No. 17-71

In the Supreme Court of the United States

WEYERHAEUSER COMPANY,

Petitioner,

v.

UNITED STATES FISH AND WILDLIFE SERVICE, ET AL.,

Respondents.

On Writ of Certiorari to the United States Court of Appeals for the Fifth Circuit

BRIEF OF AMICI CURIAE SCIENTISTS IN SUPPORT OF RESPONDENTS

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STATEMENT OF INTEREST[1]

Amici are prominent scientists with expertise in conservation biology, population biology, ecology, and other fields relating to the interaction of organisms with their environments, including management of endangered and threatened species. Amici support the United States Fish and Wildlife Service's interpretation of "essential" in critical habitat designations for unoccupied areas. Amici include leading scientists who have conducted cutting-edge research on species preservation and recovery that inform society's understanding of habitat. They have joined this brief because they believe the Fifth Circuit correctly held that the Fish and Wildlife Service properly applied the concept of "habitat" under the Endangered Species Act in this case.

The fifteen scientists who join in this brief as amici curiae include, in alphabetical order:

Ronald Carroll, Ph.D. is Professor Emeritus, Graduate Faculty, Odum School of Ecology at the University of Georgia. He is co-author of Principles of Conservation Ecology, one of the most widely used graduate level textbooks in the field, and directed the University of Georgia Institute of Ecology for over six years. He has expertise in conservation biology, sustainable development, plant-animal interactions, forest regeneration, and invasive species.

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[1] No counsel for a party authored this brief in whole or in part, and no person other than amici made a monetary contribution intended to fund the preparation or submission of this brief. The parties have all filed blanket consents to amicus briefs.

Francesca J. Cuthbert, Ph.D. is Professor of Fisheries, Wildlife and Conservation Biology, University of Minnesota. She is a Fellow of the American Ornithological Society and has been designated a Recovery Champion by the U.S. Fish and Wildlife Service. She has worked as a researcher and conservation biologist on the recovery of the endangered Great Lakes population of piping plovers for more than 30 years. At listing, only 11-17 pairs were documented in one state, nesting on two Great Lakes. In 2017-18, 76 pairs were recorded in five Great Lakes states, plus Ontario, and birds had reoccupied all five Great Lakes.

Paul R. Ehrlich, Ph.D. is Bing Professor of Population Studies and President, Center for Conservation Biology, Stanford University. He investigates a wide range of topics in population biology, ecology, evolution, and human ecology and evolution. He received the MacArthur Fellowship. Dr. Ehrlich is a fellow of the American Association for the Advancement of Science, the United States National Academy of Sciences, the American Academy of Arts and Sciences, and the American Philosophical Society. He is a Crafoord Laureate (an explicit substitute for the Nobel Prize in fields of science where the latter is not given), Tyler Laureate, Fellow of U.S. National Academy of Sciences, and Foreign Member of the Royal Society of London.

Bill Laurance, Ph.D. is Distinguished Professor, College of Science & Engineering, James Cook University (Australia). He holds an Australian Laureate Fellowship, one of Australia's highest scientific awards. His research focuses on the impacts of intensive landuses, such as habitat fragmentation, logging, hunting and wildfires, on tropical forests and their biodiversity. To date he has published eight books and over 400 scientific and popular articles. He is a fellow of the American Association for the Advancement of Science and former president of the Association for Tropical Biology and Conservation. Dr. Laurance has received many scientific honors including the BBVA Frontiers in Ecology and Conservation Biology Award, a Distinguished Service Award from the Society for Conservation Biology, and the Heineken Environment Prize.

Simon Levin, Ph.D. is James S. McDonnell Distinguished University Professor in Ecology and Evolutionary Biology, Princeton University. His research interests are in understanding how macroscopic patterns and processes are maintained at the level of ecosystems and the biosphere. Dr. Levin is a Fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science, and a past President of the Ecological Society of America, among other professional organizations. Levin received the Robert MacArthur Award (1988), Distinguished Service Citation (1998), and the Eminent Ecologist Award (2010) of the Ecological Society of America.

Julie Lockwood, Ph.D. is Professor of Ecology, Evolution and Natural Resources at Rutgers University. Professor Lockwood's research specializes on threatened and endangered animals in the United States, including species that are dependent on wetland and grassland ecosystems. Her expertise is in demography, population dynamics and habitat use. She has authored or co-authored over 100 journal articles and book chapters.

Lynn Maguire, Ph.D. is Professor of the Practice Emeritus of Environmental Decision Analysis, Nicholas School of the Environment, at Duke University. Dr. Maguire was a member of the National Academy of Sciences panel that authored *Science and the Endangered Species Act* (National Academy Press, 1995). She is a current member of the National Center for Socioenvironmental Synthesis working group assisting the U.S. Fish and Wildlife Service with decision tools for allocating resources among activities to recover listed species, and has over 35 years' experience using decision analysis for research and management of endangered species in the U.S. and elsewhere.

Reed Noss, Ph.D. is President and Chief Scientist, Florida Institute for Conservation Science; Chief Science Advisor, Southeastern Grasslands Initiative; and Visiting Scholar, Nicholas School of the Environment, Duke University. His recent research topics include disturbance ecology; road ecology; ecosystem conservation and restoration; and vulnerability of species and ecosystems to climate change and sea-level rise. He has published several books on ecology and biology. Dr. Noss has served as Editor-in-Chief of Conservation Biology and President of the Society for Conservation Biology. He is an Elected Fellow of the American Association for the Advancement of Science.

Steward Pickett, Ph.D. is a Distinguished Senior Scientist at the Cary Institute of Ecosystem Studies. He is a Fellow of the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the Ecological Society of America, and a past president of the Ecological Society of America. His areas of expertise include plant ecology, landscape ecology, urban ecology, and disturbance ecology. He was a member of the National Academy of Sciences panel that authored *Science and the Endangered Species Act*.

Stuart Pimm, Ph.D. is Doris Duke Professor of Conservation Ecology at Duke University. He is a world leader in the study of present day extinctions and what can be done to prevent them. His research covers the reasons why species become extinct, how fast they do so, the global patterns of habitat loss and species extinction and the management consequences of this research. The Institute of Scientific Information has ranked him as one of the most highly cited environmental scientists for over a decade. His international honors include the Tyler Prize for Environmental Achievement, the Dr. A.H. Heineken Prize for Environmental Sciences from the Royal Netherlands Academy of Arts and Sciences, the Society for Conservation Biology's Edward T. LaRoe III Memorial Award, and the Marsh Award for Conservation Biology (awarded by the Zoological Society of London).

Peter Raven, Ph.D. is George Engelmann Professor of Botany Emeriti and President Emeritus, Missouri Botanical Garden, Washington University in St. Louis.

He has published more than 700 articles, books, and monographs covering topics in evolution, taxonomy and systematics, biogeography, coevolution, plant conservation, ethnobotany, and public policy, including several textbooks. He received the U.S. National Medal of Science and the MacArthur Fellowship, among other awards; is a former President of the American Association for the Advancement of Science; and serves as a member of National Geographic Society board of trustees.

H. Bradley Shaffer, Ph.D. is a Distinguished Professor in the Department of Ecology and Evolutionary Biology, and founding director of the UCLA La Kretz Center for California Conservation Science at the University of California, Los Angeles. He is an expert in evolutionary biology, ecology, and conservation biology of amphibians and reptiles. Recent research projects include comparative phylogeography of amphibians and reptiles in California and the central U.S., systematics of freshwater turtles and tortoises in Australia, California, and the rest of the globe, and conservation genetics of endangered California amphibians and reptiles.

John Terborgh, Ph.D. is James B. Duke Professor Emeritus of Environmental Science at Duke University. He is a member of the National Academy of Science, and for the past thirty-five years, he has been actively involved in tropical ecology and conservation issues. An authority on avian and mammalian ecology in neotropical forests, Dr. Terborgh has published numerous articles and books on conservation themes. In 1992 he was awarded a MacArthur Fellowship, and in 1996 he was awarded the National Academy of Science Daniel Giraud Elliot medal for his research, and for his book Diversity and the Tropical Rainforest.

John Vucetich, Ph.D. is a Professor of Wildlife Conservation at the School of Forest Resources and Environmental Science, Michigan Technological University. He is an expert in the population biology of small populations and the human dimensions of conservation. He has made contributions to the scholarly understanding if the Endangered Species Act. I have authored or co-authored more than 100 scientific articles, book chapters, and formal reports. Collectively, they have been cited in the scientific literature more than 2,000 times.

Edward O. Wilson, Ph.D. is University Professor Emeritus, Harvard University. He is recognized as one of the creators of two scientific disciplines (island biogeography and sociobiology), three unifying concepts for science and the humanities jointly (biophilia, biodiversity studies, and consilience), and one major technological advance in the study of global biodiversity (the Encyclopedia of Life). Among more than 100 awards he has received worldwide are the U. S. National Medal of Science, the Crafoord Prize of the Royal Swedish Academy of Sciences, the International Prize of Biology of Japan; and in letters, two Pulitzer Prizes in nonfiction.

SUMMARY OF ARGUMENT

Courts and federal agencies should employ a scientific understanding of habitat, not a dictionary definition, to conserve endangered species and fulfill Congress's mandates under the Endangered Species Act ("ESA" or "Act"). Habitat loss and degradation are the leading causes of species endangerment in North America. Congress commanded that the Fish and Wildlife Service use the "best scientific data available" in designating critical habitat to address species endangerment.

To implement Congress's mandate, the Service must interpret the concept of habitat broadly, applying two core principles when it evaluates what habitat is necessary for species conservation. First, habitat is both spatially variable and temporally dynamic. Second, habitat must be understood broadly to evaluate effectively and accurately species' needs. As corollaries to these principles, several concepts are key: a proper understanding of habitat requires a landscape-scale view; habitats vary in quality, suitability, and location; an area need not be currently occupied or suitable to be essential for the long-term survival of a species; and habitat areas are capable of being restored to more suitable conditions. A definition of habitat that is limited to areas that are currently ideal for a species fails to account for the fact that habitat may vary in quality over space and time. Planning must account for this principle to ensure an endangered species has room not only to survive, but also to recover.

In light of these principles and the important role critical habitat plays in species recovery, the Act requires that the Service include areas essential to species conservation, even where those areas are unoccupied or need restoration. Without landscape scale planning and the ability to designate of a broad range of habitat, including restorable habitat, as critical habitat, the Service cannot fulfill Congress's mandates under the Act.

For these reasons, we conclude unequivocally that the Act requires an inclusive understanding of habitat. Petitioner's narrow unscientific interpretation would fail to provide for the survival and recovery of endangered species, ignoring Congress's plain mandate. To "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved," 16 U.S.C. § 1531(b), using the "best scientific data available," courts and agencies must understand critical habitat to encompass all areas essential to that species' recovery.

ARGUMENT

I. Introduction

Since its enactment, the Endangered Species Act has embodied scientific principles in service of Congress's goal of conserving[2] species. The law's purpose

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[2] "Conservation" is a defined term in the Act that includes "all activities associated with scientific resource management": "The terms 'conserve', "conserving', and 'conservation' mean to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary. Such methods and procedures

is "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" and "to provide a program for the conservation of such endangered species and threatened species." 16 U.S.C. § 1531(b).

Scientists agree that habitat loss and degradation are the leading causes of species' endangerment. David S. Wilcove et al., *Quantifying Threats to Imperiled Species in the United States*, 48 BioScience 607, 607 (1998); *see also* Amy N. Hagen & Karen E. Hodges, *Resolving Critical Habitat Designation Failures: Reconciling Law, Policy, and Biology*, 20 Conservation Biology 399, 400 (2006). Because of the centrality of habitat in the conservation of biological diversity and populations of organisms, Nat'l Research Council, *Science and the Endangered Species Act* 72 (1995) (hereinafter "NRC Report")[3], any habitat loss generates significant negative impacts. According to one

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include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking." 16 U.S.C. § 1532(3).

[3] The NRC Report was a landmark work, researched and drafted by a team of the most esteemed and knowledgeable scientists working on endangered species conservation. The publisher describes it thus:

> In this volume a distinguished committee focuses on the science underlying the ESA and offers recommendations for making the act more effective.
>
> The committee provides an overview of what scientists know about extinction—and what this understanding

study, "habitat loss accounts for thirty-six percent of extinctions where the cause is known, but likely accounts for a much greater percentage where the cause is not known," given the difficulties of quantifying habitat loss. Jason M. Patlis, *Paying Tribute to Joseph Heller with the Endangered Species Act: When Critical Habitat Isn't*, 20 Stan. Envtl. L. J. 133, 142 (2001) (citing NRC Report). And while "habitat loss has a much larger effect than habitat fragmentation per se on population extinction," Lenore Fahrig, *Relative Effects of Habitat Loss and Fragmentation on Population Extinction*, 61 J. of Wildlife Mgmt. 603, 607 (1997), habitat "destruction and fragmentation . . . are the 2 most important factors in the current species extinction event." *Id.* at 603.

Unsurprisingly, habitat loss and degradation deeply imperil species listed as threatened or endangered under the Endangered Species Act: In fact, habitat destruction and degradation "contribut[ed] to the endangerment of 85%" of ESA-listed species analyzed in a seminal study, Wilcove, *supra*, at 609, and "the majority of recovery plans identify threats to habitat as a significant factor endangering the species." Hagen & Hodges, *supra*, at 400.

Because habitat loss and degradation have been the leading cause of species endangerment, habitat

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means to implementation of the ESA. Habitat—its destruction, conservation, and fundamental importance to the ESA—is explored in detail.

https://www.nap.edu/catalog/4978/science-and-the-endangered-species-act. The NRC Report is available at https://www.nap.edu/read/4978/.

preservation has always been an integral tool for executing that purpose. Various provisions of the Act reflect Congress's recognition of that fact. These include the incorporation of habitat into the determination of a species as threatened or endangered (16 U.S.C. § 1533(a)(1)(A) (listing as a considered factor "the present or threatened destruction, modification, or curtailment of its habitat or range")), designation of critical habitat (16 U.S.C. §§ 1533(a)(3), (b)(2), (b)(6)), development of the recovery plan (16 U.S.C. § 1533(f)(1)(B)), requirement for consultation and prohibition against adverse modification of habitat (16 U.S.C. § 1536), and requirement of habitat "conservation plans" as conditions of private parties obtaining "incidental take" permits (16 U.S.C. § 1539(a)(2)). *See* NRC Report, at 74-75. Together, these provisions reflect "the understanding of conservation biology that certain habitat is essential for species survival" as well as for recovery. NRC Report at 75.

Both the Fifth Circuit and the Federal District Court for the Eastern District of Louisiana acknowledged the broad, conservation-oriented objective of the ESA and correctly upheld the Fish and Wildlife Service's ("the Service" or "FWS") determination that certain areas should be designated as critical habitat because they are essential for the conservation of the gopher frog. Petitioner, however, seeks to narrow the definition of habitat impermissibly to exclude certain kinds of unoccupied habitats, including restorable habitats. Science does not support this narrow construction, which would impair proper implementation of the ESA. Critical habitat designation protects against habitat loss and degradation and, consequently, extinction—precisely the ongoing and urgent threat to listed species that Congress enacted the Act to address. Therefore, the Court should view habitat as scientists do: at the landscape scale, to facilitate species survival and recovery most effectively.

While social and cultural values, as well as economic considerations, are undoubtedly important and reflected in the ESA, Congress enacted the ESA as an inherently and explicitly science-based tool enacted for the purpose of conservation, requiring that the Service employ the "best scientific data available" in designating critical habitat. 16 U.S.C. § 1533(b)(2). Courts thus should interpret the Act in light of scientific understanding, to ensure the implementation of the Act as Congress intended.

II. Habitat, from a scientific perspective, is dynamic and must be understood broadly

Successful planning and action to promote species survival and recovery, including proper critical habitat designation informed by science, is essential to implementing the Endangered Species Act as Congress intended. Congress commanded that the Fish and Wildlife Service use the "best scientific data available" in designating critical habitat. 16 U.S.C. § 1533(b)(2). To implement Congress's mandate, the Service must apply two core principles when it evaluates what habitat is necessary for species conservation. First, habitat is temporally dynamic and spatially variable. Second, habitat must be understood broadly to evaluate effectively and accurately species' needs.

A. Proper planning for species survival and recovery requires that habitat be understood as dynamic.

The fact that the natural environment is dynamic underpins the scientific understanding of habitat. There is constant "temporal and spatial variation in physical and biotic features of the environment." NRC Report at 134. These movements include, for example, "the rhythm of natural disturbance, the waxing and waning of predator and prey populations, and the cycling of soil nutrients," each of which can "change [] the distribution, growth, abundance, and interaction of species." NRC Report at 95. While change is inevitable, some types and rates of change are more likely to preserve species and ecosystems than others. Reed F. Noss, *Some Principles of Conservation Biology, as They Apply to Environmental Law*, 69 Chi.-Kent L. Rev. 893, 908 (1994). Thus, conservation planning must make appropriate distinctions among the kinds of changes occurring. Moreover, conservation planning cannot singularly "focus[] on protecting today's biodiversity with the assumption that it will be tomorrow's biodiversity." Joshua J. Lawler et al., *The Theory Behind, and the Challenges of, Conserving Nature's Stage in a Time of Rapid Change*, 29 Conservation Biology 618, 618 (2015). Indeed, not accounting for future environmental changes can be fatal and "may fail to adequately protect species in the future." *Id.* Therefore, plans addressing species survival and recovery must also seek to conserve "ongoing evolutionary processes and potential." NRC Report at 95.

As the natural environment is dynamic, so too is what constitutes habitat for a species at any given moment in time. Habitat is a basic requirement of all living organisms, and thus its protection is crucial to species survival and recovery. Scientists have defined habitat as "the physical and biological setting in which organisms live and in which the other components of the environment are encountered." NRC Report at 71. It is one of "the four components of environment" for species, "along with climate variables, nutrients, and other interacting organisms." *Id.* (citing H.G. Andrewartha & L. Charles Birch, *The Distribution and Abundance of Animals* 26 (1954). Habitat and species are thus "inextricably linked." Patlis, *supra*, at 140.

Both survival and recovery success depend ultimately on "proper consideration of how the species interacts with surrounding biotic and physical environmental factors." NRC Report at 199. For example, habitat that is larger and keeps species well-distributed protects the species more effectively against catastrophes, disturbances, or other negative influences across the habitat range. *Id.* at 131.

B. "Habitat" must be understood broadly, including at the landscape level, to assess effectively and accurately the needs of species.

It is well known to scientists that habitat is heterogeneous, spatially variable, and temporally dynamic, and that these qualities allow species to survive and thrive. Monica G. Turner & Robert H. Gardner, *Landscape Ecology in Theory and Practice: Pattern* *and Process* 229-231 (2d ed. 2015).[4] Habitat is confined neither to those areas currently occupied by species, nor to the current conditions of those areas. At a minimum, habitat—as recognized by scientists—has these features: it should be viewed at a landscape scale; may vary in suitability or quality, and this variance itself may change over time; may not be currently occupied; may be restorable or restored; and may be as-yet unrecognized.

1. Habitats should be viewed at a landscape scale.

Scientists generally view habitat at the landscape scale. The landscape is "a large area in which a certain array of ecosystem types is linked by natural disturbance regime, pattern of human land use and disturbance, and distributions of land forms." NRC Report at 97. The landscape view of habitat broadly considers "species' spatial distribution over time" and "highlights the fluxes between patches [of habitat]," because it recognizes that species' habitat needs are context-specific. Patlis, *supra*, at 140 (quoting NRC Report at 96-97). Variability within a landscape is normal, as "[l]andscapes are usually not a binary mosaic of habitat patches and non-habitat matrix, but are comprised of a variety of habitat types placed on a species-specific gradient of habitat qualities." Dagmar Söndgerath & Borish Schröder, *Population Dynamics and Habitat Connectivity Affecting the Spatial Spread of Populations – A Simulation Study*, 17 Landscape Ecology 57, 58 (2002).

[4] *Available at* https://link.springer.com/book/10.1007%2F978-1-4939-2794-4.

This "spatial heterogeneity in ecological systems at various scales often influences important functions, ranging from population structure through community composition to ecosystem processes." S. T. A. Pickett and M. L. Cadenasso, *Landscape Ecology: Spatial Heterogeneity in Ecological Systems,* 269 Science 331, 334 (1995). Acknowledging both this spatial variability and the dynamic changes in habitat over time enables scientists to understand the needs of species and ecosystems. Thus, the landscape view provides the flexibility necessary to respond to the dynamic characteristics of nature. Researchers have further noted that the landscape view of habitat "is also the *only* way to conserve organisms and processes in poorly known or unknown habitats and ecological subsystems." Jerry F. Franklin, *Preserving Biodiversity: Species, Ecosystems, or Landscapes?*, 3 Ecological Applications 202, 203 (1993) [emphasis in original].

2. Habitats may vary by location and over time in their suitability or quality.

As a corollary of the landscape view of habitat, habitats typically are not defined as specific bounded geographical areas at single points in time. Habitats can shift in suitability or quality through time because of changes in weather patterns, climate, human activity in adjacent areas, or other forces. They can "be created or destroyed by episodic or rare events, such as fire or windstorms." NRC Report at 96. Effective habitat identification and management require an understanding of these variations. David B. Lindenmayer & Joern Fischer, *Habitat Fragmentation and Landscape Change: An Ecological and Conservation Synthesis* 42 (2006).

Moreover, habitats may vary in quality because they are so context-dependent. Habitats may range from those with "higher potential conservation value" and "intermediate potential value" to "lower potential value" (NRC Report at 89), based on such characteristics as size, density, configuration, proximity to other habitats, and interconnectivity. Turner & Gardner, *supra*, at 229. The understanding that habitats vary in location over time and in quality provides the basis of scientists' ability to identify the features of habitat, as a tool both for building scientific knowledge and for species conservation and habitat management.

3. Habitats need not be occupied currently.

Some areas unoccupied at any particular time may be essential habitat, because "that a species is absent from a given habitat does not mean that the habitat is not critical to the persistence of the species." NRC Report at 76. Populations migrate or move for a variety of reasons, on a variety of time scales, for reasons including "response to seasonal cycles, reproductive behavior, localized resource depletion or creation, and a search for protection." *Id.* at 96-97. Moreover, a population may not occupy areas on which it relies for important or essential resources. Because these dynamics often require more habitat than is occupied at a given moment, unoccupied areas may thus be vital habitat for a species or population.

For example, "dispersal habitat" is habitat that "organisms occasionally or periodically disperse through." *Id.* at 101. This type of habitat may also be essential for population or species survival, because they can "be arrayed as stepping stones or unbroken corridors" that facilitate species' movement to, or between, other habitats. *Id.* Additionally, areas that provide species temporary refuge and resources to recolonize are part of habitat. *Id.* When "physical environmental stress or unusually intense or large disturbances" cause species to leave their regular habitat, these species need areas that provide shelter or areas "in which seeds, larvae, or adults can persist through disturbances and stresses." *Id.*

Moreover, essential habitat may even include areas that, while unoccupied, provide resources crucial to a species' survival. This type of habitat has been recognized in previous critical habitat designations, including habitat providing upstream sources of sediment for the fish species the Santa Ana sucker, 75 Fed. Reg. 77962, 77973 (December 14, 2010), and the source of dune sand for the Coachella Valley fringe-toed lizard, 45 Fed. Reg. 63812, 63818 (September 25, 1980). In these cases and others, the Service has correctly designated the areas as critical habitat even though the species are unlikely to, or even cannot, occupy those areas physically, because the species could not survive without the resources they provide.

4. Habitats may be restored or capable of restoration.

Habitat includes areas that, with some human effort, can be restored to a state that serves threatened or endangered species more effectively. Restoration may include reconstruction of habitat, which entails "reconstitut[ing] ecosystems at alternative sites," NRC Report at 185, or rehabilitation, which seeks to restore degraded habitat to "an ecologically superior state," through management interventions where necessary. Dan Borg, Ian Rutherford, & Mike Stewardson, *The Geomorphic and Ecological Effectiveness of Habitat Rehabilitation Works: Continuous Measurement of Scour and Fill Around Large Logs in Sand-Bed Streams*, 89 Geomorphology 205, 206 (2007). These practices have led to the improvement or restoration of ecosystem functions and "hold[] much promise for the protection of endangered species," NRC Report at 201, because they often are the only tools to effectively address habitat loss and degradation—the most significant drivers of species endangerment.

Research confirms that, among other things, "[h]abitat restoration results in an increase in population size—and therefore, viability—because of an expansion in available habitat. Importantly, connecting fragments allows immigration from source populations that rescue floundering populations." William D. Newmark et al., *Targeted Habitat Restoration Can Reduce Extinction Rates in Fragmented Forests*, 114 Proceedings of the National Academy of Sciences 9635, 9635 (2017).

5. Habitats may be unknown or unappreciated.

Finally, a broad and dynamic concept of habitat is adaptable to improvements in scientific information, including around unrecognized habitat. Some habitats are suitable despite difficulty understanding fully their historic function for a species. This principle suggests that agencies should err on the side of caution when considering potential habitat areas, and not dismiss potential habitat without investigating and understanding species' needs. Some areas do not become habitat due to a change in the environment or in species' behavior—they simply are, and have always been, habitat, even if human knowledge has not yet developed that understanding. For example, many ecologically rich habitat types, such as forest canopies, belowground subsystems, and the hyporheic zones, were previously "unappreciated habitats." Franklin, *supra*, at 203. Yet scientists today consider these habitat types integral to the conservation of numerous species.

III. "Critical habitat" should be interpreted to include areas essential to species conservation, even where those areas are unoccupied or need restoration

In its definition of "critical habitat," Congress specifically included "areas outside the geographical area occupied by the species," where the Secretary of Interior finds "that such areas are essential for the conservation of the species." 16 U.S.C. § 1532(5)(A)(ii). Congress recognized that threatened and endangered species may require habitat different from, or in larger area than, currently occupied areas for their populations to survive and recover.[5] In designating all critical habitat, whether occupied or unoccupied, the statute further directs the Service to rely on the "best scientific data available." 16 U.S.C. § 1533 (b)(2); see also *Markle Interests, LLC v. U.S. Fish & Wildlife Service*, 827 F.3d 452, 472 (5th Cir. 2016).

[5] Even unlisted species show considerable year -to-year variability in habitat occupancy, a dynamic that is likely essential for their survival.

This clear directive in the statute led the Fifth Circuit to uphold the Service's scientific determination and refuse to accept Petitioner's argument, which would uncouple the finding of what habitat is "essential" from scientific principles. As the Fifth Circuit noted:

> "…the ESA requires the Service to base its finding of essentiality on "the best scientific data available." Id. § 1533(b)(2). This requirement further cabins the Service's power to make critical-habitat designations. Here, the Final Designation was based on the scientific expertise of the agency's biologists and outside gopher frog specialists. If this scientific support were not in the record, the designation could not stand.

Markle Interests, LLC, 827 F.3d at 472.

Emphatically, we agree: A non-scientific understanding of habitat is neither helpful nor appropriate in designating critical habitat to fulfill Congress's mandate. The narrow definition of habitat suggested by Petitioner would not only contravene Congress's command to employ the best scientific data available, but also would frustrate the very purpose of the Act:

> "[...] to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section."

16 U.S.C. § 1531(b).

In this section we discuss both the importance of incorporating scientific understanding to meet Congress's mandate under the Act, and the scientific understanding of the role that unoccupied habitat, including habitat that may require restoration, plays in ensuring the conservation of threatened and endangered species.

A. Critical habitat designations protect listed species and are necessary to address habitat loss.

Congress enacted Section 4 of the ESA, which allows for the designation of critical habitat, to mitigate some of the damage from habitat loss and thereby facilitate species conservation. Critical habitat "is a valid biological concept" that recognizes certain habitats as "essential for species survival." NRC Report at 75. Nonetheless, despite the central importance of habitat, over half of listed species do not have critical habitat designated.

Contrary to Petitioner's assertions, the critical habitat designation is working where the Service has implemented it. Each designation helps stem the tide of habitat loss and resulting extinction by protecting the physical habitat necessary for species survival and recovery. Martin F. J. Taylor et al., *The Effectiveness of the Endangered Species Act: A Quantitative Analysis*, 55 Bioscience 360, 366 (2005). According to a study analyzing data reported by the U.S. Fish and Wildlife Service and National Marine Fisheries Service, "[s]pecies with critical habitat for two or more years appeared to be more likely to be improving and less likely to be declining than species without"; the researchers found their "results suggest that critical habitat assists species recovery, independent of the length of time listed and the presence of recovery plans." *Id.* at 362. Critical habitat designations also enhance education and public awareness about the listed species and its habitat (Hagen & Hodges, *supra*, at 402), which in turn generates greater public support and federal funding for recovery planning and habitat management. NRC Report at 198. The critical habitat designation thus "confers unique protections," including "more comprehensive protection than might be afforded by piecemeal protection via other regulatory mechanisms." Hagen & Hodges, *supra*, at 402.

B. Habitat "essential for the conservation" of a species" may include unoccupied habitat and habitat that may require restoration.

Petitioner argues that the Fish and Wildlife Service must interpret habitat narrowly, to mean only "habitable" areas, and—in the case of unoccupied areas—only areas where all biologically important features are present. This unscientific interpretation would fail to meet Congress's mandates both to use the best scientific data available, and ultimately to promote species' survival and recovery.

As discussed above, habitat loss and degradation are the primary factors driving species toward extinction. Many listed species are in this perilous position because species occupy smaller and smaller areas as their habitats are degraded or destroyed, causing their numbers to dwindle and reducing their chance of survival. In those cases, if remaining suitable habitat were sufficient to support the species, it would not have become threatened or endangered. Consequently, limiting habitat to only those areas would thwart the ESA's goal of species conservation, including recovery. In some cases, essential habitat will have to include habitat that may need restoration; otherwise, the sharply limited critical habitat designation would do nothing other than perpetuate the harm that put the species at risk in the first place.

In many cases, recovery will necessarily require that the species can reoccupy some portion of the former range, even if that portion may not currently be entirely suitable. Hagen & Hodges, *supra*, at 404. Where this is true, broader protection of unoccupied habitat is essential to ensure that the species can reoccupy these areas in the future, either through natural dispersal or through managed reintroductions. Abbey E. Camaclang et al., *Current Practices in the Identification of Critical Habitat for Threatened Species*, 29 Conservation Biology 482, 483 (2015). A failure to plan for reintroduction into currently unoccupied areas will likely impede species' recovery, especially in cases where the habitat loss caused the species' decline. *Id.* at 488.

Furthermore, as discussed above, occupied habitat both is spatially heterogeneous and varies over time for many, perhaps all, species. A species may not continuously occupy portions of the species' habitat, and not all portions of habitat serve the same role in supporting species. See, e.g., 75 Fed. Reg., *supra*, at 77973; 45 Fed. Reg., *supra*, at 63818. Species may occupy different portions of their historical range over months or years owing to factors such as seasonal cycles, reproductive behaviors, localized resource depletion or creation, or a search for protection; these areas may not be suitable for the species continuously over time, but they are certainly habitat for that species. NRC Report at 96-97. A definition of critical habitat that requires an area to possess all features at any given point in time would fail to capture essential areas intermittently occupied by a listed species, or otherwise essential because of resources they may provide for species survival and recovery.

C. Landscape scale planning is crucial in the critical habitat designation process.

Within the critical habitat designation process, assessing habitat at a landscape scale is crucial for species conservation. Incorporation of landscape-scale planning guards against localized extinctions, accounts for the dynamic nature of habitat over time, and captures the spatial variability of habitat quality. Scientists prioritize "protecting an array of biological communities and habitat types within a larger landscape context." NRC Report at 200.

First, protecting unoccupied habitat is immensely important to the conservation of endangered and threatened species because doing so guards against localized extinctions. Species that are already threatened by habitat loss and degradation are even more susceptible to stochastic, or random, threats such as natural disasters. Lindenmayer & Fischer, *supra,* at 73. Flooding, drought, windstorms, hurricanes, fires, and changes in prey availability or reproductive success all pose risks to populations. *Id.* at 73-75. This is especially true for small populations, where an unexpected threat in their limited range could eliminate the remaining members of the species. *Id.* at 73.

Because of the risk that a localized disturbance may force members of a species from their usual habitat by, the long-term survival of species requires that they have areas of refuge or recolonization, where they can relocate temporarily or permanently if their occupied habitat is destroyed. NRC Report at 101. Landscape scale planning for conservation of endangered species, including critical habitat designation, can take the risk of localized extinctions into account and provide nearby restored or mitigated habitat into which the species can disperse. Gary R. Huxel & Alan Hastings, *Habitat Loss, Fragmentation, and Restoration*, 7 Restoration Ecology 309, 313 (1999).

The widely accepted "multiplicity principle" states that it is preferable to have many reserves for a species rather than just a few. Noss, *supra*, at 900. Consistent with this, providing for broader distribution of a species is a crucial conservation strategy. The fact that the ESA allows for listing of distinct population segments, even when the species as a whole is not threatened, incorporates this principle by aiming to prevent local extinctions and preserve significant species populations. *Id.* If critical habitat is interpreted very narrowly, it is more likely that species will be limited to fewer distinct areas. This would make the species more susceptible to stochastic events, which could cause great harm and even extinction.

Second, the dynamic nature of habitat counsels strongly toward using a landscape scale framework to protect habitat. A landscape consists of a patchwork or mosaic of ecosystems, all subject to various disturbances, both natural and human-created. NRC Report at 95-97. A specific patch of habitat may become more or less suitable over time due to a variety of factors.

Id. This landscape scale mosaic changes over time, resulting in changes in population dynamics in any given area. Because of this shifting mosaic of habitat, a species' distribution at any one time may underestimate the range of habitat actually necessary to sustain the species and allow for recovery. *Id.* Thus "an inclusive and dynamic view of habitat" is crucial for recovery planning. *Id.* Recovery planning is far more likely to be successful when it incorporates a landscape view of habitat. *Id.*

Finally, because there is natural variability in habitat quality throughout a species' range over time, a landscape view of habitat is crucial to critical habitat designation. Many individuals in a species' population may live in an area that, while important for the overall diversity of the species, would not be by itself sufficient for the species over the long term. *Id.* at 99. For example, some habitats, referred to as "source habitats," are highly productive. In these areas, reproductive success leads to a growing population. Other areas, known as "sink habitats," are lower quality habitats, where a species has less reproductive success and local population growth is lower than the mortality rate. Sink habitats rely on the relocation of individuals from source habitats to replenish the population. *Id.* at 98. In many species, both are necessary for survival and recovery at any given time.

D. Designation of restorable critical habitat is a crucial tool for the conservation of species.

To ensure species have enough habitat to survive and recover, restorable unoccupied habitat must be an available option for critical habitat designation where that habitat is essential for conservation of a species. Ecological or habitat restoration involves taking action to address ecosystem degradation and damage, typically caused by humans, and assist in ecosystem recovery. Jose M. Rey Benayas et al., *Enhancement of Biodiversity and Ecosystem Services by Ecological Restoration: A Meta-Analysis*, 325 Science 1121, 1121 (2009). Restoration may involve stopping a degrading activity, removing an invasive species, reintroducing certain flora or fauna, or prescribed burning, to name only a few possible approaches. *Id.* at 1122.

Including unoccupied and degraded habitat in critical habitat designation with plans for future restoration "may also be necessary particularly where habitat loss and degradation have been the primary causes of a species' decline." Camaclang et al., *supra*, at 483. In such cases, habitat restoration and management are "critically important to the species recovery process." Ronald Carroll et al., *Strengthening the Use of Science in Achieving the Goals of the Endangered Species Act: An Assessment by the Ecological Society of America*, 6 Ecological Applications 1, 13 (1996). Conservation of species will require both preventing habitat loss and increasing efforts to restore degraded habitat. Fahrig, *supra*, at 609. To be effective, a listed species' recovery plan must determine the current extent of ideal habitat, assess the quality of remaining habitat, and prioritize areas for restoration. Carroll et al., *supra*, at 13.

Research confirms the importance of habitat restoration in conserving species. A meta-analysis of 89 published scientific assessments of restoration efforts and outcomes, in a variety of ecosystems on all continents except Antarctica, demonstrates the point. The study aimed to determine whether ecological restoration efforts correlated with changes in ecosystem services and biodiversity. The researchers assessed biodiversity by measures such as "abundance, species richness, diversity, growth, or biomass of organisms present." Benayas et al., *supra*, at 1122. The study showed that measures of ecosystem services and biodiversity were 25% and 44% higher, respectively, after restoration than in the degraded ecosystem before restoration. *Id.* The authors conclude that "ecological restoration is likely to lead to large increases in biodiversity." *Id.* at 1123.

The majority of recovery plans for ESA-listed species require either one-time restoration or ongoing active management of habitat to ensure species recovery. The National Research Council has pointed out that "[e]ach recovery plan is to include 'site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species,'" NRC Report, *supra*, at 75 (citing 16 U.S.C. § 1533(f)(1)(B)), and that "[b]ecause most species are endangered due to loss or degradation of habitat, site-specific actions should include identification, restoration, and management of habitat." *Id.* One study found that "[p]robably the most striking result of our recovery plan analysis is that 63% of the plans were classified as calling for habitat restoration or active management—that is, simply preserving habitat will not be sufficient to recover these species." Theodore C. Foin at al., *Improving Recovery Planning for Threatened and Endangered Species*, 48 BioScience

177, 183 (1998). In light of the evidence, a "habitability" requirement makes no sense and would fail to do what Congress requires.

Critical habitat includes those areas essential for conservation of a species—including recovery. Examples of successful habitat restoration under ESA recovery plans abound, and include, for example, the Golden-cheeked Warbler, U.S. Fish & Wildlife Service, *Golden-cheeked Warbler Recovery Plan*, at 53-55 (1992)[6], and the Karner Blue Butterfly, U.S. Fish & Wildlife Service, *Karner Blue Butterfly Recovery Plan*, at 67-70 (2003)[7]; U.S. Fish & Wildlife Service, Karner Blue Butterfly (Lycaeides melissa samuelis).[8]

Restoring habitat to address the cause of a species' endangerment can prevent extinction risks that have been triggered but not realized. If habitat loss causes endangerment of a species, restoration should target rapid improvement in habitat quality; if small population size is the problem, efforts should restore a large enough area to allow the population to grow. Peter Torok & Aveliina Helm, *Ecological Theory Provides Strong Support for Habitat Restoration*, 206 Biological Conservation 85, 88-89 (2017). Given the ability of such efforts to avoid extinctions, designating restorable unoccupied areas as critical habitat is not only sensible, but also sometimes necessary, to fulfill

[6] *Available at* https://ecos.fws.gov/docs/recovery_plan/920930f.pdf.

[7] *Available at* https://www.fws.gov/midwest/endangered/insects/kbb/pdf/kbb-final-rp2.pdf.

[8] https://www.fws.gov/midwest/endangered/insects/kbb/karnerbl.html (discussing habitat restoration projects for the butterfly).

the purpose of the ESA: conservation (including recovery) of threatened and endangered species.

E. A non-scientific definition of habitat would fail to implement Congress's mandate and would undermine the Endangered Species Act's effectiveness.

The text of the ESA commands agencies to "designate critical habitat. . . *on the basis of the best scientific data available* and after taking into consideration the economic impact . . . of specifying any particular area as critical habitat." 16 U.S.C. § 1533(b)(2) (emphasis added). While the critical habitat designation process involves consideration of economic factors, the statutorily-mandated process of identifying what habitat is essential is fundamentally science-based. Yet many arguments criticizing the efficacy of critical habitat designation appear "politically and economically driven." Hagen & Hodges, *supra*, at 400-401. Isolating the definition of critical habitat from underlying scientific principles, as Petitioner attempts to do, would undercut the science-based mandate of Congress, and cripple the ESA's ability to protect habitat and, consequently, to prevent species extinction.

A critical habitat designation is a determination that "the best scientific data available" support viewing that habitat as essential to the conservation of the species, and thus that its designation is necessary to fulfill Congress's goal to ensure the survival and recovery of a listed species. Where the Service has already used its discretion to determine, based on application of science, the need for habitat designation to support species conservation, courts should accord deference to that science-based decision to designate the habitat as critical.

CONCLUSION

The judgment of the U.S. Court of Appeals for the Fifth Circuit should be affirmed.

Respectfully submitted,

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