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**Aircraft Overflights | Interpreting the Wilderness Act
Wild Rivers Global Assessment | The Untrammelled Wild**

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On the Cover

Carved by the Snake River, Hells Canyon plunges over a mile below Oregon's west rim, and 8,000 feet below snowcapped He Devil Peak of Idaho's Seven Devils Mountains.

Photo © Boyd Norton



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IJW Editor-in-Chief Emeritus



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International Journal of Wilderness

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MANUSCRIPTS TO: Robert Dvorak, Dept. of Recreation, Parks and Leisure Services, Central Michigan University, Room 108 Finch Hall, Mount Pleasant, MI 48859; Telephone: (989) 774-7269. E-mail: dvora1rg@cmich.edu.

BUSINESS MANAGEMENT AND SUBSCRIPTIONS: The WILD Foundation, 717 Poplar Ave., Boulder, CO 80304, USA. Telephone: (303) 442-8811. E-mail: info@wild.org.

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Stewardship and Science in a Changing World


by Robert Dvorak

The framing of any discourse within the concept of "a changing world" certainly takes on the risk of being cliché. One could argue that change is inevitable, especially across the dynamic and interconnected landscapes of wilderness and protected areas. However, organizations and institutions consistently utilize the perspective of a changing world to foster discussion, analysis, collaboration, and advocacy. It is a symbol that invokes an immediacy and relevancy for the complex sociopolitical and ecological challenges that professionals must consistently address in wilderness stewardship and conservation. Therefore, it seems appropriate for the direction of the *International Journal of Wilderness* to enter 2018 in the context of "a changing world."

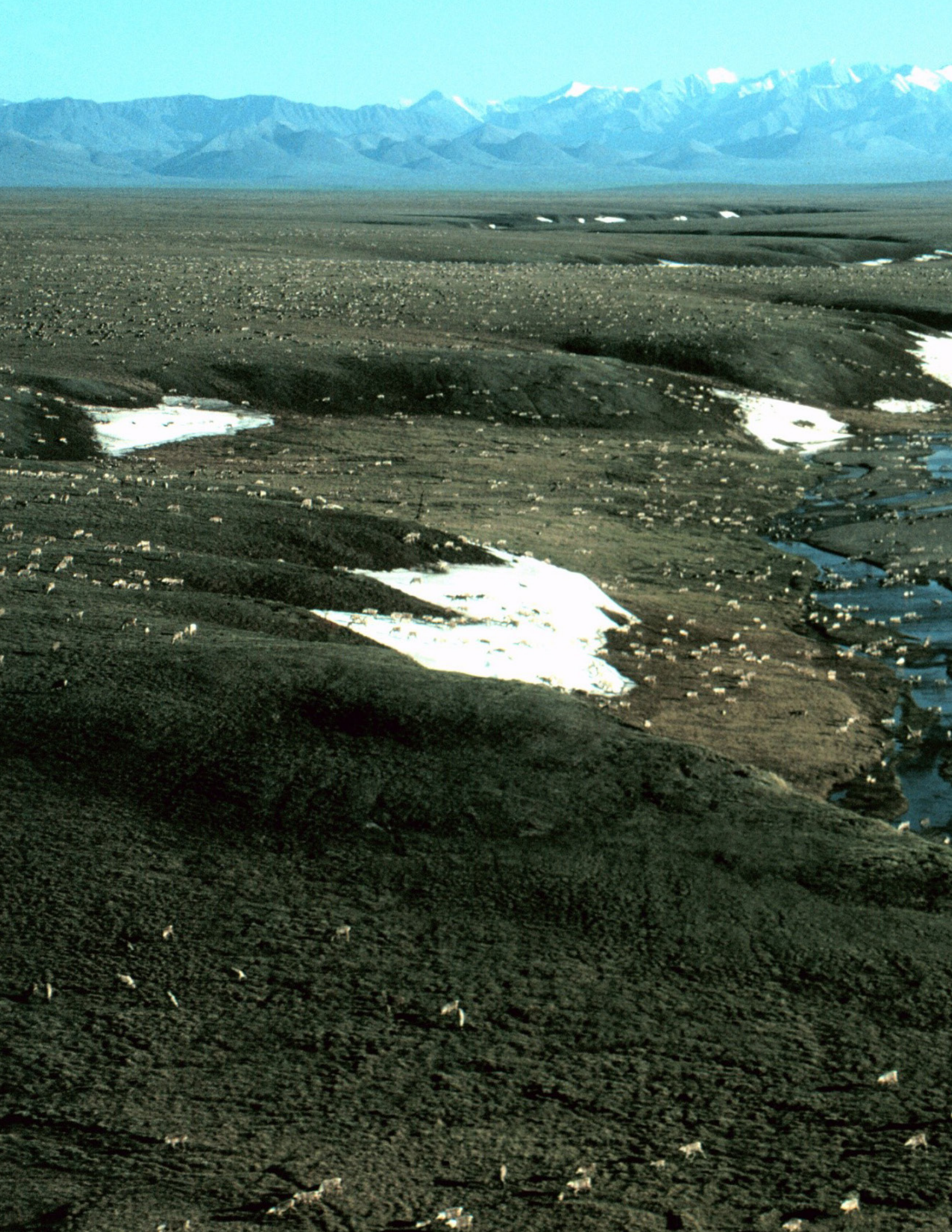
In 2017, *IJW* began an online publishing format. This format will continue in 2018 as we seek to reach our diverse audience in multiple ways that are consistent with current professional and academic dissemination of science and stewardship. We also have the opportunity to expand our social media presence and outreach by changing how we provide information and content to practitioners, scientists, advocates, and stewards. Plans include providing open access via the *IJW* website to the tables of contents, editorials, and the "Soul of the Wilderness" for the current volume. It may include videos, slideshows, rejoinders, and other forums for peer-review manuscripts and featured manuscripts for *IJW* subscribers. Through these changes, it is our goal to provide ongoing engagement, discourse, and exposure for the important topics and issues raised by the contributing authors of *IJW* and its valued readership.

It is also important to recognition and thank Dr. Chad Dawson for his immense and ongoing contributions to *IJW* as Editor-in-Chief. As I take over the role in 2018, I cannot thank Chad enough for his mentorship, dedication, and tireless efforts. He has provided a forum that supports young wilderness professionals and scholars, an atmosphere for civil discourse and debate, and a voice for so many individuals in this "changing world". We sincerely thank you Chad for all that you do to champion wilderness and wild places!

In the December 2017 issue, Steve Chesterton and Alan Watson compiled a special issue in recognition of the 50th anniversary of the US Wild and Scenic River Act, being celebrating in 2018. That issue examined topics that spanned from rewilding rivers and ecosystem-based resilience to the role wild and scenic rivers have in the conservation of aquatic biodiversity. In this issue of *IJW*, we take the opportunity to build upon that “watershed moment” for river conservation and science by including additional papers from that special issue. Steve Carver utilizes GIS-based approaches to examine the global distribution of wild rivers. Zdenka Křenová discusses canoeing the Vltava River on the Czech-German Border. Peng Li describes international collaboration and support for the designation of the Quigzhu National Protected River in China.

This issue also compiles several papers that speak to our changing world. Roger Kaye discusses untrammelled wild and wilderness character in the time of the Anthropocene. Reyn Hutten describes citizen science efforts in monitoring glacial recession in Alaska. Finally, we have Gregory Hansen highlighting the emergence of the next generation of Native Youth Corp programs. 

ROBERT DVORAK is editor-in-chief of *IJW* and professor in the Department of Recreation, Parks, and Leisure Services Administration at Central Michigan University: email: dvora1rg@cmich.edu



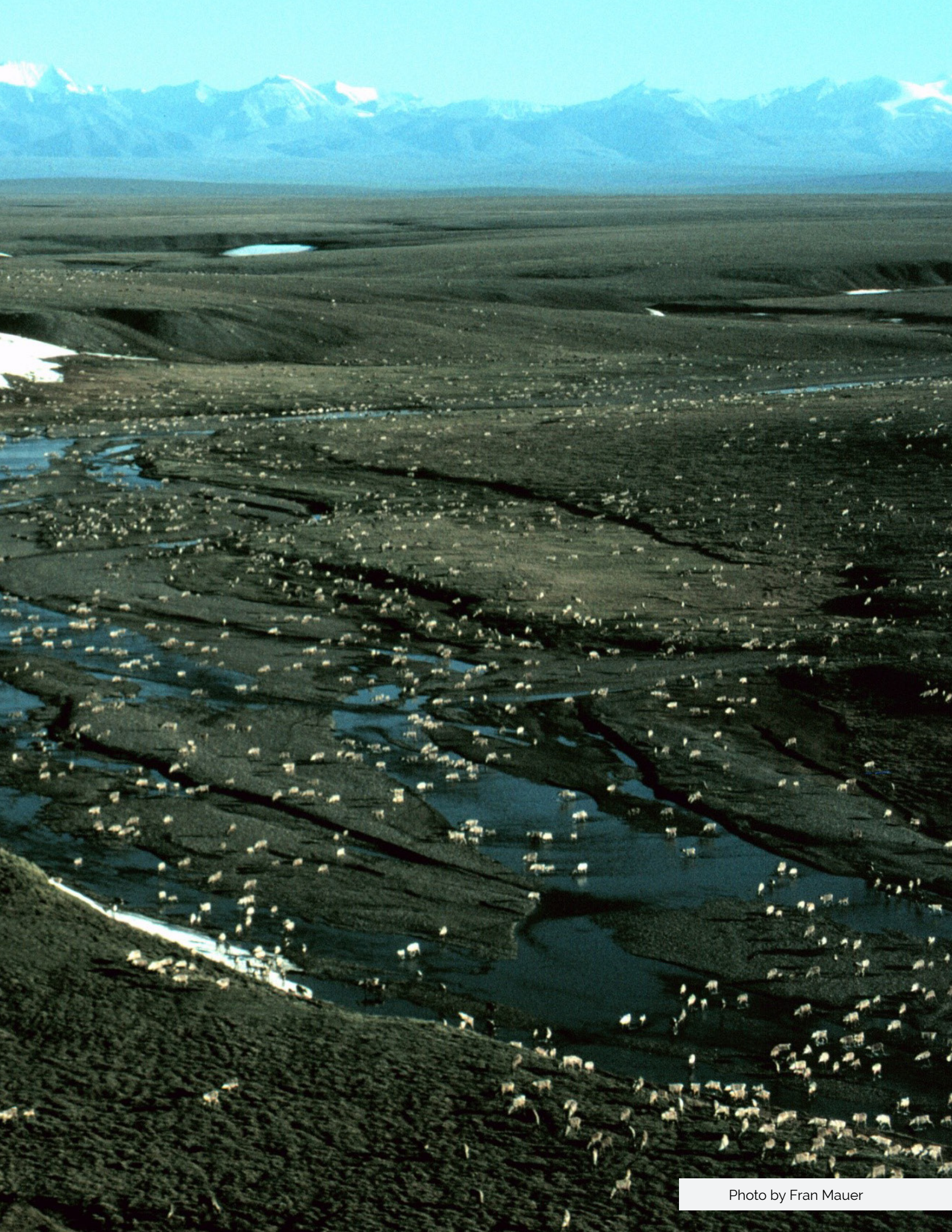


Photo by Fran Mauer

The Untrammeled Wild and Wilderness Character in the Anthropocene

Untrammeled: It's the essence of Wilderness, the source of its mystique, its otherness, and its transcendent function. It's a state wherein the landscape remains free from the human intent to alter, control, or manipulate its components and ecological and evolutionary processes. It's the key word of the Wilderness Act's "DEFINITION OF WILDERNESS," which states "A wilderness, in *contrast* with those areas where man and his works dominate the landscape, is hereby recognized as an area of the earth and its community of life are *untrammeled* by man . . ." (emphasis added).

But why did the Act's principal author and proponent Howard Zahniser, an editor and meticulous wordsmith, choose the rather unusual term *untrammeled* as the main descriptor of Wilderness? Why not define Wilderness as an area that is simply wild? After all, by definition, an area that is untrammeled is wild.

Untrammeled lends transcendent meaning to wildness. Understanding that meaning is crucial to understanding the Wilderness Act's overarching mandate to preserve wilderness character. It reveals why preservation of wilderness character, and not just the tangible qualities of the Wilderness it includes, is the purpose of the Act and central to the larger function it was to serve. Wilderness, as historian Roderick Nash (1982) documents, was to serve as "an important symbol of a revolutionary new way of thinking about man's relationship to



by Roger Kaye

“Might not the heirs of this coming Brave New World appreciate inheriting some areas whose freedom from human agency provide the ultimate contrast to the dominant value-and-manage-everything-for-us paradigm? Might they not appreciate inheriting a few authentic remnants of this Earth...”



Figure 1 – Nobel laureate Paul Crutzen co-coined the term *Anthropocene*. "This name," he wrote, "would stress the enormity of humanity's responsibility as stewards of the Earth." Photo courtesy of Paul Crutzen.

the earth." And today, another symbol of revolutionary thinking—the Anthropocene—reminds us that, as the concept's central proponent Nobel laureate Paul Crutzen (2011) emphasizes, "We must change the way we perceive ourselves and our role in the world."

Crutzen, who co-coined the term, and other Earth-system scientists proposed the *Anthropocene* to describe a new geological epoch wherein "Human activities have become so pervasive and profound that they rival the great forces of Nature and are pushing the Earth into planetary terra incognita" (Steffen, Crutzen, and McNeill 2007). It's a condition of myriad unknowns, with one certainty: our landscapes will undergo substantial change, as must our ways of relating to them.

But while geologists debate whether this emerging condition meets their stratigraphic standards for a new epoch or when it began, the Anthropocene has become more of a

conceptual framework for understanding, communicating, and addressing the accelerating global transformation we face. As a scientific term, the Anthropocene describes the emerging Earth-state, offering a name for the totality of planet changing human interactions. As an approach to large-scale, long-term stewardship, it challenges us to rethink long-standing notions of nature and naturalness, our role in the biosphere, and our current conservation paradigm. For Wilderness, the Anthropocene raises many questions and poses daunting dilemmas. Among them is whether, when, or where to intervene in Wilderness to maintain (or try) "natural" conditions and unit purposes in the non-analogue future. And that begs the question: How do interventions, more and more often proposed, affect wilderness character, and particularly, the role of what is arguably its most important and threatened quality: untrammelled wildness.

In the new world of the Anthropocene, if we are to maintain this ineffable, invisible, and immeasurable quality of wilderness, that is, if the reasons for perpetuating untrammelled wilderness are to fairly compete with the more tangible reasons for intervening, then we must better understand and articulate its values and functions.

The Idea of Untrammelled

As is well documented (Scott 2001, Proescholdt 2008), Zahniser chose the word *untrammelled* thoughtfully and purposely. Colleagues had recommended that he use a more common descriptor for wilderness areas. *Undisturbed* was recommended. But as Zahniser responded, "The idea within the word 'Untrammelled,' of their not being subjected to human controls and manipulations that hamper the free play of natural forces is the distinctive one that seems to make this word the most suitable one for its purpose within the Wilderness Bill" (Zahniser 1959). This is so because Zahniser's purpose for Wilderness went beyond maintaining its natural condition. More important was to respect and perpetuate the freedom of its ecological and evolutionary processes. But beyond that, he hoped that designating some areas for this purpose would serve as a step toward expanding thinking about our role within, as the Wilderness Act says, "the earth and its community of life." Therein lies the transcendent function of wilderness character, and why both the Act and the Anthropocene concept place us within the larger context of an Earth-system sensibility.



Figure 2 – Howard Zahniser, chief author of the Wilderness Act, made *untrammelled* the act's key word and placed wilderness in the context of "the earth and its community of life." Photo courtesy of Edward Zahniser.

To better understand why Zahniser determined *untrammelled* to be the most suitable word, consider it in the context of that *contrast* the Wilderness Act specifies. Physically, wilderness provides a contrast to the altered, developed, or manipulated landscape condition. But also of concern was the contrast wilderness provides between two ways of relating to—and knowing ourselves in relation to—the natural world. One way is as a species ordained to subdue and have dominion over nature. This, Zahniser (1956) said, leads people to become “less and less aware of their dependence on other forms of life and more and more misled into a sense of self-sufficiency and into disregard of their interdependence with the other forms of life . . .”

In contrast is a way of relating grounded in “an awareness of our human existence as spiritual creatures nurtured and sustained by and from the great community of life.” Thus, in a seminal summary statement reflecting the Transcendental/spiritual underpinnings of the wilderness movement and its potential to enlarge thinking about humans’ role in the larger scheme of things, Zahniser declared that:

We deeply need the humility to know ourselves as the dependent members of a great community of life . . . to know the wilderness is to know a profound humility, to recognize one’s littleness, to sense dependence and interdependence, indebtedness and responsibility.

In this writing, inserted into the *Congressional Record* and published as “The Need for Wilderness Areas,” Zahniser (1956) made clear that he did not intend this potential for expansion of our ethics and worldview to be a secondary purpose of Wilderness. As he went on to emphasize, “Perhaps, indeed, this is the *distinctive* ministration of wilderness to modern man, the characteristic effect of an area which we most deeply need to provide for in our preservation programs.”

Zahniser’s focus on *ministration*, meaning to minister to, to serve one’s deeper or spiritual needs, reveals his hope for places set apart from our utility, willfulness, and hubris. They might serve as a medium for opening us to that sense of obligation to the larger world in which we are embedded.

A Vision of Human-Earth Relations

Thought about the need for such ministration emerged from growing anxiety accompanying the accelerating environmental degradations of the 1950s post-war march of progress. The rapid loss of natural areas to urban, industrial, and resource-extractive uses, pollution and pesticides, and the awesome power and fallout of the Bomb: This new order of environmental threat led early wilderness movement leaders to realize how much the advance of industrial civilization was jeopardizing the welfare of all life. Indeed, theirs was the first generation to question whether future generations would even inherit the same Earth. They saw the need, now ever-more compelling, for an ethic to guide human–Earth relations for the changing world.

That need was central to the advocacy of Olaus Murie, Zahniser’s partner and director of the Wilderness Society through the Wilderness Act campaign. Murie’s (1960) larger hope for Wilderness was grounded in what he saw as “the real problem . . . of what the human species

is to do with this earth." Thus, their friend Aldo Leopold considered Wilderness to be the key to his first modern appeal for rethinking our environmental ethics. The wilderness movement, Leopold (1935) wrote, was ultimately "a disclaimer of the biotic arrogance of *homo americanus*. It is one of the focal points of a new attitude—an intelligent humility toward man's place in nature." Areas whose purpose was to remain untrammeled would serve as a geographic symbol of this attitude.



Figure 3 – Olaus and Mardy Murie on the Arctic Refuge, 1956. Olaus described wilderness as "nature's freedom"; Mardy declared that "it is itself, for itself."

Had the Wilderness Act's definition used *wild* instead of *untrammeled*, it would be inclusive of areas that remained wild only because humans haven't (yet) had a reason or the means to alter, control or subjugate them. True, such areas and what Zahniser (1956) referred to as "the wildness of the universe" are aesthetically inspiring. But such areas don't require anything of us to remain wild. Thus, they don't connect us to that moral vision of human-Earth relations underlying the Wilderness Act. Since they don't require us to forgo control, or to restrain or refrain, they don't challenge us to question the beliefs, attitudes, and assumptions underlying our profligate behavior toward the Earth community. While untrammeled areas are wild, the terms are not synonymous. Untrammeled is distinctive of those areas that are wild because we have decided, through political process, to restrain ourselves in order to perpetuate their wildness.

Simply put, areas that are wild by default don't impart the message of wilderness character because character derives from situations in which we face a choice that tests our willingness to subordinate self-interest to a greater good, something of more encompassing and enduring importance. We value wild Wilderness because it's the product of evolutionary processes free from human will; we value untrammelled wildness for this reason, and also because it speaks to something of our character.

The Wild Condition, the Untrammelled Relationship

So "untrammelled by man" refers to more than the landscape condition of ecological and evolutionary freedom that is wildness. At heart, *Untrammelled* is the inter-relational dimension of Wilderness. It's also about *us*, how we relate to the natural world and its other inhabitants, and who we become when we find it within ourselves to allow some of it this freedom from our willfulness.

Untrammelled is a relationship of respect for the autonomous creativity of unwilled processes, for the timeless forces that formed and shaped—and connect—our species, all species, all the Earth. It's a relationship of deference to an area's non-anthropocentric reason for being, a recognition of its intrinsic value. It's a measure of that better part of us that still holds reverence for something outside human utility and desires. Through foregoing control, we enter a most genuine relationship of humility and restraint—the relationship necessary for the preservation of Wilderness and central to that message of wilderness character.

Perpetuating some areas that embody this ecocentric-spiritual relationship will be ever-more important as we move farther into the terra incognita of the Anthropocene. Already we are in a post-natural world wherein anthropogenic and natural effects on the Earth system are becoming increasingly intertwined and inseparable, evolving ever more synergistically with humans. But imagine the future of "nature" when not only our unintended ecological degradations, but also when synthetic biology, designer ecosystems, assisted evolution, geoengineering, and who-knows-what become part of the "new natural" of an ever-more managed, manipulated, and controlled planet.

The Anthropocene fact is that every year more of the Earth's surface is modified to serve human purposes, and more of the chemical, biological, and thermal properties of its atmosphere, hydrosphere, lithosphere, and ecosphere are being pushed from their historic range of variability. Thus, wilderness areas, unfortunately, will also continue to become less and less natural. Attempting to maintain their natural conditions or components will require increasing



Figure 4 – Earthrise, a photo by Apollo 8 astronaut Bill Anders, has become a symbol of the Anthropocene. It advanced thinking about the need for global unity in protecting our shared planet.

levels of intervention, manipulation, and ecological restoration. But their untrammelled wildness, that is, their freedom from human intent, as opposed to human effect, can be perpetuated—as long as we refrain from imposing our will. We need only to allow them the autonomy to adapt and evolve as they will. To the degree this deference becomes a greater focus of our wilderness stewardship, our descendants may realize Zahniser's ministerial potential of wilderness character.

Other Wilderness Values

However, this is not to say there should never be intervention or restoration in any Wilderness. It is inevitable, if not desirable, that in some areas, in some situations, we act to maintain focal or endangered species, or meet other establishing purposes of the park, refuge, or forest units designated as Wilderness. I have reluctantly, grudgingly, concluded that in the disconcerting future we face it is not reasonable to think our society will be willing to maintain all 110 million acres of Wilderness as the framers of the Wilderness Act intended. They were visionaries, certainly, but they worked in the context of 1950s conditions and understandings of the potential for large-scale anthropogenic change. They couldn't have foreseen what is now recognized as "the dilemma of wilderness management," (Cole and Yung 2010) the question of whether, where, or when maintaining "natural" conditions or wildness should have primacy, where maintaining one compromises the other. A potential solution would be to identify some areas where limited, targeted, and temporary intervention or restoration is permissible, and others as strictly hands-off, no intervention areas. Within the latter, our role would be to allow wilderness systems to adapt and evolve as they will, and we would accept, for example, that within them some species will decline or be extirpated and replaced by others more suited to the changing conditions.

This approach would enable perpetuation of the full range of values of the national wilderness system. It may be the only viable means of ensuring that the multiple values of the untrammelled condition are perpetuated.

Untrammelled Wildness in a Brave New World

The untrammelled wild areas can serve the future, as Leopold espoused, as a scientific laboratory for understanding how ecological systems function, transition, and respond to anthropogenic change when left alone. Those who inherit the next century of the Anthropocene will surely use Wilderness as a baseline for understanding the changing Earth system. But perhaps they'll also, as Zahniser believed, use Wilderness as a reference point for thinking about who they are in relation to it. So, imagine too the potential importance of this touchstone function as society and human nature change.

Consider today's trends and future projections signaling the direction humanity is evolving. Think beyond to when bio-neural-genetic engineering, cybernetic implants, augmented reality systems and-who-knows-what will have changed our minds and bodies. Might not the heirs of this coming Brave New World appreciate inheriting some areas whose freedom from human agency provide the ultimate contrast to the dominant value-and-manage-everything-for-us paradigm? Might they not appreciate inheriting a few authentic remnants of this Earth—areas whose authenticity is not based on some desired prior condition, but rather grounded in their unbroken connection to the autonomous processes of their genesis and unfolding?



Figure 5 - The Anthropocene by artist Lindsay Carron. The Anthropocene concept speaks to the deepening intertwining of natural and human systems and challenges us to rethink long-standing notions of nature and naturalness.

Evolutionary Heritage Sites

More important to our descendants than the tangible ecological and scientific laboratory functions that untrammeled Wilderness areas can provide may well be their function as heritage sites. For the same reason that across cultures and throughout history societies have set places apart as sacred groves, monuments, memorials, and shrines, these areas can serve as places of remembering and reflection. Endowed with such meaning, untrammeled wild areas can serve to keep in memory conditions and ways of the past that provide insight into the specie's nature, and how it became as it is.

As such, untrammeled wild places can serve as an anchor point as humanity reshapes its world and itself. They can serve those who inherit the next century of the Anthropocene as living museums of the unordered, unwilled processes of their origin as creatures of the wild. They can serve as an archive of their co-evolutionary kinship—and shared destiny—with all lifeforms.

For those who visit, the main values of the "Wilderness Experience" within these monuments to untrammeled wildness may lie in the nowhere-else opportunity they provide for an atavistic, experiential glimpse of the world in which their evolutionary journey began, and to feel the sheer otherness of a place that is there for itself.


As places set apart from human willfulness and hubris, their otherness can serve Zahniser's contrast value for understanding how these traits have distanced humankind from its sense of dependence and interdependence with the rest of life. They can serve as reference points for questioning the assumptions underlying an increasingly utilitarian, materialistic, and technological society. Untrammeled wild areas will be there—if we are willing—to provide perspectives our descendants can consider in deciding what of their culture, genome, and world will be passed on.

And should the age-old and universal longing to connect to an ultimacy providing meaning outside and beyond themselves remain part of their humanity, perhaps our descendants will also find untrammeled Wilderness to serve as a cathedral of spirituality. It might function as a sort of geographical Sabbath, a reminder of why, across cultures and throughout time, great prophets and visionaries had gone to the wilds to penetrate the transcendent truth that the greater meaning of life is only to be found in relation to the larger community.

Conclusion

The deepening intertwining of natural and human systems is at the heart of the Anthropocene concept. That the sustainability of human-Earth relations is the most basic issue of our time—and for all future time—is its central insight. The scientific, ecological, experiential, and aesthetic values and functions of the wilderness condition will surely become more important as humans journey further into this uncharted and unsettling phase of planetary civilization.

But perhaps more important will be that ministrations of Wilderness character. That is, the function of untrammeled Wilderness as the symbolic embodiment of an evolutionary-ecological-ethical worldview that is grounded in the recognition of our dependence and interdependence, our need for belonging and connection, and our sense of responsibility and obligation.

Endowed with such meaning, untrammeled Wilderness becomes an encouraging demonstration and reminder of our capacity for restraint. It stands as a symbol of the willingness to think outside our utility and beyond our time that is needed to further the emergence of a new planetary sensibility. It is what Zahniser (1961) hoped might open us to “a sense of ourselves as a responsible part of a continuing community of life,” and what he knew is the essential precondition for entering into a sustainable relationship with this finite and conflicted Earth system we share. 

ROGER KAYE is the wilderness specialist for the U.S. Fish and Wildlife Service, Alaska and an affiliate faculty at the University of Alaska. This article is based on the author’s judgement, interpretation, and emphasis, and does not constitute a policy position of the author’s agency; email: rogerkaye7@gmail.com

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Next Gen Native Youth: The Emergence of Native Youth Corps Programs

In the United States, as is happening in many other regions of the world, there is an increasing respect and appreciation for the knowledge of indigenous people, and how they have lived in concert with the landscape since time immemorial. We have so much to learn from our Native peoples and we're trying to unlock that. I would encourage all people from countries around the world to really tap into that indigenous knowledge to build respect in those cultures and recognize that through bio-cultural conservation we actually have an opportunity to factor that human dimension in to help all of us. - Sally Jewell, Secretary of the Interior (IUCN 2016 World Conservation Congress)



by Gregory Hansen

Gregory Hansen (Ponca) with Ponca Nephew at Brotherhood Celebration, Pine Ridge Lakota Sioux Agency-Porcupine South Dakota.

The US data available regarding Native American employment is very concerning. More than one in four Native people live in poverty, and their labor force participation rate, which measures the share of adults either working or looking for a job, is the lowest (61.6%) for all race and ethnicity groups in the United States. Despite the negative data, Native youth have significant skills that are being developed through youth corps programs. Many are beginning to carve out futures in the natural sciences and natural resource fields. Corps programs provide opportunities to serve communities and ecosystems and lead to personal and professional development. They have proven to be successful in supporting Native peoples in building a foundation for future employment and life success. This article provides an encouraging glimpse of what has

“Native youth engagement not only delivers huge payoffs to our Native youth and public lands, it also ultimately fosters the building of positive relationships that absolutely must exist between Native peoples and public land managers/users moving forward.”



Figure 1 – 2016–2017 Arizona Conservation Corps: Phoenix Ancestral Lands Native crew. Crew leader Shayden Joe (Navajo) and assistant crew leader Lance Itubinaghtewa (Hopi).

been accomplished by Conservation Legacy, other youth corps programs, and our federal agencies in providing opportunities for Native youth to become engaged with the conservation movement, a field that in many ways was inspired by the ancestral beliefs and traditional lifeway practices of Native peoples.

Native Youth and Protected Area Stewardship

Conservation Legacy is a national nonprofit organization that fosters conservation service in support of communities and ecosystems. In 2016, Conservation Legacy engaged more than 1,500 young people and veterans in paid conservation work, completing over 1,000,000 hours of service-enhancing recreation

access, protecting communities from wildfire, stewarding conservation/protected area resources, and enhancing communities.

Conservation Legacy programs include the Arizona Conservation Corps (AZCC), Southwest Conservation Corps (Colorado, Northern New Mexico), Conservation Corps New Mexico, Southeast Conservation Corps (Tennessee), Great Appalachian Valley Conservation Corps (Virginia), Stewards Individual Placements (national, based in West Virginia), and the Preservation Youth Summit (national).

Conservation Legacy's Ancestral Lands (AL) programming is rooted in the culture and heritage of the local tribal communities they have been successfully partnering with since

2008. The power and impact of AL Native programming is due to community investment and support for each program, both tribally and locally, combined with the network of operational support from Conservation Legacy and their devoted public land managing agency partners.

Conservation Legacy Native programs provide service, training, education, and employment opportunities for Native community members, including low income and disadvantaged youth and veterans. Each of its programs engage a diverse set of participants, reflective of their community. To date there are 18 separate AL programs operating out of three Conservation Legacy home offices throughout the United States. These programs work within tribal communities and on public lands, including wilderness and other protected areas. At least 16 individual Native VISTA positions/internships were offered by Conservation Legacy in 2017, and Conservation Legacy reports they are currently developing new programs with the Hopi, Lakota Sioux, Mandan and Hidatsa, Northern Pueblos of New Mexico, and the Kupu people of Hawaii.



Figure 2 – Southwest Conservation Corps Ancestral Lands staff and alumni with Secretary of the Interior Sally Jewell at the 2016 International Union for Conservation of Nature, World Conservation Congress in Honolulu, Hawaii.

Tribal In-Community Corps Programs

The overall purpose of Conservation Legacy's tribal in-community approach is to build a solid foundation for creating sustainable "Native-led" programming within tribal communities across the United States. Conservation Legacy supports the self-empowerment of Native communities through the further development of program models that provide jobs and valuable work experience for Native youth and young adults throughout Indian country. These models also connect Native youth to their heritage and cultural values; complete important conservation work on tribal lands, public lands, and within local communities; and expose Native youth to potential careers in conservation and protected area and public land management.

Conservation Legacy established their first Ancestral Lands tribal in-community program in 2008 based at the Pueblo of Acoma (New Mexico) and has supported the expansion and replication of that program. Conservation Legacy's all-Native tribal community programs complete projects that include, but are not limited to, traditional farming, wash and river restoration, invasive vegetation inventory and monitoring, Russian olive and salt cedar removal, fuels mitigation, wilderness character monitoring, wildland and Native community trail construction and maintenance, land and historic building preservation, park and facility improvement, and cultural/language revitalization.

The Acoma Pueblo tribal in-community partnership annually employs 35 to 40 primarily tribal young people each summer. Acoma youth crews complete work on tribal lands in areas such as community parks and forests within Acoma tribal boundaries. Projects can also be nonconservation focused on the elderly and/or on improving low income-based housing. All work is prioritized by what the Acoma people believe are the most necessary projects that conserve, restore, and preserve the environment of their community.

"The Southwest Conservation Corps has been a huge asset to our community at Acoma Pueblo. In addition to the summer program for young children, they are doing important work in the community to engage our elders to pass down traditional knowledge and responsibilities to our young people. The SCC and community staff are extremely well trained and passionate about their work to build the future leaders of our community. Our Acoma people stand behind them and are hopeful that they can receive the resources they need to grow and build their capacity in the coming years." -Keegan King, Corpsmember Parent/Acoma Elder

"The work we do in the field is tough and grueling, but at the end of the day we're camping out in the wilderness with fellow tribesmen working to help our environment. It connects directly to what we believe in as Indian people and fulfills what a lot of us are missing in our everyday lives. It's no surprise then that many of us have seen and felt such transformative experiences on the crew, fallen in love with the program, and devoted ourselves to continuing this work. ..." -Anthony 'Chako' Ciocco, Southwest Conservation Corps'- National Ancestral Lands Program Coordinator

Another example of Conservation Legacy's successful tribal in-community programs is the White Mountain Apache Youth Corps program. This Native youth corps effort is based out of White Mountain, Arizona and provides young adults ages 18-25, many of whom are disconnected from their community and local economy, with an outlet for their tremendous energy and the opportunity to do something that matters for and with their home community. Along with being taught about conservation work, participants also learn teamwork, leadership, conflict resolution skills, environmental stewardship, personal responsibility, their tribal heritage, and what the land means to the White Mountain people.

Inner-city Native Youth Corps Programs

The Arizona Conservation Corps's Phoenix, Arizona, Intertribal AL program connects Native youth coming from the inner city, rural areas surrounding Indian communities, and local Native communities with their ancestral heritage and lands.

The Phoenix intertribal program recruits Native youth from the Salt River, Gila River, Ft. McDowell, San Carlos Apache, and White Mountain Apache Indian communities as well as throughout the local rural and inner-city Native populations. Participants experience significant personal development in these programs while completing priority field-based conservation

projects within Native communities and nearby public lands and waters.

In 2016 and 2017, AZCC Phoenix intertribal crews worked in the Superstition and Mazatzal Wilderness units of the Tonto National Forest completing high-priority trail maintenance and renovation backlog projects. These crews also participate in local tribal community team-building and service projects in an effort to expose corps members to day-to-day tribal operations as well as to enhance existing relations between AZCC and local tribes.

A full day of education is organized every other week for Phoenix Native crews that includes ropes/team-building courses, tours of local Native communities and museums, and a full-day Arizona State University-instructed career-development training where corps members learn how to navigate job interviews, write résumés, and search for conservation/land managing agency jobs. Arizona State career counselors also provide long-term career mentoring and résumé review for all Native crew career-training graduates.



Figure 3 – Southwest Conservation Corps and National Park Ancestral Lands crew completing restoration work on ancient Pueblo kiva.



Figure 4 – 2016–2017 AZCC Phoenix Native crew working on trail-narrowing project in Superstition Wilderness, Tonto National Forest.



Figure 5 – 2016–2017 AZCC Phoenix Native crew completing trail reconstruction work in Mazatzal Wilderness, Tonto National Forest

In 2016, La Plazita Institute partnered with Conservation Legacy to field one 12-person Intertribal/Latino inner-city crew based in the south valley communities of Albuquerque, New Mexico (USA). This crew worked at Petroglyph National Monument installing firebreaks and growing produce for local families, accrued more than 2,400 work hours, and made many positive impacts upon their community. This is a keen example of how Conservation Legacy has taken their basic Native program model and fine-tuned it to meet the needs of a specific community and that community's diverse youth demographic.

“The whole overall experience is awesome! Not only do you get the feeling of accomplishing something as a crew, but also personal accomplishments of self-set goals.” -Marcus Newood, Arizona Conservation Corps – Phoenix Native Crew Member

“I loved the experience and being a crew leader for the first time gave me a new outlook on the job. ‘Sometimes you have to be blindly sure of yourself to not instill doubt in your crew.’” -Juan Armenta, Arizona Conservation Corps- Phoenix Native Crew Assistant Crew Leader

Other Native Youth Corps Efforts

Although Conservation Legacy has clearly taken the lead on providing Native youth with empowering outdoor work experiences – there are a handful of other conservation corps that must be acknowledged for launching Native Corps programs based on the Conservation Legacy model and with the support of Conservation Legacy. These are the Montana Conservation Corps and the Conservation Corps of Minnesota and Iowa. The Northwest Youth Association, Kupu Conservation Corps, Canyon Country Youth Corps, and Student Conservation Corps programs enlist significant numbers of Native youth through their all-encompassing youth corps work and should be commended for their commitment to serving diverse populations.

US federal agencies should not be left out of the conversation of serving Indigenous youth.




Figure 6 – 2014 AZCC Phoenix Native crew participating in trails management training at Lost Dutchman State Park, Apache Junction, Arizona.

The Bureau of Indian Affairs (BIA) has partnered with Conservation Legacy's Ancestral Lands program to complete many projects to benefit the Navajo Nation. The National Park Service has also been a key partner in supporting, expanding, and replicating CL's Native youth program. The US Fish and Wildlife Service hosts a variety of Native youth programs and internships, and for years the US Forest Service has provided

American Indian young people the chance to work outdoors and to learn about careers in conservation through their Youth Conservation Corps (YCC) and Young Adult Conservation Corps (YACC) programs. Thus, it is through this combined NGO and federal agency commitment that young people coming from dozens of tribal groups around the country are now being exposed to the world of conservation and protected area management.

Leading Our Nation Back to Ecological and Cultural Well-Being

Much can be said about how far we have come regarding working with our Native populations on the intricacies of managing protected areas, and working with Native youth is certainly a prime example, as illustrated above. Native youth engagement not only delivers huge payoffs to our Native youth and public lands, it also ultimately fosters the building of positive relationships that absolutely must exist between Native peoples and public land managers/users moving forward.

However, the real work has just begun in terms of how consistently managers choose to include and effectively "listen to" our Indigenous partners on issues that affect the proper planning and stewardship of public lands. Yet it may be in the words of our young Native people themselves that speak loudest about how the Native youth corps experience can positively formulate the outdoor/professional lives of Native young people for the coming generations ... thus constructing the very foundation needed ... to build meaningful and lasting relations with our important tribal community neighbors. 

GREGORY HANSEN worked in tribal relations at the Forest and Regional levels for the US Forest Service and currently serves as the statewide tribal relations coordinator for the Arizona Conservation Corps; email: redroadone@aol.com





Military Aircraft Wilderness Overflights: Mitigating Their Impact

Military aircraft overflights of wilderness areas is a complicated issue with no easy answers. Overflights can cause negative impacts to wilderness areas and users, however the military has a requirement to maintain aviation readiness. While the Federal Aviation Administration (FAA) has given a recommendation for civilian aircraft to fly at least 2,000 ft. above National Parks, Wildlife Refuges, and Wilderness/ Primitive areas, there is no such official Department of Defense (DoD) wide recommendation or ruling that exists for military aircraft (USDOT 2014). Additionally, recent legislation designating many wilderness areas throughout the Western U.S. have included a special provision specifically allowing low altitude military flights, and the four wilderness management agencies have no authority over the airspace above protected areas (Gorte 2011). This paper will examine law, DoD regulations, and agency policies pertaining to military overflights in wilderness, as well as the impacts of low-level flights. It will also examine how coordination between the DoD and wilderness land management agencies can help mitigate overflight impacts and suggest further steps that are needed.



by Christina Carlton

“The decline of natural quiet contributes to sound disturbances to visitors and wildlife, and both seem to be becoming more accustomed to disturbances. However, the fact that visitors and wildlife may be more accustomed to noise interference should not be a reason to ignore preserving natural quiet.”

Laws and Regulations Addressing Military Overflights

Although dealing with military overflights of wilderness areas remains challenging and complex, there are a surprising amount of laws and regulations that deal with this issue. While aircraft overflights of wilderness are not addressed in the Wilderness Act, the Act does provide a baseline for management that is applicable to this subject. Section 2(a) discusses the intent of wilderness areas: "administered for the use and enjoyment of the American people...to provide for the protection of these areas, the preservation of their wilderness character" (U.S. Public Law 88-577). Section 4(b) then describes administrative responsibility: "each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area" (U.S. Public Law 88-577). The overarching goal of wilderness management is to protect and preserve wilderness character, and just as non-conforming but allowed uses such as grazing should be closely monitored to be minimally impactful, so should military aircraft overflights.

Subsequent legislation has made it clear that wilderness designation will not restrict this practice. The Nevada Wilderness Protection Act of 1989 was the first to address this issue by stating: "Nothing in this Act shall preclude low level overflights of military aircraft, the designation of new units of special airspace, or the use or establishment of military training routes over [named] Wilderness areas" (U.S. Public Law 101-195, p. 6). The Arizona Desert Wilderness Act of 1990 used similar language a year later. This special provision was then expanded even further with the California Desert Protection Act of 1994: "Nothing in this Act, the Wilderness Act, or other land management laws...shall restrict or preclude low-level overflights of military aircraft over such units, including military overflights that can be seen or heard within such units" (U.S. Public Law 103-433, p. 31). The California Desert Protection Act is also noteworthy because it concludes that "continuation of these military activities under appropriate terms and conditions [emphasis added], is not incompatible with the protection and proper management..." (U.S. Public Law 103-433). Many wilderness managers and users would disagree with this statement and would instead argue that military overflights are actually incompatible with the preservation of wilderness characteristics because of the potential disruption they can cause to both users and wildlife. However, the terminology "appropriate terms and conditions" implies that military and land management agencies should be working cooperatively to facilitate both proper training opportunities as well as preservation of protected areas.

Using special provision language to specifically allow for military overflights continued in eight more wilderness statutes centered primarily on areas in Nevada, southern California, Arizona, Idaho, and Utah (Gorte 2011). However, many other wilderness bills passed during this time did not include this provision. This inconsistency suggests that military overflights are not a universal issue in designated wilderness areas, but instead are primarily site-specific and existing where military overflights were a prior use (University of Colorado Boulder, 2004a). Most of these areas are in the Western United States where a great deal of flight training and testing is conducted. Figure 1 depicts the Military Operations Areas (MOAs) or airspace that the United States Air Force (USAF)

uses. The colored boxes are designated airspace blocks with the green boxes being those that are most often used for training. Figure 2 depicts wilderness area locations. Most of the largest green airspace blocks from Figure 1 are in the Western United States in the same regions that have most wilderness areas. Understandably, these regions were those with legislation that included the special provision language for military overflights, and these are the regions in which wilderness management will most likely encounter disturbances from military overflights.

One final piece of legislation that has been highly influential in addressing military overflights of wilderness is The National Parks Overflights Act of 1987 (U.S. Public Law 100-91). This law directed the National Park Service (NPS) and US Forest Service (USFS) to conduct studies of wilderness areas under their management to determine the impacts of aircraft overflights (both military and civilian) on wilderness users and resources. The resulting reports thoroughly outline the nature of impacts resulting from aircraft overflights and some suggested measures for mitigating these impacts.

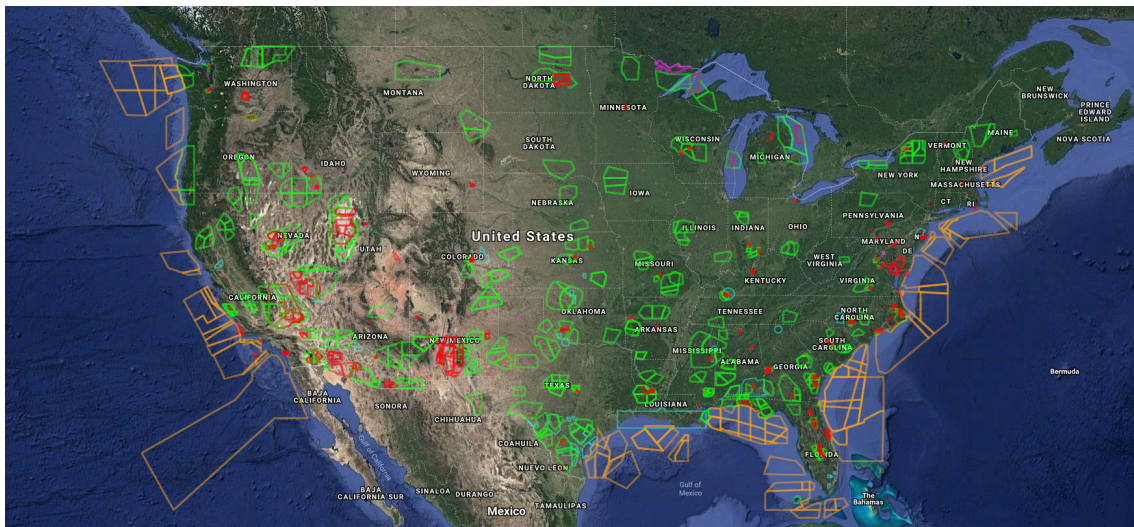


Figure 1 – MOAs used by the Air Force for flying training operations. Courtesy of Hawg-View.com.

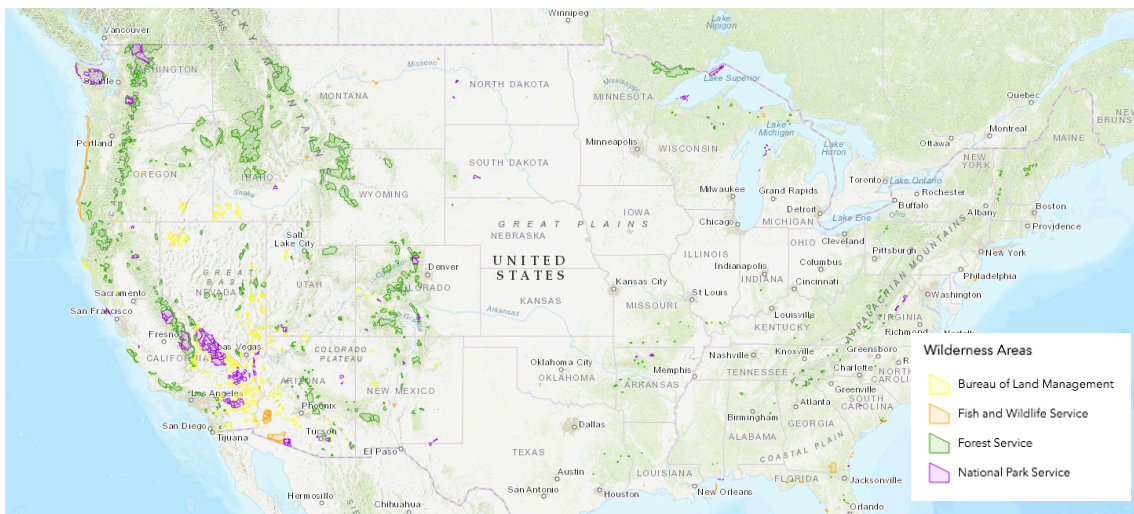


Figure 2 – Designated wilderness area locations. Courtesy of Wilderness.net.

DoD Regulations

The U.S. Air Force (USAF) and U.S. Navy (USN) are the most active and prolific users of jet propulsion aircraft in the DoD. The USN has dealt with aircraft overflights in much the same manner as the FAA by simply issuing a minimum altitude for aircraft, although in this case the altitude is mandatory. Office of the Chief of Naval Operations (OpNav) Instruction 3770.2K has a specific section on noise sensitive areas which states: "noise sensitive areas (e.g., wilderness areas, wildlife refuges) shall be avoided to the maximum extent possible; this applies for altitudes less than 3,000 feet AGL" (US DoD 2007). Going below this 3,000-ft. threshold requires specific approval, and aircraft are permitted to fly over these kinds of areas when above 3,000 ft. While not eliminating overflights completely, this instruction succinctly provides a reasonable compromise.

The USAF has several Air Force Instructions (AFIs) addressing the subject. Although overflights of protected areas are not specifically included, AFI13-201 outlines the importance of national and regional Airspace and Range Council meetings that provide for a dialogue between the DoD and other organizations such as the NPS, BLM, USFWS, and USFS (US DoD 2013). These meetings provide the optimum forum for wilderness management agencies to discuss airspace management issues or concerns such as overflight impacts. One notable result of these gatherings has been the creation of The USAF and NPS Western Pacific Regional Handbook which is a reference guide designed to improve communication between the two agencies. (US DoD & NPS 2002). In it not only are foundational operating procedures covered for both agencies, but explicit instructions are also given for how to reach out to coordinate with each other.

Besides guidance given in the above operating instructions, a method of measuring natural resources impacts has been developed for the DoD called the Military Ecological Risk Assessment Framework (MERAf). It is based on the EPA's ecological risk assessment framework and is modified to be more useful to the training and testing organizations within the DoD (which encompasses many flying units) (Suter et al., 2002). An offshoot of this framework was developed specifically to address military overflights, and it is called the Ecological Risk Assessment Framework for Low-Altitude Overflights by Fixed-Wing and Rotary-Wing Military Aircraft. Conducting an environmental assessment is required by NEPA before activities such as flying training or testing operations, and using this framework fulfills that requirement.

Wilderness Management Agency Policies

USFS direction in Chapter 2320 – Wilderness Management of the USFS Manual is to discourage flights over wilderness that are below 2,000 ft. except for emergencies or essential military missions. What qualifies a military mission as essential is not provided, however the USFS does advocate cooperating with the FAA, National Oceanic and Atmospheric Administration, and military authorities to ensure compliance with this altitude suggestion (USDA Forest

Service 2007). The Bureau of Land Management (BLM) gives almost identical guidance in the Management of Designated Wilderness Areas section of the BLM Manual. Low flights are to be discouraged except in the cases of emergencies, essential military missions, or wildlife operations. Again, cooperation with military authorities, FAA, state agencies, and pilots in the general area is encouraged if low overflights are a problem (USDI BLM, 2012). The US Fish and Wildlife Service (USFWS) policy is much the same in its direction, and like the FS and BLM, the standard FAA minimum altitude of 2,000 ft. is promoted. Military aircraft are not specifically mentioned; however, the USFWS does make a specific point to instruct wilderness administrators to "monitor and document low-level aircraft activity" (USDI FWS 2008).

In contrast, the NPS has the most abundant and clear guidance on overflights, with a specific section of their NPS Management Policies devoted to military aviation. While the other agencies advocate cooperation in general terms, the NPS specifically states: "Superintendents are responsible for opening lines of communication with base commanders controlling military training routes or military operations areas that may affect their parks, and for developing formal agreements that mitigate identified impacts" (USDI NPS 2006 p. 110). This is significant because it gives park management a clear starting point and pinpoints who exactly is responsible for this coordination. In addition, the USAF and NPS Western Pacific Regional Handbook provides thorough guidance on how to handle the issue of military overflights. Understanding the directives and legislation guiding the practice of military overflights of wilderness areas is vital in minimizing impacts. However, an equally essential step is to analyze precisely what kind of impacts overflights can cause.

Impacts of Military Overflights of Wilderness

Multiple studies have been conducted to analyze the threat that military overflights pose to preservation of wilderness areas. The types of impacts resulting from military overflights can generally be broken down into two categories: noise and visual disturbance to wilderness users and noise disturbance to wildlife. Both categories relate to the concept of natural quiet - a wilderness resource just like clean air or water, and as such, in need of protection. The decline of natural quiet contributes to sound disturbances to visitors and wildlife, and both seem to be becoming more accustomed to disturbances. However, the fact that visitors and wildlife may be more accustomed to noise interference should not be a reason to ignore preserving natural quiet.

Noise and Visual Disturbance

Measuring noise and sight disturbance to wilderness visitors is quite complex due to the many variables that contribute to whether a visitor feels disturbed. Many visitors go to wilderness to have a recreational experience in a natural setting away from the sights and sounds of civilization, and often an aircraft overflight is going to intrude on that experience. While studies

have shown that the sound and sight of aircraft overflights do act as a disturbing factor for wilderness visitors, the percentage of visitors who rated this disturbance as only slightly annoying was much greater (averaging at about 85%) compared to visitors who rated aircraft disturbance as moderately, very, or extremely annoying (USDA Forest Service 1992). This study additionally found that about 65% of visitors rated aircraft as having no effect on their visit, and about 92% of visitors intended to visit the same wilderness areas in the future.

Noise Disturbance to Wildlife

Impacts to wildlife can include but are not limited to: physiological responses, behavioral responses, indirect effects such as energy loss, and accidental injury (USDI NPS 1995). Overflights can cause a physiological response in wildlife such as increased heart rates; however, there is not much understanding or consensus on whether this is harmful (USDI NPS 1995). Behavioral responses vary wildly depending on species, age, sex, etc., with some species showing massive responses while others show no response. Some observed responses to aircraft overflights include interference in feeding and nesting of some bird species potentially leading to abandonment of the area, energy losses, and possible reproductive losses (Dewey & Mead 1994). There have also been management perceptions of raised stress levels in some mammals which combined with environmental stressors such as winter or fawning season, could potentially cause mortality (Dewey & Mead 1994). Some studies have found that many species seem to habituate to the noise intrusion over time (Larkin et al., 1996). This information shows that there is somewhat of a lack of agreement on how significant overflight impacts really are. Nevertheless, it is still important to mitigate any impacts as much as possible.

Just Fly Higher?

Often the assumption is that simply moving aircraft to a higher altitude will be enough to remove the adverse effects of aircraft overflights. However, in a 1992 report to Congress the FS found that unless aircraft are flying very low (1,000 ft. or below), increasing altitude will not seriously affect the impact of sound to wilderness visitors or resources (USDA Forest Service 1992). This finding can be still important today when trying to mitigate overflight impacts – not flying at very low altitudes over wilderness will help, but complete avoidance of these areas is ideal.

Cooperation to Mitigate Impacts

In a 2004 Management Survey conducted by the University of Colorado School of Law looking at special uses in 60 wilderness areas located in the Western United States, it was found that military overflights occurred over 34% of the areas surveyed, 47% of these flights occurred monthly or more frequently, and 43% occurred only several times a year (University of Colorado Boulder 2004b). The areas with the highest rates of overflights were those located in the Great Basin and Mojave/Sonoran/Chihuahuan areas which correlates with areas in which

wilderness designation legislation was passed that included a special provision for military overflights. Ten years later, the 2014 Wilderness Managers Survey Report found that minimizing low-level overflights remains one of the top five underachieved objectives for managers in all four wilderness management agencies. When asked does your agency "Coordinate with DoD agencies and the FAA to develop procedures and guidelines to avoid or mitigate low-level overflights," 55% of managers responded, "not at all or only slight accomplishment" and only 13% responded "high or very high accomplishment" (Ghimire et al. 2015). Wilderness agencies should know whether the wilderness areas under their jurisdiction have military overflights as a pre-existing use or will encounter the issue of military overflights. Yet 55% of managers in this survey have not effectively dealt with military overflights. Where is the breakdown occurring?

Implementing Coordination Resources

With many extensive and thorough coordination efforts and resources available, one would think that efforts to mitigate overflight impacts would be more effective. The problem may simply be that wilderness managers do not know where to start, where to find information, or who to coordinate with to mitigate military overflights. Guidelines and operating procedures lay the groundwork for great cooperation, but more guidance like the USAF and NPS Western Pacific Regional Sourcebook that facilitates cooperation may be needed. Additional needs may include:

- Holding pilots more accountable for maintaining area/altitude restrictions
- Better effort by flying squadrons to assess environmental impacts and involve outside agencies in training planning
- Greater effort by land management agencies to reach out to DoD when problems arise
- More diligent completion of tools like the Ecological Risk Assessment Framework
- Increased public involvement and notification in decisions about airspace actions and proposals

The bottom line is that to be successful, both sides of this issue must actively involve each other.

A Successful Example of Active Cooperation

A perfect example of active cooperation can be seen in Sequoia and Kings Canyon National Parks (SKCNP) near the R-2508 Military Aviation Training Complex. Conflict has existed in this area since jet aircraft began operating there in the 1950s. To help overcome these challenges, NPS managers started a wilderness pack trip in 1996 to facilitate communication and understanding between the military and NPS. Later, NPS managers started being invited to contribute to R-2508 planning, and both parties developed a cooperative system of determining when pilots flew below the 3,000-foot (914 m) mandatory minimum altitude that the military instituted (Fauth 2009). SKCNPs also contributed to the USAF and NPS Western Pacific Regional Sourcebook. The outcome of this continuous communication and cooperation is better education and understanding by both the NPS and the military as well as the achievement of each organization's goals (Fauth 2009).

Conclusion

Despite bureaucratic and legislative challenges, there has been incredible progress towards cooperation that can help mitigate overflight impacts. Managers need to take this foundation and build upon it to facilitate communication and cooperation in their individual wilderness areas. The goals of the military and NWPS do not need to be locked in a constant state of conflict. There is proof that simply reaching out to understand each other can result in the kind of partnership needed to achieve both agencies' missions.

CHRISTINA CARLTON is a captain in the United States Air Force and works as an intelligence officer supporting Tactical Air Control Party; email: christina.carlton.1@us.af.mil

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- U.S. Public Law 103-433. California Desert Protection Act of 1994, 16 USC §410aaa-410aaa-83

Recession of Shakes Glacier in Southeast Alaska

The activity of wilderness glaciers is an important indicator of both local and global environmental change. Shakes Glacier, a lake-calving glacier located 30 kilometers (18.7 miles) east of Wrangell in southeast Alaska and locally recognized for its rapid recession, has remained poorly studied due in part to difficulty of access. The glacier's terminus is nestled in a tributary of the Stikine River, within the Stikine-LeConte Wilderness of the Tongass National Forest. This pristine wildland captured the attention of naturalists long before it had any official protection status. John Muir experienced the area on his extended travels in Alaska in 1879, before it was officially designated as wilderness. He described the Stikine River Valley as "a Yosemite 100 miles long" and numbered its glaciers at nearly 300 (Davis 2004). This included Great Glacier, Shakes Glacier, and nearby LeConte Glacier, the southernmost tidewater glacier on the Pacific Coast (Stikine-LeConte Wilderness n.d.).

The crowning jewel of the Stikine-LeConte Wilderness is the unique Stikine River, the fastest, free-flowing navigable river in North America (Stikine-LeConte Wilderness n.d.). The Stikine River flows more than 500 kilometers (311 miles) from its headwaters in the Cassiar Mountains of Canada before traversing the Alaska-Canada border. The Alaskan Stikine continues 64 kilometers (40 miles) to the river's delta, where dunes of silty glacial till shift daily, inhibiting efforts to chart the channels and making it highly difficult to navigate.

In the 1970s, plans were in place to dam the Stikine River and wrangle the surrounding wildland with infrastructure



by Reyn A. Hutten

development. However, in 1980 the designation of the area as the Stikine-Leconte Wilderness by Congress via the Alaska National Interest Lands Conservation Act (US Public Law 96-487) halted all industrial speculation. The high level of conservation protection provided by this act allows the Stikine River to flow freely. What is lost in unharnessed hydroelectric power is certainly gained in visitor experiences, moments of pristine harmony with nature, and the richness of the wild salmon, trout, and eulachon. The spring and summer runs of these small marine vertebrates attract predators such as seals, sea lions, and bears, as well as the second highest concentration of bald eagles in North America (Stikine River Delta 2016). The official wilderness designation also enables student groups and professional researchers to conduct reliable long-term studies in the diverse environment, leading to a better understanding of the ecosystem and, in many cases, ecosystem responses to climate change.

Recent efforts to monitor Shakes Glacier have been driven by both historical and contemporary local observations. Longstanding Wrangell residents who visit the glacier recreationally, as tour captains and guides, or to collect calved glacier ice for subsistence purposes have observed unusually fast, potentially accelerating recession during the last 50 years. In recent history, Wrangell Island locals have worked in conjunction with the Wrangell Ranger District of the Tongass National Forest to fill a deficit in recorded data for Shakes Glacier while enriching the education of Wrangell's youth. This has been achieved through the Shakes Glacier Survey Team (SGST), established in 2011 by a quartet of Wrangell's dedicated professionals: jet boat captain and owner of Breakaway Adventures Eric Yancey, Wrangell Public School District teacher Jen Miller, and expert surveyors Gregory Scheff and Michael Howell of R&M Engineering.

In 1698 (± 5 years), Shakes Glacier extended to the end of Shakes Slough, a tributary of the Stikine River, and converged with the main channel (Viens 1995). The glacier currently terminates in Shakes Lake, a glacial lake above Shakes Slough, 14.6 kilometers (9.1 miles) from its 1698 position. It has been suggested that the width of the glacial lake at the glacier's terminus and correspondingly the surface area of the glacier terminus in contact with liquid water may positively affect the rate of glacial recession, owing to the high energy conductivity, and therefore melting power, of fresh water (Davidson 2014). Long-term changes in temperature may also affect glacial recession over a period of lag time. Lag time can be defined as the time it takes for a glacier to respond to a significant change in climate with 60% conformity, either by retreating or advancing (Pelto and Hedlund 2001).

The objective of this study was to determine the pattern of terminal recession for Shakes Glacier over the past 50 years, and to identify variables that affect the rate of terminus recession. More extensive ablation data collection (e.g., flow speed and total volumetric ice loss) and a better understanding of environmental variables are necessary to interpret recent activity of Shakes Glacier. Interpretation of glacial activity may provide scientists and managers with information to predict future changes in Shakes Glacier and its potential impact on the Stikine-LeConte Wilderness.



Figure 1 – Students from the 2017 Shakes Glacier Survey Team uncovering glacial till from a control point marker, a mark permitted in a special use permit by the Wrangell Ranger District.

Methods

Shakes Glacier Survey Team

Applications for student members of Shakes Glacier Survey Team are open to all Wrangell High School students. A new team is selected each year from the pool of applicants by Wrangell Public School District (WPSD) advisors Heather Howe and Jenn Miller, and has ranged from three to seven members. Most members enter without prior surveying experience and receive their first instruction with professional grade survey equipment from annual team training. Within a week of training, the team of students, WPSD advisors, jet boat captain and founder Eric Yancey, and on-site R&M Engineering contractor Mike Howell were transported to the glacier to collect data on the terminus position.

Terminus Position Data Collection by Shakes Glacier Survey Team

Trimble Global Navigation Satellite Systems (GNSS) were placed at two predesignated control points, serving to increase accuracy using triangulation between the rover unit, survey units, and satellites. The Trimble GNSS rover unit was then used to plot a track line via jet boat, maneuvered as close to the glacier face as safely possible. R&M Engineering later adjusted this track line to the actual terminus position using satellite imagery data and Earth models. A special land-use permit administered by the Wrangell Ranger District of the Tongass National Forest authorizes the physical monumentation of control point locations into bedrock within the dedicated wilderness. This process of recording the glacier's terminus location was conducted by the SGST team in 2011, 2013, 2014, and 2015.

Supplementary Terminus Position Data

Collected data were supplemented with remotely sensed glacier terminus data obtained from Google Earth Engine and EarthExplorer, and aerial photographs from the U.S. Navy and US Forest Service. Pre-1948 terminus location data were obtained from Viens (1995) who used dendrochronology, radiocarbon dating, and moraine location to infer historic terminus position for years 1698, 1780, and 1909.

Terminus Position and Lake Width Data Analysis

All satellite images, aerial photographs and historical terminus positions from Viens (1995) were imported into ArcGIS 10.3. The aerial photographs and Viens' data were georeferenced using the ArcGIS georeference tool (compilation of this data shown in Figure 2). Utilizing the ArcGIS measure tool, metric distance was found for lake width at each recorded terminus position and for the distance between recorded termini. The recession rate between termini was calculated, and the data separated into two, time periods based on the projected accuracy and frequency of data points: 1698-1948 and 1948-2016. The 1698-1948 is considered less accurate than the remotely sensed record of the period 1948-2016. Annual recession rate was then analyzed with lake width at the terminus for each time using Excel 15.24.

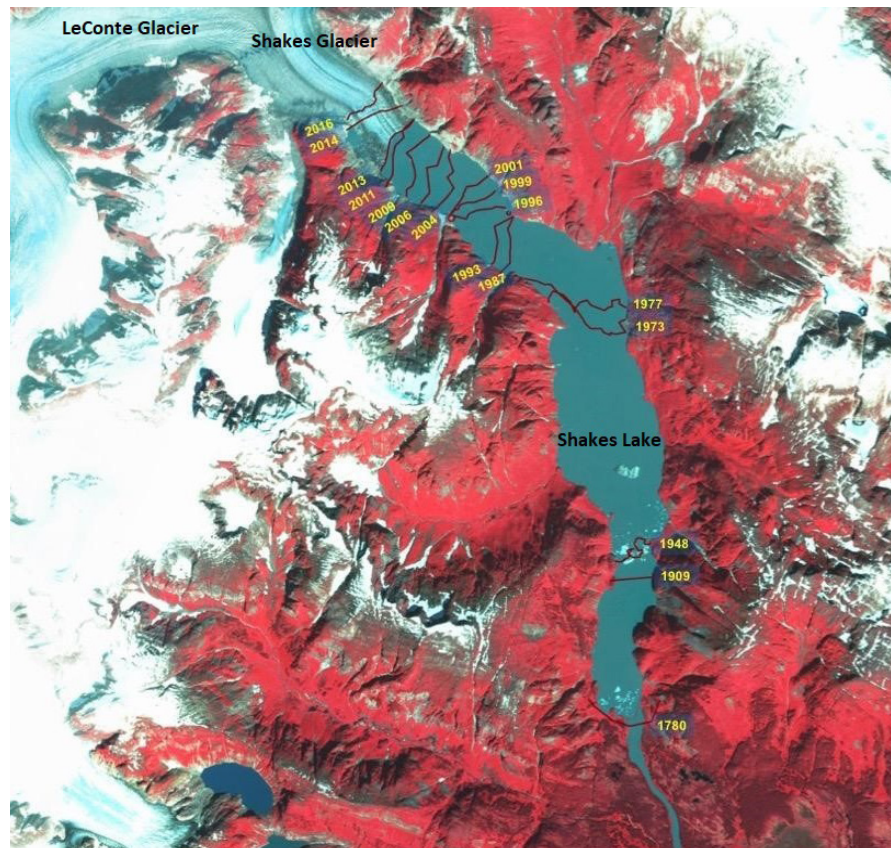


Figure 2 – Shakes Glacier historical terminus positions showing 18 of 21 terminus lines on 2013 False Color Infrared SPOT 5 Map (3 years omitted to reduce clutter).

Temperature Data Collection and Analysis

To further understand causal factors of Shakes Glacier recession, annual temperature was tested as an explanatory variable in the terminus recession rate. Average annual temperature data was gathered from NOAA when accessible (1919–2011) and supplemented with data from Weather Underground (2012–2016) for the Wrangell Airport Weather Station (~30 km [18.7 miles] southwest from Shakes Glacier), then analyzed using Excel. To smooth variation between individual years, mean decadal temperature was obtained. Decadal averages were adjusted for potential glacier lag times of 15–60 years, as ascertained for maritime glaciers located in temperate climates by Davies et al. (2014). Lag time adjustments were made by shifting the temperature data forward in 6 different 10-year increments before conducting a comparison with terminus recession rate. Inadequate data prior to 1948 for both terminus position and temperature precluded an accurate analysis for that period.

Using scatterplots, linear trend lines were fitted to determine the data's coefficient of determination (R^2). In addition, multiple linear regressions were conducted for the following variables:

x= (year, lake width 1698-2016) y= (annual terminal recession rate)

x= (year, lake width 1948-2016) y= (annual terminal recession rate)

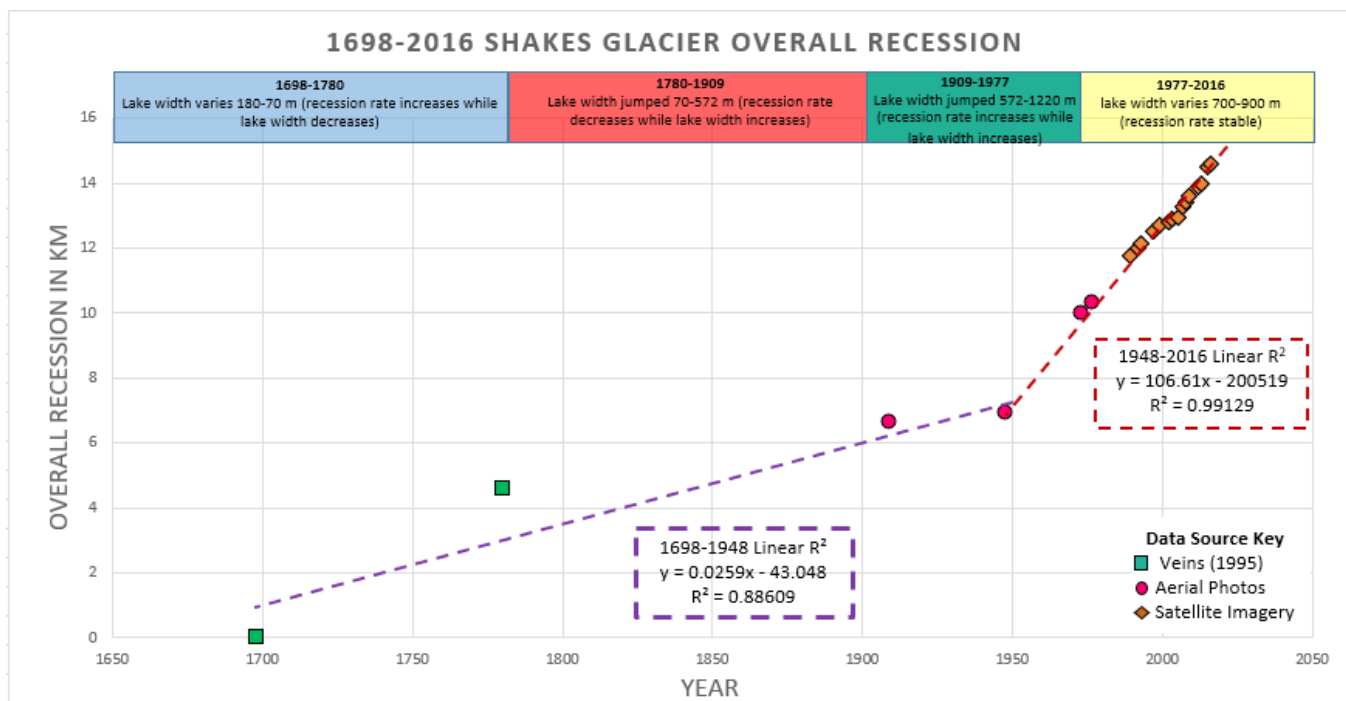


Figure 3 – Overall terminus recession graph with two linear trend lines separated by a substantial change in terminus recession rate in 1948. Colored time regions reflect substantial changes in the width of the glacial lake at the terminus.

Results

Overall Glacier Recession

Between 1698 and 1948, the mean annual terminus recession rate of Shakes Glacier was 26 meters (85 ft.) per year (m/yr). Overall recession was apparent and substantial, but due to the few data points, not statistically significant for this period. From 1948 to 2016, the mean annual recession rate was 107 m/yr (351 ft./yr) (Figure 3). This recession rate was statistically significant, with 99% of the variation in overall recession attributed to year, demonstrating that Shakes Glacier has been receding at a remarkably steady rate.

Variables Driving Recession Rate

For the period 1698–2016, there was a positive and statistically significant relationship between year and average annual recession, with 25% of the variation in recession rate attributed to year. The relationship between average decadal temperature, adjusted for 10-, 20-, 30-, 40-, 50-, and 60-year lag times, and average recession rate was examined for the period 1948–2016. This analysis did not suggest statistically significant correlations between decadal temperatures adjusted for various lag times and the contemporary recession rate of Shakes Glacier.

The analysis of lake width as an explanatory variable for terminal recession rate is represented by colored bars in Figure 2 and can be summarized by the following time periods:

- 1698–1780, terminus recession rate increased from the baseline rate of 0 m/yr and lake width decreased a net of ~110 m (351 ft.).
- 1780–1909, terminus recession rate decreased from the 1698–1780 rate, and lake width increased a net of ~500 m (1,640 ft.).
- 1909–1977, terminus recession rate increased from the 1780–1909 rate, and lake width increased a net of ~380 m (1,247 ft.).
- 1977–2016, terminus recession rate was stable and contiguous with that at the end of the prior period and lake width varied (<250m [820 ft.]).

The relationship between the variation of lake width and terminal recession rate were inverse (1698–1780 and 1780–1909), direct (1909–1977), and inconclusive (1977–2016), indicating that a consistent relationship does not exist. The relationship between lake width at the terminus and average recession rate for the entire period 1698–2016 demonstrated a significant positive correlation. However, when this regression was conducted using only the remotely sensed data from the period 1948–2016, results did not suggest a correlation between lake width at the terminus and the average rate of terminus recession, likely due to the remarkably stable recession rate despite changes in lake width (<700m [2,296.6 ft.]) for this period. Further analyses are necessary to determine the relationship between lake width and terminal recession rate.

Trend lines from single variable analysis indicated that a linear relationship was most supported by the data. As a result, multiple linear regressions were chosen to conduct analysis of the dual variable relationships between lake width, year, and average recession rate for periods 1698-2016 and 1948-2016. The models were not significantly improved when both variables were considered as explanatory for the annual terminal recession rate of Shakes Glacier.

Discussion

The data points from 1948 to 2016 provide a comprehensive record of terminus recession. The small number of data points (3) during the period of 1698–1909 (and the possible effect of increased accumulation during the Little Ice Age 1300–1850 [Fagan 2001] on recession rate calculations) limited the ability of statistical analyses to identify relationships when considering the entire period.

Regarding the effect of average decadal temperature and lake width at the terminus on the recession of Shakes Glacier, it is possible that the relationships are obscured by other variables, such as the bathymetry (underwater topography) of Shakes Lake, glacial bed slope, and actual glacial lag time. The effect of these variables may also be apparent in ice volume loss rather than terminus retreat. It would be necessary to evaluate these additional variables directly; however, many of them have yet to be measured for Shakes Glacier.

Lag time of Shakes Glacier may also have influenced the results of this study. If the lag time is 50 years or more, the full effects of anthropogenic climate change, which was first prominent in temperature models in the late 1970s, have yet to occur. Volumetric discharge and terminus recession could increase soon. Even if the rate of terminus recession remains stable at 107 meters (351 ft.) per year, Shakes Glacier will recede to a point of separation between its dual sources, dividing into two glaciers and possibly retracting from the lake, in approximately 15 years (2032). This could limit access to the glacier by locals who rely on glacier ice to keep their subsistence salmon catch fresh, as well as inhibit tourism related to the glacier, a major source of income for many Wrangell residents.


“In addition to an increased understanding and data on the trends of the Shakes Glacier, the Shakes Glacier Survey Team’s monitoring project is an exemplary model of citizen science.”

In addition to an increased understanding and data on the trends of the Shakes Glacier, the Shakes Glacier Survey Team's monitoring project is an exemplary model of citizen science. Inspired by the glacier's rapid retreat, Wrangell locals and high school students united their skill sets to form a capable survey team and obtained a permit for their proposed survey from the Wrangell Ranger District of the Tongass National Forest.

A symbiotic relationship between SGST and the Wrangell Ranger District ensures long-term continuity of the Shakes Glacier survey and enhances student and public education. Each year the project has grown to attain a higher level of scientific professionalism and reach a broader audience. Wrangell Ranger District maintains a permanent student-made display describing the project, the Tongass National Forest's webpage on Shakes Glacier now incorporates SGST's data, and in April 2017, the team gave their first presentation to the Wrangell community at the US Forest Service–organized Chautauqua speaker series event. In 2016–2017, SGST's data was made readily available to the community of Wrangell and local ecotourism companies, and SGST's captain presented the team's data and the results of this study to the professional science community for the first time at the Northwest Scientific Association's conference. The Wrangell Ranger District provided aerial photos and information regarding historic data used in this study and reviewed drafts of this article and the poster presented at the Northwest Scientific Association's conference.

In coming years, the Shakes Glacier Survey Team could expand their survey to measure additional variables such as lake depth and exposed terminus height to broaden interpretive capabilities. Because of this study, the student team now has an expansive and easily accessible historical database, and the knowledge and resources available to expand upon data mapping and statistical data analyses.

The educational enrichment of Wrangell High School students is a foundational goal of the SGST, and while adult members provided support and direction in logistics and data collection, the leadership of SGST's additional activities is largely student based. In this way, students initiated progress in the direction of their interest, and developed skills and knowledge valuable for a career in any field, although perhaps most importantly as future leaders in the global discussion of the human relationship with climate variability. Partnerships with local businesses, access to the Stikine-LeConte Wilderness, and passionate teachers and students have also enabled Shakes Glacier Survey Team to increase awareness of glacial recession and its role in envisaging the impact of climate change on wilderness character.

It is vital that conservation managers, legislators, and other decision makers remain alert to the results of these partnerships and studies, including those produced by citizen science. A comprehensive understanding and collaboration are the first steps to the continued conservation of our wilderness. 

REYN HUTTEN is an undergraduate at Dartmouth College in Hanover, New Hampshire. She was a member of the Wrangell High School Shakes Glacier Survey Team 2014-17; email: reynhutten@gmail.com

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A Spatial Demographic Approach to Wilderness Management

ABSTRACT This work provides a framework for identifying wilderness areas most at risk from recreation impacts, now and in the future. By considering metropolitan area-specific population dynamics, this research highlights the utility of applying a spatial demographic approach to wilderness research and management. This analysis suggests that by 2060, day visits to US Forest Service (FS) wilderness areas may increase by 80% from the top 24 metropolitan area populations that visit wilderness areas the most. The largest increases will likely occur in the US Southwest and Central regions, areas with ecosystems vulnerable to trampling and projected to experience severe drought events due to climate change.

PEER REVIEWED

According to survey data collected by the US Forest Service between 2011 and 2014 as part of the National Visitor Use Monitoring (NVUM) program, more than half of all Forest Service wilderness visits were day visits (USDA 2016a). This leads to use that is heavily concentrated in "front country" areas (those within the first few miles of wilderness boundaries and easily reached in a day visit) (USDA 2016a). Increasingly, Americans are migrating to large metropolitan (metro) areas, according to analysis of county-level migration data from the Applied Population Laboratory, University of Wisconsin-Madison (Winkler et al. 2013). The additive pressures of a changing climate and increases in visitor use are creating new challenges for wilderness managers (Dawson et al. 2016). These stressors are likely to increase as the US population continues to grow (US Census 2016a), particularly in large metro areas close to wilderness areas.

Drawing on wilderness visit data from the NVUM survey, population data from the US Census (US Census 2016c), and



by Rebecca Rasch



by Beth Hahn

county-level net migration data from the University of Wisconsin–Madison Applied Population Laboratory (Winkler et al. 2013), this article explores day use in wilderness areas that are near metropolitan area populations. By examining current levels of day use and forecasting future use, this analysis provides managers with a clearer vision of which urban populations are actively using wilderness areas today and probable future changes. A discussion of wilderness area ecosystem types and drought risk highlights wilderness area hotspots – locations both ecologically vulnerable to increased visitor use and where population pressures are forecast to become particularly severe in the coming decades.

Data and Methods

Assessing Current Forest Service Wilderness Day Use by Metropolitan Area

Data from the NVUM dataset 2010–2014 (USDA 2016a) were used to estimate wilderness visitation rates. These data are collected on each FS administrative unit every five years. Local metro populations were defined as those metro area residents traveling fewer than 150 miles (241 km) to reach the start of their wilderness experience. The 150-mile distance threshold (a maximum of approximately three hours in each direction) ensures all metro areas within comfortable driving distance of wilderness areas are included. Respondent-provided zip codes were matched to metro areas using the US Census zip code to metro area crosswalk (US Census 2016d). Day visits were identified as visits that began and ended on the same calendar day. A metropolitan area includes both urban and suburban areas and is defined by the US Census as an area with a core urban area with a population of at least 50,000. Only metropolitan areas with at least 20,000 annual day visits to wilderness areas were included in the analysis. This figure of 20,000 visits was selected as a cutoff to determine which metro areas would qualify as top users of Forest Service wilderness. The 20,000-visit cutoff provides a frame for focusing the analysis on the highest user metro areas, resulting in a short, yet comprehensive list for managers interested in understanding which metro area populations have the most wilderness day use. Twenty-four metro area populations met the 20,000-day visit threshold.

Looking ahead: wilderness day use through 2060

While the US population is expected to grow by 30% between 2015 and 2060, there are considerable variations in growth rates by metro area. Metro area populations were projected using the cohort-component method (Smith 1986). The cohort-component method draws on the current population levels, births, deaths, and net migration to forecast future population levels, according to the following basic demographic balancing equation:

$$P(t+n) = P(t) + B(t) - D(t) + I(t) - E(t)$$

$P(t)$ is the population at time t

$B(t)$ and $D(t)$ are number of births and deaths occurring between t and $t+n$.

$I(t)$ and $E(t)$ are the number of immigrants and of emigrants from the county during the period t to $t+n$ (UNFPA 2017)

In this analysis, births and deaths were estimated using national 2010 fertility rates (Martin et al. 2013) and 2010 mortality rates (Arias 2014), respectively. Net migration rates were estimated using age-specific, county-level net migration rates (Winkler et al. 2013). Population counts were drawn from the American Community Survey 2010–2014 (US Census Bureau 2016a).

The age-specific day-use visitation rates for each metro area were calculated using NVUM data and metro area population counts. Due to small sample sizes in the NVUM data, it was not possible to disaggregate metro area visits by age-specific gender categories (e.g., visits by 20- to 24-year-old females from Salt Lake City) and still provide reliable estimates. As such, both male and female visits were aggregated into four larger, unisex age brackets: 0–19, 20–49, 50–69, and 70 and above. There were statistically significant differences in average visitation rate (visits per 1,000 population) by age bracket, justifying the use of age-specific rates in the forecast. Average rates were 0–19 (18 per 1,000), 20–49 (72 per 1,000), 50–69 (82 per 1,000), and 70+ (31 per 1,000). The 50–69 rate was not used in the forecast to correct for a potentially inflated baby-boomer (age 50–69) visitation rate effect, which will no longer apply in the future. This effect is the notion that the baby boomer generation is more closely tied to wilderness and visits wilderness areas at a higher rate than younger generations (Bowker et al. 2006; Green 2006). To avoid a possible overestimation of visits by 50- to 69-year-olds in the future, the 20–49 rate is applied to those aged 50–69. Results are mapped (see Figures 1 and 2) using ArcGIS software, US Census, and USDA spatial data files (US Census 2015; USDA 2015).

The forecasting process is detailed below:

- Using 2010 population counts from the US Census as the base, the population of the metro area was projected, at five-year intervals (2015, 2020, 2025 ... 2060), using the cohort-component method at five-year age intervals (0, 5, 10, 15 ... 85) in STATA software. The cohort-component method was applied using observed, age-specific female fertility rates, age-specific male and female mortality rates, and overall age-specific migration rates.
- Using NVUM visitor data from 2011 to 2014, all visits to wilderness areas from respondents who reported a given metro area zip code were weighted and aggregated into four age groups: 0–19, 20–49, 50–69, and 70 and above. Using 2010 population levels, the age-specific visitor rate was calculated according to the following equation:
- Age-specific visitor rate = Total weighted, reported visits in the given age category / observed total population within age category
- To obtain the forecast of visits for 2060, the age-specific visitor rates for 0–19, 20–49, and 70 and above were applied as follows:
- Total population aged 0–19 x age-specific visitation rate for 0–19 = projected visits from residents aged 0–19
- Total population aged 20–49 x age-specific visitation rate for 20–49 = projected visits from residents aged 20–49
- Total population aged 50–69 x age-specific visitation rate for 20–49 = projected visits from residents aged 50–69

- Total population aged 70 and above x age-specific visitation rate for 70 and over = projected visits from residents aged 70 and above
- Total projected visits from residents aged 0–19, 20–49, 50–69, and 70 and above are aggregated to obtain the final estimate of day visits to wilderness areas by residents in 2060.

Results

The metro area population, annual estimated day visits, and visits per 1,000 population are listed in Table 1, ranked by number of visits. Table 2 lists projected visits by metro area for 2030 and 2060, ranked in order of projected percent increase in visits. Table 3 lists the Forest Service units by current and projected day use in wilderness areas from local, metro populations and the percent change in projected visits from the current levels to 2060.

Rank	Metropolitan Area	Population	Visits	Visits per 1,000
1	Phoenix-Mesa-Scottsdale, AZ	4,337,542	337,337	78
2	Tucson, AZ	993,144	305,190	307
3	Salt Lake City, UT	1,123,643	283,236	252
4	Albuquerque, NM	899,137	239,008	266
5	Seattle-Tacoma-Bellevue, WA	3,557,037	223,808	63

Table 1 – Day use visits to Forest Service Wilderness Areas by Metropolitan Area (abridged)

Rank	Metropolitan Area	2010-2014	2030	2060	% Change in Visits: 2010-2014 to 2060
1	Las Vegas-Henderson-Paradise, NV	137,023	292,763	684,601	400%
2	Provo-Orem, UT	26,777	46,579	83,492	212%
3	Phoenix-Mesa-Scottsdale, AZ	337,337	522,311	832,569	147%
4	Bend-Redmond, OR	20,451	24,885	50,318	146%
5	Riverside-San Bernardino-Ontario, CA	76,819	109,994	181,649	136%

Table 2 – Total Annual Day Visits to Forest Service Wilderness Areas: 2010-2014 (actual), 2030 and 2060 (projected), by Metro area (abridged)

FS Unit	Current Visits	2030	2060	% Δ Current-2060	Metro. Origin of Day Users
Humboldt-Toiyabe NF	134,419	287,201	671,594	400%	Las Vegas-Henderson-Paradise, NV
Tonto NF	263,123	407,402	649,404	147%	Phoenix-Mesa-Scottsdale, AZ
Deschutes NF	10,553	12,841	25,964	146%	Bend-Redmond, OR
Cleveland NF	15,825	22,659	37,420	136%	Riverside-San Bernardino-Ontario, CA
San Bernardino NF	15,748	22,549	37,238	136%	Riverside-San Bernardino-Ontario, CA

Table 3 – Day visits to Forest Service Wilderness by local, metro area residents (2010-2014, 2030 and 2060) (abridged)

Figure 1 displays visits from 2011 to 2014 by metro area, and Figure 2 shows projected change in day use by FS administrative unit, on a percentage basis. The increase in day use is not evenly distributed across the United States. The South, Southwestern regions, and Central Plains regions of the country are projected to experience the most significant population growth in the coming decades, and, as a result, national forest units with wilderness areas close to these growing metro areas will likely see considerable rises in day use. While migration estimates may shift in the coming years, the current data suggest percent increases in day use in the double- and even triple-digit range.

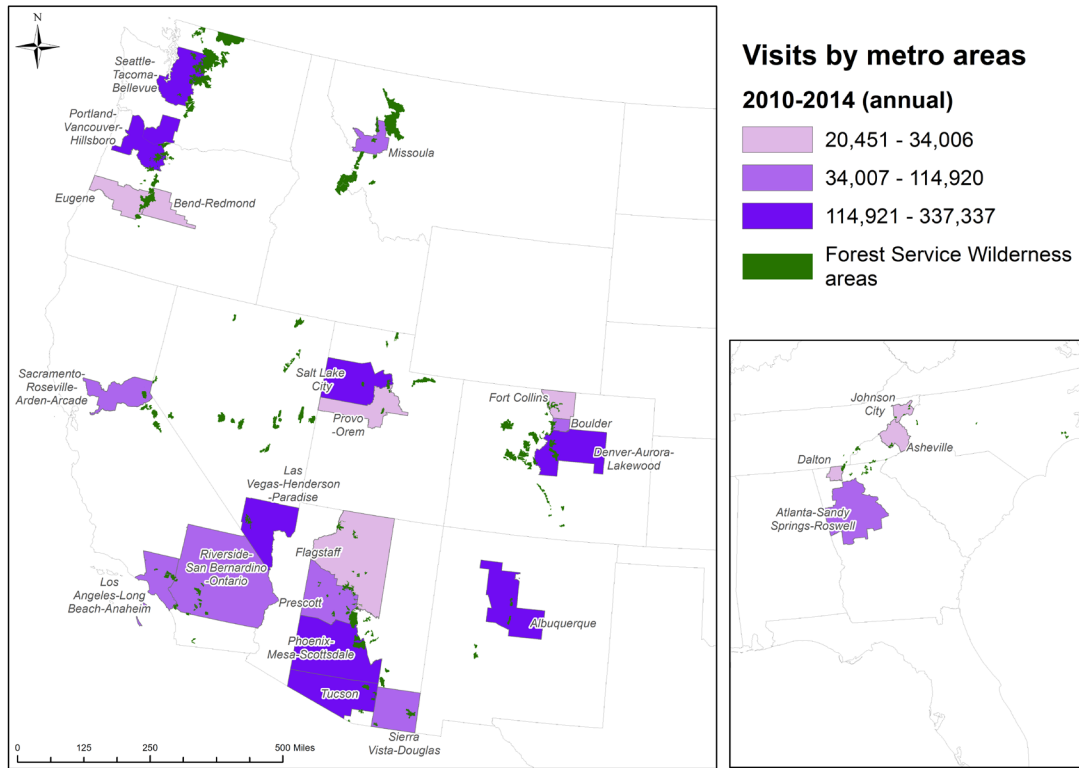
Discussion

Day use of Forest Service wilderness areas by the top 24 metro area user populations is expected to increase by 80% between 2010–2014 and 2060, an increase of more than 2 million visits. The field of recreation ecology provides insight into how visitor use can impact wilderness areas. The four key potential impacts are trampled vegetation, soil erosion, altered water quality, and disruption of wildlife (Marion et al. 2016). Moderate to heavy trampling (the act of treading on and crushing) can lead to loss of vegetation cover and change in vegetation composition. Impacts to soils include soil compaction, which may cause increased runoff during heavy rains, which may starve vegetation of the water it needs to survive. Soil erosion is also a key concern, as it leads to decreased soil moisture (Marion et al. 2016).

Forests, shrubs, grasslands, and desert ecosystems make up 90% of the wilderness areas examined (USGS GAP 2011), and are all highly vulnerable to trampling (Hill and Pickering 2009; Marion and Cole 1996; Monz, Pickering, and Hadwen 2013; Pescott and Stewart 2014). The wilderness areas in six Forest Service units that are expected to see the largest number of visits from local, urban populations by 2060 (more than 300,000 visits annually) comprise mainly forest or desert ecosystems, and are in four Southwestern and Central Plains states: Nevada, Utah, Arizona, and New Mexico. The Southwestern and Central Plains regions, including the states of Utah, Nevada, Arizona, and New Mexico, are also projected to experience the most severe drought impacts between 2050 and 2099 (Cook, Ault, and Smerdon 2015). Soils in these areas, already sensitive to trampling due to lack of soil moisture (Burns, Ward, and Downs 2013), will have an even harder time recovering from trampling effects in times of severe drought. Loss of soil moisture will also make conditions difficult for sensitive vegetation to regenerate. Table 4 lists these six FS unit hotspots.

FS Unit	Current Visits	2030	2060	% Δ Current-2060
Humboldt-Toiyabe National Forest	134,419	287,201	671,594	400%
Tonto National Forest	263,123	407,402	649,404	147%
Uinta-Wasatch-Cache National Forest	308,734	422,514	479,686	55%
Coronado National Forest	363,359	391,985	466,886	28%
Cibola National Forest	226,580	262,268	374,440	65%
Coconino National Forest	154,345	212,516	314,163	104%

Table 4 – Wilderness Area Hotspots: Forest Service units in drought prone areas expected to see over 300,000 annual day visits from local, urban populations by 2060



*Only metro areas with 20,000+ annual day visits are included in analysis

Figure 1 – Annual Day Visits to Forest Service Wilderness Area by Local Metro Area Residents (2010-2014)

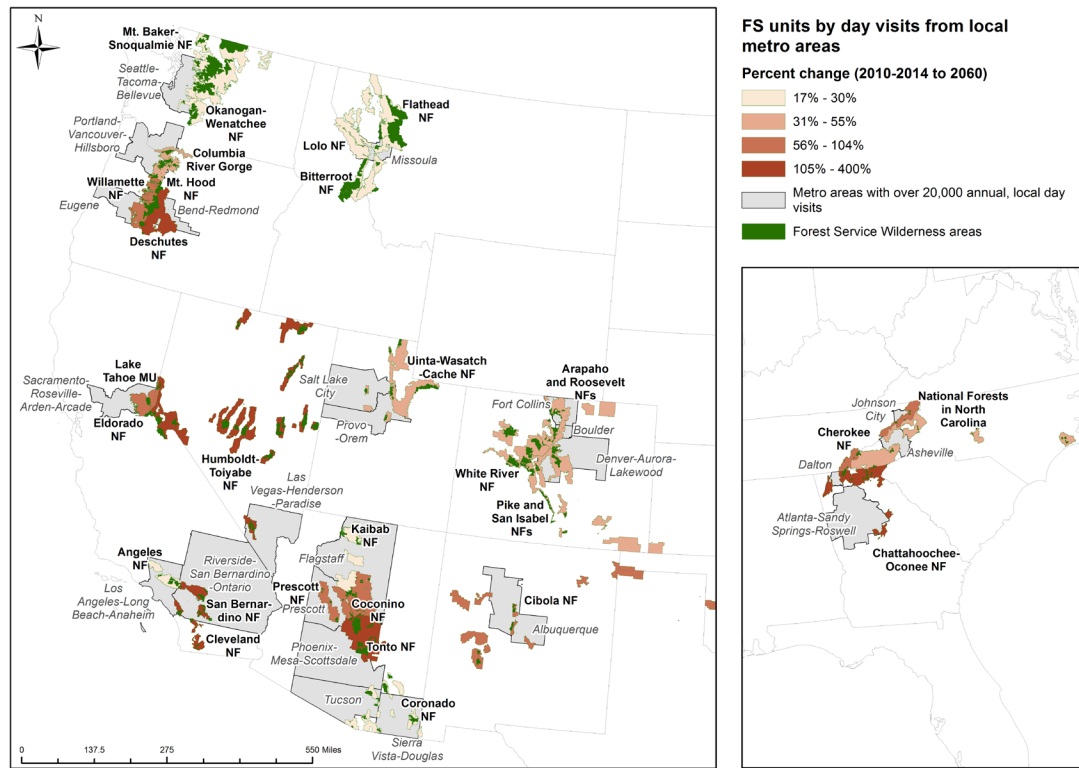



Figure 2 – Projected change in day visits to Forest Service Wilderness areas by local metro area residents

Many of the current wilderness recreation user guidelines are geared toward overnight visits and may not apply to urban day users. Wilderness managers may need to redevelop guidelines to ensure that user recommendations are comprehensible to urban day users and relevant in times of severe drought. In addition to ramping up education efforts, stewardship groups may also consider reaching out to these metro populations directly for support, either in-kind, such as trail maintenance projects, or monetary donations. Organizations that provide opportunities for children and young adults to visit wilderness may need to refocus efforts to promote not just the wilderness experience but also the value of wilderness preservation. This preservation message could be tailored to wilderness users and nonusers alike, and disseminated using easily accessible, multimedia technologies. Projects such as the short film *Untrammelled* (USDA 2016b), which highlights the experience of Montana youth in the Bob Marshall Wilderness, are an important step in this direction.

Identifying and targeting messages to urban populations is only one piece of the puzzle. The other key component is preparing administrative units for the impending influx of visits. The first step is educating unit managers about the forecasted increase in visits in the coming decades. While some wilderness areas only draw urban visitors from a single metro area, other units that are more centrally located need to consider how increasing populations in multiple metro areas may affect wilderness day use. A next step may be increasing public-private partnerships that can implement projects that maintain and/or restore wilderness character.

Conclusion

This article examined current day use of wilderness areas from local metro area populations and employed a spatial demographic approach to forecast how population dynamics may affect wilderness landscapes in the future. The research reported here provides managers with a better understanding of which metro area populations are *currently* the largest source of National Forest wilderness day use visits and identifies probable *future* wilderness use hot spots. Wilderness managers and advocates can employ these data to better target their base of supporters and communicate important messages around careful stewardship of this treasured wilderness resource. 

DR. REBECCA RASCH is the regional social scientist for the Northern Region of the USDA Forest Service in Montana; email: rrasch@fs.fed.us

DR. BETH HAHN is the deputy director of the Aldo Leopold Wilderness Research Institute, Rocky Mountain Research Station of the USDA Forest Service in Montana; email: bhahn@fs.fed.us

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Interpreting the Wilderness Act: A Question of Fidelity

When issues arise concerning wilderness planning, policy, and management, scholars often look to the Wilderness Act, written more than 50 years ago, to determine what should or should not be done. Fidelity to the text of the Wilderness Act guides their decision-making, even when considering modern developments that were unheard of when the act was passed in 1964. But this fidelity raises an issue familiar to any legal scholar or lawyer: how can a piece of legislation passed more than a half century ago logically guide the management of modern technologies that did not exist and could not have been considered at the time it was written?

In this article, we discuss this challenge by drawing an analogy between the Wilderness Act and the US Constitution. Constitutional scholars and judges routinely employ competing models of analysis for their legal interpretations, and we will do the same. Our intent is not to favor one model over another, or to argue that interpretive approaches for legal decisions and interpretive approaches for policy guidance are entirely analogous, but to stimulate thoughtful consideration of how different models might influence our thinking about what should or should not be done in wilderness planning, policy, and management in a changing world.



by Daniel Dustin
& Larry Beck
Photo by Vicki Fielden



by Jeff Rose

“Our intent is not to take positions on these issues, but to stimulate discussion and debate about which of these two frames of reference—the formalist or realist perspective—might better inform contemporary wilderness policy, planning, and management.”

The language of the Wilderness Act of 1964 oscillates between the highly precise and the poetically vague, sometimes within the same paragraph (US Public Law 88-577). For example, the act defines *wilderness* as "undeveloped federal land" of at least "5,000 acres" in size. Clear enough. But the act also provides more lyrical instruction, holding that wilderness is "untrammelled" nature of "primeval" character, a place where a person is a "visitor who does not remain," and where "primitive" and "unconfined" types of recreation prevail. The act further tells us that wilderness is a place where "motor vehicles," "motorized equipment," and other forms of "mechanical transport" are unwelcome. The meanings of *federal land*, *5,000 acres*, and *motorized* are straightforward, and the policy maker seeking fidelity to their requirements has clear guidance. But what to make of more nuanced language, such as *untrammelled*, *primeval*, *unconfined*, and *mechanical*? These require interpretation. How we approach that interpretation is the subject of our inquiry.

Interpreting the US Constitution

An American judge called to interpret the US Constitution will find certain clauses far more unambiguous than others. Sometimes a rule is clear. A US president must be at least 35 years old. Each state gets two senators. Each senator must be at least 30 years old. There is no room for sensible judges, no matter their politics or schools of legal interpretation, to disagree. Disagreement instead arises when they are asked to interpret broader, less precise clauses. For example, how do freedom of speech rights guaranteed by the First Amendment enacted in 1789 apply to the internet?

Faced with these thornier constitutional issues, judges and scholars often look to several models of analysis for help. Richard Posner, one of the nation's foremost judges and legal scholars, distills these differing models into two general categories: formalists and realists (Posner 2013, 2011). Volumes have been written debating the exact parameters of these two schools, but they posit the following:

Formalists, including self-described originalists and textualists, attempt to derive their decisions entirely from the text of the Constitution as it was signed 230 years ago. They argue that the judge's responsibility is to enforce the law as written, and that the outcome prescribed by the law (and thus the founder's intent) is reliably determinable by the judge for any relevant case. Anything else, argues the formalist, is tantamount to an unelected judge improperly legislating from the bench.

Realists consider it implausible to determine with any precision what the long-dead coauthors of a vague text may or may have not meant. Nor is such inflexibility wise. Realists view the Constitution as a living document that "evolves, changes over time, and adapts to new circumstances, without being formally amended" (Strauss 2010, p. 1). The best course, realists contend, is to investigate the real-world consequences of a proposed interpretation, examine the purpose of the clause at issue while considering basic fairness, and apply common sense accordingly.

Interpreting the Wilderness Act

How might policy makers adopting formalist and realist approaches differ in their interpretation of the Wilderness Act of 1964? How might those differing interpretations lead to different conclusions about what should or should not be done regarding contemporary issues in wilderness planning, policy, and management? To illustrate our analysis and enliven debate, we have chosen two issues currently being discussed in wilderness circles: allowing mountain bikes in wilderness and the use of cell phones in wilderness. We examine both issues through formalist and realist lenses to give the reader an idea of how these two different frames of reference might lead to differing conclusions. Again, our intent is not to take positions on these issues but rather to stimulate discussion and debate about which of these two frames of reference – the formalist or realist perspective – might better inform contemporary wilderness policy, planning, and management.

Mountain Bikes

According to the International Mountain Bike Association (IMBA), there are approximately 40 million mountain bike enthusiasts in the United States (IMBA 2005). Of concern to the IMBA is the number, location, length, and variety of trails available to the mountain biking community. While the IMBA opposes opening federally designated wilderness to mountain biking, the association lobbies for modifying boundaries of existing wilderness if it creates new mountain bike trails, as well as resisting new wilderness designations if they reduce existing mountain biking opportunities. Other organizations, such as the Sustainable Trails Coalition (STC), are more outspoken in their support of opening federally designated wilderness to mountain biking. The STC, for example, is a staunch supporter of current proposed federal legislation to amend the Wilderness Act to "ensure that the use of bicycles, wheelchairs, strollers, and game carts is not prohibited in Wilderness Areas" (H.R. 1349 2017).

Formalist Perspective

In thinking about the appropriateness of mountain bikes in wilderness, formalists refer to the language of the Wilderness Act (US Public Law 88-577), which specifically states that there shall be "no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, [and] no other forms of mechanical transport." (US Public Law 88-577, Sec. 4c). Formalists reason that mountain bikes are a form of mechanical transport and therefore should not be allowed in wilderness (Scott 2016; Scott 2003). From the formalist perspective, the Wilderness Act's framers were clear in their intent and in their language. Mountain bikes, formalists conclude, are part of our society's "growing mechanization" (US Public Law 88-577, Sec. 2a) to which the establishment of wilderness was meant to be an antidote. If the act intended to exempt bicycles from prohibited "mechanical transport," it would have done so explicitly.

Another dimension of formalist reasoning originates from the clear language that wilderness be protected and managed to offer "outstanding opportunities for solitude" (U.S. Public Law 88-577, Sec. 2c). Among the most sought-after and meaningful aspects of a wilderness experience is leaving behind the distractions we are confronted with in our day-to-day lives. Hikers who share trails with mountain bikers can be distracted from their thoughts or observations of nature when one or more mountain bikers ride past. Hikers can be startled or nearly run over by mountain bikers coming around a curve too fast. These encounters can be a disruption of an otherwise contemplative experience in nature; they can take away from the solitude many hikers seek.

Mountain bike organizations encourage their members to be courteous on the trail, and to keep speed within safe limits for others who share the trail, but part of what appeals to mountain bikers is the excitement of swift travel over rough trails. Mountain biking's allure can be about the speed of the activity and a mountain biker's focus is often, by necessity, on navigating a trail at a challenging speed, a speed that can create conflict with others on the trail (Carothers, Vaske, and Donnelly 2001).

Mountain bikers can thus interfere with people who are seeking a more contemplative experience in nature; those in search of "outstanding opportunities for solitude." Furthermore, agencies administering wilderness are responsible for "preserving the wilderness character of the area" (US Public Law 88-577, Sec. 4b). That "wilderness character" includes the peace, quiet, solitude, inspiration, and wonder that make up such places. Disruption of those qualities goes against the grain of the intent of the Wilderness Act.

Realist Perspective

Realists approach the question of mountain bikes in wilderness somewhat differently. They reason that "mechanized transportation" is too imprecise a term to clearly define what should and should not be allowed. Moreover, they note that the Wilderness Act could have explicitly prohibited bicycles, which were ubiquitous at the time, but it did not (mountain bikes had yet to be invented [Scott 2003]). Further, given this ambiguity, realists focus on the demonstrable consequences of allowing bicycles in wilderness. What harm would it cause weighed against the interests of citizens to enjoy their public lands, and would that harm contravene the purpose of the act?

Advocates for mountain bikes reason that the intent of the Wilderness Act was to prohibit nonhuman-powered forms of transport, hence the act's emphasis on motorized vehicles, motorized equipment, motorized boats, and motorized aircraft (Stroll 2004). Realists suggest that mountain biking, just like backpacking, is a human-powered form of transportation, one that has no greater environmental impact than backpacking (Marion and Wimpey 2007). To their way of thinking, mountain biking is simply a variation on a human-powered theme. Realists also reason that if mountain biking is deemed inappropriate in wilderness because of its mechanized nature, then several other forms of wilderness transport should be deemed inappropriate because of

their mechanized nature – forms that are currently allowed in wilderness – such as ski bindings, snowshoes, and rafts with metal oarlocks (Bradley 2010). Finally, realists hasten to point out that an added benefit to opening wilderness to mountain biking would be the likely recruitment of 40 million new advocates for wilderness at a time in American history when political threats to wilderness are bound to be on the rise.

There may also be realists who oppose mountain bikes in wilderness, and they have their own arguments to make. As discussed earlier, any evidence that mountain bikes ruin the sense of solitude for others, any scientific data showing that they cause more damage to the environment than currently permitted activities, that they create safety concerns, or would result in some unjustifiable increase in costs, is highly relevant to a realist analysis. In addition, realists would be far more willing to consider a middle ground. For example, concerns that mountain bikes would decrease the sense of solitude in wilderness could be addressed by restricting mountain bike use to very limited areas where they are unlikely to interfere with hikers, backpackers, or anyone else seeking a more serene experience.

Mountain Biking Summary

Mountain biking was not the popular activity in 1964 that it is today (Scott 2016). While the authors of the Wilderness Act were certainly aware of bicycling as an outdoor pursuit (Scott 2003), it did not occur to them that people might want to bicycle through wilderness someday (Scott 2003), which may explain why they did not specifically address it in the statutory language. Consequently, there is wiggle room in the act for different interpretations of its intent and meaning. Formalists favor a narrow interpretation, and are more likely to ban mountain bikes without further analysis because they plausibly can be described as the very kind of mechanical transportation prohibited by the act (Scott 2016). But should the analysis end there? Does mountain biking reflect the “growing mechanization” of society that wilderness preservation was intended to counteract? Does mountain biking infringe upon “outstanding opportunities for solitude” that the “wilderness character” of an area implies? Or is mountain biking simply a new form of nonmotorized human-powered transport that satisfies the Wilderness Act’s original intent and meaning? Whether we find these latter questions worth addressing reveals our formalist or realist leanings.

Cell Phones

Cell phones in wilderness present a subtler challenge to the intent and meaning of the Wilderness Act. Now more than ever we are a connected global community. A recent Pew Center study reported that most children in the United States receive their first wireless device by the age of 12 (Lenhart 2016). Ninety-two percent of teens between the ages of 13 and 17 report being online every day, and 24% are online “almost constantly.” By the time they reach adulthood, today’s teenagers are a “wired” generation and their predilection for immediate con-

nectivity permeates all aspects of their lives. Indeed, Turkle (2015) now estimates that American adults check their smart phone every six and one-half minutes. Given their ubiquity in modern life, the introduction of cell phones into wilderness warrants further consideration.

Formalist Perspective

Formalists reason that cell phones should be discouraged, if not banned, in wilderness (Dustin, Beck, and Rose 2017). Cell phones are devices reflecting society's growing mechanization, and they have an impact, however indirect, on movement through wilderness (Moor 2016). Cell phones with navigation apps employ Global Positioning Systems that do not require cell phone service and make it possible for hikers to know exactly where they are on wilderness trails, where the next reliable water is, and where the next campsites are. Wherever cell phone service is available, wilderness recreationists can also communicate with one another about how best to make their way down the trail.

Once again, formalists point to the language of the Wilderness Act, and emphasize the wilderness-related values that are compromised by cell phone use. For example, Section 2c of the act declares that wilderness should have "outstanding opportunities for solitude or a primitive and unconfined type of recreation" (US Public Law 88-577, Sec. 2c, 1964). Section 4b states that "each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area" (US Public Law 88-577, Sec. 4b, 1964). Cell phones detract from "solitude," "primitive and unconfined types of recreation," and "wilderness character." Moreover, Section 2a specifically addresses society's "growing mechanization" that threatens to infringe upon wilderness character (US Public Law 88-577, Sec. 2a, 1964). Cell phones are certainly part and parcel of society's growing mechanized nature and therefore should be deemed antithetical to the Wilderness Act's intent.

In nature, and especially in wilderness as it has been defined, formalists contend that people should have the opportunity to think without distraction. That is part of the attraction to wilderness. Wilderness is a place that relieves us from the constant bombardment of flickering digital screens – screens that are intentionally designed to be addictive and to hold our attention (Kardaras 2016). According to Sullivan (2016), these screens "rob us of a silence that was previously regarded as integral to the health of the human imagination." Wilderness defined as "primitive" (that is lacking in modern technology), offers silence, in which we can think without distraction. It encompasses "the very spaces where we can gain a footing in our minds and souls that is not captive to constant pressures or desires or duties. And the smartphone has all but banished them" (Sullivan 2016).

Realist Perspective

Realists are far more receptive to the argument that (1) because cell phones did not exist in 1964, it is unreasonable to speculate whether the act's authors would or would not consider cell

phones prohibited "mechanization," and (2) in practical terms, cell phones may merely represent a more advanced form of several tools that have always been permitted in wilderness. Cell phones function as cameras, maps, compasses, and convenient encyclopedias of wilderness-related information that enhance the wilderness experience rather than detract from it. Cell phones serve a safety function as well that makes it easier for wilderness recreationists and wilderness managers to respond to accidents in the backcountry. Finally, realists reason that it is virtually impossible to separate wilderness recreationists from their cell phones today. Any downside to cell phone use in wilderness, they conclude, is more than offset by their upside. Cell phones are omnipresent among the current generation of wilderness enthusiasts, and any effort to eliminate cell phones from wilderness would not only be futile, it would also run the risk of alienating potential wilderness advocates. Banishing cell phones from wilderness would also, likely, be impossible to enforce. Cell phones, in sum, are a practical fact of contemporary life and should be accepted as such in wilderness.

Once again, it is also possible that some realists might reason that given the increasingly technological nature of contemporary life, cell phones should be discouraged in wilderness because they are a clear expression of society's growing mechanization. Their rationale, however, would not be rooted in the intransigent logic of the 50-year-old Wilderness Act but rather in the realization that we are now 50 years farther down civilization's path, a path characterized by a highly urbanized citizenry that is irrevocably dependent on that "growing mechanization" to which wilderness should be an important antidote. In this case, formalists and realists might agree on the matter, but for fundamentally different reasons. Formalists would strictly adhere to what the framers of the Wilderness Act intended in 1964, while realists would focus on current conditions in relation to those intentions. Formalists would not see the Wilderness Act as a living document that "evolves, changes over time, and adapts to new circumstances, without being formally amended" (Strauss 2010, p. 1). Realists would.

Cell Phone Summary

While it is easy to appreciate the value of cell phones for safety reasons and for the immediacy of answers to most any wilderness-related question (e.g., identifying an unknown wildflower), formalists still find something disconcerting about relying almost exclusively on sophisticated electronic technology to make one's way in wilderness (Beck and Dustin 2016). Such technology, they claim, is antithetical to what wilderness was intended to be about. Realists, on the other hand, recognize the centrality of cell phones to present and, no doubt, future generations, and wonder how we might accommodate cell phones in wilderness without detracting significantly from the wilderness experience. Once again, how receptive we are to cell phones in wilderness will likely reveal our formalist or realist inclinations.

Jefferson's Problem


As we have shown, interpreting the Wilderness Act can be a complicated undertaking when considering formalist and realist perspectives. The complexity is due in large part to the fact that the act's language, just like the US Constitution's, is less precise than we think it is, and much of its meaning can be open to interpretation (Steinhoff 2010). And just like the US Constitution, people interpret the Wilderness Act through different frames of reference. Whether we see the Wilderness Act as etched in stone and as a document that must be strictly adhered to over time, or whether we see the Wilderness Act as a reflection of a time and place and as a living document that can be adjusted to fit changing times, remains a lively topic for discussion.

Perhaps the most probing question related to interpreting the Wilderness Act is not ours, but Thomas Jefferson's. In *The Living Constitution* (2010), Strauss reads from a letter Jefferson wrote to James Madison in 1789: "The earth belongs to the living and not to the dead. We seem not to have perceived that, by the law of nature, one generation is to another as one independent nation is to another" (Strauss, pp. 99–100). Paraphrasing Jefferson, Strauss continues, "What possible justification can there be for allowing the dead hand of the past to govern us today?" (Strauss, p. 100)

Jefferson was brooding over the binding authority of the US Constitution from one generation to the next, but we might ask the same question of the Wilderness Act written more than 50 years ago by individuals who are no longer living. Why should we feel obliged to follow their lead? We are a different generation. We are as an independent nation to theirs. What possible justification can there be for allowing legislation written a half century ago to govern wilderness planning, policy, and management today?

Strauss's response is that "we defer to the past because it makes sense to do so for our own purposes" (Strauss 2010, p. 100). He believes we make fewer mistakes by benefiting from the lessons of history. Both formalists and realists might agree with Strauss on that point, but they would likely disagree on the extent to which we should allow history to decide for us what we should do today. Formalists defer to history and a strict interpretation of the Wilderness Act. Realists operate from a broader interpretive perspective that allows for changing times and circumstances. While some realists might reason that the world is more mechanized than ever, and therefore that adhering to the original intent of the Wilderness Act is more important than ever, other realists might conclude that advancing technology should be welcomed in wilderness if the practical advantages of doing so outweigh the disadvantages. Jefferson's problem, it seems, is now our problem, and how we respond to it may well determine the future of wilderness in America.

The challenge for wilderness planners, policy makers, and scholars is to identify which, if any, of the values underlying the Wilderness Act ought to be treated as inviolate, and then to decide if advancing technologies compromise those values or not. If we can agree on those values, then formalist thinking might be the model of choice for informing wilderness planning, policy, and management. Indeed, if we could reach such a consensus, it might illuminate common ground

upon which formalists and realists might strike an agreement about what ought to be done in any case. However, in the absence of any such agreement, realist thinking might be the model of choice for informing wilderness decision-making. As we stated at the outset, the Wilderness Act oscillates between highly precise and poetically vague language, thereby necessitating its interpretation. When conducting that interpretation, the question of fidelity remains central. To what interpretation do wilderness planners, policy makers, and scholars owe their allegiance? And why? 

DANIEL DUSTIN is a professor in the Parks, Recreation, and Tourism Program at the University of Utah; email: daniel.dustin@health.utah.edu

LARRY BECK is a professor in the L. Robert Payne School of Hospitality and Tourism Management at San Diego State University; email: lbeck@mail.sdsu.edu

JEFF ROSE is an assistant professor in the Parks, Recreation, and Tourism Program at the University of Utah; email: jeff.rose@utah.edu

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Aldo Leopold Wilderness Research Institute Perspectives

International collaboration to support designation of the Qingzhu National Protected River:

NOTE The Aldo Leopold Wilderness Research Institute and the Wildland Research Institute of the University of Leeds are both collaborators in China's efforts to inventory and protect wild rivers and wilderness. The US Forest Service's Office of International Programs has supported international exchange of expertise and information with Yunnan University, Southwest Forestry University, and Tsinghua University in China. The following contribution by Dr. Peng Li describes considerable international collaboration to develop a proposal for designating the first Wild River in China.



by Peng Li
Photo by Hans Van Tilburg

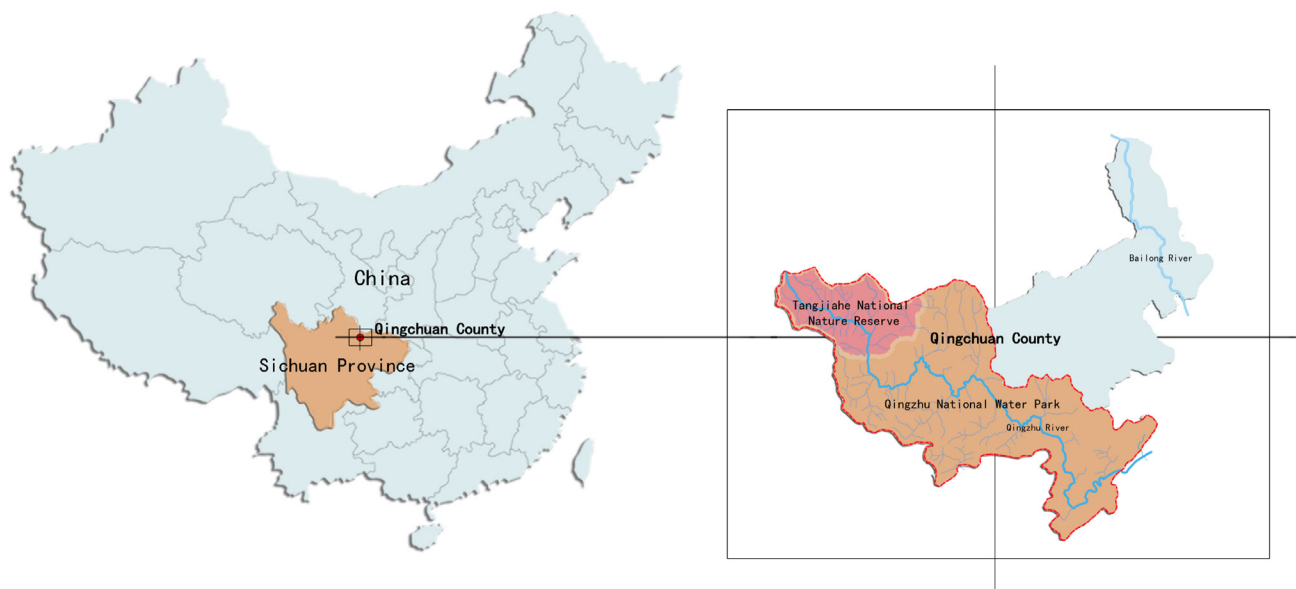


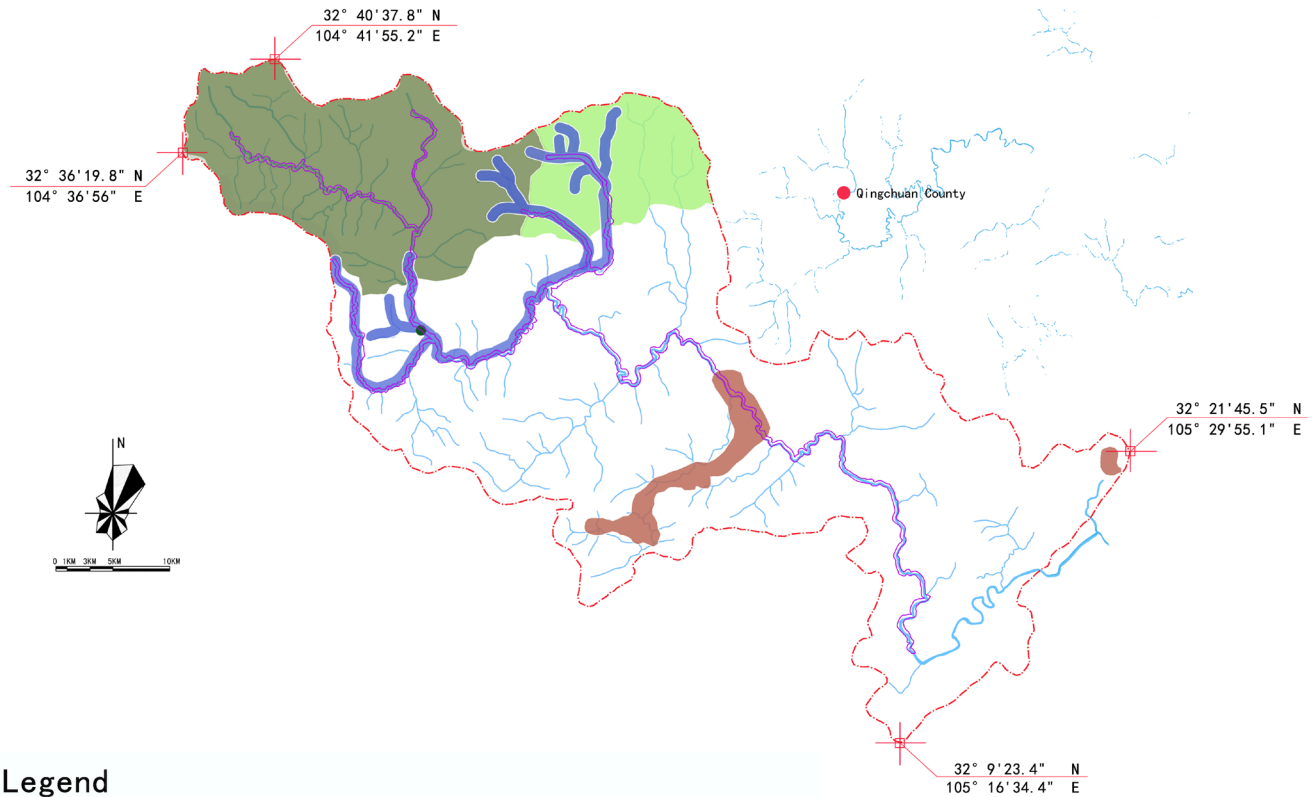
Figure 1 – Geographical location map of Quigzhu River, China.



Figure 2 – China's rivers have many outstanding natural and cultural values.

The Qingzhu River is a third-order tributary of the Yangtze River, located in Qingchuan county (Figure 1), Sichuan Province. It lies in the mountains of southwest China, at the second and third topography ladder and at the junction of the Tibetan Plateau, Loess Plateau, and Sichuan Basin. The river and its basin are a transitional area from agriculture to animal husbandry land use, and in this region the Qingzhu River demonstrates outstanding natural and cultural values (Figure 2). The Qingzhu River has been recognized as a biodiversity hot spot by the International Union for Conservation of Nature (IUCN). In addition, the Tangjia River National Nature Reserve that lies in the upper reaches of the Qingzhu River has also been included on the IUCN Green List.

The river basin is famous for Chinese dove trees, ginkgos, pandas, takins (a mammal sometimes thought to resemble a goat or antelope but most closely related to sheep), and *Rhinopithecus bieti* (the black snub-nosed monkey). The river is also located in the Longmenshan fault zone, where in 2008 the destructive Wenchuan earthquake occurred and resulted in lakes being impounded. The area also contains many cultural relics created during the Three Kingdoms Period (AD 220–280), including Motian Mountain and the Yinping Ancient Road. Other areas with substantial cultural meaning can also be found along the Qingzhu.



Legend

- Qingchuan County
- Tangjiahe National Nature Reserve
- Qingzhu River National Fish Germplasm Resources protection zone
- Dongjiangkou National Geological Park
- Boundary of Qingzhu National Water Park
- Yinping Ancient Road Provincial Scenic Area
- Dongyanggou Provincial National Reserve
- Qingzhu Ancient Wall Provincial Historical and Cultural Site Protected
- Qingzhu National River study area

Figure 3 – Different kinds of protected areas within Quigzhu River Basin.

Eight different kinds of protected areas are distributed along the river because of various outstanding values (Figure 3). Since the free-flowing condition and outstanding values of the river are not systematically preserved within the existing protected area system, a preliminary exploration of Qingzhu National Protected River has recently been launched (Figure 4). In August 2013, the Qingchuan County government in Sichuan Province commissioned Yunnan University to complete a master plan for a proposed Qingzhu National Water Park. From November 2013 to November 2015, this team completed "A Study of Qingzhu Protected River Planning in Sichuan Province." It mainly explored methods of value determination, boundary demarcation, and river segmentation, proposing the Qingzhu River as the first national protected river in China. (See Li, in December 2017 IJW issue)

International Collaboration

To learn from successful experiences of other countries, core members of the planning team traveled to interact with managers of the Canadian Heritage Rivers System and the US Wild and Scenic Rivers System. In November 2015, the planning team invited a river manager from the US Forest Service Office of International Programs for a site visit and to provide technical guidance for description of the attributes of the proposed Qingzhu Protected River.

In May 2016, the planning team participated in the 2016 River Management Symposium and National Outdoor Recreation Conference in Boise, Idaho. During the conference, the Yunnan University team had meetings with relevant river managers and discussed China's proposal for a National Protected River System (NPRS). In October 2016, staff of the Ministry of Water Resources (MWR), the Yunnan University planning team, and other Chinese scientists attended the 3rd Global Land Project Open Science Meeting in Beijing. Staff interacted with scientists from the Aldo Leopold Wilderness Research Institute in the United States, the Wildland Research Institute in the UK, and international experts on sustainability models. The focus was on methods of assessing outstanding values and prioritizing threats to protected areas. In 2017, Yunnan University applied to host a Fulbright Senior Environmental Specialist from the United States, with emphasis on wild and scenic rivers protection science. Ongoing efforts are planned for international collaboration to ensure that a proposal for this river properly identifies outstanding values, accurately reflects desires of local communities, and can prescribe an innovative management program to protect the river.

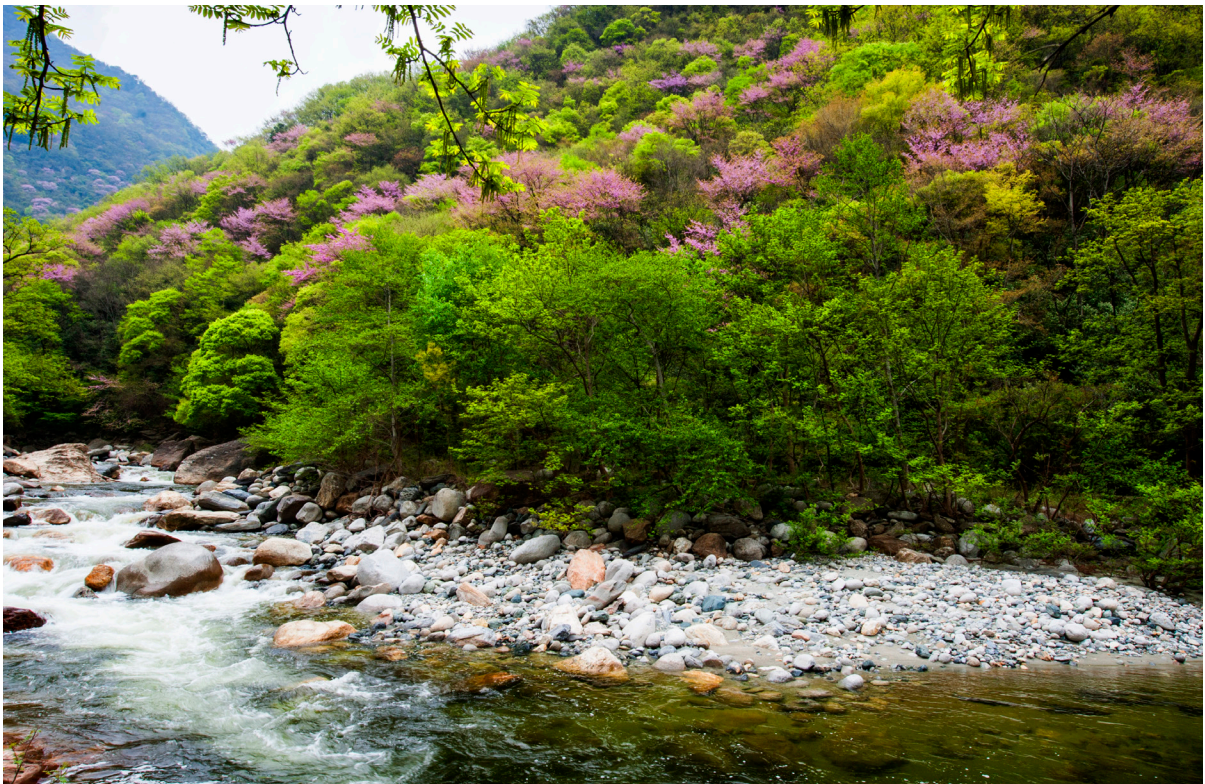



Figure 4 – A preliminary exploration of Qingzhu National Protected River has been launched to preserve outstanding values.

Progress in Protecting the Qingzhu River

A proposal to establish an NPRS for China was introduced at the People's Congress in 2016. "A Study of Qingzhu Protected River Planning in Sichuan Province" got the support of the Sichuan government, and in March 2016, 15 deputies to the National People's Congress of Sichuan Province submitted a proposal titled "Establishment of a National River Park, and Recommending Sichuan Province as a Pilot Area" (No. 1309th). At the same time, four deputies of the Guangxi Zhuang Autonomous Region submitted "A Proposal about the Designation of a National Scenic River as part of a National River Park System" (No. 2255th). The Standing Committee of the National People's Congress approved both proposals and authorized MWR to follow up, assisted by the Development and Reform Commission and the Ministry of Finance.

In July 2016, the Scenic Office of the MWR organized an investigation group, composed of experts and deputies to the National People's Congress of the Guangxi Zhuang Autonomous Region and Sichuan Province, to investigate the Qingzhu River, which may be identified as a pilot project for the NPRS. In 2017, Sichuan Province government promulgated the Sichuan River and Lake Park System Plan. Qingzhujiang was once again listed as a pilot of River and Lake Park in Sichuan Province. The investigation group and other relevant personnel hosted a research forum in Sichuan on the possibility of designation of a national protected river: The Qingzhu, China's first nationally protected wild and scenic river. With these ongoing efforts and international collaboration, the outstanding natural and cultural values of the Qingzhu River may have further recognition and protection.. 

DR. PENG LI is an associate professor at Yunnan University in Kunming, Yunnan Province, China, in the Department of Business and Tourism Management. His recent sabbatical to study wild and scenic river management in the United States and Canada was sponsored by the National Natural Science Foundation of China (Grant No. 41361107); email: leap@ynu.edu.cn

The River Wild:

Towards a Global Assessment of Wild Rivers

ABSTRACT This article looks at the global distribution of wild rivers using GIS-based approaches with the aim of developing and exploring more unified approaches to wild river identification and appraisal. There are several published versions of a global wilderness map but no integrated global map of the distribution of wild rivers. Global hydrological datasets are integrated here with global wilderness maps to identify the top 10% wildest rivers at both global and continental scales. The discussion and conclusions cover the dangers of overreliance on global datasets and the need for multiscale analyses incorporating finer scale datasets and local knowledge.

PEER REVIEWED

Rivers are an integral part of all landscapes. Running water can be found almost anywhere on the planet, from the polar regions to the driest of deserts. Rivers perform a vital role in connecting mountains to the sea, and are conveyors not just of water, but also sediments and dissolved solids and nutrients. They are agents of change, reflecting cycles of flood and drought, and periods of erosion after which sediments are transported downstream and ultimately deposited in the oceans. Rivers provide habitats for wildlife, not just for fish and other aquatic organisms but for all biodiversity that relies on them to provide water that is essential for life. For us as humans, rivers provide us with water to drink, to irrigate our crops, and to power our industry. They also provide us with stimulating recreational environments and some of the finest scenery on the planet. Yet over the years we have overexploited many of our rivers. We have used them as a water source, for travel and transport, and as convenient dumping



by Steve Carver

grounds for our waste. We have sought to control rivers with dams and levees, attempting to tame their flood-drought cycles, and put them to work generating electrical energy. As a result, many rivers are now pale reflections of their former selves, and without protection many more rivers may well be degraded and lose their wildness and the ecosystem services they provide. Being able to recognize and identify the world's remaining wild rivers in a rigorous and repeatable manner is perhaps the first step toward better protection.

Protection for Wild and Scenic Rivers

Our appreciation of the natural beauty of rivers and recognition of the threats they face provides the backdrop against which the US Wild and Scenic Rivers Act (1968) was passed (see Palmer 2017). The United States is not alone in providing a level of protection for its free-flowing wild rivers. Similar systems are present in Canada, Australia, and New Zealand. The Canadian Heritage Rivers System (CHRS) is like that of the United States. It was established in 1984 and "gives national recognition to Canada's outstanding rivers and encourages their long-term management to conserve their natural, cultural and recreational values for the benefit and enjoyment of Canadians, now and in the future" (<http://chrs.ca/>). There are currently 42 such rivers designated under the CHRS, totaling some 12,000 kilometers (7,456 miles) of rivers across the whole of Canada. However, unlike the United States, the CHRS is a voluntary process involving the nomination of rivers by provincial/territorial governments after which rivers are designated only after a rigorous screening process. The CHRS recognizes the continuing and historical importance of rivers to Indigenous people as well as early settlers and to contemporary industry, landscape, and environment.

New Zealand also has similar legislation and protects wild waters for scenic, recreational, and habitat purposes. This is implemented through Water Conservation Orders (WCOs) and began in 1984 with 15 rivers throughout New Zealand protected under this legislation (NZCA 2011). WCOs can be applied to all water bodies including rivers, lakes, ponds, wetlands, and geothermal waters. They are used to provide protection to the water body's natural state as habitats for terrestrial and aquatic life; for its "wild, scenic or other natural characteristics"; its scientific or ecological values; and recreational, historic, spiritual, and cultural purposes.

In Australia, the Wild Rivers Project sets out to "identify rivers, encourage protection, engage in voluntary management of the whole catchment, and promote the values of wild rivers" Whereas the rivers represented in the US National Wild and Scenic Rivers System (NWSRS) are included based on a case-by-case evaluation, the Australian system adopts a more quantitative, GIS-based approach. This builds on the Australian National Wilderness Inventory, which is itself a GIS-based mapping of wilderness quality across the whole of Australia (Lesslie and Maslen 1995). The Australian approach to designating their wild rivers is based on a River Disturbance Index (RDI). This is modeled across all rivers using a combination of spatial indices describing wildness within the river's catchment. These include land use, settlement, infrastructure and

extractive industry, and point pollution sources, together with indices describing specific impacts along the river itself, including dams/impoundments, flow diversions/water abstractions, and levees. Mapped at a national scale, the RDI describes a continuum of river disturbance from near pristine to highly degraded (Stein et al. 2002; Stein et al. 2001; Stein et al. 1999).

In Europe, the Water Framework Directive provides a framework for protecting water quality and habitats throughout the European Union with the emphasis on integrated catchment management. While there may be few if any truly wild and free-flowing rivers of any appreciable size left in Europe, there is a growing recognition of the value of wild rivers for associated values of natural habitats and processes, recreation, and heritage. The European Rivers Network is an NGO set up to promote this ideal and develop relevant projects throughout the EU working on the back of protected area legislation such as Natura2000 and the Habitats Directive (<http://www.ern.org/en/>).

Integrated Thinking

If we look solely at the river and its floodplain when thinking about protecting the world's remaining wild rivers, then we are in danger of missing a key part of the picture. Rivers are not just convergent linear networks but are also connected to the entire landscape via all the processes inherent within the hydrological cycle that govern runoff generation. As a result, current thinking in water and land management focuses more on integrated catchment management, since to protect the river and its values associated with flow regimes, water quality, recreation, and wildlife, we must also act to protect its catchment (Mitchell and Hollick 1993). It has long been recognized that clean water supplies come from catchments that are protected from degradation, be it through agriculture, deforestation, industry, extractive land uses, or settlement. For this reason, metropolitan areas often seek to protect the watersheds providing the city's water supplies rather than pay for expensive "end of pipe" treatment of polluted water.

“If we look solely at the river and its floodplain when thinking about protecting the world’s remaining wild rivers, then we are in danger of missing a key part of the picture. Rivers are not just convergent linear networks but are connected to the entire landscape.”

Therefore, protecting the wilderness qualities of the river catchment is the key to protecting the wildness of the river. If we can map that connectivity between land and river and how human activity within the catchment (including settlement and transportation infrastructure) and modification via human land use (agriculture, forestry, etc.) influence the hydrological functioning of watersheds, such as providing natural water flows, then we can create a draft inventory of wild rivers using purely global datasets. The remainder of this article will explore the potential and difficulties of such a model and approach.

Methods

The work presented here uses global datasets to identify the wildest rivers in the world. The datasets used here are the Human Footprint version 2, Hydro1K 30ArcSecond global DEM, and the Global Reservoir and Dams database (GRanD). Using a nested multiscaled approach, it is possible to sequentially identify the wildest rivers at a global level, on each continent, and then in each country, although for many smaller countries (e.g., Belgium or Belize) the limited resolution of the global datasets could easily present a problem requiring substitution of national level datasets. The basic model proposed links wilderness quality within a catchment to its river using a weighted flow accumulation model to create a classification of rivers and their catchments, such as that described by the Australian Wild Rivers Project, from pristine to heavily modified. This works by totaling the level of upstream human impact based on the assumption that catchments with greater upstream impacts will exhibit corresponding impacts on the wildness of the river.

Global wilderness maps range from the McCloskey and Spalding map published for the 4th World Wilderness Congress in 1987 (McCloskey and Spalding 1989) to the Human Footprint version 2 "Last of the Wild" project in 2005 (Sanderson et al. 2002; WCS 2005). Various other global scale maps and databases exist showing roadless areas (Ibisch et al. 2016), human impact on the world's oceans (Halpern et al. 2008), and declining wilderness areas (Watson et al. 2016). Except for the McCloskey and Spalding map, which was produced largely by hand from Jet Navigation Charts, all of these works are made possible by the availability of global digital spatial datasets. The Human Footprint data developed by CIESIN and WCS can be used as a global wilderness quality index to provide information on how settlement, transport infrastructure, and land use negatively impact natural ecosystems (Sanderson et al. 2002).

Hydro1K is a hydrological corrected digital elevation model that includes a river network, a flow direction matrix, and six levels of nested catchments using Pfafstetter units (Verdin and Verdin 1999). Pfafstetter units are a means of codifying nested drainage basins based on a hierarchical system from continental scale drainages (level 1) through to higher orders (levels 2–6). Within the system there are three types of drainage: basin (a drainage area that does not receive water from any other drainage), interbasins (which receive water from upstream basins), and internal basins (which do not contribute water to another drainage or ocean/lake). The coding allocated

to each basin is unique and allows the user to identify where a drainage sits within the nested series of basins below level 1. Not all the world's catchments are codified to the same degree. There are some large and poorly delimited areas within the Amazon basin, Himalayas, eastern and southern Europe, southern Africa, and the Arabian Peninsula. The GRanD database (Lehner et al. 2011) is used to identify unregulated rivers and augment the Human Footprint dataset.

The Hydro1K flow direction matrix and Human Footprint version 2 data are used together to perform a global weighted flow accumulation analysis using the hydrological modeling tools in ArcGIS 10 to calculate how the level of human impact "accumulates" downstream through the drainage networks to show the wildest rivers (i.e., those with highest upstream wilderness quality). Statistics on downstream human impact (minimum, maximum, mean, range, standard deviation) are then calculated for each of the six Pfafstetter levels in the Hydro1K nested catchments database, which enables the classification of catchments on a scale of pristine to heavily modified.

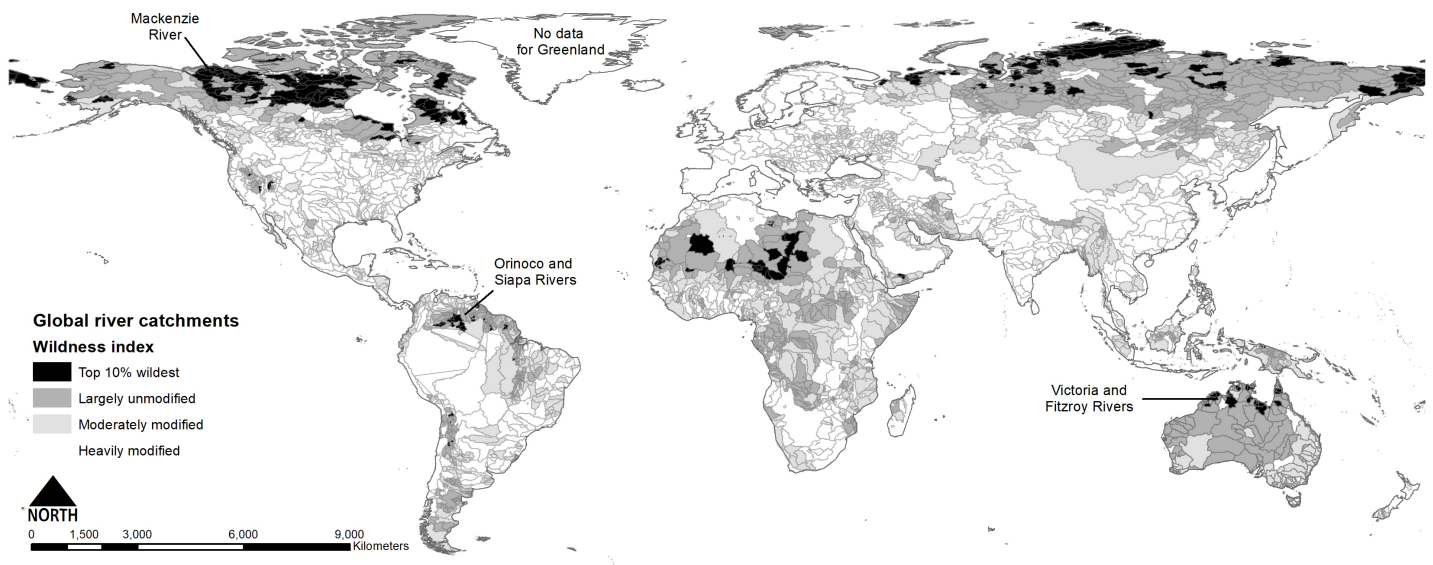


Figure 1 – Global river catchments wilderness index.

Results

Basic classifications of the wildest rivers and their contributing catchment areas are presented in Figures 1–7. Figure 1 presents the global picture with the top 10% wildest river catchments highlighted, while Figures 2–7 show similar maps scaled for each of the continents (excluding Antarctica). Other catchments are classified into one of three groups based on percentiles along the wilderness index as follows: largely unmodified (90–60%), moderately modified (60–30%), and heavily modified (30% and below). Although it is possible to map every statistic for each of the six nested Pfafstetter levels, we are principally interested here in the maximum wilderness quality within mid-level catchments that can robustly map the distribution of wild rivers without undue generalization or too much detail. The maps presented are therefore for the maximum accumulated human impact within Pfafstetter level 3 catchments.

Many of the wildest rivers fall mainly into permafrost or desert environments (Figure 1). As such these rivers are likely to be ephemeral and only flow when fed either from seasonal ice/snow-melt (e.g., Mackenzie River in Canada) or high magnitude/low frequency flash flood events in desert areas. Mid-latitude rivers in temperate or moist tropical regions are not well represented in the top 10% of wildest rivers at a global scale, the exception being those within the intact tropical rain forest areas of northern Amazonia (e.g., Orinoco and Siapa) and the larger rivers draining northern Australia (e.g., Victoria and Fitzroy).

The distribution of wild rivers at a continental scale shows a similar pattern (Figures 2–6), although more mid-latitude rivers exhibiting "normal" (i.e., constantly flowing with minimum base flow > zero) flow regimes are represented.

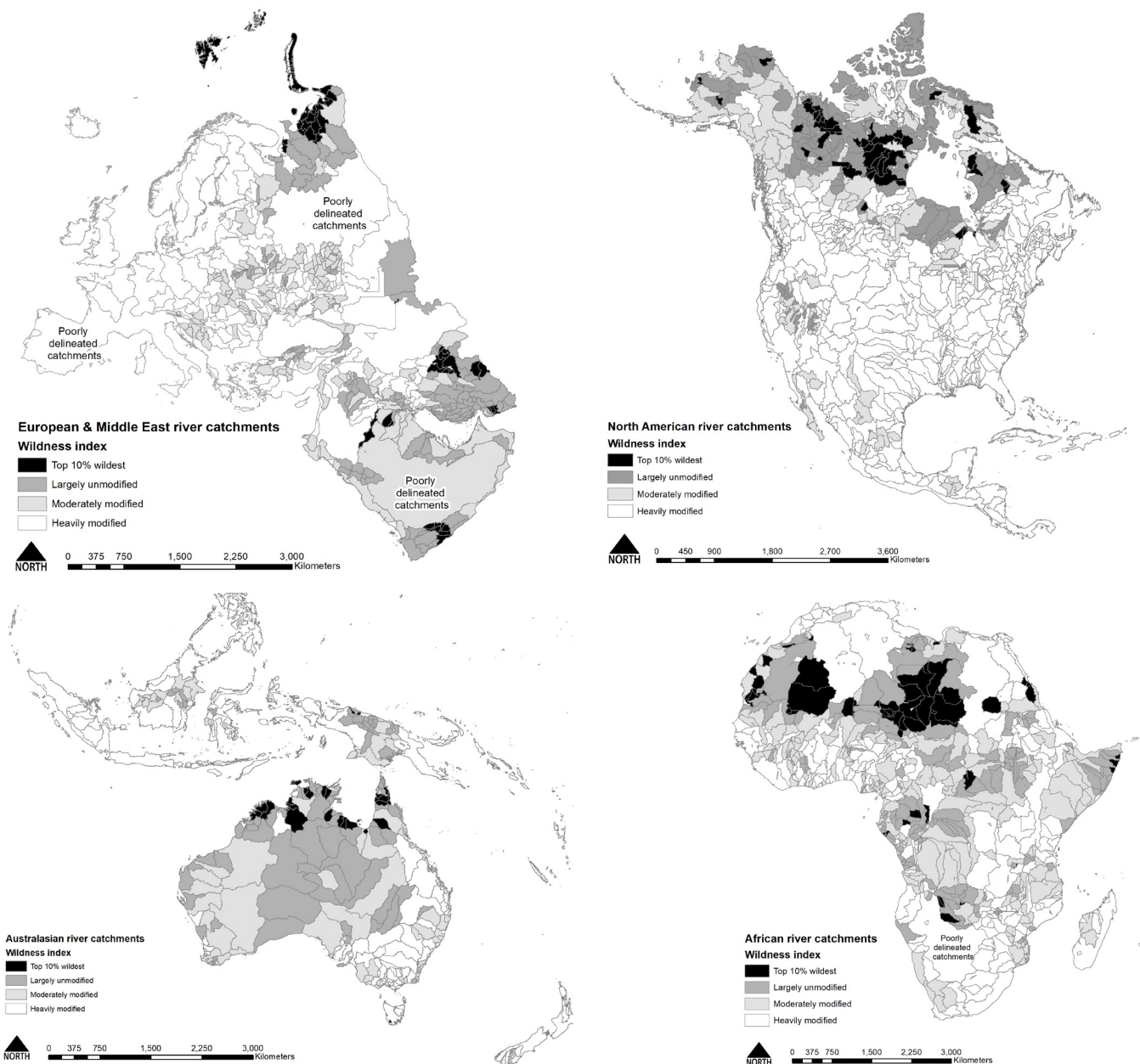


Figure 2-5 – Worldwide river catchments wildness index: North America, Africa, Australia and Europe & The Middle East

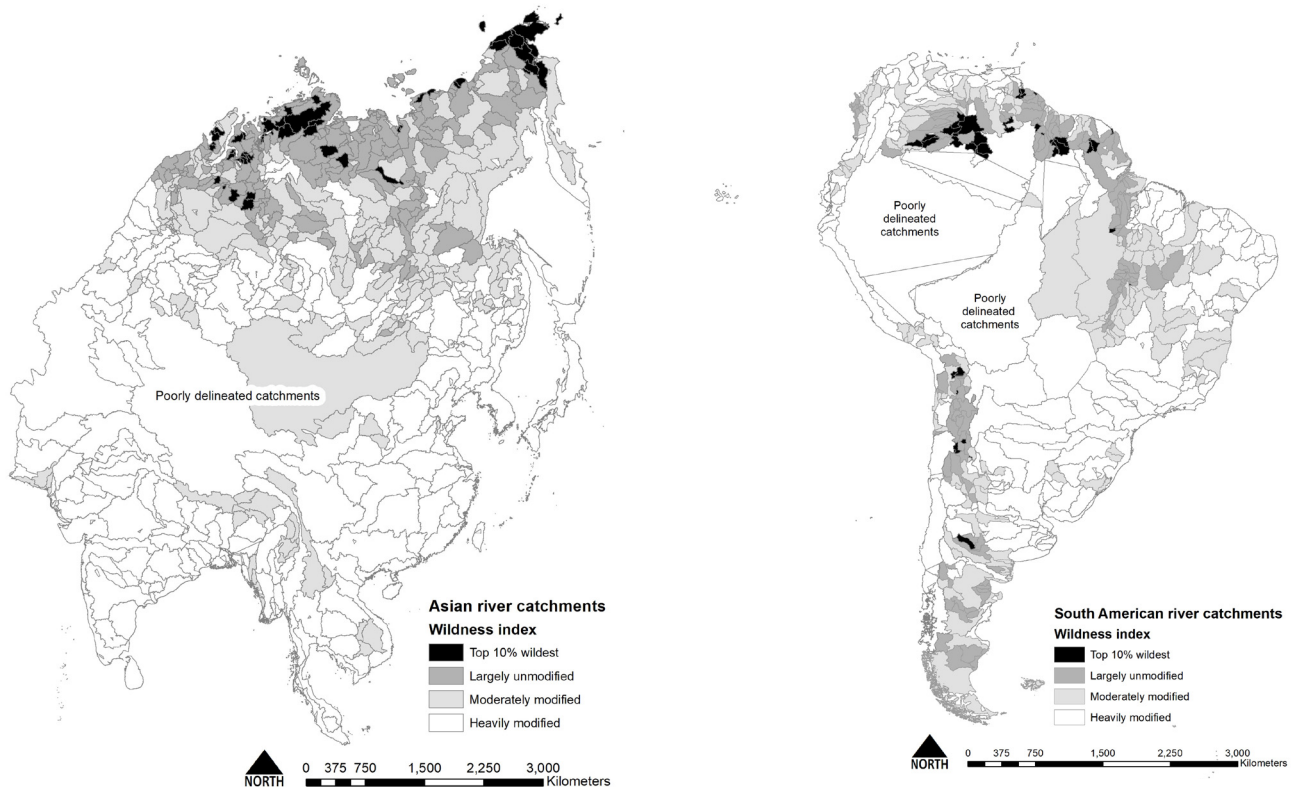


Figure 6 & 7 – Worldwide river catchments wildness index: Asia & South America

At a country level, the patterns are more widely dispersed. Figure 8 shows the pattern of wild rivers and their catchments for the lower 48 in the United States. While most of the top 10% of wildest catchments are in the west and many are internal basins in the deserts of Nevada, California and Arizona, several key mountain river catchments are present, including many within the NWSRS such as the Clearwater and Salmon Rivers.

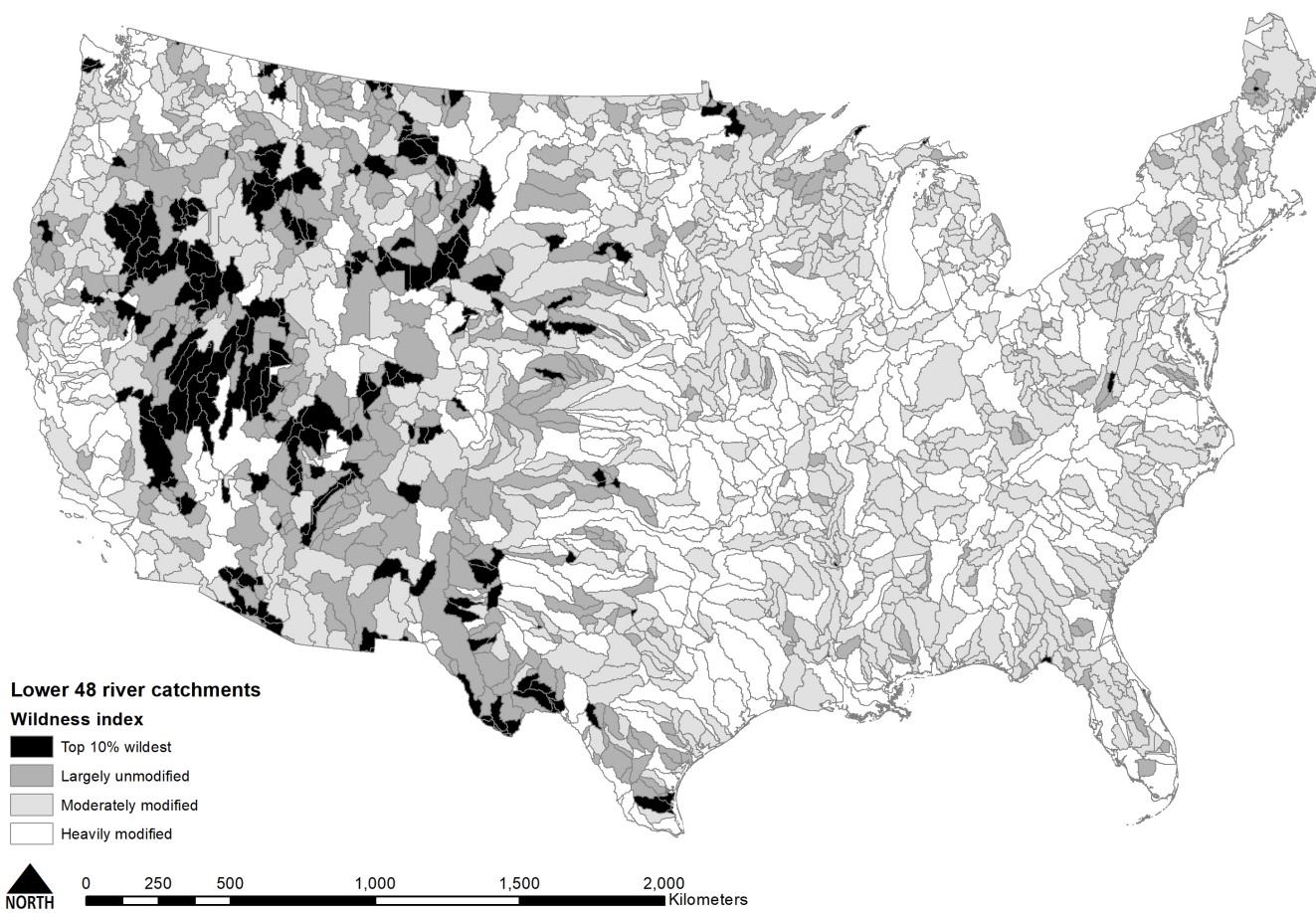


Figure 8 – Lower U.S. 48-state river catchments wildness index.


Discussion

Global datasets are generally inconsistent, coarse scale, and reliant on highly generalized data sources. This creates problems for consistent mapping at a high quality, so it is often better to map at a country scale using national datasets that, while varying in quality between countries and across national borders, will at least be internally consistent (Carver and Fritz 2016). The inconsistency and uncertainty inherent in global datasets makes continental and country-to-country comparisons difficult and open to criticism.

As the number of papers published using global datasets increases, it is important to both recognize and question the validity of the results presented. Recent examples include global analyses that purport to show catastrophic declines in wilderness areas since the early 1990s (Watson et al. 2016). While the general global trends reported are likely to be true, the quality of the data and therefore the subsequent analyses are questionable when examined in detail at the national scale and especially where reductions in human impacts are reported (<http://wcshumanfootprint.org/>). This is largely due to changes in the way the datasets were compiled and recorded between 1993 and 2009 and variations in the detail at which data on topics such as land use and population are recorded between countries.

The same can be said of the draft analyses presented here, as this study uses some of the same datasets (i.e., the Human Footprint version 2 database) to define spatial patterns in the variability of human impact, although here we are not trying to model change over time. The Human Footprint version 2 data relies heavily on global datasets including human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use/land cover), and human access (coastlines, roads, railroads, navigable rivers), all of which are subject to generalization, leading to errors of both omission and commission. The resolution of 1-kilometer (.62 mile) grid leads to further generalization. The reliability of key datasets varies spatially between countries, particularly when relying on national census data for information on population density. Problems with the base data notwithstanding, by far the greatest cause for concern with the global analysis of wild rivers is the definition of the catchment boundaries themselves. These boundaries or watersheds can be defined for any point along the length of the river while the Hydro1k and datasets like it only provide a limited series of nested catchments. This is in effect an example of the well-known Modifiable Areal Unit Problem wherein the results of dividing the world up into a series of artificially defined reporting units can markedly influence the patterns seen in the mapped data (Openshaw 1984). The catchments provided by Hydro1K are just one set of basins out of a theoretically infinite set of possibilities, and while the local topography will determine the flow direction and the catchment watershed, the choice of pour-point above which to define the contributing area is critical in determining the shape and area of the catchment. As a result, the intersection with the human impact data and the catchment's position in the global hierarchy of wild rivers can vary widely depending on the catchment boundary used. It is suggested that national or subnational analyses utilizing local scale data are almost certainly going to provide more reliable and robust outputs.

Conclusions

While the combination of the Hydro1k and Human Footprint Version 2 datasets using a weighted flow accumulation model works well in technical terms, there are some serious concerns about the validity of results when reported at global and continental scales. This is due to known limitations associated with global datasets, including coarse resolution, generalization, variable accuracy, and consistency across regions and national boundaries, as well as limitations in the use of fixed and arbitrarily defined catchment boundaries. As a result, it is suggested here that national and local assessments are also required and provide more detailed and reliable datasets, together with opportunity for nested analyses of variations in wildness indices along a river's profile. Used together with local knowledge and expert appraisals, a more robust global assessment could be developed by building up national assessments across the globe. The practical logistics in validating results using local knowledge would be substantial but could be made manageable using crowd-sourcing techniques such as GeoWikis (Fritz et al. 2009) and participatory GIS models (Huck et al. 2014). . 

STEVE CARVER is director, Wildland Research Institute, School of Geography, University of Leeds, United Kingdom; email: s.j.carver@leeds.ac.uk, URL: www.wildlandresearch.org

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Canoeing with pearl mussels

ABSTRACT Except in the far north and high mountainous areas, only a few wild rivers remain in Europe, and even these are threatened by development. Sometimes only nongovernmental organizations and public protests have been able to protect these wild rivers and their unique ecosystems from destruction. The Vltava River rises in a wild natural area close to the Czech–German border. Nine big dams were constructed on this river during the 20th century. But before the river flows into the first artificial lake, there is a unique ecosystem: the Upper Vltava River floodplain. The river slowly meanders in a boreal landscape with peat bogs and wetlands. The shallow water and oligotrophic oxbow pools are habitats for some relict plant communities, rare invertebrates, and one of the last viable Central European populations of pearl mussels. Canoeists have loved this river for decades, but low water levels have limited access. The numbers of boats increased significantly when new boat types (e.g., rafts and plastic canoes) appeared. Sensitive species and habitats have become seriously threatened. This article reviews a long negotiation for regulation of canoeing on the Upper Vltava River in the Šumava National Park to protect the unique wild river ecosystem and improve the enjoyment of visiting canoeists.

Our ancestors created the first settlements on riverbanks and rivers that were the main traffic corridors over millennia (e.g., Herold 2012). Rivers offered fish to eat and water for drinking, for washing clothes, and for irrigating fields. Later, water-powered mills were necessary for mining of gold and other metals. Even today, hydropower plants and inland shipping remain significant actors in the economies of many countries. It is hard to imagine the progress of human society without rivers and waterpower. European rivers have been used since ancient times, and river flows have been maintained and regulated for centuries. Hundreds of dams have been built, thousands of kilometers of riverbanks were straightened and concreted, and many floodplains have been drained. However, in the far north and high mountainous areas, a few wild rivers remain in Europe, though even these are threatened by development. The recently proposed project of building a dam on Albania's Vjosa River, one of the last wild European rivers naturally flowing from its spring



by Zdenka Krenova

to the estuary in the Adriatic Sea, led to big public protests, and the Albanian government has not yet decided about the project (<http://balkanrivers.net/en>). One could suppose that wild rivers, or at least their unmodified parts, could be better protected from development pressures if they were part of a protected area system – for example, national parks, landscape protected areas, or Natura 2000 sites. However, sometimes only nongovernmental organizations (NGOs) and public protests over each new threatened river have been able to protect the wildness of rivers and their unique ecosystems from destruction, such as road construction through the Biebrza National Park (NP) in Poland (van der Heijden 2010). Not only recreational canoeists and anglers but also environmentalists are calling for better protection of the last wild rivers of Europe. This article reviews a long negotiation for regulations on using the Upper Vltava River in the Šumava NP to protect the unique wild river ecosystem and improve the enjoyment of visitors.

The Upper Vltava River

The Vltava River, often called “the mother of Czech rivers,” is 430 kilometers (267 miles) long and rises in the Bohemian Forest, very close to the German border at 1,172 meters (3,845 ft.) above sea level (a.s.l.). The Bohemian Forest and Bavarian Forest together form the largest contiguous woodland area in Central Europe, covering more than 2 million hectares (4,942,108 acres) (Meyer et al. 2009). Up to the present day they have remained free of larger settlements and have not been dissected by roads to any great extent. Two national parks – the Bavarian Forest NP in Germany and the Šumava NP in the Czech Republic – protect the most valuable parts of this region and provide a unique opportunity to protect this European wilderness of forests, crystal clear mountain streams, unspoiled marshlands, mires and bog woodlands, and abandoned mountain pastures at higher elevations.

The Vltava River rises in a wild natural area, but nine dams and hydropower plants were constructed downstream during the 20th century. The Lipno Dam, holding the largest lake (48.70 km²/18.8 miles²), is the first on the river journey from the Bohemian Forest to Prague. Since 1959, when construction of the Lipno Dam was finished, the lake has covered more than half of the unique flat montane floodplain situated in the lower southeastern part of the Bohemian Forest (Figure 1).

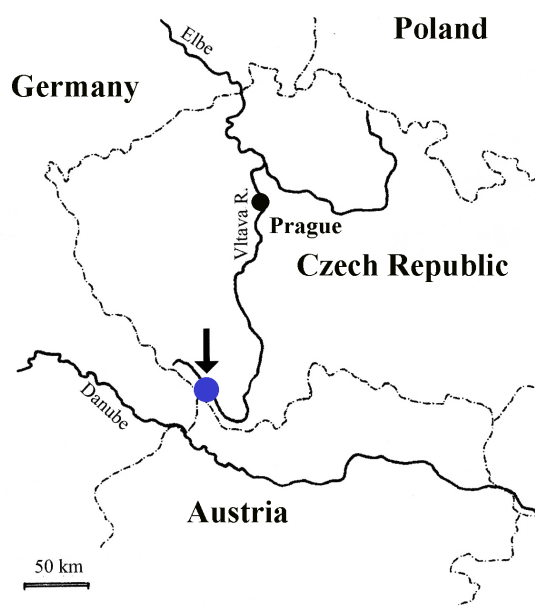


Figure 1 – The Vltava River, often called “the mother of Czech rivers,” is 430 km long. The Lipno Dam (location indicated), finished in 1959, has covered more than half of the unique flat montane floodplain situated in the lower south-eastern part of the Bohemian Forest, near the German border.

This flat and broad valley was created by orogenic processes in the adjacent area of the Alps, and its bottom was filled by late Pleistocene and Holocene deposits (Ložek 2001). Despite the whole floodplain being in a montane landscape, it has, from a geographical point of view, the character of a lowland riparian landscape. The floor of the river valley slopes gently from 730 to 720 meters (2,395 to 2,362 ft.) a.s.l. over about 15 kilometers (9.3 miles) and a much longer real river channel (about 25 km/15.5 miles). The floodplain is relatively wide (about 1.5 km/.93 mile) and the river slowly meanders, with a rich microtopography, including many oxbows, pools, backwaters, and so forth, in various stages of terrestrialization (Figure 2). The natural river dynamics are still preserved, and the area is annually flooded, mostly in the spring.

The local flora is rich in montane species with a high frequency of boreo-montane and boreo-continental elements. The potential natural vegetation is formed mainly by a mosaic of waterlogged spruce forests and various peatlands (Bufková et al. 2005). Ombrotrophic peat bogs developed within the floodplain are the valley-raised bog type typical of flat boreal and mountain valleys, and this complex includes the oldest mires in the southeastern Bohemian Forest. Deposits originating in the Late Glacial, dated to 13,000 BP, were found here (Svobodová et al. 2002). The high proportion of relict habitats, particularly peatlands, predetermine flora and relic fauna of this area. The flat valley is an important breeding area of the black grouse (*Tetrao tetrix*).



Figure 2 – A mosaic of unique habitats exist in the Upper Vltava River floodplain.

The shallow water and oligotrophic oxbow pools are habitats for some relict plant communities, rare invertebrates, and one of the last viable Central European populations of pearl mussels (*Margaritifera margaritifera*). The floodplain has no urbanization; the first nature reserve protecting the core peat bog was designated in 1933. Because of its high natural values, the floodplain was included in the core zone of the Šumava NP in 1992 and designated as a Ramsar Site. It is also part of the Šumava Natura 2000 site, and pearl mussels together with otters (*Lutra lutra*), bullheads (*Cottus gobio*), and several habitats protected under the EU 1992 Habitats Directive occur there.

Recreational Canoeing: A Long Tradition

Recreational canoeing has a long tradition in the Czech Republic. Kayaks, imported from Scandinavia, have been used on Czech rivers since the Middle Ages, and the first canoes appeared before the First World War (<https://www.kanoe.cz>). Sport canoeing, both speed and slalom, had established itself by the 1930s, and recreational wild river canoeing became very popular in between the First and Second World Wars. Increasing numbers of canoeists enjoyed the romance of floating down wild rivers, but they had to be very skilled to pass successfully through many rapids and fast-flowing river sections with simple wooden canoes.

Many wild parts of rivers gradually disappeared with massive dam building during the second half of the 20th century. Despite this, amateur canoeists could still find some good rivers and were able to test homemade fiberglass canoes and kayaks during the Communist era. New boats from durable plastic material and new types of boats (e.g., rafts) came at the end of the 20th century. Many people have benefited from the opening of borders, and some have traveled to the Alps or Scandinavia to try canoeing on big wild rivers there. However, there are still many people interested in the Czech rivers.

Czech legislation establishes that the rivers are open to public use, including canoeing, with the following limitations: (1) some weirs and dangerous river sections are accessible only at a person's own risk, and (2) canoeing in the national parks is prohibited by law. The NP Authority will allow canoeing in some river sections for specific times and type of boats. There are four national parks in the Czech Republic, and three of them have rivers suitable for canoeing. The Dyje (Thaya) River, a border river between the Podyji NP (CZ) and Thayathal NP (Lower Austria), is not open for canoeing. Canoeists can use several larger streams and smaller wild rivers in the Krkonose NP, but most of them only have enough water when the snow melts in early spring. If snow cover is substantial, canoeists can also enjoy spring water in the Vydra River in the central part of Šumava NP. Canoeing in Šumava NP is not allowed except for the Upper Vltava River.

Canoeists Versus Mussels?

Canoeists liked the area before its designation as Šumava NP. However, low water levels often limited canoeing in this river because wood, or later fiberglass, boats could easily break or come

apart. This limitation disappeared with the advent of new plastic boats at the beginning of the 21st century. Some tourist operators and companies renting boats started to organize trips for schools and larger groups. But while the plastic boats and rafts were safe for visitors, they were harmful to sensitive ecosystems, especially as use increased. Untrained visitors were not able to control the vessels and caused damage to unique macrophytes and river sediments, the important habitat of pearl mussels' larvae. High numbers of visitors also disturbed breeding and nesting birds. Some visitors complained about unsuitable behaviors of other visitors.

For more than 10 years, there have been attempts to ban canoeing in the Upper Vltava River. Experts have repeatedly warned Park Authorities that canoeing, especially disturbance of the river bottom plus noise caused by people, can seriously damage these fragile ecosystems. They suggested that a restricted number of canoes can be allowed only if the water level permits (April to August), and warned that if the number exceeds 3,000 canoes per year, the ecosystem will be damaged (Absolon and Hruška 1999; Bauer and Wächtler 2001; Simon and Kladivová 2006). Absence of regulation before 2006, and only partial regulation thereafter has resulted in serious damage to the river ecosystem (Volf 2010). The NP Authorities had both legal grounds (Natura 2000 plus Czech law) and were backed by expert opinion for immediate restriction of the number of canoes to 3,000 per year, but they failed to implement it and did not carry out a Natura 2000 assessment, as required by Art. 6.3 of the Habitats Directive, until 2011 (Bilek 2011).

The reasons for inactivity by the NP Authorities are attributable to pressure from local politicians, who have used canoeing regulation as a substitutionary excuse to battle with the NP. There is also a lack of any reinforcement of Natura 2000 by the European Union. Politicians have complained about different proposals for canoeing regulation and have argued they are not in the public interest, although the results of a survey conducted in 2006 showed that canoeists were willing to accept regulation of canoeing when the water in the Vltava River was too low (Figure 3). Although there is no entrance fee to Czech national parks, 45% of

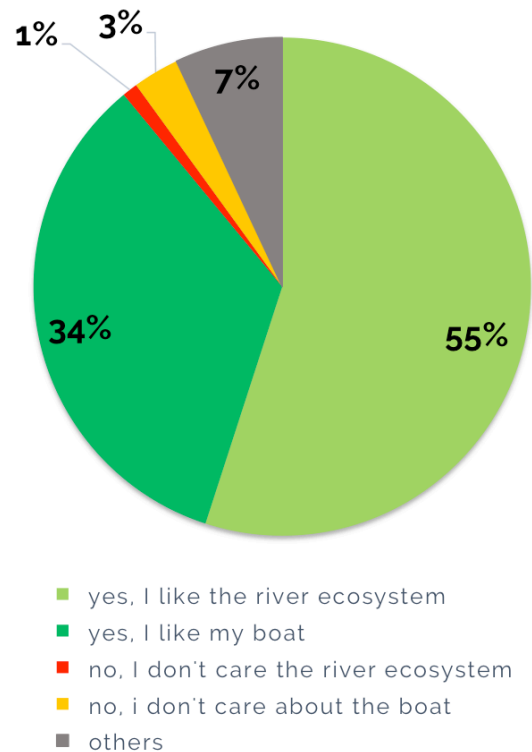


Figure 3 –Answers of 1000 respondents the following question: "Will you agree with closing the river if the water level would be lower than 45 cm at Lenora station?" A - "yes, I want to protect nature"; B - "yes, I do not want to damage my boat"; C - "no, I don't care about nature"; D - "no, I don't care about my boat"; E - other answers (Simon & Kladivová 2006).

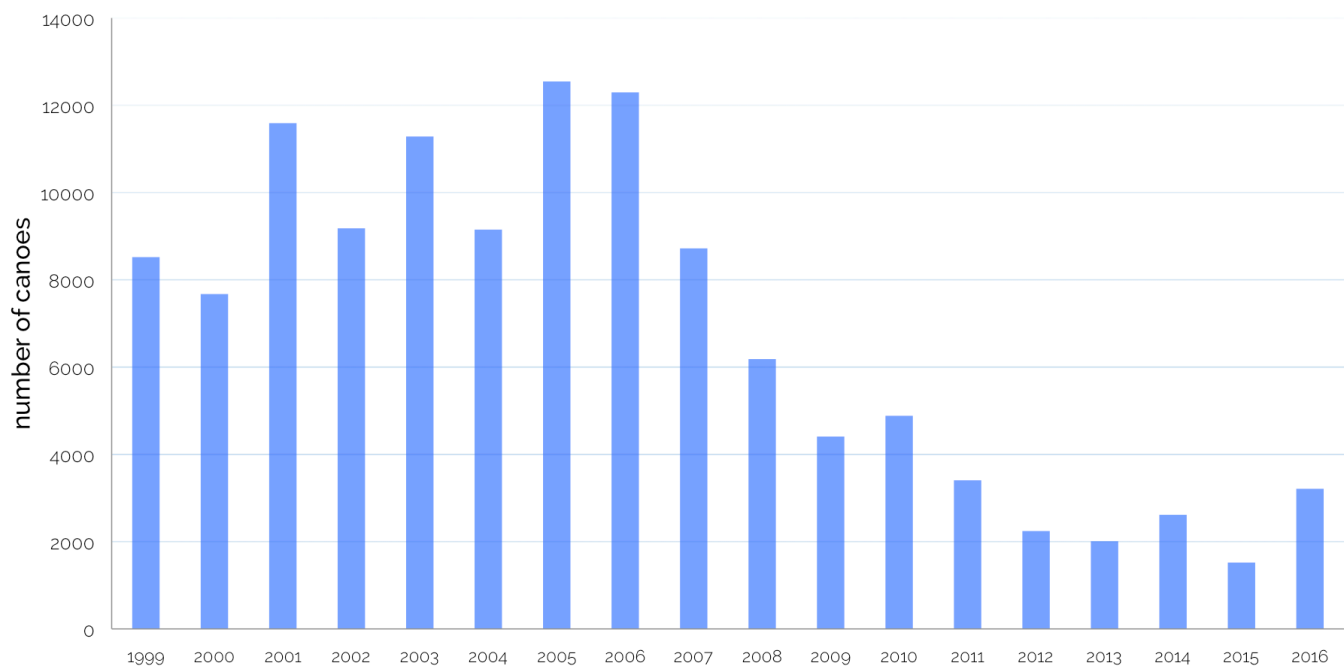


Figure 4 –Number of canoes recorded on the Upper Vltava River - they were not regulated until 2007, partially and insufficiently regulated during 2007-2011 and only starting from 2012 were the numbers recommended by scientists achieved.

respondents to a poll answered that they were willing to pay for a registration system, 42% said "no", and 13% of respondents were unsure (Simon and Kládiová 2006). It took an additional six years (2007–2012) to restrict the numbers of canoes per year to that recommended by scientists (Figure 4).

To make things even worse, part of the decline from 2007 to 2012 can be attributed to bad summer weather and low visitor interest rather than the activities of the NP Authorities. It was only after NGOs obtained a ruling from the Highest Administrative Court that the National Park Authority was in breach of Art. 6.3 of the Habitats Directive and reported the situation to the European Commission that the NP Authority mandated the number to drop to the recommended 3,000 canoes/year in 2012. The NP Authority started with regulation of canoeing and opened online registration (www.npsumava.cz). Rafts and big boats causing the most damage are no longer allowed, and the river is closed to all boats when the water level is lower than 50 centimeters (20 in.). The maximum of 20 registered kayaks and canoes/hour (i.e., 180 boats/day) is only allowed on the river from April to August, and then only if the water level is more than 61 centimeters (24 in.); only seven registered kayaks and canoes/hour (i.e., max 63 boats/day) are allowed if the water level is between 51 and 60 centimeters.

The Šumava NP Authority has improved marketing and interpretation of the regulation rules during the last five years. Information boards were installed along the river, and leaflets with rules and ecological reasons for regulation are distributed to visitors of the region. Šumava NP rangers cooperate with local companies renting boats and together with local tourist operators offer guided tours to explain the specifics of the river to visitors. Visitors have learned to use the

online registration system, and many of them are returning annually. They appreciate calming down and enjoying lower numbers of canoeists on their favorite section of the river. The latest monitoring of natural conditions, including damages to macrophytes and pearl mussel colonies, has indicated recovering of the sensitive ecosystem in the Upper Vltava River (Anonymous 2015). The Šumava NP Authority together with external researchers have recently started a new EU-


“Canoeists have accepted the regulation with on-line registration and use limits to allow threatened species and habitats to slowly regenerate”

funded project reinforcing the population of pearl mussels in the Upper Vltava River. Monitoring of underwater vegetation as an indicator of habitat quality, together with direct counting of mussels, artificial production of pearl mussel offspring, chemical analysis of water quality, and measurements supporting the local trout population, the most important host species, have been initiated.

Conclusions

Advances in modern technologies and recreation business activities, together with political interventions, threaten the unique and extremely sensitive habitats of the Upper Vltava River. New technology and demand also erode traditions and have brought some people to the area who respect neither nature nor other canoeists. It has been a challenge to mitigate negative effects on the ecosystem while allowing canoeing to continue in this very popular location. NGOs together with the Highest Administrative Court decision have forced Šumava NP Authority to launch a regulation system, which so far seems to have been successful. Canoeists have accepted the regulation with online registration and use limits to allow threatened species and habitats to slowly regenerate. The pearl mussel, as the iconic species, helps to protect many other species, habitats, and the whole unique ecosystem of the Upper Vltava River floodplain. We believe that the pearl mussels will survive, and the next generation of canoeists can enjoy this river together with them in a wilder setting.

Complex conservation measures and science have been applied to both protect a unique ecosystem with rare species and maintain good quality experiences for canoeists. The concept of sharing benefits between nature and humans should become an inspiration in other conservation areas as well. Activities aimed at conservation of the pearl mussel population reinforce protection of this wild river. This is very important not only for protection of this unique

ecosystem, but it also nicely exemplifies compatibility of biodiversity protection and wildness. One of the obstacles for larger implementation of wilderness designation in existing European protected areas is sometimes the perceived threat to biodiversity. Harmony between wild river canoeing and mussels on the Upper Vltava River suggests otherwise. 

ZDENKA KRENOVÁ is with the Global Change Research Institute of the Academy of Sciences of the Czech Republic; email: krenovaz@czechglobe.cz

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WILDERNESS DIGEST

Book Review:

John Shultis, Book Review Editor

THE NATURE OF SPECTACLE: ON IMAGES, MONEY, AND CONSERVING CAPITALISM

by Jim Igoe. 2017. University of Arizona Press. 176 pp. \$29.95 (pb).




The Nature of Spectacle: On Images, Money, and Conserving Capitalism by Jim Igoe

Jim Igoe's new book is the result of his long-term research in East Africa analyzing the relationship between protected areas and tourism and how it is mediated by the influence of capitalism and operationalized by the use of spectacular images. In previous works, the author discussed the role of images in shaping the imagery of Western society about nature and protected areas. In *The Nature of Spectacle*, Igoe continues to use a constructivist perspective to discuss how images have been producing the understanding about nature and how such initiatives "had harnessed marketing as a means for making and managing nature" (p. 30).

Building on Guy Debord's *Society of the Spectacle* (1995), he shows how not only documentary films but also Disney representations, NGO campaigns, and, most recently, social media photos and videos always rely on the same spectacular images to construct an idea of Africa and wilderness. However, as the author argues, these images were carefully selected as a way to promote tourism and generate more consumerism, reproducing the very same values of capitalism within which it was created and not contributing to achieve any real difference in nature conservation. Not only landscapes are subjected to exploitation by such images; Igoe suggests that the Maasai tribe in Tanzania was also subjected to this process. In that case, the results have complicated how the Maasai people identify themselves and how the government, NGOs, and outsiders view them.

The book has six chapters that examine "techniques and technologies of separation through which any nature can be produced ...: dissociation, control and commodification" (p. 7). The first chapters analyze how spectacular footage was used to construct an image of African countries and how the tourism industry works to meet the expectations that resulted from those images. He connects that idea with Marc Augé's concept of non-place to create what he called "circuits of control, consumption and contemplation" (p. 55). Chapter 4 argues that international congresses, such as the World Conservation Forum, also incorporate aspects of non-place, storytelling, and constructed images to guide the discussions and control debates, "gigantifying hegemonic visions of the future and managing competing ones" (p. 88). Before concluding the book, Chapter 5 discusses how conservation campaigns and NGOs continue to promote consumerism as a way to save nature, exploring people's guilt and offering redemption through the swipe of a credit card.

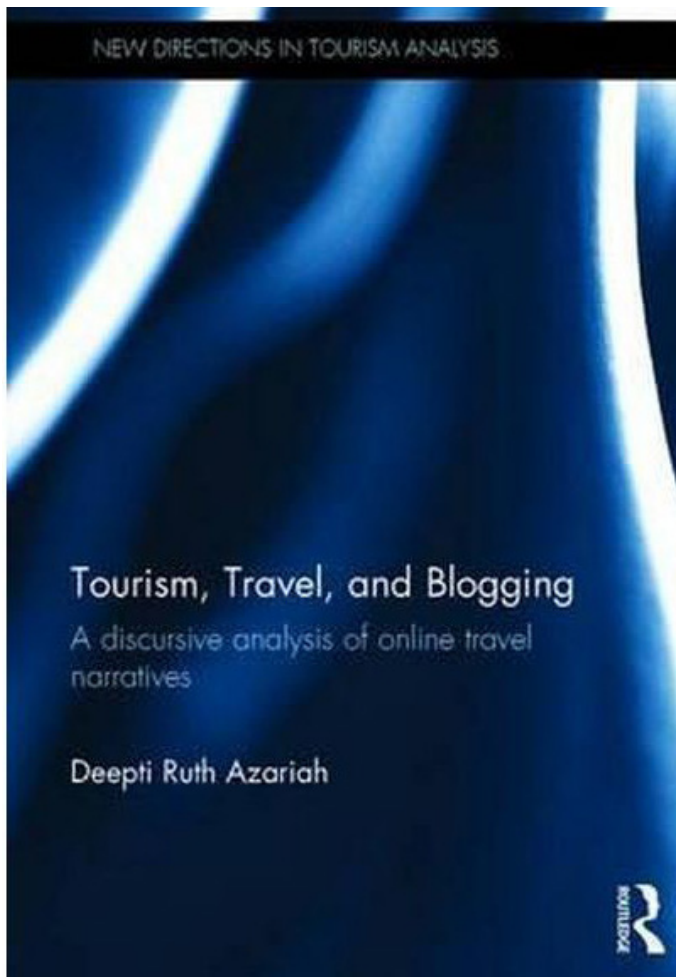
The book provides an excellent, critical reflection on the link between capitalism and conservation. However, in keeping with the author's critical analysis, it would have been welcome to see more reflexivity; scientists and researchers also provide a partial view of reality and use their arguments to produce representations. However, the author adds the concept of spectacle in an innovative, powerful way, basing his arguments on important academics (e.g., Marx, Gramsci, Tsing) and elements of pop culture. 

Reviewed by **FABRICIO MATHEUS**, PhD student in the Natural Resources and Environmental Management program at the University of Northern BC; email: matheus@unbc.ca

Book Review:

TOURISM, TRAVEL, AND BLOGGING: A DISCURSIVE ANALYSIS OF ONLINE TRAVEL NARRATIVES

by Deepti Azariah. 2017. Routledge. 180 pages. \$128.00 (hc)




Tourism, Travel, and Blogging: A Discursive Analysis of Online Travel Narratives by Deepti Azariah

As noted in the Carlson, Shultis, and Van Horn (2017) *IJW* article, "Technology in Wilderness," one current issue in wilderness management is the sharing of information to wilderness users via internet-based blogs. These blogs often provide "geotags" that allow readers to access the exact geographical coordinates, which can lead to increased use of the area. According to Azariah, a similar relationship is found in all travel-related blogs, noting a "dissonance lies in the fact that a place described as being off the beaten path by the blogger is made easily approachable or accessible.... In this sense, travel paves the way for tourism" (p. 165). As wilderness blogs can be considered a form of travel blog, wilderness managers may have much to learn from more closely examining the function and effects of blogs and bloggers.

Tourism, Travel, and Blogging provides a current, interdisciplinary review of the academic literature on blogging, focusing on the innate tension between being labeled a tourist versus a traveler. A similar division may be found among wilderness users, where "purists" are more authentic, accessing less visited areas and having more traditional experiences than other users. They, like travelers, are stoic heroes who contend with a chaotic landscape and endure uncomfortable, dangerous conditions. Tourists encounter manufactured, mass tourism destinations and experiences, with risks carefully minimized. Indeed, like wilderness blogs, the focus of most travel blogs is "on the experience of travelling rather than the destination to be reached" (p. 161), with the narration of travel being "adventurous, energetic and characteristically uncomfortable" (p. 83).

The authors use the concept of self-presentation as a lens, concluding that those "who use the themes and language of travel to position themselves as adventurous nomads publicise their texts and validate their position as experts on travel through the use of touristic narrative techniques" (pp. 160–161). The concepts of "heteroglossia (the presence of multiple discourses) and polyphony (multiple narrative voices)" (p. 3) are also used to describe the appearance, structure, content, and use of photographs of travel blogs. That is, various elements of a blog project different discourses and different voices that include traveler, tourist, expert, nomad, and adventurer. In addition, the information shared among the various social media platforms (e.g., Facebook, Instagram, Flickr, etc.) helps echo these different discourses and voices, as well as amplifying the self-presentation aspect of the blog; by "constructing 'controlled performances', individuals can ensure that they present only what they intend an audience to see" (p. 98).

Tourism, Travel, and Blogging provides a theoretically driven examination of both commercial and personal travel blogs using social science perspectives. Azariah provides a deep analysis using the existing literature on blogging and social media to highlight the tension between being perceived as a traveler versus a tourist in contemporary travel blogs. 

Reviewed by **JOHN SHULTIS**, book review editor of the *IJW* and associate professor at the University of Northern British Columbia; email: john.shultis@unbc.ca

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717 Poplar Avenue
Boulder, CO 80304 USA

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