The Endangered Species Act: Static Law Meets Dynamic World

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INTRODUCTION

Looking back to the origins of federal endangered species law, it is nothing short of astonishing how differently the discussion was framed then compared with now. The law that now stands as the most controversial of federal environmental mandates was utterly non-controversial when it was enacted. The ecological scientists who now play such an active role were nowhere to be seen. The issues that arouse so much conflict today were virtually ignored.

This Article looks at the discussion that preceded and accompanied the passage of the Endangered Species Act ("ESA"), focusing on why the law, including its implementation as well as its text, took the form it did. In particular, I am interested in why the ESA came to assume an unrealistically static vision of nature. The answer is complex. First, the Act's static structure is typical of law in general, which has traditionally embodied the human search for stability. Second, the Act is, inevitably, a product of the political times in which it was drafted and of a rapid and chaotic legislative process, which did not encourage thoughtful examination of the complex contours of the conservation problem. Third, it followed in part from incorrect but widely shared assumptions about the nature of the problem and potential solutions. Fourth, scientific understanding was itself in transition as the law was being crafted, moving from a focus on the tendency of ecological systems to approach equilibrium to one on the ongoing dynamics of many systems.

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For the first generation of ESA implementation, stability, although illusory, was a rough approximation of reality; conservation policy could largely ignore change. Unfortunately, we now find ourselves in a world where change is occurring at a sufficiently rapid pace that a static conservation strategy is doomed to failure. This Article examines the need for a dynamic approach, explaining how the ESA's tacit assumptions of stasis complicate the task of conservation. It then looks at the prospects for moving to a more dynamic model of conservation policy, and what it would take to get there. It concludes that there are real political, psychological, and practical barriers to truly dynamic conservation policy, but that there are ways to move incrementally in that direction.

I. IN THE BEGINNING

The story of the ESA's passage has been told a number of times, but from this point of increasingly distant hindsight it is worth another look. Although the ESA was by no means the first national conservation law, it marked a distinct change from past federal conservation efforts in a number of important respects. Earlier law had protected only fish and wildlife.[1] Section 4 of the 1973 ESA extended protection for the first time to imperiled plants[2] and to taxonomic groups below the subspecies level.[3] Earlier law had encouraged federal agencies to engage in conservation where it was consistent with their primary missions.[4] Through section 7, the new ESA imposed a conservation mandate on all federal agencies

1. *See* National Wildlife Refuge System Administration Act of 1966, Pub. L. No. 89-669, § 1a, 80 Stat. 926 (1966) (providing for conservation of "selected species of native fish and wildlife"); Endangered Species Conservation Act of 1969, Pub. L. No. 91-135, § 1(2), 83 Stat. 275 (1969) (extending coverage to invertebrates, but not to plants).

2. *See* Endangered Species Act of 1973, Pub. L. No. 93-205, § 3(11), 87 Stat. 886 (1973) (codified as amended at 16 U.S.C. § 1532(16)(2000)) (including plants in the definition of "species").

3. The 1969 Endangered Species Conservation Act had allowed protection of subspecies. § 3(a), 83 Stat. at 275. The 1973 ESA defined "species" to include subspecies and "any other group of fish or wildlife of the same species or smaller taxa in common spatial arrangement that interbreed when mature." § 2(11), 87 Stat. at 886 (1973).

4. *See* National Wildlife Refuge System Administration Act of 1966, § 2(d) (directing the Secretary of the Interior to use programs under his jurisdiction to further conservation purposes "to the extent practicable" and to "encourage other Federal agencies" to do so).

requiring that their actions not jeopardize listed species.[5] Earlier law had imposed no restrictions on actions beyond federal lands. Through section 9, the ESA forbade the "take," broadly defined,[6] of any endangered species by any person anywhere within the United States.[7]

Despite these sweeping changes, enactment of the ESA was a surprisingly placid affair. Essentially no skepticism was expressed about either the law's conservation goals or its regulatory strategies. There was no organized interest group opposition. No one voted against the Senate bill. Twelve members of the House of Representatives initially voted no, but none of them spoke against the bill, and only four persisted in their opposition after the bill came back from the conference committee.[8] To the extent there was any disagreement among legislators or witnesses at the legislative hearings, it was focused entirely on the role of states,[9] an issue that receded to the background as soon as the law was passed.

Not long after The ESA's passage, Steven Yaffee described it as "one of the last pieces of environmental bandwagon legislation."[10] Legislators appear to have regarded it as an opportunity to deliver ringing rhetoric that would please the environmental movement without facing any immediate political costs. Discussion centered on charismatic species like grizzly bears, bald eagles, and timber wolves.[11] Lawmaker after lawmaker stepped up to describe the potential for disastrous results, up to and including threats to survival

5. § 7, 87 Stat. at 892. This mandate was later softened slightly, so that it now requires only that federal agencies "insure" that their actions are "not likely" to cause jeopardy or adversely modify critical habitat. 16 U.S.C. § 1536(a)(2) (2006).

6. Endangered Species Act of 1973 § 3(14) (codified at 16 U.S.C. § 1532(19) (2006)).

7. Endangered Species Act of 1973 § 9 (codified at 16 U.S.C. § 1538 (2006)).

8. Shannon Petersen, Comment, *Congress and Charismatic Megafauna: A Legislative History of the Endangered Species Act*, 29 ENVTL. L. 463, 475–76 (1999).

9. *Id.* at 474–75.

10. STEVEN L. YAFFEE, PROHIBITIVE POLICY: IMPLEMENTING THE FEDERAL ENDANGERED SPECIES ACT 48 (1982).

11. Petersen, *supra* note 8, at 479–80. Petersen suggests that the Nixon administration may not even have realized that the law as enacted extended protection to plants. *Id.* at 480. That may not have seemed like an important question at the time, since the taking of listed plants, even on federal lands, was not prohibited until 1982. Endangered Species Act Amendments of 1982, Pub. L. No. 97-304, § 9(b), 96 Stat. 1411, 1426 (1982) (codified as amended at 16 U.S.C. § 1538(a)(2)(B) (2000)).

of the human species, if the extinction tide were not stemmed.[12] Apparently, few foresaw the extent to which the ESA would conflict with established federal agency missions and private economic interests.

Although the statute's words seem clear, it is widely believed that most legislators were not aware of the full scope of the ESA's coverage when they voted for it. Early drafts of section 7 left considerable wiggle room in federal obligations, mandating only that agencies take "practicable" steps to conserve listed species, much like the 1966 Act. But a handful of White House and congressional staffers reworked the bill, introducing a firm prohibition on federal actions that would jeopardize listed species or adversely modify critical habitat. According to Curtis Bohlen, Undersecretary of the Interior at the time, "there were probably not more than four of us who understood its ramifications."[13] Comments made during Senate consideration of the final bill suggest that Bohlen was right,[14] although representatives of the Nixon administration had frankly acknowledged in legislative hearings that section 7 would "prevent [agencies] from taking action which would jeopardize the continued existence of endangered species."[15]

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12. A number of citations from the legislative history are collected in Holly Doremus, *The Rhetoric and Reality of Nature Protection: Toward a New Discourse*, 57 WASH. & LEE L. REV. 11, 21 n.60 (2000).

13. CHARLES C. MANN & MARK L. PLUMMER, NOAH'S CHOICE: THE FUTURE OF ENDANGERED SPECIES 160 (1995) (quoting then-Deputy Secretary of the Interior, E.U. Curtis Bohlen).

14. *See* Petersen, *supra* note 8, at 481 (quoting remarks by Senator Tunney, floor manager of the bill, to the effect that federal agencies would decide after consultation whether to proceed with a project). The true strength and rigidity of section 7 were not much disguised to those who took the time to look. A law student interpreting the new law shortly after its passage wrote: "[I]t seems inevitable that § 7 will bring federal actions to a grinding halt in the near future." Rudy R. Lachenmeier, Student Article, *The Endangered Species Act of 1973: Preservation or Pandemonium?*, 5 ENVTL. L. 29, 82–83 (1974). By 1976, with the first case interpreting section 7 decided and the Tellico Dam conflict looming, others had also noted "the apparently absolute mandate" of section 7. *See* Kate Hutcherson, *Endangered Species: The Law and the Land*, J. FORESTRY, Jan. 1976, 31, 32 (quoting a Forest Service official as saying that section 7 "has the potential to drastically change management prerogatives on large areas of land"); Richard Mallory, Note, *Obligations of Federal Agencies under Section 7 of the Endangered Species Act of 1973*, 28 STAN. L. REV. 1247, 1253 (1976).

15. Hearings on the Endangered Species Act of 1973 before the Subcomm. on Environment of the Senate Comm. on Commerce, 93d Cong., 1st Sess., at 68 (1973) (statement of Douglas Wheeler, Deputy Assistant Secretary of the Interior for Fish, Wildlife and Parks);

With respect to the take prohibition of section 9, again the language of the statute seems clear. No one may "take" an endangered wildlife species without a permit.[16] The statute defines "take" to include to "harm" or "harass" as well as to kill or capture.[17] The word "harm" was added in a Senate floor amendment, but the Senate Report on the bill provided that "[Take] is defined . . . in the broadest possible manner to include every conceivable way in which a person can 'take' or attempt to 'take' any fish or wildlife."[18] That the law might limit habitat destruction also seems implicit in its findings, which include that "economic growth and development untempered by adequate concern"[19] have been responsible for past extinctions, and its first-mentioned purpose of conserving "the ecosystems upon which endangered species and threatened species depend."[20]

Still, Shannon Petersen may be right that "no one in Congress contemplated that the prohibition against taking a listed species might lead to the regulation of land use activities on private property."[21] There certainly were statements in the legislative history about the importance of habitat destruction as a threat to species, but such statements were coupled with references to the ability of the federal government to purchase habitat rather than to the regulatory power of section 9.[22] Much greater emphasis was put on the need to control overhunting.[23] To the extent that people noticed the apparent strength of the ESA, they may simply have assumed that it was not intended to and would not result in exercise of such broad regulatory powers.

Hearings on Endangered Species before the Subcomm. on Fisheries and Wildlife Conservation and the Environment of the House Comm. on Merchant Marine and Fisheries, 93d Cong., 1st Sess., at 188 (1973).

16. Endangered Species Act of 1973 § 9, 16 U.S.C. § 1538 (2006).

17. *Id.* § 1532(19).

18. S. REP. NO. 93-307, at 7 (1973), *reprinted in* 1973 U.S.C.C.A.N. 2989, 2995. The House Report used similar language, asserting that "the broadest possible terms" were used to describe takings. H.R. REP. NO. 93-412, at 15 (1973).

19. *Id.* § 1531(a)(1).

20. 16 U.S.C. § 1531(b) (2006).

21. Petersen, *supra* note 8, at 481–82.

22. *See* Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 706 n.19 (1995); *id.* at 728–29 (Scalia, J., dissenting); Lachenmeir, *supra* note 14, at 39–41; Petersen, *supra* note 8, at 482.

23. Petersen, *supra* note 8, at 482.

Environmental citizen suits were new in 1973, and their strength was largely untested. The fact that the ESA included a citizen suit provision,[24] therefore, would not necessarily have put people on notice that the implementing agencies could be pushed to go beyond politically easy steps in implementing the law.

Shortly after the ESA was signed, a law student noted its "alarming"[25] potential to require strong habitat protection:

> [I]t is conceivable that the government could argue that destruction of habitat for whatever reason, including logging, could be harassment and harmful to endangered species. As applied to private land, such an interpretation would appear to be on the fringe area of possible interpretations because of both the wording of the Act itself and the world-stopping effects.[26]

That the Act's passage went almost unnoticed by the national press suggests that no such "world-stopping effects" were anticipated. The *Washington Post* editorialized in favor of the new law while it was under consideration.[27] The *New York Times* had campaigned for the first federal endangered species law in 1966.[28] But the *Post*, *Times*, and other major papers barely acknowledged the milestone when the 1973 ESA was finally signed into law.[29]

The scientific community appears to have been similarly unimpressed. Today, it is difficult to find an issue of *Science*, *BioScience*, *Conservation Biology*, or any major ecology journal that does not mention conservation law and policy. Today, any important legislative or regulatory development is extensively covered in the scientific press. But in 1973 almost nothing was said about the

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24. 16 U.S.C. § 1540(g) (2006).

25. Lachenmeier, *supra* note 14, at 39.

26. *Id. See also* Mallory, *supra* note 14, at 1252 (suggesting that "the most significant reference to habitat may be in section 7, since that section imposes controls on all federal actions with an impact on habitat"). With remarkable prescience, Lachenmeier went on to suggest a hypothetical: "[c]onsider here that if the spotted owl was determined to be endangered and that if it needs 200 to 300 acres of old-growth Douglas fir per mating pair, how many acres of timber could be tied up . . . ." Lachenmeier, *supra* note 14, at 39. Others insisted that "because of property rights, it is not possible to legally protect critical habitat on private lands." Hutcherson, *supra* note 14, at 33.

27. Editorial, *Protecting Endangered Species*, WASH. POST, June 26, 1973, at A22.

28. Editorial, *Man, the Endangered Species*, N.Y. TIMES, Jan. 26, 1966, at 36.

29. Petersen, *supra* note 8, at 483.

impending passage of the ESA. That was not simply because scientists of the era were apolitical or did not recognize the importance of law for conservation. *Science* covered the rise of environmental law and the increasingly active practice of environmental litigation in the late 1960s, noting the role of scientists in that litigation.[30] *BioScience* had noted the anthropogenic extinction crisis as early as 1970, and praised biologists who were becoming more active in addressing the problem.[31] In 1973 the scientific publications covered the negotiations that produced the Convention on International Trade in Endangered Species[32] and later criticized the slow pace of ratification and U.S. implementation of that treaty.[33] But they said nothing about the domestic ESA until the Tellico case bubbled up.[34] It seems that conservation scientists, like the general-interest press and most legislators, did not consider the ESA groundbreaking, or even particularly important.[35]

It sounds strange to say it, given the heat of the conflicts that developed within the first few years of the ESA's legislative life and have persisted ever since, but the birth of the law may have been too easy. If legislators had thought more carefully about what they were doing, they might not have passed a law with the same strength and scope. In that sense, the lack of controversy worked to the benefit of conservation interests. But it also left some key issues, including the

30. Luther J. Carter, *Conservation Law I: Seeking a Breakthrough in the Courts*, 166 SCI. 1487 (1969); Luther J. Carter, *Conservation Law II: Scientists Play a Key Role in Court Suits*, 166 SCI. 1601 (1969).

31. Lee M. Talbot, *Endangered Species*, 20 BIOSCIENCE 331 (1970). A responsive letter pointed out some shortcomings of the Department of the Interior's interpretation of the 1969 Endangered Species Conservation Act. Kenneth Crowell, Letter in response to Lee Talbot, *Endangered Species*, 20 BIOSCIENCE 790 (1970).

32. International Trade in Endangered Species of Wild Fauna and Flora, *Convention Done*, Mar. 3, 1973, 27 U.S.T. 1087, T.I.A.S. No. 8249. For scholarly coverage of the treaty, see, e.g., Robert Gillette, *Endangered Species: Moving toward a Cease-Fire*, 179 SCI. 1107 (1973).

33. *See* Constance Holden, *Slow Going on the Endangered Species Front*, 189 SCI. 623 (1975).

34. *See generally* Constance Holden, *Endangered Species: Review of Law Triggered by Tellico Impasse*, 196 SCI. 1426 (1977).

35. *See* Holden, *supra* note 34, at 1426. Passage of the Marine Mammal Protection Act in 1972 was also lightly covered in the scientific press, garnering only a brief story in *BioScience*. *See* Anita M. Kongelbeck, *The Marine Mammal Protection Act of 1972*, 22 BIOSCIENCE 548 (1972).

law's goals, strategies for its implementation, and its effects on private economic activities, undiscussed.

A wave of amendments followed the Tellico Dam controversy in the late 1970s and early 1980s,[36] but the key features of the law have proved surprisingly politically resilient. Since 1988, when minor changes were made,[37] legislative gridlock and risk aversion on all political sides have prevented amendment of the ESA. In important respects, the Act continues to rest on a series of assumptions that have never been rigorously examined or tested. Some of those assumptions turn out to be both wrong and ill-suited to the conservation tasks of the twenty-first century.

II. A STATIC VISION OF NATURE AND OF LAW

In at least three respects, the ESA as implemented relies on an unrealistically static vision of nature and on a commitment to static law. First, although the legislative history reveals a familiarity with evolution and a desire to protect it, the law nevertheless has come to embody the essentialist notion that natural types are distinct and unchanging. Second, the regulatory provisions of the ESA assume a vision of nature that is both static and simplistic, in which affirmative management is not required and the best thing people can do for other species is to leave them alone. Third, driven by political pressures and an entirely conventional view of the nature of commitments, the agencies that implement the ESA have promised that conservation commitments, once made, will not later be increased.

Although I discuss these three fallacies sequentially for analytical purposes, they are inextricably linked in both origins and impacts. Of course, all of this discussion is exaggerated to make a point; the ESA, like the concepts that underlie it, is not and never has been entirely static. But, like ecologists and lawyers, it has frequently overemphasized the static and underplayed the dynamic. This is becoming a more obvious flaw—and a more troublesome one—as we

36. Act of Nov. 10, 1978, Pub. L. No. 95-632, 92 Stat. 3751 (1978); Act of Dec. 28, 1979, Pub. L. No. 96-159, 93 Stat. 1225 (1979); Act of Oct. 13, 1982, Pub. L. No. 97-304, 96 Stat. 1411 (1982).

37. *See* Endangered Species Act Amendments of 1988, Pub. L. No. 100-478, 102 Stat. 2306 (1988).

come to understand that nature is dynamic on human time scales, and as human actions increase the pace of change in the natural world.

A. Conservation Goals and the Essentialist Fallacy

The ESA sets out as its purposes the conservation of species and the ecosystems upon which they depend,[38] based on findings that species that are of value to the nation and its people in a variety of ways have become or are in danger of becoming extinct.[39] That seems straightforward enough, but its implementation necessarily requires agreement on what "species" are and how they should be identified.

Agreement on those questions is surprisingly hard to reach. There is no unambiguous, widely accepted, and uniformly applicable definition of a species. That is not because scientists have not tried to develop one: the identification of natural kinds has been a human preoccupation for centuries.[40] The problem is that species are not discrete in the way that chemical elements are; the boundaries between or around species are not fixed, and there is no objective way to decide precisely where those boundaries should be drawn.[41] Line-drawing, because it cannot be objective, must be tailored to some purpose or derived from some principles if it is to be non-arbitrary. However, neither Congress nor the agencies that implement the ESA have articulated principles for resolving the conservation taxonomy problem.

One reason for that oversight is that the conservation taxonomy problem was not recognized when the ESA was being drafted; it only became apparent later, when the agencies implementing the ESA actually confronted controversy and had to navigate difficult choices.

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38. 16 U.S.C. § 1531(b) (2006). There is a third purpose: to take appropriate steps to achieve the purposes of a list of international conservation agreements. *Id.*

39. 16 U.S.C. § 1531(a) (2006).

40. Ernst Mayr has called taxonomy, the science of classifying organisms, biology's oldest branch. ERNST MAYR, THE GROWTH OF BIOLOGICAL THOUGHT: DIVERSITY, EVOLUTION, AND INHERITANCE 243 (1982).

41. Charles Darwin recognized the unavoidable arbitrariness of species divisions as soon as he recognized that species are not unchanging entities. *See* MAYR, *supra* note 40, at 269; Jody Hey et al., *Understanding and Confronting Species Uncertainty in Biology and Conservation*, 18 TRENDS ECOLOGY & EVOLUTION 597, 597 (2003).

People tend to think they know the difference between species, based on differences in appearance and reproductive boundaries, even if they cannot supply a precise definition. Most familiar species, under most conditions, appear invariant on time scales relevant to a human life. As a result, even people who are quite familiar with evolution can easily fall into the essentialist fallacy (the assumption that species are—or at least can be treated as if they are—invariant).[42] In the absence of close scientific engagement in the drafting process, legislators might easily have assumed, incorrectly, that species are both easily identifiable using objective tools[43] and unchanging on time scales relevant to conservation policy efforts.

1. The Species Problem in Taxonomy

Early taxonomic classification systems, the best known of which was developed by Linnaeus, were explicitly essentialist. They relied on differences in appearance and behavior as markers assumed to reveal the boundaries between natural kinds created by God that were distinct and unchanging.[44] The development of evolutionary theory undermined the conceptual basis for such systems, and for a time cast taxonomy adrift. Eventually, though, evolutionary theory brought its own principles to the exercise of classification. At least since 1942, when Ernst Mayr published an influential book articulating the biological species concept,[45] the dominant taxonomic principle has been the identification of evolutionary relationships.

Mayr's biological species concept ("BSC") remains the best-known and probably the most widely used species definition. The BSC identifies as a species any group of organisms that interbreeds within the group but not with outsiders.[46] It focuses on reproductive

42. The essentialist species concept is discussed in MAYR, *supra* note 40, at 256–58.

43. *See* Stephen T. Garnett & Les Christidis, *Implications of Changing Species Definitions for Conservation Purposes*, 17 BIRD CONSERVATION INT'L 187, 188 (2007).

44. ERNST MAYR, SYSTEMATICS AND THE ORIGIN OF SPECIES 108–09 (1942); Editorial, *The Legacy of Linnaeus*, 446 NATURE 231, 232 (2007); Emma Marris, *The Species and the Specious*, 446 NATURE 250, 251 (2007).

45. *See* MAYR, *supra* note 44.

46. *See* EDWARD O. WILSON, THE DIVERSITY OF LIFE 38 (1982) ("[A] species is a population whose members are able to interbreed freely under natural conditions.") (emphasis

isolation as the foundation of genetic divergence and, therefore, of the development of new species.

Mayr's articulation of the BSC did not end debate among biologists about how species ought to be identified, and for good reason. At the operational level, the BSC does not fit all situations. It cannot be coherently applied to organisms that reproduce primarily by asexual means, and it would give misleading results if applied stringently to the many species that hybridize readily with others but still manage to retain their genetic and morphological distinctiveness in nature.[47] It also can be difficult to operationalize, because it is not easy to observe whether interbreeding is or might be occurring.[48] Finally, it is now recognized that reproductive isolation is not essential to genetic divergence and speciation; adaptive selection can effectively substitute for isolation and genetic drift.[49]

Scientists dissatisfied with the BSC have developed a host of competing species concepts. Ten years ago, a review found twenty-two such concepts in the modern literature,[50] and the issue remains a hot topic for debate.[51] The differences among all these concepts, however, are not fundamental. They reflect considerable disagreement about the appropriate criteria for identifying species—morphology, interbreeding, or genetic divergence (neutral or adaptive)—and the degree of separation necessary to recognize a boundary. The plurality of definitions persists, and is likely irreducible, because no single definition works for every type of

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omitted); Stephen J. O'Brien & Ernst Mayr, *Bureaucratic Mischief: Recognizing Endangered Species and Subspecies*, 251 SCI. 1187, 1187 (1991).

47. Holly Doremus, *Listing Decisions under the Endangered Species Act: Why Better Science Isn't Always Better Policy*, 75 WASH. U. L.Q. 1029, 1091 (1997).

48. 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, 391 (2005).

49. Patrik Nosil, *Ernst Mayr and the Integration of Geographic and Ecological Factors in Speciation*, 95 BIOLOGICAL J. LINNEAN SOC'Y 26, 26–27 (2008).

50. R. L. Mayden, *A Hierarchy of Species Concepts: The Denouement in the Saga of the Species Problem*, *in* SPECIES: THE UNITS OF BIODIVERSITY 381, 389 (M. F. Claridge, H. A. Dahwah & M. R. Wilson eds., 1997). *See also* Marris, *supra* note 44, at 251 (quoting one systematist as saying "We have more definitions [of species] than I can even remember.").

51. *See, e.g.*, SPECIES CONCEPTS AND PHYLOGENETIC THEORY: A DEBATE (Quentin D. Wheeler & Rudolf Meier eds., 2000).

organism.[52] Despite these differences, there is general agreement that the species represents a fundamental organizing unit, even if it cannot be clearly defined. Conceptually, the species represents a shared evolutionary history, "the contemporaneous tip of an evolutionary lineage."[53]

Notwithstanding this fundamental conceptual agreement, the choice of species definitions can make a significant difference in practice. For example, the "phylogenetic species concept" ("PSC") is probably the most widely used after Mayr's BSC. The PSC recognizes as species "populations differing by at least one taxonomic character from all others,"[54] whether or not reproductively isolated. Its use tends to produce more species than reliance on the biological species concept, which requires a showing of reproductive isolation.[55] Despite this general tendency toward "taxonomic inflation,"[56] use of the phylogenetic approach also calls into question some established taxonomic distinctions.[57]

Subspecies are an even more contested category. Subspecies do not have the fundamental biological significance of species; they are

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52. Mark L. Blaxter, *The Promise of a DNA Taxonomy*, 359 PHIL. TRANSACTIONS: BIOLOGICAL SCIS. 669, 669 (2004).

53. Jody Hey, *On the Failure of Modern Species Concepts*, 21 TRENDS ECOLOGY & EVOLUTION 447, 449 (2006). *See also* Kevin de Queiroz, *Ernst Mayr and the Modern Concept of Species*, 102 PROC. NAT'L ACAD. SCIENCES 6600, 6603 (2005) (explaining that the species represents a "separately evolving metapopulation lineage"); Dylan J. Fraser & Louis Bernatchez, *Adaptive Evolutionary Conservation: Towards a Unified Concept for Defining Conservation Units*, 10 MOLECULAR ECOLOGY 2741, 2745 (2001) ("[S]pecies concepts are fundamentally not very different from each other.").

54. Nick J.B. Isaac et al., *Taxonomic Inflation: Its Influence on Macroecology and Conservation*, 19 TRENDS ECOLOGY & EVOLUTION 464, 465 (2004). The distinct character can be morphological but more often is a difference in a conserved gene sequence. *Id.*

55. *Id.* One study found that the phylogenetic approach generated an average of forty-eight percent more species than the biological species concept applied to the same groups of organisms. Paul-Michael Agapow et al., *The Impact of Species Concept on Biodiversity Studies*, 79 Q. REV. BIOLOGY 161, 164 (2004).

56. The term "taxonomic inflation" appears to have been coined by David Patterson. *See* David Patterson, *The Diversity of Eukaryotes*, 154 AM. NATURALIST S96, S99 (1999). Isaac et al. define it as the situation "in which many existing subspecies are raised to species level." Isaac et al., *supra* note 54, at 464. Or, as one of the co-authors of that study describes it on his web page, "[t]axonomic inflation is the rapid accumulation of scientific names due to processes other than new discoveries of taxa." James Mallet, Taxonomic Inflation, http://www.ucl.ac.uk/taxome/jim/Sp/taxinfl.html (last visited Apr. 21, 2010).

57. It suggests, for example, that polar bears are in the same species as brown bears. Marris, *supra* note 44, at 250.

not the units of evolution. Nor does their identification follow logically from one or more species concepts.[58] Indeed, many subspecies are relics of earlier classification systems; subspecies proliferated as the spread of the BSC resulted in the "demotion" of named entities that did not fit Mayr's demanding definition.[59] Those studying different organisms have developed different naming cultures.[60] Birds, for example, tend to be separated into more subspecies than fish, even when the pattern of variation is similar.[61] It is frequently observed that subspecies are "inherently subjective," or even arbitrary.[62] Because of its difficulties, "the subspecies concept is gradually falling out of favour with most current taxonomists,"[63] although it continues to be used and "many subspecies are evolutionarily definable entities."[64]

Below the subspecies level, the situation gets even murkier. The distinction between a subspecies and a population is unclear, both at

58. There is no room for subspecies in the phylogenetic species concept. Under Mayr's BSC, which identifies species on the basis of reproductive isolation, it might be logical to recognize as subspecies groups that are partially reproductively isolated, but that is not how subspecies have been identified in practice. Susan M. Haig et al., *Taxonomic Considerations in Listing Subspecies under the U.S. Endangered Species Act*, 20 CONSERVATION BIOLOGY 1584, 1585 (2006).

59. *See* Robert M. Zink, *The Role of Subspecies in Obscuring Avian Biological Diversity and Misleading Conservation Policy*, 271 PROC: BIOLOGICAL SCI. 561, 561 (2004).

60. *See* Isaac et al., *supra* note 54, at 464.

61. NAT'L RESEARCH COUNCIL, SCIENCE AND THE ENDANGERED SPECIES ACT 55 (1995). *See also* Haig et al., *supra* note 58, at 1588 (noting that "under a strict subspecies definition," the fish of every isolated creek could be considered a unique subspecies, but that subspecies classification has been used "sparingly"). For an analysis of speciation differences among taxa, see generally ALESSANDRO MINELLI, BIOLOGICAL SYSTEMATICS: THE STATE OF THE ART (1993).

62. *See* MAYR, *supra* note 40, at 251–53; M.A. Cronin, *The Preble's Meadow Jumping Mouse: Subjective Subspecies, Advocacy and Management*, 10 ANIMAL CONSERVATION 159, 159 (2007) and citations therein; Matthew A. Cronin, *Systematics, Taxonomy, and the Endangered Species Act: The Example of the California Gnatcatcher*, 25 WILDLIFE SOC'Y BULL. 661, 661–62 (1997); Haig et al., *supra* note 58, at 1586 ("In an extensive literature review, we found no universally accepted subspecies definition within or across taxa."); Oliver A. Ryder, *Species Conservation and Systematics: The Dilemma of Subspecies*, 1 TRENDS ECOLOGY & EVOLUTION 9, 9 (1986) ("The folklore of mammalogy is replete with humorous anecdotes such as two subspecies being named from individuals that were littermates. Yet, other taxa that have been considered by some authorities to be conspecific, for example the barking deer or muntjacs of India and China, produce sterile hybrids.").

63. Rainer Froese, *The Good, the Bad, and the Ugly: A Critical Look at Species and Their Institutions from a User's Perspective*, 9 REVS. FISH BIOLOGY & FISHERIES 375, 376 (1999).

64. Haig et al., *supra* note 58, at 1586.

the conceptual and at the pragmatic level,[65] and the term population (like subspecies) has no fixed biological significance. The criticisms of subspecies identification apply equally to the identification of populations as taxonomic units: as with subspecies, "there is no consensus as to the extent of differentiation required."[66]

2. Translating Taxonomy to Law

The difficulties of identifying taxa might concern only taxonomists, except that the ESA attaches significant regulatory and economic consequences to taxonomic line-drawing. The ESA calls for protection of species that are in danger of extinction or likely to become so in the foreseeable future.[67] It includes a definition of "species" that is broad, but not a model of clarity:

> The 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.[68]

The more narrowly a "species," within the meaning of the statute, is defined, the more likely it is to qualify for listing. Fewer individuals and smaller ranges magnify the impact of threats.[69]

Fights about ESA protection resting on taxonomy are frequent. One might think that the significance of divisions at the species level would be minimal, because the law allows protection of subspecies and distinct population segments. But it turns out that species-level taxonomy matters in at least two situations: when dealing with hybrids or possible hybrids, and when determining how important a threatened local population is to its full taxon.

Hybridization could push against listing, if it led to the conclusion that the group in question is not a "true" species, or that a once-extant species has ceased to exist. Or it could push toward listing, if outbreeding poses a threat to the "true" species. And without regard

65. *See* Froese, *supra* note 63, at 376.
66. Cronin, *supra* note 62, at 663.
67. *See* 16 U.S.C. § 1533(a)(1) (2006); § 1532(6) (20).
68. 16 U.S.C. § 1532(16) (2006).
69. Marris, *supra* note 44, at 251.

to the legal ramifications, hybridization might seem like the only hope for any kind of future for the most severely reduced groups.

The U.S. Fish and Wildlife Service ("FWS") and National Marine Fisheries Service ("NMFS," also known as NOAA Fisheries) (together "the Services"), do not currently have a formal policy on hybrids. The Interior Solicitor's office waffled in the early days of the ESA, first concluding that any progeny of a protected entity was itself protected, then quickly reversing course to say that the progeny of interbreeding between species or even between subspecies were flatly ineligible for federal protection.[70] That stance was withdrawn as too "rigid" in 1990.[71] A new policy was proposed in 1996,[72] but it was never finalized. FWS now evaluates the legal consequences of hybridization on a case-by-case basis.[73]

So far, the hybrid question has arisen infrequently. In 1981, the dusky seaside sparrow, a listed subspecies, was down to five individuals, all male.[74] Biologists deliberately bred those males with females from a morphologically similar subspecies, under a plan designed to produce birds that would be morphologically indistinguishable from the dusky within a few generations.[75] The breeding program was ended, however, when FWS concluded that it could not provide funding because the hybrid progeny would not be protectable under the ESA.[76] In 2005, NMFS refused to list a type of coral known as the fused-staghorn because, although it was described as a species in the taxonomic literature, recent genetic evidence suggested that it was a hybrid between two other species.[77] On the

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70. *See* Kevin D. Hill, *The Endangered Species Act: What Do We Mean by Species?*, 20 B. C. ENVTL. AFF. L. REV. 239, 243–46 (1993); O'Brien & Mayr, *supra* note 46, at 1187.

71. Reconsidered Finding for an Amended Petition to List the Westslope Cutthroat Trout as Threatened throughout Its Range, 68 Fed. Reg. 46,989, 46,992 (Aug. 7, 2003) (citing a 1990 Memorandum from the Assistant Solicitor for Fish and Wildlife, U.S. Department of the Interior, to Director, U.S. Fish and Wildlife Service) (to be codified at 50 C.F.R. pt. 17) [hereinafter WCT Finding].

72. Proposed Policy and Proposed Rule on the Treatment of Intercrosses and Intercross Progeny (the Issue of "Hybridization"), 61 Fed. Reg. 4710 (Feb. 7, 1996) (to be codified at 50 C.F.R. pt. 424).

73. WCT Finding, 68 Fed. Reg. at 46,992.

74. Hill, *supra* note 70, at 258.

75. *Id.* at 258–59.

76. *Id.* at 259–61.

77. Proposed Threatened Status for Elkhorn Coral and Staghorn Coral, 70 Fed. Reg.

other hand, FWS twice has denied petitions requesting that the red wolf be removed from the protected list on the grounds that it is "only" a hybrid between the gray wolf and the coyote.[78] FWS determined that the evidence did not support the claim that the red wolf originated by hybridization, but also asserted that even if that were its origin, the red wolf could and would remain protected because it is "representative of the canids that roamed the Southeast historically and . . . morphologically and behaviorally distinct from coyotes and gray wolves."[79]

Most recently, FWS has grappled with the taxonomic status of the westslope cutthroat trout ("WCT"), a species known to have hybridized in some locations with non-native fish that were stocked to support recreational fishing. FWS initially determined that the WCT was neither endangered nor threatened.[80] In making that determination, the agency counted all populations, including those known to have substantial introgression from non-native trout species, even though it recognized hybridization with those other species as a major threat. This method of counting helped FWS conclude that the trout was sufficiently abundant and widespread that it did not qualify for listing. A federal court struck that decision down, finding that FWS had not adequately explained its inclusion of populations with substantial introgression.[81] On its second take, FWS decided to include all populations within the recognized range of the WCT that showed morphology within the range expected for the WCT. FWS justified its choice on the grounds that:

> [N]atural populations conforming morphologically to the scientific taxonomic description of WCT are presumed to

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24,359, 24,360 (May 9, 2005) (to be codified at 50 C.F.R. pt. 223). NMFS eventually listed both parent species as threatened. Final Listing Determinations for Elkhorn Coral and Staghorn Coral, 71 Fed. Reg. 26,852 (May 9, 2006) (to be codified at 50 C.F.R. pt. 223).

78. 90-Day Finding for a Petition to Delist the Red Wolf, 62 Fed. Reg. 64,799 (Dec. 9, 1997) (to be codified at 50 C.F.R. pt. 17); Finding on a Petition to Delist the Red Wolf, 57 Fed. Reg. 1246 (Jan. 13, 1992).

79. Finding on a Petition to Delist the Red Wolf (Canis rufus), 57 Fed. Reg. 1246, 1250 (Jan. 13, 1992) (to be codified at 50 C.F.R. pt. 17).

80. 12-Month Finding for an Amended Petition to List the Westslope Cutthroat Trout as Threatened throughout Its Range, 65 Fed. Reg. 20,120 (Apr. 14, 2000) (to be codified at 50 C.F.R. pt. 17).

81. Am. Wildlands v. Norton, 193 F. Supp. 2d 244, 257 (D.D.C. 2002).

> express the behavioral, ecological, and life-history characteristics of WCT native to the geographic areas where those populations occur.[82]

In other words, the agency interpreted the ESA as protecting the expected look, behavior, and ecological role of the native species, whether or not the fish expressing those characteristics had some level of "outside" genes. That approach was upheld by the D.C. Circuit.[83]

The scope of a species can determine whether a population warrants listing or not. The ESA itself says little about which populations can be listed—it simply defines a "distinct population segment" ("DPS") eligible for listing as one that "interbreeds when mature."[84] But a congressional report warned implementing agencies that they should list populations cautiously;[85] not surprisingly, they have taken the hint. In 1996, the Services issued a joint policy saying that a group would qualify as a listable distinct population segment only if it were shown to be both "substantially reproductively isolated" and "an important component in the evolutionary legacy of the species."[86] That second element means that whether a group constitutes a listable population depends critically on the definition of the species to which it belongs.

Defining "species" became a point of contention when NMFS had to decide whether to list killer whales in the Puget Sound area. The taxonomic community formally recognizes only one global species of killer whale. Although NMFS scientists believed that taxonomy was outdated and did not accurately reflect the biology of the killer whale, the agency used the global species as the comparison taxon. It found

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82. Reconsidered Finding for an Amended Petition to List the Westslope Cutthroat Trout as Threatened throughout Its Range, 68 Fed. Reg., 46,989, 46,995 (Aug. 7, 2003) (to be codified at 50 C.F.R. pt. 17). The agency still found that the WCT did not warrant listing, because WCT populations retaining "substantial portions of their genetic ancestry" were widely distributed in secure habitats. *Id.* at 47,006.

83. *Am. Wildlands*, 530 F.3d, at 998–1000.

84. 16 U.S.C. § 1532(16) (2006).

85. S. REP. NO. 96-151, at 7 (1979), *as reprinted in* CONGRESSIONAL RESEARCH SERVICE, A LEGISLATIVE HISTORY OF THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED IN 1976, 1977, 1978, 1979, AND 1980, at 1397 (1982).

86. Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species Act, 61 Fed. Reg. 4722, 4722 (Feb. 7, 1996).

that the Puget Sound whales were not significant to the global taxon. Accordingly, it declined to list them. A reviewing court ruled that the agency had improperly relied on a global taxon its own scientists universally believed was incorrect, violating the ESA's requirement that listing decisions rest on the best available scientific information.[87] On remand, NMFS found that the Puget Sound killer whales "likely belong to an unnamed subspecies of resident killer whales in the North Pacific," are significant with respect to that population, and warrant listing as a DPS.[88]

Subspecies and populations make up a significant portion of the ESA protected list,[89] and many listings of subspecies and populations have been highly controversial. The narrower the lines drawn around a group identified as a "species" for purposes of the Act, the more likely it is to be listed, with attendant economic consequences. Given the stakes and the lack of clear rules for line-drawing, it is not surprising that the Services have struggled to determine a consistent approach, or that they have faced frequent challenges in individual cases. I detailed the Services' incoherent approach to the ESA taxonomy problem thirteen years ago.[90] Not much has changed since then. Litigation over the protection of subspecies and distinct population segments is still common. It remains unclear what principles the Services use to identify subspecies, other than an established consensus in the taxonomic world. Where such consensus is absent or susceptible to new information, the Services are cast adrift. The relevant principles have been more clearly articulated for the identification of distinct population segments, but those principles are contested and difficult to apply.

A few recent examples illustrate the challenges of the taxonomic tasks facing the Services, and how they have responded. At the subspecies level, the stories of the Preble's jumping mouse and the western sage grouse are illustrative. At the level of distinct population segments, Pacific salmon are the best example.

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87. Ctr. for Biological Diversity v. Lohn, 296 F. Supp. 2d 1223, 1243 (W.D. Wash. 2003).

88. Endangered Status for Southern Resident Killer Whales, 70 Fed. Reg. 69,903, 69,904 (Nov. 18, 2005) (to be codified at 50 C.F.R. pt. 224).

89. As of 2006, roughly one-fourth of the entities listed under the ESA were subspecies or populations. Haig et al., *supra* note 58, at 1585.

90. Doremus, *supra* note 47, at 1103–12.

The greater sage grouse is a chicken-like, ground-nesting bird found in the western United States and Canada,[91] "renowned for its spectacular breeding displays."[92] The western sage grouse was first described as a subspecies of the greater sage grouse in 1946.[93] The American Ornithologists Union ("AOU"), the taxonomic authority for birds in North America, recognized two subspecies, the eastern and western, of greater sage grouse in 1957.[94] The most recent edition of the AOU's authoritative *Birds of North America*, published in 2000, continues to list both subspecies but describes them as "weakly differentiated" and difficult to diagnose.[95]

From 1980 through 2001, FWS accepted the AOU taxonomy, treating the western sage grouse as a subspecies without additional analysis,[96] despite noting in 2001 that "there is no apparent genetic distinction between the recognized eastern and western subspecies."[97] In 2003, however, faced with a petition to list the entire western subspecies, FWS changed its taxonomic tune. It rejected the petition on the grounds that there was "insufficient evidence to indicate that the western population of sage grouse is a valid subspecies or a Distinct Population Segment."[98] While conceding that the AOU continued to recognize the subspecies FWS pointed out that the AOU had "not formally or officially reviewed" subspecies.[99] The agency noted that sage grouse experts disagree about the validity of the subspecies. Based on the lack of evidence of distinct genetic differences or ecological or physical isolation, FWS concluded that

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91. 12-Month Finding for a Petition to List the Washington Population of Western Sage Grouse (*Centrocercus urophasianus phaios*), 66 Fed. Reg. 22,984, 22,985 (May 7, 2001) (to be codified at 50 C.F.R. pt 17) [hereinafter 2001 Sage Grouse Petition Finding].

92. M.A. Schroeder, J.R. Young & C.E. Braun, *Greater Sage-Grouse (Centrocercus urophasianus)*, *in* BIRDS OF NORTH AMERICA ONLINE (A. Poole ed., 1999), http://bna.birds.cornell.edu/bna/species/425.

93. John W. Aldrich, *New Subspecies of Birds from Western North America*, 59 PROC. BIOLOGICAL SOC'Y WASHINGTON 129 (1946).

94. *See* 2001 Sage Grouse Petition Finding, 66 Fed. Reg. at 22,985.

95. Schroeder et al., *supra* note 92.

96. *See* Review of Vertebrate Wildlife, 50 Fed. Reg. 37,958, 37,959 (Sept. 18, 1985) (to be codified at 50 C.F.R. pt. 17); 2001 Sage Grouse Petition Finding, 66 Fed. Reg. at 22,985.

97. 2001 Sage Grouse Petition Finding, 66 Fed. Reg. at 22,991.

98. 90-Day Finding on a Petition to List the Western Sage Grouse, 68 Fed. Reg. 6500, 6500 (Feb. 7, 2003).

99. *Id.*

the western sage grouse "is not a valid subspecies."[100] That conclusion, however, did not survive judicial review. The Ninth Circuit ruled that FWS had not sufficiently explained its change of heart from 2001 to 2003, particularly considering that the only sage grouse taxonomist consulted said that the validity of the official taxonomy could not be tested with the data available and raised questions about the conclusion by FWS biologists.[101] FWS subsequently began a status review, considering among other things the taxonomic validity of the western subspecies.[102] In March 2010 it concluded again that the western sage grouse is not a valid taxonomic entity, based on the lack of clear and consistent geographic, morphological, or genetic distinctions.[103]

The Preble's meadow jumping mouse (*Zapus hudsonius preblei*) is a three-inch rodent with a long tail and big feet, capable of three-foot leaps, that lives in riparian areas in the Rocky Mountains.[104] The Preble's mouse was identified as one of twelve subspecies of the meadow jumping mouse in 1954 based on morphology (coloring and skull shape) and geographic isolation from other meadow jumping mouse populations.[105] The taxonomic status of the Preble's mouse was an obscure topic until its listing as a threatened species in 1998[106] complicated development in some of the fastest-growing communities in the region. At that point, the Preble's mouse became a cause célèbre. When Dr. Rob Roy Ramey, a scientist at the Denver Museum of Nature and Science, proposed a study of whether the

100. *Id.* at 6503. FWS went on to conclude that the lack of clear isolation meant that the western sage grouse also did not qualify as a distinct population segment. *Id.*

101. Inst. for Wildlife Prot. v. Norton, 174 Fed. App'x 363, 366–67 (9th Cir. 2006).

102. 90-Day Finding on a Petition to List the Western Sage-Grouse (*Centrocercus urophasianus phaios*) as Threatened or Endangered, 73 Fed. Reg. 23,170, 23, 170 (Apr. 29, 2008) (to be codified at 50 C.F.R. pt. 17). Although the twelve months allowed for that review have passed, no finding has yet been announced.

103. 12-Month Findings for Petitions to List the Greater Sage-Grouse (*Centrocercus urophasianus*) as Threatened or Endangered, 75 Fed. Reg. 13,910, 13,912–15 (Mar. 23, 2010).

104. Christie Aschwanden, *Is It or Isn't It (Just Another Mouse)?*, HIGH COUNTRY NEWS, Aug. 7, 2006, at 12.

105. *See* Philip H. Krutzsch, *North American Jumping Mice (Genus Zapus)*, 7 UNIV. KAN. PUBLICATIONS, MUSEUM NAT. HIST. 351 (1954), *available at* http://www.biodiversitylibrary.org.

106. Final Rule to List the Preble's Meadow Jumping Mouse as a Threatened Species, 63 Fed. Reg. 26,517 (May 13, 1998) (to be codified at 50 C.F.R. pt. 17).

Preble's mouse deserved subspecies status, the State of Wyoming was happy to provide funding. It was even happier when Ramey's study concluded that the Preble's mouse did not warrant classification as a unique subspecies.[107] Ramey's study provoked a sharp exchange in the normally staid journal literature, featuring charges on both sides of advocacy trumping science.[108]

Relying heavily on Ramey's work, Wyoming petitioned FWS to remove the Preble's meadow jumping mouse from the protected list. In response to that petition, FWS proposed delisting[109] but also sought additional scientific input. After receiving conflicting opinions from fourteen scientists, FWS commissioned a new genetic study by US Geological Survey scientist Tim King. Using slightly different methods, King affirmed the earlier taxonomy, concluding that the Preble's mouse was genetically distinct from other subspecies.[110] Wyoming sought a third opinion from a biologist at Brigham Young University, who concluded that there were "differences between the Preble's and Bear Lodge mice, but not enough to justify their description as two subspecies."[111] New studies appeared, King and Ramey traded ugly comments,[112] and FWS eventually empanelled an

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107. Rob Roy Ramey, II et al., *Genetic Relatedness of the Preble's Meadow Jumping Mouse (*Zapus Hudsonius Preblei*) to nearby Subspecies of* Z. Hudsonius *as Inferred from Variation in Cranial Morphology, Mitochondrial DNA and Microsatellite DNA: Implications for Taxonomy and Conservation*, 8 ANIMAL CONSERVATION 329, 334 (2005).

108. *See* S.N. Vignieri et al., *Mistaken View of Taxonomic Validity Undermines Conservation of an Evolutionarily Distinct Mouse: A Response to Ramey et al. (2005)*, 9 ANIMAL CONSERVATION 237 (2006); R.R. Ramey, II et al., *Response to Vignieri et al. (2006): Should Hypothesis Testing or Selective* Post Hoc *Interpretation of Results Guide the Allocation of Conservation Effort*, 9 ANIMAL CONSERVATION 244 (2006); A. Martin, Letter to the Editor, *Advocacy Dressed up as Science: Response to Ramey et al. (2005)*, 9 ANIMAL CONSERVATION 248 (2006); K.A. Crandall, Letter to the Editor, *Advocacy Dressed up as Scientific Critique*, 9 ANIMAL CONSERVATION 250 (2006); M.A. Cronin, Correspondence, *The Preble's Meadow Jumping Mouse: Subjective Subspecies, Advocacy and Management*, 10 ANIMAL CONSERVATION 159 (2007).

109. 12-Month Finding on a Petition to Delist the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) and Proposed Delisting of the Preble's Meadow Jumping Mouse, 70 Fed. Reg. 5404 (Feb. 2, 2005) (to be codified at 50 C.F.R. pt. 17).

110. Tim L. King et al., *Comprehensive Genetic Analyses Reveal Evolutionary Distinction of a Mouse* (Zapus Hudsonius Preblei) *Proposed for Delisting from the U.S. Endangered Species Act*, 15 MOLECULAR ECOLOGY 4331, 4345–47 (2006).

111. Peter Aldhous, *The Mouse That No One Can Ignore*, NEW SCIENTIST, July 15, 2006, at 12.

112. King accused Ramey of making a systematic error. Ramey responded that, "Tim King's station in life seems to be to do scientific colonoscopies." Jim Erickson, *Biologists Pelt*

expert advisory body to sort it all out. The panel determined that the Preble's mouse was a valid subspecies under most definitions, although it conceded that a crucial test, revisiting the morphological measurements used to establish the subspecies in 1954, had not been undertaken.[113]

The panel's report offered two major explanations for the disagreement between King and Ramey, one scientific and the other not. First, the panel concluded that Ramey had poorly designed, carried out, and interpreted some of the genetic studies that purportedly demonstrated shared DNA sequences between the Preble's and other meadow jumping mice.[114] Second, the panel noted that King and Ramey disagreed about the level of difference needed to justify separating groups into different subspecies, the amount of evidence needed to justify overturning a long-established taxonomic distinction, and the significance of lack of evidence.[115]

Although it is a cliché in science that "absence of evidence is not evidence of absence,"[116] it remains commonplace for investigators to conclude that the failure to demonstrate a difference between two data sets is tantamount to demonstrating their equivalence.[117] It is surely human nature to assume that failure to disprove assertion X amounts to at least some evidence that assertion X is true, but in fact there may be no way to estimate the likelihood that two populations are equivalent from a result that does not show significant differences.[118] That creates a quandary when management decisions

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One Another over Mouse, ROCKY MTN. NEWS, June 21, 2006, at 12A.

113. Letter from Steven P. Courtney, Vice President, Sustainable Ecosystems Inst., to Seth Willey, U.S. Fish and Wildlife Service (July 20, 2006); SUSTAINABLE ECOSYSTEMS INST., EVALUATION OF SCIENTIFIC INFORMATION REGARDING PREBLE'S MEADOW JUMPING MOUSE (2006), http://www.fws.gov/mountainprairie/species/mammals/preble/Prebles_SEI_report.pdf.

114. SUSTAINABLE ECOSYSTEMS INST., *supra* note 113, at 3.

115. *Id.* at 4.

116. *See, e.g.*, Douglas G. Altman & J. Martin Bland, *Absence of Evidence Is Not Evidence of Absence*, 311 BRIT. MED. J. 485 (1995).

117. *See, e.g.*, Fiona Fidler et al., *Impact of Criticism of Null-Hypothesis Significance Testing on Statistical Reporting Practices in Conservation Biology*, 20 CONSERVATION BIOLOGY 1539, 1542 (2006) (concluding that Null-Hypothesis Significance Testing is still prevalent in articles published in leading conservation biology journals).

118. Berry J. Brosi & Eric G. Biber, *Statistical Inference, Type II Error, and Decision Making under the U.S. Endangered Species Act*, 7 FRONTIERS ECOLOGY & THE ENV'T, *available at* http://www.esajournals.org/doi/pdf/10.1890/080003.

must be made (as they frequently must) based on sharply limited information. Investigators may feel the need to reach a conclusion, despite acute awareness of the limits of their data, and decision-makers may have no choice but to do so. Inevitably one assumption or another is privileged in the evaluation and wins in the face of inconclusive evidence. In the Preble's dispute, Ramey privileged the assumption that subspecies should not be recognized in the absence of strong evidence of differentiation.[119] King, on the other hand, privileged the assumption that established taxonomy should continue to be regarded as valid absent statistically significant evidence that it was erroneous. The review panel agreed with King's assumption,[120] and therefore with his conclusion that the traditional recognition of the Preble's as a subspecies was justified.[121]

At the smallest taxonomic scale, the ESA allows listing of "distinct population segments" ("DPSs") of vertebrate animals.[122] Congress has not further defined that term, nor is it a taxonomic term of art. The Services, however, have been more forthcoming about their understanding of DPSs than about how they identify species or subspecies. DPS delineation first became an issue in Pacific salmon, in part because fish systematists have not traditionally recognized subspecies to the extent as have other taxonomists. In 1990, faced with petitions to list several Pacific salmon stocks, NMFS encountered the difficult task of identifying protectable entities within species characterized by a combination of large ranges with substantial local variation and reproductive isolation. In 1991, NMFS issued a policy declaring that it would consider for listing only "evolutionary significant units" ("ESUs") of salmon species.[123] ESUs

119. The Sustainable Ecosystems Institute panel noted that Ramey's criteria for recognizing a subspecies were more conservative than the norm for the taxonomic community. *See* SUSTAINABLE ECOSYSTEMS INST., *supra* note 113, at 10, 34, 38–39.

120. "Because *Z. h. preblei* is a formally described, valid, and commonly recognized taxon, we concluded that the burden of proof should lie in clearly showing that its taxonomic status is not warranted." *Id.* at 39.

121. Ramey agrees that his key differences with King and other detractors are "conceptual and philosophical" but continues to defend the high threshold he would require for the recognition of a subspecies. Marris, *supra* note 44, at 252–53.

122. 16 U.S.C. § 1532(16) (2006).

123. Policy on Applying the Definition of Species under the Endangered Species Act to Pacific Salmon, 56 Fed. Reg. 58,612 (Nov. 20, 1991).

must satisfy two criteria: they must be "substantially reproductively isolated" and "represent an important component in the evolutionary legacy of the species."[124]

A few years later, the Services jointly published a more general policy for recognizing DPSs. Described as "consistent with" the earlier ESU policy, the new DPS policy requires that a group be both "discrete" and "significant" to the larger taxon in order to qualify as a DPS.[125] Although there are some differences between the two,[126] they play out similarly in practice. The Services consider morphology but tend to emphasize genetic distinctness as the basis for a finding of reproductive isolation (under the ESU Policy) or discreteness (under the more general DPS Policy), probably because that emphasizes their expertise and disguises the inevitable role of value judgments.[127] Genetic distinctness also factors into the evolutionary legacy (ESU) and significance (DPS) criteria.[128]

The ESU policy aims to identify and protect populations that matter most in an evolutionary sense. That is precisely the role that modern species and subspecies classification schemes are supposed to play, but it is widely recognized that they do not do so effectively for many taxa of conservation interest. Indeed, the term ESU itself originated in the frustration of zoo biologists "with the limitations of current mammalian taxonomy in determining which named subspecies actually represent significant adaptive variation," and their search for a better category than the subspecies.[129] NMFS was engaged in a similar search when it developed the ESU policy, which seeks to identify and protect "the genetic variability that is a product of past evolutionary events and that represents the reservoir upon

124. *Id.*

125. Policy Regarding the Recognition of Distinct Population Segments under the Endangered Species Act, 61 Fed. Reg. 4722 (Feb. 7, 1996).

126. For example, the joint DPS Policy recognizes international boundaries as a basis for distinguishing between populations, while the ESU Policy does not. *See id.* at 4725; Policy on Applying the Definition of Species under the Endangered Species Act to Pacific Salmon, 56 Fed. Reg. at 58,613.

127. Doremus, *supra* note 47, at 1106–07.

128. *See* Policy on Applying the Definition of Species under the Endangered Species Act to Pacific Salmon, 56 Fed. Reg. at 58,618; Policy Regarding the Recognition of District Vertebrate Population Segments under the Endangered Species Act, 61 Fed. Reg. at 4725.

129. Ryder, *supra* note 62, at 9.

which future evolutionary potential depends," with the ultimate goal of ensuring that "the dynamic process of evolution will not be unduly constrained in the future."[130]

Because the DPS policy is "a detailed extension" of the more general DPS policy,[131] the two must share the same general purpose. But the DPS policy presents its purpose in a more static manner, as serving the ESA's twin goals of "conserving genetic resources and maintaining natural systems and biodiversity over a representative portion of their historic occurrence."[132]

3. Looking Forward, Looking Back, Standing Still

Systematists now basically agree on the core of the species concept, which is the identification of a common evolutionary line distinct from other evolutionary lines.[133] Below the species category, it is less clear what classifications should be recognized. Subspecies and ESUs or DPSs seem to serve three distinct functions in the taxonomic scheme. First, they fill gaps in formal taxonomies established when the understanding of evolutionary relationships was hazy. Taxonomy is an exceedingly conservative science; as the orca and sage-grouse stories show, formal classifications do not always keep up with new information. Recognition of subspecies and ESUs can be more nimble. Second, those lower classifications can smooth out some of the differences between species concepts. The BSC remains the dominant concept, but as explained earlier it does not work for all species, and it does not account well for all forms of speciation.[134] Adding subspecies and ESU designations can effectively make the BSC more like its main rival, the PSC, which focuses on detectable differences without demanding reproductive isolation. Finally, subspecies and ESUs can be used to identify

130. Policy on Applying the Definition of Species under the Endangered Species Act to Pacific Salmon, 56 Fed. Reg. at 58,616.

131. Policy Regarding the Recognition of District Vertebrate Population Segments under the Endangered Species Act, 61 Fed. Reg. at 4722.

132. *Id.* at 4723.

133. Of course that does not come close to answering every practical question; the required degree of distinctness, in particular, remains hotly contested.

134. *See supra* notes 46–49 and accompanying text.

groups that are in the process of diverging toward new species but have not yet reached that level of differentiation.

The conceptual focus, for all of these units, is now squarely on evolution. That gives taxonomic classification both a backward- and a forward-looking element: species share an evolutionary history and are expected to share an evolutionary fate. The emphasis in species (as well as in subspecies and ESU) identification, though, has been on the backward look. That is unavoidable, since it is impossible to observe the evolutionary future. Taxonomists look at morphology, genetics, ecology, and other traits (in varying combinations depending upon the practitioner's preferred species concept) to decide whether the group has diverged sufficiently from others to warrant separate treatment.

It is not surprising that the ESA presents the taxonomy question the way it does. At the time the ESA was adopted, there were essentially two dominant views of species classification, either of which could have justified the approach the ESA took. The first was the Linnean essentialist view, which dominated early classification systems. The second was the Biological Species Concept.[135] The essentialist view, tied as it is to the biblical creation story, still holds sway with a good portion of the American public.[136] High-profile disputes over the merits of evolutionary theory versus the biblical

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135. Alternative species concepts did not really begin to proliferate until the 1970s. For a discussion of the Biological Species Concept and the emergence of alternative models, see Kevin de Queiroz, *Ernst Mayr and the Modern Concept of Species*, 102 PROC. NAT'L ACAD. SCI. 6600, 6600–01 (2005).

136. There is no direct polling on what Americans think the word "species" signifies. But over the past twenty years there has been regular polling on their view of evolution, particularly as it relates to the origins of the human species. Two 2009 polls, one by Gallup and the other by the Pew Research Center for the People and the Press, found that well under a majority believe in evolution. Frank Newport, *On Darwin's Birthday, Only 4 in 10 Believe in Evolution*, GALLUP, Feb. 11, 2009, http://www.gallup.com/poll/114544/Darwin-Birthday-Believe-Evolution.aspx (thirty-nine percent of respondents said that they "believe in the theory of evolution"); News Release, Pew Research Center for the People and the Press, Scientific Achievements Less Prominent Than a Decade Ago: Public Praises Science; Scientists Fault Public, Media 38 (July 9, 2009), http://people-press.org/reports/pdf/528.pdf (thirty-two percent of the total public believe human beings evolved through natural processes). Belief in evolution may have increased in recent years. A compilation of poll results from 1982 to 2006 found that the belief that humans evolved through natural processes varied from a low of nine percent to a high of fifteen percent. Eric Plutzer & Michael Berkman, *Trends: Evolution, Creationism, and the Teaching of Human Origins in Schools*, 72 PUB. OPINION Q. 540, 545 (2008).

creation story were in full swing when the ESA was drafted.[137] Laws prohibiting the teaching of evolution were still a fresh memory, and textbooks had just begun to deal openly with the topic.[138]

No battle with fundamentalists was necessary to pass the ESA. Creationism is not inconsistent with a desire for conservation.[139] Treatment of taxonomy in the law did not need to challenge creationist views. Although conceptually the BSC is tied to the theory of evolution, in practice its use tended to boil down to a search for morphological differences. Taxonomists in the 1960s and 1970s were mostly using Linnaean tools, and getting Linnaean answers. Not all, but certainly many, BSC-recognized species corresponded closely with groups recognized as distinct long before the development of evolutionary theory. Static (or essentialist) and evolutionary views of species coexisted easily in the legislative reports and statements that preceded the Act's passage.[140] It is entirely possible that many legislators held both views of species simultaneously.

There is little in the legislative history to explain the inclusion of subspecies and DPSs within the law's coverage. Perhaps that was another way the law's scope was quietly expanded by insiders. It seems more likely, though, that there was a vague sense that species lines would not always protect what the law's supporters thought was important. The law's drafters may have noticed some of the discrepancies in taxonomic treatment among different groups and not wanted the law to replicate those discrepancies. Or they may have looked to fisheries practice, which traditionally had managed fish species as "stocks," without implying anything particular about the origin or evolutionary significance of those groups. Whatever the explanation, acknowledging the existence of and providing protection for subspecies and some populations is not necessarily inconsistent with a view of species as unchanging creations of the almighty. After all, human classifiers are fallible, and Congress had recognized that it

137. *See, e.g.*, Nicholas Wade, *Creationists and Evolutionists: Confrontation in California*, 178 SCI. 724 (1972).

138. *See id.* at 728.

139. Willett Kempton found that a majority of Americans agreed with the statement "[b]ecause God created the natural world, it is wrong to abuse it." WILLETT KEMPTON ET AL., ENVIRONMENTAL VALUES IN AMERICAN CULTURE 91 (1995).

140. Doremus, *supra* note 47, at 1092–93.

was sometimes desirable to protect local occurrences even if a species were secure at the global level.[141]

Nor is it surprising that the Services have struggled to answer the taxonomy question as the ESA presents it. Species and their subdivisions are not wholly discrete entities; there is therefore no objective way to draw a line marking when a new species has become separate from its progenitor. The principles that have been articulated, for example identifying evolutionary lineages, are difficult to put into practice and do not enjoy universal acceptance. As one systematist puts it, distinguishing one species from a close relative is like trying to fix the boundary between childhood and adulthood.[142] The natural boundaries are even less clear below the species level. Nonetheless, like most laws, the ESA requires that lines be drawn—in this case to separate the protected from the unprotected. Add to the mix that many people assume that the line-drawing exercise should be both easy and objective, and the agencies are faced with a very difficult practical and political problem.

The problem of deciding which groups merit protection and which do not is now widely acknowledged, albeit not solved. For purposes of this Article, I want to emphasize a different problem that has received much less attention: the fact that the ESA frames the taxonomy issue in a static way. That was very much the scientific perspective of the time. Biologists like Mayr were aware that evolution had produced the biotic world around them but thought of evolution as an historical process. Although they knew that evolution was never over, they did not think it occurred at time scales relevant to human decision-making.

B. Conservation Strategies and the Wilderness Fallacy

In addition to taking a static view of species, the ESA takes a static view of the places where species live, and therefore of the work

141. *See id.* at 1093–94 (noting that inclusion of the term "any other group of fish or wildlife . . . that interbreed when mature" in the 1973 ESA can be traced to the coverage of "population stocks" in the Marine Mammal Protection Act, and that the inclusion of stocks in the MMPA was intended to ensure protection of polar bears in the United States, regardless of their taxonomic relationship to other arctic bears).

142. *See* Marris, *supra* note 44, at 251 (quoting Scott Steppan).

needed to protect those places and their inhabitants. Again, this is not an interpretation that is explicitly written into the law. But it is an important aspect of the way the law works on the ground. Like the assumption of static species, the assumption of static landscapes is unsurprising in light of what was known about the problem of extinction at the time, the history of conservation efforts, and the political and practical challenges of more dynamic strategies.

1. A Limited History

There is no doubt that the ESA was broader in scope and stronger in its requirements than any prior conservation law in the U.S., and probably in the world. It did not, however, mark a radical shift in terms of conservation strategies. The history of public conservation efforts prior to the ESA involved only a few strategies: control of harvest, control of commerce, and the creation of publicly owned reserves. In practice, the ESA relies heavily on precisely those strategies.

By 1973, the states had long regulated hunting and fishing,[143] backed up since 1900 by the federal Lacey Act,[144] which prohibits the transport across state lines of wildlife taken in violation of state law. The federal government itself had been in the business of directly regulating some wildlife harvest since passage of the Migratory Bird Treaty Act in 1918[145] and the addition of the Bald Eagle Protection Act in 1940.[146] It had provided advice to the states on coastal fisheries regulation and had directly managed fisheries off of Alaska prior to statehood.[147]

143. *Cf.* Geer v. Connecticut, 161 U.S. 519, 527–28 (1896) (quoting Blackstone's commentaries for the proposition that hunting rights are subject to government restraint under the common law), *overruled by* Hughes v. Oklahoma, 441 U.S. 322, 325 (1979).

144. Act of May 25, 1900, ch. 553, 31 Stat. 187 (codified as amended at 16 U.S.C. §§ 701, 3371–3378; 18 U.S.C. § 42 (2006)).

145. Migratory Bird Treaty Act, ch. 128, 40 Stat. 755 (1918) (codified as amended at 16 U.S.C. §§ 703–712 (2006)).

146. Bald Eagle Protection Act, ch. 278, 54 Stat. 250 (1940) (codified as amended at 16 U.S.C. §§ 668–668d (2006)).

147. *See* MICHAEL L. WEBER, FROM ABUNDANCE TO SCARCITY: A HISTORY OF U.S. MARINE FISHERIES POLICY 76–78 (2001).

Federal control of international and interstate commerce in wildlife began with the Lacey Act, which in addition to backstopping state hunting regulations with restrictions on interstate commerce also prohibited the import of a small number of foreign animals, and allowed the Secretary of Agriculture to add any species deemed injurious to agriculture to that list.[148] Additional federal restrictions on commerce followed in the Black Bass Act,[149] Migratory Bird Treaty Act,[150] Bald Eagle Protection Act,[151] and, shortly before the ESA's enactment, the Wild Horses and Burros Act[152] and the Marine Mammal Protection Act of 1972.[153] While the constitutionality of other federal conservation strategies frequently has been questioned, from an early date there was no serious doubt the federal government has the authority to regulate commerce in wildlife, wildlife parts, and products made from wildlife.[154]

The third major conservation strategy was the designation of nature preserves, typically under public ownership. In the United States, federal preserves date back to the creation of Yellowstone National Park in 1872.[155] The early U.S. national parks focused on the preservation of public access to spectacular scenic areas.[156] Later, Congress created the national park system,[157] and by the mid-twentieth century it had expanded that system to include areas such as the Everglades, protected primarily for their unique biota rather than their scenery.[158] Another preserve system, the National Wildlife Refuge System, got its start at roughly the same time as the national

148. § 2, 31 Stat. at 188.
149. Act of May 20, 1926, ch. 346, 44 Stat. 576.
150. § 2, 40 Stat. at 755.
151. 54 Stat. at 250.
152. Wild Horses and Burros Protection Act of 1972, Pub. L. No. 92-195, 85 Stat. 649.
153. Marine Mammal Protection Act of 1972, Pub. L. No. 92-522, 86 Stat. 1027.
154. MICHAEL J. BEAN & MELANIE J. ROWLAND, THE EVOLUTION OF NATIONAL WILDLIFE LAW 39 (3d ed. 1997).
155. Act of March 1, 1872, ch. 24, 17 Stat. 32. Yosemite was actually set aside earlier as a preserve, but initially it was conveyed to California for management. Act of June 30, 1864, ch. 184, 13 Stat. 325. It was returned to federal ownership in 1906. H.R.J. Res. 27, 49th Cong., 34 Stat. 831 (1906).
156. ALFRED RUNTE, NATIONAL PARKS: THE AMERICAN EXPERIENCE 28–47 (3d ed. 1997).
157. Act of Aug. 25, 1916, ch. 408, § 1, 39 Stat. 535 (codified at 16 U.S.C. §§ 1–4 (2006)).
158. *See* MICHAEL GRUNWALD, THE SWAMP: THE EVERGLADES, FLORIDA, AND THE POLITICS OF PARADISE 208–09 (2006).

parks. It began with Theodore Roosevelt designating Pelican Island as a "preserve and breeding ground for native birds" in 1903.[159] With new acquisitions funded primarily by the Duck Stamp Act,[160] by mid-century the refuge system focused primarily on the conservation of migratory birds.[161]

The triumvirate of harvest regulation, restrictions on commerce, and reserve creation that continues to dominate conservation policy has been appealing for several reasons. These strategies clearly were on sound legal ground in the early days of the conservation movement, when the validity of others seemed questionable, at least at the federal level.[162] They address the most obvious threats to wildlife. Overharvest clearly was a problem for American wildlife by the turn of the century, when market hunting decimated such once-abundant species as the bison and passenger pigeon.[163] Restrictions on commerce reinforce restrictions on harvest by limiting the ability of poachers to profit from their misdeeds. Preserves address another threat to wildlife that became apparent in the mid-twentieth century: destruction of habitat. Purchased preserves (at least those that are purchased in voluntary transactions rather than by condemnation) also are politically appealing because they promote both the public interest in conservation and the private interest in using or profiting from land.

The traditional triumvirate of conservation strategies assumes that what nature needs most is for people to leave it alone. Harvest restrictions tell people in no uncertain terms to leave enough of the target species alone to ensure its survival into the future. Commerce restrictions limit the economic incentives to violate harvest

159. Executive Order of March 14, 1903.

160. Duck Stamp Act, ch. 71, 48 Stat. 451 (1934).

161. For an excellent history of the refuge system in the U.S., see Robert L. Fischman, *The National Wildlife Refuge System and the Hallmarks of Modern Organic Legislation*, 29 ECOLOGY L.Q. 457, 464–501 (2002).

162. *See* Holly Doremus, *Patching the Ark: Improving Legal Protection of Biological Diversity*, 18 ECOLOGY L.Q. 265, 292–93 (1991) (explaining that the scope of the commerce power was unclear prior to the New Deal).

163. *See* PAUL EHRLICH & ANNE EHRLICH, EXTINCTION: THE CAUSES AND CONSEQUENCES OF THE DISAPPEARANCE OF SPECIES 115–16 (1981); DAVID S. WILCOVE, THE CONDOR'S SHADOW 27–30 (1999); Scott Farrow, *Extinction and Market Forces: Two Case Studies*, 13 ECOLOGICAL ECON. 115, 115–16 (1995); Dean Lueck, *The Extermination and Conservation of the American Bison*, 31 J. LEGAL STUD. 609, 617–20 (2002).

restrictions. Preserves impose additional limits on human interactions with nature in specific places. They have traditionally been understood as places where nature's own processes could flourish.

The idea that the best action for preserving nature is inaction—that what is needed is not active human management but human restraint allowing nature to be its wild self—is apparent in the writings of early American preservationists like Henry David Thoreau,[164] John Muir,[165] and Aldo Leopold.[166] It also dovetailed nicely with the theologically-inspired idea that nature had once been perfect in the Garden of Eden, before its disruption by human misbehavior.[167] Ecologist Frederic Clements provided a scientific grounding for the "hands-off" approach in the 1920s with his theory of succession. Clements argued that, left to its own devices, nature would reach a stable equilibrium point. As Fred Bosselman and Dan Tarlock have explained, Clements's theory, which "dominated American ecology throughout the first half of the twentieth century,"[168] "reinforced a static concept of the future landscape."[169]

I do not mean to oversell the idea of natural stability. As both Dan Tarlock and Bryan Norton have pointed out, the ecologists of the day did not subscribe to a notion of perfectly stable nature.[170] The world they observed had too much dynamism to ignore. But in their efforts to understand nature, they emphasized relative stability over flux.

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164. *See, e.g.*, 5 HENRY DAVID THOREAU, *Walking*, *in* THE WRITINGS OF HENRY DAVID THOREAU 205, 224 ("[I]n Wildness is the preservation of the world.").

165. *See, e.g.*, JOHN MUIR, *The Wild Parks and Forest Reservations of the West*, *in* OUR NATIONAL PARKS 1, 4 (1901) ("None of Nature's landscapes are ugly so long as they are wild . . . .").

166. *See, e.g.*, Aldo Leopold, *The Wilderness and Its Place in Forest Recreational Policy*, 19 J. FORESTRY 718, 719 (1921) (arguing that large areas of the national forests should be "kept devoid of roads, artificial trails, cottages, or other works of man").

167. Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI. KENT L. REV. 847, 855 (1994).

168. *Id.* at 856.

169. *Id.* at 855.

170. *See* Bryan Norton, *Change, Constancy, and Creativity: The New Ecology and Some Old Problems*, 7 DUKE ENVTL. L. & POL'Y F. 49, 53–54 (1996) (pointing out that Aldo Leopold and other ecologists of his era understood that nature was dynamic, often violating equilibrium assumptions); A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOYOLA L.A. L. REV. 1121, 1126 (1994) (noting that Tansley, a leading ecologist of the 1930s, described nature as a "relatively stable dynamic equilibrium").

When ecology was translated into common understanding, though, and combined with deep-seated notions of perfectability and essentialism, the subtleties were easily lost. So the popular picture became a static balance of nature. That static picture made a system of preserves within which human impacts would be minimized look like the perfect conservation strategy.

2. Something Old is New Again

The ESA incorporates all three of the traditional conservation policy strategies. Section 9 prohibits the "take" of endangered fish or wildlife,[171] and also forbids the import, export, interstate shipping, and sale in interstate or foreign commerce of endangered fish, wildlife, and plants.[172] Threatened species are protected by "such regulations as [the Secretary of Interior or Commerce] deems necessary and advisable to provide for [their] conservation" up to the full force of section 9.[173] Section 5 authorizes land acquisition to conserve listed species.[174]

The ESA is not explicitly limited to these three strategies. Notably, it defines "take" quite broadly, so that prohibited actions include not just deliberate harvest but also other forms of harm.[175] FWS regulations define "harm" as any "act which actually kills or injures wildlife," including "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering."[176] The Supreme Court upheld that regulation in 1995.[177]

In addition, the ESA has another important regulatory provision, section 7, which provides that all federal actors must ensure that their actions do not jeopardize the continued existence of any listed species, or adversely modify habitat the Services have designated as

171. Endangered Species Act of 1973 § 9, 16 U.S.C. § 1538(a)(1)(B), (C) (2006).
172. 16 U.S.C. § 1538(a)(1)(A), (E), (F); § 1538(a)(2)(A), (C), (D).
173. 16 U.S.C. § 1533(d).
174. *Id.* § 1534(a).
175. *Id.* § 1532(19).
176. 50 C.F.R. § 17.3 (2008).
177. Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 708 (1995).

critical.[178] Section 7 allows the Services to insist on changes to the manner, extent, or location of any federal activity if necessary to protect listed species.[179]

Nonetheless, in practice the Services' strategies both for limiting "take" and for implementing section 7 commonly boil down to the establishment of formal or informal preserved areas. With respect to section 7, the designation of critical habitat amounts to designation of (sharply) limited preserves. Critical habitat encompasses "the specific areas within the geographical area occupied by the species . . . on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection"; and specific areas outside the range that the Services determine "are essential for the conservation of the species."[180] Critical habitat designation has no direct effect on private actions; its statutory role is strictly confined to section 7. To the extent it does come into play,[181] section 7's prohibition on adverse modification of critical habitat sets critical habitat areas aside from those federal actions that would interfere with the habitat elements needed by listed species. It takes a Clementsian view of nature, assuming that in the absence of human

178. Endangered Species Act of 1973, § 7, 16 U.S.C § 1536(a)(2) (2006).

179. *See* Bennett v. Spear, 520 U.S. 154, 169 (1997) ("By the Government's own account, while the Service's Biological Opinion theoretically serves an "advisory function," in reality it has a powerful coercive effect on the action agency.") (citation omitted); Holly Doremus, *Water, Population Growth, and Endangered Species in the West*, 72 U. COLO. L. REV. 361, 382–84 (2001) (explaining the consultation process, and noting that although Services' biological opinions are not formally binding on action agencies, they "are virtually determinative of the outcome").

180. 16 U.S.C. § 1532(5)(A).

181. Its role has been limited even with respect to federal actions, because the Services' regulatory definitions make it virtually impossible for an action to adversely modify critical habitat without also jeopardizing the continued existence of the species. The Services have defined jeopardy to include actions "that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery" of the species in the wild. 50 C.F.R. § 402.02 (2008). They have defined adverse modification of critical habitat as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species." *Id.* Although the Fifth and Ninth Circuits have found the definition of adverse modification unlawfully narrow, the Services have not yet revised it. *See* Donald C. Baur, Michael J. Bean & Wm. Robert Irvin, *A Recovery Plan for the Endangered Species Act*, 39 ENVTL. L. REP. NEWS & ANALYSIS 10,006, 10,009 (2009).

action habitat will remain stable, and therefore will continue to support its tenant species.

With respect to section 9, the Services have been unwilling to push their authority to its limits. In part, this is a matter of politics. Resentment of the ESA is common in local communities, and that resentment can readily make its way up to the national level. Beginning with oversight hearings in 1979, shortly after *TVA v. Hill* brought home the power of the law, the Services regularly have been reminded "that aggressive implementation of the ESA might lead to its repeal."[182] But there is more to their timidity than politics. Until the Supreme Court decided *Babbitt v. Sweet Home Chapter*,[183] it was not clear how far the authority to regulate indirect habitat modification extended. Even after *Sweet Home Chapter*, confusion remains, because a majority of the Court endorsed the idea that proximate cause is a necessary element of a section 9 violation.[184] Furthermore, it can be difficult to prove harm to an identifiable individual of the species, as *Sweet Home Chapter* also requires.[185] Because of those difficulties, even litigious environmental groups have made little use of section 9.

When it is enforced or when a cautious potential defendant volunteers to meet its requirements,[186] section 9 frequently results in the establishment of one or more preserves. Since 1982, section 10 of the ESA has allowed the Services to issue "incidental take" permits authorizing actions that otherwise would violate section 9.[187] In order

182. Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of "New Age" Environmental Protection*, 41 WASHBURN L.J. 50, 58 (2001). For insider accounts of how that political dynamic played out during the Clinton administration, when the Republicans controlled Congress, see John D. Leshy, *The* Babbitt *Legacy at the Department of the Interior: A Preliminary View*, 31 ENVTL. L. 199 (2001); Joseph L. Sax, *Environmental Law at the Turn of the Century: A Reportorial Fragment of Contemporary History*, 88 CAL. L. REV. 2375 (2000).

183. Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687 (1995).

184. *Id.* at 708.

185. *Id.*

186. For an examination of the HCP permit process from the perspective of a potential land developer, see J.B. Ruhl, *How to Kill Endangered Species, Legally: The Nuts and Bolts of Endangered Species Act "HCP" Permits for Real Estate Development*, 5 ENVTL. LAW. 345 (1999).

187. Endangered Species Act of 1973, § 10, 16 U.S.C. § 1539(a)(1)(B) (2006). For the story of adoption of this provision and its early years, see Robert D. Thornton, *Searching for*

to obtain an incidental take permit, the applicant must prepare a "habitat conservation plan" ("HCP"), and the relevant Service must make three primary findings: (1) that the taking is incidental to, and not the purpose of, the proposed activity; (2) that the impacts of the taking will be minimized and mitigated to the maximum extent practicable; and (3) that issuance of the permit will not violate the prohibition on jeopardy.[188] To date, the vast majority of incidental take permits issued have allowed land development or extractive use of terrestrial resources (such as timber harvest). The dominant strategy for mitigating the take of endangered species has been the setting aside of designated preserves.[189]

At the time the ESA was adopted, it was entirely predictable—and probably unavoidable—that the new law would rely on these three traditional conservation strategies. They were familiar and clearly within federal authority. They addressed the two major recognized threats to species: overharvest and habitat loss. With the "balance of nature" theory in the ascendant, they seemed scientifically sound.[190]

Consensus and Predictability: Habitat Conservation Planning under the Endangered Species Act of 1973, 21 ENVTL. L. 605 (1991).

188. *See* 16 U.S.C. § 1539(a)(1)(B). The "no jeopardy" requirement comes not just from the explicit terms of section 10, but also from section 7, since the issuance of an incidental take permit is a federal action subject to section 7.

189. That was the strategy of the first) (San Bruno Mountain) conservation plan, on which the HCP program was modeled, Thornton, *supra* note 187, at 621–23; and the second (in the Coachella Valley), Timothy Beatley, *Balancing Urban Development and Endangered Species: The Coachella Valley Habitat Conservation Plan*, 16 ENVTL. MGMT. 7 (1992). A 1997 study found that conservation easements, land acquisition, and habitat restoration were among the conservation strategies included in HCPs. *See* Laura Watchman, Martha Groom & John Perrine, *Science and Uncertainty in Habitat Conservation Planning*, 89 AM. SCIENTIST 351 (2001). The large regional plans, by far the most important aspect of the program, continue to rely on a primary strategy of assembling reserves on the basis of standardized fees assessed to developers. *See* NRDC v. Kempthorne, 506 F. Supp. 2d 322 (E.D. Cal. 2007) (describing the Natomas Basin HCP). In the Bush administration, the Services also incorporated habitat "banking," which allows the private creation of reserves and sale of credits, into the HCP program. *See* J.B. Ruhl, *Regulation by Adaptive Management—Is It Possible?*, 7 MINN. J. L. SCI. & TECH. 21, 43–44 (2005).

190. The writings of Eugene and Howard Odum, primary supporters of that theory, were widely read by non-scientists. Bosselman & Tarlock, *supra* note 167, at 866.

C. Conservation Planning and the Rule of Law Fallacy

Finally, the ESA takes a static view of the law. In part, this static view is a product of the ESA's focus on a reserve strategy, which is difficult to make dynamic; in part, it is a product of the human desire for stability and discomfort with change; and in part, it is based on a misreading of the nature of law.

Once again, caveats are in order. In some respects, the ESA is anything but static. The list of protected species changes constantly with additions, deletions, and status revisions. The Secretary of the Interior is required to review the status of each listed species every five years[191] and can be prodded to undertake status reviews for other species or at other times by citizen petitions.[192] Section 7 consultation is also dynamic; the process must be restarted if, while discretionary federal action remains, a new affected species is listed, new information shows that the impacts are worse than expected, or the permissible take specified in the biological opinion is exceeded.[193]

Nonetheless, in an important respect, the ESA as implemented prohibits the updating of legal obligations. Incidental take permittees are routinely promised that if species decline notwithstanding their implementation of an approved HCP, they will not be required to give more to the conservation cause. This "no surprises" policy was first implemented informally by FWS during the Clinton administration to make the HCP program attractive to landowners.[194] Premised on the simple notion that "a deal is a deal,"[195] no-surprises is intended to assure permittees that the government will not change the legal rules in the middle of the game. As later written into regulations, it provides that if additional conservation measures prove necessary because of "unforeseen circumstances" during the duration

191. 16 U.S.C. § 1533(c)(2) (2006).
192. *Id.* § 1533(b)(3).
193. 50 C.F.R. § 402.16 (2008).
194. *See* Donald J. Barry, Keynote Speech, *Opportunity in the Face of Danger: The Pragmatic Development of Habitat Conservation Plans*, 14 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 867, 867–68 (2008); News Release, Dep't of the Interior, Administration's New Assurance Policy Tells Landowners: "No Surprises" in Endangered Species Planning (Aug. 11, 1994), http://www.eswr.com/august07/199940811fwsnosurpr.pdf [hereinafter News Release, Dep't of the Interior].
195. *See* News Release, Dep't of the Interior, *supra* note 194.

of the permit, those measures "will not involve the commitment of additional land, water or financial compensation or additional restrictions on the use of land, water, or other natural resources otherwise available for development or use under the original terms of the conservation plan without the consent of the permittee."[196] The regulations allow incidental take permits to provide for changes in conservation measures in response to "changed circumstances,"[197] but any change in circumstances not specifically addressed in the HCP and associated incidental take permit cannot be the basis for additional conservation requirements.[198] The "no surprises" policy puts pressure on the Services to negotiate terms that impose increased conservation obligations when triggering events occur. Since the premise of the no surprises program from its outset was that landowners would not agree to permit terms without strong assurances that they would not be required to do more in the future, it is not surprising that the Services have not proven to be strong negotiators. As a result, most HCPs do not require modification if the initial mitigation procedures are insufficient to protect the intended species.[199]

The insistence on static conservation requirements for private landowners is primarily a product of uncertainty about the extent of legal authority to require more of them and certainty about the extent of political resistance that would occur if heightened obligations were imposed. There has always been a lack of clarity about the outer boundary of the Services' statutory and constitutional power to restrict the use of private property in order to protect listed species.[200] The statutory uncertainty was resolved in 1995, when the Supreme Court issued its decision in *Babbitt v. Sweet Home Chapter Communities for a Great Oregon*, upholding the Services' interpretation of "harm" as including habitat modification that

196. 50 C.F.R. § 17.22(b)(5)(iii)(B) (2008) (for endangered species); *Id.* § 17.32(b)(5)(iii)(B) (2008) (for threatened species).

197. 50 C.F.R. § 17.22(b)(5)(i); *Id.* § 17.32(b)(5)(i).

198. 50 C.F.R. § 17.22(b)(5)(ii); *Id.* § 17.32(b)(5)(ii).

199. Alejandro E. Camacho, *Can Regulation Evolve? Lessons from a Study in Maladaptive Management*, 55 UCLA L. REV. 293, 332–33 (2007).

200. *See, e.g.*, Fred P. Bosselman, *The Statutory and Constitutional Mandate for a No Surprises Policy*, 24 ECOLOGY L.Q. 707, 729–34 (1997).

actually kills or injures protected animals.[201] It is telling that the case made it all the way to the Supreme Court, where three Justices would have read the statute to provide for habitat protection only through federal land acquisition.[202] There remains uncertainty about constitutional boundaries of the ESA's regulatory provisions today.[203]

There never has been any doubt that pushing the legal boundaries of the ESA's regulatory power, wherever they might lie, would arouse political resistance.[204] When he was Secretary of Interior, Bruce Babbitt made it clear that he believed the Act should not be stretched to its constitutional limits.[205] The no surprises policy is one way to prevent regulatory excess.

The no surprises policy also rests on the idea that because government has the power to change rules it must provide strong reassurances to its negotiating partners that it will not do so. That is an understandable view for a government anxious to find negotiating partners, and one with powerful political resonance. But it elides an important aspect of the governance problem. Rules must change as the world, our understanding of it, and societal goals change. Legal rules necessarily are not fixed in stone. Legislatures cannot bind their successors,[206] and courts are free to reconsider past doctrine.[207]

Changes in the law are not supposed to be easy because, in the words of Justice Brandeis, "in most matters it is more important that the applicable rule of law be settled than that it be settled right."[208] Tensions are particularly high, and the doctrine correspondingly

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201. Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687 (1995).

202. *Id.* at 714 (Scalia, J., dissenting).

203. *Compare* Casitas Mun. Water Dist. v. United States, 543 F.3d 1276 (Fed. Cir. 2008), *and* Klamath Irrigation Dist. v. United States, 532 F.3d 1376 (Fed. Cir. 2008), *with* Tulare Lake Basin Water Storage Dist. v. United States, 49 Fed. Cl. 313 (Ct. Cl. 2001).

204. *See supra* notes 182–87 and accompanying text.

205. Bruce Babbitt, *The Endangered Species Act and "Takings": A Call for Innovation within the Terms of the Act*, 24 ENVTL. L. 355, 361–62 (1994).

206. *See, e.g.*, Fletcher v. Peck, 10 U.S. 87, 135–36 (1810).

207. *See, e.g.*, Hertz v. Woodman, 218 U.S. 205, 212 (1910) ("The rule of *stare decisis*, though one tending to consistency and uniformity of decision, is not inflexible. Whether it shall be followed or departed from is a question entirely within the discretion of the court, which is again called upon to consider a question once decided.").

208. Burnet v. Coronado Oil & Gas Co., 285 U.S. 393, 406 (1932) (Brandeis, J., dissenting). For an analysis of legal transition costs, see Michael P. Van Alstine, *The Costs of Legal Change*, 49 UCLA L. REV. 789 (2002).

difficult to sort out, when the government seeks to change rules that are foundational to a contract by which it has agreed to be bound.[209]

Nonetheless, a deal with the government is not always unshakeable. Under the Sovereign Acts doctrine, the government retains the power to legislate in ways that affect earlier contracts.[210] Moreover, since the problem with changing the rules after a deal has been made is one of surprise, the government can negotiate contracts that explicitly incorporate the prospect of change. There is no legal barrier to a habitat conservation plan agreement that would require permittees to make additional conservation efforts if necessary to ensure the survival of the species.

While it is mostly about politics and authority, the no surprises policy also illustrates the continuing influence of the equilibrium vision of nature. If nature tends toward equilibrium, it should be possible to predict the future state of reserves. An HCP should work if the Services correctly identify the lands to be set aside. Under the equilibrium vision, therefore, government has only itself to blame if HCPs prove insufficient. But if nature is dynamic, it is much more difficult to predict. The non-equilibrium view undermines the expectation that experts can accurately foresee the future and know

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209. The badly fractured opinion of the Court in *United States v. Winstar*, 518 U.S. 839 (1996), is perhaps the best illustration of the difficulties of resolving these issues when powerful interests in stability collide with equally powerful interests in allowing necessary change.

210. Bowen v. Pub. Agencies Opposed to Soc. Sec. Entrapment, 477 U.S. 41, 52 (1986). The Court held:

> While the Federal Government, as sovereign, has the power to enter contracts that confer vested rights, and the concomitant duty to honor those rights, we have declined in the context of commercial contracts to find that a 'sovereign forever waives the right to exercise one of its sovereign powers unless it expressly reserves the right to exercise that power in' the contract. Rather, we have emphasized that without regard to its source, sovereign power, even when unexercised, is an enduring presence that governs all contracts subject to the sovereign's jurisdiction, and will remain intact unless surrendered in unmistakable terms. Therefore, contractual arrangements, including those to which a sovereign itself is party, remain subject to subsequent legislation by the sovereign.

Id. (quoting Merrion v. Jicarella Apache Tribe, 455 U.S. 130, 148 1982) (internal citations omitted. *See also* Klamath Irrigation Dist. v. United States, 75 Fed. Cl. 677 (Fed. Cl. 2007) (holding that Sovereign Acts doctrine provided a defense to breach of contract claims based on reductions in water deliveries from a federal irrigation project for the benefit of species listed under the ESA).

how to get there.[211] Under the non-equilibrium view, it is more important to be able to adjust conservation strategies over time and less obvious that the government should bear the costs of any imperfections in the initial predictions.

III. THE IMPORTANCE OF BEING DYNAMIC

The ESA's static view of species, landscapes, and conservation obligations, while entirely understandable, has become a hindrance to effective conservation. The ESA's lofty goals of conserving species and the ecosystems upon which they depend cannot be achieved without a more realistic vision of the dynamic qualities of nature and the ability to respond to the changes that are inevitable in dynamic systems.

A. Accounting for Evolution

Conceptually, modern taxonomy focuses on evolution; it aims to recognize groups that are on evolutionarily separate paths.[212] But several aspects of the practice of taxonomy have made it difficult for implementation of the ESA to accurately reflect the evolutionary present or forecast the evolutionary future. Taxonomy is both a highly conservative and an underfunded discipline. As a result, formally recognized taxonomic categories change slowly, and, as the saga of the orca shows,[213] do not always represent the best and most current understanding of the relationships among groups. This problem sounds easy to fix—it seems to require only that the Services consult the top scientists currently working in the field, not just the dusty standard taxonomic reference.

Of course, that significantly understates the practical difficulty of the task. It is not always easy for an outsider to locate criticisms of

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211. *See* Timothy H. Profeta, *Managing without a Balance: Environmental Regulation in Light of Ecological Advances*, 7 DUKE ENVTL. L. & POL'Y F. 71, 75 (1996) ("[I]f ecosystems are dynamic, shifting systems . . . resources must be regulated under considerable and ever-changing uncertainty."); William H. Rodgers, Jr., *Adaptation of Environmental Law to the Ecologists' Discovery of Disequilibria*, 69 CHI.-KENT L. REV. 887, 887–88 (1994) (noting that non-equilibrium theory undermines the theory of comprehensive rationality in management).

212. *See supra* notes 45–53 and accompanying text.

213. *See supra* notes 87–88 and accompanying text.

existing taxonomic groups, which may be found predominantly in the grey literature or even in the informal conversations of scientists. It is even more challenging to update taxonomic categories where taxonomists have not done so. In the absence of a clear consensus among the field's practitioners, the Services will need to make difficult choices, often from a position of non-expertise.[214] Political pressures make these choices especially difficult; the Services may be reluctant to aggressively revise or challenge standard taxonomy for fear of calling the legitimacy of the ESA into question.

It is even more difficult to ensure that the identification of protectable entities takes account of the evolutionary future as well as the evolutionary past. The goal of much modern taxonomy is to look to the future: taxonomists seek to distinguish between independently evolving populations, which have the potential to develop unique adaptations. That focus coincides well with what many scientists believe should be the primary goal of conservation efforts—to ensure the current and future functioning of evolutionary processes.[215] Yet, because of the limited palette of tools available to evaluate divergence and the assumption that evolution is a slow process relative to the time scale of human decision-making, the field practice of taxonomy remains focused on the past. That is true at every taxonomic level.[216]

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214. *See* Holly Doremus, *Data Gaps in Natural Resource Management: Sniffing for Leaks along the Information Pipeline*, 83 IND. L.J. 407, 441–42 (2008) (observing that in deciding whether to list the Puget Sound population of killer whales, NMFS was faced with a taxonomic community that agreed the standard taxonomy of the species was wrong but did not agree on a replacement).

215. *See, e.g.*, Keith A. Crandall et al., *Considering Evolutionary Processes in Conservation Biology*, 15 TRENDS ECOLOGY & EVOLUTION, 290, 293 (2000) (describing primary conservation goals as "to preserve adaptive diversity and evolutionary processes across the geographic range of a species"); Haig et al., *supra* note 89, at 1590 (asserting that the ESA provides for protection of groups or populations in order to conserve evolutionary potential); Amy G. Vandergast et al., *Are Hotspots of Evolutionary Potential Adequately Protected in Southern California?*, 141 BIOLOGICAL CONSERVATION 1648, 1648 (2008) ("Across a variety of biological subdisciplines, there is growing recognition that conservation should aim to protect not only key species and populations . . . but also the evolutionary processes that create and sustain these patterns." (citation omitted)).

216. Fraser and Bernatchez explain that a variety of methods for identifying ESUs (in a taxonomic rather than a regulatory sense) emphasize historic isolation. Fraser & Bernatchez, *supra* note 53, at 2742–44. *See also* Crandall et al., *supra* note 215, at 290 (noting that "efforts

The focus on the past is problematic in two different respects. First, taxonomy that overemphasizes the past ignores the fact that evolution can occur within a matter of decades or even years.[217] This phenomenon, known as "contemporary evolution," is familiar to biology students from the story of the peppered moth, which rapidly changed its coloring after the industrial revolution to better hide on soot-blackened tree bark.[218] Until recently, that sort of rapid evolution was thought to be rare,[219] but examples have now begun to pile up. Hunting and fishing pressure can drive rapid evolutionary change, such as the development of tuskless elephants in Africa and Asia, small-horned bighorn sheep in the Rocky Mountains, and fish that mature without growing big.[220] Other selective pressures can also lead to rapid evolution. Introduced predators appear to have caused a significant shift toward nocturnal behavior in the Santa Cruz Island fox within the span of eleven years.[221] Earlier springs mediated by global climate change have caused red squirrels in Canada to breed earlier; some of that difference apparently is due to behavioral plasticity, but some is genetic.[222]

Second, by overemphasizing historic genetic isolation, the static species paradigm creates evidentiary difficulties and fails to acknowledge that isolation is not an essential prerequisite to evolution. Recent genetic separation may be evolutionarily significant but difficult to detect through genetic analysis,[223] especially if that analysis relies on "neutral" genetic markers.

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to document ESUs have emphasized reproductive isolation rather than the maintenance of adaptive differences").

217. For a discussion of "rapid" or "contemporary" evolution, see Craig A. Stockwell, Andrew P. Hendry & Michael T. Kinnison, *Contemporary Evolution Meets Conservation Biology*, 18 TRENDS IN ECOLOGY & EVOLUTION 94 (2003).

218. Bob Holmes, *In the Blink of an Eye*, NEW SCIENTIST, July 9, 2005, at 28.

219. There was evidence by the mid-1980s that contemporary evolution was relatively common, *see, e.g.*, JOHN A. ENDLER, NATURAL SELECTION IN THE WILD (1986), but it was not until the next decade that studies confirming the phenomenon began to proliferate. S.P. Carroll et al., *Evolution on Ecological Time-Scales*, 21 FUNCTIONAL ECOLOGY 387, 389 (2007).

220. *See* Carroll et al., *supra* note 219, at 389; Stockwell et al., *supra* note 217, at 97.

221. H.M. Swarts et al., *Possible Contemporary Evolution in an Endangered Species, the Santa Cruz Island Fox*, 12 ANIMAL CONSERVATION 120, 123–24 (2009).

222. Denis Reale et al., *Genetic and Plastic Responses of a Northern Mammal to Climate Change*, 270 PROC. ROYAL SOC'Y LONDON B 591 (2003).

223. *See* Matthew A. Cronin, *Systematics, Taxonomy, and the Endangered Species Act: The Example of the California Gnatcatcher*, 25 WILDLIFE SOC'Y BULL. 661, 664 (1997).

Furthermore, genetic divergence can occur in the absence of strong genetic isolation if there is some selective pressure.[224] Even rapid evolution is possible in the presence of gene flow.[225]

NMFS's struggles to identify appropriate units of conservation concern in Pacific salmon illustrate the problems created by focusing on demonstrable past genetic divergence. Counting cutthroat trout and steelhead, there are seven recognized species of Pacific salmonids.[226] Within those species, salmon do not have a highly articulated formal taxonomic structure, but they do show considerable genetic, behavioral, and ecological variation from stream to stream, and even within a single stream. Beginning in the 1940s, some salmon biologists recognized fish that spawned in a particular location at a particular time as stocks.[227] The existence of discrete stocks remained contested until about 1980,[228] and there was never a formal consensus on recognized stocks. When fisheries scientists, environmental groups, and Indian tribes began petitioning for the protection of Pacific salmon under the ESA, NMFS had to decide what units should be the focus of conservation concern. It responded with the ESU Policy, which identifies populations that are substantially reproductively isolated and represent an important component of the evolutionary legacy of the species as listable entities.[229]

The ESU policy is never easy to apply; it requires drawing seemingly arbitrary lines between stocks.[230] But the line-drawing is particularly challenging—and controversial—with respect to hatchery-spawned fish.

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224. *See* Haig et al., *supra* note 89, at 1591.

225. *See* Carroll et al., *supra* note 219; Stockwell et al., *supra* note 217, at 94–95.

226. R.S. Waples et al., *Characterizing Diversity in Salmon from the Pacific Northwest*, 59 J. FISH BIOLOGY 1, 1 (Supp. A 2001).

227. Willa Nehlsen, Jack E. Williams & James A. Lichatowich, *Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington*, 16 FISHERIES 4, 5 (1991).

228. *Id.* at 6.

229. *See supra* notes 123–24 and accompanying text.

230. *See* Holly Doremus & A. Dan Tarlock, *Science, Judgment, and Controversy in Natural Resource Regulation*, 26 PUB. LAND & RESOURCES L. REV. 1, 14–15 (2005) (explaining the complexities of identifying ESUs for coho salmon on the Oregon and California coasts).

Fish hatcheries were developed in the nineteenth century to compensate for heavy harvesting pressure and loss of habitat in increasingly industrialized rivers.[231] Construction of the first Pacific salmon hatchery began in 1872.[232] By 1930, some seventy-three hatcheries on the Pacific Coast were putting massive numbers of fry and juveniles in the region's rivers every year.[233] Although early hatchery practices seem to have done at least as much harm as good to salmon abundance,[234] the hatchery experiment rolled on. By 1981, "the network of hatcheries along the coast from California to Alaska released an estimated 1.06 billion artificially reared salmon juveniles."[235] According to NMFS, there are now some 365 hatchery programs in the Pacific Northwest alone,[236] releasing about 300 million young fish annually.[237] Another source reports that over six billion smolts are released in the Pacific Rim.[238] Hatchery fish dominate the catch in many of the region's commercial fisheries.[239]

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231. JAMES A. LICHATOWICH, SALMON WITHOUT RIVERS: A HISTORY OF THE PACIFIC SALMON CRISIS 114–23 (1999).

232. *Id.* at 123.

233. *Id.* at 143.

234. *Id.* at 143–44.

235. Michael L. Goodman, Comment, *Preserving the Genetic Diversity of Salmonid Stocks: A Call for Federal Regulation of Hatchery Programs*, 20 ENVTL. L. 111, 124 (1990).

236. NOAA's National Marine Fisheries Service, Northwest Regional Office, Hatcheries (Artificial Propagation), http://www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/Hatcheries/ (last visited Apr. 20, 2010).

237. U.S. DEP'T OF COMMERCE, NAT'L OCEANIC & ATMOSPHERIC ADMIN., NAT'L MARINE FISHERIES SERV., TECHNICAL MEMORANDUM NMFS-NWR/SWR, SALMONID HATCHERY INVENTORY AND EFFECTS EVALUATION REPORT, 2-1 (2004), http://www.nwr.noaa.gov/Publications/upload/SHIEER.pdf.

238. R.J. Beamish, C. Mahnken and C.M. Neville, *Hatchery and Wild Production of Pacific Salmon in Relation to Large-Scale Natural Shifts in the Productivity of the Marine Environment*, 54 ICES J. MARINE SCI. 1200, 1206 (1997).

239. "Depending on species and area, the salmon enhancement programs in the U.S. Pacific Northwest produce as much as 70 to 90% of salmon harvested in the commercial and recreational fisheries." GUNNAR KNAPP, CATHY A. ROHEIM & JAMES L. ANDERSON, THE GREAT SALMON RUN: COMPETITION BETWEEN WILD AND FARMED SALMON 54 (2007), http://www.iser.uaa.alaska.edu/iser/people/Knapp/pubs/TRAFFIC/SalmonReport_Ch_4-Hatcheries.pdf. *See also* Phillip S. Levin & John G. Williams, *Interspecific Effects of Artificially Propagated Fish: An Additional Conservation Risk for Salmon*, 16 CONSERVATION BIOLOGY 1581, 1582 (2002) ("Hatchery-reared salmon now dominate the salmonid fauna of the Columbia River Basin, with more than 95% of coho, 70% of spring-run chinook, 80% of summer-run chinook, 50% of fall-run chinook, and 70% of steelhead adults reared in hatcheries."); XANTHIPPE AUGEROT, ATLAS OF PACIFIC SALMON 34–35 (2005) (stating that eighty percent of salmon harvest in the Pacific northwest is hatchery-derived).

Carefully managed hatcheries hold promise as conservation tools, although their value has yet to be demonstrated in practice.[240] But hatchery fish also pose a threat to wild fish through competition, direct predation, attracting other predators by their sheer numbers, and gene swamping.[241]

The ESU Policy does not directly address treatment of hatchery fish. In 1993, NMFS published an interim hatchery policy providing that hatchery fish would be evaluated along with wild ones for inclusion in ESUs, but would not be listed with their ESU unless deemed essential to the recovery of wild fish.[242] That policy was overturned by a federal district court on the grounds that the statute did not permit the effective listing of a partial ESU.[243] If an ESU includes both hatchery fish and wild fish, the court ruled, the decision whether to list the ESU must apply to both.[244] Rather than appeal the decision, NMFS chose to redraft its hatchery policy. The new Hatchery Listing Policy, issued in 2005, again provides that hatchery fish will be included in ESUs with their genetically similar wild cousins.[245] NMFS will decide whether to list the ESU based on the likelihood that natural self-sustaining populations can persist.[246] Although that decision will apply to both wild and hatchery-spawned members of the ESU, NMFS will exercise its discretion to issue

240. *See generally* NAT'L OCEANIC & ATMOSPHERIC ADMIN., NAT'L MARINE FISHERIES SERV., NOAA TECHNICAL MEMORANDUM NMFS-NWFSC-38, A CONCEPTUAL FRAMEWORK FOR CONSERVATION HATCHERY STRATEGIES FOR PACIFIC SALMONIDS (1999), http://www.nwfsc.noaa.gov/publications/techmemos/tm38/tm38.pdf.

241. Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead, 71 Fed. Reg. 834, 857 (Jan. 5, 2006) (to be codified at 50 C.F.R. pt. 223–224); Kathryn Kostow, *Factors That Contribute to the Ecological Risks of Salmon and Steelhead Hatchery Programs and Some Mitigating Strategies*, 19 REV. FISH BIOLOGY & FISHERIES 9 (2009); Nicholas W. Vidargas, *A Means to Conserve? Wild Salmon and Hatcheries under the Endangered Species Act*, 32 ENVIRONS ENVTL. L. & POL'Y J. 345, 355–58 (2009).

242. Interim Policy on Artificial Propagation of Pacific Salmon under the Endangered Species Act, 58 Fed. Reg. 17,573, 17,574–75 (Apr. 5, 1993). For a more detailed explanation of the events that led to the present hatchery policy, see Michael C. Blumm & Hallison T. Putnam, *Imposing Judicial Restraints on the "Art of Deception": The Courts Cast a Skeptical Eye on Columbia Basin Salmon Restoration Efforts*, 38 ENVTL. L. 47, 70–76 (2008).

243. Alsea Valley Alliance v. Evans, 161 F. Supp. 2d 1154, 1162–63 (D. Or. 2001).

244. *Id.* at 1163.

245. Policy on the Consideration of Hatchery-Origin Fish in Endangered Species Act Listing Determinations for Pacific Salmon and Steelhead, 70 Fed. Reg. 37,204, 37,215 (June 28, 2005) (to be codified at 50 C.F.R. pt. 223-224).

246. *Id.*

regulations under ESA section 4(d) allowing the selective take of hatchery fish from threatened ESUs.[247] Two district courts split on the validity of the Hatchery Listing Policy.[248] The Ninth Circuit upheld it, together with the downlisting of Upper Columbia River steelhead from endangered to threatened, based on the contribution of hatchery fish to the ESU's likelihood of persistence.[249]

In promulgating the Hatchery Listing Policy, NMFS declined to reconsider its ESU policy or to apply that policy differently to hatchery than to wild fish. Surely that is in part a political choice, since refusing to treat hatchery fish as ESU-mates of wild fish would enhance the likelihood both that more ESUs would qualify for listing and that hatchery operations would have to be constrained to protect those ESUs. But it also follows directly from the framing of the ESU Policy and from the Services' taxonomic efforts more generally. Looking backward, many hatchery stocks do share a recent evolutionary history with the wild stocks from which they are derived. Furthermore, hatchery and wild fish typically are not entirely reproductively isolated once a hatchery is in operation; stray hatchery fish mate with their wild cousins, and wild fish provide gametes for the hatchery.

The problem lies in the other temporal direction; hatchery fish and wild fish may share an evolutionary past, but they have distinct evolutionary futures. Hatchery fish face strong selective pressures unlike anything experienced by wild-spawned fish. They can evolve rapidly under those pressures; for steelhead, fitness in the wild declines noticeably within just one or two hatchery generations.[250]

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247. *Id.* NMFS concurrently issued such rules in its revised listing determinations for sixteen salmon ESUs. Final Listing Determinations for 16 ESUs of West Coast Salmon and Final 4(d) Protective Regulations for Threatened Salmonid ESUs, 70 Fed. Reg. 37,160 (June 28, 2005).

248. *See* Trout Unlimited v. Lohn, No. CV 06-0483-JCC, 2007 WL 1795036 (W.D. Wash. June 13, 2007) (holding the Hatchery Listing Policy invalid), *rev'd*, 559 F.3d 946 (9th Cir. 2009); Alsea Valley Alliance v. Lautenbacher, No. 06-6093-HO, 2007 WL 2344927 (D. Or. 2007) (finding the Hatchery Listing Policy valid).

249. Trout Unlimited v. Lohn, 559 F.3d 946 (9th Cir. 2009).

250. Hitoshi Araki et al., *Fitness of Hatchery-Reared Salmonids in the Wild*, 1 EVOLUTIONARY APPLICATIONS 342, 346 (2008). *See also* JODY HEY ET AL., CONSIDERING LIFE HISTORY, BEHAVIORAL, AND ECOLOGICAL COMPLEXITY IN DEFINING CONSERVATION UNITS FOR PACIFIC SALMON: AN INDEPENDENT PANEL REPORT, REQUESTED BY NOAA FISHERIES 8–11 (2005), http://www.nwfsc.noaa.gov/trt/regarding_salmon_esus.pdf.

That divergence may show up quickly in behavior and fitness, but "may not be detectable with randomly selected or neutral molecular genetic markers,"[251] the tests most frequently used to evaluate reproductive isolation. As an advisory committee convened by NMFS put it, "By holding to a phylogenetic criterion and overlooking a population perspective of exchangeability, salmon ESUs are sometimes treated largely as taxonomic units rather than as evolutionary and ecological role players."[252] Because NMFS recognizes that hatchery and wild-spawned fish are not equivalent, it has turned itself inside out to avoid treating them equivalently when evaluating ESU status and imposing protective regulations. Adjusting the ESU policy would be more straightforward and easier to explain to the public.

A more forward-looking taxonomic approach might also change the Services' approach to hybrids and subspecies. The Services understand that hybridization is not always a bad thing, but they tend to look at it only in hindsight. The 1996 proposed hybrid policy,[253] the approach to the red wolf, and treatment of the westslope cutthroat trout[254] all focus on preserving the morphology of the past even if genetic purity is lost. From an evolutionary perspective, genetic purity is overrated. Hybridization can be a route to speciation.[255] At the same time, hybridization is not always good. It may be either a natural phenomenon capable of creating a new evolutionary future or an unnatural commingling made possible only by human action. The westslope cutthroat trout, which has hybridized with non-native trout deliberately stocked in its range, is an example of such "unnatural" hybridization.[256] While "natural" hybridization should neither be prevented nor prohibit protection, the better approach to "unnatural

251. HEY ET AL., *supra* note 250, at 6.

252. *Id.*

253. Proposed Policy and Proposed Rule on the Treatment of Intercrosses and Intercross Progeny (the Issue of "Hybridization"), 61 Fed. Reg. 4710 (Feb. 7, 1996) (to be codified at 50 C.F.R. pt. 424).

254. *See supra* notes 78–83 and accompanying text.

255. *See* Pamela S. Soltis & Douglas E. Soltis, *The Role of Hybridization in Plant Speciation*, 60 ANN. REV. PLANT BIOLOGY 561 (2009); 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).

256. *See supra* notes 80–81 and accompanying text.

hybridization" seems to be to protect populations with the "right" morphology and only limited genetic introgression (as FWS has done in the case of the WCT), while aggressively seeking to remove the interloper species to prevent further introgression.

With respect to subspecies, focusing on the future might not change the outcome so much as the way it is explained. The Preble's meadow jumping mouse became a cause célèbre among conservation skeptics because it is easy to ridicule distinctions based on minor differences in the shape of the skull or in mitochondrial DNA sequences, and to malign the motives of those who insist on protecting such barely distinct rodents. The best explanation for continued recognition of the subspecies so far has been that there is not enough evidence to justify overturning a fifty-year-old taxonomy arrived at without conservation in mind. The sage grouse dispute shows many of the same characteristics: it boils down to a dispute over what it takes to overcome an old but formally recognized taxonomic classification. The public can be excused for confusion and disinterest in arguments conducted by experts in arcane language about genetic isolation and dusty taxonomic authorities.

Turning the focus toward the future and explicitly factoring in the dynamism of evolution might change the tone and focus of the debate over subspecies recognition. It could force FWS to talk more about the conservation purposes served by recognizing subspecies or DPSs. That in turn would open up the discussion to more participants and relate it more directly to the goals of conservation policy. A forward-looking approach will not end the controversy, but it might make the discussion and the consequences of the decision more transparent.

The ESU and DPS Policies, because they are so focused on detectable genetic divergence, turn the Services' attention too much to the evolutionary past and too little to the evolutionary future. If one purpose of the ESA is to ensure that evolutionary processes can continue with minimal anthropogenic interference, the ESU and DPS policies need to be reconsidered.

B. Accommodating a Changing Climate

By the time the ESA was adopted, the limits of the static "hands off" preserve strategy already had been noticed in other contexts. As

early as the 1950s, some preserve managers had become aware that their charges, left alone, were nonetheless changing right before their eyes. Daniel Botkin tells the story of the Hutchinson Memorial Forest Nature Preserve in New Jersey.[257] Never logged since European settlement, the forest was celebrated as an example of primeval American nature and set aside as a preserve with much fanfare. But nature was not standing still; the oaks and hickories for which the forest was famous were being replaced by maples. It turned out that the oak-hickory forest historically had been maintained by fires periodically set by Native Americans. With the exclusion of fire, the European-Americans who thought they were preserving a living museum had ensured that it would instead become "a forest that nobody had predicted,"[258] and that no one really wanted.

Of course, the Hutchinson Forest story is entirely consistent with the Clementsian theory of succession—the preserve's managers were witnessing succession toward a climax community in the absence of disturbance. But it powerfully illustrates that nature will not automatically produce the preferred human outcome—a perfect garden of Eden—if it is simply walled off from human influence. What we think of as nature may be neither stable nor natural, in the sense of having been shaped primarily by forces other than human influence. The story also demonstrates that nature or what we think of as nature is difficult to predict: we cannot be sure that marking boundaries on the land and walking away will achieve our conservation goals, but we also may not know what affirmative management actions *would* help us reach those goals.

In 1973, both ecological theory and practical experience supported the static "hands off" approach, notwithstanding some chinks in the armor. The balance of nature theory did not long survive the ESA's passage, however. Paradigm shifts in science can come rapidly once they gather enough momentum. By 1992 Eugene Odum, perhaps the best-known advocate of the equilibrium view, had publicly recanted, declaring that ecosystems are "far from equilibrium."[259] Practice

257. Daniel B. Botkin, *Adjusting Law to Nature's Discordant Harmonies*, 7 DUKE ENVTL. L. & POL'Y F. 25, 29–31 (1996).

258. *Id.* at 31.

259. Eugene P. Odum, *Great Ideas in Ecology for the 1990s*, 42 BIOSCIENCE 542, 542

changed more slowly. By the mid-1980s, though, observers and managers of the national parks, the highest-profile preserve system in the United States, were publicly worrying about the vulnerability of those preserves to external threats and wondering whether to let "natural" (lightning-caused) fires burn.[260] In 1989, Bill McKibben proclaimed "The End of Nature," arguing that, in light of anthropogenic global climate change, there was no place on Earth remote enough to harbor nature unaltered by humanity.[261] That observation knocked the intellectual underpinnings out from under the "hands off" strategy but did not end either its intuitive or practical appeal.

At this point, three problems with the "hands off" strategy have become obvious. First, some parts of nature are not helped by a preserve-based strategy. As we have expanded our sights from the systems we know best, conventional terrestrial ecosystems, we have found more and more places where we simply cannot wall nature in or adverse impacts out. Technology can help, but it cannot solve the core problems of high permeability and interdependence. Improvements in mapping and monitoring, for example, have made it simple enough to draw lines on the water that "ocean zoning," a concept that a generation ago was applied only to keep foreigners out of "our" waters, is now a highly articulated concept that is widely advocated and beginning to be applied.[262] But we cannot fence fish into areas designated as marine reserves. Similarly, in freshwater systems, it is typically impractical to have flowing water in one reach

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(1992).

260. Robert B. Keiter, *The Law of Fire: Reshaping Public Land Policy in an Era of Ecology and Litigation*, 36 ENVTL. L. 301, 308–11 (2006); Paul Schullery, *The Fires and Fire Policy*, 39 BIOSCIENCE 686 (1989). Debates over fire policy came to a head in the wake of the 1988 fires at Yellowstone National Park. For an in-depth analysis of the Yellowstone fires and their impact on fire policy, see ROCKY BARKER, SCORCHED EARTH: HOW THE FIRES OF YELLOWSTONE CHANGED AMERICA (2005).

261. BILL MCKIBBEN, THE END OF NATURE (1989).

262. *See, e.g.*, Josh Eagle, James N. Sanchirico & Barton H. Thompson, Jr., *Ocean Zoning and Spatial Access Privileges: Rewriting the Tragedy of the Regulated Ocean*, 17 N.Y.U. ENVTL. L.J. 646 (2008); Karen Hansen, Kathryn Mengerink & Michael Sutton, *A Bold New Ocean Agenda: Recommendations for Ocean Governance, Energy Policy, and Health*, 39 ENVTL. L. REP. NEWS & ANALYSIS 10012 (2009); Deborah A. Sivas & Margaret R. Caldwell, *A New Vision for California Ocean Governance: Comprehensive Ecosystem-Based Marine Zoning*, 27 STAN. ENVTL. L.J. 209 (2008).

of a stream while allowing another to be "dewatered" for out-of-stream uses.

Second, many natural systems are internally dynamic, and that dynamism is essential to the maintenance of their unique biota. In Nebraska, for example, the Platte River was historically a braided system of many shallow channels broken up by low sandbars. Those sandbars provided nesting sites for the endangered piping plover. Low sandbars can be maintained only by a river with highly variable flows that periodically scour and even relocate the sandbars. Constant flows which leave the sandbars undisturbed are not suitable; in the absence of scouring flows, vegetation growth destroys the sandbars' value as nesting habitat.[263] Piping plovers require a dynamic system that is constantly both destroying and simultaneously creating habitat. Many other species, including fire-adapted[264] and estuarine[265] species, are now thought to depend upon variable or dynamic environments.

Third, external effects can undermine even the largest and best-managed preserves. McKibben's 1989 observation is widely accepted today: there is no hiding from phenomena like global warming and ocean acidification. Glacier National Park soon will be without glaciers, and Joshua trees are not regenerating in their namesake park.[266] Range shifts and behavioral changes already are widely observed,[267] and a significant number of climate "niches" are likely to disappear (while other new ones appear) in the relatively near future.[268] No wall can keep those effects out; even the most active

263. NAT'L RESEARCH COUNCIL, ENDANGERED AND THREATENED SPECIES OF THE PLATTE RIVER 193–99 (2004).

264. Catherine L. Parr & Alan A. Andersen, *Patch Mosaic Burning for Biodiversity Conservation: A Critique of the Pyrodiversity Paradigm*, 20 CONSERVATION BIOLOGY 1610 (2006) (explaining, and criticizing as insufficiently examined, the promotion of patchy burning to create heterogeneous habitat for birds, mammals, invertebrates, and plants). *See also* Richard A. Minnich, *Fire Mosaics in Southern California and Northern Baja California*, 219 SCI. 1287 (1983).

265. JAY LUND ET AL., ENVISIONING FUTURES FOR THE SACRAMENTO-SAN JOAQUIN DELTA 62–78 (2007) (arguing that the key to restoring desirable species in the Delta is to recreate habitats featuring high variability in salinity, channel flows, depth, and water clarity).

266. Daniel B. Wood, *How Climate Change May Be Threatening National Parks*, CHRISTIAN SCI. MONITOR, Apr. 9, 2009, *available at* http://www.csmonitor.com/Environment/Global-Warming/2009/0409/how-climate-change-may-be-threatening-national-parks.

267. Camille Parmesan & Gary Yohe, *A Globally Coherent Fingerprint of Climate Change Impacts across Natural Systems*, 421 NATURE 37, 38–39 (2003).

268. John W. Williams, Stephen T. Jackson & John E. Kutzbach, *Projected Distributions*

management measures within the preserve are futile. As Bill Rodgers observed in 1994, "global warming alone might mean that to achieve anything approaching ecological stability, Yellowstone National Park would have to travel northwards at a rate of about three kilometers per year."[269] As a conservation tool, the preserve strategy may still be necessary, but it is no longer sufficient.

C. Facilitating Adaptive Management

The collapse of the equilibrium paradigm shattered our illusions that we could manage nature on a comprehensive rationality model.[270] In a non-equilibrium world, nature is full of surprises. What we now know is that there is much we do not know. Learning has become as important as acting. When ignorance is everywhere, actions should be tentative, not necessarily hesitant or cautious, but subject to reconsideration as the knowledge base builds up.[271]

Roughly coincident with the move away from the equilibrium paradigm, ecologists began to look for tools to deal with uncertainty and facilitate learning. Drawing on disciplines as diverse as decision theory, organizational behavior, and policy analysis,[272] Carl Walters and C.S. ("Buzz") Holling offered "adaptive management" as a structured approach to learning and adjusting management decisions.[273]

Adaptive management aims to create policies that can help organizations, managers, and other stakeholders respond to and take advantage of unanticipated events. Instead of seeking precise predictions of future conditions, adaptive management recognizes the uncertainties associated with forecasting future outcomes and calls

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of Novel and Disappearing Climates by 2100 AD, 104 PROC. NAT'L ACAD. SCI. 5738, 5738 (2007).

269. Rodgers, Jr., *supra* note 211, at 890.

270. *Id.* at 887–88.

271. *See* Daniel A. Farber, *Environmental Protection as a Learning Experience*, 27 LOYOLA L.A. L. REV. 791, 798 (1994) ([W]hen the information base is itself subject to rapid change . . . [i]t makes little sense to agonize over today's decision when it is likely to require revision tomorrow anyway.").

272. NAT'L RESEARCH COUNCIL, ADAPTIVE MANAGEMENT FOR WATER RESOURCES PROJECT PLANNING 19 (2004).

273. CARL WALTERS, ADAPTIVE MANAGEMENT OF RENEWABLE RESOURCES (1986); ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed., 1978).

for consideration of a range of possible future outcomes: "[M]anagement policies are designed to be flexible and are subject to adjustment in an iterative, social learning process."[274]

Learning can happen in a variety of ways, ranging from trial and error to rigorously controlled experimentation. Any form of structured learning could be called adaptive management; the essential elements are an iterative or incremental set of decisions, monitoring to provide the opportunity for learning, and a commitment to revisiting or adjusting decisions in light of new knowledge.[275] Many conservation policymakers are enthusiastic advocates of adaptive management, but it remains "an idea often appealed to but rarely achieved in natural resource management."[276]

HCP approval under the ESA is one prominent example of giving lip service to the concept of adaptive management while ignoring its substance. The Services claim to be committed to adaptive management, talking about its role in dealing with uncertainty, and requiring contingency planning for changed circumstances.[277] But they have not actually used adaptive management as a tool to reduce uncertainty or to make course corrections. Instead, empty promises of adaptive management have been used as an excuse to grant permits on the basis of very thin information, while the "no surprises" policy has precluded any serious reevaluation of permit terms as more information is gathered.[278]

This strategy is problematic for existing HCPs, given the limited information base on which most are founded. It becomes more problematic as climate change looms. Although climate models are now reasonably good at predicting global-scale changes in temperature, they are much less good at predicting local changes in temperature, precipitation patterns, sea level, and the like that mediate species-level impacts.[279] Even less is known about how

274. NAT'L RESEARCH COUNCIL, *supra* note 272, at 20.

275. Ruhl, *supra* note 189, at 28. *See also* NAT'L RESEARCH COUNCIL, *supra* note 272, at 24–27.

276. Holly Doremus, *Precaution, Science, and Learning while Doing in Natural Resource Management*, 82 WASH. L. REV. 547, 568 (2007).

277. *See* Camacho, *supra* note 199, at 329–30; Doremus, *supra* note 182, at 69–70.

278. Camacho, *supra* note 199, at 331–35; Doremus, *supra* note 182, at 69–74.

279. *See* U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-07-863, CLIMATE CHANGE:

biotic interactions and adaptation might change the scenario.[280] Climate change thus magnifies the difficulty of predicting the future effectiveness of current conservation measures and greatly increases the need for robust adaptive management.

IV. CAN WE GET THERE FROM HERE?

So far, I have argued that, as a product of its time and context, the ESA takes an unrealistically static view of species, landscapes, and legal obligations, and I have endeavored to show that the disjunction between the Act's static assumptions and dynamic reality undermines its ability to serve its conservation goals. The next step is to ask whether the Act's assumptions can be made more realistic.

We now have a better understanding of relevant science than was available at the time of the ESA's enactment, or at the time that initial implementation decisions were being made. This knowledge highlights the importance of escaping the static mindset. We can see that species are not only dynamic entities but also entities that can change on time scales relevant to policy choices. We know that protected landscapes not only are not static, they are currently facing change on a scale and at a rate without precedent in human experience. We understand that entrenching legal obligations

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AGENCIES SHOULD DEVELOP GUIDANCE FOR ADDRESSING THE EFFECTS ON FEDERAL LAND AND WATER RESOURCES 9 (2007) ("[Federal resource managers] do not have sufficient site-specific information to plan for and manage the effects of climate change on the federal resources they oversee. In particular, they lack computational models capable of providing local projections of expected changes."); NAT'L RESEARCH COUNCIL, EVALUATING PROGRESS OF THE U.S. CLIMATE CHANGE SCIENCE PROGRAM 5 (2007) ("Information at regional and local scales is most relevant for state and local resource managers and policy makers, as well as for the general population, but progress on these smaller spatial scales has been inadequate."); NAT'L SCI. & TECH. COUNCIL, COMM. ON ENV'T & NATURAL RES., SCIENTIFIC ASSESSMENT OF THE EFFECTS OF GLOBAL CHANGE ON THE UNITED STATES 3 (2008), http://www.ostp.gov/galleries/NSTC%20Reports/Scientific%20Assessment%20FULL%20Report.pdf (observing that "attribution of the drivers of long-term temperature changes on time scales of less than 50 years and at regional scales (e.g., county, state, or multiple states, as opposed to continental), with limited exceptions, has not yet been established").

280. *See, e.g.*, Matthew C. Fitzpatrick & William W. Hargrove, *The Projection of Species Distribution Models and the Problem of Non-Analog Climate*, 18 BIODIVERSITY & CONSERVATION 2255 (2009); Richard G. Pearson & Terence P. Dawson, *Predicting the Impacts of Climate Change on the Distribution of Species: Are Bioclimate Envelope Models Useful?*, 12 GLOBAL ECOLOGY & BIOGEOGRAPHY 361 (2003).

provides certainty to the regulated community at the potential expense of protected resources.

Recognizing that change is important does not alone make it happen. Law is quite deliberately resistant to change; it requires a high activation energy to move it from its established state to a new one. Legal change is always costly, so it should not be sought unless there is a reasonable probability that the new state will be preferable to the old. In this section, I examine the very real barriers to dynamic conservation law and look for steps that could help us move at least incrementally in that direction.

A. The Barriers: Politics, Psychology, and Practicality

One potential barrier can be set aside at the outset: there is nothing in the ESA that would preclude a more dynamic approach. None of the static interpretations here are explicitly demanded by the statute. Comprehensive legislative reconsideration of the ESA, which is sufficiently cumbersome and sufficiently risky that it has not happened for more than twenty years,[281] is not needed to better match the law with the reality of changeable nature.

Nonetheless, there are very real barriers to creating a more dynamic law. I will consider them in order of the height of the hurdle I believe they present to improving implementation of the law.

The first of these barriers is politics. Any change that increases the law's demands of landowners and resource users will face stiff resistance, particularly if it is known in advance where those demands will fall most heavily. Throughout its history, ESA implementation has been a story of political compromise and accommodation of development interests, with only scattered sightings of an administrative spine.[282] That is not surprising, given that the costs of regulation fall on a relatively small, identifiable, and politically sophisticated group, while the benefits are spread widely across society.[283]

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281. The ESA was last significantly amended in 1988. Endangered Species Act Amendments of 1988, Pub. L. No. 100-478, 102 Stat. 2306 (1988) (codified at 16 U.S.C. §§ 1531–1544 (2006)).

282. *See, e.g.*, Doremus, *supra* note 182, at 57–63.

283. *See* JOSEPH L. SAX, DEFENDING THE ENVIRONMENT 52–62 (1970) (describing

Nonetheless, I do not believe that the changes contemplated here are politically unfeasible. For one thing, endangered species are not without their own politically sophisticated allies, who are currently enjoying renewed influence in the legislative and executive branches after eight or more years of wandering in the political desert. For another, these changes would be made at the level of general regulations or policy guidance, a level at which national environmental groups have their best opportunity to mobilize effective support, rather than in individual implementing decisions that might fly under the national radar. If environmental interests were willing to push, and if the administration were not too distracted by its other priorities, these changes would at least be politically possible.

The second barrier to adopting a more dynamic conservation law is human psychology. People are uncomfortable with dynamic natural systems and have spent considerable effort and resources in a quest to remove variability from those systems.[284] "Ever since human beings decided to anchor themselves to the map by cultivating fields they have been obsessed with stabilizing dynamic nature."[285] Floods, fires, droughts, and other manifestations of nature's instability are hard on settled, territorial creatures. It is unnatural, in a very real sense, to expect people to embrace the notion that nature must be allowed to be dynamic at their expense. The psychological pull of a stable vision of nature makes it difficult even to confront the problem. People, even people who intellectually know better, intuitively see natural kinds as invariant and landscapes as static. The invisibility of nature's true dynamic nature undoubtedly complicates the political challenge.

The psychological challenge is even greater with respect to overcoming the ESA's static vision of legal obligations. People are

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situations in which agency decisions were successfully manipulated by narrow special interests); Daniel A. Farber, *Public Choice and Just Compensation*, 9 CONST. COMMENT. 279, 289 (1992) (describing that "small groups with high stakes have a disproportionately great influence on the political process").

284. Holly Doremus & Michael Hanemann, *The Challenges of Dynamic Water Management in the American West*, 26 UCLA J. ENVTL. L. & POL'Y 55, 62 (2008); Norton, *supra* note 170, at 54–55.

285. Doremus & Hanemann, *supra* note 284, at 62.

just as uncomfortable with unstable regulatory systems as they are with dynamic nature.[286] That is especially true when capital and emotional investments are at stake, as they typically are with land and water use regulations. People want security in their investments. Even when the investment is someone else's, people may find it easy to empathize with the victims of rule changes, particularly if they seem to have been targeted by the government for unfavorable treatment.[287] For that reason, the political and psychological difficulties of revising the "no surprises" policy are likely to be particularly acute.

The third barrier to adopting a dynamic conservation strategy is the difficulty of finding practical alternatives to the current structure. Perhaps surprisingly, this may be the most difficult barrier to surmount. If we let go of the static view of nature, it may be difficult to find alternative stopping points that are concrete enough to be enforceable and limited enough to win political acceptance. With respect to the taxonomy problem, for example, as difficult as it may be to identify populations that merit protection, it is much more difficult to identify and operationalize protection of biological diversity, ecosystems, ecosystem processes, resilience, ecosystem services, or any other target.[288] Given the need to define units of regulatory focus and the intuitive appeal of individual species, I do not believe that we can evade the taxonomy problem by protecting higher levels of organization.

Practicality is also a barrier to efforts to get away from the paradigm of static preserves as a conservation strategy. The static vision allows us to use history as our conservation target and to

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286. *Id.* at 63.

287. This is the kind of effect Frank Michelman had in mind when he argued that demoralization costs must be taken into account in any efficiency calculation of the consequences of an uncompensated government taking of property. *See* Frank I. Michelman, *Property, Utility, and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law*, 80 HARV. L. REV. 1165, 1214–15 (1967). Here, I am not endorsing Michelman's views on compensation, but simply observing that there seem to be special psychological costs to the loss of something that has been viewed as an entitlement.

288. *See* Oliver A. Houck, *On the Law of Biodiversity and Ecosystem Management*, 81 MINN. L. REV. 869, 873 (1997) (concluding that "however high we raise our sights towards managing the whole, the requirements of individual species will remain the bottom line, or we will have no bottom line, and the entire effort will fail").

achieve that target by simply forbidding disruption of the status quo. Without history as a target, it will be difficult to understand or define what we want to protect. And without faith in the persistence of the status quo, it may be difficult to decide what obligations may fairly be imposed. Uncomfortable as these questions are, we cannot avoid them in a world where we know the status quo is unstable.

B. Baby Steps toward a More Mature Law

Even with these barriers, we can take small steps toward an incrementally more dynamic law. The essentialist fallacy can be addressed by revisions to the ESU and DPS Policies, coupled with new guidance for the identification of species and subspecies. The Services should explicitly acknowledge that evolution is a current, not just an historical, phenomenon. They may continue to use evidence from the past, such as divergence in neutral genetic markers, but they should also take into account the possibility of rapid divergence within groups with the same genetic history. This means looking for adaptive divergence in phenotype, behavior, ecology, and genes; supporting the development of new tests for adaptive divergence; and drawing lines between groups that are likely to be rapidly diverging, like hatchery and wild-spawned fish, no matter how recently they shared a common ancestor. Lines will still be difficult to draw, contested, and at some level arbitrary, but at least they will rest on realistic principles.

The wilderness fallacy is likely to present the greatest challenge to adopting a more dynamic conservation model. It must be addressed with a new focus on restricting harmful actions across the landscape, rather than designating a small proportion of inviolate reserves. This will be challenging because so much of the human footprint on the landscape is, or at least seems to be, irreversible. It may mean restricting the most intensive land uses to smaller portions of the landscape until we learn more about what the natural world of the future will look like. Given the radical uncertainty that global climate change brings, an effective conservation strategy will certainly require weaning ourselves off the arrogant notion that we can strike the perfect balance between use and conservation of the natural world around us. On the other hand, that same uncertainty may paralyze

decision makers, leaving them grasping at the "hands off" strategy as the most humble approach to a world that is neither static nor predictable.[289] In order to avoid that paralysis, we must strive to improve our forecasting tools as rapidly as possible, so that managers have a better idea of viable targets for the lands under their stewardship and the regulated community has a better idea of what might be expected of them in the future.

With respect to the rule of law fallacy, we must acknowledge uncertainty and focus on learning and retaining flexibility to respond to new information. An easy step in that direction would be to tie the extent of "no surprises" protection explicitly to our level of knowledge about the system. The more we know, the more confident we are of our predictions for the future, the more willing we should be to offer strong regulatory certainty to a permittee. The less we know at the outset, the more we should require a permit applicant to accept the possibility of increased future obligations.

CONCLUSION

The drafting and implementation of the ESA reflect the context of the times, including the prevailing scientific beliefs, the political context, and common background assumptions. Such beliefs, contexts, and assumptions pushed it toward three fallacies based in a static conception of nature and of law: the essentialist fallacy, the wilderness fallacy, and the rule of law fallacy. At the time, those ideas approximated reality closely enough to work reasonably well, but that no longer is the case. We now know that nature is capable of rapid change, and we expect such change to be the rule rather than the exception in the twenty-first century. For the ESA to effectively serve our conservation goals, it must adopt a more realistic view that accounts for nature's dynamic qualities and avoids freezing legal obligations. These changes will not be easy to achieve, because dynamic regulatory regimes are politically, psychologically, and practically difficult to implement. There are, however, some

289. M. Martin Smith & Fiona Gow, *Unnatural Preservation*, HIGH COUNTRY NEWS, Feb. 1, 2008, at 12.

relatively straightforward steps that could move the ESA incrementally toward the dynamic law it will have to be in the future.