



Comments on Petition of Pacific Legal Foundation, et al., for Rule-Making Under the Administrative Procedure Act (Which Aimed to Promulgate New Regulatory Definitions of “Species” and “Subspecies” Under the Endangered Species Act)

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Re: Comments on Petition of Pacific Legal Foundation, et al., for Rule-making under the Administrative Procedure Act

Harvard Law School's Emmett Environmental Law and Policy Clinic submits the following comments on behalf of James Mallet, Paul Ehrlich, Frank Gill, John McCormack, and Peter Raven in response to the Petition of Pacific Legal Foundation, *et al.* ("PLF"), for Rule-Making under the Administrative Procedure Act (the "Petition"), which was submitted on November 10, 2017 to the United States Department of Interior, the United States Department of

Commerce, the United States Fish and Wildlife Service, and the National Marine Fisheries Service (collectively, “the Services”). The Petition asks the Services to promulgate regulatory definitions of “species” and “subspecies” under the Endangered Species Act (“ESA” or “the Act”).

We urge the Services to deny the Petition, because PLF’s proposal contains several flaws:

- (1) The Services should not give “species” a single regulatory definition under the ESA because there is no universally accepted species concept among taxonomists.
- (2) PLF’s proposed definitions of “species” and “subspecies” are flawed because they are based on erroneously cited authority and they create tension with the statutory definitions in the ESA.
- (3) Adopting a single regulatory definition of “species” and “subspecies” is impermissible under the ESA because the Services would not be using the best available science (“BAS”), as required by the Act.
- (4) It is appropriate for the Services to continue to make case-by-case species determinations, using the best available science in each case.

BACKGROUND ON COMMENTERS

Professor James Mallet is Professor of Organismic and Evolutionary Biology in Residence in the Department of Organismic and Evolutionary Biology at Harvard University. His areas of research interest include tropical field biology, applied entomology, systematics, evolutionary biology, population genetics, and genomics. He has concentrated most of his work on the genetics and evolution of ithomiine and heliconiine butterflies of South and Central American rainforests, and in understanding speciation and hybridization among species. Professor Mallet has authored several articles on species concepts. In the Petition, PLF erroneously cites Professor Mallet’s research on species concepts and taxonomy to support part of its proposed definition of “species.”

Paul Ehrlich is Bing Professor of Population Studies Emeritus, President of the Center for Conservation Biology, Department of Biology, Stanford University and Adjunct Professor,

University of Technology, Sydney. He has carried out field, laboratory and theoretical research on a wide array of problems ranging from the dynamics and genetics of insect populations, studies of the ecological and evolutionary interactions of plants and herbivores, and the behavioral ecology of birds and reef fishes, to experimental studies of the effects of crowding on human beings, studies of cultural evolution, especially the evolution of norms, and investigation of health problems related to industrialization. He has authored and coauthored more than 1100 scientific papers and articles in the popular press and over 40 books. Professor Ehrlich is a Fellow of the American Academy of Arts and Sciences, the American Entomological Society and the Beijer Institute of Ecological Economics, and a member of the United States National Academy of Sciences and the American Philosophical Society. Among his many other honors are the Royal Swedish Academy of Sciences, Crafoord Prize in Population Biology and the Conservation of Biological Diversity (an explicit replacement for the Nobel Prize); a MacArthur Prize Fellowship; the Volvo Environment Prize; UNEP Sasakawa Environment Prize; the Heinz Award for the Environment; the Tyler Prize for Environmental Achievement; the Heineken Prize for Environmental Sciences; the Blue Planet Prize; the Eminent Ecologist award of the Ecological Society of America, the Margalef Prize in Ecology and Environmental Sciences, and the BBVA Frontiers of Knowledge Award in Ecology and Conservation Biology.

Frank B. Gill has been the Chief Scientist, Interim President, and CEO of the National Audubon Society. He came to Audubon after 25 years at the Academy of Natural Sciences in Philadelphia. He is also a past President of the American Ornithologists' Union ("AOU"). Dr. Gill's published works include his acclaimed textbook, *Ornithology* (W.H. Freeman, 1989, 1994, 2007) and over 150 scientific and popular articles. His worldwide research programs included pioneering field studies of island birds, hybridization by Blue-winged and Golden-winged

warblers, flower-feeding strategies of sunbirds of Africa and of hermit hummingbirds of Middle America, and phylogeny through DNA of the chickadees of the world. Dr. Gill leads the international effort to align the species taxonomy of the birds of the world on behalf of the International Ornithological Union (see <http://www.worldbirdnames.org>). For his outstanding contributions to ornithology, Dr. Gill received the William Brewster Medal of the AOU in 1998.

John E. McCormack is Associate Professor in Biology at Occidental College in Los Angeles and Director and Curator of the Moore Laboratory of Zoology Bird and Mammal Collection. His work focuses on bird evolution and taxonomy and the origin of species, with most studies focusing on the species level and just below. He has published numerous papers delimiting species using multifarious types of data that evaluate these data against competing species and subspecies concepts.

Peter H. Raven is Director Emeritus of the Missouri Botanical Garden and Engelmann Professor of Botany Emeritus at Washington University in St. Louis. Dr. Raven champions research around the world to understand biodiversity as fully as possible and is a leading advocate for conservation and a sustainable environment. Co-editor of the 49-volume Flora of China, he has worked tirelessly to promote international collaboration in science. He is the recipient of numerous prizes and awards, including the prestigious International Prize for Biology from the government of Japan and the U.S. National Medal of Science, the country's highest award for scientific accomplishment. He has held Guggenheim and John D. and Catherine T. MacArthur Foundation fellowships. Dr. Raven is the author of numerous books and publications, both popular and scientific, including his co-authorship of the leading textbooks *Biology* (now in its 11th edition), *The Biology of Plants* (now in its 8th edition), and *Environment* (now in its 9th edition).

ARGUMENT

I. **The Services Should not Give the Term “Species” a Single Regulatory Definition because there is no Universally-accepted Species Concept among Taxonomists**

PLF proposes that the Services adopt a specific regulatory definition for the term “species” under the ESA. The ESA does not contain statutory definitions of this term, but instead provides only that “[t]he term ‘species’ *includes* any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature.”¹ PLF proposes that “species” be defined as follows: “A species is a group of actually or potentially interbreeding populations that are reproductively isolated from other such groups to the extent that the rate of fertile hybridization is less than 1% per generation.”² As explained below, this proposed definition is seriously flawed.

A. **Taxonomy and Species Concepts**

The science of taxonomy aims to identify, classify, and name different organisms.³ The Linnaean hierarchy, named after the 18th-century Swedish scholar Carl Linnaeus, is the preferred framework for constructing biological classifications and representing hierarchical taxonomic relationships.⁴ As adapted today, this system contains eight distinct taxonomic ranks: Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species. The lower the rank of a group, the more similar are the organisms grouped in it. A species is considered a fundamental unit of classification, although within species further units may be recognized as subspecies.

¹ 16 U.S.C. § 1532(16) (emphasis added).

² Petition of Pacific Legal Foundation, *et al.*, for Rulemaking under the Administrative Procedure Act 16 (Nov. 10, 2017) [hereinafter “PLF Petition”].

³ See ERNST MAYR, *PRINCIPLES OF SYSTEMATIC ZOOLOGY* 2 (1969).

⁴ See Kevin de Queiroz, *The Linnaean Hierarchy and the Evolutionization of Taxonomy, With Emphasis on the Problem of Nomenclature*, 15 *ALISO* 125 (1997); Marc Ereshefsky, *The Evolution of the Linnaean Hierarchy*, 12 *BIOLOGY & PHILOSOPHY* 493 (1997).

The scientific understanding of “species” has changed over time. In Linnaeus’ view, “both species and genera [are] fixed, real, and known by definitions.”⁵ Thus, “individual members of a species come and go in terms of existence, [but] the species itself remains the same, . . . unchanged since the beginning of creation.”⁶ Each species had a true, Aristotelian essence, and variation within a species was “the imperfect expression of the species essence.”⁷

Charles Darwin challenged this Linnaean view by arguing that, through natural selection, species can evolve into new forms.⁸ He did not regard species as fixed forms; in addition, he did not view species as qualitatively different from intra-specific varieties. “Species, in Darwin’s view, are recognized by consistent gaps in morphology, but they form part of a continuum with varieties within species, which do not show such gaps.”⁹

In the mid-twentieth century, Ernst Mayr, Darwin’s intellectual descendent, argued for what came to be called the Biological Species Concept. There are two primary aspects of the Biological Species Concept. First is the idea of reproductive isolation: that members of a single species can reproduce with one another but are reproductively isolated from other species. Second is the idea of the polytypic species: that a single species can be made up of multiple, geographically separated “subspecies.”

⁵ JOHN S. WILKINS, *SPECIES: A HISTORY OF THE IDEA* 70 (2009).

⁶ DAVID N. STAMOS, *THE SPECIES PROBLEM: BIOLOGICAL SPECIES, ONTOLOGY, AND THE METAPHYSICS OF BIOLOGY* 112 (2003).

⁷ James Mallet, *Mayr’s View of Darwin: Was Darwin Wrong about Speciation?*, 95 *BIOLOGICAL J. LINNEAN SOC.* 3, 5 (2008).

⁸ CHARLES DARWIN, *ON THE ORIGIN OF SPECIES* (1859).

⁹ James Mallet, *Hybridization, Ecological Races and the Nature of Species: Empirical Evidence for the Ease of Speciation*, 363 *PHIL. TRANS. R. SOC’Y B.* 2971, 2972 (2008).

While the Biological Species Concept is very important, it has never been the only species concept adopted by taxonomists. In fact, over the past few decades, the number of competing concepts has grown, to the point that there are currently approximately two dozen different species concepts that taxonomists have proposed.¹⁰ Some of the most commonly discussed species concepts include the Biological Species Concept (as discussed above, defined by reproductive isolation), the Ecological Species Concept (defined by niches or adaptive zones), the Evolutionary Species Concept (defined by evolutionary roles and tendencies), the Cohesion Species Concept (defined by phenotypic cohesion), the Phylogenetic Species Concept (defined by monophyly, or by fixed character differences), the Phenetic Species Concept (defined by clusters of phenotypes), and the Genotypic Cluster Species Concept (defined by genotypic clusters).¹¹ The Phylogenetic Species Concept, in particular, has become very influential in recent years.¹²

B. PLF’s Proposed Definition of “Species” is Scientifically Problematic

Despite the ongoing debate about species concepts in the scientific community, PLF proposes that the Services promulgate a regulatory definition that embodies only one of these concepts: the Biological Species Concept. For several reasons, it would be scientifically indefensible for the Services to adopt PLF’s proposed definition.

¹⁰ See, e.g., James Mallet, *Species, Concepts of*, 6 ENCYCLOPEDIA OF BIODIVERSITY 679 (Simon A. Levin ed., 2d ed. 2013); Kevin de Queiroz, *Species Concepts and Species Delimitation*, 56 SYSTEMATIC BIOLOGY 879 (2007).

¹¹ See generally Mallet, *supra* note 10; de Queiroz, *supra* note 10.

¹² Nick J.B. Isaac et al., *Taxonomic Inflation: Its Influence on Macroecology and Conservation*, 19 TRENDS IN ECOLOGY & EVOLUTION 464 (2004) (noting a “recent trend away from the broad-brush biological species concept towards more fine grained phylogenetic species concepts”).

First, adopting PLF's proposed definition of "species" would lock the Services into using a single, inflexible definition when there is not a definition with which all (or even most) biologists agree.¹³ As indicated above, there are at least two dozen species concepts that are currently the subject of debate among biologists. New concepts continue to be introduced; for example, Bernhard Hausdorf proposed the "differential fitness species concept" in 2011.¹⁴ Given that the scientific understanding of "species" is in flux, the Services should not lock in a single, universal definition.

Second, the taxonomic lists that scientists have developed for different groups of organisms are based on different species concepts and taxonomic cultures. For example, ant taxonomists "describe new morphological forms with restricted distributions as separate species," while butterfly taxonomists "describe many local subspecies within widely distributed species."¹⁵ The result is that a population with certain characteristics would be classified as a species if it was an ant, but as a subspecies if it was a butterfly. Similarly, the Biological Species Concept has been much less influential in plant taxonomy than in animal taxonomy.¹⁶ If the Services adopt a regulatory definition for "species," that definition would apply to *all* species subject to the ESA. Adopting a single definition would require the Services to use that approach

¹³ See, e.g., Mallet, *supra* note 10, at 680 ("[A] generally accepted definition [of species] has yet to be found, and indeed is believed by some to be an impossibility."); de Queiroz, *supra* note 10, at 879 ("[C]urrently different subgroups of biologists advocate different and at least partially incompatible species concepts."); Anna L. George & Richard L. Mayden, *Species Concepts and the Endangered Species Act: How a Valid Biological Definition of Species Enhances the Legal Protection of Biodiversity*, 45 NAT. RESOURCES J. 369, 370 (2005) ("[T]here is no universally accepted definition for a biological species.").

¹⁴ Bernhard Hausdorf, *Progress toward a General Species Concept*, 65 EVOLUTION 923 (2011).

¹⁵ Isaac et al., *supra* note 12, at 464.

¹⁶ Sandra Knapp, *Species Concepts and Floras: What Are Species For?*, 95 BIOLOGICAL J. LINNEAN SOC'Y 17 (2008); Melissa Luckow, *Species Concepts: Assumptions, Methods, and Applications*, 20 SYSTEMATIC BOTANY 589 (1995).

even when it is inconsistent with the practice of the taxonomists who work with certain groups of organisms.¹⁷

Third, a temporal instability exists between taxonomic lists produced at different times for particular taxa. Specifically, two different groups with classifications established at different times might embody different species concepts. For example, primate taxonomy is currently undergoing a shift from a classification based on the Biological Species Concept to one based on the Phylogenetic Species Concept, such that the number of primate species is now approximately double that recognized in the 1980s, even though very few new taxa have actually been discovered.¹⁸

Finally, taxonomic concepts are inherently uncertain. One reason is that complex processes underlie the genetic discontinuities that taxonomists recognize as species. The relative importance of factors driving diversification varies among clades, geographical regions, and ecological backgrounds.¹⁹ Another reason is that taxonomy is based on hypotheses, and taxonomists have the right to formulate their own hypotheses, provided that their rationale is clear and bolstered by unambiguous data.²⁰ Indeed, there are even different versions of

¹⁷ PLF concedes in its petition that the Biological Species Concept is inapplicable to asexual organisms. PLF Petition, *supra* note 2, at 20 (“It is also true that the biological species concept does not work with organisms that do not reproduce sexually.”). This concession clearly undermines the proposal, because PLF is proposing that the Services adopt a *universal* definition. See George & Mayden, *supra* note 13, at 391 (“One further problem of the BSC is its applicability only to sexual organisms, a limitation that greatly reduces its effectiveness in recognizing diversity. Despite the prevalence of scientific research conducted on sexual—primarily vertebrate—animals, an unknown, but large amount of the earth’s diversity is composed of asexual species.”).

¹⁸ Isaac et al., *supra* note 12, at 464.

¹⁹ Cf. Peter Hollingsworth, *Taxonomy: Avoid Extra Bureaucracy*, 546 NATURE 600 (2017) (“The current lack of a universally accepted concept of what constitutes a species reflects biological and social reality.”).

²⁰ Markus Lambert, *Taxonomy: Retain Scientific Autonomy*, 546 NATURE 600 (2017).

individual species concepts; for example, the biological species concept is itself interpreted very differently today than in the 1970s literature cited by the PLF in the Petition.²¹ Therefore, for all of these reasons, “species” should not be given a single regulatory definition under the ESA.

C. The Biological Species Concept is not the “Plain Meaning” of “Species” under the ESA

Use of the Biological Species Concept is not required under the “plain meaning” canon of statutory construction because it was not universally adopted by taxonomists even at the time the ESA was enacted. PLF contends that at the time of the Act’s passage, the only scientifically based species concept used by taxonomists was the Biological Species Concept.²² Statutory text, when not specifically defined, should be interpreted according to its ordinary, public meaning at the time of enactment. Hence, PLF argues that interpreting “species” consistently with the Biological Species Concept would comport with this principle of statutory construction. This argument fails for at least five reasons.

First, there was disagreement in the taxonomic community at the time the ESA was enacted both about whether the Biological Species Concept was the best species concept and about how to define it. Prominent biologists published critiques of the Biological Species Concept both shortly before and after the enactment of the ESA.²³ In addition, in the early

²¹ See Frank B. Gill, *Species Taxonomy of Birds: Which Null Hypothesis?*, 131 THE AUK 150, 151 (2014) (“Applications of the Biological Species Concept increasingly incorporate empirical delimitations of lineage independence, the hallmark of the Evolutionary Species Concept.”).

²² PLF Petition, *supra* note 2, at 17.

²³ See Peter Raven, *Systematics and Plant Population Biology*, 1 SYSTEMATIC BOTANY 284 (1976); Robert Sokal & Theodore Crovello, *The Biological Species Concept: A Critical Evaluation*, 104 THE AMERICAN NATURALIST 127 (1970); Paul Ehrlich & Peter Raven, *Differentiation of Populations*, 165 SCIENCE 1228 (1969).

1970s, there were many different versions of the Biological Species Concept itself.²⁴ The Biological Species Concept—particularly in PLF’s formulation of it—was therefore not the universal “public meaning” of “species” at that time.

Second, the plain meaning principle on which PLF relies does not apply to technical or scientific terms when the relevant expert community does not agree on a single meaning for the term. As a general rule of construction, when a statute contains technical words, it is proper to explain them by reference to the field of study to which they are appropriate. However, when a court determines that the statutory term is subject to different interpretations within the relevant expert community—as was the case with “species” at the time of the ESA’s enactment—a dispute about the term’s proper construction cannot be resolved simply by labeling one competing interpretation the “plain meaning.”²⁵ Doing so would require an impermissible “value-laden choice.”²⁶ Therefore, where technical experts differ in their use of a term, the

²⁴ Sokal & Crovello, *supra* note 23, at 129 (“The number of species definitions that have been proposed since the advent of the New Systematics and that fall within the general purview of the BSC is very large.”).

²⁵ *Massachusetts v. Blackstone Valley Elec. Co.*, 67 F.3d 981 (1st Cir. 1995). The issue in this case was the meaning of “cyanides” under the Comprehensive Environmental Response, Compensation, and Liability Act and in particular whether the term encompassed ferric ferrocyanide (“FFC”). First, the court assumed that the “scientific community” was the appropriate body with reference to which the meaning of “cyanides” should be determined. Next, it determined that the term was ambiguous because the scientific community was “not a monolithic entity that ha[d] spoken . . . in a single voice,” given that credible expert affidavits directly contradicted one another, and “members of different disciplines within the scientific community at large are apt to take sharply contrasting approaches.” *Id.* at 986.

²⁶ *Id.* The court stated that the term “cyanides” suffers from an ambiguity classified as a “categorical indeterminacy” *Id.* at 987 (citing Clark D. Cunningham et al., *Plain Meaning and Hard Cases*, 103 YALE L.J. 1561, 1585 (1994)). “At least on the record before us, the category ‘cyanides’ does not admit of crisply defined boundaries, and resolution of the disagreement about whether FFC falls within those fuzzy boundaries requires a value-laden choice from among competing interpretive assumptions, a choice that cannot be made through mere inspection of the term’s normal or ordinary usage.” *Id.*

presumption that Congress has adopted a definition based on the relevant expert community grows weaker and courts will rely more heavily on other tools to ascertain Congress's meaning, such as legislative history.²⁷

Third, the legislative history of the Act indicates that Congress did not want a single definition of "species." Specifically, in 1978, Congress rejected an amendment that would have limited the ESA's protections to groups meeting the narrowest definition of the Biological Species Concept: sexually reproducing groups incapable of breeding with others. The House passed a bill which would have redefined "species" as "a group of fish, wildlife, or plants, consisting of physically similar organisms capable of interbreeding but generally incapable of producing fertile offspring through breeding with organisms outside this group."²⁸ The Senate rejected a similar proposal,²⁹ and the Conference Committee adopted the Senate version, leaving the statutory definition of species untouched.³⁰ The legislative dispute over the ESA's most fundamental definition reflects the inability of the bare term "species" to capture the nuances Congress sought to incorporate.

Fourth, PLF's proposed definition of "species" is also flawed because it does not include "subspecies" or "distinct population segments," which are explicitly part of the statutory definition of "species" in the Act.³¹ A regulation must be consistent with the statute from which

²⁷ *Shell Petroleum, Inc. v. U.S.*, 182 F.3d 212, 220–21 (3d Cir. 1999).

²⁸ H.R. 14104, 95th Cong., 2d Sess. §5(2) (1978), *reprinted in* Cong. Research Service, 97th Cong., 2d Sess., *A Legislative History of the Endangered Species Act of 1973* (Comm. Print 1982), at 685.

²⁹ S. 2899, 95th Cong. (1978).

³⁰ *See generally* Karl Gleaves et al., *The Meaning of "Species" under the Endangered Species Act*, 13 PUB. LAND L. REV. 25, 30-31 (1992).

³¹ 16 U.S.C. § 1532(16).

it is derived. “Subspecies” and “distinct population segments” are considered “species” under the Act but would not be under PLF’s proposed definition. PLF’s proposed definition of “species” would thus be in tension with the statutory definition.

Finally, PLF’s proposed definitions do not adhere to Congress’ intent regarding the conservation of biodiversity and ecosystems under the Act.³² Biodiversity conservation aims to preserve the broad diversity of life, rather than just species.³³ Congress explicitly recognized the value of conserving ecosystems when it passed the Act.³⁴ For example, the Act directs the Secretary of the Interior to identify critical habitat for listed, threatened, and endangered species, and the Secretary must designate the amount of habitat necessary for the particular listed species to recover and to eventually exist without the protections of the Act.³⁵ In addition, the Supreme

³² Biodiversity is “[t]he variety of organisms considered at all levels, from genetic variants belonging to the same species, through arrays of species to arrays of genera, families and still higher taxonomic levels; includes the variety of ecosystems, which comprise both the communities of organisms within particular habitats and the physical conditions under which they live.” E.O. WILSON, *THE DIVERSITY OF LIFE* 393 (1992).

³³ See RICHARD FRANKHAM, ET AL., *INTRODUCTION TO CONSERVATION GENETICS* 2 (2002) (“[W]e have a stake in conserving biodiversity for the resources we use, for the ecosystem services it provides us, for the pleasure we derive from living organisms and for ethical reasons.”); John Copeland Nagle, *Playing Noah*, 82 *MINN. L. REV.* 1171, 1215 (1998) (“[B]iodiversity as a whole has overwhelming utilitarian value, but most individual species do not.”) (quoting CHARLES C. MANN & MARK L. PLUMMER, *NOAH’S CHOICE: THE FUTURE OF ENDANGERED SPECIES* 133 (1995)).

³⁴ One of the purposes of the Act 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 . . . species.” 16 U.S.C. § 1531(b). In furtherance of these goals, Congress expressly stated in section 2(c) that “all Federal departments and agencies *shall* seek to *conserve endangered species* and threatened species.” 16 U.S.C. § 1531(c) (emphasis added); see also Robin Waples, NMFS, *NOAA Technical Memorandum NMFS F/NWC-194: Definition of a “Species” under the Endangered Species Act: Application to Pacific Salmon* 11 (1991) (“[T]he major goal of the [Endangered Species] Act [is] to conserve the genetic diversity of species and the ecosystems they inhabit.”).

³⁵ 16 U.S.C. § 1533(a)(3) requires the Secretary of the Interior to designate “critical habitat” concurrently with the listing of a species. “Critical habitat” includes the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those

Court has recognized that the Act “is intended to protect and conserve endangered and threatened species *and their habitats*.”³⁶ Given Congress’s broad biodiversity conservation goals, the terms in the Act should not be interpreted in a way that would artificially restrict the Services’ flexibility in identifying the species to be afforded protection under the Act. PLF’s proposed definition of “species” would have precisely this effect, and should therefore be rejected.

II. PLF’s Proposed Definition of “Species” is Flawed

A. The 1% Threshold is Arbitrary

PLF proposes that the Services adopt the following definition for “species”:

A species is as group of actually or potentially interbreeding populations that are reproductively isolated from other such groups to the extent that the rate of fertile hybridization is less than 1% per generation.³⁷

PLF recognizes that requiring absolute reproductive isolation is unrealistic, because many different species are capable of producing hybrids in nature.³⁸ They therefore propose a “1% rule” to establish the permissible level of hybridization. This proposed rule, however, finds no support in the scientific literature.

In support of the “1% rule,” PLF relies on a paper by one of the signatories of these comments, Professor James Mallet.³⁹ In particular, PLF quotes the following statement: “a

physical or biological features essential to the conservation of the species, which may require special management considerations or protections. 16 U.S.C. § 1532(a)(5)(A)(i). Conserving the species means using all methods and procedures which are necessary to bring any threatened or endangered species to the point at which it can exist without the protections of the Act. 16 U.S.C. § 1532(a)(3).

³⁶ *Natl. Ass’n of Home Builders v. Defs. of Wildlife*, 551 U.S. 644, 651 (2007).

³⁷ PLF Petition, *supra* note 2, at 16.

³⁸ *Id.* at 16-17.

³⁹ James Mallet, *Hybridization, Ecological Races and the Nature of Species: Empirical Evidence for the Ease of Speciation*, 363 PHIL. TRANSACTIONS ROYAL SOC’Y B 2971 (2008).

reasonable definition of species is that they should represent differentiated clusters of genotypes between which hybridization is very rare, say less than approximately 1% per generation.”⁴⁰

This statement does not support the definition that PLF proposes. Professor Mallet was simply utilizing the 1% benchmark as an *ad hoc* yardstick to separate ecological races that overlap spatially from species, so as to discuss ecological races. He explicitly stated in his paper that the 1% rule was stipulated and arbitrary:

The rate of hybridization and gene flow should be greater than approximately 1% per generation when the races are sympatric, or we might be tempted to classify them instead as separate species. The 1% stipulation is not meant to be a hard and fast rule, and it indeed highlights the lack of any obvious distinction along a gene flow continuum between species and sympatric intraspecific races and ecotypes. The main problem with classifying all such ecological races as separate species is that we would not find it very convenient, owing to their inconstancy and extensive gene flow.⁴¹

Professor Mallet was not proposing a scientific rule to be cited as authority for a proposed regulatory definition. In fact, the major purpose of the paper cited was to point out *the lack of a* clear distinction in the continuum between species, on the one hand, and subspecies or other diversity within species, on the other. Professor Mallet had originally proposed the 1% gene flow cut-off with Michèle Drès in order to distinguish ecological races (from species), rather than to distinguish species (from races).⁴² In fact, Mallet considers that recognizable ecological races (a category that includes parasite “host races”) *are* species, but that it would be inconvenient to name all such entities with Linnean binomials.

[H]ost races in our definition and in those of Feder (1998) and Berlocher & Feder (2002) are an arbitrarily defined subset of genotypic cluster species. Distinguishing host races from species in this way is only useful because most

⁴⁰ PLF Petition, *supra* note 2, at 17, n. 56 (quoting Mallet, *supra* note 39, at 2979).

⁴¹ Mallet, *supra* note 39, at 2977.

⁴² Michèle Drès & James Mallet, *Host Races in Plant-feeding Insects and their Importance in Sympatric Speciation*, 357 PHIL. TRANSACTIONS ROYAL SOC’Y B 471, 475 (2002).

systematists would hesitate to name taxa that may have few fixed differences and that exchange genes at a rate greater than 1% per generation.⁴³

Furthermore, PLF's proposed rule would exclude some widely-recognized species and is therefore inconsistent with taxonomy as actually practiced in the scientific community. For example, "[p]er generation hybridization rates can be much higher in some populations of plants and animals, where it reaches several per cent, for example in some oaks (*Quercus*), Darwin's finches, and some cases in *Heliconius* butterflies."⁴⁴

B. PLF's Definition is Inconsistent with the Actual Practice of Species Delimitation

Further, while the Biological Species Concept is a widely-recognized species *concept*, requiring its universal use is inconsistent with the practice of species *delimitation*. As explained by Kevin de Queiroz in an influential paper, "the conceptual problem of defining the species category (species conceptualization" is distinct from "the methodological problem of inferring the boundaries and numbers of species (species delimitation)."⁴⁵ In performing species delimitation, the actual practice of taxonomists is not to rely on reproductive isolation (including rates of hybridization) as the sole characteristic upon which to base species classifications. A common criticism of the Biological Species Concept is that it does not provide operational criteria that can be used for species delimitation when two populations do not come into contact with each other.⁴⁶ In the absence of such contact, whether or not the two populations would

⁴³ *Id.* (citing J.L. Feder, *The Apple Maggot Fly, Rhagoletis pomonella: Flies in the Face of Conventional Wisdom*, in ENDLESS FORMS. SPECIES AND SPECIATION (D. J. Howard et al., 1998); S.H. Berlocher & J.L. Feder, *Sympatric Speciation in Phytophagous Insects: Moving Beyond Controversy?*, 47 ANN. REV. ENTOMOLOGY 773 (2002)).

⁴⁴ James Mallet, et al., *How Reticulated are Species?*, 38 BIOESSAYS 140, 142 (2016).

⁴⁵ De Queiroz, *supra* note 10, at 883.

⁴⁶ George & Mayden, *supra* note 13, at 391.

interbreed cannot be determined in the wild. In addition, even taxonomists who support the Biological Species Concept in principle use different kinds of characteristics when making practical classification decisions.⁴⁷ “Considerations of multiple criteria, such as diagnosability, lineage monophyly, and species recognition blend strict applications of different species concepts into an integrated practice.”⁴⁸ If the Services adopt PLF’s proposed definition of “species,” they will force themselves to use a single diagnostic criteria to delimit species, which is inconsistent with current scientific practice.

III. PLF’s Proposed Definition of Subspecies is also Problematic

Similarly, PLF’s proposed definition of “subspecies” is problematic because the “75% rule” is arbitrary and fixed. PLF proposes that “subspecies” be defined as follows: “A subspecies is a population for which at least 75% of its distribution lies outside the distribution of any other population within the same species, based on two or more independent characters—such as genetics, morphology, or ecological distinctiveness—that reflect authentic evolutionary significance.”⁴⁹

Although the 75% rule has been proposed as a definition for subspecies, it is arbitrary because taxonomists disagree about the percentage threshold for subspecies diagnosability and the number of characters that should be used when comparing populations.⁵⁰ For example, some

⁴⁷ Jack W. Sites, Jr. & Keith A. Crandall, *Testing Species Boundaries in Biodiversity Studies*, 11 CONSERVATION BIOLOGY 1289, 1292 (1997) (“[I]n many instances the operational criteria of the BSC is that of morphological differences, not the diagnostic criterion of reproductive isolation.”).

⁴⁸ See Gill, *supra* note 21, at 151.

⁴⁹ PLF Petition, *supra* note 2, at 22.

⁵⁰ Susan M. Haig, et al., *Taxonomic Considerations in Listing Subspecies Under the U.S. Endangered Species Act*, 20 CONSERVATION BIOLOGY 1584, 1586 (2006) (citing Michael A. Patten & Philip Unitt, *Diagnosability Versus Mean Differences of Sage Sparrow Subspecies*, 119 THE AUK 26 (2002)).

taxonomists advocate for a 95% rule based on one character,⁵¹ some advocate a 50% rule,⁵² and others advocate for a “75% from 75%” rule.⁵³ Even PLF concedes in its petition that “there is no consensus as to how far down the evolutionary road a population must be to qualify as a subspecies.”⁵⁴ Because of this lack of consensus, it would be inappropriate to lock in a single definition in a regulation.

Another flaw with PLF’s proposed definition of “subspecies” is that it does not recognize the different approaches to recognizing subspecies among taxonomists working with different groups of organisms.⁵⁵ For example, subspecies classifications are widely used in butterfly and bird taxonomy, but rarely used in fish taxonomy.⁵⁶ Adopting a single “subspecies” definition would require the Services to use that approach even when it is inconsistent with the practice of the taxonomists who work with particular groups of organisms.

⁵¹ See Patten & Unitt, *supra* note 50, at 27-28.

⁵² L. Rand & Melvin A. Traylor, *The Amount of Overlap Allowable for Subspecies*, 67 THE AUK 169, 176 (1950) (citing E. Stresemann, *Oekologische Sippen-Rassen-, und Arten-unterschiede bei Vögeln*, 91 J. FÜR ORNITHOLOGIE 205 (1943)).

⁵³ This rule is that 75% of one subspecies are separable from 75% of another. See Rand & Traylor, *supra* note 52, at 176 (citing A.H. Miller, *Speciation in the Avian Genus Junco* 264 (1941)).

⁵⁴ PLF Petition, *supra* note 2, at 22.

⁵⁵ Holly Doremus, *Static Law Meets Dynamic World*, 32 WASH. U.J.L. & POL’Y 175, 187 (2010) (“Those studying different organisms have developed different naming cultures.”) (citing Isaac et al., *supra* note 12, at 464).

⁵⁶ See James Mallet, *Subspecies, Semispecies, Superspecies*, 7 ENCYCLOPEDIA OF BIODIVERSITY 45, 47 (Simon A. Levin ed., 2d ed. 2013) (noting that “birds and butterflies . . . often have many morphologically or genetically distinct subspecies . . .”); Haig et al., *supra* note 50, at 1588 (noting that “under a strict subspecies definition,” the fish of every isolated creek and pond could be considered a unique subspecies, but that subspecies classification has been used “sparingly”).

IV. PLF's Proposed Definitions are not the Best Available Science

Under the ESA, the Services must make listing decisions “solely on the basis of the best scientific and commercial data” available.⁵⁷ To make a listing decision, the Services must determine both the identity of a species (i.e. the species delimitation question) and its status. Therefore, it follows logically that the “best available science” mandate applies not only to species status decisions, but also to species delimitation decisions.

This conclusion is supported by the legislative history. For example, the 1982 House report explaining the amendment that introduced the best available science mandate emphasized Congress' intent to remove economic considerations from “*any phase* of the listing process,”⁵⁸ replacing them with science. The Senate report accompanying the 1979 ESA Amendments stated that distinct population segments should be listed only when warranted by the “biological evidence.”⁵⁹ More generally, “the repeated emphasis on science throughout the ESA implies that the listing agencies must apply the best available scientific information to all scientific questions.”⁶⁰

As explained above, PLF's proposed definitions of “species” and “subspecies” are inconsistent with the current scientific understandings of those terms. As such, they do not reflect the “best available science” and the Services therefore cannot adopt them under the ESA.

⁵⁷ 16 U.S.C. §1533(b)(1)(A). In this context, “commercial” does not refer to the economic impact of listing decisions, but to the trade in endangered species or species parts. H.R. REP. NO. 97-567, at 20 (1982), *reprinted in* 1982 U.S.C.C.A.N. 2807, 2820; *see also* Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science Isn't Always Better Policy*, 75 WASH. U. L.Q. 1029, 1043 (1997).

⁵⁸ H.R. REP. NO. 97-567, at 20 (1982) (emphasis added), *reprinted in* 1982 U.S.C.C.A.N. 2807, 2826.

⁵⁹ S. REP. NO. 95-151, 7 (1979).

⁶⁰ Doremus, *supra* note 57, at 1096.

V. It is Appropriate for the Services to Continue to Rely on Case-by-case Species Delimitation Using the Best Available Science

Under their current practice, the Services do not adhere to any single species concept, or to any single source of information.⁶¹ PLF’s proposed definition of “species” would rely solely on data regarding reproductive isolation, particularly the rate of fertile hybridization. By contrast, the Services typically rely on “morphological, karyological (chromosomal), biochemical (including DNA analysis and other molecular genetic techniques), physiological, behavioral, ecological, and biogeographic characters” because “[t]he most scientifically credible approach to making taxonomic determinations is to consider all available data involving as many different classes of characters as possible.”⁶²

It is appropriate for the Services to remain flexible with regard to the species concept they employ in identifying species for conservation purposes and not to be wedded to any single concept.⁶³ This approach recognizes that taxonomy is always in flux and allows the Services to

⁶¹ Cf. Doremus, *supra* note 57, at 1101 (“The task of defining the taxonomic groups referenced in the ESA’s definition of ‘species’ . . . does not fit the view of science. . . . While it is not wholly arbitrary, in the sense of wholly unconstrained, this task is not effectively constrained by empirical data, as we envision science being. The plethora of species definitions offered by biologists demonstrates that empirical data impose only loose limits. Instead, the constraints on species definitions come from the purposes for which those definitions are developed. Species concepts are tools, adopted for their ability to perform particular functions. We should not blindly apply any existing biological species concept to the ESA’s taxonomy problem. Rather, we should seek a tool that fits the special purposes of the ESA. . . . [T]hose purposes are not likely to be fully served by any of the schemes biologists have developed.”).

⁶² *Alabama-Tombigbee Rivers Coal. v. Kempthorne*, 477 F.3d 1250, 1255 (11th Cir. 2007) (quoting Final Rule to List the Alabama Sturgeon as Endangered, 65 Fed. Reg. 26,438, 26,452 (May 5, 2000) (internal quotation marks omitted)). In this case, the Fish and Wildlife Service reviewed existing scientific literature, requested five scientists to review the proposed listing.

⁶³ See Jose M. Padial, et al., *The Integrative Future of Taxonomy*, FRONTIERS IN ZOOLOGY 7:16 (2010) (“[T]axonomy needs to be pluralistic to improve species discovery and description, and to develop novel protocols to produce the much-needed inventory of life in a reasonable time.”); Benjamin M. Fitzpatrick, et al., *Hybridization and the Species Problem in Conservation*, 61 CURRENT ZOOLOGY 206, 206 (2015) (“Discontinuities evolve gradually and sometimes disappear. Exactly how to define particular species is not always obvious. Hybridization

use the best available science with regard to any particular organism. While it makes sense for scientists to debate which species concept is “correct,” practical conservation decisions must be pragmatic. Further, such case-by-case decisions can be carried out in a sensible way,⁶⁴ and courts have upheld such an approach.⁶⁵

CONCLUSION

For the foregoing reasons, commenters urge the Services to deny PLF’s petition.

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between taxonomic species reminds us that species classification is not a perfect representation of nature. Classification is a model that is very useful, but not adequate in all cases.”).

⁶⁴ See Peter Hollingsworth, *supra* note 19 (“Continued integration of conservation assessments with taxonomic accounts is a straightforward mechanism for peer review. In high-profile cases, taxonomists can work with conservation biologists, agencies and industry to resolve disputes.”).

⁶⁵ In *Alabama-Tombigbee Rivers Coalition*, the 11th Circuit upheld the Fish and Wildlife Service’s case-by-case approach to species determinations. 477 F.3d at 1259.