

## IMPORTANCE OF LARGE TREES AND MATURE/OLD-GROWTH FORESTS OF ALL TYPES TO HELP STEM THE BIODIVERSITY AND CLIMATE CRISES

*“As a researcher of old-growth forests and old trees I am strongly convinced that every possible old tree should be preserved if possible. We have lost too many of those living witnesses of the past. Old trees and old-growth forests are the "island" containing the genes of resilience, which is increasingly important in these times of climate extremes and forecasts of warming and more extreme climate.”*  
Dr. M Panayotov, University of Forestry, Bulgaria

Submitted to [www.regulations.gov](http://www.regulations.gov) regarding Advanced Notice for Proposed Rulemaking (36CFR Part 200)

As scientists with expertise in forest ecosystems, climate change, and natural resources, we fully support global efforts to protect large trees and old forests (mature and old growth) from logging along with restoring logged forests as natural climate solutions<sup>1</sup>. In response to President Joe Biden’s [Executive Order 14072](#) on forests and climate change, federal agencies are in the process of formulating conservation policies for large trees and old forests in the United States via national rulemaking. We urge conservation groups, decision makers, and land managers to maximize protection of **large trees of all species as well as mature and old-growth forests** as the nation’s most effective “[climate-smart forestry](#)” approach. Simply put, there is no substitute for their outsized role, and no ecological reason to log large trees and old forests. Many of the current and proposed forest management actions in the US are inconsistent with climate goals and global efforts to protect 30% to 50% of lands for myriad ecosystem and biodiversity benefits<sup>2</sup>.

Large, old trees are among the biggest terrestrial organisms on the planet but are on the decline globally mainly due to logging and development<sup>3</sup>. These trees and old forests that harbor them are the most critical terrestrial sinks and easily scalable climate mitigation opportunities at our disposal. They are also essential to soil integrity and complexity, water circulation, stable microclimates, nutrient exchange, and wildlife habitat, regardless of whether the trees are alive or dead. Protecting them enables irreplaceable ecosystem services and biodiversity benefits, including habitat for hundreds of imperiled species<sup>4</sup>. Importantly, while large trees make up just 1% (globally)<sup>5</sup> to 3% (eastern Oregon)<sup>6</sup> of the overall tree density in older forests, they contain 50% to 42%, respectively, of the above ground carbon in forests. As they age, large trees and old forests continue to sequester and accumulate massive amounts of atmospheric carbon in biomass and soils<sup>7</sup>. From a climate and biodiversity perspective, it is essential not to log the large trees and old forests. Broad-scale thinning (e.g., ecoregions, regions) to reduce fire risk or severity results in more carbon emissions than fire, creating a long-term carbon deficit that undermines climate goals<sup>8</sup>.

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<sup>1</sup>Lindenmayer et al. 2012. Global decline in large old trees. *Science* Vol 338:1305-1306. 10.1126/science.1231070. Mackey et al. 2015. Policy options for the world’s primary forests in multilateral environmental agreements *Conservation Letters* 8:139-147 doi: 10.1111/conl.12120. Griscom et al. 2017. Natural climate solutions. *PNAS* 114 pnas.org/cgi/doi/10.1073/pnas.1710465114. Moomaw et al. 2019. Intact forests in the United States: proforestation mitigates climate change and serves the greatest good. *Frontiers in Forests and Global Change* <https://doi.org/10.3389/ffgc.2019.00027>. Law et al. 2022. Creating strategic reserves to protect forest carbon and reduce biodiversity losses in the United States. *Land* 2022, 11, 721. <https://doi.org/10.3390/land11050721>. DellaSala et al. 2022. Mature and old-growth forests contribute to large-scale conservation targets in the conterminous United States. *Frontiers in Forests and Global Change* <https://doi.org/10.3389/ffgc.2022.979528>. Faison et al. 2023. The importance of natural forest stewardship in adaptation planning in the United States. *Conservation Science and Practice* 2023:e12935. <https://doi.org/10.1111/csp2.12935>.

<sup>2</sup>Law, B.E. et al. 2022. *Ibid*

<sup>3</sup>Lindenmayer et al. 2012. *Ibid*. Lutz et al 2018. Global importance of large diameter trees. *Global Ecol Biogeogr*:1-16.

<sup>4</sup>Brandt et al. 2014. Multi-functionality and biodiversity: ecosystem services in temperate rainforests of the Pacific Northwest, USA. *Biol. Cons.* 169:362-71. <http://dx.doi.org/10.1016/j.biocon.2013.12.003>. Buotte et al. 2020. Carbon sequestration and biodiversity co-benefits of preserving forests in the western United States. *Ecol. Applic.* 30(2), 2020, e02039. Morgan et al. 2021. Capturing multiple forest ecosystem services for just benefit sharing. The basket of benefits approach. *Ecos. Services* <https://doi.org/10.1016/j.ecoser.2022.10142>. Law et al. 2022. *Ibid*. DellaSala et al. 2022. *Ibid*.

<sup>5</sup>Lutz et al. 2018. *Ibid*

<sup>6</sup>Mildrexler et al. 2020. *Ibid*

<sup>7</sup>Stephenson et al. 2014. *Ibid*. Birdsey et al. 2023. Assessing carbon stocks and accumulation of mature forests and large trees in U.S. federal forests. *Frontiers in Forests and Global Change* <https://doi.org/10.3389/ffgc.2022.1074508>.

<sup>8</sup>Law et al. 2022. *Ibid*

In the US, most large trees and old forests were eliminated decades ago following European colonization and expansion. What remains is mostly on federal lands<sup>9</sup> that are vital to restoring forest ecosystems from the coastal rainforests of Alaska and the endemic *Sequoia giganteum* groves of California to mixed hardwoods, pines, oaks, cypress and many other forest types across the country. We note this includes protecting forests affected by insect outbreaks and characterized by **frequent and infrequent fire return intervals and mixed fire severities**. Notably, large trees and old forests tend to be the most fire and drought resistant ecosystem elements, serving as critically important fire<sup>10</sup> and climate refugia<sup>11</sup>. They also contain unique genetic adaptations for conferring resilience to natural disturbances and climate change<sup>12</sup>. Increased forest protections would not result in greater fire risks<sup>13</sup> but would instead allow forest managers to focus limited resources on previously logged and degraded forests that are more likely to burn and be located near residences. However, large trees have often been inappropriately targeted in “fuel reduction” by land managers,<sup>14</sup> despite myriad benefits and relative fire resistance and resilience.

In some regions (e.g., eastern Cascades of Oregon/Washington, Appalachia, northeast, Great Lakes), large tree densities and older forests have increased due to restrictions on logging and fire suppression policies but still remain far below historical levels due to logging writ-large<sup>15</sup>. Concerns have been raised by federal managers in eastern hardwood forests that despite the rarity of old forests in the landscape, they are replacing young forests and now need intensive logging to reset succession even though such practices do not mimic complex early seral forests generated by natural disturbances<sup>16</sup>. Moreover, trees in eastern Oregon’s Cascades have increased in density and size due largely to fire suppression, potentially competing for limited resources. However, large trees in these forests now represent the remaining old-forest cohort that have developed fire resistant properties overtime by dropping lower branches and increasing bark thickness. A recent study showed that despite a claim that there is substantial encroachment and competition from large grand fir (*Abies grandis*) on ponderosa pine (*Pinus ponderosa*) and western larch (*Larix occidentalis*) in six National Forests in eastern Oregon, large pine and large fir are found together on only 8% of all plots (n=1616) sampled, while large grand fir and large larch co-mingled on only 4%. In other words, large pines are by far the most common tree and infrequently co-mingle with large grand firs at the plot scale. **There is no ecological reason to remove large trees of any species**<sup>17</sup>.

As federal agencies develop older forest conservation policies, we note that the recent [IPCC AR6 report](#) states, in relation to natural climate solutions, “...protection of forest ecosystems is the highest priority for reducing GHG emissions (Moomaw et al. 2019) and restoration may not always be practical.” Protecting irreplaceable natural systems from logging is therefore the first step. The IPCC report also noted that maintaining the resilience of biodiversity and ecosystem services at a global scale is “fundamental” to climate mitigation and adaptation, requiring “effective and equitable conservation of approximately 30 to 50% of Earth’s land, freshwater and ocean areas, including current near-natural ecosystems”<sup>18</sup>.

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<sup>9</sup> DellaSala et al. 2022. Ibid.

<sup>10</sup>Leismeister et al. 2019. Mixed-severity wildfire and habitat of an old-forest obligate. *Ecosphere* 10(4) Article e02696. Leismeister et al. Northern spotted owl nesting forests as fire refugia: a 30-year synthesis of large wildfires. *Fire Ecology* 17 <https://doi.org/10.1186/s42408-021-00118-z>. Law et al. 2022. Ibid. Mildrexler et al. 2023. Protect large trees for climate mitigation, biodiversity, and forest resilience. *Conservation Science and Practice* DOI: 10.1111/csp2.12944.

<sup>11</sup>Frey et al 2016. Spatial models reveal the microclimatic buffering capacity of old-growth forests. *Sci Adv* 2016:e1501392. 9 pp. doi: 10.1126/sciadv.1501392. Law et al. 2022. Ibid.

<sup>12</sup>Faison et al. 2023. Ibid.

<sup>13</sup>Bradley et al. 2016. Does increased forest protection correspond to higher fire severity in frequent-fire forests of the western United States? *Ecosphere* 7:Article e01492.

<sup>14</sup>DellaSala et al. 2022. Have western USA fire suppression and megafire active management approaches become a contemporary Sisyphus? *Biol. Cons.* <https://doi.org/10.1016/j.biocon.2022.109499>

<sup>15</sup>Mildrexler et al. 2020. Ibid. Kellett et al. 2023. Forest-clearing to create early-successional habitats: questionable benefits, significant costs. *Frontiers in Forests and Global Change* <https://doi.org/10.3389/ffgc.2022.1073677>. Mildrexler et al. 2023. Ibid.

<sup>16</sup>Swanson et al. 2010. The forgotten stage of forest succession: early-successional ecosystems on forest sites. *Front. Ecol. Environ* doi:10.1890/090157. Kellett et al. 2023. Ibid.

<sup>17</sup>Mildrexler et al. 2023. Ibid.

<sup>18</sup>Law et al. 2022. Ibid.

The White House recently released its “[roadmap to nature-based solutions](#),” noting the importance of green infrastructure and other natural climate solutions. We submit that this policy must embrace the protection of large trees and old forests **of all types and species** as one of the nation’s most important “nature-based solutions.” Such an effort in rulemaking would send a clear message to the global community that the United States is making a serious effort to enlist natural climate solutions, while reducing its emissions across all sectors, including forestry. Protecting large trees and old forests in national rulemaking would also comply with the Paris Climate Agreement (Article 5.1), the IPCC AR6 Report, demonstrate steps toward the President’s [Executive Order 14008](#) to protect 30% of all lands and waters by 2030, and showcase the President’s national commitment to the [Glasgow Forest Pledge](#) to end global forest degradation and deforestation.

Sincerely (affiliations for identification purposes only),

*35 Lead Signatures*

Richard Birdsey, Ph.D.  
Senior Scientist  
Woodwell Climate Research Center  
Falmouth, MA

William R. Moomam, Ph.D.  
IPCC Scientist  
Tufts University, Woodwell Climate  
Falmouth, MA

William H. Schlesinger, Ph.D.  
Dean Emeritus  
Nicholas School of the Environment, Duke University  
Durham, NC

Tom Veblen, Ph.D.  
Distinguished Professor Emeritus  
University of Colorado  
Boulder, CO

Wayne Walker, Ph.D.  
Chief Scientific Officer/ Senior Scientist  
Woodwell Climate Research Center  
Falmouth, MA

Norman Christensen, Ph.D.  
Professor Emeritus and Founding Dean  
Nicholas School of Environment, Duke University  
Durham, NC

Reed Noss, Ph.D.  
Florida Institute for Conservation Science Garden  
University of Florida  
Gainesville, FL

Thomas L. Fleischner, Ph.D.  
Director Emeritus, Natural History Institute;  
Faculty Emeritus, Prescott College  
Prescott, AZ

Donald M. Waller, Ph.D.  
John Curtis Professor Botany (retired)  
University of Wisconsin  
Madison, WI

Beverly Law, Ph.D.  
IPCC Scientist; Professor Emeritus Global Change  
Biology  
Oregon State University  
Corvallis, OR

Dominick A. DellaSala, Ph.D.  
Chief Scientist  
Wild Heritage, A Project of Earth Island Institute  
Berkeley, CA

Brendan Mackey, Ph.D.  
IPCC AR6 Scientist  
Griffith Climate Action Beacon, Griffith University  
Gold Coast, Queensland, Australia

William J. Ripple, Ph.D.  
Distinguished Ecology  
Oregon State University  
Corvallis, OR

Tania Schoennagel, Ph.D.  
Research Scientist  
Department of Geography, University of Colorado  
Boulder, CO

Cathy Whitlock, Ph.D.  
Regents Professor Emerita  
Montana State University  
Bozeman, MT

Peter H. Raven, Ph.D.  
President Emeritus  
Missouri Botanical Garden  
St. Louis, MO

Susan A. Masino, Ph.D.  
Veron D. Roosa Professor Applied Science  
Trinity College  
Hartford, CT

Stuart Pimm, Ph.D.  
Doris Duke Professor Conservation  
Nicholas School of the Environment, Duke University  
Durham, NC

Barry Noon, Ph.D.  
Professor Emeritus  
Dept. Fish, Wildlife & Conservation Biology,  
Colorado State University  
Fort Collins, CO

David Mildrexler, Ph.D.  
Eastern Oregon Legacy Lands  
Joseph, OR

John W. Terborgh, Ph.D.  
James B. Duke Professor, Emeritus  
Nicholas School of the Environment, Duke University  
Durham, NC

Rosemary Sheriff, Ph.D.  
Professor, Chair Geography, Environment & Spatial  
Analysis  
California Polytechnic State University, Humboldt  
Arcata, CA

David McWethy, Ph.D.  
Associate Professor  
Department of Earth Sciences Montana State  
University  
Bozeman, MT

Gary Meffe, Ph.D.  
Conservation Biologist (retired)  
Dept. Wildlife Ecology & Conservation, University of  
Florida  
Gainesville, FL

Gary Table, MES, VMD  
President  
Center for Large Landscape Conservation  
Bozeman, MT

Alfredo Di Filippo, Ph.D.  
Professor in Plant Biology and Ecology;  
National Geographic Explorer  
Università della Tuscia  
Viterbo, Italy

George M. Woodwell, Ph.D.  
Founding President Woods Hole Research Center;  
Member National Academy Sciences  
Woods Hole Research Center  
Falmouth, MA

Jon Evans, Ph.D.  
Professor of Biology;  
Director, Sewanee Herbarium,  
The University of the South  
Sewanee, TN

Stephen C. Trombulak, Ph.D.  
Professor Emeritus Biology & Environmental Studies  
Middlebury College  
Middlebury, VT

Thomas M. Power, Ph.D.  
Research Professor Emeritus  
Economics Department, University of Montana  
Bozeman, MT

Lee E. Frelich, Ph.D.  
Director  
University of Minnesota Center for Forest Ecology  
St Paul, MN

Jim Hansen, Ph.D.  
Director  
Climate Science, Awareness & Solutions, Columbia  
University Earth Institute  
New York, NY

Tara Hudiburg, Ph.D.  
Associate Professor  
Director Institute Climate Solutions,  
University of Idaho  
Moscow, ID

David Lindenmayer, Ph.D.  
Research Professor Australian Research Council  
Laureate Professor  
The Australian National University  
Canberra, Australia

*146 Additional signers (affiliations for identification purposes only)*

Timothy A. Pearce, Ph.D.  
Curator of Collections - Mollusks Section  
Carnegie Museum Natural History  
Pittsburg, PA

Garry Rogers, Ph.D.  
President Agua Fria Open Space Alliance, Inc.  
Humboldt, AZ

Phillip Myers, Ph.D.  
Professor Emeritus  
Department Ecology & Evolutionary Biology -  
University of Michigan  
Ann Arbor, MI

Robert M. Pyle, Ph.D.  
Founder, The Xerces Society for Invertebrate  
Conservation  
Gray's River, WA

Philip Nyhus, Ph.D.  
Professor of Environmental Studies  
Environmental Studies Department Colby College  
Waterville, ME

Brian Miller, Ph.D.  
Professor, Department of Biology  
Middle Tennessee State University  
Murfreesboro, TN

Tzvetan Zlatanov, Ph.D.  
Institute of Biodiversity & Ecosystem Research  
Bulgaria Academy of Sciences, Bulgaria

John Sterman, Ph.D.  
JW Forrester Professor & Director  
Sustainability Initiative, Sloan School of Management  
Massachusetts Institute of Technology  
Cambridge, MA

Hans D. Knapp, Ph.D.  
Honorary Professor  
Succow Foundation for Protection of Nature  
Greifswald University, Germany

Nataliya Stryamets, Ph.D.  
Researcher  
Swedish University of Agricultural Sciences  
Skinnskatteberg, Sweden

Alistair S. Jump, Ph.D.  
Professor  
University of Stirling  
Stirling, Scotland UK

Monica L. Bond, Ph.D.  
Principal Scientist  
Wild Nature Institute  
Concord, NH

Peter Hobson, Ph.D.  
Professor of Biodiversity Conservation  
School of Sustainable Environments, Writtle  
University College  
Writtle, England UK

Esther C. Peter, Ph.D.  
Professor  
Department of Environmental Science & Policy,  
George Mason University  
Fairfax, VA

George Wuerthner, M.S.  
Ecologist  
Bend, OR

William P. Nanavati, Ph.D.  
Postdoc Researcher  
Department of Ecosystem and Conservation Sciences,  
University of Montana  
Missoula, MT

Fred M. Rhoades, Ph.D.  
Research Associate  
Biology Department, Western Washington University  
Bellingham, WA

Marcel Rejmanek, Ph.D.  
Professor Emeritus  
University of California, Davis  
Davis, CA

C. Riley Nelson, Ph.D.  
Professor Biology  
Department of Biology and Life Science Museum -  
Brigham Young University  
Provo, UT

Roger A. Powell, Ph.D.  
Department of Applied Ecology - North Carolina  
State University  
Raleigh, NC

Javier Rodriguez, Ph.D.  
Professor of Biological Sciences  
School of Life Sciences University of Nevada  
Las Vegas, NV

Tobias Kuemmerle, Ph.D.  
Professor Biogeography  
Geography Department, Humboldt-University  
Berlin, Germany

Christopher J. Paradise, Ph.D.  
Professor Biology & Environmental Studies  
Davidson College  
Davidson, NC

Brett Riddle, Ph.D.  
Professor Emeritus and Editor-in-Chief, Journal of  
Mammalogy  
University of Nevada Las Vegas  
Las Vegas, NV

Derek E. Lee, Ph.D.  
Associate Research Professor Biology  
Pennsylvania State University, State College  
State College, PA

Momchil Panayotov, Ph.D.  
Associate Professor of Dendrology  
University of Forestry  
Sofia, Bulgaria

Miroslav Svoboda, Ph.D.  
Professor Silviculture & Forest Ecology;  
Head of the Dept. Forest Ecology  
Czech University of Life Sciences  
Prague, Czech Republic

Pamela Morgan, Ph.D.  
Professor Environmental Studies  
School of Marine & Environmental Programs,  
University of New England  
Bidderford, ME

Robert M. Hughes, Ph.D.  
Professor  
Department Fisheries, Wildlife, & Conservation  
Sciences  
Oregon State University, Corvallis, OR

George Robinson, Ph.D.  
Emeritus Professor Biological Sciences  
State University of New York  
Albany, NY

Francesco Maria Sabatini, Ph.D.  
Asst. Professor  
Dept. Biological, Geological, and Environmental  
Sciences, University of Bologna  
Bologna, Italy

Jerzy Szwagrzyk, Ph.D.  
Professor  
Department of Forest Biodiversity, University of  
Agriculture  
Krakow, Poland

Keiko Kitamura, Ph.D.  
Senior Researcher  
Forestry and Forest Products Research Institute  
Hokkaido, Japan

Andreas Fichtner, Ph.D.  
Senior Scientist – Institute of Ecology  
Leuphana University of Lüneburg  
Lüneburg, Germany

Dušan Roženbergar, Ph.D.  
Assistant Professor  
University of Ljubljana, Biotechnical Faculty  
Department of Forestry & Renewable Forest  
Resources, Ljubljana, Slovenia

Kamil Kral, Ph.D.  
Silva Tarouca Research Institute  
Czech Republic

Parisa Panahi, Ph.D.  
Associate Professor  
National Botanical Garden of Iran  
Tehran, Iran

Mary S. Booth, Ph.D.  
Director  
Partnership for Policy Integrity  
Pelham, MA

Amy Stuart, M.S.  
Basin Manager (retired)  
Oregon Dept Fish & Wildlife, Deschutes  
Prineville, OR

Roger Sabbadini, Ph.D.  
Professor Emeritus  
Biology, San Diego State University  
San Diego, CA

Will Harlan, M.S.  
Southeast Director  
Center for Biological Diversity  
Asheville, NC

Jerry Freilich, Ph.D.  
Research Coordinator  
US National Park Service (retired)  
Bend, OR

Carolyn E. Ramírez, Ph.D.  
Staff Scientist  
Natural Resources Defense Council  
Chicago, IL

Sarah Adloo, Ph.D.  
Old-Growth Forest Network  
Atlanta, GA

Chad Hanson, Ph.D.  
Ecologist  
John Muir Project  
Kennedy Meadows, CA

Rob Mrowka, M.S.  
Landscape Ecologist (retired)  
Machias, NY

Donald S. Ross, Ph.D.  
Research Professor Emeritus  
Department of Plant and Soil Science, University of  
Vermont  
Burlington, VT

Bryant Baker, M.S.  
Director Conservation & Research  
Los Padres Forest Watch  
Santa Barbara, CA

Nickolay Tsvetanov, Ph.D.  
Chief Assistant Professor of Dendrology  
University of Forestry  
Sofia, Bulgaria

Darlene Chirman, M.S.  
Restoration biologist (retired)  
UC Davis  
Davis, CA

Rick Martinson, Ph.D.  
Worthy Environmental/ Winter Creek  
Bend, OR

Deborah A. Giles, Ph.D.  
Science & Research, Wild Orca, Friday Harbor  
San Juan Island, WA

Kerry Kriger, Ph.D.  
Ecologist  
Save the Frogs!  
Laguna Beach, CA

David Bain, Ph.D.  
Chief Scientist  
Orca Conservancy  
Bothell, WA

Joan Maloof, Ph.D.  
Professor Emeritus, Salisbury University  
Founder Old Growth Forest Network  
Berlin, MD

Nick Gayeski, Ph.D.  
Fisheries Scientist  
Wild Fish Conservancy  
Duvall, WA

Mitchell M. Johns, Ph.D.  
Professor Emeritus of Soil and Plant Science  
College of Agriculture, California State University  
Chico, CA

Kendra Klein, Ph.D.  
Deputy Director Science  
Friends of the Earth  
Berkeley, CA

Marielle Anzelone, M.S.  
Botanist and Founder  
PopUP Forest  
New York, NY

William Armbruster, Ph.D.  
Principal Research Scientist  
University of Alaska Fairbanks  
Fairbanks, AK

Erik Asphaug, Ph.D.  
Professor  
University of Arizona  
Tucson, AZ

Jonathan Aurnou, Ph.D.  
Professor  
UCLA Earth, Planetary & Space Sciences  
Los Angeles, CA

Carl Baker  
Research Scientist III  
University of Washington (retired)  
Seattle, WA

William Baker, Ph.D.  
Emeritus Professor  
University of Wyoming Program in Ecology  
Laramie, WY

Michael Baranski, Ph.D.  
Emeritus Professor of Biology  
Catawba College  
Salisbury, NC

Linda Sue Barnes, Ph.D.  
Emeritus Professor of Botany  
Methodist University  
Fayetteville, NC

Craig Benkman, Ph.D.  
Robert Berry Chair in Ecology, Emeritus  
University of Wyoming  
Laramie, WY

Scott Black, M.S.  
Executive Director  
Xerces Society for Invertebrate Conservation  
Portland, OR

James Blauth, Ph.D.  
Professor of Biology  
University of Redlands  
Redlands, CA

Brian Bodenbender, Ph.D.  
Professor of Geology and Environmental Science  
Hope College  
Holland, MI

William Bromer, Ph.D.  
Professor Emeritus  
University of St. Francis  
Joliet, IL

Philip Cafaro, Ph.D.  
Professor of Environmental Ethics  
Colorado State University  
Fort Collins, CO

John Cannon, Ph.D.  
Director  
Conservation Biology Institute  
Corvallis, OR

Bobb Carson, Ph.D.  
Professor Emeritus  
Earth and Environmental Sciences, Lehigh University  
Bethlehem, PA

Kai Chan, Ph.D.  
Professor and Canada Research Chair  
University of British Columbia  
Vancouver, British Columbia Canada

Raymond Clarke, Ph.D.  
Professor Emeritus  
Sarah Lawrence College  
Yonkers, NY

Joseph Cook, Ph.D.  
Distinguished Professor of Biology  
University of New Mexico  
Albuquerque, NM

Paul Dayton, Ph.D.  
Emeritus Professor  
Scripps Institution of Oceanography  
San Diego, CA

Craig Downer, M.S.  
Wildlife Ecologist  
Andean Tapir Fund (also has Wild Horse and Burro  
Fund branch)  
Minden, NV

Scott Edwards, Ph.D.  
Alexander Agassiz Professor of Zoology  
Harvard University  
Cambridge, MA

Michael Fox, Ph.D., DSc  
Veterinary Consultancy  
Kansas City, MO

Jed Fuhrman, Ph.D.  
McCulloch-Crosby Chair, Professor of Biological  
Sciences  
University of Southern California  
Los Angeles, CA

T. Luke George, Ph.D.  
Senior Instructor  
Colorado State University  
Fort Collins, CO

Steven Green, Ph.D.  
Emeritus Professor  
University of Miami  
Miami, FL

Gregory Gretger, Ph.D.  
Professor  
University of California  
Los Angeles, CA

Gary Grossman, Ph.D.  
Professor Emeritus, Distinguished Research Professor  
University of Georgia  
Athens, GA

Charles Halpern, Ph.D.  
Research Professor, Emeritus  
University of Washington  
Seattle, WA

Richard Halsey, B.A.  
Director  
California Chaparral Institute  
Escondido, CA

Ken Helms, Ph.D.  
Research Affiliate  
University of Vermont  
Burlington, VT

Bill Hilton Jr., D.Sci.  
Executive Director  
Hilton Pond Center for Piedmont Natural History  
York, SC

Richard Holmes Harris, Ph.D.  
Professor of Environmental Biology, Emeritus  
Dartmouth College  
Hanover, NH

Edward Huang, Ph.D.  
CIEDM Principal Researcher  
California Institute of Environmental Design &  
Management (CIEDM)  
Arcadia, CA

Malcolm Hunter, Ph.D.  
Professor Emeritus  
University of Maine  
Orono, ME

Mrill Ingram, Ph.D.  
Participatory Action Research Scientist  
Center for Madison, WI  
East Troy, WI

David Inouye, Ph.D.  
Professor Emeritus  
University of Maryland  
College Park, MD

Jay Jones, Ph.D.  
Emeritus Professor of Biology and Biochemistry  
University of La Verne  
La Verne, CA

David Karowe, Ph.D.  
Professor of Biological Sciences  
Western Michigan University  
Kalamazoo, MI

James R. Karr, Ph.D.  
Professor Emeritus  
School of Aquatic and Fishery Sciences, University of  
Washington  
Seattle, WA

Andréa Kuchy, Ph.D.  
Conservation Scientist  
Wild Heritage, a Project of Earth Island Institute  
Berkeley, CA

Rick Landenberger, Ph.D.  
Science & Management Specialist  
West Virginia Land Trust  
Morgantown, WV

Marc Lapin, Ph.D.  
Associate Laboratory Professor & College Lands  
Conservationist  
Middlebury College  
Middlebury, VT

Gene E Likens, Ph.D.  
Founding Director and President Emeritus  
Cary Institute of Ecosystem Studies  
Millbrook, NY

Yunpeng Liu, Ph.D.  
Postdoc  
University of Florida  
Gainesville, FL

Robert Meese, Ph.D.  
Staff Research Associate IV  
University of California at Davis  
Davis, CA

Faisal Moola, Ph.D.  
Associate Professor  
University of Guelph  
Guelph, ON

K. Greg Murray, Ph.D.  
T. Elliot Weier Professor Emeritus of Plant Science  
Hope College  
Holland, MI

William D. Newmark, Ph.D.  
Research Curator  
Natural History Museum of Utah  
Salt Lake City, UT

Harvey Nichols, Ph.D.  
Emeritus Professor of Biology (retired)  
University of Colorado  
Boulder, CO

Gretchen North, Ph.D.  
Endowed Professor of Biology  
Occidental College  
Los Angeles, CA

Richard Nyhof, Ph.D.  
Professor of Biology, emeritus  
Calvin University  
Grand Rapids, MI

Richard S. Ostfeld, Ph.D.  
Distinguished Senior Scientist  
Cary Institute of Ecosystem Studies  
Millbrook, NY

Anthony Povilitis, Ph.D.  
Life Net Nature  
Willcox, AZ

James Quinn, Ph.D.  
Professor Emeritus  
Rutgers University  
New Brunswick, NJ

John Ratti, Ph.D.  
Professor and Research Scientist (retired)  
University of Idaho  
Moscow, ID

Eric Rechel, Ph.D.  
President  
Non-profit Desert Ecosystem Analysis & Restoration  
Grand Junction, CO

Marcel Rejmanek, Ph.D.  
Professor of Ecology  
University of California at Davis  
Davis, CA

Barbara Reynolds, Ph.D.  
Professor (retired)  
University of North Carolina  
Asheville, NC

Matthew Rubino, M.S.  
Research Scholar  
North Carolina State University  
Raleigh, NC

Melissa Savage, Ph.D.  
Associate Professor Emerita  
University of California at Los Angeles  
Los Angeles, CA

Paul Schaeffer, Ph.D.  
Associate Professor  
Miami University  
Oxford, OH

Paula Schiffman, Ph.D.  
Professor of Biology  
California State University, Northridge  
Northridge, CA

Robin Sears, Ph.D.  
Executive Director  
Williamstown Rural Lands  
Williamstown, MA

Thomas Sherry, Ph.D.  
Professor Emeritus/Visiting Scholar  
Tulane University/Dartmouth College  
New Orleans, LA

Hank Shugart, Ph.D.  
W.W. Corcoran Professor Emeritus  
University of Virginia  
Charlottesville, VA

Rodney Siegel, Ph.D.  
Executive Director  
The Institute for Bird Populations  
Petaluma, CA

Pamela Soltis, Ph.D.  
Director  
University of Florida Biodiversity Institute,  
University of Florida  
Gainesville, FL

Wayne Spencer, Ph.D.  
Chief Scientist  
Conservation Biology Institute  
Corvallis, OR

Timothy Spira, Ph.D.  
Professor (retired)  
Clemson University  
Clemson, SC

Alan Stemler, Ph.D.  
Professor Emeritus  
University of California Davis  
Davis, CA

James Strittholt, Ph.D.  
President and Executive Director  
Conservation Biology Institute  
Corvallis, OR

Juliet Stromberg, Ph.D.  
Emeritus Professor  
Arizona State University  
Phoenix, AZ

Robert Summerfelt, Ph.D.  
Professor Emeritus Natural Resource Ecology  
(retired)  
Iowa State University  
Ames, IA

Stephen Tettelbach, Ph.D.  
Professor Emeritus of Biology  
Long Island University  
Long Island, NY

Pepper Trail, Ph.D.  
Senior Scientist (retired)  
US Fish and Wildlife Service  
Ashland, OR

Vicki Tripoli, Ph.D.  
(retired)  
Geos Institute  
Ashland, OR

Mary Tyler, Ph.D.  
Professor Emerita of Zoology  
University of Maine  
Orono, ME

Rick Van de Poll, Ph.D.  
Research Director  
Tin Mountain Conservation Ctr  
Center Sandwich, NH

Mike Vandeman, Ph.D.  
Founder  
Machine-Free Trails Association  
San Ramon, CA

Gwyn Wahlmann  
Citizen Advisory Committee /  
CAC Green Rivers Greenway  
Saint Louis, MO

Tina Rhea, M.S.  
Greenbelt, MD

Vicki Watson, Ph.D.  
Professor Emeritus  
University of Montana  
Missoula, MT

Judith Weis, Ph.D.  
Professor Emerita  
Rutgers University  
New Brunswick, NJ

Jack A. Sobel, M.S.  
None

Sue Wick, Ph.D.  
Professor Emerita  
University of MN-Twin Cities  
Minneapolis, MN

David Wilcove, Ph.D.  
Professor of Ecology, Evolutionary Biology, and  
Public Affairs  
Princeton University  
Princeton, NJ

John Vickery, M.S.  
Biologist  
Self-employed

Evan Frost, M.S.  
Terrestrial Ecologist  
Wildwood Consulting, LLC/  
Ashland, OR / Bishop, CA