The Diversity of Wilderness

Ecosystems Represented in the U.S. National Wilderness Preservation System

BY H. KEN CORDELL

Nature has fascinated me since childhood. Many a Sunday afternoon would find several of us boys headed for the woods to explore and ... be boys. The beginnings of the mountains of western North Carolina were at our back doors – out and up we would go. In deciding where to go to college and what to study, I followed this interest in nature into early adulthood. I selected North Carolina State University and majored in forestry. My senior paper was on wilderness, whereas most of the papers by classmates were about timber and growing pines faster. Later, while comajoring in forestry and economics, I did my dissertation on urban open land, including, of course, public parks. Throughout my career, I have observed and valued the public lands of this country, and have come to appreciate their importance more and more. My research has always had some wilderness content, as well as content about other protected public lands. One of my ongoing studies looked at Americans' values toward wilderness (designated wilderness), and there it became clear that others value protected lands as well.

Thus, it is not surprising that my current research, including my most recent venture, includes some aspect of wilderness. I am one of a national team of Forest Service scientists that has just completed a broad-scale assessment of the status and future of forest, range, and other natural resources. This is the Forest Service's Renewable Resources Planning Act Assessment of Forest and Range Lands (RPA). Working with this national RPA team, my assignment has been to look at trends and futures for recreation, protected lands, and associated population trends and futures. My research group, in Athens, Georgia, examined the degree to which ecosystems are represented within some of the most protected of U.S. federal lands. The focus was on national parks, national wildlife refuges, and the National Wilderness Preservation System (NWPS). The results of this research are being published by the Forest Service (Cordell et al., forthcoming). Presented in this article are just the results for the NWPS. It is important to step back now and then to examine various indicators of the importance of wilderness, including ecosystem representation from swamps (see Figure 1) to highest snow-covered peaks.

H. Ken Cordell. Photo by Babs McDonald.

Figure 1 – Okefenokee Swamp National Wildlife Refuge and Wilderness Area in the Subtropical Division, Georgia and Florida. Photograph by Ken Cordell.

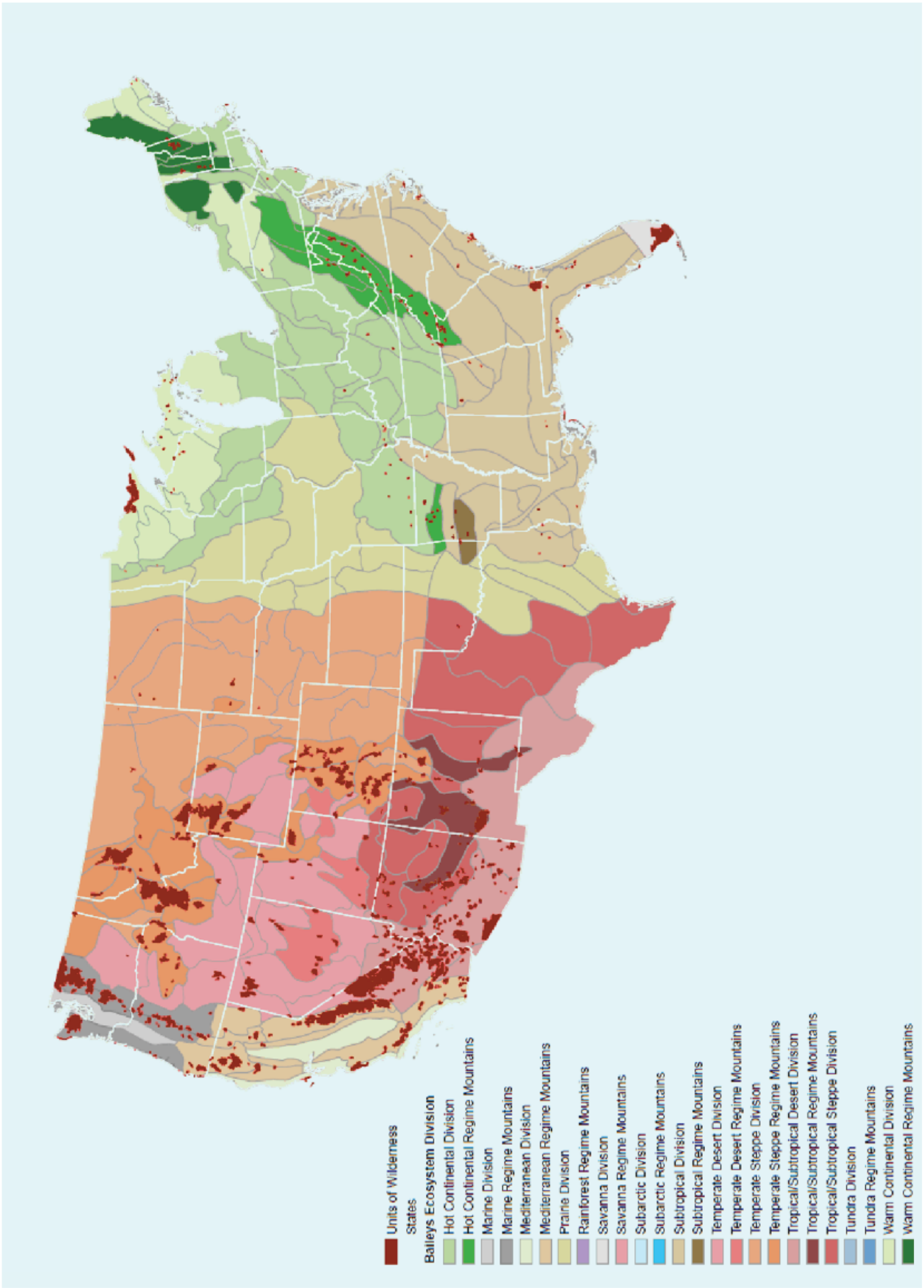

Figure 2 – National Wilderness Preservation System coverage of ecosystem division in the continental United States (excluding Alaska and Hawaii).

Some Previous Ecosystem Representation Research

Consideration of ecosystem representation as a criterion for designating federal lands as wilderness dates back to the Forest Service's second Roadless Area Review and Evaluation (RARE II) in 1978. Attention was given to evaluating the adequacy of ecosystem diversity of roadless areas using the Bailey-Kuchler ecosystem classification (USDA Forest Service 1978). For purposes of proposing roadless additions to the NWPS, sufficient representation was defined as there being a minimum of two separate areas (at least 400 ha/988 acres large) representing a particular type of ecosystem. In the 1980s, Davis (1989) undertook a review across the 261 major U.S. terrestrial ecosystems and found that 104 ecosystem types were not protected in the NWPS. He recommended that a representative sample of each major ecosystem should be included within the NWPS. Noss (1994, p. 235) reinforced this suggestion by stating that the first of four objectives under the heading of Ecological Goals is "to have represented all native ecosystem types across their natural range of variation in a system of protected areas." Underscoring the importance of protecting the diversity of ecosystems in the United States, the Nature Conservancy estimated that 85 to 90% of all plant and animal species in a region can be protected by ensuring ecosystem representation (Widen 2010).

A follow-up evaluation of ecosystem representation within the NWPS was reported by Loomis and Echohawk (1999; see also Loomis et al. 1999) in the late 1990s. Their analysis, done for the Forest Service 2000 RPA Assessment (Cordell et al. 1999), was one of the early studies to rely on GIS to overlay NWPS areas with Bailey's ecoregion boundary data to determine which ecoregions are represented. In their evaluation, an "ecoregion" was considered synonymous with the province class within the hierarchy of domains and divisions as defined by Bailey (1995). They found that 23 of the 35 provinces in the 48 coterminous states have less than 1% of their land area protected as wilderness. They also found that 7 of the 35 provinces had no land at all protected through wilderness designation.

There are varying degrees of ecosystem representation in the NWPS.

Much of that unprotected land was (and still is) privately owned, particularly in the Midwest and Southeast. However, a surprisingly large amount of the unprotected land was federal land in the Intermountain states of Nevada and Utah. Significant acreages of this land have now been added to the NWPS (Wilderness Institute 2009). A nationwide ecosystem gap analysis based on a national vegetation cover map that depicted the degree of representation of ecosystem analysis units (a precursor of ecosystem types) indicated that just 4% of the land area in 554 of the ecosystem units was conserved in the top two GAP protection classes (Dietz and Czech 2005). Cordell et al. (forthcoming) have followed up with a similar ecosystem representation study at the Bailey's Division level as part of the U.S. Forest Service 2010 RPA Assessment. This *IJW* feature article summarizes the more recent 2010 RPA Assessment.

Trends

By comparing the 1999 and forthcoming RPA studies, it is estimated that ecosystem protection in the NWPS in the 48 contiguous states has improved through the addition of several million acres since 1994 (Loomis and Echohawk 1999; Cordell et al. forthcoming), a total area increase of 18%. Across ecosystems, the Temperate Desert Division showed the largest increase as a proportion of the total NWPS land area, rising from 2 to more than 7% of the system between 1994 and 2009. However, trends reported here are approximate and not completely comparable because of differing data sources and GIS technologies. Mountainous areas in the Temperate Desert Division experienced the second largest increase in percentage representation in the NWPS (among the contiguous states), more than doubling from 1.1% in 1994 to 2.3% in 2009. The Temperate Desert Mountains Division also more than doubled its share of total land area in wilderness, growing from less than 2% to more than 4%. Other divisions posting more than a 1% gain were the Mediterranean Mountains, Temperate Desert, and Tropical/Subtropical Desert.

The Data and the Analysis

In this recent look at ecosystem representation in wilderness (Cordell et al. forthcoming), a GIS analysis was applied using digital boundary data for estimating land area in different ecosystem types (at division level [Bailey 2009]). The resulting map showing how lands in the NWPS overlay ecosystem boundaries is presented as Figure 2 and depicts the spatial relationships between wilderness and ecosystems across the contiguous 48 states. Including Alaska and Hawaii, we estimated that 24 ecosystem divisions across the United States are represented in the Wilderness System. Eleven of these are mountain divisions. To conserve map scale, Alaska and Hawaii are not shown in Figure 2,

but the ecosystem divisions and wilderness in these two states are included in the nationwide estimates in Table 1.

Table 1 reports the degree to which different ecosystem types are protected by their inclusion in the NWPS. The estimated ecosystem acreages within wilderness boundaries by Bailey's Division are national and, unlike Figure 2, do include Alaska and Hawaii. To add perspective, not only are estimates of each represented division's acreages shown (second column of numbers), also shown are total surface areas across the United States by division, percentage of the NWPS in each Bailey Division, and percentage of each division within wilderness boundaries.

Because wilderness areas are designated from already existing federal lands, the NWPS table and map in the source RPA publication (Cordell et al. forthcoming) somewhat overlap with maps and tables covering the National Park and National Wildlife Refuge Systems. Wilderness also includes designated national forest and Bureau of Land Management lands. The designated wilderness lands of all four agencies are included in the NWPS table.

As defined in the National Atlas (www.nationalatlas.gov), ecoregions are large-scale areas that share common climatic and vegetation characteristics. The four-level hierarchy shown in the National Atlas originated from (Bailey 1976) and continues to be refined by Robert Bailey (2009). The broadest

Table 1 – Acreage of U.S. surface area by ecosystem division, acres of the National Wilderness Preservation System in each division, percentage of division protected by wilderness areas, and percentage of the National Wilderness Preservation System area in each division.

Domain and Ecosystem Division	Total surface millions of acres in ecosystem division	National Wilderness Area millions of acres	Percentage of division in Wilderness Areas	Percentage of National Wilderness acres in division
DRY DOMAIN				
Temperate Desert Division	172.2	3.8	2.23	3.51
Temperate Desert Regime Mountains	27.9	1.2	4.23	1.08
Temperate Steppe Division	272.1	0.5	0.20	0.49
Temperate Steppe Regime Mountains	144.6	15.3	10.59	14.02
Tropical/Subtropical Desert Division	110.6	11.3	10.19	10.32
Tropical/Subtropical Regime Mountains	32.1	1.3	4.07	1.20
Tropical/Subtropical Steppe Division	163.0	1.4	0.84	1.25
HUMID TEMPERATE DOMAIN				
Hot Continental Division	239.1	0.2	0.08	0.18
Hot Continental Regime Mountains	47.7	0.6	1.35	0.59
Marine Division	9.3	0.05	0.57	0.05
Marine Regime Mountains	73.4	18.8	25.69	17.26
Mediterranean Division	21.7	0.3	1.43	0.28
Mediterranean Regime Mountains	59.8	7.4	12.38	6.77
Prairie Division	191.0	0.002	<0.01	<0.01
Subtropical Division	263.0	0.7	0.26	0.63
Subtropical Regime Mountains	5.6	0.05	0.85	0.04
Warm Continental Division	93.9	1.4	1.49	1.28
Warm Continental Regime Mountains	28.0	0.2	0.88	0.23
HUMID TROPICAL DOMAIN				
Rainforest Regime Mountains	4.0	0.2	3.91	0.14
Savanna Division	5.0	0.8	15.24	0.70
POLAR DOMAIN				
Subarctic Division	53.8	2.0	3.74	1.84
Subarctic Regime Mountains	118.5	12.4	10.44	11.33
Tundra Division	55.7	2.5	4.51	2.30
Tundra Regime Mountains	99.9	26.8	26.80	24.50
National Totals	2,292.0	109.2	——	100.00

Source: Ecosystem divisions based on Robert G. Bailey, 1995. Description of the ecoregions of the United States. 2nd ed., rev. and expanded. Misc. Publ. No. 1391, Washington DC: USDA Forest Service.

classification is the domain, which Bailey has described as a grouping of landscapes with similar climates, but that are differentiated by precipitation and temperature. There are four ecosystem domains across the landmass of the United States: polar, humid temperate, dry, and humid tropical. Domains are made up of divisions (the level of this article's analysis) that differentiate climates within domains that have varying precipitation levels and temperature profiles. Divisions are subdivided into provinces based on vegetation or other natural land covers. Mountainous provinces are differentiated by elevation, which is one of the primary determinants of vegetation and other natural cover (see Figure 3). The finest-grained level of ecosystem classification is a section, which is a subdivision of provinces and is based primarily on terrain.

The data and spatial analysis for generating the ecosystem maps, acreages, and percentages of area relied on both wilderness and Bailey's division level boundary data. Decimal degree boundary data for Bailey's Ecosystem Divisions (BED) (Bailey 1995) were downloaded from the U.S. Geological Survey website at nationalatlas.gov/atlasftp.html#ecoregp. ESRI ArcMap 9.2 was used to calculate the total land area in decimal-degree units covered by each division. The general approach was to calculate total decimal degrees of land area for each county in the United States. Next, the ESRI tool, Intersect Analysis, was used to find the BED decimal degree area for each BED within each county. Intersect computes the geometric intersection of features or portions of features. The proportion of land area within each BED represented in each respective county was then multiplied by the square-mile total land area provided by ESRI for each county. This product (square miles of ecoregion division) was multiplied by 640 (acres per square mile) to derive acres of BED within each county. For Table 1, acres were then summed across counties for each division and then across divisions for a national total.

Figure 3 –The Raggeds Wilderness in Colorado in the Temperate Steppe Regime Mountains Division. Photograph by Ken Cordell.

Wilderness boundary data were downloaded from www.wilderness.net/index.cfm?fuse=NWPS&sec=geography. The ESRI tool, Intersect, was again used, this time to lay wilderness area boundaries over BED boundaries for each county. This enabled computation of proportions of wilderness within each BED by county. Next, the ESRI tool, Calculate, was used to find the decimal degree area of wilderness within the BED by county. Transferring these decimal degree data to an Excel spreadsheet, the proportion of total county area in designated wilderness was multiplied by county total acreage to estimate number of acres of wilderness in each BED. Acres were then summed nationally.

Wilderness Acres by Bailey's Ecosystem Division

Figure 2 and Table 1 report ecosystem representation (at BED level) across the National Wilderness Preservation System. As we know, the NWPS is found mostly in the western regions of the United States, particularly in Alaska. Alaska alone contains more than 52% of the NWPS, most of which is under the management of the National Park Service and U.S. Fish and Wildlife Service. Including Alaska, about 96% of the NWPS is located in the West. Without Alaska, the proportion drops only slightly to 92%.

In terms of percentage of the National Wilderness Preservation System among BEDs (Table 1), the greatest portions are Tundra Regime and Subarctic Mountains in Alaska; Marine Regime Mountains in Washington, Oregon, and southeast Alaska; and Temperate Steppe Mountains, mostly in Montana, Idaho, Wyoming, and Utah. Also represented is the Tropical/Subtropical

Figure 4 – Southernmost part of the United States, the south reaches of the Big Island, Hawaii, at sunset in the Humid Tropical Domain. Photograph by Ken Cordell.

Desert Division of the Southwest. In terms of the percentage of BEDs designated as wilderness, Alaskan Tundra and Subarctic Divisions, Marine Mountains, Temperate Steppe Mountains and Tropical Desert are among the highest. As a percentage of BEDs, significant percentages of the Savanna of southern Florida and the Mediterranean Mountains of California can be seen (Figure 2). Some of the divisions not well represented include the Temperate Steppe, Tropical/Subtropical Steppe, Hot Continental, Marine (non-mountainous), Prairie, Subtropical, and Warm Continental Divisions.

Observations

Preserving and even restoring naturally functioning ecosystems is important, if not indispensible. A diversity of natural ecosystems is valuable in many ways. Many wildlife species require a diversity of habitat, whereas others are restricted to very specific habitats. Plants also require varying degrees of diversity, and are largely responsible for habitat diversity in the first place.

The broad diversity of ecosystems that exists also makes up the diversity of natural scenery of the United States (and world). It is this scenery and the recreational opportunities it represents that draw many people to set up residence near, or within natural areas. As more people set up such residences, the natural areas being settled soon cease to be natural and evolve into developed land (residential, transportation, commercial, industrial, etc.). Herein lies a significant challenge.

From the swamplands of the Okefenokee on the U.S. East Coast, to the southernmost extremes of Hawaii (see Figure 4), the challenge of ecosystem protection is huge, if not daunting. The sheer magnitude of housing development alone across the U.S. landscape over the past few decades, especially the last two, is a clear indicator of the challenge to protecting nature.

Designating federal land as wilderness has been a much-employed tool for natural land protection. For all who have used and viewed and read about wilderness, it is quite clear how special area designation is. But the dilemma with wilderness is that it is a designation of federal lands that already have varying levels of protection. There are many more millions of acres of private lands without protection than there are federal, or federal plus state lands with protection. The current recession has slowed the pace of land development, residential development especially. But for how long?

As Figure 2 and Table 1 have shown, there are varying degrees of ecosystem representation in the NWPS. In fact, some ecosystem types are not represented at all. Although wilderness designation is not the only means of protecting natural land, it is one of the more important ones. Unless federal law is changed, the NWPS, National Park System, and National Wildlife Refuge System provide the best protection and stand a good chance of being sustained.

In the future, not only land development, but also climate change threatens wilderness and other natural areas (Cole 2008). Climate change can exacerbate threats to the natural functioning of areas, such as the threats from invasive species and habitat fragmentation. As Cole (2008) notes, wilderness provides many ecosystem services, such as cleaner air, wildlife, and water. But these services are highly vulnerable to climate change. And because biological composition of ecosystems is in large part determined by climate, it is possible that some ecosystems may disappear entirely, whether or not land development occurs.

On the hopeful side, there has been growing interest in protection of both public and private land and water

Continued on page 25

Symbols, Stories, and Ceremonies. New York: Penguin Group.
Leiserowitz, A. 2010. Public understanding of climate change. National Research Council. Available at www7.nationalacademics.org/hdgc/Session_Moderator_Public%20Understanding_of_Climate_change_Anthony_Leiserowitz.pdf.
Magzul, L. 2009. The Blood Tribe: Adapting to climate change. *Prairie Forum* 34(1): 289–309.
McDonald, W. H. 1973. *Creation Tales from the Salish*. Montana Indian Publication Fund. Billings, MT: Montana Reading Publications.
Obama, B. 2009. Memorandum for the heads of executive departments and agencies. Subject: Tribal consultation. Retrieved February 13, 2012, from www.whitehouse.gov/the-press-office/memorandum-tribal-consultation-signed-president.
Patterson, M. E., A. E. Watson, D. R. Williams, and J. R. Roggenbuck. 1998. An hermeneutic approach to studying the nature of wilderness experiences. *Journal of Leisure Research* 30(4): 423–452.
Salmon, E. 2000. Kincentric ecology: Indigenous perceptions of the human-nature relationship. *Ecological Applications* 10(5): 1327–1332.
Turner, N. J., M. B. Ignace, and R. Ignace. 2000. Traditional ecological knowledge and wisdom of aboriginal peoples in British Columbia. *Ecological Applications* 10(5): 1275–1287.
Turner, N. J., and H. Clifton. 2009. "It's so different today": Climate change and indigenous lifeways in British Columbia, Canada. *Global Environmental Change* 19: 180–190.
Watson, A., L. Alessa, and B. Glaspell. 2003. The relationship between traditional ecological knowledge, evolving cultures, and wilderness protection in the circumpolar north. *Conservation Ecology* 8(1): 2–21.
Watson, A. E. 2004. Human relationships with wilderness: The fundamental definition of wilderness character. *International Journal of Wilderness* 10(3): 4–7.
Watson, A. E. 2011. The role of wilderness protection and societal engagement as indicators of well-being: An examination of change at the Boundary Waters Canoe Area Wilderness. *Social Indicators Research*, DOI 10.1007/s11205-011-9947.
Watson, A., B. Glaspell, N. Christensen, P. Lachapelle, V. Sahanatien, and F. Gertsch. 2007. Giving voice to wildlands visitors: Selecting indicators to protect and sustain experiences in the eastern Arctic of Nunavut. *Environmental Management* 40: 880–888.
Watson, A., R. Matt, K. Knotek, D. R. Williams, and L. Yung. 2011. Traditional wisdom: Protecting relationships with wilderness as a cultural landscape. *Ecology and Society* 16(1): 36.
Weber, E. 2006. Experience-Based and Description-Based Perceptions of Long-Term Risk: Why Global Warming does not Scare us (Yet). *Climate Change* 77: 103-120.
Whiting, A. 2004. The relationship between Qikiktagrugmiut (Kotzebue tribal members) and the Western Arctic Parklands, Alaska, United States. *International Journal of Wilderness* 10(2): 28–31, 8.
Wildcat, D. R. 2009. *Red Alert: Saving the planet with indigenous knowledge.* Golden, CO: Fulcrum Publishing.

ALAN WATSON is a research social scientist at the Aldo Leopold Wilderness Research Institute, USDA Forest Service, Rocky Mountain Research Station, 790 E. Beckwith Ave., Missoula, MT 59801, USA; email: awatson@fs.fed.us.

LINDA MOON STUMPFF is a faculty member at The Evergreen State College, 2700 Evergreen Parkway, Lab One, Olympia, Washington 98505, USA; email: stumpffL@evergreen.edu.

JENNIFER MEIDINGER is a University of Montana Climate Change intern at the USDA Forest Service, Rocky Mountain Research Station, 790 E. Beckwith Ave., Missoula, MT 59801, USA.

Continued from THE DIVERSITY OF WILDERNESS, page 20

resources. To provide an inventory of these resources, the Protected Areas Database program for the United States is being improved to help in describing ownership and protection status across the country. This effort is important because the United States is losing about 2 million acres (809,715 ha) of forest, farm, and other open space each year. Pushing against this tide of open land loss, there is a rise in the nongovernmental land trust movement and the land protection that results. In addition, between 1998 and 2005, state governments conserved 8.6 million acres (3.48 million ha) of land and spent $13 billion for its protection (Cordell et al. forthcoming). The ecosystem protection challenge is large, but perhaps some of this rising interest in protection of natural lands will be increasingly effective. Perhaps we will see continued support for more wilderness designation. I, for one, am hopeful this will be the case.

Acknowledgments

Shela Mou, Forest Service, Athens, Georgia, provided data acquisition, ArcGIS analysis, and mapping. Carter Betz, Forest Service, Athens, Georgia, provided data validation and review. Appreciation is extended to the blind reviewers for the source RPA publication on which this article is based.

References

Bailey, Robert G. 1976. Ecoregions of the United States (map). Ogden, UT: United States Forest Service, Intermountain Region. 1:7,500.00 colored.
———. 1995. Description of the ecoregions of the United States. Retrieved November 8, 2011, from www.fs.fed.us/land/ecosysmgmt/index.html.
———. 2009. *Ecosystem Geography: From Ecoregions to Sites*. New York: Springer Publishing.
Cole, David N. 2008. Wilderness, protected areas and climate change. May 20. Retrieved October 26, 2011, from www.fs.fed.us/ccrc/topics/wilderness.shtml.
Cordell, H. Ken, Carter J. Betz, J. M. Bowker, Donald B. K. English, Shela H. Mou, John C. Bergstrom, R. Jeff Teasley, Michael A. Tarrant, and John Loomis. 1999. *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends*. Champaign, IL: Sagamore Publishing.
Cordell, H. Ken, Carter J. Betz, and Stanley J. Zarnoch. (Forthcoming). Recreation and protected land resources in the United States: A technical document supporting the Forest Service 2010 RPA Assessment.

Continued on page 38

By providing guidance and resources, Wilderness50 promotes consistency, cooperation, and partnership and eliminates duplication in 50th anniversary planning and programming. As a result, 2014 will feature creative, highly participatory, and diverse events, including (but not limited to) community walks for wilderness; stewardship projects; classroom and public wilderness educational programs; concerts; fairs; art and photography contests; lectures; new books and magazine articles; museum, airport, and visitor center exhibits; television and movie productions; a national 50th anniversary website; and many other ways to learn about wilderness and the anniversary online.

Special attention is being placed on engaging youth and nonwilderness organizations and communities who care about nature, but have not been previously involved in wilderness advocacy or use. Wilderness50 is also communicating with the international wilderness community in an effort to simultaneously honor the many successes that have been achieved abroad in wildlands designation and stewardship.

Getting Involved in the 50th Celebration

Readers who desire formal involvement should consider participating in planning efforts. Wilderness50 still seeks to recruit participants of various planning committees to help plan nationwide activities in 2014. Readers interested in national-level planning should contact the authors for more information on how to join a 50th working committee. Those interested in local or state-specific celebration planning can contact the authors to be connected with existing coalitions or people who are already organizing events at local levels. For Wilderness50's "50th Anniversary Toolbox," which provides resources and ideas for local events and resources for planning and implementing 50th programming and activities, go to www.wilderness.net/50th/.

Conclusion

The 1964 Wilderness Act represented a fundamental cultural shift from a need to conquer nature to the need to preserve it, and it is a modern philosophical expression of the human need to find in nature spiritual solace and refuge from daily-life stress. Over the past 50 years, and as a result of America's continuing support for wilderness, Congress has added nearly 100 million acres (over 40 million ha) to this unique land preservation system. The remarkable 50-year achievement of wilderness stewardship will be celebrated during 2014 throughout the United States and we – and the entire Wilderness50 team – invite each and every reader to join us in this milestone event!

GREGORY HANSEN spent his entire Forest Service career in wilderness management and is retired from the agency's Washington, D.C., office. He instructs, writes, and consults for the Arthur Carhart National Wilderness Training Center and Southwest Youth Corps, is the program committee chair for the Society for Wilderness Stewardship, and is serving as a 50th Anniversary Wilderness Act Celebration national co-chair (federal agencies); phone: (602) 237-2021; email: redroadone@aol.com.

VICKY HOOVER has been a Sierra Club wilderness activist for more than 25 years. She currently chairs the Sierra Club's California/Nevada Wilderness Committee, is active in various additional initiatives to enhance public lands protection and education relating to the importance of our wildlands heritage, and is a 50th Anniversary Wilderness Act Celebration national co-chair (NGOs); phone: (415) 977-5527; email: vicky.hoover@sierraclub.org.

Continued from pg 25

Davis, G. D. 1989. Preservation of natural diversity: The role of ecosystem representation within wilderness. In *Wilderness Benchmark 1988: Proceedings of the National Wilderness Colloquium*, ed. Helen R. Freilich (pp. 76–82). USDA Forest Service General Technical Report SE-51. Asheville, NC: USDA Forest Service, Southeastern Forest Experiment Station.

Dietz, R. W., and B. Czech. 2005. Conservation deficits for the continental United States: An ecosystem gap analysis. *Conservation Biology* 19(5): 1478–1487.

Huber, P. R., S. E. Greco, and J. H. Thorne. 2010. Boundaries make a difference: The effects of spatial and temporal parameters on conservation planning. *The Professional Geographer* 62(3): 409–425.

Loomis. J., and J. C. Echohawk. 1999. Using GIS to identify under-represented ecosystems in the National Wilderness Preservation System in the USA. *Environmental Conservation* 26(1): 53–58.

Loomis, J., K. Bonetti, and J. C. Echohawk. 1999. Demand for and supply of wilderness. In *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends*, ed. H. K. Cordell (pp. 351–376). Champaign, IL: Sagamore Publishing.

Noss, R. F. 1994. The Wildlands project: Land conservation strategy. In *Environmental Policy and Biodiversity*, ed. Edward R. Grumbine. Washington, DC: Island Press. pp. 233-266.

U.S. Department of Agriculture (USDA) Forest Service. 1978. RARE II draft environmental impact statement 78-04, roadless area review and evaluation. Washington, DC: Government Printing Office.

Widen, J. 2010. Testimony on H.R. 3914, San Juan Mountains Wilderness Act. Presented to the House Committee on Natural Resources Subcommittee on National Parks, Forests and Public Lands, January 21, 2010. Retrieved October 20, 2011, from wilderness.org/files/Testimony-Widen-San-Juan-Wilderness-20100121.pdf.

Wilderness Institute. 2009. National Wilderness Preservation System Dataset. University of Montana. Retrieved July 6, 2009, from wilderness.net/index.cfm?fuse=NWPS&sec=advSearch.

H. KEN CORDELL is a senior scientist with the USDA Forest Service, Southern Research Station, located in Athens, Georgia; email: kcordell@fs.fed.us.