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PROTECTING ENDANGERED SPECIES IN AN ERA OF CLIMATE CHANGE: THE NEED FOR A SMARTER LAND USE ETHIC

Eric V. Hull*

*The most unique feature of Earth is the existence of life,
and the most extraordinary feature of life is its diversity.¹*

INTRODUCTION

In 1973, Congress responded to the cumulative impacts human activities had on plant and animal species by passing the Endangered Species Act (ESA).² Congress recognized that many of the nation's native plants and animals were in danger of becoming extinct, and created the ESA as a means to protect and recover imperiled species and the ecosystems upon which they depend.³ Two decades later, the international community collaborated to establish the Convention on Biological Diversity dedicated to promoting sustainable development and the conservation of biological diversity worldwide.⁴ Fundamentally, these protection efforts are predicated on the understanding that individual species provide measureable value to society, that biologically diverse ecosystems are more productive, and that ecosystems provide useful services upon which society relies.⁵ Yet, despite significant efforts to protect endangered species,

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1. Bradley J. Cardinale et al., *Biodiversity Loss and Its Impact on Humanity*, 486 NATURE 59, 59 (2012).

2. 16 U.S.C. § 1531 (2012).

3. *Id.* § 1531(b).

4. *History of the Convention*, CONVENTION ON BIOLOGICAL DIVERSITY, <http://www.cbd.int/history/> (last visited Jan. 22, 2015). The Convention “entered into force” on December 29, 1993. *Id.* “Biodiversity is the variety of life, including variation among genes, species and functional traits. It is often measured as: richness is a measure of the number of unique life forms; evenness is a measure of the equitability among life forms; and heterogeneity is the dissimilarity among life forms.” Bradley J. Cardinale et al., *supra* note 1, at 60.

5. Bradley J. Cardinale et al., *supra* note 1, at 60 (“There is now unequivocal evidence that biodiversity loss reduces the efficiency by which ecological communities capture biologically essential

in many areas of the world, many species at risk of extinction are moving closer to extinction.⁶ Of the more than 70,000 species that have been assessed, more than 20,000 are threatened with extinction.⁷ The status of many species has not yet been assessed, so the total number of species in decline may actually be much higher.⁸

Human activities continue to dismantle the Earth's ecosystems at an alarming rate, and the impact appears greater than previously understood. Today, most natural systems are impaired to some degree.⁹ Anthropogenic impacts on the global biosphere now control major facets of ecosystem function.¹⁰ Widespread fragmentation and degradation of natural ecosystems continue to drive declines in biodiversity and in ecosystem services that may have profound effects on society.¹¹ The cumulative impact of human exploitation of the natural environment is becoming clear. One recent study suggests

resources, produce biomass, decompose and recycle biologically essential nutrients. . . . There is mounting evidence that biodiversity increases the stability of ecosystem functions through time.”)

6. See, e.g., David Wilcove et al., *Leading Threats to Biodiversity: What's Imperiling U.S. Species*, in PRECIOUS HERITAGE 239, 243 (Bruce A. Stein et al. eds., 2000). Almost a quarter of plant species are estimated to be threatened with extinction. *Id.* See also *Summary Statistics*, THE IUCN RED LIST OF THREATENED SPECIES Fig. 1, http://www.iucnredlist.org/about/summary-statistics#Dynamic_Red_List (last visited Jan. 13, 2015) (showing the declining status of amphibians, birds, corals, and mammals).

7. *Table 1: Numbers of Threatened Species by Major Groups of Organisms (1996-2014)*, IUCN RED LIST, http://cmsdocs.s3.amazonaws.com/summarystats/2014_3_Summary_Stats_Page_Documents/2014_3_RL_Stats_Table_1.pdf (last visited Jan. 13, 2015); *Table 2: Changes in Numbers of Species in Threatened Categories (CR, EN, VU) From 1996 to 2014*, IUCN RED LIST, http://cmsdocs.s3.amazonaws.com/summarystats/2014_3_Summary_Stats_Page_Documents/2014_3_RL_Stats_Table_2.pdf (last visited Jan. 13, 2015).

8. See, e.g., *Overview of The IUCN Red List, Expanding the Taxonomic Coverage of the Red List*, THE IUCN RED LIST OF THREATENED SPECIES, <http://www.iucnredlist.org/about/overview> (last visited Jan. 13, 2015) (noting that the IUCN Global Species Programme is currently managing data on over 73,000 species and seeks to increase that number to 160,000 species).

9. See *infra* Part II.A.

10. Stephen R. Palumbi, *Humans as the World's Greatest Evolutionary Force*, 293 SCIENCE 1786, 1786 (2001).

11. CONVENTION ON BIOLOGICAL DIVERSITY, GLOBAL BIODIVERSITY OUTLOOK 2, at 2 (2006), available at <http://www.cbd.int/doc/gbo/gbo2/cbd-gbo2-en.pdf>. The target agreed by the world's governments in 2002, “to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth,” has not been met. *Id.* Extensive fragmentation and degradation of forests, rivers and other ecosystems have also led to loss of biodiversity and ecosystem services. *Id.* at 3. Ecosystem services are the suite of benefits that ecosystems provide to humanity. *Id.* at 14. It focuses on two types of ecosystem services—provisioning and regulating. *Id.* Provisioning services involve the production of renewable resources (for example, food, wood, fresh water). *Id.* Regulating services are those that lessen environmental change (for example, climate regulation, pest and disease control). *Id.*

that the impact has been so significant that the earth may be in the midst of a sixth mass extinction.¹²

Climate change poses a fundamental threat to species survival, but it is not mentioned in the ESA nor in any of its implementing regulations.¹³ The potential impacts of climate-induced changes to ecosystems will likely impede the effectiveness of species protection efforts under the ESA because habitat preservation is critical to preserving imperiled species.¹⁴ Globally, approximately 20% to 30% of plant and animal species are at an increased risk of extinction if climate change continues.¹⁵

Although the impact of climate change and other major environmental stressors on the natural environment has garnered significant attention in the literature, comparatively little attention has been paid to how land use practices in an era of climate change impact species protection efforts.¹⁶ Historic land use regulation designed to separate incompatible uses of land has led to harmful sprawl away from cities into previously pristine areas and compromised ecosystems.¹⁷ Burgeoning human populations continue to convert remote landscapes to create artificial, human-dominated environments that interfere with natural disturbances caused by fire, flood, drought and storm patterns essential to ecosystem health.¹⁸ In many areas, development and use of land has altered local geography and hydrology in such profound ways that species are unable to use remaining land to obtain food and water or to produce offspring.¹⁹

12. Anthony D. Barnosky et al., *Has the Earth's Sixth Mass Extinction Already Arrived?*, 471 NATURE 51, 51 (2011).

13. *See infra* Part II.B.

14. *See generally* U.S. FISH AND WILDLIFE SERVICE, APPENDIX: 5-YEAR ACTION PLAN FOR IMPLEMENTING THE CLIMATE CHANGE STRATEGIC PLAN (2009), available at <http://www.fws.gov/home/climatechange/pdf/CCDraftActionPlan92209.pdf> (developing measures to address species protection in anticipation of changes in climate); *see also* 16 U.S.C. § 1533 (b)(2) (2012) (requiring the Secretary to designate critical habitat for species listed for protection under the Act).

15. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT 48 (2007) [hereinafter 2007 SYNTHESIS REPORT], available at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf (observing the risk increases if global average temperature exceeds 1.5° to 2.5°C).

16. Mark Lorenzo, *Sizing up Sprawl*, WILD EARTH, Fall 1999, at 72.

17. *Id.*

18. *See id.*

19. *See id.*

These changes and others have contributed to a significant decline in species biodiversity. Recent studies have shown that the loss of biodiversity within a system decreases overall system resilience in ways that are nearly equivalent to the introduction of pollutants, invasive species, and other major stressors.²⁰ The loss of species diversity, accompanied with the damage from climate change, will further degrade impaired ecosystems and place greater pressure on the species.²¹

Climate-induced changes in the natural environment are expected to cause dramatic shifts in the geographical distribution of plant and animal species by the end of this century.²² These shifts will present major challenges to local communities seeking to balance the land use needs of burgeoning populations with the requirement to protect imperiled species, and force communities to reevaluate their existing land ethic.²³ This article examines how land use practice and decisions impact species protection efforts under the ESA and considers how these activities could exacerbate biodiversity loss as climate change progresses. Section II examines key provisions of the ESA that are implicated by land use decisions, and addresses how a warming climate impacts implementation of these provisions. Section III considers the impact of climate change on imperiled species and the critical role land use decisions play in responding to climate change. Section IV evaluates historic land use patterns and practices and their impact on species protection efforts, and examines how emerging efforts to guide future land use decisions may not go far enough to protect species affected by climate change. The article concludes that the ESA remains the strongest tool to protect imperiled species, but may be insufficient to meet the challenge

20. Bradley J. Cardinale et al., *supra* note 1, at 61.

21. *See id.* at 59–63.

22. John Kostyack & Dan Rohlf, *Conserving Endangered Species in an Era of Global Warming*, 38 *Env'tl. L. Rep.* 10,203, 10,204–05 (2008).

23. *See, e.g.*, ALDO LEOPOLD, *The Land Ethic*, in *A SAND COUNTY ALMANAC* 168 (1949) (calling for a new “ethic dealing with man’s relation to land and to the animals and plants which grow upon it”). A land ethic is a philosophy that seeks to guide the actions when humans use or make changes to the land. *Id.* “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.” *Id.* at 189.

posed by climate change without changes in policy and the development of a more eco-centric land ethic.

I. THE ENDANGERED SPECIES ACT: A PRIMER

The ESA was enacted to promote the conservation of threatened and endangered plants and animals and to preserve their critical habitats.²⁴ The Act provides a comprehensive legal regime designed to protect imperiled species and the ecosystems upon which they depend.²⁵ It is jointly administered by the National Marine Fisheries Service (NOAA Fisheries) and the United States Fish and Wildlife Service (USFWS), collectively (Services), with each Service having jurisdiction over particular species.²⁶ The primary goal of the Act is to return imperiled species to a point where protection under the Act is no longer required.²⁷ Today, more than 1,300 species are protected under the ESA because they are either threatened or endangered with future extinction.²⁸ Unfortunately, the number of species currently afforded protection represents only a fraction of those species at risk from current conditions and from those changes anticipated to occur within ecosystems as climate change progresses.²⁹

24. 16 U.S.C. § 1531(b) (2012).

25. ALISON RIESER ET AL., OCEAN AND COASTAL LAW CASES AND MATERIALS 749 (4th ed. 2013).

26. See, e.g., Memorandum of Understanding Between U.S. Fish and Wildlife Serv. and Nat'l. Marine Fisheries Serv. Regarding Jurisdictional Responsibilities and Listing Procedures Under the Endangered Species Act of 1973 (Aug. 28, 1974) [hereinafter NOAA & USFWS Memo]. By agreement NOAA Fisheries has jurisdiction over marine and anadromous species, and USFWS has jurisdiction over terrestrial and freshwater species. *Id.*

27. 16 U.S.C. §§ 1531(b), 1532(3).

28. See *Endangered Species Act 40th Anniversary*, U.S. FISH AND WILDLIFE SERVICE, <http://www.fws.gov/endangered/esa40/index.html> (last updated June 27, 2014) (noting that 1,311 species are currently protected under the ESA).

29. See, e.g., *Endangered and Threatened Marine Species*, NAT'L. OCEANIC AND ATMOSPHERIC ADMIN., http://www.nmfs.noaa.gov/pr/pdfs/species/esa_table.pdf (last updated Jan. 29, 2014) (identifying marine species currently protected under the ESA); see also Kostyack & Rohlf, *supra* note 22, at 10,207 (asserting that climate change will result in the need for more species listings under the ESA).

A. ESA: Species Listing and Designation of Critical Habitat

A species must be designated as threatened or endangered to receive protections afforded under the ESA.³⁰ The Act authorizes the Services to identify those species at risk of extinction and to list those species as either threatened or endangered.³¹ This status determination must be made based on the best scientific and commercial data available, taking into consideration any other efforts then underway to protect the species.³² Economic considerations are irrelevant.³³ A species may be listed if that species is threatened or endangered due to any of the following: “(A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization [of the species] for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.”³⁴ These factors are all influenced to some degree by land use decisions.

Once a species is listed under the ESA as endangered, the ESA requires the Services “to the maximum extent prudent and determinable” designate areas as critical habitat for the species.³⁵ In identifying critical habitat, the Services are required to consider those physical and biological features that are essential to the conservation of the species, including habitats that are protected from

30. 16 U.S.C. § 1533(a). A species is considered endangered when that species is in danger of extinction throughout all or a significant part of its range, and is threatened when it is likely to become an endangered species within the foreseeable future. *Id.* § 1533(b). The Secretary of Commerce determines the status of marine species and anadromous fish, and the Secretary of Interior makes the decision for other species. *See* NOAA & USFWS Memo, *supra* note 26.

31. 16 U.S.C. § 1533(a).

32. *Id.* § 1533(b)(1)(A).

33. H.R. REP. NO. 97-835, at 20 (1982) (Conf. Rep.), *reprinted in* 1982 U.S.C.C.A.N. 2807, 2861.

34. 16 U.S.C. § 1533(a)(1).

35. *Id.* § 1533(a)(3). Critical habitat is defined as the “specific areas within the geographical area occupied by the species, at the time it is listed . . . 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.” *Id.* § 1532(5)(A)(i). “Critical habitat is not determinable when one or both of the following situations exist: (i) Information sufficient to perform required analyses of the impacts of the designation is lacking, or (ii) The biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.” 50 C.F.R. § 424.12 (a)(2) (2013).

disturbance.³⁶ The area designated may be expanded to include areas outside the geographical area occupied by the species at the time it is listed if essential for the conservation of the species.³⁷ The designation of critical habitat is not required for species listed prior to the 1978 ESA amendments that added critical habitat provisions.³⁸ As a result, many species afforded protection under the ESA do not have a critical habitat designated.³⁹

B. *ESA: Prohibitions on Takings and Jeopardy*

Once listed, the ESA makes it unlawful for any person, including private and public entities subject to the jurisdiction of the United States, to “take” any endangered species.⁴⁰ This prohibition may be extended to threatened species through regulation.⁴¹ It is also unlawful to cause another party to take a protected species.⁴² Thus, courts may enjoin government acts that authorize other parties to engage in activities that results in the taking of protected species.⁴³ A taking may occur when an action results in significant habitat modification or degradation that causes the death or injury of the listed species, or where it impairs a species’ essential behavioral

36. 50 C.F.R. § 424.12(b) (2013). The Secretary does not have to designate critical habitat where either: “(i) The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of such threat to the species, or (ii) Such designation . . . would not be beneficial to the species.” *Id.* § 424.12(a)(1). That decision must be made based on the “best scientific data available, after taking into consideration the probable economic and other impacts of making such a designation.” *Id.* § 424.12(a).

37. 16 U.S.C. § 1533(b)(2). Unless the failure to designate a particular area as critical habitat will result in the extinction of the listed species, the Secretary may exclude any portion of such an area from the critical habitat if the benefits of such exclusion outweigh the benefits of specifying the area as part of the critical habitat. *Id.*

38. *Endangered and Threatened Marine Species*, *supra* note 29.

39. *See, e.g., id.* (designating which of the endangered marine species also have critical habitats).

40. 16 U.S.C. §§ 1532(19), 1538(a); 50 C.F.R. § 17.21(c) (noting that “[i]t is unlawful to take endangered wildlife within the United States”); 50 C.F.R. § 17.31(a). “Take” means to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct.” 16 U.S.C. § 1532(19).

41. 16 U.S.C. § 1533(d).

42. *Id.* § 1538(g).

43. *See, e.g., Strahan v. Cox*, 127 F.3d 155, 163, 166 (1st Cir. 1997) (finding government action of issuing a fishing permit, which resulted in the taking of endangered whale, violated ESA’s takings prohibition).

patterns.⁴⁴ These behavioral patterns include, but are not limited to, breeding, feeding or sheltering.⁴⁵ Actions that pose an imminent threat of future harm may be enjoined.⁴⁶

Unless otherwise exempted, each federal agency must also insure that its actions will not “jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of such habitat of such species.”⁴⁷ Federal agencies that authorize, fund, or otherwise carry out activities that may affect a listed species are required to consult with the relevant service before proceeding.⁴⁸ If a federal agency finds, and the Services agree, that the action is unlikely to adversely affect a listed species, the project may proceed.⁴⁹ Otherwise, the project is halted and the agency must initiate formal consultation.⁵⁰ During the formal consultation process, the Services use the best available science to assess the anticipated impact of the proposed activity on listed species and their designated critical habitat, including impacts resulting from both indirect and cumulative effects.⁵¹ If the Services find that the proposed action will likely jeopardize the species or destroy or adversely modify its critical habitat, the Services will issue a biological opinion.⁵² This includes, *inter alia*, a list of reasonable and prudent alternatives (RPA) to the action. If RPA are unavailable, the project cannot proceed absent an exemption.⁵³

The Services may authorize the incidental taking of listed species under certain circumstances, including where the harm from the incidental take is mitigated to the degree possible through adoption of a species habitat conservation plan (HCP).⁵⁴ Once issued, an HCP

44. 16 U.S.C. § 1532(19); 50 C.F.R. § 17.3.

45. 50 C.F.R. § 17.3; 50 C.F.R. § 222.102; *see also* Babbitt v. Sweet Home Chapter of Cmty. for a Great Or., 515 U.S. 687, 691 (1995).

46. *See* 16 U.S.C. § 1540(g)(1)(A); *see also* Marbled Murrelet v. Babbitt, 83 F.3d 1060, 1064 (9th Cir. 1996) (holding ESA allows injunction before harm occurs under that statute).

47. 16 U.S.C. §§ 1536(a)(2), 1538(a)(1)(B)–(C).

48. *Id.* § 1536(a)(2); 50 C.F.R. § 402.14(a).

49. 50 C.F.R. § 402.14(b).

50. 16 U.S.C. § 1536(d); 50 C.F.R. § 402.14(a).

51. 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(g)(3)–(4), (8).

52. 50 C.F.R. § 402.14(h)(3).

53. 16 U.S.C. § 1536(g)–(h); 50 C.F.R. § 450.01 (defining *alternative courses of action*).

54. 16 U.S.C. § 1539(a)(1)(B); *see also* 50 C.F.R. §§ 17.32(b)(2), 222.307(c) (requiring the Services

provides protection to the permittee against surprise imposition of additional costs or resources to address unforeseen circumstances that threaten the species, so long as the permittee has complied with the permit and the activity does not jeopardize the continued existence of the species.⁵⁵ Changed or extraordinary circumstances, however, may allow the Services to require the permittee to take additional action to mitigate the harm.⁵⁶ Absent such exception, where additional mitigation measures are required, the cost must be borne by the government or others.⁵⁷ Because climate change poses additional risks to species and their habitat, some have suggested that the Services be required to adjust the level of take authorized for those species most vulnerable to climate change impacts.⁵⁸ The protective value of HCPs is often limited by inadequate understanding of the species and its requirements for survival. Uncertainty associated with climate change augments this existing problem and makes it more difficult to establish effective plans.⁵⁹ Because climate change may render habitats unsuitable, HCPs must account for anticipated spatial shifts as climate change progresses by considering the need to protect currently unoccupied land to allow for such shifts.⁶⁰

The takings and jeopardy provisions of the ESA provide meaningful opportunities to promote species conservation. Where the take occurs as an incident to climate change, mitigation of the prohibition may be of limited value.⁶¹ As interpreted by the courts,

to find that the impact from the permitted incidental take will be assessed through monitoring and mitigation efforts to prevent appreciable reduction in the changes for the species to survive).

55. See Endangered Species Act, 63 Fed. Reg. 8859, 8859 (Feb. 23, 1998) (codified at 50 C.F.R. pt. 17, 222); H.R. REP. NO. 97-835, at 30 (1982) (Conf. Rep.), *reprinted in* 1982 U.S.C.C.A.N. 2871 (discussing congressional intent for the 1982 amendments that allow the Services to issue permits authorizing an incidental take of listed species in the course of otherwise lawful activities).

56. H.R. Rep. No. 97-835, at 30 (1982) (Conf. Rep.), *reprinted in* 1982 U.S.C.C.A.N. 2871.

57. FISH & WILDLIFE SERVICE, U.S. DEPT. OF THE INTERIOR, HABITAT CONSERVATION PLANNING AND INCIDENTAL TAKE PERMIT PROCESSING HANDBOOK 3-29 to 3-30 (1996), *available at* <http://www.fws.gov/endangered/esa-library/pdf/hcpbk3.pdf>.

58. MELINDA TAYLOR & HOLLY DOREMUS, HABITAT CONSERVATION PLANS AND CLIMATE CHANGE: RECOMMENDATIONS FOR POLICY 10 (2011), *available at* https://www.utexas.edu/law/centers/energy/wp/wp-content/uploads/centers/energy/HCPs_and_Climate_Change1.pdf.

59. *See id.* at 14.

60. *Id.*

61. *See* Friends of the Earth, Inc. v. Laidlaw Envtl. Servs., Inc., 528 U.S. 167, 180–81 (2000) (noting that any person bringing such claim must meet the Article III standing requirements); *see also* 16 U.S.C.

the takings provision requires proof of a causal connection between the action and actual injury to a listed species.⁶² This application of proximate cause analysis to the take of a species poses a substantial hurdle in the context of climate change. Listed species are already impacted by a multitude of environmental stressors, and climate change is likely to work synergistically with those existing stressors to increase their impacts.⁶³ Thus, the requirement to show proximate cause may be inconsistent with traditional evaluations of risk to species that has considered a multitude of factors including direct injury, habitat loss, fragmentation, and other impacts.⁶⁴ While actions that result in the direct take of species can be prevented under the ESA, it is unclear how climate-related changes in ecosystems that increase stress on imperiled species may be prevented using the takings prohibition. Many activities, including land use, disrupt the environment in ways that necessarily impact the surrounding habitats.⁶⁵ Although the jeopardy analysis required under the ESA is intended to permit the Services to decide whether to allow a project to proceed in the face of uncertain information,⁶⁶ climate change adds an unprecedented level of uncertainty to the process that will likely render the analysis suspect in some instances.

C. Recovery Plans

The ESA requires the Services to develop and implement recovery plans for the conservation and survival of listed species, unless such a plan will not promote the conservation of the species.⁶⁷ The Act contains no timetable in which the plan must be created.⁶⁸ The purpose of the recovery plan is to guide all of the requirements under

§ 1540(g)(2)(A) (2012) (requiring plaintiffs to file a sixty day notice prior to filing suit).

62. *Babbitt v. Sweet Home Chapter of Cmty. for a Great Or.*, 515 U.S. 687, 712 (1995).

63. TAYLOR & DOREMUS, *supra* note 58, at 8–9.

64. Dale D. Goble, *Recovery*, in *ENDANGERED SPECIES ACT: LAW, POLICY, AND PERSPECTIVES* 70, 86 (Donald C. Baur & Wm. Robert Irvin eds., 2d ed. 2010).

65. *Id.* at 87.

66. *See* 16 U.S.C. § 1536(a)(2)–(3).

67. *Id.* § 1533(f)(1). In developing recovery plans, the Secretary may use “all methods and procedures which are necessary” to return the species to the point where protection under the Act is no longer needed. *See id.* §§ 1532(3), 1533(f).

68. *See id.* § 1533(f)(3).

the ESA as they relate to the recovery of a listed species.⁶⁹ Properly structured, a recovery plan will sufficiently address the physical and biological threats impacting the continued viability of the species and provide a regulatory mechanism that adequately ensures that future threats to species viability are managed properly.⁷⁰ An effective plan, when fully implemented and followed, will decrease the risk to the species to a level that is sufficient to warrant delisting.⁷¹ An agency has discretion to use the recovery plan and generally cannot be required to implement specific recovery measures listed in a plan.⁷² However, a recovery plan may be held invalid if it identifies a specific threat to a listed species but fails, without explanation, to suggest corrective action.⁷³

Recovery plans are most effective when a species has been impacted by a single, identifiable threat. Most species, however, are at risk from habitat degradation caused by a multitude of factors. Thus, any recovery plan prepared to reduce the risk posed to a listed species is unlikely to be successful absent effective strategies to address cumulative impacts of these stressors.⁷⁴ Even where steps have been taken to address known impacts to species from land use activities, those steps may prove inadequate over time because climate-induced changes are likely to augment existing impacts on listed species and their habitats.

69. *Id.* § 1533(f)(1).

70. Goble, *supra* note 64, at 85.

71. 16 U.S.C. § 1533(f)(1)(B); 50 C.F.R. § 402.02 (2013). Although the ESA does not mandate particular recovery actions, each recovery plan must, to the maximum extent practical, include: (1) management actions that are deemed necessary to conserve and ensure the survival of the species, (2) objective measureable criteria for delisting the species, and (3) and explanation of the timeline and expense of recovery. 16 U.S.C. § 1533(f)(1)(B).

72. *Fund for Animals, Inc. v. Rice*, 85 F.3d 535, 548 (11th Cir. 1996); *Morrill v. Lujan*, 802 F. Supp. 424, 433 (S.D. Ala. 1992) (holding that the contents of a species recovery plan are discretionary).

73. *Funds for Animals v. Babbitt*, 903 F. Supp. 96, 108 (D.D.C. 1995).

74. *See Wilcove, et al., supra* note 7, at 243 (noting that next to habitat loss, invasive species pose the greatest threat to listed species).

II. CLIMATE CHANGE AND ENDANGERED SPECIES: THE LAND CONNECTION

The concentration of greenhouse gases in the atmosphere has risen steadily since the beginning of the Industrial Revolution.⁷⁵ The primary cause of this trend is increasing anthropogenic carbon dioxide (CO₂) emissions from the combustion of fossil fuels.⁷⁶ Other significant causes include land use, land use change, and forestry.⁷⁷ Between 2000 and 2010, greenhouse gas emissions rose globally 2.2% each year compared to a 1.3% increase per year from 1970 to 2000.⁷⁸ That upward trend continues today.⁷⁹ Economic growth and expanding populations continue to drive the increased use of fossil fuel that cause harmful emissions, and their impacts have outpaced corresponding improvements made in the energy sector.⁸⁰

Increasing atmospheric concentrations of greenhouse gas emissions have pushed the planet to a dangerous point.⁸¹ Today, there is scientific consensus that concentrations of carbon dioxide and other greenhouse gases in the atmosphere pose a significant threat to humanity.⁸² Despite strong scientific evidence suggesting that atmospheric concentrations of carbon dioxide exceeding 350 parts per million (ppm) are “too high to maintain the climate to which humanity, wildlife, and the rest of the biosphere are adapted,” anthropogenic CO₂ emissions have driven the planet past that

75. EPA, CLIMATE CHANGE INDICATORS IN THE UNITED STATES: ATMOSPHERIC CONCENTRATIONS OF GREENHOUSE GASES 1 (2014), available at http://www.epa.gov/climatechange/pdfs/print_ghg-concentrations-2014.pdf.

76. *Id.*

77. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Drivers, Trends and Mitigation*, in CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 7 (2014) [hereinafter IPCC CH. 5], available at http://report.mitigation2014.org/drafts/final-draft-postplenary/ipcc_wg3_ar5_final-draft_postplenary_chapter5.pdf.

78. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Summary for Policymakers*, in CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 6 (2014) [hereinafter 2014 IPCC SUMMARY FOR POLICYMAKERS], available at http://report.mitigation2014.org/spm/ipcc_wg3_ar5_summary-for-policymakers_approved.pdf.

79. *Id.*

80. *Id.* at 8.

81. James Hansen et al., *Target Atmospheric CO₂: Where Should Humanity Aim?*, 2 OPEN ATMOSPHERIC SCI. J. 217, 228 (2008).

82. *Id.*

threshold.⁸³ Recently, the amount of heat-trapping carbon dioxide in the atmosphere has exceeded 400 ppm and continues to climb.⁸⁴ This 400 ppm threshold has been widely recognized as a dangerous level that could drastically worsen the effects of human-caused global warming.⁸⁵ Using present emission control strategies, atmospheric concentrations of CO₂ will likely exceed 450 ppm by 2030.⁸⁶ To maintain levels close to 450 ppm, large scale changes in the energy sector are needed that result in 40% to 70% reductions in emissions in 2050 from 2010 levels, and emissions levels near zero by 2100.⁸⁷ Without significant mitigation, global mean surface temperature is expected to increase from between 3.7°C and 4.8°C by 2100 compared to pre-industrial levels.⁸⁸ In some areas, temperature increases could be even greater.⁸⁹

Temperature affects “virtually all [life] processes.”⁹⁰ The impacts of rising temperatures will be complex and likely result in differential responses within ecosystems and among species.⁹¹ Rising temperatures could have “profound effects on terrestrial ecosystems,” particularly to critical biological and chemical processes essential for life.⁹² As global temperatures rise, ocean water will thermally expand and ice sheets will melt.⁹³ This expansion is already occurring in some areas and will likely accelerate as global temperatures

83. *See id.*

84. CO2NOW.ORG, <http://co2now.org/> (last visited Jan. 22, 2015).

85. Press Release, United Nations Framework Convention on Climate Change, Statement by UNFCCC Exec. Sec’y on Crossing 400 ppm CO₂ Threshold (May 13, 2013), available at http://unfccc.int/files/press/news_room/press_releases_and_advisories/application/pdf/400_ppm_media_alert_13052013.pdf.

86. 2014 IPCC SUMMARY FOR POLICYMAKERS, *supra* note 78, at 9.

87. *Id.* at 13.

88. *Id.* at 9.

89. *Id.*

90. Gaius. R. Shaver et al., *Global Warming and Terrestrial Ecosystems: A Conceptual Framework for Analysis*, 50 BIOSCIENCE 871, 872 (2000).

91. *Id.* at 872–73.

92. Edith Bai et al., *A Meta-analysis of Experimental Warming Effects on Terrestrial Nitrogen Pools and Dynamics*, 199 THE NEW PHYTOLOGIST 441, 448 (2013).

93. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Summary for Policymakers*, in CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS 11 (2013) [hereinafter 2013 IPCC SUMMARY FOR POLICYMAKERS], available at http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf.

increase.⁹⁴ These changes, in turn, will combine to produce elevations in sea level.⁹⁵ Under present scenarios, average global sea levels could rise as much as six and a half feet by 2100.⁹⁶ In some U.S. coastal regions, sea level rise is occurring at rates that far exceed the global average.⁹⁷

The impact rising seas has on species inhabiting coastal areas may be particularly severe. Today, 233 federally protected species—17% of the nation’s imperiled animals and plants—inhabit areas within twenty-three coastal states that are at risk from sea level rise.⁹⁸ In some areas, rising seas will submerge species habitat or erode it away, while in other areas rising seas will result in salt water intrusion that will destroy plant communities.⁹⁹ These changes will likely alter habitats in such profound ways that many species will seek refuge further inland where a large percentage of the U.S. population currently resides.¹⁰⁰

In recent years the narrative on climate change has shifted from mitigation-based policies focused on emission reductions to adaptation-based strategies to protect local interests. This shift is due in large part to the inability of policy makers at all levels of government to take action that effectively reduces emissions. While climate change policies are being developed, local governments must take steps to ensure that land use decisions do not result in further harm to species.

94. *Id.*; Adam Chandler, *Rising Sea Levels Are Exposing Bodies of Buried WWII Soldiers*, THE WIRE (June 7, 2014, 10:44 AM), <https://news.yahoo.com/rising-sea-levels-exposing-bodies-buried-wwii-soldiers-144400560.html> (noting how the Marshall Islands are already experiencing the effects of sea level rise).

95. *Oceans & Sea Level Rise*, CLIMATE INSTITUTE, <http://www.climate.org/topics/sea-level/index.html> (last visited Nov. 8, 2014).

96. CENTER FOR BIOLOGICAL DIVERSITY, *DEADLY WATERS: HOW RISING SEAS THREATEN 233 ENDANGERED SPECIES 1* (2013), available at http://www.biologicaldiversity.org/campaigns/sea-level_rise/pdfs/SeaLevelRiseReport_2013_print.pdf.

97. *Id.* at 2 (noting that “sea levels from North Carolina to Boston are rising 3 to 4 times faster than the global average”).

98. *Id.* at 1.

99. *Id.* at 2–3.

100. See NAT’L OCEANIC AND ATMOSPHERIC ADMIN., *What Percentage of the American Population Lives Near the Coast?*, NAT’L OCEAN SERVICE, <http://oceanservice.noaa.gov/facts/population.html> (last visited Nov. 8, 2014) (noting that 39% of the nation’s population lived in counties directly on the shoreline, and that the percentage is expected to increase by 8% by 2020).

III. LAND USE AND SPECIES PROTECTION: THE SCOURGE OF SPRAWL AND THE NEED FOR AN ECO-CENTRIC LAND ETHIC

State governments retain wide authority to regulate land use and the use of natural resources not otherwise governed under federal law. Each state, through the exercise of its police power, and local governments through delegation of this power from the states, has the authority to regulate activities within its territory to promote the health, safety, morals, and general welfare of their inhabitants.¹⁰¹ Historically, states and local governments have used these powers to meet the demands of growing populations while indirectly encouraging expansive and inefficient uses of land that have had lasting effects on species and the environments they inhabit.¹⁰²

A. *The Lingering Impact of Urban Sprawl*

Beginning in 1928 with promulgation of the Standard City Planning Enabling Act, the power to regulate land use planning and development was delegated by states to local governments.¹⁰³ Although delegation of this power provided local governments with significant power to advance sustainable planning and development, historically local land use practices were guided by short-sighted, “parochial perspective[s]” that often failed to account for “extralocal effects of actions.”¹⁰⁴

Throughout the early part of the twentieth century, land conversion and development proceeded to meet the increasing demand for new housing, recreation, and retailing by expanding into open fields, forests, and wetlands.¹⁰⁵ This movement into previously pristine

101. *Vill. of Euclid v. Ambler Realty Co.*, 272 U.S. 365, 394 (1926).

102. Lorenzo, *supra* note 16, at 72.

103. ADVISORY COMM. ON CITY PLANNING AND ZONING, U.S. DEP’T OF COMMERCE, A STANDARD CITY PLANNING ENABLING ACT 7 (1928).

104. DAVID L. CALLIES ET AL., *CASES AND MATERIAL ON LAND USE* 43 (6th ed. 2012).

105. Lorenzo, *supra* note 16, at 72, 75. As Annie Faulkner, coordinator of the New England Coalition for Sustainable Population states, “[w]ith the quadrupling of human population since 1900, the Earth is experiencing the sixth mass extinction event in history. The primary cause of extinction is human-induced habitat alteration, fragmentation, and destruction; other important causes are exotic species invasion, pollution, and overhunting.” *Id.* at 75.

environments has been described as subjecting natural ecosystems and their inhabitants “to death by a thousand cuts.”¹⁰⁶ Although early zoning efforts provided the important benefit of separating incompatible land uses in an era of limited environmental regulation, it had the unintended effect of encouraging inefficient, unsustainable use of land.¹⁰⁷ Urban sprawl emerged following World War II, encouraged by fiscal and legislative policies that reduced public facilities and resources in urban areas and by an increase in individual interests in large lots, privacy, and exclusivity not available in urban areas.¹⁰⁸ It soon became apparent that sprawl negatively impacts human health; leads to ecosystem fragmentation and loss of biodiversity; and contributes to the loss of spiritual, cultural, and recreational connections with land.¹⁰⁹ In 1968, the National Commission on Urban Problems opined that the prevention of urban sprawl was an important public purpose that justified restricting development through regulation in areas inappropriate for development.¹¹⁰ This, however, did little to stop development into new areas.

In ensuing years, various approaches to solving the inherent problems of traditional zoning emerged to address the impacts of sprawl.¹¹¹ Most of these efforts have been directed at addressing the weaknesses of decentralized community structures and inefficient land use patterns by making more intelligent uses of land.¹¹² Recent

106. *See id.* at 72.

107. *See* CALLIES ET AL., *supra* note 104, at 773; *see also* G. Schultink, *Sustainable Land Use and Urban Growth Management: Demand-Supply Factors and Strategic Planning Considerations*, 1 J. AGRIC. FOOD & ENVTL. SCI., no. 1, 2007, available at <http://www.scientificjournals.org/journals2007/articles/1030.htm> (discussing multiple impacts of urban to rural land migration).

108. *See id.* at 771, 773 (noting urban sprawl has “been with us since World War II”); *see also* Lorenzo, *supra* note 16, at 74 (noting that community and state decisions often ignore resulting ecological losses); *In re* Dollington Land Grp., 839 A.2d 1021, 1028 n.8 (Pa. 2003) (defining sprawl as “development that is inefficient in its use of land (i.e. low density); constructed in a ‘leap frog’ manner in areas without existing infrastructure, often on prime farmland; automobile dependent, and consisting of isolated single use neighborhoods requiring excessive transportation.”).

109. *See* Lorenzo, *supra* note 16, at 74–76.

110. NAT’L COMM’N ON URBAN PROBLEMS, BUILDING THE AMERICAN CITY, H.R. DOC. NO. 91-34, at 245 (1969).

111. *See, e.g.*, Lorenzo, *supra* note 16, at 76.

112. CALLIES ET AL., *supra* note 104, at 775–76.

“smart growth” approaches to land use are designed to depart from traditional development patterns that have been described as “fiscally wasteful, competitively unwise, environmentally damaging, and racially and socially divisive.”¹¹³ Smart growth advocates assert that the recentralization of American communities will control sprawl and provide important societal benefits including the rehabilitation and revitalization of the central city, reductions in greenhouse gas emissions through reductions in energy consumption, and the preservation of agricultural and open spaces.¹¹⁴ Developing within existing infrastructure can reduce the impacts and “preserve[] green space, wetlands, and farm land.”¹¹⁵ Such growth has the potential to improve environmental protection, decrease local taxes, reduce traffic congestion, and improve quality of life.¹¹⁶ Today, an increasing number of states are integrating smart growth concepts into future planning decisions to support sustainability initiatives that address renewable energy, global warming, pollution, transportation, air quality, affordable housing, and other infrastructure provisions to make effective land use decisions.¹¹⁷ These movements present opportunities for change, but their success will be limited without public support and shifts in perspective regarding what the future holds in the absence of change.¹¹⁸ In 2008, California passed a law intended to limit sprawl, promote more compact and walkable communities served by transit, and to reduce greenhouse gas emissions, all through a regional planning process that would coordinate land use plans with transportation funding.¹¹⁹ The attempt largely failed because it required a voter-approved sales tax initiative to fund transportation improvements and its voluntary nature did

113. *Id.* at 775.

114. *Id.* at 773.

115. *Id.* at 775.

116. *Id.*

117. *Id.* at 840 (citing Robert H. Freilich & Neil M. Popowitz, *The Umbrella of Sustainability: Smart Growth, New Urbanism, Renewable Energy and Green Development in the 21st Century*, 42 URB. LAW. 1 (2010)).

118. See CALLIES ET AL., *supra* note 104, at 775.

119. *Id.* at 840–845 (citing Ethan Elkind, *So Much for California’s Anti-Sprawl Law*, THE BERKLEY BLOG (July 7, 2011), <http://blogs.berkeley.edu/2011/07/07/so-much-for-california%e2%80%99s-anti-sprawl-law/>).

almost nothing to require local governments to change their practices.¹²⁰ Although smart growth initiatives are laudable and move states in the right direction to address human desires, alone, they may be insufficient to protect species in an age of climate change due to the existing legal framework that protects property interests in the United States.

Under the traditional Euclidean zoning framework, local governments have a variety of tools, such as variances, overlay zones, and other mechanisms available to reshape their community.¹²¹ Local governments retain the authority to completely change their zoning framework by amending their comprehensive plan and enacting zoning regulations that comport with the new plan. In some states that require local government planning to be guided by a comprehensive plan, such as Washington, Oregon, California, Maryland, and Florida, local governments may find more support to try new approaches that balance community desires for developed environments with the need to preserve open spaces.¹²² States may seek to protect critical and sensitive areas from future development by acquiring the land or incentivizing its protection, or they may enact regulations that limit further impacts.¹²³ But such change requires making complex policy and social choices that will undoubtedly prompt legal challenges. Land use plans and regulations implicate land development and impact property and constitutional rights of developers, owners, and neighbors.¹²⁴ Given the prospective nature of zoning, absent voluntary compliance, local governments must pay to remove existing harmful uses immediately or risk violating the constitutional prohibition against taking private property.¹²⁵ The eminent domain power provides some opportunity

120. *Id.*

121. *See generally* *Vill. of Euclid v. Ambler Realty Co.*, 272 U.S. 365 (1926) (upholding the state's use of zoning, and similar laws and regulations, as an exercise of its police power).

122. REID EWING ET AL., *ENDANGERED BY SPRAWL: HOW RUNAWAY DEVELOPMENT THREATENS AMERICA'S WILDLIFE* 24 (2005), available at <http://www.nwf.org/pdf/Wildlife/EndangeredbySprawl.pdf>.

123. *Id.* at 29.

124. *See, e.g., Vill. of Euclid*, 272 U.S. at 384, 386 (addressing due process in relation to denying property rights).

125. *CALLIES ET AL.*, *supra* note 104, at 45.

for local governments to immediately remove unwanted structures and uses,¹²⁶ but the cost of doing so on a city-wide level would likely be prohibitive. Thus, even using existing tools to recentralize communities, doing so does little to remove the impacts already present in environments. Although cities may be willing to allow non-conforming uses to continue and amortize the remaining useful life of those land uses, that process does not address the immediate needs of species impacted.¹²⁷ Further, recentralizing communities through development within existing infrastructure necessarily requires higher density development in major cities, many of which are located at lower elevations and within coastal zones that are currently home to a significant number of listed species.¹²⁸ Increased use of land along coastal areas that is subject to rising sea levels could pose insurmountable obstacles to species forced to migrate landward to replace habitat destroyed by sea level inundation.

B. Land Use and Species Distribution: An Inconvenient Reality

Species richness and diversity generally increase at lower elevations; yet, historically land conservation efforts have focused on protecting lands at higher elevations and away from the coast.¹²⁹ In the United States, species richness coincides with population densities because U.S. populations are concentrated at lower elevations and toward coastal areas.¹³⁰

Although the urban environment accounts for less than 10% of the nation's land mass, it remains a critical component of the environmental policy debate on species preservation.¹³¹ Approximately 60% of the nation's rarest and most imperiled species

126. See NAT'L COMM'N ON URBAN PROBLEMS, BUILDING THE AMERICAN CITY, H.R. DOC. NO. 91-34, at 246, 250 (1969) (recommending state governments use eminent domain power for large planned unit developments for the public interest).

127. *Id.*

128. See *infra* Part III for discussion on density of people and endangered species on the coasts.

129. EWING ET AL., *supra* note 122, at 17.

130. *Id.*

131. JOHN COPELAND NAGLE & J.B. RUHL, THE LAW OF BIODIVERSITY AND ECOSYSTEM MANAGEMENT 978 (Robert C. Clark et al. eds., 2d ed. 2006).

are found in human-dominated environments.¹³² Nearly one-third of these species live within the fastest growing metropolitan areas in the United States.¹³³ As a result, local land use decisions in developed areas threaten the survival of many species, especially highly localized species.¹³⁴ Even where land is set aside for species conservation efforts, the land may not be sufficient to provide meaningful, long-term protection.¹³⁵ Most land use decisions are local in nature, and some commentators have argued that local governments have failed to ensure that species' habitats and associated needs are adequately considered in land use decisions.¹³⁶ The rapid urbanization of America poses the fastest growing threat to species.¹³⁷ Nearly three quarters of Americans live in urban or suburban areas, and rapidly expanding populations will likely result in increased conversion of available land to create buildings, roads, sewers, water systems, and other structures needed to meet human needs.¹³⁸ Such development pressure will add to the existing environmental stressors to degrade habitats and drive more species toward extinction.¹³⁹

C. *Mitigating Climate Change: A Land Perspective*

Choices on how best to respond to climate change are directly tied to land use decisions, and those decisions necessarily impact species protection efforts. It is clear that mitigation efforts require significant changes in energy policy and energy use.¹⁴⁰ Any large scale shift toward cleaner energy technologies will likely involve extensive land use that place additional stress on species and their habitats.¹⁴¹ Efforts to use renewable energy such a solar or wind energy will

132. EWING ET AL., *supra* note 122, at viii, 1.

133. *Id.*

134. *Id.* at viii, 1, 20.

135. *Id.* at viii, 13.

136. *Id.* at viii–ix, 17–18.

137. *See id.* at 1.

138. EWING ET AL., *supra* note 122, at 1–2 (noting that the population in metropolitan areas is expected increase by almost 30% between 2000 and 2025).

139. *Id.* at vii, 7–15.

140. *See supra* Part IV.A.

141. *See supra* Part IV.A.

involve uses of land and equipment that may pose additional risks to species. Solar energy is free from greenhouse gas emissions, but utility-scale solar facilities raise concerns about land degradation and habitat loss.¹⁴² Although the total land area requirements vary depending on the site and the system used, utility-scale systems range from 3.5 to 16.5 acres per megawatt of energy produced.¹⁴³ “Smaller scale solar [photovoltaic] arrays, which can be built on homes or commercial buildings, also have minimal land use impact.”¹⁴⁴ Wind turbines produce zero greenhouse gas emissions and occupy relatively small land areas, but they raise other important considerations related to species protection.¹⁴⁵ With blades rotating at up to 160 miles per hour for some turbines, wind fields pose substantial risks to some flying species.¹⁴⁶ By some estimates, fourteen birds are killed each year per megawatt of wind energy produced (approximately 440,000 birds), and that number is expected to increase as the use of wind turbines becomes more popular.¹⁴⁷ Methods used to extract clean-burning natural gas from below ground can lead to contamination of ground water resources, depletion of freshwater, degradation of air quality, and migration of harmful chemicals that contaminate surface area and pose risks to humans and species living in the area.¹⁴⁸

The way land is used will play a major role in responding to climate change. Terrestrial and coastal ecosystems play a key role in sequestering enormous quantities of carbon that would otherwise add

142. *Environmental Impacts of Solar Power*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/environmental-impacts-solar-power.html (last visited Nov. 9, 2014).

143. *Id.* (noting that utility-scale photovoltaic systems range from 3.5 to 10 acres per megawatt, while estimates for concentrating solar thermal plants are between 4 and 16.5 acres per megawatt).

144. *Id.*

145. *Environmental Impacts of Wind Power*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/environmental-impacts-wind-power.html (last visited Nov. 9, 2014) (“[L]ess than 1 acre per megawatt is disturbed permanently and less than 3.5 acres per megawatt are disturbed temporarily during construction.”).

146. *See id.* (“[T]urbines themselves and the surrounding infrastructure . . . occupy a small portion of the total area of a wind facility.”); Umair Irfan, *Bats and Birds Face Serious Threats From Growth of Wind Energy*, N.Y. TIMES (Aug. 8, 2011), <http://www.nytimes.com/cwire/2011/08/08/08climatewire-bats-and-birds-face-serious-threats-from-gro-10511.html?pagewanted=all>.

147. Irfan, *supra* note 146.

148. Valerie J. Brown, *Putting the Heat on Gas*, 115 ENVTL. HEALTH PERSP. A 76, A 76 (2007).

to the atmospheric concentrations.¹⁴⁹ Yet, these systems are disappearing at an alarming rate that has important implications for predicting the rate of climate change because the amount of carbon released could significantly alter model-based projections that do not adequately account for this contribution.¹⁵⁰ Rampant coastal development continues to alter these important carbon sinks, resulting in the release of millions of tons of carbon dioxide each year.¹⁵¹ Proposals to reduce harmful emissions of greenhouse gases include plans to grow crops used to sequester carbon or to produce biofuel as an alternative to fossil fuels.¹⁵² Recent estimates suggest that these actions could contribute 20% to 60% of total cumulative abatement by 2030, and 15% to 40% by 2100.¹⁵³ Reducing emissions will require large-scale changes in land use to grow the biomass or retain vegetation for carbon sequestration and will likely increase the competition for land, water, and other resources.¹⁵⁴ Competition for resources will result in conflicts between the need to promote food security, mitigate the effects on climate, and to sustain a natural environment.¹⁵⁵

Historic land use practices have fundamentally altered natural environments that continue to threaten the existence of many species.

149. See STEPHEN CROOKS ET AL., MITIGATING CLIMATE CHANGE THROUGH RESTORATION AND MANAGEMENT OF COASTAL WETLANDS AND NEAR-SHORE MARINE ECOSYSTEMS: CHALLENGES AND OPPORTUNITIES 1 (2011), available at http://www-wds.worldbank.org/external/default/WDSCContentServer/WDSP/IB/2011/04/07/000333038_20110407024117/Rendered/PDF/605780REPLACEM10of0Coastal0Wetlands.pdf; *Coastal Blue Carbon*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., <http://www.habitat.noaa.gov/coastalbluecarbon.html> (last visited Nov. 9, 2014) (noting recent studies show that coastal systems may contain three to five times more carbon than that stored in a hectare of tropical forests).

150. See CROOKS ET AL., *supra* note 149, at 19–20 (observing that management strategies mitigate damage but that coastal mangrove forests are still rapidly declining largely because of land use).

151. *Id.* at 2 (finding that 5–7.5 million tons of carbon are released each year from development of the Sacramento-San Joaquin Delta in California); see also Daniel C. Donato et al., *Mangroves Among the Most Carbon-Rich Forest in the Tropics*, 4 NATURE GEOSCIENCE 293, 293 (2011) (finding that despite accounting for less than 1% of the total tropical forest, clearing of mangroves generates 10% of carbon emissions from all global deforestation).

152. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Agriculture, Forestry, and Other Land Use*, in CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 4 (2013) [hereinafter IPCC Ch. 11], available at http://report.mitigation2014.org/drafts/final-draft-postplenary/ipcc_wg3_ar5_final-draft_postplenary_chapter11.pdf.

153. *Id.* at 5.

154. *Id.* at 6.

155. *Id.* at 6–9.

Burgeoning populations, increasing use of fossil fuel, demand for natural resources, and climate-induced changes to natural systems will likely exacerbate the threats to species and undermine species protection efforts.¹⁵⁶ Ironically, it is these same systems that have the capability of protecting humanity from itself if action is taken to preserve and restore what remains.¹⁵⁷ Preservation will require a new, eco-centric land ethic.

D. Toward a New Eco-centric Land Ethic.

In his 1949 definitive work, *A Sand County Almanac*, Aldo Leopold discussed the need for a new land ethic that ushered in the modern conservation movement.¹⁵⁸ Leopold envisioned a community designed for the mutual benefit of all predicated on the understanding that the community includes humans as well as non-human elements such as soils, waters, plants, and animals.¹⁵⁹ Recognition of the interrelationship between human and nonhuman components of a community necessarily implies a human role in protecting and preserving the health of each component of the community.¹⁶⁰ Notwithstanding the emergence of extensive environmental and land use regulation aimed at protecting the natural environment, the collective impact of humanity has left many natural systems impaired and vulnerable to further decay as climate change progresses with wide ranging implications for humans.¹⁶¹ As society prepares to address one of the most significant threats to the earth system, it is imperative that a new land ethic emerge, centered on the vital role ecosystems play in humanity's future welfare. Adopting a new land ethic will require a fundamental shift in thinking regarding the services humans receive from ecosystems and an understanding of the true value of those services to the community.

156. 2007 SYNTHESIS REPORT, *supra* note 15, at 48.

157. *See generally* IPCC CH. 11, *supra* note 152.

158. Leopold, *supra* note 23.

159. *Id.* at 171.

160. *Id.* at 173.

161. *See* CONVENTION ON BIOLOGICAL DIVERSITY, *supra* note 11, at iv, 1–2.

E. *The Real Value of Ecosystems*

Until recently, consumptive land development practices have proceeded to meet human demands, through destruction and degradation of the natural environment, with little understanding of the net value lost to communities.¹⁶² Healthy ecosystems provide a multitude of critical services to communities. They regulate climate and erosion, filter pollutants, provide food and fresh water, and provide for recreation, aesthetic enjoyment, and other important services.¹⁶³ But society has been slow to recognize the inherent value of these systems to human wellbeing, in large part, because the true costs of human impacts have not been monetized and have therefore not been adequately reflected in the market.¹⁶⁴ Historically, non-monetized services have been ignored or insufficiently addressed in environmental decision-making.¹⁶⁵ And community members charged with making land use decisions that impact these systems have done so with insufficient information.¹⁶⁶ This failure to make fully informed land use decisions, in turn, has indirectly encouraged actions that have significantly impacted natural systems and impaired their ability to provide critical services.¹⁶⁷ Climate change will likely exacerbate these problems.¹⁶⁸

For a new, eco-centric land ethic to emerge, it is imperative to effectively articulate to community members the true value obtained of all market and non-market resources provided by ecosystems. With that information, planners can make more informed land use

162. See Lorenzo, *supra* note 16, at 73–74 (discussing the comparatively new studies of the costs of environmental harm resulting from urban development).

163. NEJEM RAHEEM ET AL., THE ECONOMIC VALUE OF COASTAL ECOSYSTEMS IN CALIFORNIA 2–3, available at <http://www.nceas.ucsb.edu/files/news/Raheemreport.pdf>.

164. See Cardinale et al., *supra* note 1, at 65. (“Although there are good estimates of society’s willingness to pay for a number of non-marketed ecosystem services, we still know little about the marginal value of biodiversity . . . in the production of those services.”)

165. See *id.*; see also RAHEEM ET AL., *supra* note 163, 18–19.

166. See *id.* at 18–19.

167. See MILLENNIUM ECOSYSTEM ASSESSMENT, LIVING BEYOND OUR MEANS: NATURAL ASSETS AND HUMAN WELL-BEING 17 (2005), available at <http://millenniumassessment.org/documents/document.429.aspx.pdf>; TAYLOR & DOREMUS, *supra* note 58, at 21.

168. Eysteing Jansen et al., *Palaeoclimate*, in CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 431, 447–48 (Susan Solomon et al. eds., 2007), available at http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4_wg1_full_report.pdf.

choices. By one estimate, ecosystems contribute between \$16 and \$54 trillion in services to the global community annually.¹⁶⁹ Still, some of the most biologically diverse and economically valuable ecosystems on earth are disappearing at alarming rates as a result of human activities.¹⁷⁰

The destruction of land-based forests releases significant quantities of CO₂, a major driver of climate change.¹⁷¹ The loss of coastal systems is particularly troubling because these systems serve as one of the planet's largest carbon sinks by sequestering atmospheric carbon in plant material and soil.¹⁷² In fact, coastal systems may contain three to five times more carbon than that stored in a hectare of tropical forests.¹⁷³ Rampant coastal development has fundamentally altered these complex systems causing the release of millions of tons of carbon dioxide each year.¹⁷⁴ This trend may continue as migration to coastal counties continues, despite the threat of sea level rise. Today, more than half of the U.S. population lives in coastal counties.¹⁷⁵ Continued demand for development along the coast will likely place increasing pressure on coastal counties to develop infrastructure to accommodate growth.¹⁷⁶

This problem raises important questions about the relative values of different land use activities—development and preservation—that have historically tipped in favor of development. Adoption of a more eco-centric land ethic would help rebalance the decision making process by adding the true value of ecosystem services into the decision calculus. The disturbance of natural systems through land

169. Lorenzo, *supra* note 16, at 73.

170. CROOKS ET AL., *supra* note 149, at 2 (noting that certain coastal ecosystems are disappearing at a rate of 2% per year as a result of development, clearing for aquaculture, and pollution).

171. *Id.* at 5.

172. *Id.* at vii.

173. Donato et al., *supra* note 151, at 294.

174. CROOKS ET AL., *supra* note 149, at 2; *see also* Donato et al., *supra* note 151, at 293.

175. U.S. CENSUS BUREAU, 2012 STATISTICAL ABSTRACT: POPULATION IN COASTAL COUNTIES (2012), available at <http://www.census.gov/compendia/statab/2012/tables/12s0025.pdf> (showing that in 2010, 52% of the U.S. population resided in a coastal counties).

176. *See, e.g., Coastal Development*, GULFBASE.ORG, <http://www.gulfbase.org/issue/view.php?iid=coastal2> (last visited Nov. 10, 2014) (“[T]he Census Bureau estimates a 72 percent increase in the population of the five Gulf Coast states between 1995 from a total of 44.2 million to an estimated 61.4 million in 2025.”).

development addresses immediate needs, but comes at substantial present and future costs.¹⁷⁷ These costs can only be adequately addressed when decisions makers understand the value of each alternative. In the absence of effective state and national policies to decrease harmful greenhouse gas emissions, preservation and restoration of critical ecosystems represents a logical and necessary strategy to pursue. This strategy will not only provide an added level of protection for species threatened with extinction from climate change, but will pass along the co-benefits of water purification, shoreline protection, nutrient cycling, flood control, habitat preservation, and sustainable resources.¹⁷⁸ Adoption of a more eco-centric land ethic is critical to garnering the public support necessary to encourage leaders and policy makers to make tough choices and to develop financial and other incentives to protect and preserve critical ecosystems from further disturbance.¹⁷⁹ Programs that include payments for ecosystem services, and low-impact development should be given additional consideration.¹⁸⁰

IV. RECOMMENDATIONS

The ESA provides an overarching set of federal requirements to promote species preservation, but state and local governments will play an increasingly vital role in species protection efforts as climate-induced changes alter natural systems at the local level. To provide the greatest possible level of protection to imperiled species, additional action is required. Steps should be taken to strengthen the ESA, to adopt a new land ethic centered on the value of ecosystems, and to employ strategies that permit smarter growth.

177. 16 U.S.C. § 1531(a)(1)–(3) (2012).

178. See CROOKS ET AL., *supra* note 149, at 29.

179. See *id.* at 29–30.

180. See, e.g., Elkind, *supra* note 119.

A. *Strengthen the ESA*

In enacting the ESA, Congress empowered federal agencies to “use . . . all methods and procedures which are necessary” to ensure that the status of any listed species is restored to the point where the species no longer requires protection under the Act.¹⁸¹ All federal agencies have an affirmative obligation to “utilize their authorities in furtherance of the purposes of [the ESA] by carrying out programs for the conservation of endangered species and threatened species listed.”¹⁸² These broad mandates reflect a congressional recognition of the natural systems species provide to society.¹⁸³ Habitat loss continues to pose the single greatest threat to species listed under the ESA, and decisions on how land is used directly impact the future effectiveness of the ESA.¹⁸⁴ Climate change and its anticipated impacts may work synergistically with existing causes of habitat degradation to place greater pressure on species and poses significant challenges to any efforts to conserve species.¹⁸⁵

To protect habitats and species, the Services must be willing to require a higher level of proof that proposed activities will not harm listed species. Greater emphasis must be placed on actions that do not directly impact species, but could have significant, indirect effects. The choices made to address climate change at the local level must be evaluated more closely to assess potential, indirect impacts on species survival over the long term. For example, a decision to recentralize communities by increasing density in areas using preexisting infrastructure could reduce fossil fuel use and reduce overall emissions.¹⁸⁶ However, taking such action now may have the effect of closing available inland migration routes for animals that become displaced at some point in the future. The Services must take

181. 16 U.S.C. § 1532(3).

182. *Id.* § 1536(a)(1).

183. *See id.* § 1531(a)(3).

184. *Id.* § 1531(a)(1).

185. *See Statement for the Record: Hearing on Invasive Species Management on Federal Lands Before the Subcomm. on Public Lands and Envtl. Regulation of the H. Nat'l Res. Comm.*, 113th Cong. (2013) (statement of U.S. Dept. of the Interior), available at http://www.doi.gov/ocl/hearings/113/invasivespeciesmanagement_051613.cfm.

186. *See Elkind, supra* note 119.

into consideration anticipated geographical species shifts and include requirements for action when such migration occurs.

It has been suggested that the Department of Interior should begin to designate important inland areas as critical habitat that would remain off limits to federal activities and available to accommodate displaced species.¹⁸⁷ This option should be pursued, but the fate of many species rests largely with decisions made at the local level.¹⁸⁸ States must reevaluate their land use practices to ensure that sufficient, useful open space remains accessible to species displaced by climate-induced changes in natural systems. This is particularly important in coastal zones where sea level rise will likely displace many listed and unlisted species.¹⁸⁹ Although the ESA addresses direct impacts to species and can be used to limit state activities, it is the cumulative impacts from many indirect state actions that will likely have the largest impact on species survival.¹⁹⁰

The Services must be more willing to deny permits and to issue injunctions to prevent activities that pose an indirect threat of future harm that may be exacerbated by climate change.¹⁹¹ Such decisions must be based on a complete assessment of how a proposed action may work synergistically with other stressors to augment the risk of harm; only then will the strength of the takings and jeopardy provisions be fully realized. The failure to take more aggressive steps to protect species will almost certainly result in the need to list more species in the future. More aggressive action is required now primarily because local governments will be forced to take action to address climate change directly in the future. Those responses will likely lead local governments to take actions to combat climate change that are not discretionary and therefore not subject to the ESA's duties to consult and avoid jeopardy imposed on non-

187. CENTER FOR BIOLOGICAL DIVERSITY, *supra* note 96, at 15.

188. See RAHEEM ET AL., *supra* note 163, 18–19 (noting that California requires projects affecting coastal ecosystems to consider the economic value of those ecosystems, but putting a value on those ecosystems is such a new idea that “there are few examples where ecosystem services or other non-market values have informed policy decisions in California or elsewhere”).

189. *Oceans and Sea Level Rise*, *supra* note 95.

190. See 16 U.S.C. § 1531(a)(5) (2012).

191. *Cf. Marbled Murrelet v. Babbitt*, 83 F.3d 1060, 1064 (9th Cir. 1996).

discretionary agency action.¹⁹² Where a government agency takes action to address climate change under the ESA, such action is likely to go unchallenged under the agency's statutory mandate.¹⁹³ Given the danger posed by the current level of atmospheric CO₂ and the reluctance of governments to establish meaningful emissions controls, future action to address climate change is necessary.¹⁹⁴ There is scientific consensus that mitigation must be coupled with adaptation to address the myriad of challenges that climate change will present.¹⁹⁵ This fact will necessitate future action that will necessarily impact ecosystems and species that depend on those systems, and those anticipated responses must be factored into decisions on whether a project is likely to harm a species or its habitat.

The ESA must be re-examined to more accurately identify what should be protected. It was designed to protect and recover imperiled species and the ecosystems upon which they depend until protection is no longer needed.¹⁹⁶ But this statement of purpose does not specifically indicate what Congress intended to protect.¹⁹⁷ If Congress simply intended to ensure that organisms survive, then preservation is simply a numbers game. However, it is unlikely that Congress had such a narrow intent.¹⁹⁸ It is considerably more likely that Congress understood, albeit to a lesser degree than understood today, that protection is essential to conserve the species' functional role in the ecosystem it occupies.¹⁹⁹ As one author notes, the value of this approach is the recognition that "species interact with the biotic and abiotic elements of the system and play a dynamic role in

192. *Nat'l Ass'n of Home Builders v. Defenders of Wildlife*, 551 U.S. 644, 645 (2007) (noting the no-jeopardy duty only applies to discretionary agency activities).

193. *Id.* at 645–46 (noting that the duty to consult does not apply to actions an agency is required by statute to undertake).

194. *See Future Climate Change*, EPA, <http://www.epa.gov/climatechange/science/future.html> (last visited Nov. 10, 2014) ("The extent of future climate change depends on what we do now to reduce greenhouse gas emissions. The more we emit, the larger future changes will be.")

195. *See* 2007 SYNTHESIS REPORT, *supra* note 15, at 63–70.

196. 16 U.S.C. § 1531(b) (2012).

197. *See id.*

198. Goble, *supra* note 64, at 86–87.

199. *Id.*

shaping the system.”²⁰⁰ Ensuring that a species continues to be a functioning component of the ecosystem it occupies has important implications for responding to climate change. It is now widely recognized that maintaining and restoring biodiversity is required to sustain ecosystem health and resilience against global change.²⁰¹

As climate change facilitates range expansion for many species, the need for consultations under the ESA is likely to increase and will require careful reanalysis of critical habitats for many listed species. Climate change will likely increase the number of species in need of protection, lead to increased demand for listing and critical habitat designation, cause delays in delisting decisions, and increase litigation related to these issues.²⁰² How well the Services respond to these challenges remains to be seen, but past history indicates that these pressures will likely have negative impacts on conservation efforts.²⁰³ Thus, listing and designation of critical habitat should be guided primarily by considerations of the species role in the ecosystem.²⁰⁴ This method, in turn, will require changes in the way species are protected, which will likely require more listings, more critical habitat designation, and greatly increased funding. To minimize these impacts, steps must be taken now to limit the degree to which species already stressed are further impacted by climate change. Protection and restoration of ecosystem resilience represents

200. *Id.* at 87.

201. See John J. Stachowicz et al., *Understanding the Effects of Marine Biodiversity on Communities and Ecosystems*, 38 ANN. REV. ECOLOGY EVOLUTION & SYSTEMATICS 739, 740–41 (2007).

202. The ESA permits any person or organization to petition to add a species to the list. See 16 U.S.C. § 1531 (2012). The decision to list or not list a species is subject to review under the Administrative Procedure Act, but that review is limited. *Id.* at § 1533(b). Any person may petition the Secretary to revise a critical habitat designation. *Id.*

203. See, e.g., Press Release, U.S. Fish and Wildlife Serv., Flood of Court Orders Preclude New Listings of Threatened and Endangered Species in FY 2001 (Nov. 22, 2000), <http://www.fws.gov/news/ShowNews.cfm?ID=F41A0A59-C574-11D4-A17B009027B6B5D3> (noting that in 2000 the FWS, responding to court orders requiring it to designate critical habitats, announced that it was unable to add any new species to the endangered species lists the following year except on an emergency basis); see also Goble, *supra* note 64, at 31.

204. See Kostyack & Rohlf, *supra* note 22, at 10, 210; see, e.g., Endangered and Threatened Wildlife and Plants; Listing 48 Species on Kauai as Endangered and Designating Critical Habitat, 73 Fed. Reg. 62,591, 62,593 (Oct. 21, 2008) (codified at 50 C.F.R. pt. 17) (proposing to organize the species based on their ecosystems).

the most effective tool and must be utilized as a frontline defense to global warming.

B. *Eco-centric Land Use*

Healthy, biologically diverse ecosystems are more resilient to change.²⁰⁵ Unfortunately, human activities have systematically degraded ecosystems throughout the world and in the process have impaired natural systems' abilities to provide the critical ecosystem services humans depend upon.²⁰⁶ Unsustainable development of land and exploitation of species have been primary drivers of biodiversity loss, and this loss impairs system dynamics in ways that can limit the ability of affected species to respond to other environmental stressors that, in turn, contribute to further biodiversity loss.²⁰⁷ Climate change is likely to contribute to existing environmental stressors and decrease overall ecosystem resilience, increasing the probability that some species will struggle to survive.²⁰⁸

Coastal development has destroyed or impaired critical habitats that provide natural buffers to storm surge, and these impacts are magnified by rising seas.²⁰⁹ Land development along the coast continues to release tremendous quantities of previously sequestered CO₂ back into the atmosphere.²¹⁰ By some estimates, preserving and restoring coastal habitats in the United States could reduce the impacts of sea level rise on people and their property by half.²¹¹ Altered biogeochemical processes, increasing atmospheric CO₂, hydrological modification, altered food webs, and habitat

205. Stachowicz et al., *supra* note 201, at 749.

206. 2007 SYNTHESIS REPORT, *supra* note 15, at 48, 50.

207. See *Overexploitation*, ENVTL. LITERACY COUNCIL, <http://www.envroliteracy.org/article.php/1514.html> (last updated Jan. 9, 2009).

208. See Lewis H. Ziska, *Evaluation of the Growth Response of Six Invasive Species to Past, Present and Future Atmospheric Carbon Dioxide*, 54 J. EXPERIMENTAL BOTANY 395, 395 (2003); see also, John P. McCarty, *Ecological Consequences of Recent Climate Change*, 15 CONSERVATION BIOLOGY 320, 326 (2001).

209. See *supra* Part III.

210. See *supra* Part IV.C.

211. Katie K. Arkema et al., *Coastal Habitats Shield People and Property from Sea-Level Rise and Storms*, 3 NATURE CLIMATE CHANGE 913, 913–14 (2013).

fragmentation are all anticipated impacts of climate change.²¹² Collectively, these changes destroy an ecosystem's ability to provide critical ecosystem services that humanity depends upon.

It is now clear that a fundamental shift in perspective is required to adequately protect species and the environments they inhabit. Given the multitude of existing stressors, and those expected to emerge as climate change progresses, conservation efforts must focus on retaining and restoring ecosystem resilience. In the absence of meaningful action to address climate change, it is imperative that policy makers reassess the environmental and economic value of preserving natural ecosystems as a frontline defense to global warming. This will require policy makers to embrace a more eco-centric land ethic that focuses on ecosystem function and the role listed species perform in the ecosystem. This approach should inform all future land use decisions.

C. *Engage in Smarter Growth*

Prevailing systems of community development intended to promote public health have promoted harmful sprawl.²¹³ Traditional zoning practices focused on regulating land development by controlling land use.²¹⁴ The inefficiency associated with this approach prompted calls for smarter development. Smart growth principles typically focus on controlling the form of development in ways that create centralized cities and more open space, while reducing energy consumption through reductions in transportation.²¹⁵ The SmartCode has emerged as a useful alternative to traditional development. The SmartCode uses a model transect-based planning and zoning document based on environmental analysis.²¹⁶ The SmartCode divides land into six habitats based on the level and

212. *See id.*

213. *See supra* Part IV.A.

214. *Id.*

215. *See generally* ANDRES DUANY ET AL., SMARTCODE VERSION 9.2 (2009) (planning land use regulation based on "the rural-to-urban transect").

216. *Id.*

intensity of their physical and social character.²¹⁷ A key value of the SmartCode is its ability to integrate “methods of environmental protection, open space conservation, and water quality control.”²¹⁸ The code, attempting to preserve natural infrastructure, provides for a wilderness zone of land and encourages pedestrian-oriented communities.²¹⁹ Similar attempts to restructure American communities should be pursued, but alone, they do not represent a panacea for land-based impact to species. It is critical to consider how recentralizing American cities will impact species and their habitats, and to consider how directing economic activity toward such change will impact species preservation. Smart growth, under any of its existing forms, does little to remove existing built environments. Moreover, by design, it seeks to concentrate populations in centralized communities through use of existing infrastructure.²²⁰ This scheme will increase density in ways that may negatively impact species forced to shift their range in response to increasing temperatures and rising sea levels.²²¹ Thus, any effort to engage in smart growth must be smart enough to provide for migratory corridors.

CONCLUSION

As natural ecosystems continue to decay, the impact of land development on listed species could be significant. The ESA was created to address all threats to listed species without exception.²²² But the Act’s ability to protect listed species is limited by the fragmented response taken to species impacts in the United States. As climate change progresses, more species will face extinction and even more will require protection.²²³ To protect species in a changing environment, it is imperative that action be taken to increase the

217. *Id.* at vi.

218. *Id.* at viii.

219. *Id.* at 2–3, 27.

220. *See supra* Part IV.A.

221. *See supra* Part III, IV.A.

222. 16 U.S.C. § 1531(b) (2012).

223. *See supra* Part II.

resiliency of natural ecosystems. This will require a fundamental shift in perception and adoption of a new, more eco-centric land ethic.