any area it thought might be worthy (that is, nationally significant). This included sites unknown to Congress and others where these legislators had expressed interest. For example, during a five-year period prior to 1969, NPS conducted 260 such studies (Swem 1969).

The beginning of the end for Section 8 came in the mid-1990s. Section 3003(a)(1) of the 1995 Federal Reports and Elimination and Sunset Act (109 Stat. 735) stopped agencies from continuing to prepare hundreds of *nonessential* (emphasis added) congressional reports. Included on this list was the Section 8 report, whose mandate, as a result of this legislation, ran out after 1999. The mandate to identify the annual "list of 12" new national parks and periodic monitoring of earlier site submissions was ignored after 1980 until it was repealed in 1999. In other words, the law was not enforced for 18 years simply because many members of Congress were hostile towards it.

Nonetheless, the natural region theme studies and the Section 8 requirements have had residual positive impacts. The information used to create new NNLs (and some new national parks) was derived from the natural region theme studies conducted between 1968 and 1986. As well, NPS continued to prepare the report for threatened and damaged NNLs in 2000 and 2001 because it was a valuable tool to alert America about impending threats. After that, NNL threats and damages were noted briefly in NPS "biennial reports" available on the NNL website. Some of the clear-cut threats to NNLs that were first identified in Section 8 reports include highway rerouting (Allerton Natural Area, Illinois; Moss Island, New York; Volo Bog, Indiana; Hoosier Prairie, Indiana), pipeline rerouting (Caverns of Sonora, Texas; Ginko Petrified Forest, Washington); powerline rerouting (Slumgullion Earthflow, Colorado; Valles Caldera, New Mexico), and dam relocation (Big Walnut Creek, Indiana; Piedmont Beech Natural Area, North Carolina; Busse Forest Nature Preserve, Illinois; Dinosaur Valley, Texas). One housing development was also relocated (Roxborough State Park, Colorado). The list could go on. For example, Hagerman Fauna Sites, Idaho, was saved from water erosion; Belt Woods, Maryland, did not suffer adjacent highway widening; and Shaver's Mountain Spruce–Hemlock Stand, West Virginia, did not succumb to underground mining. All of the above NNLs and many more benefited from the "threatened and damaged NNLs" aspect of the Section 8 report, which was submitted to Congress for 20 years, beginning in 1977.

Assessing *Part Two*

Part Two of the National Park System Plan: Natural History has been judged harshly. I shall examine three related criticisms.

1. *Part Two* "did not dominate the process for identification or authorization of new areas in the 1970s" (Conservation Foundation 1985: 272). This is mostly true but demands elaboration. Although the theme studies generated new park recommendations, Congress sometimes forged ahead on its own. The omnibus park acts of 1978 and 1980 are good examples. On the other hand, during the 1970s, many members of Congress regularly asked NPS about the quality and suitability of any site they were considering. Once in the 1970s, the head of the NNL Program, Frank H. Ugolini (armed with theme study recommendations) was invited to fly over much of the West with high-level Department of the Interior officials to decide on areas for new national parks. However, examine Tables 1–5. Several sites identified by the natural region theme studies were added to the national park system in the 1970s: for example, Cumberland Island, Big Cypress, Big Thicket, and Congaree. This is not to suggest that, in these cases, a theme study's new park recommendation or its NNL status always *caused* the area in question to be added to the national park system. Sometimes it was likely just coincidental. But in some cases, that recommendation, or its threatened NNL status, had a big influence. This is the case for Congaree, El Malpais, Valles Caldera, City of Rocks, and Hagerman Fossil Beds.

2. *Part Two* was "doomed … to virtual disuse" (Rettie 1995: 17). This is mostly true. *Part Two* was banned in the early 1980s but was used officially before that time. This writer recalls dozens of times in the 1970s when it was used as a tool to provide a negative response for an area being pushed by a member of Congress or, more proactively, used to steer him or her towards a better area identified by theme study teams. Sometimes the response was the need to await the outcome of a theme study.

3. *Part Two* was "largely ignored" (Wright and Mattson 1996: 11). Again, mostly true. My repeated observation after 1980 was that when opportunities arose to add new units to the national park system, the secretary of the interior or Congress only rarely consulted NPS. As far as where the best areas were, Congress and the secretary often acted as if they knew best and proceeded. And of course they all had their pet areas to protect or promote. They were often unaware that NPS sat on a database compiled over 18 years because it had to be kept quiet.

However, ignoring the issue of natural region theme studies yielding site-specific park recommendations, a glance at the various charts in *Part Two* allows one to determine whether a site could fill a gap in representation. For example, Great Basin, Brooks Range and some other Alaskan additions, and American Samoa all filled major gaps in natural region representation. In addition, Congaree, Big Thicket, Tallgrass Prairie, El Malpais, Hagerman, John Day, Big Cypress, Mojave, Great Sand Dunes, City of Rocks, Salt River Bay, and Guadalupe all filled gaps in theme representation. I am convinced that NPS frequently used *Part Two* in this fashion from the 1970s onward to ascertain the worth of a proposed new park. This is does not constitute being "ignored," *at least by NPS*. Where the natural region theme studies really shine is in their identification of potential NNLs.

Systematic park system planning

The unfortunate reality in the US is that any attempt to apply a systematic approach of adding new national park areas breaks down when additions must be approved by a legislature. They may cost too much, be opposed by special interest groups, or be unfavored by the state's congressional delegation. In fact, even if NPS thought a site was unworthy of addition to the system, Congress sometimes added it anyway (Mackintosh 1991 [2004]). During the 1970s, NPS initiated its own "new area studies" (i.e., a comprehensive examination of a potential park) on sites it thought were good candidates to improve or help "round out" the system. These new area studies addressed "suitability and feasibility" (NPS 2006). Today, such a study might also address factors like the site's potential for cooperative ventures in effective boundary expansion and habitat connectivity (NPS 2014a). With Section 8 now defunct, new approaches are being sought.

NPS system planning recommendations after the millennium

Science has learned more about preserving landscapes since 1972. The discipline of conservation biology did not surface until 1978 (Meine et al. 2006). During the 1980s, we began to appreciate factors such as reserve size, connectivity, replication, numbers, and shape (Shafer 1990). After the millennium, the National Park System Advisory Board hinted at a new vision for a system plan. They said that NPS should "restore wildlife corridors to provide biological linkages among habitats throughout North America.... The National Park Service should become an active participant in a national effort to create such connections" (Franklin et al. 2001: 15, 17):

They also criticized NPS, saying "there is no grand plan or vision guiding the evolution" of the national park system" (p. 26). On this point they may have been unaware that NPS once used *Part Two* during the 1970s and how park expansion was stopped by 1980 because of antagonistic attitudes by some members of Congress.

In 2004, the Science Committee of the Advisory Board (Earle et al. 2004 [2009]: 15) recommended establishing wildlife corridors as part of the NPS mission. In 2009, the Second Century Commission, an independent commission given the task of providing a 21st-century vision for the national park system, recommended that NPS "begin immediately to develop a new national park system plan in ways that reflect the goals of the national conservation network" (Baker et al. 2009: 23). They also recommended corridors be established. Such recommendations about corridors had been made much earlier, in 1990, by NPS staff in a private capacity (Shafer 1990).

In 2011, NPS issued *A Call to Action: Preparing for the Second Century of Stewardship and Engagement* (NPS 2011), which identified 36 actions the agency should undertake before its centennial in 2016. Among them was Recommendation #22: promote large landscape conservation using partnerships with public and private landowners. NPS Director Jonathan B. Jarvis later clarified that partnerships could be negotiated with "federal, tribal, state, and local government entities, non-governmental organizations, and private landowners to create continuous corridors" (Committee on Energy and Natural Resources 2012: 38). This may be in part too idealistic. Partnerships represent a gamble. Getting private landown-

Congaree National Park, South Carolina (1976)
Big Cypress National Preserve, Florida (1974)
Big Thicket National Preserve, Texas (1974)
Cumberland Island National Seashore, Georgia (1972)
El Malpais National Monument, New Mexico (1987)
Mojave National Preserve, California (1994)
National Park of American Samoa, American Samoa (1988)
Bering Land Bridge National Preserve, Alaska (1980)
Aniakchak National Monument and Preserve, Alaska (1980)
Cape Krusenstern National Monument, Alaska (1980)
Tallgrass Prairie National Preserve, Kansas (1996)

Table 1. New parks recommended by theme studies and later added as new units of the national park system (date established).

Channel Islands National Park, California
Great Basin National Park, Nevada
Olympic National Park, Washington
Death Valley National Park, California

Table 2. Boundary expansions recommended by theme studies and added to the national park system.

ers to cooperate is not going to work much of the time. Incentives and even coercion may have to come into play (Shafer 2015b). These are some of the approaches available to plan for climate change (Shafer 2015a). NGOs will need to get involved to assist NPS efforts.

In 2012, the Advisory Board produced another report, *Revisiting Leopold: Resource Stewardship in the National Parks* (Colwell et al. 2012). This was a reexamination of policies recommended in the famous Leopold Report (NPS 1970; originally published 1963), arguably the most respected natural resources management policy document ever to guide NPS. The report said:

> NPS management strategies must be expanded to encompass a geographic scope beyond the park boundaries to larger landscapes and to consider larger time horizons. Specific tactics include improving the representation of unique ecosystem types within the National Park System, prioritizing the protection of habitats that may serve as climate refugia, the maintenance of critical migration corridors, and strengthening the resilience of park ecosystems (Colwell et al. 2012: 14–15).

Cassia Silent City of Rocks NNL (1974) became City of Rocks National Reserve, Idaho (1988)
Hagerman Fauna Sites NNL (1975) became Hagerman Fossil Beds National Monument, Idaho (1988)*
Salt River Bay NNL (1980) became Salt River Bay National Historical Park and Ecological Preserve, US Virgin Islands (1992)*
John Day Fossil Beds NNL (1966) became John Day Fossil Beds National Monument, Oregon (1974)
Congaree River Swamp NNL (1974) became Congaree National Park, South Carolina (1976)
Grants Lava Flow NNL (1969) became El Malpais National Monument, New Mexico (1987)

Table 3. National natural landmarks that were later added as new units to the national park system (first date, when the NNL was designated; second, when the park was established). Those marked with an asterisk (*) were also listed on an NNL Section 8 threatened and damaged report.

Point of Arches (1971) NNL into Olympic National Park, Washington
Cowles Bog (1965), Pinhook Bog (1965), and Hoosier Prairie (1974) NNLs into Indiana Dunes National Lakeshore, Indiana*
Cinder Cones Natural Area (1973) and Eureka Sand Dunes (1983) NNLs into Death Valley National Park, California*
Hermitage (1977) NNL into Appalachian National Scenic Trail, Maine to Georgia
Valles Caldera NNL (1975) into Bandelier National Monument, New Mexico*
Arrigetch Peaks (1967) and Walker Lake (1968) NNLs into Gates of the Arctic National Park and Preserve, Alaska
Iliamna Volcano (1976) and Redoubt Volcano (1976) NNLs into Lake Clark National Park and Preserve, Alaska
Aniakchak Crater (1967) NNL into Aniakchak National Monument and Preserve, Alaska
Malaspina Glacier (1968) NNL into Wrangell–St. Elias National Park and Preserve, Alaska

Table 4. National natural landmarks later subsumed into units of the national park system (date designated). Those marked with an asterisk (*) were also listed on an NNL Section 8 threatened and damaged report.

New Jersey Pinelands National Preserve, New Jersey, managed by the New Jersey Pinelands Commission
Canaan Valley National Wildlife Refuge, West Virginia, managed by the US Fish and Wildlife Service; became an NNL in 1974*
Mount St. Helens National Volcanic Monument, Oregon, managed by the US Forest Service
Old Paria into Grand Staircase-Escalante Canyon National Monument, Utah, managed by the Bureau of Land Management
Part of Nipomo Dunes–Point Sal Coastal Area, CA, became Guadalupe–Nipomo Dunes National Wildlife Refuge, managed by the US Fish and Wildlife Service; became an NNL in 1974*

Table 5. Sites identified in theme studies that subsequently became well-known protected reserves under non-NPS administration. Those marked with an asterisk (*) were also listed on an NNL Section 8 threatened and damaged report.

In August 2014, NPS rolled out a glossy document called *A Call to Action: Preparing for a Second Century of Stewardship and Engagement* (NPS 2014a). It said "we will work with communities and partners to submit to Congress a comprehensive National Park System plan…" (p. 9). That same year, an attractive booklet entitled *Scaling Up: Collaborative Approaches to Large Landscape Conservation* (NPS 2014b) provided a collection of park stories depicting scaling-up activity already underway, that is, cooperative park boundary expansion and cooperative corridor facilitation. During October 23–24, 2014, NPS, US Fish and Wildlife Service, BLM and others sponsored the National Workshop on Large Landscape Conservation (www.largelandscapenetwork.org/2014-national-workshop) in Washington, D.C. In the view of this author, this was one of the most forward -thinking conservation activities that the Department of the Interior, under the leadership of Secretary Sally Jewell, has supported for a very long time.

Political interference in retrospect

How much freedom a park agency in the US has in creating new parks depends on the views of the political party in power. In the early 1970s, Congress was supportive of national park system planning. By the mid-to-late 1970s, that support was mixed with opposition. By 1980, having a national park system plan was regarded as very dangerous by NPS managers, and touting one was even tantamount to political suicide; this view generally held until the end of the George W. Bush administration in January 2009. This history supports an observation by the political scientist John Freemuth, who wrote that "NPS will find it difficult, if not impossible, to insulate itself from political influence" (Freemuth 1999: 75).

But by 2001, a new concept of park planning was becoming integrated into the minds of NGOs, park planners, and managers. This new mind-set was no longer only about locating the best representative sites to fill gaps in the national park system, and then addressing their suitability and feasibility. Nor was it so much about adding new parks as about making existing parks more viable and part of a larger protected area network. Now the thrust was about park integration into the surrounding region, corridors for animal dispersal, increasing a park's effective size through cooperative boundary expansion, and preparing for climate change. Skeptics knew it also had to address an activity that federal agencies dread to consider because of the inevitable political opposition: land use planning outside park boundaries (Shafer 2015b). A similar recommendation about the need for land use planning outside parks was made in 1972, well before the climate change issue surfaced (Conservation Foundation 1972).

Is it possible that all political parties can work together in the best interest of park biota? Past history suggests the answer is no. For three decades, congressional interference prevented NPS from pursuing its mandate for new parks more vigorously. This review illustrates that when agencies are suppressed by politicians beholden to the natural resources extraction industries, private property rights groups, and shrinking budgets, the result can be costly for Americans who want more and better parks.

Acknowledgments

I thank Judy Shafer for her comments on drafts of this article. I must recognize Gary Waggoner, Bill Halverson, Ron Hiebert, and Ralph Root, who were also involved in administering the National Park System Plan in the 1970s. I dedicate this account to Frank H. Ugolini who was ultimately responsible for all the activity described herein in the 1970s and all ensuing positive results. Some of this material from Shafer (1999) was reused with the permission of Springer Science + Business Data.

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Saving the Bar BC Dude Ranch: A New Method for Setting Preservation Priorities

Frank Matero

On the secluded flats of the Snake River in full view of the majestic Teton Range, an upstart Philadelphian and Princeton graduate, Maxwell Struthers Burt, introduced countless Americans to the raw beauty of the Mountain West. According to his own biography, Burt had always been attracted to the American West and acted on that dream in 1906 after an abrupt departure from Princeton. In so doing he would significantly influence public advocacy for protecting and preserving the scenery, rivers, valleys, and wildlife of that country through the establishment of Grand Teton National Park and, more broadly, the creation of the National Park Service in 1916.[1] A leading proponent of dude ranching in America, Burt founded Jackson Hole's first dude ranch, the JY in 1908, followed by the Bar BC Dude Ranch four years later, in the summer of 1912. Together with his partner Horace Carncross, and later his wife, Katharine Newlin, Burt would transform the Bar BC into the most successful and influential of the first generation of Wyoming's dude ranches (Figure 1).

Dude ranching was introduced in America by the 1880s as western ranches began to accept paying guests to experience the "cowboy life" (Bourne 1983). By the beginning of the new century dude ranches began to proliferate, partly fueled by nostalgia for a disappearing frontier and its rustic lifestyle. Guest or "dude" wrangling offered working ranches additional and welcome income, especially during difficult years when cattle operations were marginal. The Jackson Hole, greater Cody, and Sheridan–Buffalo areas in Wyoming emerged as the first dude ranching centers, along with Montana (especially areas north of Yellowstone) and scattered areas in Colorado. According to Burt, "the dude wrangler is a ranch man, a cowman, a horseman, a guide, a wholesale chambermaid, a cook, and storekeeper rolled into one"(Burt 1938: 49, 58). Burt's Philadelphia and Princeton connections and his literary reputation, along with that of his wife, Katharine Newlin, brought a constant stream of important guests, including eastern socialites, writers, actors, and politicians—among them a few presidents.

The George Wright Forum, vol. 33, no. 1, pp. 47–58 (2016).

ISSN 0732-4715. Please direct all permissions requests to info@georgewright.org.

Figure 1. Bar BC Dude Ranch, n.d., before 1945. View toward the Tetons with cabins, landscape and reflecting pool. (Photo by H.R. Crandall, Jackson Hole Historical Society and Museum.)

First and foremost a business, dude ranching promoted the economic benefits of wilderness scenery, hunting, and fishing, yet its interests also coincided with the nascent environmental movement and have much in common with today's ecotourism. At first wary of government interference, Burt himself eventually came to passionately support the National Park Service's efforts to preserve the Grand Tetons as a natural recreational area, recognizing the mutual benefits to be derived from preservation of the natural resources and the scenery as well as the control of unsightly development in and around Jackson Hole.[2] Already sensing the value of preserving both the strong frontier flavor of Jackson Hole through its vernacular log buildings and ranching as well as the natural scenery surrounding it, Burt proposed the entire area as "a museum on the hoof"(Righter 1982: 33). His belief in and understanding of the public's desire to experience the American West through dude ranch tourism was correct. In its heyday period from 1919 to 1929, dude ranching was the area's dominant industry, with guests often exceeding the resident population.[3] After the Second World War, with the rise of automobile-based tourism, shorter vacation periods, and Americans' increasing access to international travel, many dude ranches closed, and their legacy and contributions to the conservation movement were largely forgotten.

A vanishing treasure

In 1986, after years of decline, the Bar BC Dude Ranch property came under the direct management of Grand Teton National Park, part of the park's long-awaited expansion in 1950 to include the valley's bottomlands. In 1990 the property was listed as a nationally significant historic district on the National Register of Historic Places, and in 1999 an in-depth historic structure report (HSR) was begun followed by a cultural landscape inventory (CLI) (Graham 1994; Shapins and Associates 1999). Despite these efforts and sporadic attempts to stabilize the structures to preserve the country's oldest surviving dude ranch, the Bar BC continues to languish and today remains largely unknown to the vast majority of visitors who come to the park every year.

For those who know of the place through Burt's own recounting of his experiences as a dude rancher in his popular 1924 *Diary of a Dude Wrangler*, or the intrepid visitors who travel the site's rocky road to fish the Snake River or ride the horse trails, the reward is as impressive as it must have been for Bar BC's guests in the ranch's heyday. A dry, dusty, bone-jolting ride down the access road off the Inner Park Loop Road across the first two benches eventually opens to a spectacular panoramic view of the meandering Snake River and the Gros Ventre range beyond. A series of small log guest cabins tucked in clusters within stands of trees consciously placed along the bottomlands can be clearly discerned, along with several larger purpose-built log structures, including a barn, stable, figure eight corral, and a heap of logs that was once the main cabin (Figure 2). At its period of peak operation from 1912 to1941 (which is considered the "period of significance" for cultural resource management purposes), the Bar BC had over 45 structures across 600+ acres, including a tack shed, dance hall, ranch store, and natural river-fed swimming pool. Although the park fully recognizes the significance of the place, locally and nationally, other better known and equally historic complexes, such as Mormon Row, compete for time and funding for much-needed preservation and interpretation.

Figure 2. Bar BC Dude Ranch, 2015. Current condition of overgrown landscape and ruined buildings. (Photo courtesy of the Architectural Conservation Laboratory/University of Pennsylvania.)

This situation, all too common at many western parks, and especially those whose reputation has been based historically on their natural and scenic values, has required the need for creative solutions to cultural resources suffering from a backlog of deferred maintenance and advocates for low-impact use and interpretative programs. Recognizing the importance of the long cultural imprint on park lands, Grand Teton National Park is currently completing a historic properties management plan (HPMP) to assist resource managers in establishing preservation and management priorities throughout the park. Through a unique partnership between the park and the Western Center for Historic Preservation, an education and resource center dedicated to the preservation and maintenance of cultural resources in the western national parks, and the Architectural Conservation Laboratory in the School of Design at the University of Pennsylvania, an innovative project was begun in 2011 to develop an assessment of the Bar BC site and especially its structures in terms of their significance, integrity, and condition.

The basic problem facing cultural resource managers in evaluating a large ,complex site such as Bar BC is deciding what resources get attention first and for how long. We devised a rapid assessment survey to tease out the individual and combined effects of critical variables, such as design, construction, materials, and orientation, to test various cause-and-effect scenarios. In addition, by evaluating each structure independently in terms of its principal preservation assets (historical significance, integrity, and physical condition), the entire assemblage of structures could be effectively evaluated within a given classification (e.g., guest cabins) or across an asset (e.g., condition). The goal of the survey and assessment was to help create a conservation and management plan for Bar BC Ranch and to enable resource managers to make informed decisions about immediate and long-term actions for the site (Longfield 2011). The use of a geographic information system (GIS) platform allowed the researchers to gather large data sets and analyze and visualize those data spatially as well. It also has proven beneficial in monitoring the deterioration, maintenance, and future service life of various types of repairs of all log structures in the park.

Methodology

This project develops and tests levels of recording and the critical data needed to assist resource managers to better understand and mitigate specific threats and risks associated with log structures. To do this, the survey was guided by first understanding the agents that threaten the structures. While damage, in this context, is the cumulative measurable response of cultural fabric to specific agents deleterious to it, and can be recorded as "condition," associated contextual factors such as topography, climate, vegetation, and public access can affect the type and degree of damage. As a result, both past and existing conditions of the structures as well as that of their associated context must be documented and studied to assess risk and to develop a plan to manage it.

Conservation based on risk mitigation is defined as "preventive." If risk can be reduced or controlled, deterioration will be slowed, thus the integrity of the cultural resource can be preserved and maintained to a higher degree than if no action were taken. "Remedial" conservation includes actions such as material restoration and structural stabilization. The merits of indirect or preventive conservation versus direct or remedial conservation can be longer retention of original material and avoidance of expensive episodic campaigns of restoration.

The architectural condition survey and assessment, reported herein, was based on a rapid visual inspection of each structure focusing on key elements that were identified as critical to log building stability and performance. In this way, the survey attempted to quickly rank structures in order to prioritize those deemed in need of more in-depth documentation and analysis in the future as funds become available. The majority of the assessment focused on the exterior of the structures; however, interior integrity and condition were also surveyed.

At Bar BC, significance is related to the date, use, and prominence of the buildings within the context of the ranch's development; specifically, its period of significance, 1912–1941. This assessment was performed independently of that for condition and integrity because significance, as a quantifiable asset, is understood to be less easily measured. "Condition" refers to the physical state of a building and its individual elements. Since the interiors contain few structural elements not already visible on the outside, condition was largely determined from the exterior inspection. "Integrity," according to the Secretary of the Interior's Standards on Historic Preservation, is "the authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during the property's historic or prehistoric period." In the case of Bar BC, integrity is a measure of the degree of surviving original fabric and is a function of condition alone because the structures have not been subjected to repair or significant restorations that can compromise integrity.

Individual building elements (foundations, walls, and roofs) were identified and assessed separately according to their major role in the construction and performance of the log structures. For each of these elements, several attributes were identified and their conditions recorded to allow a comparative rating within each element class. For example, in the case of foundations, the type and number of footings were considered. Each wall elevation was assessed for condition of the upper and lower halves, respectively, the sill log (which was not considered in the evaluation of the lower half of logs), extant chinking, openings within the wall, and the type of corner detail. Overall structural problems recorded were tilting, racking, displacement, and deformation. Finally, associated contextual aspects that can accelerate the decay process such as exposure, vegetation, grade, and drainage were noted and documented as well.

All roofs are of gable construction and each slope of the roof was assessed separately. Fundamental roof attributes included the skin or covering, wood sheathing, and the number of purlins in sound condition. Porch analysis identified the number of posts intact versus the number of posts intended, basal rot, and closed or open joints. Additionally, the floor slope and floorboard condition were considered. Finally, the chimney masonry was assessed for deformation, cracking, and loss.

To obtain an overall condition assessment for each building and its elements, a comparative rating system was developed for all the described features. This rating system, depending on the attributes, was a scaled description, a choice between yes and no, or a fraction. The ratings were then converted into a Likert scale, which allowed further elaboration and evaluation through summing and multiplication. This rating system provided different scales of evaluation. Either a single element or the entire building could be comparatively assessed and analyzed within or across categories (Figure 3). A detailed description of each term and condition rating was included in an illustrated glossary to ensure recording consistency across individual surveyors.

The information generated in the survey was entered into a Microsoft Access database, which allowed the data to be analyzed quantitatively. The data were then queried to suggest relationships between the condition of the building and site characteristics such as orientation, as well as comparisons between architectural elements within a single building or across multiple examples. The creation of a "ranked" list of buildings by condition and/or integrity was created to help prioritize stabilization and preservation work on the structures as funds and assistance become available. In order to visualize the data, the Access database was linked to a GIS, producing a site plan complete with symbol-coded values for the condition of individual elements as well as an entire building (Figure 4).

Risk and threat

The condition assessment provided information that could be related to specific risks and the threats to the buildings. Three different aspects of risk were recorded: environmental (context), architectural (design and materials), and structural. Each aspect is important to understand how the buildings have and will continue to perform if left untreated. Using regression analysis, each aspect was compared against another to determine if there was a correlation between them. A correlation between two aspects could suggest a cause-and-effect relationship. Assuming processes of decay can be explained through observable conditions, measures can be taken to ultimately mitigate hazards and prolong the historic fabric of the structures through careful monitoring and maintenance.

Analysis was performed on the average scores for each of the major building components: foundations, walls, and roofs. The results demonstrated several important correlations. First, that the condition of the walls is significantly related to the condition of the roofs, i.e., a building with a low score for roof condition often has walls that also score low for condition. Regression analysis did not show any significant relationships between walls and foundations or foundations and roofs. Since roof and wall conditions are closely related, these elements were further analyzed in an attempt to isolate conditions that have the greatest effect on each of the components.

Roofs protect the walls and interiors from exposure to rain, snow, and sun (solar radiation), and are equipped with sacrificial materials such as asphalt roll roofing that will decompose under the heavy onslaught of ultraviolet radiation and precipitation. Underneath the roofing material is a layer of plywood or wood planks. This layer is supported by a series of log purlins that are exposed on the interior of the buildings. Of all the construction materials within each structure, the roofing has the lowest average service life due mainly to its high ex-

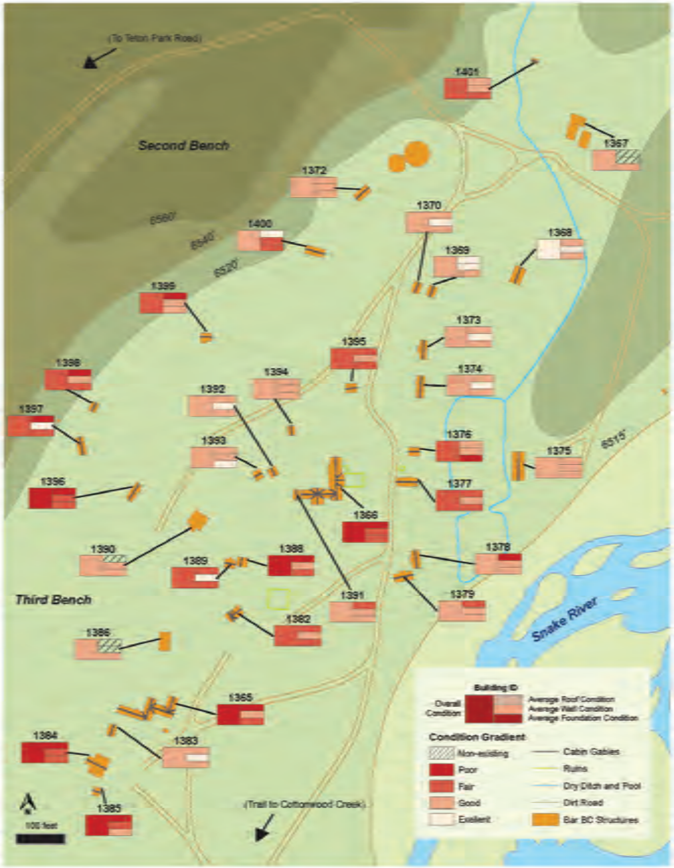
Figure 3 (opposite). Bar BC Condition Assessment. Survey Data: Overall. Table of Scores, 2012. (Photo courtesy of the Architectural Conservation Laboratory, University of Pennsylvania.)

BAR BC Condition Assessment

SURVEY DATA: OVERALL

GIS ID Number	Dode Cabin Number	Date Surveyed	Date Entered	Weather while Surveying	Number of Trees w/in 20 Feet	Presence of Overhanging Branches	Gable Direction	Foundation Type	Foundation Footings (# in Good Condition/ # Intended)	Foundation Stabilization?	Foundation Repairs?	Foundation Notes	Average Foundation Condition Score	Average Wall Condition Score	Average Roof Condition Score	Purlin Condition (# in good condition/ # intended)	Purlin Condition Score	Roof Notes
1365		07/26/11	8/25/2011	SUNNY	20	YES	ALL	SLAB	0	FALSE	FALSE		2.89	4.22	1.22	15/20	2	COULDN'T GET INTO 1365-B, THE STORE ROOM, BECAUSE OF THE TYPE OF NAILS IN THE PLYWOOD BLOCKING THE ENTRANCE.
1366		07/26/11	8/7/2011	SUNNY	20	NO	ALL	SLAB	0	FALSE	FALSE		3.19	3.67	1.89	21/47	3	
1367		07/25/11	7/28/2011	FAIR	2	NO	NA	SLAB	0	FALSE	FALSE		4.60			NA		
1368		07/25/11	7/25/2011	SUNNY	6	NO	N-S	RAISED	6/6	FALSE	FALSE		4.40	4.69	4.33	6/7	2	
1369	5	07/25/11	7/25/2011	FAIR	10	YES	N-S	RAISED	2/4	FALSE	FALSE		3.60	4.97	4.56	5/5	5	
1370	2	07/25/11	7/25/2011	FAIR	10	YES	N-S	RAISED	7/7	FALSE	FALSE	FOOTINGS IN FRONT OF CABIN MAY INDICATE THAT IT WAS MOVED	4.40	4.85	4.11	5/5	3	NAILS POPPING OUT ALONG FLASHING
1372		07/25/11	7/25/2011	FAIR	4	NO	N-S	RAISED	11/11	FALSE	FALSE	RAISED FOOTINGS: CABIN STONE 4/6, PORCH CONCRETE 5/5	3.64	4.47	4.00	5/5	3	
1373	3	07/25/11	7/25/2011	SUNNY	5	NO	N-S	RAISED	6/6	FALSE	FALSE		4.00	4.87	3.89	5/5	5	
1374	4	07/25/11	7/25/2011	SUNNY	6	NO	N-S	RAISED	6/6	FALSE	FALSE		3.98	4.53	4.13	5/5	4	FLASHING INSTALLED ALONG ROOF EDGE
1375		07/25/11	7/26/2011	SUNNY	8	NO	N-S	RAISED	8/8	FALSE	FALSE	CONCRETE PAD—SE PAD MAY EXIST BELOW GRADE BUT NO LONGER SUPPORT STRUCTURE	3.93	4.44	3.58	NA		DEFORMATION OCCURS WHERE PORCH WAS; BOLTS IN TRUSS POSTS AND BEAMS; LOOKS LIKE SHEATHING REPLACED
1376		07/25/11	7/26/2011	FAIR	6	NO	E-W	RAISED	4/4	FALSE	FALSE		3.99	4.28	3.67	5/5	3	
1377	5	07/25/11	7/26/2011	FAIR	8	NO	E-W	RAISED	6/6	FALSE	FALSE	CONCRETE PADS	3.00	3.85	2.88	NA		NEW SHEATHING
1378	6	07/26/11	7/26/2011	SUNNY	8	NO	N-S	RAISED	6/6	FALSE	FALSE		3.97	4.26	5.00	5/5	5	
1379	7	07/28/11	7/26/2011	SUNNY	6	NO	E-W	RAISED	6/6	FALSE	FALSE		4.17	4.13	2.67	4/5	3	
1382		07/22/11	7/26/2011	FAIR	3	NO	N-S	RAISED		FALSE	FALSE		2.80	3.90	3.35	5/5	5	
1383		07/22/11	7/26/2011	FAIR	6	NO	N-S	RAISED	4/4	FALSE	FALSE		4.10	4.90	3.56	4/5	3	
1384		07/20/11	7/26/2011	FAIR	7	NO	E-W	RAISED	8/8	FALSE	FALSE		3.35	2.90	1.13	NA		
1385		07/22/11	7/26/2011	FAIR	10	YES	E-W	RAISED	4/4	FALSE	TRUE	RAISED ON WOODEN SLED FOUNDATION	3.78	2.76	1.00	2/5	1	
1386		07/22/11	7/26/2011	FAIR	5	NO	NA	RAISED	8/8	FALSE	FALSE	BUILDING HAS BEEN DISASSEMBLED, NEW FOOTINGS HAVE BEEN POURED	4.40			NA		
1388	7	07/28/11	7/26/2011	SUNNY	8	NO	N-S	GRADE	0	FALSE	FALSE		2.80	3.72	1.78	5/7	3	
1389		07/20/11	7/28/2011	FAIR	5	YES	E-W	RAISED	4/4	FALSE	FALSE		3.15	4.58	3.67	7/7	3	UNDERNEATH WHERE ASPHALT INTACT, GOOD SHEATHING; WHERE ASPHALT DETERIORATED, SHEATHING DETERIORATED
1390		07/20/11	7/28/2011	FAIR	1	YES	NA	SLAB	0	FALSE	FALSE	CONCRETE POURED FOUNDATION WITH RANDOM RUBBLE WALL FRAGMENTS	4.40	4.85		NA		NO ROOF DUE TO CATASTROPHIC FIRE
1391	8	07/25/11	7/28/2011	SUNNY	8	NO	N-S	RAISED	4/4	FALSE	FALSE		4.75	4.78	4.60	5/5	4	
1392	10	07/25/11	7/28/2011	SUNNY	8	YES	E-W	RAISED	4/4	FALSE	FALSE	STONE FOOTINGS	3.85	4.86	3.78	5/5	3	
1393	9	07/25/11	7/28/2011	SUNNY	10	YES	E-W	RAISED	4/4	FALSE	FALSE		4.50	4.15	3.89	5/5	5	
1394		07/25/11	7/28/2011	FAIR	8	NO	N-S	RAISED	4/4	FALSE	FALSE		4.50	3.97	3.67	3/5	3	
1395	11	07/25/11	7/28/2011	SUNNY	2	YES	E-W	RAISED	4/4	FALSE	FALSE		3.25	4.00	3.11	4/5	3	
1396	14	07/25/11	7/28/2011	FAIR	20	NO	N-S	RAISED	5/6	FALSE	FALSE		3.13	2.33	1.00	1/5	1	
1397	15	07/25/11	7/28/2011	FAIR	3	NO	N-S	RAISED	6/6	FALSE	FALSE		2.37	4.69	1.56	3/5	3	
1398	16	07/25/11	7/28/2011	FAIR	12	NO	N-S	RAISED	4/4	FALSE	FALSE		3.15	4.39	1.00	3/5	3	
1399	17	07/25/11	7/28/2011	SUNNY	15	NO	E-W	RAISED	4/4	FALSE	FALSE		3.50	4.28	1.72	5/5	5	
1400	18	07/25/11	7/28/2011	FAIR	8	YES	E-W	RAISED	5/6	FALSE	FALSE	1 OF THE RAISED FOUNDATIONS ARE CONCRETE	2.63	3.44	5.00	5/5	5	
1401		07/25/11	7/28/2011	FAIR	10	YES	E-W	SLAB	0	FALSE	FALSE		2.80	3.58	1.75	NA		

22



NPSNum	Overall Average	Average Found	Average Wall	Average Roof
1384	2.39	3.15	2.90	1.13
1385	2.41	3.48	2.76	1.00
1396	2.52	3.13	3.43	1.00
1388	2.77	2.80	3.72	1.78
1365	2.78	2.89	4.22	1.21
1366	2.85	3.19	3.47	1.89
1398	2.88	3.25	4.39	1.00
1397	3.07	2.97	4.69	1.56
1399	3.13	3.90	4.28	1.22
1377	3.24	3.00	3.85	2.88
1376	3.28	1.90	4.28	3.67
1382	3.36	2.83	3.90	3.35
1401	3.38	2.80	3.58	3.75
1395	3.45	3.25	4.00	3.11
1389	3.47	3.15	4.58	2.67
1378	3.58	3.97	4.26	2.50
1379	3.65	4.17	4.13	2.67
1400	3.69	2.63	3.44	5.00
1391	3.86	4.35	3.78	3.44
1375	3.96	3.93	4.44	3.50
1394	3.98	4.30	3.97	3.67
1372	4.02	3.64	4.42	4.00
1392	4.16	3.85	4.86	3.78
1393	4.17	4.50	4.11	3.89
1383	4.19	4.10	4.92	3.56
1374	4.20	3.98	4.51	4.11
1373	4.28	4.07	4.87	3.89
1369	4.38	3.60	4.97	4.56
1367	4.40	4.40		
1386	4.40	4.40		
1390	4.42	4.40	4.45	
1370	4.45	4.40	4.83	4.11
1368	4.45	4.40	4.63	4.33

OVERALL CONDITIONS

BAR BC DUDE RANCH

Grand Teton National Park, WY

Graduate Program in Historic Preservation
University of Pennsylvania, 2012
Documentation Team: Mary Catherine Collins, Maria Diadato, Christine Leggio, Nels Yougborg

Sources: Graham, Roy Eugene. Bar B-C Dude Ranch Historic **Structures Report. National Park Service, U.S. Department of the** Interior. Washington, D.C. 1993; Burt, Maxwell Struthers. Diary of a Dude-Wrangler, Charles Scribner's Sons, 1925; Burt, Nathaniel. Jackson Hole Journal, University of Oklahoma Press. 1983

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Figure 4 (opposite). Bar BC Condition Assessment. Overall conditions site map, 2012. (Photo courtesy of the Architectural Conservation Laboratory, University of Pennsylvania.)

posure, material, and vulnerable (albeit historical) installation method (horizontal rather than vertical). Therefore, it is not surprising to find that the roofs have the most apparent damage as compared with the walls and foundations. As the roofs are the first line of defense of the other structural components of the buildings, so the maintenance of roofing components is of the utmost importance.

The data gathered suggested that structures with roofs in good condition had walls in good condition. Therefore, it is important to identify what environmental circumstances were of greatest significance to the condition of the roofs. Two of the environmental variables that had the highest correlation were the presence of trees within twenty feet and roof orientation. Trees add twig and leaf litter to roofs which retain moisture and create adverse conditions that speed deterioration of the asphalt roofs. (Both sod and asphalt roofs were used historically; however no sod roofs were in active use at the time of the survey.[4])

Results of the analysis show that roofs with a north–south orientation were in worse condition overall than roofs with an east–west orientation. However, the rate of structural deformation of the roofs was consistently high between both gable orientation types. This relationship could be caused by environmental factors such as prevailing winds and solar radiation patterns. These hazards damage the roof both directly and indirectly. Since our results showed a relationship between the condition of the roof and the condition of the walls, a north–south orientation indirectly affects the roof by damaging the walls, therefore leading to potential roof damage. Analysis of wall orientation and condition shows that a north–south orientation correlated with the worst wall conditions, the same as for the roof orientation and condition.

Another relationship that was analyzed was purlin condition and average roof condition. The results of this analysis showed a very strong relationship. Poor purlin conditions were associated with poor roof scores, and good purlin scores were associated with good roof scores. Since this was a strong relationship, a failure in one component most likely would lead to failure in the other. Roof material had the shortest useful life. Failure in the roofing material leads to deterioration of the sheathing and then will lead to deterioration of the purlins, which has structural implications. This is an obvious and direct relationship.

Although many of the walls exhibited signs of sun and moisture damage, especially on the southern elevation, the overall condition of the individual logs was good. Despite good log condition, structural conditions observed during the field survey, such as tilting, racking, displacement and deformation, were prevalent in a great many structures. In order to understand what other factors might be significant, context (grade, orientation) and design details (wall corner treatments, purlins, and sill logs) were also studied as potential contributors.

Analysis of sill logs and overall structural conditions (an average of tilting, racking, displacement, and deformation scores) for the walls showed a unilateral relationship. Instead of a mutually damaging relationship, the presence of structural deterioration was often indicated by a damaged sill log, but damaged sill logs were not good indicators of structural deterioration. Also, not all four of the structural deterioration types were associated with sill condition. The presence of deformation and tilting showed a strong relationship with sill logs in poor condition, whereas racking and displacement showed a poor relationship to the condition of the sill log. The relationship between purlin condition and the structural condition of the walls did not provide a good indicator of condition, either. Further analysis of the relationship between purlin condition and structural condition within each wall corner type may demonstrate higher correlations. For example, cabins with box and post or "hog trough" corners may have worse structural wall damage and deteriorated purlins, as opposed to cabins with more secure corner types such as square notch and saddle joined. Analysis between corner type and structural wall condition showed a strong relationship between tilting, racking, and deformation; however, displacement was not a good indicator of corner condition. Once again, further analysis of each corner type may be valuable due to the flexible strength of square notch and saddle log joints compared with hog trough corners that lack the ability to stay together during deformation. What these relationships suggest is that the conditions of the sill logs, roof, and type of corner detail have the greatest effect on the overall structural stability of a log cabin.

The sill logs of the cabins exhibited more damage than any other components within each wall. This was due to the threats that constantly surround these members: vegetation, grade level, and slope of drainage. Analysis demonstrated that soil grade had the strongest relationship with the condition of the sill log. A positive soil grade was related to a better sill log condition score, while a negative grade was related to a worse sill log condition score. A zero grade level had a less significant relationship to sill log condition; however, it was slightly negative. Each of the relationships studied showed a trend in grade hazards and sill condition, yet no single threat could be identified as the strongest indicator of condition other than a prevalence of moisture-related decay in those sill logs on the gable roof slope elevation.

Conclusions

When architectural significance and integrity are defined by the unique character-defining form and fabric of built heritage—in this case, local materials and traditional methods—preservation of the original or, if necessary, repair in kind, is critical to the continued meaning and understanding of traditional places such as Bar BC. While many of these performance relationships are well known to building pathologists and especially log construction professionals, the combined effects of multiple variables such as materials, design, and orientation are often not evident enough to suggest trends in how any given structure weathers. With over 40 buildings of similar material and age, yet variable orientation and detailing, this project afforded the team ample opportunity to test various cause-and-effect scenarios. Ultimately the goal of the survey was to devise immediate remedial and long-term preventive strategies to address the physical needs of the majority of the most important structures at Bar BC.

With the completion of the condition survey and analysis, and the preparation of the conservation and management plan, preservation of Bar BC's structures has proceeded annually since 2011 according to a prioritized list that identifies the most significant structures in the greatest need of stabilization. Stabilization work has been accomplished through volunteer labor under park and partner supervision, but the key has been a clearly defined set of parameters to guide the process of building selection and the methods of intervention for everyone. The project demonstrates how a rapid assessment survey based on a resource's individual assets, along with a quantitative and visual database using GIS, can offer cultural resource managers a clear way out of the dilemma of deciding what resources get attention first and for how long. The conservation and management of cultural resources are not like those of natural resources, in that they are not renewable in the biological sense. However, quantitative methods can be used to describe and evaluate cultural resource assets so that informed decisions can be made to preserve as much of a site as possible without compromising its values.

Endnotes

1. On the influence of Struthers Burt and the dude ranching industry on the early environmental movement and the creation of Grand Teton National Park, see Righter 1982.
2. This moment of conversion is often identified with Burt's attendance at a meeting at Maud Noble's cabin in 1923, where a group of locals and the National Park Service devised the Jackson Hole Plan to preserve and protect the area from development.
3. In 1925 the *Jackson's Hole Courier* reported that over 600 dudes were visiting the valley in the summer, 200 over the resident population. Cited in Longfield 2011, 13.
4. In an effort to gain better service life of the roofs, a research program was initiated in 2011 to reinstall the historic sod roofs using green roof technology. See Cantu 2012.

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America's Lost National Park Units: A Closer Look

Joe Weber

In 1991, Alan Hogenauer (1942–2013) published two papers (1991a, 1991b) in *The George Wright Forum* on the topic of lost park units. These comprised five categories that park units could fall within: proposed, authorized but never established, established and active, separately established but eventually absorbed, and delisted sites. The 26 sites in the last group were formerly part of the national park system but have been removed, and received the most attention. The numbers have changed somewhat since Hogenauer wrote about them, as the John F. Kennedy Center for the Performing Arts in Washington, DC, was delisted in 1994 and the Oklahoma City National Memorial (created in 1997) was delisted in 2007. But aside from these papers by Hogenauer and one by Barry Mackintosh, a National Park Service (NPS) bureau historian (Mackintosh 1995), very little attention has been given to these places. It is safe to say the prevailing attitude towards them has been one of disdain and they are seen as being unworthy of ever having been in the national park system. The goal of this paper is to examine these delisted sites more closely. A closer examination shows that they tell us more about the history of the park system than might be thought. Rather than being exceptions to the rule of selecting only high-quality sites to become park units, the delisted sites were actually quite typical.

Hogenauer provided general descriptions of the various delisted units, but no details or maps. Unfortunately, he also provided no sources or references for his descriptions. However, the National Park Service Office of Legislative and Congressional Affairs (National Park Service 2016) has collected all laws and proclamations relating to the national park system, and these can be accessed through their website. This was the primary source of information used here. All of the delisted units Hogenauer discussed, with the exception of Wolf National

The George Wright Forum, vol. 33, no. 1, pp. 59–69 (2016).

ISSN 0732-4715. Please direct all permissions requests to info@georgewright.org.

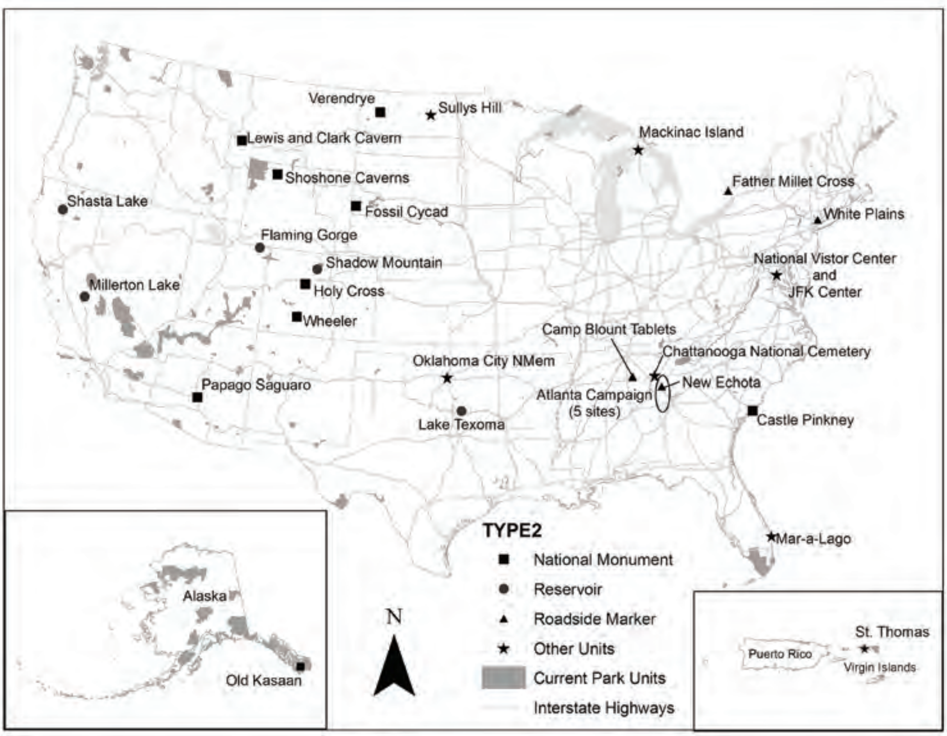
Scenic Riverway in Wisconsin (for which no information could be found showing it to have been an established unit), were found and mapped (Figure 1).

As Hogenauer (1991a) noted, these sites are distributed across the country. However, there are in fact geographic patterns among the delisted units. Most can be fit into one of three groups: national monuments (NMs), western reservoirs, and roadside markers. Each group has a different geography as well as a unique story about its role in the shaping of the national park system. Not all the delisted units fit into these three sets of stories. The fates of the National Visitor Center, Kennedy Center for the Performing Arts, and Oklahoma City National Memorial lie in management issues (Hogenauer 1991; Mackintosh 1995), while Sullys Hill entered the national park system because its original overseeing agency was within the Department of Interior, which administered national parks before NPS was created (Harmon 1986). It was dropped from the system because it did not meet the standards later developed by NPS. The strange saga of Mar-a-Lago National Historic Site (NHS) has been discussed in detail by Rettie (1995).

National monuments

Ten of the delisted units were abolished national monuments, mostly in the West. These are

Figure 1. Location of the delisted national park units.



perhaps the best known of all the units and the ones whose stories best fit the narrative of lost units. South Dakota's Fossil Cycad NM was established in 1922 and is legendary within the park system for being delisted after having lost the resource it was created to protect (Santucci and Hughes, n.d.). It was one of several national monuments in the Black Hills, and is today bisected by US Highway 18 north of Edgemont. Of the national monuments that were eventually delisted, Wheeler NM was the first, created in 1908 to protect a small area of high-altitude badlands in the Colorado Rockies near Creede (Szasz 1977). Holy Cross NM included the Mount of the Holy Cross, a 14,005-foot-tall peak in the central Rockies named for the appearance of a cross of snow in its crevices during spring. Papago Saguaro NM preserved rocks and saguaro cacti outside of Phoenix, Arizona (Swarth 1920), while Old Kasaan NM preserved an abandoned Alaska native village on Prince of Wales Island in the Alaskan panhandle (Norris 2000). Shoshone Cavern NM was created in 1909 near Cody, Wyoming, only six months after it had been discovered (Roberts 2012). Montana's Lewis and Clark Cavern NM was created in 1908 and remains a state park today. Verendrye NM was created to commemorate the route of explorers who traveled the northern plains almost 100 years before Lewis and Clark (Smith 1980).

These lost monuments were, in their geography and features, typical of others that were being created and which were retained in the national park system. Fossil Cycad was only one of many fossil-based western national monuments. Others still in the system include Dinosaur, Petrified Forest, Agate Fossil Beds, Fossil Butte, John Day Fossil Beds, Hagerman Fossil Beds, and Florissant Fossil Beds (Mackintosh 1991). The trend continued with President Obama's 2015 proclamation of Tule Springs Fossil Beds NM in Nevada. Like many other early national monuments, such as Devils Postpile, Pinnacles, Natural Bridges, Rainbow Bridge, Capulin Volcano, Arches, and Cedar Breaks, Wheeler and Holy Cross were created to protect geological oddities. The two delisted cave units were among many national monuments and a few national parks created to preserve caves, including Wind Cave and Mammoth Cave national parks, and Jewel Cave, Carlsbad Caverns, Lehman Caves, Timpanagos Cave national monuments (in several cases, the monuments discussed here have since been redesignated as or absorbed into a national park).

What caused the delisted units to be eliminated from the national park system? These delisted national monuments were made possible by the Antiquities Act of 1906, one of America's most important and best-known conservation laws (Sellars 2007). The act allows the president to proclaim areas of federal public land as a national monument, which has been done more than 100 times (national monuments can also be created by Congress, but none of those delisted were established this way). The intent of the act was to allow for the timely preservation of objects of scientific interest (originally archaeological sites). Preserving a scientific curiosity under the act did not originally involve any judgment or consideration about whether a site could be developed for tourism (Rothman 1991). Only once NPS was created and became intent on developing the varied national parks and monuments under its jurisdiction did tourist development become an important factor in the evaluation of a potential national monument. This was especially important for those sites, such as Zion or Bryce Canyon, for which monument status served as a temporary status on the way to full "parkhood" (Righter 1989; Rothman 1989). Not all sites met both sets of standards. The fact that delisted national monuments were not developed for tourism does not mean they were not worthy of protection or that their proclamation was not a valid use of the Antiquities Act.

What is more, the delisted sites were comparable to retained sites in their lack of development. The other fossil, cave, and geological-oddity monuments were, at the time of their creation, generally no larger than those that were delisted (Table 1). Most western monuments of that era, for example Gila Cliff Dwellings, Montezuma Castle, or Tonto, had little or nothing in the way of facilities until Mission 66 completely transformed them in the 1950s and 1960s (Russell 1992; Protas 2002; Dallett 2008). Wheeler, Holy Cross, and Fossil Cycad were not enlarged or developed, and this is as much a reason for their delisting as it was the cause. One can argue that they were eliminated before Mission 66 could transform them in similar ways.

Roadside parks

Several delisted sites were little more than roadside markers or monuments, all in eastern states. New Echota, for example, was simply a stone obelisk marking the site of the Cherokee nation's capital city near Calhoun, Georgia, sitting on one acre of land. These are perhaps the hardest to understand today, but that is because they were not originally a product of the national park system. Before the 1933 reorganization many national monuments were administered by the Department of Agriculture and the Department of War. The latter department also had a number of national military parks, battlefields, and similar units, all of which were transferred to NPS along with its national monuments. Some of these dated back to the late 19th century when Gettysburg, Chickamauga and Chattanooga, Shiloh, and Vicksburg all became battlefield parks (Lee 1973). After these were designated, proposals for many more battlefield parks soon emerged. Antietam was also preserved in 1890, but rather than preserving the entire battlefield only key locations were made part of the park (Lee 1973; Snell and Brown 1986). This approach became the "Antietam Plan," followed by a number of later battlefields.

Calls for battlefield preservation accelerated after World War I, leading to a study of how this could most effectively be carried out (Lee 1973). It was recognized that there were different groups of battlefield sites, some large (as with Gettysburg), those organized along the Antietam Plan, and smaller sites only commemorated by markers or monuments. In 1926 this distinction was formalized into three groups of military parks: Class I (large), Class IIA (small), and Class IIB (markers) (Lee 1973; Dilsaver 1994). In Class IIB were those "[b]attles of sufficient historic interest to be worthy of some form of monument, tablet, or marker to indicate the location of the battle field" (Dilsaver 1994: 72). It was not expected that

Name	Created	Delisted	Origin	Current Status
National Monuments				
Lewis and Clark Caverns	1908	1937	Presidential proc	State park
Wheeler	1908	1950	Presidential proc	National Forest
Shoshone Cavern	1909	1954	Presidential proc	BLM
Papago Saguaro	1914	1930	Presidential proc	City park
Old Kasaan	1916	1955	Presidential proc	National Forest
Verendrye	1917	1956	Presidential proc	State Park
Fossil Cycad	1922	1956	Presidential proc	BLM
Castle Pinkney	1924	1956	Presidential proc	Private
Holy Cross	1929	1950	Presidential proc	National Forest
Small Markers and Memorials				
Father Millet Cross	1925	1949	Presidential proc	State Park
White Plains	1926	1956	Congress	Roadside marker
New Echota	1930	1950	Congress	State Park
Camp Blount Tablets	1930	1944	Congress	Roadside marker
Atlanta Campaign	1944	1950	Sec of Interior proc	Roadside markers
Reservoir-based NRAs				
Millerton Lake	1945	1957	Interagency agreement	State Park
Shasta Lake	1945	1948	Interagency agreement	National Forest
Lake Texoma	1946	1949	Interagency agreement	Army Corps/State Park
Shadow Mountain	1952	1979	Interagency agreement	National Forest
Flaming Gorge	1963	1968	Interagency agreement	National Forest
Other units				
Mackinac NP	1875	1895	Congress	State park
Sullys Hill	1904	1931	Congress	US Fish & Wildlife Service
Chattanooga National Cemetery	1933	1944	Congress	Veterans Affairs
St. Thomas NHS	1960	1975	Sec of Interior proc	Local museum
National Visitor Center	1968	1981	Congress	Private
Mar-a-lago NHS	1972	1980	Sec of Interior proc	Private
JFK Center for Performing Arts	1972	1994	Congress	Foundation
Oklahoma City NMem	1997	2007	Congress	Local

Table 1. The delisted national park units.

Class IIB sites would become permanent units of the national park system, because "on fields where single monuments have been erected it has been the policy of the Government, as soon as they have been completed, to transfer them to some local association for care and maintenance" (Dilsaver 1994: 72). However, by 1933 a number of these small sites were still in War Department ownership and transferred to NPS.

These sites were quite different from existing parks and monuments (Table 2). They were very small in size, centered on small markers, and often commemorated relatively minor events. They were more similar to the thousands of locally erected roadside historical markers that have proliferated nationwide than to a national park unit. What was NPS to do with these? They had no scenery, no large battlefield to tour, no historic homes, museums, or other trappings of parks at the time. Several solutions were evident. Many were increased in size and became conventional park units, such as Cabrillo NM. This was created in 1913 around a statue of Juan Cabrillo in Fort Rosecrans, near San Diego (NPS 2016). The boundaries originally encompassed 0.5 acres, but were later increased to include a lighthouse, coastal tidepools, and other attractions. Two small sites, Tupelo National Battlefield and Brices Crossroads National Battlefield Site in Mississippi, have remained much as they were. They still have the one-acre boundaries they possessed when transferred to NPS in 1933, and neither has any facilities other than a parking lot, cannons, and several signs.

The remaining small memorial sites were cut from the park system and turned over to local control, as was the original intent for Class IIB-type sites (Dilsaver 1994). Father Millet Cross is said to have been the smallest park unit ever created at 0.0078 acres, as it consisted of

Table 2. Small memorials transferred to NPS in 1933.

Name	Date	Original Size	Disposition	2014 size
Chalmette NHP	1907	Marker	Part of Jean Lafitte NHP (1978)	22,420.86 ac
Cabrillo NM	1913	0.5 ac	Expanded	159.94 ac
Kennesaw Mountain NBP	1917	Marker	Expanded	2,852.64 ac
Father Millet Cross NMem	1925	0.0074 ac	Delisted	—
White Plains NBS	1926	Tablet or marker	Delisted	—
Kill Devil Hill	1927	Monument	Expanded	428 ac
Cowpens NB	1929	max 1 ac	Expanded	841.56 ac
Monocacy NB	1929	max 1 ac	Expanded	1,647 ac
Appomattox Court House NHP	1930	approx 1 ac	Expanded	1,774.12 ac
New Echota	1930	max 1 ac	Delisted	—
Tupelo NB	1930	max 1 ac	Unchanged	1 ac
Brices Crossroads NBS	1930	max 1 ac	Unchanged	1 ac
Camp Blount Tablets	1930	Tablet or marker and bridge	Delisted	—
Atlanta Campaign NHS	1944	5 markers totalling 14.52 ac	Delisted	—

an 18x18-foot square around a cross in Fort Niagara, north of Buffalo, New York. However, White Plains and Camp Blount Tablets never had any acreage listed in NPS documents. The Camp Blount Tablets marker was to commemorate the site of Camp Blount (outside of Fayetteville, Tennessee), a meeting place for troops joining Andrew Jackson's campaign against the Creek Indians in 1813 (his victory against them the next year was commemorated by the creation of Horseshoe Bend National Military Park in 1956). The marker site was to include an 1861 stone arch bridge over the Elk River, though this bridge was constructed long after the events commemorated. The Atlanta Campaign NHS differs in that it was created in 1944 and was therefore an NPS site from the beginning. This unit consisted of five roadside markers on small plots of land along US Highway 41 between Chattanooga and Atlanta marking events from the 1864 Civil War campaign. The campaign is still commemorated at Kennesaw Mountain National Battlefield Park, a small War Department Class IIB site from 1917, later expanded and developed.

Reservoirs

Five of the delisted units were western reservoir-based recreation areas: Shasta and Millerton lakes in California, Lake Texoma on the Red River between Texas and Oklahoma, Shadow Mountain in Colorado, and Flaming Gorge National Recreation Area (NRA) in Utah and Wyoming.

NPS has long had an uneasy relationship with reservoirs (Harvey 1994; Righter 2005), and the first NRA, Lake Mead, was controversial in being created around such a lake (Dodd 2007). Rather than protecting unspoiled nature, the park would be centered on an artificial reservoir. This proved a popular type of park unit and the forerunner of many NRAs, national lakeshores, and national seashores. Lake Mead also pioneered a new way of creating a park unit. It was not signed into law or proclaimed by the president. It was instead created through an interagency memorandum between NPS and the Bureau of Reclamation. The bureau was well aware of the recreational potential of the new lake, but had no wish to be involved in the development or management of recreation. NPS essentially became a subcontractor to the bureau to develop and manage the lake for recreation.

This relationship was replicated at many other reservoirs, including all of those that were delisted. Curecanti and Lake Roosevelt NRAs were never legislatively created and are in fact still governed by their interagency agreements (McKay and Renk 2002). These sorts of arrangements can be found elsewhere. Big South Fork National River and Recreation Area in Tennessee and Kentucky was developed by the Army Corps of Engineers and then transferred to NPS. The Land Between the Lakes NRA (also in Kentucky and Tennessee) was created through similar interagency memorandums, though without the involvement of NPS (Foresta 2013).

The delisted reservoirs have a precedent in the 45 recreation demonstration areas (RDAs) established in the 1930s in that NPS was involved in developing recreational facilities without intending to manage the site once completed. Nonetheless, 11 RDAs were incorporated into the national park system (Hogenauer 1991b), but the remainder were transferred to state parks or other local agencies, as planned. The RDAs are remembered with pride today; perhaps the delisted reservoirs should be as well. Today, affiliated areas of the national park system, such as national reserves and national heritage areas, represent another round of involvement by NPS in locations that the agency will not directly oversee.

Conclusions

Why bother to examine places that were judged unworthy of being included in the national park system? They still have important lessons for us. Their existence and delisting reveals much about the evolution of the national park system, including the changing views of, and purposes for, creating national monuments, the diverse set of places that were brought into the system in 1933, and the ways NPS worked with other agencies to create an American recreational landscape. They were anything but a collection of poor-quality sites whose presence in the national park system was a mistake.

Another lesson is that the distinction between parks lost and those remaining in the system is not always very great. The delisted national monuments were entirely typical of their time and place, regardless of how deficient or limited they may seem to us today. These units should not be evaluated based on what little development they had, as many other units had equally little back then; like those other units, the delisted ones would quite likely have been developed and expanded had they remained under NPS. Lehman Caves NM, one of many small cave monuments, became part of Great Basin National Park, while the tiny Dinosaur NM (which was, at the time of its creation, one-quarter the size of Fossil Cycad) was expanded into a vast park unit in the 1930s. Further evidence of this comes from the experience of national monuments that were almost abolished but survived. The small and remote Gila Cliff Dwellings NM in New Mexico was almost delisted in 1955 before being expanded after more ruins were discovered (Russell 1992). Hopewell Culture National Historical Park started out as Mound City Group NM in 1923 and was nearly removed from the system in 1937, 1954, and 1956 (Cockrell 1999). It was eventually expanded and given a new name. There are many other nearly delisted units with which these could be compared (Ise 1961; Rettie 1995).

Any mention of delisted units raises the question of whether delisting has been a good or bad step for the national park system. Fears of watering down the system with inferior units have existed since the earliest days (Ise 1961) and Hogenauer (1991a, 1991b) felt that selective pruning of the park system could be beneficial. Others disagree, and feel that pruning, no matter how carefully carried out, could grow beyond the original intent (Rettie 1995). This discussion of delisted units suggests that parks are opportunities to create something; those parks lost are opportunities lost. Might not an expanded and still roadless Holy Cross or Wheeler park in the high Rockies be appealing? There was an attempt to create a national military park out of the Camp Blount Tablets site in 1927 (Hogenauer 1991a), but any such opportunity is long gone. The old stone bridge collapsed in 1969, and the site of the original military encampment is now occupied by a WalMart store. A state historical marker commemorates the site, and a nearby city park includes a replica of the old stone bridge. Today Shoshone Caverns is known as Spirit Mountain Caverns but has still never been fully explored (Rhinehart 2011). There is reason to believe it is part of an extensive cave system, but the presence of hydrogen sulfide gas makes any deeper explorations (or tourist development) difficult. As a scientific curiosity it remains fascinating.

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The Role of the National Park Service in Recognizing Scientific Achievement

Editorial Introduction

In 2012, the Science Committee of the National Park System Advisory Board released *Revisiting Leopold,* an important report offering fresh thinking on resource stewardship in the US national parks. Soon after its appearance we reached an agreement to reproduce the report, in facsimile form, in order to make it easily available to George Wright Society members and other readers of *The George Wright Forum.* The reprint appeared in volume 29, number 3 of the journal, and remains available in PDF format on our website.

We are pleased to be able to do the same thing with another new and significant report of the Science Committee. In December 2015, the committee published *Recognizing Science: American Scientific Achievement and the Role of the National Park Service*. It is a response to a request from the NPS director for a study that would address the agency's role in recognizing scientific achievement in the United States. Particularly acute is the need to preserve historic sites related to the accomplishments of women and people of color. Doing so, the committee believes, will not only advance public understanding of science; it will serve as a gateway of inspiration for young people to take up careers in science, technology, engineering, and mathematics.

In writing the report, the committee was augmented by additional scientific specialists, and also sought out collaborators from several allied fields in cultural resources. This mix of team members, who are individually listed in Appendix I, make the report a truly interdisciplinary endeavor.

So what follows is a facsimile reproduction of *Recognizing Science* in its entirety, including appendices. You can also download the report at www.georgewright.org/331_recognizing_science.pdf.

Dave Harmon & Rebecca Conard
Co-editors, *The George Wright Forum*

The George Wright Forum, vol. 33, no. 1, p. 70 (2016).

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RECOGNIZING SCIENCE: American Scientific Achievement and the Role of The National Park Service

A Report

of the

National Park System Advisory Board

Science Committee

National Park System Advisory Board

Citizen advisors chartered by Congress to help the National Park Service care for special places saved by the American people so that all may experience our heritage.

November 2015

Honorable Jonathan Jarvis
Director, National Park Service
Washington, DC

Dear Director Jarvis,

On behalf of the National Park System Advisory Board and its Science Committee, we present to you a report entitled *Recognizing Science: American Scientific Achievement and the Role of the National Park Service.*

Science and scientific achievement have always been part of the American experience. The National Park Service-including its National Park System, historic preservation programs, and site designations-has a lead responsibility in recognizing science and scientific achievement as part of the Nation's history.

Several science-related sites have already been formally recognized. However, recognition of American science by preserving appropriate historic sites is, as noted in your charge to the Board, "significantly incomplete." In particular, women and persons of color who have contributed to advancement of American science are under-represented. Hence, your charge was to prepare a report that included specific sites and scientists for consideration for recognition, as well as recommendations on how to use those designated sites as portals for science, technology, engineering, and mathematics education.

The Board's Science Committee, which included historians of science and representatives of professional scientific societies, met in Washington, DC, and held conference calls to develop their recommendations. The final report received full endorsement of the Science Committee and National Park System Advisory Board.

Site suggestions and additional recommendations are included in the report, and are intended to enhance the role of the National Park Service in educating and inspiring the next generation and build public support for science. Recognizing historical scientific achievement in the parks and programs of the National Park Service is both a continuation of the American story, and a significant investment in the future of our nation.

Sincerely

Tony Knowles
Chair, National Park System Advisory Board

Rita Colwell
Chair, Science Committee
National Park System Advisory Board

1849 C Street, NW I Room 2719 I Washington, DC 20240

RECOGNIZING SCIENCE: American Scientific Achievement and the Role of The National Park Service

A Report
of the
National Park System Advisory Board
Science Committee

December 15, 2015

Introduction

Science and scientific achievement have always been a part of the American experience. Many of the Founding Fathers were familiar with science, and several were skilled in scientific research. Benjamin Franklin was internationally known for his scientific studies, and founded the American Philosophical Society (at the time the nation's most prestigious scientific academy) in 1743. Thomas Jefferson was elected Vice-President of the United States and president-elect of the Society in the same year (1797), and made significant contributions to natural history. John Adams and James Madison had strong scientific educations that influenced their contributions to the writing of the Constitution.

As the nation grew, so did the role of science in its development. The Lewis and Clark Expedition and its "Corps of Discovery" (1804), the research of George Washington Carver (1860-1943), the "scientific forestry" of Gifford Pinchot (1865-1946), the Manhattan Project of WWII resulting in the atomic bomb (1942-1946), and the environmental science of Rachel Carson (1907-1964) all played a part in American history. Including science in the telling of the American story is both a responsibility and opportunity; recognizing scientific achievement by preserving historic resources in the United States is a task shared by many institutions.

The National Park Service (NPS)—including its National Park System (with 409 units) and historic preservation programs and site designations—has a lead responsibility in recognizing science and scientific achievement. Science and scientific achievement are part of existing "themes" that help frame NPS historical conservation. There are numerous existing sites that are science-related and formally recognized: Thomas Edison's laboratory is a National Historical Park, Charles Best's home is on the National Register of Historic Places, and John Burroughs' cabin (named "Slabsides") is a National Historic Landmark, for example.

Yet the recognition of American science through preservation of appropriate historic sites is, as NPS Director Jonathan Jarvis has noted, "significantly incomplete." The achievements of scientists such as Luis Alvarez, Grace Hopper, Richard Feynman, and Barbara McClintock are not yet stories generally known or told through the NPS. Women and persons of color that have contributed to the advancement of American science are underrepresented.

The responsibility of the National Park Service is not just to complete an "inventory" of important scientists and commemorative sites. Such sites, scientists and their stories are invaluable opportunities to introduce visitors—particularly young visitors—to learning about science, scientific careers, and the importance of science to the nation's future. They can serve as "transformative portals" to science, technology, engineering, and mathematics (STEM) education—educating and inspiring future generations. These historic sites can help educate citizens on the methods and limitations of science, and increase understanding and support for the scientific enterprise. Expanding recognition of science and scientific achievement in the historic programs of the NPS both advances the mission of the National Park Service and serves the civic good.

The scope and purpose of this report

This report recommends two ambitious goals for the NPS: *1) to increase recognition, public awareness, and appreciation of the significant contributions of diverse fields of science and diverse scientists to the health, wealth, and quality of life of all Americans, and 2) to help build public understanding of and support for science.* Both goals can be furthered by recognizing additional sites of American science and scientific achievement, and by developing additional educational and interpretive programs that treat these sites as STEM portals.

In this report, *science* refers to the full range of major disciplines including chemistry, physics, astronomy, computer and information science, engineering, life sciences (including medical science), geosciences, mathematics, the social, cultural, and economic sciences, and interdisciplinary science. *Scientific achievement* refers to the accomplishments of a scientist, team of scientists, or scientific institution, where these accomplishments significantly advance science and/or serve society.

The report is organized as follows. After this introduction, a brief overview of the various historical designations available to the NPS is presented. Next, the methods used to develop the report's recommendations are described, as well as the involvement of numerous scientific societies. The criteria for selecting a short list of sites to recommend for recognition are explained.

Following these introductory sections, 12 potential sites are highlighted for consideration by the NPS for possible recognition or, in cases of existing sites, expanded recognition. For each site, brief background information is provided to help identify why the site is an excellent candidate for recognizing scientific achievement and serving as a transformative STEM portal. Following these site recommendations, additional recommendations on delivering STEM education, engaging scientific societies, and preparing for additional site recognition are presented. A brief conclusion ends the report.

The NPS has a thorough and detailed process for evaluating historic sites for recognition, and the National Historic Landmarks Committee of the National Park System Advisory Board, and the Board itself, have significant responsibilities and expertise. This report does not substitute for the necessary engagement with property owners, assessments and evaluations by NPS professionals, program leaders, and recommendations by the National Historic Landmarks Committee. It is a complement to that process, and provides advice and guidance from the scientific community on potential historic sites that could be considered for such studies and possible designations.

Alternative opportunities for recognition

There are several opportunities under federal law for gaining national recognition for historic sites of significant scientific achievement in America. These forms of recognition provide several designation alternatives to the NPS for recognizing science.

The *National Register of Historic Places* (NRHP) was authorized by the National Historic Preservation Act of 1966 (NHPA) to serve as America's official list of historic properties recognized as worthy of preservation. The National Register program is administered by the NPS, in cooperation with federal, state, and tribal Historic Preservation Offices. Currently there are approximately 90,000 historic districts and properties listed on the National Register. Properties can be nominated to the Register by anyone. A nomination includes extensive documentation that is prepared for submission to the appropriate nominating official (a Historic Preservation Officer), who determines that the property is qualified, and transmits the nomination to NPS for possible listing in the Register. Such sites are determined to be of local, state, or national significance through the review process. If nominated sites are on private lands, landowner permission is required prior to official listing, though a site may be "determined eligible" for listing regardless.

National Historic Landmarks are the nationally significant historic sites listed on the National Register. Under the National Historic Preservation Act, the Secretary of the Interior makes the final determination of a site's qualification and national significance, based upon a recommendation from the Historic Landmarks Committee of the National Park System Advisory Board, which undertakes an extensive review of nomination data compiled by NPS professionals and others.

National Historic Sites are historic places of national significance on federal lands. National Historic Sites can be designated by an act of Congress, and the Secretary of the Interior can make this designation administratively through issuance of a Secretarial Order, under authority granted by the Historic Sites Act of 1935. Most such sites designated by the Secretary have later become units of the National Park System by acts of Congress.

National Monuments are proclaimed by the President under authority granted exclusively to that Office by the Antiquities Act of 1906. Such sites occur only on federal lands, though these may be donated to the federal government by state governments, local governments, or private individuals prior to such national monument proclamation.

National Parks or a variety of other nomenclature designations, such as National Historic Park, occur by individual Acts of Congress and signed into law by the President. Prior to designation, Congress may authorize NPS to conduct a "special resources study" of the proposed site, in order to determine national significance, feasibility, and suitability for management as a unit of the National Park System.

Individual sites may be only appropriate for one of these designations; other sites may be appropriate for multiple designations. Often a site is first recognized on the

National Register, then as a National Landmark, and sometimes a National Historic Site or even National Park status. All of these alternatives for designation are opportunities for recognizing scientific achievement in the United States.

Identifying potential candidate sites

To help identify potential candidate sites, the Science Committee engaged representatives of professional scientific societies, the historic preservation community, and historians of science. NPS historical preservation staff provided technical assistance. The Committee (and its expanded group of representatives, see Appendix 1) met by phone and in person to discuss the Director's charge, criteria for selection, and initial candidate sites. Committee members were encouraged to submit additional candidates via email, and a list of approximately 180 potential sites was assembled. In some cases, a scientist was identified as worthy of recognition but a specific site linked to that scientist was to be decided after additional study. Each site or scientist was placed in an appropriate major scientific discipline, based on categories of the National Science Foundation Supported

Disciplines: 1) chemistry, 2) computer and information science, 3) engineering, 4) geosciences, 5) life sciences, 6) mathematical sciences, 7) physics and astronomy, 8) psychology, and 9) social sciences (see Appendix 2).

The committee agreed on criteria to be used to select a short list of sites and/or scientists for possible recognition. The criteria reflect the charge to the National Park System Advisory Board and the Science Committee by NPS Director Jarvis. Three criterion were used:

Criterion A: *The site represents significant American scientific achievement.*

- Significant scientific achievement reflects the application of the scientific method, theoretical and/or applied research, and lasting influence upon science and/or society.
- Scientific achievement in the full range of physical sciences, life sciences, engineering and computer sciences, mathematics, and social sciences were eligible.
- The achievement could be in theory, methods, empirical results, and/or application.

Criterion B: *The site has potential for advancing STEM education in multiple fields of science.*

- Potential for STEM education reflects the opportunities provided by the site for:

- engaging young people
- increasing public understanding and support for science, encouraging careers in science, and linking the site to multiple fields of science.

Criterion C**:** *The site represents diversity in American scientific achievement.*

- Diversity in scientific achievement reflects the contribution of:
  - women
  - persons of color
  - members of the LGBT community
  - other underrepresented groups

The individual committee members evaluated the list of potential sites and/or scientists. Each committee member evaluated those sites within their particular discipline and other sites for which they had sufficient knowledge. From this evaluation, a short list of 20 sites was created. The committee met by phone to discuss each of the sites and/or scientists on this short list, and committee members then individually recommended their top candidates. The final list of 12 candidate sites and/or scientists reflected these recommendations; there was a strong consensus among committee members.

Recommended sites and/or scientists

Luis Alvarez (Site TBD) (Physics and Astronomy)

Luis Walter Alvarez (1911-1988) was an experimental physicist. He worked on a number of WWII radar projects, including what are now known as transponders. He is best known for the radar system, "Ground Controlled Approach" (GCA). He worked with both Enrico Fermi at the University of Chicago on nuclear reactors and Robert Oppenheimer at Los Alamos on the Manhattan Project. He also worked as a member of Project Alberta and observed both the Trinity nuclear test and the bombing of Hiroshima. After WWII, he contributed to work on a liquid hydrogen bubble chamber, which allowed him and co-workers to discover many short-lived particles and resonance states. For this work he was awarded the Nobel Prize in Physics in 1968. In addition, Alvarez is known for breakthroughs in accelerators. With his son Walter and two nuclear chemists, he is also responsible for introducing the hypothesis that the cause for the Cretaceous-Paleogene extinction of the dinosaurs was a meteorite that crashed into Earth 66 million years ago.

Bell Telephone Laboratories, NJ (Engineering)

Bell Telephone Laboratories is a leading research organization in information technology and communications headquartered in New Jersey. Now owned by Alcatel-Lucent, it was originally formed as an amalgamation of engineering departments within AT&T and the Western Electric Company. Researchers were tasked with engineering a communications network built for the national scale. Once the network was established and the telephone industry took hold in the 1920s, the institution turned its focus to the future of information technology and communications and the areas of science most likely to be integral to the future of communications. The organization has since served as a source of significant innovation. Researchers working at Bell Labs such as John Bardeen are credited with inventing radio astronomy, the transistor, lasers, information theory, the C, S, and C++ programming languages, microchips, UNIX, mobile phones, and mobile networks, among others. Eight Nobel Prizes have been awarded for research undertaken or begun at Bell Labs since 1925.

Gertrude Belle Elion (Site TBD) (Life Sciences)

Gertrude Belle Elion (1918 – 1999) was a chemist by training. After completing her master's degree, she began work with George H. Hitchings at the Burroughs-Wellcome pharmaceutical company in North Carolina and subsequently held the position of research professor at Duke University. Her and Hitchings' investigation of pyrimidine and purine as parts of DNA aided in their work to develop many new drugs, including those for AIDS, leukemia, malaria, kidney stones, herpes, and gout. Additionally, Elion aided in the early development of immunosuppressant drugs, which enable patients to receive organs from donors they are not related to. For her work in developing many of these drugs, she was jointly awarded the Nobel Prize for Physiology or Medicine in 1988 along with her colleague George Herbert Hitchings and Joseph Black. She was elected to the National Academy of Science in 1990 and awarded the National Medal of Science in 1991.

Alice Evans (Site TBD) (Life Sciences)

Alice Evans (1881-1975) was a microbiologist. After studying at Cornell University and the University of Wisconsin, she began her career as a part of the United States Department of Agriculture. She studied the bacteriology of milk and milk products, which led her to the discovery of brucellosis in milk. She published her findings in 1918, overturning the supposition that brucellosis in humans was a different disease than in cattle, and increasing awareness about the danger of unpasteurized milk. In the 1930s, when the dairy industry instituted the pasteurization of all milk due to Evans' research, the number of cases of brucellosis decreased dramatically. Evans next worked for the United States Public Health Service beginning in 1918. There, she aided in the study of infectious diseases, including epidemic meningitis and influenza. At the department's Hygienic Laboratories, where she undertook most of her research, she became infected with brucellosis in 1922 and suffered from it for twenty years. She was elected as the first female president of the Society of Microbiology in 1929 and continued work in the field when possible.

Alice Hamilton, Hull House, IL (Social Sciences)

Alice Hamilton (1869-1970) was a physician and activist. She lived and worked at Hull House, the famous settlement house in Chicago, while a Professor of Pathology at Northwestern University's Women's Medical School. Hamilton treated poor immigrants and members of the working class for diseases that were often the result of poor working conditions. Inspired to treat these ailments at their source, she surveyed the extent of industrial sickness from hazardous materials and dangerous occupational procedures through membership and leadership of various commissions. She focused on lead-based industries. Her reports spurred state and federal laws to increase safety of workers and expand measures and medical examinations for workers at risk. She soon became known as the leading authority on industrial diseases, particularly lead poisoning. She lectured as an assistant professor of Industrial Medicine at the Harvard Medical School beginning in 1919, making her the first woman to be on the Harvard faculty, over 30 years before Harvard admitted women as students. She received a Lasker Award for Public Service in 1947.

Ernest Everett Just, Woods Hole, MA (Life Sciences)

Ernest Everett Just (1883-1941) was trained as a biologist. He began his career at Howard University in Washington, D.C., in 1907 and held the position of Head of the Department of Zoology from 1912 until 1929, and again in 1940 until his death. Frank R. Lillie, head of the University of Chicago's Department of Zoology and director of the Marine Biological Laboratory (MBL) at Woods Hole, MA, invited Just to be his research assistant at MBL in 1909. Just spent summers thereafter until 1929 at MBL conducting research, focusing mainly on experimental embryology of marine invertebrate eggs. He received a Ph.D. in zoology from the University of Chicago in 1916, while also upholding his duties at Howard. Just spent the years 1929-1940 in Europe conducting research, largely motivated by experiences with limitations imposed on him due to racism. Just was regarded as the leading authority on the embryology of marine mammals. He advocated for the use of whole cells in research, arguing that the ectoplasm, to which he focused his attention, was of equal importance to the nucleus. Extrapolating this to a broader scale, his lab experiments sought to as closely as possible recreate natural conditions of the phenomena he studied.

Kinsey Institute for Research in Sex, Gender, and Reproduction, IN (Social Sciences)

The Kinsey Institute for Research in Sex, Gender, and Reproduction (originally the "Institute for Sex Research" and also known as "The Kinsey Institute") was established by Alfred Kinsey at Indiana University in 1947 to increase knowledge related to sex and advance sexual health. As first director through 1956, Kinsey and his Institute sparked controversy for openly discussing sexuality and their use of erotic materials in research. The research Kinsey collected through interviews was published in two books, one on sexual behavior in human males and the other on females, commonly referred to as the "Kinsey Reports." The institute has since continued interview-based research and publishing the results as significant works. Under Director June Machover Reinisch (1982-1993), the name was changed to indicate the Institute's expanded focus from sex to include gender and reproduction research. Research has been conducted on at-risk sexual behavior, prenatal exposure to medications and its effects on sexual and psychosexual development, the psychology of sexual behavior, hormonal effects on sex, condom usage, sex in long-term relationships, and hormones and reproduction.

Mauna Loa Observatory, HI (Geosciences)

Mauna Loa Observatory (MLO) is a research station primarily focused on monitoring the atmosphere. The location of MLO is particularly suited for monitoring because of its altitude. It is now part of the Earth System Research Laboratory, a branch of the National Oceanic and Atmospheric Administration (NOAA). Charles David Keeling began overseeing frequent, regular measurements of atmospheric carbon dioxide (CO^2) at MLO in 1958, and readings have continued for over 56 years. The measurements of MLO scientists are the basis of the global atmospheric CO^2 record commonly utilized by climate scientists. Keeling's plotting of this data showing progressive growth in the concentration of CO^2 in the atmosphere is known as the "Keeling Curve." This was the first hard evidence of rapidly increasing CO^2 levels in the atmosphere and provided the basis for initial concern about the possibility of anthropogenic global warming and climate change. Keeling also showed atmospheric carbon dioxide concentrations to be correlated with fossil fuel combustion (and thereby global warming due to the greenhouse effect).

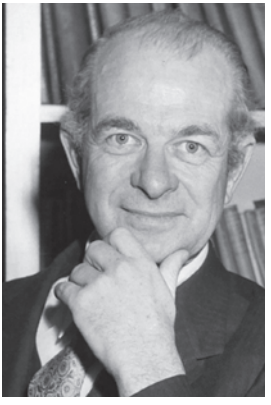
Barbara McClintock, Cold Spring Harbor, NY (Life Sciences)

Barbara McClintock (1902-1992) was a distinguished cytogeneticist. She carried out much of her work as part of the staff of the Carnegie Institution of Washington in Cold Spring Harbor, New York, a laboratory (today called Cold Spring Harbor Laboratory) with research programs that focus on cancer, neuroscience, plant genetics, genomics, and quantitative biology. Starting as an undergraduate at Cornell, she studied the genetics of maize (corn). Her observations of mutation in kernels led her to the discovery of transposable or "jumping" genes: genes that can move within and between chromosomes. Initially, her finding that genes are not stable was discounted because it challenged conventional thinking. It was later confirmed and "jumping genes" were found in microorganisms and insects. Practical implications of her research are widespread, and transposable genes explain many phenomena, such as how resistance to antibiotics can be transmitted between bacteria types that are different. For her groundbreaking work, she won a Lasker Award for Basic Medical Research in 1981 and the Nobel Prize in Physiology or Medicine in 1983.

Margaret Mead (Site TBD) (Social Sciences)

Margaret Mead (1901-1978) was a cultural anthropologist who largely popularized the field in America. Mead focused her research on the ways adolescents are shaped by adult society, child-rearing, and mental and sexual development in different cultures. She sought to understand the human experience holistically, and applied the knowledge she gained through fieldwork to a wide range of issues in modern life. Throughout her career, Mead held many positions, including executive secretary of the National Research Council's Committee on Food Habits, curator of ethnology at the American Museum of Natural History, lecturer at The New School, adjunct professor at Columbia University, Professor of Anthropology and Chair of the Division of Social Sciences at Fordham University's Lincoln Center Campus, and Distinguished Professor of Sociology and Anthropology at the University of Rhode Island. She was elected to the American Academy of Arts and Sciences in 1948 and both the president and chair of the executive committee of the board of directors of the American Association for the Advancement of Science.

Linus Pauling (Site TBD) (Chemistry)



Linus Pauling (1901-1994) was a chemist and activist. As an undergraduate, he studied how the electronic structure of atoms and molecules is related to physical and chemical properties, and his subsequent work largely stemmed from this original interest. Throughout his career, he pioneered the application of quantum theory to the structure of molecules and studied the molecular structures of many substances. Pauling introduced the concept of orbital hybridization and he proposed a scale of electronegativity in 1932, known as the "Pauling Scale," which is still the most commonly used method of calculation and relates to how bonds between atoms and molecules function. Pauling's research on the nature of the chemical bond and its usefulness for understanding molecular structure, for which he won the Nobel Prize in Chemistry in 1954, is largely compiled in *The Nature of the Chemical Bond*. This book is still considered a foundational work in chemistry. He was awarded the Nobel Peace Prize in 1962 for his work to stop nuclear testing, especially concerned about resulting long-term genetic effects. He is the only person to ever have been awarded two unshared Nobel Prizes and one of only two people to be awarded Nobel Prizes in different fields.

Sapelo Island, GA (Life Sciences)

Sapelo Island is a barrier Island seven miles off the coast of Georgia, now jointly owned by the Georgia Department of Natural Resources and National Oceanic and Atmospheric Administration (NOAA). R.J. Reynolds, the tobacco heir, bought the island from its previous owner in 1934 and founded the Sapelo Island Research Foundation in 1949. Subsequently, he funded the research of Eugene Odum and the University of Georgia. Odum's research on Sapelo helped launch systems ecology. He is credited with advancing the term "ecosystem," and advocating for a holistic approach to biological training. He was awarded the Tyler Prize for Environmental Achievement in 1977 and the Crafoord Prize in 1987. The public can now visit Sapelo with an appointment, and the Georgia Department of Natural Resources offers scheduled tours throughout the week.

Recommended actions

Advancing recognition of science and scientific achievement in the United States is and should continue to be an important responsibility of the National Park Service. The scientific community-including professional scientific societies, historians of science, and individual practicing scientists should be enthusiastic advocates and partners for such recognition of science, as well as NPS historic preservation and educational programs. The following are recommended actions.

1. *The National Park Service should carefully review the 12 recommended sites and/or scientists, and select some or all of the sites for detailed review and study for possible listing on the National Register of Historic Places, National Landmark status, or inclusion in the National Park System.* This review, study, and formal nomination process will require resources, and the NPS should provide the necessary support as appropriate and available. In some cases, scientific societies may be able to partner with the NPS and provide technical assistance or other resources in support of the nomination process. In all cases, early engagement of current property owners to assess support for recognition of the potential site will be essential, and should be led by NPS professionals.

2. *The NPS should examine the larger list of candidate sites for additional sites for future review and study,*

leading to possible designation. This list should be periodically updated by the NPS with engagement of the scientific community, historians of science, and property owners, and be publicly available.

3. *The NPS should examine its current interpretative and educational programs at existing sites recognizing science and scientific achievement, and develop expanded, new, and additional programs to use such sites as "transformative portals" for STEM education*. Emphasis should be placed on STEM education for underrepresented youth, to increase the long-term diversity of the scientific community and the National Park Service.

4. *The NPS should prepare and distribute to the public one or more of its regional "heritage travel itineraries" focused on American scientific achievement*. Such an itinerary, with accompanying maps, phone apps, and other interpretive material, can encourage the public (and especially youth and young adults) to visit science sites and learn about the role of science in American history and culture.

5. *The NPS should develop active, on-going engagement and partnerships with professional scientific societies, focused on both recognition of scientific achievement and STEM education within NPS parks and programs*. Possible partners are the American Association for the

Advancement of Science, the Ecological Society of America, the American Geophysical Society, and more. These partnerships can and should create an advocate community for recognizing science within NPS parks and programs, as well as support for science in parks. The professional societies can provide their own and distinctive recognition to selected sites, and can contribute to interpretive and educational programs.

6. *The NPS and the National Park System Advisory Board should prepare and distribute outreach materials to develop support for increased historical recognition of scientific achievement*. This could include distribution of this report, preparation of op-ed pieces and articles for scientific magazines and journals, and commentary through the social media of professional scientific societies.

7. *The NPS should work to complete recognition of selected sites recommended in this report as part of its Centennial Year*. 2016 is the centennial of the NPS, and recognizing scientific achievement can contribute to the NPS centennial goal "to connect with and create the next generation of park visitors, supporters, and advocates".

Conclusion

Science continues to play an important role in the American story. Advances in genomics, climate change research, bioengineering, and other scientific fields will influence industry, business, education, culture, and government, as well as the lives of individual Americans. New discoveries will lead to new questions, for science is a process of "perpetual discovery".

In addition, a new generation of young scientists (necessarily more diverse to reflect the American population) is now preparing to conduct innovative research, lead scientific teams and laboratories, and apply their science to the complex challenges of the times. Historic sites and their interpretation can inspire and educate this next generation, and build public support for science. Hence, recognizing historical scientific achievement through the important role of the National Park Service is both a continuation of the American story, and critical investment in the future of our nation.

Appendix 1
National Park System Advisory Board
Science Committee

Dr. Rita Colwell *(Committee Chair)**
Distinguished University Professor, University of Maryland College Park and Johns Hopkins University Bloomberg School of Public Health; Chairman and President, CosmosID, Inc., College Park, MD

Dr. Susan Avery
President and Director, Woods Hole Oceanographic Institution, Woods Hole, MA

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Dr. Michael Novacek
Senior Vice President, Provost of Science, Curator at the American Museum of Natural History, New York, NY

Sir Richard J. Roberts, Ph.D.
1993 Nobel Laureate in Physiology or Medicine, Chief Scientific Officer, New England Biolabs, Ipswich, MA

Dr. Richard Tapia
University Professor, Director of the Center for Excellence and Equity in Education; Director of Alliances for Graduate Education and the Professoriate, Maxfield and Oshman Professor in Engineering, Rice University, Houston, TX

Dr. Gary Machlis (Liaison to the Committee)*
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**Subcommittee for the Historic Science Sites Project*

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Appendix 2
Suggested Historic Science Sites

Sites included in this appendix are in addition to the 12 sites recommended in the report. Sites are listed within NSF Supported Disciplines. Only NSF Supported Disciplines that had suggested sites categorized within them are included. Disciplines and sites are listed in alphabetical, not priority order. If sites are currently on the National Register of Historic Places (NR) or designated as National Historic Landmark (NHL), these designations are shown.

Chemistry

1. **Russell Henry Chittenden House, CT (NR)**
   Known as the father of American biochemistry, he was a professor at Yale University.

2. **Herbert Henry Dow House, MO (NR)**
   He was a chemical industrialist who founded Dow Chemical Company in 1897, and is remembered as a prolific inventor of chemical processes, compounds, and products, as well as a successful businessman.

3. **John William Draper House, NY (NR)**
   He was a chemist who was the first President of American Chemical Society, and is credited with producing the first clear photo of a face and the first detailed photo of the moon.

4. **Irving Langmuir House, NY (NR)**
   He was a physicist-chemist who won the 1932 Nobel Prize in Chemistry for his work in surface chemistry during his career at General Electric, who also invented the gas-filled incandescent lamp and the hydrogen welding technique.

5. **Willard Libby (Site TBD)**
   He was a physical chemist whose lead role in developing radiocarbon dating led to the Nobel Prize in Chemistry in 1960.

6. **Joseph Priestley House, PA (NHL)**
   In 1774, he discovered oxygen, and later developed the carbonation process, identified carbon monoxide and other gases, conducted early experiments in electricity, and achieved an early understanding of the interrelationship of plants and animals mediated by gases.

7. **University of Virginia Rotunda, VA (NHL)**
   An early architectural example of publicly funded secular education in the US.

Engineering

8. **Alexander Graham Bell (Site TBD)**
He was inventor of the first practical telephone and metal detector, did groundbreaking work in optical telecommunications, hydrofoils, and aeronautics, and was one of the founding members of National Geographic Society.

9. **George Eastman House, NY (NR)**
House of the founder of Eastman Kodak Company that is now the location of the George Eastman House International Museum of Photography and Film, one of the oldest museums dedicated to collecting, preserving, and presenting the history of photography and film.

10. **R.A. Fessenden House, MA (NR)**
A physicist who performed pioneering experiments in radio, including use of continuous waves and is credited with the first AM radio transmissions of voice and music.

11. **General Electric Research Laboratory, NY**
This was the first industrial research facility in the United States, established in 1900.

12. **The Harvard Computation Laboratory, MA**
This is the facility where Dr. An Wang developed the core memory of computers.

13. **The Machine room, a building on Olden Lane near the Institute for Advanced Study in Princeton, NJ**
This research facility is associated with John Von Norman and the IAS computer.

14. **Samuel P. Morse House, NY**
He was the inventor who co-developed Morse code, and helped develop commercial use of telegraphy.

15. **Research Laboratory of Physics, Harvard (later the Lyman Laboratory of Physics), MA**
This is where Grace Hopper, Howard Aiken, and their colleagues worked on the ASSC Mark I computer during World II, and later the Mark II.

16. **Count Benjamin Rumford Birthplace, MA**
An 18th century US physicist, inventor, and British spy who performed groundbreaking research into the design of heating systems, fostering the development of the Rumford stove.

17. **Charles H. Townes (Site TBD)**
A physicist who worked on radar bombing systems at Bell Labs during WWII and created the maser with Nikolay G. Basov and Aleksandr M. Prokhorov, for which they won the Nobel Prize in Physics in 1964, and later pioneered use of masers and lasers in astronomy.

18. **Trinity Site, NM**
Site of the first detonation of a nuclear weapon test (code named Trinity), conducted by the United States Army on July 16, 1945 as part of the Manhattan Project.

Geosciences

19. **Cleveland Abbe House, DC (NR)**
He was founder of the US Weather Bureau.

20. **Agassiz Bedrock Outcrop Research site, ME**
The field research site of Louis Agassiz that is a geographic feature significant in the history of geology - an outcrop of the Ellsworth schist marked with striations created by glacial action between 25,000 and 13,000 years ago.

21. **Atomic Energy Commission Geophysical Laboratory, Carnegie Institution of Washington, DC**
The laboratory of Director Phil Abelson who was a leader in chemistry, physics, geophysics, and geochemistry and was instrumental in uranium-isotope separation for the first atomic bomb.

22. **Beecher's Trilobite Bed, NY**
The site is named for Charles Emerson Beecher who found exceptionally preserved trilobites in the bed that have facilitated soft tissue study.

23. **Nathaniel Bowditch House, MA (NR)**
A self-taught 18th century astronomer and founder of modern navigation who was President of the American Association for the Advancement of Science.

24. **Channeled Scablands, WA**
An important field research site investigated by J. Harlen Bretz that exhibited scouring from the cataclysmic Missoula Floods.

25. **Cosmos Club, DC (NR)**
Founded by John Wesley Powell, this social club facilitated scientific discussions, and was where The National Geographic Society was founded in 1888 and the Wilderness Society was founded in 1935.

26. Reginald Aldworth Daly House, MA (NR)
A geologist and head of the Department of Geology at Harvard from 1912-1942, who formulated a theory on the origins of igneous rocks and later published Igneous Rocks and Their Origin in 1914, who was also an early proponent of continental drift theory and anticipated aspects of plate tectonics.

27. James Dwight Dana House, CT (NR)
A Yale University geology professor who produced the first published works emphasizing that the study of geology was a much broader discipline than the examination of individual rocks.

28. George Davidson (Site TBD)
A geographer who conducted pioneering research for the Unites States Coast survey, founded the first astronomical observatory on the North American Pacific Coast, was the first geography professor at the University of California, Berkeley, and president of the American Association for the Advancement of Science.

29. William Morris Davis House, MA (NR)
A geology professor at Harvard who was influential in the development of meteorology and geomorphology as scientific disciplines and who developed the organizing theory of erosion.

30. Max Delbruck, (Site TBD)
A biophysicist who helped launch research into molecular biology and won the Nobel Prize in Physiology in 1969 with Salvador Luria and Alfred Hershey for discoveries concerning the replication and genetic structure of viruses.

31. Garden Park, CO "Bone Wars" site, CO
The famous Jurassic dinosaur site that was included in the "Bone Wars" dispute between Edward Drinker Cope and Othneil Charles Marsh, where several important dinosaur specimens have been recovered.

32. George Brown Goode (Site TBD)
An oceanic ichthyologist who was founder of the American Historical Society, head of the Smithsonian Institution, and a member of both the American Association for the Advancement of Science and the National Academies of Science.

33. Ice Age Floods Sites, WA
The site of cataclysmic floods that swept periodically across eastern WA and down the Columbia River Gorge at the end of the last ice age, which has been researched since the 1920s.

34. **James Hall (NY) (NHL)**
The office and lab of James Hall, a leading paleontologist who led geological research in North America in the 1800s and was the first President of the American Geological Society.

35. **Hubbard Brook Forest, NH**
The field research station conducting long-term ecological research where acid rain was first discovered and biogeochemistry budgets were first put together.

36. **Lamont-Doherty Earth Observatory, NY**
A research unit of Columbia University and observatory where scientists provided the first definitive evidence to support the theory of plate tectonics and continental drift, first explained the role of large-scale ocean circulation systems in abrupt climate change, and provided the first evidence that the Earth's inner core is spinning faster than the rest of the planet.

37. **Lewiston, ID**
Site of the Missoula flood deposits that overlie Bonneville flood conglomerates, documenting two mega flood sequences.

38. **The Los Angeles City Oil Field (2nd Street Park site), CA**
A large oil field located north of downtown Los Angeles where Edward Doheny's successful well resulted in a petroleum boom in the area and the oil field at one time being the highest producing in California, this site marks the birthplace of the petroleum industry we know today due to not only the discovery of oil beneath, but also the creation of a market for the product.

39. **O.C. Marsh House, CT (NHL)**
Home of the preeminent paleontologist, O.C. Marsh who discovered and described dozens of new dinosaur species and who formulated theories on the origins of birds.

40. **Edward W. Morley House, (CT) (NR)**
The physicist who is known for his collaboration with Albert A. Michelson on the Michelson-Morley experiment that is a fundamental test of special relativity theory, and for his work on the precise atomic weights of hydrogen and oxygen.

41. **Museum of Comparative Zoology, Harvard, MA**
Founded through efforts of Louis Agassiz, and made better known in recent years by the work of Stephen Jay Gould, the museum collection illustrates comparative relationships of organisms.

42. **New Harmony Historic District, IN (NR)**
A 19th century Utopian community that was known as a center of reform for mathematics education.

43. **Old Naval Observatory, DC (NHL)**
The observatory was under the leadership of Matthew Fontaine Maury, the father of modern oceanography, from 1844 and 1861 when he made his greatest contributions and it became widely known as a world center for advances in oceanography and navigational information.

44. **Pleistocene Lakes, UT**
Many of the unique geological characteristics of the Great Basin are due to the effects of Lake Bonneville, a prehistoric pluvial lake that covered much of Great Basin region.

45. **Project Faultless, Nevada Test Site, NV**
The site where the Atomic Energy Commission tested Project Faultless, the first calibration test for a series of underground thermonuclear tests, more powerful than any undertaken before.

46. **San Andreas Fault, CA**
As geologist/mineralogist for the 1854 Pacific Railroad Survey, William Phipps Blake noted indication of mass dislocation along what would later be referred to as the San Andreas Fault, the discovery of ancient Lake Cahuilla and the lowest elevation in the conterminous U.S.

47. **San Juan Basin, NM**
Where Edward Drinker Cope of the "Bone Wars" fame investigated mammalian paleofauna, including the oldest Paleocene assemblage which was found here.

48. **Sauk County, Sloss type locality, WI**
Location of the first of six cratonic sequences identified by Lawrence Sloss that formed the basis of sequence stratigraphy.

49. **George Gaylord Simpson (Site TBD)**
Called the most influential paleontologist of the 20th century, he was a professor of zoology at Columbia University and curator at the American Museum of Natural History.

50. **Stockton Bar, Lake Bonneville, UT**
G.K. Gilbert documented Lake Bonneville, a large freshwater lake of western Utah during the last Ice Age and recognized Stockton Bar as a huge sandbar, containing unique deposits that document a nearly continuous record of geologic history of Utah during the last Ice Age.

51. **Temple Mountain, San Rafael Swell, UT**
An Atomic Energy Commission Site that has a rich history of mining, notably Temple Mountain ore was sent to Marie Curie for her experiments, and the site supplied radium during World War I and uranium during World War II.

52. **Willapa Bay, WA**
Where peat swamps and drowned forests, documented by Brian Atwater, proved that the Pacific Northwest is prone to tsunamis during major earthquakes along the Cascadia subduction zone.

Life Sciences

53. **Alexander Agassiz (Site TBD)**
A chemist and engineer by training who was a specialist in marine ichthyology in the museum of natural history his father founded at Harvard, was also President of National Academies of Science and curator of Harvard Museum of Comparative Ecology.

54. **Archbold Biological Station at Red Hill Research Site, FL (NR)**
A 5000-acre research station built by biologist Richard Archbold, whose family supported conservation widely, including Glover-Archbold Park in DC.

55. **Arnold Arboretum, MA (NHL)**
One of the earliest botanic gardens established in the United States.

56. **Spencer Fullerton Baird (Site TBD)**
A leading naturalist/ornithologist who was the first curator of Smithsonian Institute and the second Secretary of the Smithsonian Institute.

57. **Charles Herbert Best Home, ME (NR)**
He worked with Frederick Banting to isolate insulin for the treatment of diabetes while still a medical student.

58. **Liberty Hyde Bailey Birthplace, MI (NR)**
A botanist/horticulturist whose most significant and lasting contributions were in the botanical study of cultivated plants.

59. **John Bartram House, PA (NHL)**
An 18th century botanist and horticulturalist whose garden is the oldest surviving botanic garden in North America, he was one of co- founders of the American Philosophical Society.

60. **Willis Blatchley House, FL (NR)**
An entomologist and malacologist who made contributions to the study of Coleoptera, Orthoptera, Hemiptera, and the freshwater mollusks of Indiana.

61. **Body Farm, University of Tennessee, TN**
Site where cadavers were used to develop forensic analysis, leading to more accurate criminal convictions and acquittals.

62. **Norman Borlaug (Site TBD)**
Known as the father of the Green Revolution, he studied wheat production and is one of only seven Americans to win the Nobel Prize, the Medal of Freedom, and the Congressional Gold Medal.

63. **Luther Burbank House & Garden, CA (NR)**
A horticulturist/botanist who developed more than 800 strains and varieties of plants over his 55-year career, his varied creations include fruits, flowers, grains, grasses, and vegetables.

64. **John Burroughs, NY, (NHL)**
A popular 19th-early 20th century naturalist and nature essayist, he was an early popularizer of nature and was active in the US conservation movement, supporting his friend President Theodore Roosevelt.

65. **Rachel Carson House, ME (NHL)**
Her seminal book, Silent Spring described the harmful effects of pesticides on the environment, and her writings are credited with advancing the global environmental movement.

66. **College of Medicine Maryland, MD**
Established in 1807, it was the first public and fifth oldest medical school in the US, and the first to institute a residency training program. Devidge Hall is the oldest building in the US still used for medical education.

67. **Connecticut Agricultural Experiment Station, CT**
Founded in 1875, it is the oldest state experiment station in the United States and serves as a state government facility that engages in scientific research and public outreach in agriculture and related fields.

68. **Edward Drinker Cope House, PA (NHL)**
Prolific paleontologist and herpetologist whose contributions helped define the field of American paleontology.

69. **Gerty Cori (Site TBD)**
She shared the 1947 Nobel Prize in Medicine with her husband for their work on how glycogen is broken down in muscle and how the body breaks down carbohydrates, and also did independent research on heredity human diseases.

70. **Elliott Coues House, DC (NHL)**
An ornithologist whose work was instrumental in establishing the currently accepted standards of trinomial nomenclature - the taxonomic classification of subspecies - in ornithology, and ultimately the whole of zoology.

71. **Theodosius Dobzhansky (Site TBD)**
An evolutionary biologist/geneticist who won the NAS Kimber Genetics Award in 1958, the National Medal of Science 1964, and the Franklin Medal in 1973.

72. **Charles Richard Drew House, VA**
African American surgeon who demonstrated that plasma has a longer life than whole blood, and whose leadership on stockpiling blood plasma saved lives during World War II. Though he was a director of the Red Cross Blood Bank in 1941, he resigned when Red Cross decided to segregate blood according to the race of the donor.

73. **Paul R. Ehrlich (Site TBD)**
A biologist best known for decades of dire predictions about the impacts of population growth and resource exhaustion, particularly in his controversial book, The Population Bomb, which asserted that the world's human population would soon increase to the point where mass starvation ensued.

74. **Asa Gray House, MA (NHL)**
Leading Harvard botanist who published the first complete work on American flora.

75. **Percy Lavon Julian (Site TBD)**
A research chemist who pioneered the synthesis of medical drugs from plants, and was one of the first African American PhDs in Chemistry and the second African American inducted into National Academies of Science from any field.

76. **Robert Kennicott House & Grove, IL (NHL)**
A 19th century naturalist and explorer who helped found the Chicago Academy of Sciences.

77. **Mary Claire King (Site TBD)**
A geneticist who identified the breast cancer gene, demonstrated that humans and chimps are 99% genetically identical, and applied genomic sequencing to identify victims of human rights abuse.

78. **Lab at Rockefeller University, NY**
The prominent laboratory dedicated to the advancement of science for human good, where Rebecca Lancefield did her work on streptococcal infections.

79. **Karl Landsteiner (Site TBD)**
The biologist and physician who co-discovered poliovirus and won the Nobel Prize in Medicine in 1930.

80. Aldo Leopold "Shack," WI (NR)
A 20th century wildlife biologist whose seminal book, Sand County Almanac (1949) is regarded as one of the founding books of modern environmentalism, and who was influential in development of modern conservation ethics and in the movement for wilderness protection.

81. James Logan House, PA (NHL)
An 18th century biologist/horticulturalist who discovered the vital role of pollen in the fertilization of corn.

82. Robert MacArthur (Site TBD)
An ecologist who had a major impact on many areas of community and population ecology, and played an important role in the development of niche partitioning; co-authored The Theory of Island Biogeography, a work which changed the field of biogeography and led to the development of modern landscape ecology.

83. Lynn Margulis (Site TBD)
A biologist who developed endosymbiotic theory, he was elected to the National Academy of Sciences in 1983 and won the National Medal of Science in 1999.

84. Mayo Clinic, MN
Where pathologist Philip Hench studied the effects of arthritis and determined that these effects can be reversible, and the site where he and others fostered development of wonder drugs beginning in 1940.

85. Ernst Mayr (Site TBD)
An evolutionary biologist, ornithologist, taxonomist, tropical explorer, and historian of science whose work contributed to the conceptual revolution that led to the modern evolutionary synthesis of Mendelian genetics, systematics and Darwinian evolution, and to the development of the biological species concept, for which he was awarded the Leidy Medal in 1946, the Darwin-Wallace Medal 1958, and the Crafoord Prize in 1967.

86. C. Hart Merriam Base Camp, AZ (NHL)
The field research site and base camp of Clinton Hart Merriam, the United States' first eco-biologist.

87. Missouri Botanical Garden, MO (NR)
Founded in 1859, the garden is one of the oldest botanical institutions in the United States.

88. Thomas Hunt Morgan (Site TBD)
An evolutionary biologist who won the Nobel Prize in Physiology or Medicine in 1933 for work that contributed to understanding the role chromosomes play in heredity.

89. **New York Botanical Gardens, NY (NHL)**
The 250-acre site's verdant landscape supports over one million living plants in extensive collections and operates one of the world's largest plant research and conservation programs, it includes the Pfizer Plant Research Laboratory, a pure research institution and the LuEsther T. Mertz Library, one of the most comprehensive botanical library in the world.

90. **Old Scripps Building, CA (NHL)**
The oldest oceanographic research building that has been continuously used in the United States.

91. **Parke-Davis Research Laboratory, MI**
A subsidiary of the pharmaceutical company Pfizer, which was once the world's largest pharmaceutical company, credited with building the first modern pharmaceutical laboratory and developing the first systematic methods of performing clinical trials of new medications.

92. **Ellen Swallow Richards Residence, MA (NHL)**
An industrial and environmental chemist, the first woman to graduate from the Massachusetts Institute of Technology and its first female instructor, she introduced revolutionary ideas about home sanitation and conducted pioneering work that led to the establishment of the field of home economics.

93. **Jonas Salk (Site TBD)**
A medical researcher and virologist who developed first polio vaccine, discovered Type B influenza virus, and won the Presidential Medal of Freedom 1977.

94. **Margaret Sanger Clinic, NY**
The facility that housed the Clinical Research Bureau, where founder of the National Birth Control League (later Planned Parenthood), and health reformer Margaret Sanger and her successors provided contraception services and conducted research from 1930 to 1973.

95. **Saranac Lake, NY**
Site where tuberculosis research was undertaken that contributed to understanding diseases.

96. **Shedd Aquarium, IL (NR)**
An indoor public aquarium opened on May 30, 1930.

97. **Tuskegee Institute, AL (NHL)**
Site of the Public Health Service syphilis experiment where 399 poor, African American sharecroppers were part of a study on the non-treatment and natural history of syphilis that led to measures regulating the protection of human subjects from experimentation.

98. **James D. Watson (Site TBD)**
A molecular biologist who co-discovered DNA and won the Nobel Prize in Physiology or Medicine in 1953.

99. **Worcester Foundation for Biomedical Research, MA**
The facility where Gregory Pincus, Catherine McCormack, and John Rock worked on oral contraceptives and the development of drugs to treat breast cancer.

100. **Jane Wright (Site TBD)**
The pioneering cancer researcher and surgeon noted for her contributions to chemotherapy, who is credited with developing the technique of using human tissue culture rather than laboratory mice to test the effects of potential drugs on cancer cells, and who also pioneered the use of the drug methotrexate to treat breast cancer and skin cancer.

Mathematical Sciences

101. **Henry Barnard House, CT (NR)**
Henry Barnard was an early champion of free public elementary education (common schools), and an early advocate of the metric system.

102. **G.D. Birkhoff House, MA (NHL)**
An early 20th century mathematician considered by many the preeminent American mathematician of his time, who is best known for the "ergodic theorem," and his study of dynamical systems like the solar system.

103. **Sabbathday Lake Shaker Village, ME**
Established in 1782, 1783, or 1793, it was an early center for the production of teaching apparatus relating to the metric system, and the last active Shaker village in the US.

104. **United States Military Academy, NY**
Served as a center for mathematics education in the early 1800s.

Physics and Astronomy

105. **Adler Planetarium, IL (NR)**
America's first planetarium and part of Chicago's Museum Campus, which includes the John G. Shedd Aquarium and The Field Museum, its mission is to inspire exploration and understanding of the Universe.

106. Alabama Redstone Test Stand, AL (NR)
The site which was used to develop and test fire the Redstone missile, the first missile to detonate a nuclear weapon, the Jupiter-C rocket, the Juno I launch vehicle, that put the first American satellite, Explorer 1 into orbit, and Mercury-Redstone launch vehicle that carried the first American astronaut, Alan Shepard into space.

107. Benjamin Banneker, MD (Site TBD)
A largely self-taught 18th century African American astronomer who helped survey the District of Columbia and published Almanacs.

108. Hans Bethe (Site TBD)
A physicist who is best known for his contributions to the theory of nuclear reactions, especially his discoveries concerning the energy production in stars for which he won the Nobel Prize in Physics in 1967, and was head of the theoretical division of the Manhattan Project at Los Alamos.

109. Niels Bohr (Site TBD)
He won the Nobel Prize in Physics in 1922 for his services in the investigation of the structure of atoms and of the radiation emanating from them, and worked on the atom bomb at Los Alamos in WWII.

110. Percy Williams Bridgman House, MA (NHL)
A physicist who was awarded the Nobel Prize in 1946 for his work on the physics of high pressures, which led to machinery that produced the first artificial diamonds, and whose discoveries gave insight to the physical processes that take place within the earth.

111. Cape Canaveral Air Force Station, FL (NR)
A number of American space exploration "firsts" were launched here, including the first U.S. Earth satellite (1958), first U.S. astronaut (1961), and the first U.S. astronaut in orbit (1962).

112. Cincinnati Observatory, OH (NHL)
The oldest professional observatory in the United States, it currently operates as a 19th-century observatory.

113. Cinder Field, Astronaut Training Center, AZ
Astronauts Roger Chaffee, Mike Collins, Ed White, and others trained here in preparation for lunar missions.

114. Arthur H. Compton House, IL (NHL)
The physicist who discovered the Compton Effect, proving that light has both a particle and a wave aspect, shared the Nobel Prize in 1927, and led the Manhattan Project from the University of Chicago in WWII.

115. **Cornell University Laboratory for Planetary Studies, NY**
The Laboratory of physicist Carl Sagan, popularizer of astronomy in particular and science in general through his books *Broca's Brain* (1979) and *Cosmos* (1980).

116. **Albert Einstein House, NJ (NHL)**
The prominent theoretical physicist who developed the general theory of relativity, which is one of two pillars of modern physics, whose work is known for its influence on the philosophy of science, and who received the Nobel Prize in Physics in 1921.

117. **Experimental Breeder Reactor No. 1, ID**
This facility became the world's first electricity-generating nuclear power plant when it produced sufficient electricity to illuminate four 200-watt light bulbs.

118. **Enrico Fermi (Site TBD)**
Often referred to as the father of the atomic bomb, he was a physicist who won the Nobel Prize in Physics in 1938 for his work on induced radioactivity by neutron bombardment and the discovery of transuranic elements. He is also credited with creation of the first nuclear reactor, the Chicago Pile-1 and made significant contributions to the development of quantum theory, nuclear and particle physics, and statistical mechanics.

119. **William Ferrel (Site TBD)**
A 19th century meteorologist who studied atmospheric physics and hurricane prediction and worked for the United States Army Signal Service, which later became the United States Weather Bureau.

120. **Richard Feynman (Site TBD)**
A theoretical physicist who developed modern quantum thermodynamics for which he was awarded the Nobel Prize in Physics in 1965, who also popularized physics through books and lectures.

121. **Gaithersburg Latitude Observatory, ME**
One of six observatories, and one of the four original observatories built by 1899 tracking the degree of "wobble" occurring on the earth's north-south axis and resultant variation of latitude.

122. **Murray Gell-Mann (Site TBD)**
A theoretical physicist who was awarded the Nobel Prize in Physics in 1969 for his work on elementary particles and their interaction and formulated the theory of the quark as one of the fundamental constituents of matter.

123. Sheldon Lee Glashow (Site TBD)
A particle physicist who shared the Nobel Prize in Physics 1979 for his work on electroweak force theory, which unified electromagnetic and nuclear force theories.

124. Goddard Rocket Launching Site, MA (NR)
Launch site of the world's first successful liquid-fueled rocket by Robert H Goddard.

125. Hale Solar Observatory, CA
Lab of astronomer George Ellery Hale, known for inventing the spectrohelioscope (as an undergraduate at MIT) with which he made his discovery of solar vortices, he also established that sunspots are magnetic and played a key role in founding the National Research Council.

126. Edwin Hubble House, CA (NHL)
The astronomer who played a crucial role in establishing the field of extragalactic astronomy and is generally regarded as one of the most important observational cosmologists of the 20th century, known for showing that the recessional velocity of a galaxy increases with its distance from the earth, implying the universe is expanding, known as "Hubble's law."

127. Henry Joseph House, NJ (NHL)
A prominent 19th century physicist, he discovered the electromagnetic phenomenon of self-inductance, was the first secretary of the Smithsonian Institution, developed the electromagnet into a practical device, and invented a precursor to the doorbell.

128. Kennedy Space Center, FL
NASA's Launch Operations Center that was originally built for the Saturn V, the largest and most powerful operational launch vehicle in history constructed for the Apollo program, and since the end of the Apollo manned missions in 1972 has been used to launch every NASA human space flight.

129. Robert A. Millikan House, IL (NHL)
Physicist awarded the Nobel Prize in Physics in 1923 for his measurement of the elementary electronic charge and his work on the photoelectric effect.

130. Maria Mitchell (Site TBD)
At the forefront of American astronomy in 1847 when she spotted a blurry streak—a comet—through her telescope, she was the first woman to be elected to the American Academy of Arts and Sciences, and the first female astronomy professor in the United States (hired by Vassar College in 1865).

131. John von Neumann (Site TBD)
The mathematician/physicist who worked on the Manhattan Project and later worked to develop the hydrogen bomb.

132. J. Robert Oppenheimer (Site TBD)
The theoretical physicist, known as the father of the atomic bomb, who was head of the Manhattan Project and later became an advisor to the Atomic Energy Commission and an arms control advocate.

133. Portland Observatory, ME (NHL)
Historic maritime signal tower built in 1807 in Portland, ME that is the only known surviving tower of its type in the United States.

134. Propulsion and Structural Test Facility, AL
Site where the first single-stage rockets with multiple engines were tested and the Saturn Family of launch vehicles was developed.

135. Pupin Physics Laboratory, Columbia, NY (NR)
This lab is significant for its association with experiments relating to the splitting of the atom, achieved in connection with the Manhattan Project.

136. H.A. Rowland House, ME (NHL)
19th century physicist who was the first president of the American Physical Society and is remembered for the high quality of the diffraction gratings he made and the work he did with them on the solar spectrum.

137. Site of First Self-Sustaining Nuclear Reaction, IL
Site of the first man-made self-sustaining nuclear chain reaction, which was initiated in Chicago Pile-1 (the world's first artificial nuclear reactor) on December 2nd, 1942 under the supervision of Enrico Fermi.

138. Edward Teller (Site TBD)
The theoretical physicist known as father of the hydrogen bomb, though he earlier worked extensively on the atomic bomb at Los Alamos as well, and much later was the leading advocate of the Strategic Defense Initiative ("Star Wars").

139. Unitary Plan Wind Tunnel, CA
The research facility used extensively to design and test new generations of commercial and military aircraft as well as NASA space vehicles, including the Space Shuttle.

140. University of Illinois Observatory, IL
Observatory that played a key role in the development of astronomy as home to a key innovation in the area of astronomical photometry, and was directed at different times by notables such as Joel Stebbins and Robert Horace Baker.

141. U.S. Naval Academy, MD (NR)
Includes site of an early experiment of Academy graduate and physicist A.A. Michelson, the first US recipient of the Nobel Prize in 1907, who was later made notable for the Michelson-Morley experiment which forms one of the fundamental tests of special relativity theory.

Social Sciences

142. Administrative Building, Carnegie Institution of Washington, DC
A facility founded and endowed by Andrew Carnegie in 1902 to encourage scientific "investigation, research and discovery" that would lead "to the improvement of mankind."

143. American Philosophical Society Hall, PA (NR)
Now a museum, this is the original home of the eminent scholarly organization of international reputation that promoted useful knowledge in the sciences and humanities through excellence in scholarly research, professional meetings, publications, library resources, and community outreach.

144. Arts & Industries Building, Smithsonian, DC
Second oldest of the Smithsonian museums on the National Mall in Washington, D.C, the facility was initially named the National Museum and it was built to provide the Smithsonian Institution with its first proper facility for publicly displaying its growing collections.

145. Beginning Point of the U.S. Public Lands Survey, OH
Beginning point of the first mathematically designed cadastral survey conducted nationwide in a modern country in 1785, it opened what was then the Northwest Territory for settlement and is studied as a basis for land reform in other countries.

146. Franz Boas (Site TBD)
Known as the father of American anthropology, he was one of the most prominent opponents of scientific racism. He introduced the concept of cultural relativism, which holds that cultures cannot be objectively ranked as higher or lower, or better or more correct, but that all humans see the world through the lens of their own culture.

147. Noam Chomsky (Site TBD)
Often described as the father of modern linguistics, he has also been called the "world's top public intellectual," who entered the public consciousness through his vocal opposition to U.S. involvement in the Vietnam War in part through his essay “The Responsibility of Intellectuals” and came to be associated with the New Left while being arrested on multiple occasions for his anti-war activism.

148. Kenneth and Mamie Phipps Clark (Site TBD)
African-American PhD psychologist husband and wife team who became active in the civil rights movement, and whose research including their doll experiment on children's attitudes about race influenced the *Brown vs. Board of Education* decision, the Supreme Court case that determined that racial segregation in education is unconstitutional.

149. Daniel C. Gilman Summer Home, ME
First president of Johns Hopkins University, the first university in the United States founded with the express purpose of encouraging advanced scientific research.

150. Owenite Community, IN
The site of Robert Owen's utopian experiment where renowned teachers and scientists were assembled, including geologist William Maclure and zoologist and entomologist Thomas Say; though the site was closed after two years, several important outgrowths resulted, including the first US kindergarten, trade school, library, and public school system to offer equal educational opportunities for both girls and boys; the site also the original headquarters of the US Geological Survey.

151. Charles Wilson Peale House, PA (NHL)
Organized the first US biological and geological exploration expedition in 1801 and founded the Philadelphia Museum, later known as Peale's American Museum, a museum of natural history.

152. Peale's Baltimore Museum, MD (NR)
The first building specifically designed to be a museum (for paintings and natural history), established by Charles Wilson Peale.

153. Robbers Cave State Park, OK
Site of influential social conflict theory experiments conducted by Turkish-American social psychologist Muzafer Sherif, a founder of modern social psychology who developed several unique and powerful techniques for understanding social processes, particularly social norms and social conflict.

154. B.F. Skinner (Site TBD)
Psychologist, behaviorist, and social philosopher who won the National Medal of Science in 1968, he developed a philosophy of science that he called radical behaviorism and founded a school of experimental research psychology.

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