Fordham Environmental Law Review

Volume 27, *Number* 1 2015 *Article* 2

The Biodiversity Paradigm Shift: Adapting the Endangered Species Act to Climate Change

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THE BIODIVERSITY PARADIGM SHIFT: ADAPTING THE ENDANGERED SPECIES ACT TO CLIMATE CHANGE

Kalyani Robbins[*]

Abstract:

The Endangered Species Act (ESA) was designed to protect species that had been rendered more vulnerable to extinction as a result of human activity. As such, its implementation has traditionally focused on keeping human beings away from such species and giving the species (and their ecosystems) space to heal on their own. Climate change is altering the landscape everywhere on the globe, rendering the hands-off approach no longer sufficient. Active interventions will become more necessary as we get further into the changing climate. Taking decisive action in response to climate change will also require a fundamental shift in our approach to nature, in which we leave behind the static preservationist view and accept that change is happening so that we can manage that change. Making the move from passive management (the hands-off approach, focused on prohibiting certain actions) to proactive management techniques will require some triage, which is impossible without this psychological shift. Climate change is resulting in widespread disturbances to ecological functioning, regardless of whether human beings have set foot in a given area, and we can no longer apply a static approach to a dynamic world. Rather than cling to a goal of reducing human interaction with nature, we must focus on the goal of increasing species resilience to change – these goals have coincided in the past, but this is lessening with each warming year.

This Article will review the impacts of climate change on biodiversity and the sort of management approaches that will become

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more appropriate in the Anthropocene, an era characterized by rapid non-linear change and multi-scale tipping points. Dealing with climate change requires effort both to mitigate (reduce anthropogenic greenhouse gasses) and adapt, so the Article will discuss the relationship between the ESA and both mitigation (which is not an ideal area for ESA application) and adaptation (where the most work is needed). While there are several provisions in the ESA that will prove useful to supporting the new strategies for species and ecosystem management, utilizing them properly will require a shift in implementation priorities and greater acceptance of the demise of what once was. Moreover, because the existing potential for applying ESA measures to support more active management techniques is both inadequate and voluntary, it will be worthwhile to build these new modalities into the statute itself in order to maximize the potential for species climate adaptation. I propose several changes to the ESA – amendments designed to bring what is rapidly becoming a rusty old statute into the new world we must manage today.

Outline:

INTRODUCTION

Change is nothing new. Heraclitus, an early Greek philosopher, pointed out that change was constant, most famously noting that a person could not step twice in the same river. Everything changes. Indeed, change itself is subject to change. It can be gradual, exponential, or sudden, as with tipping points. It can go in one direction or another, allowing us to speculate about potential alternate universes in which every possible path has been taken. For much of human existence, albeit with exceptions, the planet has changed somewhat gradually, and the direction has been largely one of improved functioning and interactions. Humans have enjoyed a relatively prosperous era for biodiversity. Species evolved by selecting ideal traits for survival. Ecosystems, albeit dynamic and

generally disturbance-oriented, worked toward the repeated return to self-maintenance. Humans evolved alongside other species, causing mostly small harms, and enjoying the benefits of healthy ecosystems.

This era of peacefully coexisting with nature is approaching its end, however, and the rate of that progression has been increasing exponentially. It began with human destruction of wildlife habitat in bite-sizes, a sort of behavior one can start and stop at will, but human activity crossed the point of no return when it interfered with the broader chemical balance of the entire earth's atmosphere. The resulting change in climate that is irrevocably underway will require us to make another change: our approach to biodiversity conservation. If we hope to maintain as many species as possible, as well as the ecosystem functions upon which we and they depend, we will need to shift from our long-standing preservationist paradigm to one of guiding the inevitable and rapid change. We will have to let go of the past and get creative about the future. It would be helpful, of course, if the law could join us in this evolution. This Article is about that legal policy transition.

When it comes to legislative and regulatory policy, we are teetering on the precipice of a new day in species conservation. Yesterday stretches out long behind us, filled with ecosystems and their inhabitants facing varied hurdles. Some might be in a great location for human housing or commercial development. Others may live in a forest marked for timber exploitation, or need to swim up a river cluttered with hydropower dams. Yesterday's problems are diverse, but most share one thing in common: they are within human control. We can choose whether to build there, whether to log there, whether to construct or continue to operate that dam. The dangers faced along the road behind us are relatively immediate, and the human behavior that creates them is thus subject to regulation on an as-needed, even emergency-oriented basis. Species are taken to the brink of extinction and then federal superheroes swoop in to halt the oncoming train just before it pushes them over (at least in theory). That is the nature of old-school endangered species regulation.

We had relatively immediate control yesterday, which is what makes tomorrow so frightening. We now face a less governable problem for biodiversity: a rapidly changing climate that simultaneously alters every ecosystem on earth. Unlike traditional human development, we cannot just cut it off at the moment it becomes clearly destructive. We set this beast in motion many years

ago, and now (at least *for now*) it is an unstoppable force. We can mitigate the extent to which we feed it and groom it for future mischief, but it will not do our bidding in this moment – it is not directly subject to our regulation. The federal superheroes are no match for it. No wonder we begin this new day with trepidation, but this dread will not help us. Fear of the unknown certainly will not help us. We must step confidently (but carefully) into this new day, as it is our reality now, and we can work with it once we acknowledge it.

This theoretical paradigm shift – from preservationist values to the acceptance and management of change – carries important practical consequences. In the days behind us, while we directly and immediately caused the harm, endangered species protection has been reactive to those causes. In the new world ahead, in which harm is happening no matter what we do (or stop doing) at the moment, we must shift to proactive strategies for endangered species management. We have to move from back-stop measures to preventative ones. The goal of keeping human hands off is no longer adequate – protecting species is rapidly becoming a hands-on endeavor. The question is: *Can we bring our old Endangered Species Act with us into this new world?*

This Article proposes amendments to the Endangered Species Act (ESA), ranging from the minimal to the more ruthless, suggesting a transformation which would allow it to remain functional as we shift to the new change-based approaches for biodiversity management. The focus is on atmospheric climate, not political climate, so the political and economic ball and chain dangling from the feet of Congress is well beyond its scope. It is about steps that we can and should take, once we are ready for these priorities. The Article reflects the author's position that this kind of interdisciplinary work – the effort to bring our scientific knowledge into the process of determining what kind of policy reform is needed – is important regardless of whether those in power are ready to act on it. That said, the practical value often lies in the potential that some, even if not all, suggestions may be adopted.

In a 2010 research study, for which federal land managers were interviewed regarding the effectiveness (or existence) of strategies for climate adaptation, "a large majority (81%) of respondents believed that the Endangered Species Act was a barrier to climate change adaptation, while few (9%) believed this law to be an

enabler."[1] Political infeasibility is not really an option, in spite of how daunting it may in fact be, as the existing ESA approach is beginning to cause more harm than good. Biodiversity advocates have traditionally argued that it is not worth the risk of "opening up the statute" to improve it, as doing so could place its much-needed protections in danger. That said, once the world around the statute changes so substantially that the ESA stands in the way of conservation, causing more harm than good,[2] this equation is arguably altered as well. There is less and less to lose the longer it stays the same.

So, whether we like it or not, we are on the brink of a dramatic paradigm shift in our relationship with nature. We have reached the tipping point, both in terms of population and technology, for the toppling of our human/nature dualism. Humanity and nature may no longer exist as entirely separate entities. Via climate change, our hands now reach every inch of the globe, whether we have directly set foot there or not. If we hope to keep any of it into the future, whether in the interests of wildlife or simply because our lives depend on ecosystem services, we will have to roll up our sleeves and actively participate in the design of the New Nature. Part I of this Article explores the wide range of impacts climate change is having and will have on biodiversity and ecosystems. Climate change has the potential to destroy it all, so Part I reviews the various effects, demonstrating their reach to every type of ecosystem. This will be followed in Part II by a discussion of some key methods conservation biologists have begun to develop for rescuing climate-imperiled species, including adaptive ecosystem management, ecosystem defragmentation (or restoration of connectivity), and the somewhat

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1. Lesley C. Jantarasami, et al., *Institutional Barriers to Climate Change Adaptation in U.S. National Parks and Forests*, ECOLOGY AND SOC'Y 15(4): 33 (2010), *available at* http://www.ecologyandsociety.org/vol15/iss4/art33/.
Respondents described a high potential for the ESA to hinder adaptation given its focus on single-species management to recover threatened or endangered species in specific habitats and geographic areas. They believed that this approach contradicts adaptation's emphasis on dynamic management of ecosystem processes and recognition that it may not be possible to sustain all species in their current ranges under a changing climate. Respondents also noted tensions between short- and long-term species protection and limited ability to actively manage in areas designated as critical habitat or containing nesting sites.
Id. at p. 11.

2. I do not intend to suggest that we are there yet.

controversial concepts of assisted migration and ecosystem design. Part III explores the philosophical and psychological underpinnings of our relationship with nature, and how those will have to change (the paradigm shift) in order to move forward with the necessary biodiversity conservation techniques.

Turning to the role of the ESA in all this change, Part IV begins by ruling out the ESA as a tool for climate mitigation,[3] though it is potentially an ideal tool for climate adaptation.[4] The Part then identifies six provisions already present in the existing ESA that may be utilized to further some or all of the proposed techniques for maximizing species survival in the face of climate change. Given sufficient motivation within the wildlife agencies to take on proactive climate adaptation, there is a good deal of potential authority already available for doing so. However, because the existing measures available in the statute are neither designed with climate adaptation in mind nor mandatory with respect to the actions they authorize, Part V proposes six amendments to the ESA calculated to better tailor it to the needs of climate-sensitive species (which, eventually, could be all of them). The Article concludes that we can only get so far by manipulating the existing ESA provisions, and as such it is highly advisable to make adjustments to the statute to bring it (and many of the species it seeks to protect) into the future.

I. IMPACT: THE DRAMATIC AND PERMANENT ALTERATION OF THE EARTH'S ECOSYSTEMS

Global climate change is rapidly becoming the greatest worldwide problem since the dawn of humanity. While there would presently be some gradual warming of the atmosphere anyway, as part of a grand-scale climate cycle, human activity has accelerated this warming. We have dramatically increased, to an unnatural level, an otherwise natural occurrence known as greenhouse gasses. This term well describes the phenomenon. Under normal atmospheric conditions,

3. "Climate mitigation" refers to policies that lead to a reduction in greenhouse gas emissions to slow the future progression of climate change.

4. "Climate adaptation" refers to policies designed to maintain the resilience of human populations and ecosystems in the face of a changing environment, though in this Article the term is largely concerned with biodiversity adaptation and not human adaptation.

energy from the sun enters the atmosphere, after which some of it is absorbed and some (quite a bit) is sent back into space. How the energy is divided between these two potential outcomes determines the atmospheric temperature. The more it is sent into space, of course, the cooler the atmosphere, and vice versa. Greenhouse gasses absorb and re-emit infra-red radiation, standing in the way of some of the energy-reflection from the earth. When the energy is re-emitted, it goes both into space and back toward the earth. Because this creates a net increase in retained solar radiation, more greenhouse gasses in the atmosphere result in warmer average temperatures within the earth's atmosphere. There are natural greenhouse gasses for which we cannot take the blame (and which are not blameworthy anyway, as without them the earth's atmosphere would be inhospitably cold), but when we emit certain chemicals into the air, particularly carbon dioxide, methane, nitrous oxide, and sulphur hexafluoride, they collect in the atmosphere in unnatural quantities and contribute to the excessive greenhouse effect.[5]

Our GHG emissions are a long-term commitment. We cannot turn back now. This is because "the excess carbon dioxide we put in the atmosphere today is removed exceedingly slowly, meaning that the carbon dioxide we emit in the next half-century will alter the climate for millennia to come; even if we wholly ceased using fossil fuels after fifty years, the harm could not be undone."[6] Because we have already committed ourselves to climate change, we will need to get used to the idea that things will be different around the globe, and must regulate biodiversity accordingly.

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5. For a frightening, yet necessarily conservative, assessment of the state of anthropogenic climate change, see Climate Change 2014: Synthesis Report, Intergovernmental Panel on Climate Change, https://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf. These reports tend to be conservative in representing the predictions for both scientific and political reasons, and as a result in the years following each we learn that the situation is worse than stated, as has certainly been the case since Climate Change 2007: Synthesis Report, Intergovernmental Panel on Climate Change, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf. *See, e.g.*, Richard A. Betts et al., *When Could Global Warming Reach 4°C?*, 369 PHIL. TRANSACTIONS ROYAL SOC'Y A 67 (2011); Julie Steenhuysen, *Global Warming Worse than Predicted-US Scientist*, REUTERS NEWS, Feb. 14, 2009 (discussing the IPCC report's underestimation of climate change).

6. R.T. Pierrehumbert, *Climate Change: A Catastrophe in Slow Motion*, 6 CHI. J. INT'L L. 573 (2006).

Climate change is impacting biodiversity across the board. Indeed, biodiversity may well be the catastrophe's greatest victim. We have already seen relatively dramatic changes in habitat and species behavior, and it is very clear that what has taken place so far is only the tip of the iceberg. The following is a sampling of some of the major areas of concern.

A. HYDROLOGY

While the hydrological cycle may not be the first thing people think of when wringing their hands over climate change, the impact in this area may be substantial, with serious consequences for both human populations and ecosystems. Research has found that the greenhouse effect "will alter the timing and magnitude of runoff and soil moisture, change lake levels, and affect water quality."[7]

A warmer atmosphere increases the rate of evaporation, which speeds up the entire hydrologic cycle. This, along with greater pressures on air currents, is pushing storm activity further from the equator. The result is that wet areas are getting wetter and dry areas are getting drier.[8] A greater proportion of precipitation falls as rain rather than snow, which reduces the capacity for water storage. Rivers and streams are maintained by the gradual melting of water previously stored as snow, and will lose volume during the lengthened dry seasons with the diminished quantity of snow melting more quickly and running out. This will cause water shortages for human communities as well as severe harm to aquatic and riparian ecosystems. In addition to regional changes, precipitation is becoming more temporally concentrated into heavy rainfall events separated by longer dry periods, which leads, paradoxically, to an increase in both droughts and floods. Both events cause problems for ecosystems and can kill off large populations of plant and tree species.[9]

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7. Peter H. Gleick, *Climate Change, Hydrology, and Water Resources*, 27 REVIEWS OF GEOPHYSICS 329 (1989).

8. *See* Thomas R. Karl, Jerry M. Melillo, & Thomas C. Peters eds., GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES41-42(2009) (report to Congress by U.S. Global Change Research Program), *available at* http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

9. *Id.* at 44.

Hydrologic changes also create increased competition for the limited and fluctuating water resource between human populations and dwindling fish species. Because many of the impacted species are listed under the ESA, we have already begun to see courts requiring the wildlife agencies to consider climate change impacts on species in their decision-making. One example of this is the California delta smelt at issue in a 2007 case, *Natural Resources Defense Council v. Kempthorne*,[10] in which a biological opinion allowing for a water project that delivered water to much of southern California was struck down for failing to consider the impact of climate change on the delta smelt. The Fish & Wildlife Service (FWS) should have taken into account the likelihood of climate-change-caused decreases in water volume and increases in water temperature, both of which could be devastating to the fish. This ruling initially halted the water diversions to California's arid south.[11] They were only partially resumed,[12] and users were forced to manage on just forty percent of their expectations.[13] One can imagine future scenarios in which the human cost is too great to bend to the dictates of the ESA, which could endanger the statute itself. The climate change context creates conflicts that go beyond the traditional economic sacrifices associated with the ESA.

B. SEASONS

The shifting of seasons is one of the easiest changes for average people to observe in their everyday lives. The flowers are budding earlier, the fall colors come later, and the birds are migrating by at different times than one might recall from their youth.[14]

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10. 506 F. Supp. 2d 322 (E.D. Cal. 2007).

11. *See* Glen Martin, Smelt Decline Turns Off Delta Water Pumps; Official Says Users Relying on State Project Will Be Okay, S.F. Chron., June 1, 2007, at B1.

12. *See* Jeanne Marie Kerns, *California Cuts Water Supply by a Third to Protect Endangered Delta Smelt Fish*, ASSOCIATED CONTENT, Sept. 2, 2007, http://www.associatedcontent.com/article/366070/california_cuts_water_supply_by_a_ third.html (on file with the Harvard Law School Library).

13. *See* Bettina Boxall, State Water Deliveries Up, L.A. TIMES GREENSPACE BLOG, May 20, 2009, http://latimesblogs.latimes.com/greenspace/2009/05/water-deliveries.html (on file with the Harvard Law School Library).

14. *See* U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 80 (Thomas R. Karl, Jerry M. Melillo, &

In the United States, spring now arrives an average of 10 days to two weeks earlier than it did 20 years ago. The growing season is lengthening over much of the continental United States. Many migratory bird species are arriving earlier. For example, a study of northeastern birds that migrate long distances found that birds wintering in the southern United States now arrive back in the Northeast an average of 13 days earlier than they did during the first half of the last century. Birds wintering in South America arrive back in the Northeast an average of four days earlier.[15]

While such shifts may not seem like cause for great alarm, and one might even find some positive spin (such as the increase in growing season for crops and recreational opportunities, though it also increases fire season for foresters), it serves as a canary in the planetary coalmine. Once you let it sink in – the timeframe in which this can be observed – it becomes quite ominous. Moreover, the shifting of seasons plays a role in the habitat selection patterns of those bird and land species that do migrate, resulting in the range alterations and jumbled ecosystems described next.

C. SPECIES GEOGRAPHIC RANGE

We have begun to see shifts in the geographic ranges of many species, and expect to see such movement increase substantially if not impeded. Species are seeking out their historic climates, the conditions in which they evolved. With a warming atmosphere, one must keep moving in order to stay the same, whether northward or upward in altitude. While this can sound like a self-managed problem, it is rare that such migrations are successful. If they need to move northward, they run quickly into the upper boundaries of their conservation island, unable to cross large areas of human development (or even something as narrow as a road, for some species), even if there is any suitable habitat to the north of it (which there may not be in any case). If they are moving up in altitude, some may find short-term success, due to less human development on mountains than elsewhere, but there is a rather obvious endpoint: the mountaintop itself. Even if there is suitable habitat on a higher

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Thomas C. Peters eds., 2009), *available at* http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf.

15. *Id.*

mountain nearby, there is no way to survive the trip through the valley in between, so the population is stranded.[16] Finally, even where migration is not impeded, a population may be faced with leaving behind certain habitat needs or encountering a new predator. Ecosystems are complex interdependent webs, no more designed to be broken apart than the organs in your body. Studies show species populations at the southern end of the species' range going extinct in spite of the availability of suitable habitat to the north.[17]

Further, species migration may harm other species, leading to cascading effects. As just one example, tree species face the same predicament as wildlife, also moving northward albeit a bit more slowly. When entire forests move, it not only alters the habitat they provide within, but also encroaches on non-forest habitat to the north.[18] Caribou, for example, require open tundra habitat to the north of the tree line. As the tree line moves north, the southern border of caribou habitat moves north. The northern border, however, remains the same, so the result is a continuous shrinking of total caribou habitat.

D. DISPERSAL AND INVASION

As mentioned above, some species will attempt to move northward or upward in altitude. Others, however, will not do so, or will do so on a later schedule, due to variation in sensitivity to both climate change and migration.[19] This variation in movement will result in a breaking up of ecosystems, which carries the potential to be the greatest catastrophe for biodiversity, as well as for human enjoyment of ecosystem services. The results of such a phenomenon are difficult to predict, as it is unprecedented, but there is no question that many species will not survive the crumbling of their ecosystems.

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16. This is happening now to the adorable pika, as many learned from talks by J.B. Ruhl nearly a decade ago. *See* J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. REV. 1, 2 (2008).

17. Karl, et al., *supra* note 8, at 80.

18. Hinzman, et al., *Evidence and implications of recent climate change in northern Alaska and other Arctic regions*, 72(3) CLIMATIC CHANGE, 251-98 (2005).

19. ARCTIC COUNCIL, ARCTIC CLIMATE IMPACT ASSESSMENT 139 (2005), *available at* http://www.acia.uaf.edu.

Not only will this new tendency toward dispersal be harmful to the scattering ecosystem itself, but the pieces it sends out into the world may wreak havoc wherever they land. After habitat destruction, invasive species are the second leading cause of species extinctions. Most invasive species problems thus far have been introduced directly by human beings. Generally with innocent intentions, shortsighted individuals and governments have attempted to solve small problems by introducing new species that ultimately created large problems. Some infamous examples are kudzu ("the vine that ate the south"), Asian carp, and the zebra mussel. The break-up of ecosystems and migration of species will usher in a new era of invasive species: species that showed up in their new homes completely on their own, with no direct assistance from humans. Of course, these invasions are still human-caused (due to anthropogenic climate change), and still our responsibility to address.

Some climate-encouraged invasions have even more sinister impacts than simply destroying their host ecosystems, in that they can contribute directly to the greenhouse gas overload. Mountain pine beetles, like most insects, are heavily dependent on climate. Warmer temperatures speed up their life cycles and the expanding area of warm climate has substantially increased their geographic range. Shorter and less intense winters are especially valuable to the beetle, as cold winters are what traditionally kept their populations in check, even in those regions in which they could survive part of the year. The mountain pine beetle destroys pines in a rapid and widespread fashion, and has spread to nearly double its former range, pushing up into Canadian forests and causing great devastation there.[20] These pine forests serve as carbon sinks, so not only does this cause loss of their potential to continue to absorb carbon, but worse, their destruction releases all that stored carbon into the atmosphere.

E. OCEAN ACIDIFICATION AND OXYGEN-POOR DEAD ZONES

What is likely the most devastating issue is unfortunately also the least commonly understood or even known. Perhaps because many never see the ocean, and we do not live there, it has received deceptively little play in the media. Or perhaps it is because even the

20. *See* Brian Hoyle, *Plight of the Pines*, NATURE REP. CLIMATE CHANGE, Apr. 24, 2008, http://www.nature.com/climate/2008/0805/full/climate.2008.35.html.

scientific community waited so long to research the issue, such that we've only had information to access (or not access, as the case may be) for a couple of decades.[21] We ignore this 70% of our planet at our peril, as the ocean is absorbing an entire third of all that excessive CO_2 we are emitting into the atmosphere.[22] When this carbon dioxide dissolves in water it acidifies the water, resulting in poor conditions for coral species to form their skeletons.[23] This is a problem not only for coral, but for shellfish as well. Researchers for the U.S. Global Change Research Program warned that "[i]f carbon dioxide concentrations continue to rise and the resulting acidification proceeds, eventually, corals and other ocean life that rely on calcium carbonate will not be able to build these skeletons and shells at all."[24] If it gets to that, the entire food chain will be thrown off, resulting in widespread human suffering.[25] The ocean, a living resource, will die.[26]

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21. *See* Ryan P. Kelly & Margaret R. Caldwell, *Ten Ways States Can Combat Ocean Acidification (And Why They Should)*, 37 HARV. ENVTL. L. REV. 57, 59 (2013) ("The past ten years have seen an explosion of primary scientific literature, but little legal analysis or commentary on ocean acidification. As a result, the legal and policy options lag behind the science even as improved understanding of the phenomenon opens up new policy avenues to combat the global change.").

22. *See* Scott C. Doney et al., *Ocean Acidification: The Other CO_2 Problem*, 1 ANN. REV. MARINE SCI. 169, 170 (2009).

23. *See* R.T. Pierrehumbert, *Climate Change: A Catastrophe in Slow Motion*, 6 CHI. J. INT'L L. 573, 579 (2006) ("Carbon dioxide becomes an acid when it dissolves in water; the resulting acidification of the ocean will make it harder for coral to form their skeletons.").

24. Karl, et al., *supra* note 8.

25. *See* Nat'l Sci. and Tech. Council Interagency Working Group on Ocean Acidification, STRATEGIC PLAN FOR FEDERAL RESEARCH AND MONITORING OF OCEAN ACIDIFICATION 70 (2012), www.st.nmfs.noaa.gov/iwgoa/DRAFT_Ocean_Acidification_Strategic_Research_Plan.pdf (noting that "ocean acidification has the potential to increase instability in regions of the world where the effects of decreasing pH on marine life will threaten the food supply of over one billion people.").

26. Other countries have begun to take action, thankfully, though the U.S. has a long way to go toward addressing the problem. A useful review of the harms caused by ocean acidification, as well as the governmental responses to the issue, can be found in Heidi R. Lamirande, *From Sea to Carbon Cesspool: Preventing the World's Marine Ecosystems from Falling Victim to Ocean Acidification*, 34 SUFFOLK TRANSNAT'L L. REV. 183 (2011).

Changes in ocean chemistry will probably affect marine life in three different ways: (1) decreased carbonate ion concentration could affect the calcification process for calcifying organisms (e.g., corals); (2) lowered pH could affect acid-base regulation, as well as a variety of other physiological processes; and (3) increased dissolved CO_2 could alter the ability of primary producers to photo-synthesize.[27]

Speaking to the second point in this list, if you have ever tried to care for a home aquarium, you know that fish are extremely sensitive to even the slightest alterations in water temperature or chemistry. Given that climate change has a substantial impact on both of these characteristics of water bodies, it places a heavy burden on fisheries. It will become increasingly important to manage aquatic ecosystems for resilience.[28]

Finally, when you combine a reduction in photosynthesis with the increase in fertilizer run-off that we already struggle with, you maximize the problem of oxygen-poor dead zones.[29] These are areas in which the oxygen level drops so dramatically that everything there dies at once. Even the warming itself contributes to the problem, as "[w]arm water holds less oxygen than cold water."[30] Such dead zones have been on the rise for years. While there is some public awareness of the hypoxic coastal dead zones caused by agricultural run-off, many do not realize that the deep ocean has become an oxygen-poor dead zone that is expanding upward due to warming temperatures and declining ocean circulation.[31] "It leaves just a very thin lens on

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27. Cheryl A. Logan, *A Review of Ocean Acidification and America's Response*, 60 BIOSCIENCE 819 (2010).

28. *See* Robin Kundis Craig, *Re-Tooling Marine Food Supply Resilience in a Climate Change Era: Some Needed Reforms*, 38 SEATTLE U. L. REV. 1189 (2015).

29. *See* United Nations Environment Programme & Convention on Biological Diversity, IMPACTS OF CLIMATE-RELATED GEOENGINEERING ON BIOLOGICAL DIVERSITY, Subsidiary Body on Scientific, Technical and Technological Advice, 2012 ("Wider, long-term indirect effects of oxygen depletion and deep-water acidification could be regionally significant if there were cumulative deposition, and subsequent decomposition, of many gigatonnes of organic carbon.").

30. Pierrehumbert, *supra* note 6, at 578.

31. *See* Craig Welch, *Oceans Are Losing Oxygen—and Becoming More Hostile to Life*, NATIONAL GEOGRAPHIC, March 13, 2015, *available at* http://news.nationalgeographic.com/2015/03/150313-oceans-marine-life-climate-change-acidification-oxygen-fish/ ("Warming temperatures are sucking oxygen out of waters even far out at sea, making enormous stretches of deep ocean hostile to marine life.").

the top of the ocean where most organisms can live," according to Sarah Moffitt of the Bodega Marine Laboratory at the University of California, Davis, which in turn results in an increased risk for historically deep-water species of falling prey to surface predators or getting caught in long-lines from fishing boats.[32]

F. MELTING SEA ICE AND SEA LEVEL RISE

Some geographic areas are more sensitive than others, as well as more susceptible to catastrophic tipping points or even rapidly escalating feedback loops. The Arctic is an excellent example of all three weaknesses in one region. Because much of the Arctic habitat consists of sea ice, the habitat literally melts away, leaving its inhabitants stranded and homeless. In addition to being hypersensitive to warming temperatures due to ice-dependency, the Arctic also suffers from a relatively early tipping point. This is because it does not take very much warming, melting of ice, and reduction (in both range and duration) of snow cover to trigger a devastating feedback loop. To wit: there is an initial reduction of snow cover and melting of ice, thereby reducing the reflective surface area for deflecting the sun's radiation, causing more of it to be absorbed, resulting in additional warming and melting, and so on.[33]

This places sea-ice-dependent species among those with the most urgent of circumstances, as they are rapidly losing their habitat. Their habitat is not merely undergoing gradual change; it is disappearing altogether.

Walruses, polar bears, seals, and other marine mammals that rely on sea ice for resting, feeding, hunting, and breeding are particularly threatened by climate change. For example, studies reveal that in 1980, the average weight of female polar bears in western Hudson Bay, Canada, was 650 pounds. While in 2004, their average weight was only 507 pounds. It is believed that the progressively earlier breakup of the Arctic sea ice is responsible for the decrease in the

32. *Id.*

33. *See* U.S. Climate Change Sci. Program, Synthesis & Assessment Product 4.2: Thresholds of Climate Change in Ecosystems 2 (2009).

polar bears' average weight, as this ice loss reduces their hunting season and food intake.[34]

In addition to the devastating loss of sea ice habitat, all this melting ice is resulting in sea level rise. Indeed, the Intergovernmental Panel on Climate Change ("IPCC") concluded that sea level rise was "inevitable" no matter what we do at this point.[35] The causes of sea level rise include not only melting ice sheets and glaciers, but a substantial contribution comes from ocean expansion due to warming, with an estimated 2,000-year commitment to rising seas already underway.[36] Rising seas are devastating to coastal ecosystems such as tidal marshland or mangroves.[37] For this reason, creative efforts at adaptation assistance to such ecosystems will be essential.

II. RESPONSE: PROACTIVE SPECIES MANAGEMENT IN THE ANTHROPOCENE

There is no doubt that we need to find a way to reduce our GHG emissions with the goal of slowing down (and eventually halting) our impact on global climate. However, we have also seen that climate change is already underway, that it operates with a multi-decade lag time, and that we are neither economically nor politically capable of immediate and/or complete cessation of GHG emissions. In other words, we will be stuck with climate change for at least a few decades, likely longer, and it is likely to get worse before it gets

34. Ahmed Djoghlafa, *Climate Change and Biodiversity in Polar Regions*, 8 SUSTAINABLE DEV. L. & POL'Y 14 (2008).

35. Intergovernmental Panel on Climate Change, Climate Change 2007: Synthesis Report: Summary for Policymakers 20 (2007).
Sea level rise under warming is inevitable. Thermal expansion would continue for many centuries after GHG concentrations have stabilised, for any of the stabilisation levels assessed, causing an eventual sea level rise much larger than projected for the 21st century.

36. Anders Levermann, et al., *The multimillennial sea-level commitment of global warming, in* Proceedings of the National Academy of Sciences (PNAS), 2013.

37. *See* Joanna C. Ellison & David R. Stoddart, *Mangrove Ecosystem Collapse during Predicted Sea-Level Rise: Holocene Analogues and Implications*, 7 J. COASTAL RES. 151 (1991).

better.[38] For this reason, our traditional vision of keeping some ecosystems untouched by human influence – the goal of pristine land – is no longer realistic, as it has all been impacted by human activity now, regardless of whether humans have ever set foot on it.

We need resilient ecosystems, ready to withstand the changes that come. This will sometimes entail restoration, in cases where we have weakened ecosystems without actually destroying them, recognizing that just because they have remained intact thus far does not mean they are prepared to adapt to climate change. Restoration can bring back the strength and vitality needed to survive change. In other circumstances (such as where no amount of restoration will make a given location remain habitable) the primary concern may be connectivity, allowing species greater room for movement, given the likelihood of increased movement in response to climate change. Connectivity is important even in a pre-climate-change world, as fragmentation weakens ecosystems and reduces the size and variability of species populations. For this reason, connectivity will be an important factor in ecosystem resilience to climate change. Achieving the necessary connectivity could require actually designing migration corridors from scratch in areas where there is presently human development.

The unprecedented problems created by global climate change will require unprecedented responses. The methods we have used in the past – setting aside conservation areas and discouraging human contact with imperiled species and habitats – are making less sense with each passing decade. Indeed, considering some of the issues in Part I, we can see how these approaches would not only fail to be helpful, but become directly harmful. Placing a baby in a crib from which it cannot escape is only an effective safety strategy if the house is not on fire. Similarly, setting up isolated nature preserves, even if quite large and biodiverse, is only helpful as long as the habitat remains habitable, and with a changing climate can eventually become the burning house from which the protected species cannot escape. Although ecosystems are capable of adapting to gradual

38. *See* T.M.L. Wigley, *The Climate Change Commitment*, 307 SCIENCE 1766 (2005).

change, the rapid rate of global climate change renders adaptation unlikely for many ecosystems.[39]

We have reached the end of the hands-off era, the end of preserving anything that is truly pristine. By touching the global climate we have left nothing untouched. We can no longer hope not to break it, and must instead accept the responsibility for fixing what we have already broken. This is an affirmative responsibility, one which requires action and not merely ceasing to cause harm (as it is both impossible to stop and too late even if we could). This Part reviews several of the methods conservation biologists are beginning to recommend with greater frequency as global climate change develops.

A. ADAPTIVE ECOSYSTEM MANAGEMENT

One notable characteristic of the impacts climate change will have on species and ecosystems is that they are largely unpredictable. Frontloaded policymaking requires predictability and is thus a mismatch for managing ecosystems in this time of rapid change (or ever, for that matter, as even under more typical circumstances nature can be unpredictable). Nor is it ideal to operate entirely reactively, both because this ignores prevention and because policy choices may excessively fall prey to special interest influences. Instead, as much of the broader policy principles as possible should be determined on the front end – goals should be set, with initial plans to achieve those goals and various adjustments to be made in response to the range of possible feedbacks – and the implementation details managed as we go. Consider it like writing a "choose your own adventure book" for nature to play: many possible storylines and outcomes depending upon which page the ecosystem turns.

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39. *See* William E. Eastering III, Brian H. Hurd & Joel B. Smith, COPING WITH GLOBAL CLIMATE CHANGE: THE ROLE OF ADAPTATION IN THE UNITED STATES, Pew Center on Global Climate Change (2004), *available at* http://www.c2es.org/docUploads/Adaptation.pdf ("Although biological systems have an inherent capacity to adapt to changes in environmental conditions, given the rapid rate of projected climate change, adaptive capacity is likely to be exceeded for many species. Furthermore, the ability of ecosystems to adapt to climate change is severely limited by the effects of urbanization, barriers to migration paths, and fragmentation of ecosystems, all of which have already critically stressed ecosystems independent of climate change itself.").

The adaptive management approach originally developed as a response to natural uncertainty. Nature has always been unpredictable, so conservation biologists pointed out that we needed to work with that uncertainty better, prepared to adjust to feedback and tailor management strategies to the actual needs presented over time. Because climate change magnifies this existing uncertainty, it also magnifies the need for adaptive management. It is our best method of "learning by doing."[40] Given that the stakes and the uncertainties are both at their highest when species are brought to the brink of extinction or rapidly adapting to new environments, adaptive management becomes especially valuable in such a context.[41]

With adaptive management of an ecosystem, management actions have the dual purpose of conservation and research.[42] "Rigorously experimental adaptive management should maximize the rate and extent of learning from management actions."[43] Management results are monitored and varying strategies are compared for relative effectiveness. Initial plans ideally should provide: 1. clear objectives by which experiments may be assessed, and 2. specific criteria or triggers for when strategies must be adjusted to reflect new information or changed circumstances. The flexibility in the planning allows land managers to adapt their approaches based on the feedback from initial efforts, as well as in response to changes in circumstances. Meanwhile, the detailed initial plans for what to monitor and how to respond to certain feedbacks or changes helps to avoid excessive discretion, which of course may be subject to conflicted influences. Today there is no better method for managing

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40. CJ Walters & CS Holling, *Large-scale management experiments and learning by doing*, 71 ECOLOGY 2060 (1990).

41. *See* J.B. Ruhl, *Taking Adaptive Management Seriously: A Case Study of the Endangered Species Act*, 52 U. KANSAS L. REV. 1249, 1265 (2004) ("The one spot on the spectrum of species decline we ought to hope and expect to find adaptive management at work is at the point when we think a species might very well become extinct. If we do not practice adaptive management at that stage, what is the point of doing anything?").

42. *See* Kalyani Robbins, *An Ecosystem Management Primer: History, Perceptions, and Modern Definition*, in THE LAWS OF NATURE: REFLECTIONS ON THE EVOLUTION OF ECOSYSTEM MANAGEMENT LAW AND POLICY (Kalyani Robbins ed., 2013).

43. Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of New Age Environmental Protection*, 41 WASHBURN L.J. 50 (2001).

ecosystems in the face of change, so adaptive management is the gold standard approach for handling climate adaptation.

B. ECOSYSTEM DEFRAGMENTATION / RESTORATION OF CONNECTIVITY

As the human population grows, extracts resources, and develops the landscape, it cuts vital wildlife habitat to pieces. Once contiguous habitats become isolated "islands," effectively trapping wildlife within shrinking confines. Conservation biologists point to this process, habitat fragmentation, as one of the leading causes of extinction. Habitat fragmentation afflicts not only wide-ranging animals, but virtually all species, down to the endangered Preble's meadow jumping mouse (Zapus hudsonius preblei). Additionally, its effects are becoming apparent even in our largest wildlife reserves.[44]

This problem is especially acute in the face of climate change and the resulting increase in species relocation needs. Conservation biologists have been pointing to the need for wildlife migration corridors for many years, but recently the level of urgency has been on the rise. Although the problem of fragmented habitat has only become severe in the past century or so, we can see what the long-term impact might be like by looking at an area of study called "island biogeography," which studies biodiversity on actual islands (the kind separated by water rather than urban sprawl). This area of research has demonstrated the value of accessibility to biodiversity – the closer an island is to mainland (so that it is easier to get to) or the larger it is (so it is a bigger target for migrating wildlife), the more biodiverse. As our inland "islands" become smaller and further apart, this is a serious concern, especially in light of the climate stressors increasing the need to migrate.

Conservation biologists have focused much study on a pragmatic solution—ensuring at least minimal connectivity by preserving biological corridors, strips of habitat that connect larger habitat areas and prevent complete fragmentation. Experimentation shows that this alternative to the ideal of preserving complete, natural connectivity may offer survival and stability to many wildlife species that otherwise would face extinction.[45]

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44. Mark R. Thompson, *Keeping the Door Open: Protecting Biological Corridors with Existing Federal Statutes*, 34 ENVTL. L. 703, 705 (2004).

45. *Id.* at 703.

Indeed, a University of Florida study observed substantial benefits to species survival with greater connectivity via biological corridors.[46] The value of such corridors has been demonstrated in a range of contexts since well before this study as well.[47] Sometimes connectivity is as easy as building wildlife bridges over roads, and at other times there may be greater economic impact at stake, given that species vary in their need for broad corridors versus ability to manage with narrow ones.[48] For this reason the need for greater connectivity is one of great trade-offs and thus prone to controversy. While public lands can serve as a substantial part of the web, some private lands will also be required.

C. ASSISTED SPECIES TRANSLOCATION

When a population finds that its habitat is no longer suitable due to climate change, there may be other habitat that is either still suitable or newly suitable as a result of climate change. In some cases it will be possible for the wildlife to migrate on their own, especially where we have succeeded in creating usable wildlife corridors. This self-directed migration is virtually always preferable, at least when the conditions are adequately safe to do so. But what about when they are not? What is to come of populations for which there is suitable habitat but that habitat is not accessible to them? This is where assisted species translocation, also commonly called assisted migration, come in. With assisted migration, humans move the population from one habitat to another. As you might imagine, this is an extremely invasive procedure. It is ER treatment for problems that may have fared better with appropriate preventative care.

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46. University Of Florida, *After Massive Experiment, Results Favor Wildlife Corridors*, SCIENCEDAILY, 20 Sept. 2002,www.sciencedaily.com/releases/2002/09/020917065650.htm (finding that wildlife corridors serve to increase chances of survival in otherwise separated populations).

47. *See* David B. Lindenmayer & Jerry F. Franklin, CONSERVING FOREST BIODIVERSITY 112 (2002).

48. *See* Vicky J. Meretsky et al., *Migration and Conservation: Frameworks, Gaps, and Synergies in Science, Law, and Management*, 41 ENVTL. L. 447, 463 (2011) (explaining the difference between broad corridors and narrow corridors, along with how they are utilized).

While research results have varied,[49] the expected success rate of survival after assisted migration is approximately half,[50] but such outcomes must be interpreted with great caution given the variables that impact success,[51] so it should be seen as the rate to hope for if we have done it correctly. Because of the many risks involved, it is important to take baby steps when opening the door to greater implementation of the assisted migration techniques. Professor Alex Camacho proposes "provisionally limiting experimental translocations to situations where translocation is technically and economically feasible, and where the species is endangered, ecologically valuable, and compatible with the proposed site."[52] This cautious approach both maximizes the benefits and minimizes the costs, allowing the choice to more easily pass muster under a cost-benefit analysis. Some of these factors may become more likely over time.

III. PARADIGM SHIFT: MOVING FROM STATUS QUO PRESERVATION TO MANAGING CHANGE

One day, there will be a chapter in your grandchildren's high school history textbooks about the dawn of the Anthropocene,[53] a label for our era that is rapidly gaining ground in the academic community, especially among geologists. The concept that a geologic era can be defined by the impact of humans on the earth creates a giant crack in the foundation of human/nature dualism. Perhaps this false dichotomy will reach its demise in Natural History museums

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49. *See, e.g.*, Mark Williamson & Alastair Fitter, *The Varying Success of Invaders*, 77 ECOLOGY 1661, 1662 (1996) (noting that only one in ten introduced species becomes established, with a range of success rates from about five to twenty percent).

50. *See* Jonathan M. Jeschke & David L. Strayer, *Invasion Success of Vertebrates in Europe and North America*, 102 PROC. NAT'L ACAD. SCI. 7198, 7198 (2005) ("We find a success rate of ~50% at each step.").

51. *See* Jonathan M. Jeschke & David L. Strayer, *Determinants of Vertebrate Invasion Success in Europe and North America*, 12 GLOBAL CHANGE BIOLOGY 1608, 1614 (2006).

52. Alejandro E. Camacho, *Assisted Migration: Redefining Nature and Natural Resource Law Under Climate Change*, 27 YALE J. ON REG. 171, 171-72 (2010).

53. *See* Will Steffen et al., *The Anthropocene: From Global Change to Planetary Stewardship*, 40 AMBIO 7 (2011).

with exhibits on coal-fired power plants and the atmosphere, or displays on ecosystem services, assisted species migration, and geoengineering. Eventually we will come to accept that our place in the world is as *part of the world*, with roles to play just like everything else. We are a part of natural history.

As with most change, however, there is likely to be a sticking point that is tougher to get past than other aspects. For the shift deeper into the irreversibly-triggered Anthropocene, and away from the traditional human-nature duality, this sticking point is preservation. Our relationship with this concept is deeply entrenched in our morality and ethical approach to nature. The desire to preserve as much of the world as possible in its natural state, defining natural in terms of the absence of human influence, has long been the more noble position, the right that would one day conquer the wrong. How can we possibly characterize preservation as anything but good?

The question, however, is not really whether preservation is good or bad, right or wrong, but whether it is possible. If it is not possible, there is no use in debating its merits, and our attention must turn instead to what is the good or right *alternative* to preservation. The policy proposals in Parts IV and V of this Article are premised on the notion – a notion freshly gaining ground in the academic community but woefully lacking in PR – that the best alternative goal is *resilience*.[54] Resilience is simply the ability to survive change. This generally requires some measure of "adaptive capacity," which refers to "the regenerative ability of ecosystems and their capability in the face of change to continue to deliver resources and ecosystem services that are essential for human livelihoods and societal development."[55] *Preservation rejects change; resilience assumes it.*

Now that we are experiencing a paradigm shift in scientific understanding of nature, from static to fluid, we will need to quickly follow that with similar paradigm shifts in popular views of nature as well as in law. As Professor Robin Craig notes, "environmental and natural resources law are currently based on assumptions of ecological stationarity and pursue goals of preservation and restoration. Neither those assumptions nor those goals fit a world of

54. *See* Melinda Harm Benson, *Reconceptualizing Environmental Challenges—Is Resilience the New Narrative?*, 21 J. ENVTL. & SUSTAINABILITY L. 99 (2015).

55. W. Neil Adger et al., *Socio-Ecological Resilience to Coastal Disasters*, 309 SCIENCE 1036 (2005).

continual, unpredictable, and nonlinear transformations of complex ecosystems—but that is the world that climate change is creating."[56] Consider how wilderness is defined in the Wilderness Act, entirely in terms of its relationship to humans:

> an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain[;] . . . an area of underdeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable . . .[57]

This is the direct result of centuries of setting ourselves apart from the rest of the planet[58] – centuries of thinking in terms of "us" and "everything else" – and this human-nature duality must dissolve somewhat if we are to succeed in a stewardship role for the planet. This paradigm shift is not optional; the only choice is whether to make it in time to do more with it.

A. FOUNDATIONS OF THE OLD PARADIGM

In his classic Sand County Almanac, Aldo Leopold famously set forth his philosophy in which human beings are members of the earthly community, with the duty to respect the rest of that community as equal constituents.[59] In other words, the natural world is all there is, such that we and all that we create are a part of it. I have found that this position often surprises students, or seems somewhat radical. This is likely because of the centuries we have spent distancing ourselves from the natural world, a process which

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56. Robin Kundis Craig, *"Stationarity Is Dead" -Long Live Transformation: Five Principles for Climate Change Adaptation Law*, 34 Harv. Envtl. L. Rev. 9, 9 (2010).

57. Wilderness Act of 1964, 16 U.S.C. §§ 1131-1136 (2006).

58. *See* BILL MCKIBBEN, THE END OF NATURE 47 (2006) (people seek to maintain "pristine places, places substantially unaltered by man").

59. *See generally* ALDO LEOPOLD, A SAND COUNTY ALMANAC (1966).

has ultimately led us to view our own inventions as something separate from nature. We are like separate deities, designing our own distinct world as we choose, a world we define separately from that which was either designed by our chosen deity or naturally evolved from matter, from a more atheistic viewpoint. Either way, it is two separate worlds in many modern minds. This is human-nature dualism.[60]

Under typical human-nature dualist thinking, wild nature tends to be deemed normatively good and any human interference is inherently bad.[61] "The human/nature dichotomy is one of a number of heuristic distinctions grasped by culture, and often embedded in the law, to sort the good from the bad, the higher (superior) from the lower (inferior)."[62] In the U.S., human-nature dualism has been somewhat of a self-fulfilling prophesy. It was the thinking that led to segmentation of the land into spaces that were clearly either "natural" or human-dominated.[63] Once separated from one another in this manner, this results in policies that aim to keep human hands off the nature zones and make no effort to restrict human activity in human zones[64] – very dualist policy. Of course, where does this thinking leave us when we reach a time such as the Anthropocene? This is a time in which keeping hands off might mean the end for many species. Instead of basing policy choices on what is or is not "natural," the focus needs to move to the likely consequences of our actions or inaction – outcomes will become more important than the extent of human involvement required to achieve those outcomes.[65]

Change in the ecological context is not new, but merely becoming more rapid. Yet the ESA is designed to preserve an exceedingly static

60. *See* RODERICK NASH, THE RIGHTS OF NATURE 17-18, 70, 88-90 (1989).

61. *See, e.g.*, Eric Katz, *The Ethical Significance of Human Intervention in Nature*, 9 RESTORATION & MGMT. NOTES 90, 92 (1991) ("[R]estored and redesigned natural areas will appear more or less natural, but they will never be natural—they will be anthropocentrically designed human artifacts.").

62. Jonathan Baert Wiener, *Beyond the Balance of Nature*, 7 DUKE ENVTL. L. & POL'Y F. 1, 17 (1996).

63. *See* Alejandro E. Camacho, *Transforming the Means and Ends of Natural Resources Management*, 89 N.C. L. REV. 1405, 1441 (2011).

64. *See id.* at 1442.

65. *See* Wiener, *supra* note 62, at 17.

status quo.[66] Why was the ESA drafted this way? Professor Holly Doremus gives us four possible reasons for this shortcoming:

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.[67]

This fourth point must not be underestimated, as it wasn't until 1992 that the "static equilibrium" concept was clearly debunked.[68] That said, because this issue is so key to the design of the ESA, and because our scientific understanding has dramatically changed in this area, it shows just how important it is that we change our approach.

B. BENEFITS OF THE NEW PARADIGM

The law is shaped by our understanding of the world, and reflects our expectations for cause and effect. Only by changing the way we think about nature can we change the way we regulate it. Most of our environmental and natural resources laws were drafted around four-and-a-half decades ago, and thus reflect the attitudes and scientific understandings of the early 1970's. This may not seem so long ago, and perhaps throughout most of history four-and-a-half decades would not be so long, but environmental change has accelerated in recent years, and is arguably at a tipping point at this very moment. Yet even now, in the midst of the greatest natural chaos in human history, many cling to the old static paradigm. Doing so could be the ultimate end game. Thus, the benefit to changing the way we think of

66. See Holly Doremus, *The Endangered Species Act: Static Law Meets Dynamic World*, 32 Wash. U. J.L. & Pol'y 175 (2010).

67. *Id.* at 175.

68. *See* Eugene P. Odum, *Great Ideas in Ecology for the 1990s*, 42 BIOSCIENCE 542, 542 (1992) (best known advocate of the equilibrium view admits he was wrong, and that ecosystems are in fact "far from equilibrium").

nature – shifting the paradigm from stillness to motion – is no less than our very survival on this planet.

We cannot catch a moving target by standing still. Nor can we preserve only what is staying the same and ignore that which is moving on. We must find a way to support those constituents of nature that are forced to change as well. "Climate change is creating a world of triage, best guesses, and shifting sands, and the sooner we start adapting legal regimes to these new regulatory and management realities, the sooner we can marshal energy and resources into actions that will help humans, species, and ecosystems cope with the changes that are coming."[69] The sooner we accept that change is happening, whether we like it or not, the better chance we have of finding early and effective treatments for the symptoms of that change. We can improve the outcome of all this change by participating in it and not by living in denial – by focusing our policy choices on where nature is headed rather than on where it is now (and will very soon have left behind). The very concept of preservation assumes that there is something to preserve, but in a state of constant flux, there is no way to identify that something – it is a ghost, an illusion of that which does not exist at all.[70]

In 2007, the IPCC concluded that "[u]nmitigated climate change would, in the long term, be likely to exceed the capacity of natural, managed and human systems to adapt."[71] Clearly mitigation efforts are not optional.[72] The IPCC went on to note that "[a]daptation is necessary in the short and longer term to address impacts resulting from the warming that would occur even for the lowest stabilisation scenarios assessed."[73] In other words, even our best adaptation efforts would be no match for unmitigated climate change and even the best mitigation effort will be too late to avoid the need for adaptation.

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69. Craig, *Stationarity Is Dead, supra* note 56, at 16.

70. *See id.* at 30-31; J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. Rev. 1, 18-23 (2008).

71. IPCC, *supra* note 35, at 19.

72. See Matthew D. Zinn, *Adapting to Climate Change: Environmental Law in a Warmer World*, 34 Ecology L.Q. 61, 64 (2007) (warning against policies that promote adaptation to the exclusion of mitigation).

73. IPCC, *supra* note 35, at 19.

Neither one is optional. Managing nature, of course, falls largely in the adaptation category,[74] so adaptation is the concern of this Article.

C. TRANSITIONAL HURDLES

Vipariṇāma-dukkha—Suffering as produced by change. Anxiety regarding the transience of all things, excessive attachment, and the stress of uncertainty as things change.

If you have ever studied Buddhism, you have likely heard the saying "attachment is sorrow." This refers to a fundamental roadblock to happiness. We set our sights on a state of things that we view as good, and when that is not how it goes we are disappointed (or, depending upon personality, angry). We fixate on a single agenda, fearing the alternatives.

One way to get out of the old preservationist paradigm and ready ourselves to deal with the rapidly changing future is to remove the anthropogenic focus when thinking about climate change. In the mitigation world blame can be quite valuable, as we need to place the blame in order to correct the behavior at fault for the climate change problem. In the adaptation world, however, blame has no value, or indeed it is harmful, in that it is holding us back. By thinking of the changes as human-caused, we tend to think of them as under human control. The reality, however, is that the impact on ecosystems is no longer under human control. If we view the changing world as a natural phenomenon (as it indeed is, once you shed the duality of humans and nature), we can better accept it and attempt to work with it. Accepting it does not require our approval of it, and is not a determination of the value of ecosystems as they once were versus what they are becoming. It is just realism. Climate change is a natural disaster.

Of course, the most obvious road block to working with change is the existence of extreme political challenges resulting from the fact that the early 21st century is an unusually polarized time. While this circumstance wreaks all kinds of environmental havoc, there are three especially significant aspects of this political drag for the context of climate adaptation for wildlife and ecosystems. The first is the lack of willingness to invest in biodiversity at the expense of

74. Except, of course, to the extent that ecosystems impact climate, such as via carbon sequestration or solar reflection.

other goals. The bottom line is that whatever we do costs money, and is thus a choice not to receive a different economic benefit. This sort of prioritizing tends to be quite corrupted in the U.S., where decades of poor management of the political process[75] have resulted in substantial corporate capture. The second major hurdle is the lack of understanding of the economic value of healthy ecosystems. Human populations depend quite heavily on ecosystem services in ways that would be extremely expensive to artificially duplicate, but this economic interest rarely gets its due in actual cost-benefit analyses. Finally, and while this last problem is slowly improving it is far too slow, the failure to appreciate climate change itself is a political hurdle to sound adaptation planning.

IV. SIX EASY PIECES:[76] A MANUAL FOR CHANGE-MANAGEMENT USING THE EXISTING ESA

Climate change forces us to reconsider our regulatory goals, as they developed around maintaining a state of nature that no longer exists. "Climate change adaptation law must be able to accommodate the transforming ecological realities of particular places and not attempt to freeze ecosystems and their components into some prior state of being."[77] Effectively, all law involving regulation of nature will become "climate change adaptation law." For this reason, at a time in which legislative reform can be tough to come by (and, for that matter, risky), at the very minimum the wildlife agencies will need to get creative in their implementation of the ESA, as it was written so many years ago. This Part provides a few suggestions for how they might do so.

Before getting started with the good ideas, however, let us first do away with the bad. It is important to clarify that the ESA is not an appropriate tool for climate *mitigation*. In other words, it is not a realistic avenue for going after GHG polluters, in spite of the indirect

75. Including a major contribution to the mess by the Supreme Court in its disastrous landmark decision in *Citizens United v. Fed. Election Comm'n*, 558 U.S. 310 (2010).

76. *See* Richard Feynman, SIX EASY PIECES (1994).

77. Craig, *Stationarity is Dead*, *supra* note 56 at 31.

harm they may be causing to listed species and their habitat.[78] This issue has been very well addressed by others,[79] leaving few who still disagree,[80] so it will occupy only a few paragraphs here.

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78. That said, indirect harm via habitat modification is indeed a prohibited "take" under the ESA, at least when it injures a member of a listed species (and injury includes interference with breeding, feeding, or sheltering behaviors). *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. 687, 688 (1995).

79. J.B. Ruhl has most comprehensively crushed this idea. *See, e.g.*, J.B. Ruhl, *Climbing Mount Mitigation: A Proposal for Legislative Suspension of Climate Change "Mitigation Litigation"*, 1 WASHINGTON & LEE JOURNAL OF ENERGY, CLIMATE, & THE ENVIRONMENT 71 (2010); Ruhl, *Climate Change and the Endangered Species Act, supra* note 16.

80. Even in the face of seemingly insurmountable doctrinal and practical obstacles, there remain some holdouts who believe that the ESA can and should be used to go after GHG emissions, especially in light of the conspicuous absence of any targeted federal legislation on the matter.

> The notion that there is no causal connection between greenhouse gas emissions and the decline of the polar bear (or other species) is demonstrably incorrect. The connection between greenhouse gas emissions and sea ice reductions—and the effect that sea ice decline has on polar bears—is supported by voluminous scientific literature and, indeed, is the central reason for the decision to place the polar bear on the list of threatened and endangered species. Just as there is no requirement to link the thinning of any particular bald eagle egg to any particular molecule of DDT to demonstrate that authorization of the use of DDT may result in a taking of bald eagles, there is no requirement to link any particular molecule of carbon dioxide or other greenhouse pollutant to the death of an individual bear. As the Supreme Court stated in Tennessee Valley Authority, section 7 "admits of no exception," and affords endangered species "the highest of priorities." The administration's attempt to create an exception for the most important threat to biodiversity the Earth has ever seen is almost certainly doomed to failure.

Anna T. Moritz et al., *Biodiversity Baking and Boiling: Endangered Species Act Turning Down the Heat*, 44 TULSA L. REV. 205, 226 (2008); *see also* Zdravka Tzankova, et al., *Can the ESA Address the Threats of Atmospheric Nitrogen Deposition? Insights from The Case of the Bay Checkerspot Butterfly*, 35 HARV. ENVTL. L. REV. 433 (2011) (drawing from and expanding on the literature favoring use of the ESA to target GHG emissions); Ari N. Sommer, *Taking the Pit Bull off the Leash: Siccing the Endangered Species Act on Climate Change*, 36 B.C. ENVTL. AFF. L. REV. 273 (2009); Sarah Jane Morath, *The Endangered Species Act: A New Avenue for Climate Change Litigation*, 29 PUB. LAND & RESOURCES L. REV. 24 (2008).

The effort to mitigate our contribution to the rapidly developing climate change phenomenon is unquestionably one of the essential responses to the problem. GHGs are not going to decline unless there is significant regulatory pressure to reduce emissions. Human impact, including anthropogenic climate change, is the greatest threat to biodiversity since the mass extinction 65 million years ago.[81] It is thus certainly worth considering the wisdom and practicality of using our legal tools designed for the protection of biodiversity (given that many species are especially climate-sensitive and all are climate-dependent at some point) as leverage to force reductions in greenhouse gasses.

Some proponents of maximizing climate mitigation strategies argue that the ESA should be used for this purpose.[82] The ESA has very strict provisions forbidding anyone from "taking" endangered species,[83] as well as federal agency action that jeopardizes listed species or destroys their designated critical habitat.[84] Because climate change is both taking and jeopardizing listed species, as well as destroying their critical habitat, it appears that the ESA could arguably apply to prevent activities that emit GHGs. It is certainly tempting.

There are three major problems with using the ESA in this manner. First, it does not in fact apply as simply as it appears to at first blush. It may well be impossible to make the necessary causal connections as a legal matter. Second, it is impracticable to the point of destroying the ESA itself if full implementation in this area were to be expected. Third, it is not what the ESA is really about, as an Act designed to focus on individual species on a case-by-case basis and protect them from direct harm.

Perhaps the greatest obstacle to this strategy is the fact that it doesn't actually work, as a logical or legal matter. Because the harm is not direct (i.e. not shooting a polar bear with a gun, nor even building something on its habitat), there are connectivity issues between the action to be proscribed and the harm to be caused. There are at least two steps, that of demonstrating that climate change causes the harm (the easy step) and that of showing that the action

81. Gerardo Ceballos, et al., *Accelerated modern human–induced species losses: Entering the sixth mass extinction*, 1 SCIENCE ADVANCES 5 (19 Jun 2015).

82. *See* Sommer, *supra* note 80; Moritz, *supra* note 80.

83. 16 U.S.C. § 1538(a)(1).

84. 16 U.S.C. § 1536(a)(2).

causes climate change (the tricky part).[85] The latter is faced with at least four debilitating challenges: 1) the fact that there are numerous and varied contributors to the GHG problem, rendering it difficult to determine how substantial is the impact of a single contribution; 2) the fact that the harm is occurring outside the "action area," which is the area normally considered in ESA consultations; 3) the tradition of comparing an action with the "environmental baseline," which is one of climate change already occurring due to past actions; and 4) the inability to trace GHGs to their sources. Indeed, the failure of causation has led the U.S. Fish & Wildlife Service to take the position that it will not regulate GHG's. In a May 14, 2008 letter from the Director to the Regional Directors, this decision was explained as follows: "The best scientific data available today do not allow us to draw a causal connection between GHG emissions from a given facility and effects posed to listed species or their habitats, nor are there sufficient data to establish that such impacts are reasonably certain to occur." The bottom line is that, while there may be some room for argument here, it is not at all simple, and not a likely avenue to ever succeed.

Aside from the doctrinal issues with the ESA's applicability to GHG emissions, the practical implications are devastating. Even if we can see some potential for getting past the causation issue, the idea of actually going forward with such an approach is quite daunting, and arguably completely impossible.

> Given [the] attributes of greenhouse gas emission effects on climate, it is difficult to conceive of how the agency would go about aggressively regulating greenhouse gas emissions through the jeopardy consultation program. The FWS does not have the pollution control expertise of the EPA, nor does any provision of the ESA explicitly provide authority to engage in emissions regulation. Given that all emission sources contribute to warming effects, the threat of jeopardy findings would have to be applied universally to all sources. This, in turn, might induce emission sources to engage in emission offsets (e.g., by purchasing forestation credits) or technological and operational emission reductions. But is the FWS equipped to assume the role of nation-wide regulator of farms, industrial facilities, auto emissions, and everything else? In short, the idea that all emission

85. *See* Matthew Gerhart, *Climate Change and the Endangered Species Act: The Difficulty of Proving Causation*, 36 ECOLOGY L. Q. 167 (2009).

sources present jeopardy conditions to each and every climate-threatened species would prove too much, and likely render the ESA and the FWS political targets in the first degree.[86]

The impracticability of tasking the wildlife agencies with going after air polluters rises to the level of patently absurd.[87] They cannot even implement the traditional ESA mandates due to lack of funding.[88]

Besides the difficulty of asking the wildlife agencies to regulate GHG emissions across the board, there is the problem of getting too far away from congressional intent in drafting the ESA. The statute is designed around individualized protections for vulnerable species on a case by case basis, not for regulating a massive world-wide pollution-related problem. Indeed, the ESA can actually play a role in *stalling* climate mitigation efforts, given the extent of conflict between renewable energy methods (such as solar, wind, and hydro) and wildlife.[89] This is not to say that the ESA is of no use in helping struggling species weather climate disruption, just that mitigation is probably not the right approach for the statute.

In sum, climate change mitigation is not in line with the purpose of the ESA, which was to focus on individual species on a case-by-case basis and protect them from harm.[90] This purpose, of helping struggling species through human-induced tough times, is exactly why it is so clearly appropriate for climate adaptation. The problem, however, is that the ESA has historically applied in a reactive manner, and in the face of climate change we will increasingly need to address biodiversity concerns in a proactive manner. Thankfully,

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86. J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. REV. 1, 47 (2008).

87. *See* Ruhl, *Climbing Mount Mitigation, supra* note 79.

88. After being sued by many biodiversity NGOs for its failure to address hundreds of listing petitions in a timely manner, the FWS entered into a multi-party multi-species settlement in 2011, creating a half-decade timeline (which later increased) for determining the listing status for around 250 candidate species. *See Listing Workplan Overview*, U.S. FISH & WILDLIFE SERVICE, http://www.fws.gov/endangered/improving_ESA/listing_workplan.html. As for enforcement against those who harm already listed species, this takes place at a tiny fraction of the estimated violations.

89. *See generally* Kalyani Robbins, *Responsible, Renewable, and Redesigned: How the Renewable Energy Movement can make Peace with the Endangered Species Act*, 15 MINN. J.L. SCI. & TECH. 555 (2014).

90. *See* Ruhl, *Climate Change and the Endangered Species Act, supra* note 16.

whether intended or not, the ESA does have some existing provisions that may be applied to support modern "hands on" conservation techniques. This means going beyond the present court-mandated strategy of simply taking climate change into account in the jeopardy consultation process.[91] It means working creatively with provisions that were not designed for climate adaptation.

A. DESIGNATING UNOCCUPIED CRITICAL HABITAT

The ESA requires that critical habitat be designated concurrently with listing a species as threatened or endangered.[92] Once the species is listed and the critical habitat designated, the ESA requires that all federal agencies "insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [designated critical] habitat of such species."[93] In order to avoid jeopardy or adverse modification, the action agency is required to consult with the appropriate ESA-implementing agency any time an action might affect a listed species.[94] The consulting agency then issues its opinion as to whether the action will jeopardize the species or adversely modify its designated critical habitat.[95] This opinion is not binding, but it is guidance that will be given weight in court should the action agency's later decisions be challenged. Adverse modification of critical habitat renders it less valuable to the recovery of the species.[96]

The designation of critical habitat may include *unoccupied* habitat when doing so is "essential for the conservation of the species."[97] This would be an excellent method for setting aside target land areas

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91. *See, e.g.*, *Pacific Coast Federation of Fishermen's Associations v. Gutierrez*, 606 F. Supp. 2d 1122 (E. D. Cal. 2008); *NRDC v. Kempthorne*, 506 F. Supp. 2d 322 (E.D. Cal. 2007).

92. 16 U.S.C. § 1533(a)(3).

93. *Id.* § 1536(2).

94. *Id.* § 1536(a)(1).

95. *Id.* § 1536(b)(3)(A).

96. *See* Kalyani Robbins, *Recovery of an Endangered Provision: Untangling and Reviving Critical Habitat under the Endangered Species Act*, 58 BUFFALO L. REV. 1095 (2010); *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 378 F.3d 1059, 1069-70 (9th Cir. 2004).

97. 16 U.S.C. § 1532(5)(A)(ii).

for future migrations, whether assisted or not. One helpful aspect of the critical habitat adverse modification analysis, unlike the jeopardy analysis, is that actual harm to the species need not come from the action at issue. The action can adversely modify the critical habitat and thereby reduce its *future* value to the species in spite of the fact that it is not presently in use as habitat.

Because the wildlife agencies are to take into account the economic impact of designation, and conduct a cost-benefit analysis for any area of land to be included, there would have to be a strong likelihood that the species will eventually need to occupy the prospective habitat. This is actually a good deal more ecologically valuable a requirement than it sounds like. It has the effect of forcing the agencies to start considering the likely future migration patterns of a species at the time it is listed. This kind of forward thinking will not only result in the setting aside of some post-climate-change habitat, but may also contribute to other planning processes, such as developing adaptive management plans, forecasting future assisted migrations, or locating the necessary connectivity spots.

B. FOCUSING RECOVERY PLANNING ON ACTIVE AND ADAPTIVE MANAGEMENT

Recovery planning can be designed for adaptive management and targeted to the need for climate adaptation, employing more active management methods. Climate considerations can be built into the existing Recovery Planning Framework, such that climate adaptation becomes part of that process. In order to target the most useful adaptation strategies it will be necessary to identify actions that address climate-related impacts on species numbers, habitat, or essential interactions. This should include actions that intervene in non-climate human activities that compound impacts from climate exposure, as well as actions that increase resilience or species' ability to respond to impacts from climate exposure. Perhaps most notably, recovery plan managers would need to prioritize actions that protect/restore recovery units that may be *less affected* by changes in climate.

Recovery plans are not enforceable, and thus have little teeth.[98] This may actually be more of a benefit in a climate change scenario than a curse. The potential downside is the obvious: the plans are made but not carried out, or at least not fully carried out. However, the theme of this Part is what the agencies can do about climate change adaptation, assuming the motivation to do anything about it, if they are forced to work with the existing ESA. As such, in this hypothetical context[99] we can hope that if recovery planning is one such strategy, every effort will be made to follow through. The upside, however, is that the lack of mandatory detail-following sets the stage better for an adaptive management approach. Recovery plans should be designed as adaptive management plans,[100] across the board or nearly so, as has already taken place in some cases.[101] In calculating the possible future changes, it will be essential to take climate change modeling into account.

C. USING EXPERIMENTAL POPULATIONS FOR ASSISTED MIGRATION

At first blush, assisted migration, which may become essential to the survival of especially climate-sensitive species, would be a clear *violation* of the ESA. It would be a "take," the definition of which includes terms such as "pursue," "trap," and "collect."[102] The 10(j) provisions for experimental populations create potential for assisted migrations without the usual risk of take violations, by allowing the wildlife agencies to transport populations of listed species out of their current range if doing so "will further the conservation of such species."[103] Regulations interpreting this provision allow for the use of habitat outside a species' historic range when "the primary habitat of the species has been unsuitably and irreversibly altered or

98. *See* Federico Cheever, *The Road to Recovery: A New Way of Thinking about the Endangered Species Act*, 23 ECOLOGY L.Q. 1, 23-27 (1996).

99. Indeed, this entire Part has no value without an administration that is concerned with biodiversity climate adaptation, as it is all about how to go beyond what the ESA requires, while using the ESA as a tool to do so.

100. Described Part II(A), *supra*.

101. *See, e.g.*, U.S. Fish & Wildlife Service, *Recovery Plan for the Northern Spotted Owl*, May 13, 2008, available at http://www.fws.gov/ecos/ajax/docs/recovery_plan/NSO%20Final%20Rec%20Plan%20051408.pdf.

102. 16 U.S.C. § 1532(19).

103. *Id.* § 1539(j)(2)(A).

destroyed."[104] Not only is this already often the case just due to traditional human development issues, but of course it will be determined more frequently over time in the climate change context. By using this provision, the FWS can move populations of listed species from former habitat rendered unsuitable by climate change to new habitat that may now be suitable because of climate change, in spite of not historically serving that species.

D. MAKING USE OF SECTION 7(A)(1) AFFIRMATIVE MANDATE AUTHORITY

Section 7(a)(1) is potentially the dark horse of the ESA. It has yet to amount to much, but that could change with the right administration (trying to function without the right Congress opening up the ESA). It is an oddly unenforceable affirmative mandate applying to all federal agencies:

> The Secretary shall review other programs administered by him and utilize such programs in furtherance of the purposes of this Act. All other Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to section 4 of this Act.[105]

There is neither deadline nor detail – little to enforce. Nor has it been taken very seriously in practice. There are few regulations and very few court cases[106] relating to the section or providing any pressure to act on it. Nonetheless, there is sits, available for use if needed.

Because section 7(a)(1) is an affirmative mandate to *conserve*, which means to use "all methods and procedures which are necessary to bring any [listed] species to the point at which the measures provided in this [act] are no longer necessary,"[107] it could provide the *authority* needed to engage in relatively invasive management techniques such as restoration and assisted migration. This is

104. 50 C.F.R. §§ 17.81(a).

105. 16 U.S.C. § 1536(a)(1).

106. The two that actually analyze the enforceability of the section are *Sierra Club v. Glickman*, 156 F.3d 606 (5th Cir. 1998), and *Pyramid Lake Paiute Tribe of Indians v. United States Dep't of the Navy*, 898 F.2d 1410 (9th Cir. 1990).

107. 16 U.S.C. §1532(3).

especially valuable to agencies not already purposed with the task of assisting struggling species, including the land-management agencies.

Administrative agencies do not operate on any source of independent power, but rather serve to implement statutes that have been passed through the legislative process. They may not engage in actions, no matter how beneficial, that do not further their statutorily mandated objectives. The value in this section of the ESA is that *it adds endangered species conservation to the purposes of every single federal agency*. This holds enormous potential for enabling agencies to engage in relatively aggressive techniques that may be upsetting to some,[108] or expensive to others, triggering court challenges. Actions entirely focused on species conservation would survive a challenge on the basis of being outside the agency's statutory authority. It is within every agency's authority to engage in such action, so long as it does not actually violate the statute.

E. REQUIRING HABITAT CONSERVATION PLANS TO ACCOUNT FOR CLIMATE ADAPTATION

Private parties wishing to gain permission for any amount of take (which is common in land development) must submit a habitat conservation plan (HCP) for that species, containing mitigation planning that is directly tied to the species take that will occur.[109] The wildlife agencies then have the option to approve the plan along with the expected take.[110] As is already required in the context of jeopardy analyses,[111] and recommended here in the context of recovery plans,[112] so too should habitat conservation plans take the need for climate adaptation into account. However, unlike the recovery planning context, it may be less appropriate in the HCP context to use a truly flexible adaptive management approach, with the exception of regional HCPs.

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108. *See* Part III, *supra*.

109. 16 U.S.C. § 1539(a).

110. *Id.* § 1539(d).

111. *See Pacific Coast Federation of Fishermen's Associations v. Gutierrez*, 606 F. Supp.2d 1122 (E.D. Cal. 2008); *NRDC v. Kempthorne*, 506 F.Supp. 2d 322 (E.D. Cal. 2007).

112. *See* Part IV(B), *supra*.

HCP mitigation plans are intended to last for a very long time – evidence of long-term funding is even one of the required elements.[113] If they are planned without taking climate change into account they could be of little use to the species rather quickly. As noted above, the ecosystem impacts of climate change are not always predictable, such that adaptive management is becoming increasingly important.[114] That said, private party HCPs are to be implemented and managed by the private party, who may have little interest in doing anything more to help the species than was promised in the original HCP. For adaptive management to work, the ongoing decisionmaker(s) must have the goal of, well, it working. When management needs change, approaches are adapted for the benefit of the species. Even when implemented by government entities this can be tainted by lobbying for other interests, but when implemented by a private party within an HCP this risk would be at its peak. For this reason, the usual flexibility one would expect to see in a proper adaptive management plan (albeit always with preset goals and expected responses to change) must be largely eliminated, resulting in a hybrid of static and adaptive management. Plan for change, especially change likely to result from climate disruption, but lock in management responses, in spite of this not otherwise being the ideal approach.

A better opportunity for adaptive management is the regional habitat conservation plan (RHCP), in which multiple covered parties in a given region must contribute to a mitigation plan in exchange for a limited ability to "take" listed species on their land.[115] The agencies are able to tie specific requirements to this take permission, as well as group together parties in a region for a regional HCP, rendering it a source of substantial agency control over project development.[116]

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113. 16 U.S.C. § 1539(a)(2)(B)(iii).

114. *See* Part II(B), *supra*.

115. *See, e.g.*, *Midwest Wind Habitat Conservation Plan*, U.S. FISH & WILDLIFE SERV., http://www.fws.gov/midwest/endangered/permits/hcp/r3wind/index.html (last visited Oct. 20, 2013) ("To meet the growing demand for rapid approval of wind energy plants, yet ensure conservation of federally-listed species, the Service and a coalition of eight states, The Conservation Fund, and representatives of the wind energy industry are preparing a Multi-Species Habitat Conservation Plan.").

116. *See* J.B. Ruhl, *Who Needs Congress? An Agenda for Administrative Reform of the Endangered Species Act*, 6 N.Y.U. ENVTL. L.J. 367, 382 (1998) ("One of the most sweeping movements in ESA administrative policy is FWS's promotion of habitat conservation planning processes under section 10(a)(1) of the ESA,

This ideally results in conservation of large and interconnected areas of highly desirable habitat, at a scale that cannot be achieved via the traditional individual HCP.[117] It can also reduce administrative costs and improve implementation, in both cases as a result of taking the process out of the hands of the individual landowner.[118] This is why it is an especially valuable tool in the climate change planning and adaptive management context. Not only do we develop more valuable management plans when we are planning for a larger area, but we can utilize more fully the adaptive management approach when management is implemented by state, local, and federal agencies rather than by private individuals.

F. INCREASING THE USE OF ADAPTIVE MANAGEMENT IN INCIDENTAL TAKE STATEMENTS

The context of ESA incidental take statements is similar to that of incidental take permits, but different in some key respects for the use of adaptive management. As noted, incidental take permits are provided to private parties with development plans that may take members of a listed species, in exchange for an HCP. Incidental take statements, on the other hand, are the take permission slips granted to federal agencies in response to the consultation process required to avoid actions which jeopardize a listed species or adversely modify its listed critical habitat. Because the incidental take statement (ITS) goes to an entity within the federal government, it is easier to control the ongoing management decisions.

In addition to removing some of the risks of major conflicts of interest in the HCP context,[119] the federal government has the option of creating an expert team to implement ITS adaptive management plans going forward. "In order to successfully conserve nature over meaningful lengths of time, we must develop management

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particularly at regional scales."); 16 U.S.C. § 1540(a)(1) (2006) (illustrating civil penalties for otherwise prohibited acts).

117. *See* George Frampton, *Ecosystem Management in the Clinton Administration*, 7 DUKE ENVTL. L. & POL'Y F. 39, 40 (1996); Robert D. Thornton, *Habitat Conservation Plans: Frayed Safety Nets or Creative Partnerships?*, 16 NAT. RESOURCES & ENV'T 94 (2001).

118. *See* Kalyani Robbins, *Responsible, Renewable, and Redesigned: How the Renewable Energy Movement can make Peace with the Endangered Species Act*, 15 MINN. J.L. SCI. & TECH. 555 (2014).

119. *See* Part IV(E), *supra*.

institutions suited to the efficient and effective production, identification and integration of new scientific knowledge into our natural resource management decisions."[120] Now that the wildlife agencies are required to consider climate change impacts in the biological opinions for the jeopardy determination itself, it is reasonable to expect such considerations to be included in the ITS that issues from that biological opinion. To the extent that such climate-change-oriented adaptive management plans proliferate within the federal government, it will become increasingly important to have a dedicated group of federal land managers and ecologists to supervise such programs.

V. SIX NOT-SO-EASY PIECES:[121] WHAT WE REALLY NEED TO DO TO THE ESA

Although Part IV has endeavored to provide agencies with suggestions for working with the existing ESA in a climate-altered world, it can admittedly be described as desperate measures for desperate times.[122] In truth, the only way for us to seriously get our act together with biodiversity climate adaptation is to recraft the ESA with climate change in mind. Rather than forcing the agencies to squeeze out whatever discretion they can find, in an ideal political world we would actually provide them with the targeted tools, structure, and guidance they need. This Part has some suggestions for doing so.

A. DESIGNING LISTING PROCESS AROUND CLIMATE-CAUSED STRESSORS

The ESA provides a set of factors to consider in determining whether to list a species as endangered or threatened:

(A) the present or threatened destruction, modification, or curtailment of its habitat or range;

(B) overutilization for commercial, recreational, scientific, or educational purposes;

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120. Doremus, *Adaptive Management and the ESA, supra* note 43.

121. *See* Richard Feynman, SIX NOT-SO-EASY PIECES (1998).

122. And by "desperate times," I refer not to the pressures of climate change, but to the gridlock in Congress.

(C) disease or predation;

(D) the inadequacy of existing regulatory mechanisms;

(E) other natural or manmade factors affecting its continued existence.[123]

The catch-all factor at the end already provides the agencies with the discretion to consider any impact, including climate impacts. What this section does not provide, however, is a consistent structure for working climate change issues into the implementation of the Act. The listing process can be designed to lay a foundation for all other actions to follow, providing both climate-stress data and bases for prioritization. Indeed, the listing factors the FWS provides for a given species (the specific threats that support listing) can serve as a warning that such behaviors may be the most likely to result in a violation of the Act, by highlighting the species' greatest concerns.[124]

Rather than simply listing factors to consider, the ESA should provide a climate-adaptation-inspired structure for the listing process. It would look something like this:

1. Determine possible and likely effects of climate change on species and critical habitat;
2. Determine whether climate change will compound current threats that are responsible for species decline and endangerment;
3. Determine how human responses to climate change are likely to influence other threats;
4. Rate threats (including climate exposures) with respect to their impact on recovery;[125] and
5. Evaluate the likelihood of success for conserving the species in the face of climate change.

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123. 16 U.S.C. § 1533(a)(1).

124. Such as with species listed due to impacts from hydraulic fracturing, which sends a clear message regarding the risk of continuing such actions in the region. *See* Kalyani Robbins, *Awakening the Slumbering Giant: How Horizontal Drilling Technology Brought the Endangered Species Act to Bear on Hydraulic Fracturing*, 63 CASE W. RES. L. REV. 1143 (2013).

125. As suggested by Noah Matson, VP for Climate Change and Natural Resource Adaptation at Defenders of Wildlife, in his powerpoint presentation at the Natural Resources Law Teachers Institute, Rocky Mountain Mineral Law Foundation, May 29-31, 2013, Flagstaff, AZ.

These steps have two kinds of value: informational and normative. Not only will this process play a role in determining whether to list the species, but the rulemaking drafted in compliance with this requirement will set the stage for all other aspects of ESA implementation. The recovery planning discussion in Part IV.B above is an excellent example of climate-adaptive ESA implementation work that could benefit from listings which have been through such a rigorous climate-focused process. The listing should be the best possible road map for all aspects of ESA implementation going forward, which today means the listing must address climate adaption issues.

B. REQUIRING MULTI-JURISDICTIONAL COLLABORATION AMONG LAND MANAGERS FOR ACTIVE MANAGEMENT TECHNIQUES

The Healthy Forest Restoration Act of 2003[126] broke fresh ground in the area of mandating collaboration among land managers at different levels or in different agencies.

The HFRA directs the USFS to implement hazardous fuels treatments on federal land to mitigate catastrophic wildfire risk and to collaborate across administrative and landownership boundaries and interests to coordinate treatments on non-Federal land. The venue for collaboration is in the development of Community Wildfire Protection Plans which in turn "identifies and prioritizes areas for hazardous fuels reduction treatments and recommends the types and methods of treatment on Federal and non-Federal land."[127]

This step was followed just a year later with a far more sweeping (applying to many land management contexts) collaboration mandate via executive order, requiring that the Departments of the Interior, Agriculture, Commerce, and Defense and EPA "implement laws relating to the environment and natural resources in a manner that promotes cooperative conservation, with an emphasis on appropriate inclusion of local participation in Federal decisionmaking, in accordance with their respective agency missions, policies, and

126. 16 U.S.C. § 6501.

127. Antony S. Cheng, *Build It and They Will Come? Mandating Collaboration in Public Lands Planning and Management*, 46 NAT. RESOURCES J. 841, 850-51 (2006).

regulations."[128] Cooperative conservation was defined as "actions that relate to use, enhancement, and enjoyment of natural resources, protection of the environment, or both, and that involve collaborative activity among Federal, State, local, and tribal governments, private for-profit and nonprofit institutions, other nongovernmental entities and individuals."[129]

As species management becomes increasingly fluid and far less geographically stable, it raises the value of collaboration across jurisdictional lines. More than ever we need the input[130] and assistance[131] of multiple federal agencies, state agencies, local governments, and private parties. The ESA, as the primary legislation designed to prevent extinctions and protect ecosystems, would be a good place for this type of 21st century legislative innovation. The collaboration mandate should be designed to minimize concentrated power, which will both produce a corresponding reduction in the conflicts created by agency capture and enable far more open adaptive management strategies. Both of these benefits will serve to increase the value of the ESA to climate adaptation. An amendment creating such a collaborative environment, especially in the context of planning for greater use of adaptive management, would also need to give this collaborative a good deal of discretion to avoid constant litigation from those frustrated by the diminished place for agency capture. Adaptive management by definition requires substantial discretion.[132]

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128. Exec. Order No. 13,352, *Facilitation of Cooperative Conservation*, § 1, 69 Fed. Reg. 52989 (2004). *See also* Robert D. Comer, *Cooperative Conservation: The Federalism Underpinnings to Public Involvement in the Management of Public Lands*, 75 U. COLO. L. REV. 1133 (2004).

129. Cooperative Conservation Executive Order, supra note 128.

130. Information sharing is another valuable target of collaboration, given how often we have programs working simultaneously but entirely separately toward the same or similar goals. *See* Kalyani Robbins, *Governing the Ungovernable: Integrating the Multimodal Approach to Keeping Agricultural Land Use from Swallowing Ecosystems*, 46 MCGEORGE L. REV. 67 (2015).

131. Holly Doremus, et al., Center for Progressive Reform, *Making Good Use of Adaptive Management* 5 (2011) (adaptive management "requires more resources than conventional management, because doing it right requires taking the time to carefully analyze the system at the outset, monitor the results, and periodically reassess and revise").

132. *See* J.B. Ruhl, *A Manifesto for the Radical Middle*, 38 IDAHO L. REV. 385, 405-06 (2002) ("Adaptive management cannot work if citizens can challenge every recalibration decision with this full range of public participation tools. There must

C. SUPPORTING RENEWABLE ENERGY DEVELOPMENT

There is no "green pass" in the ESA.[133] Given the inherent risks and likely abuses of a broad exception for green actions, or even a balancing process for green versus green, this is a good thing. However, as set out in Part I of this Article, climate change poses the single greatest threat to biodiversity, and renewable energy development is an essential path to climate change mitigation. Although the ESA is best suited to climate adaptation and not generally fit for climate mitigation, at least in the direct sense of regulating emissions, as it is drafted it is actually standing in the way of progress in this area. Even environmentalists are beginning to turn on the ESA as a result of this tension.[134] The statute needs a carefully-designed work-around for high-value renewable energy projects that might not traditionally survive a jeopardy analysis, but that would fall short of causing the extinction of the species. Consideration would go to matters such as an absence of alternatives[135] and even the likelihood that the species would not survive anyway, so that we can stop missing the forest for the trees.

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be some insulation of the adaptive management process from the debilitating participation of every interest group demanding a "seat at the table" and right to challenge each and every move the agency makes."); Mary Jane Angelo, *Stumbling Toward Success: A Story of Adaptive Law and Ecological Resilience*, 87 NEB. L. REV. 950, 1002-03 (2009); Bradley C. Karkkainen, *Panarchy and Adaptive Change: Around the Loop and Back Again*, 7 MINN. J. L., SCI. AND TECH. 59, 74-75 (2005).

133. *See* J.B. Ruhl, *Harmonizing Commercial Wind Power and the Endangered Species Act Through Administrative Reform*, 65 VAND. L. REV. 1769, 1770 (2012) (noting that "wind power has no 'green pass' to get out of the ESA.").

134. *See* John Copeland Nagle, *Green Harms of Green Projects*, 27 NOTRE DAME J.L. ETHICS & PUB. POL'Y 59 (2013) (discussing litigation pitting renewable energy hopes against the ESA and other environmental statutes).

135. For example, in some areas of renewable energy development technology advances are improving our ability to utilize the resource with minimal harm to species. *See* Kalyani Robbins, *Responsible, Renewable, and Redesigned: How the Renewable Energy Movement can make Peace with the Endangered Species Act*, 15 MINN. J.L. SCI. & TECH. 555 (2014). That said, in some cases this may not go far enough to avoid ESA troubles, so an amendment would be useful in such contexts as well.

D. ALLOWING FOR SPECIES TRADE-OFFS

This is likely the most controversial proposal for conservationists, as it is a bitter pill to swallow. At what point do we have to reconsider our goal of protecting every last vulnerable species – a goal which is quite strictly mandated by the ESA in its present form. There will be times when letting go of one species, already not likely to make it, may be necessary to assist another species with a better chance at survival. Trying to save two species with conflicting needs may, in some contexts resulting from the ecosystem reshuffling spawned by climate change, become almost nonsensical. What we might do for one could be harmful to the other. In addition, there will be times when, regardless of the existence of such a conflict, a species is doomed with near certainty, and would require substantial resources to protect. Although it may seem contradictory to the original purposes of the ESA to build in some agency discretion for species exemptions, the world is no longer as it was in the early 1970's. Management planning that seeks to maximize ecosystem functioning and overall species survival must not be impeded by the fact that it may jeopardize an already doomed species. Agencies need discretion to allow for such exemptions, along with very clear standards to avoid unnecessary harm.

E. DELEGATING CONDEMNATION AUTHORITY FOR CONNECTIVITY EMERGENCIES

If the prior suggestion was the most controversial for conservationists, it is easily offset by this, the proposal most likely to offend the property rights crew. As noted above,[136] connectivity of habitat and ability to migrate are essential to surviving the perils of climate change. At times, when a species needs to move there will be no hope at all, such as where the entire geographic area to the north of its existing habitat is developed for miles. Or perhaps in such cases there is habitat further north that requires assisted migration to reach. Assisted migration, however, comes with many risks and setbacks, and self-directed migration is far preferable wherever possible. For this reason, where the distance is not as great, wildlife corridors will need to be established.

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136. *See* Part II.B, *supra*.

Experimentation shows that at least to some extent, corridors allow certain populations of species to persist when those populations might otherwise face extinction due to fragmentation. The theory is that corridors reduce extinction rates through several methods: They allow for genetic exchange among adjoining populations, thus avoiding or decreasing inbreeding depression; they provide a mechanism through which a species can colonize new habitat or recolonize habitats in which a population extinction event occurred; and they provide an avenue for emigrating and commingling, decreasing the occurrences of extinction by stochastic threats.[137]

Not only is this a need that is very clearly in tune with the goal of the ESA (extinction prevention), but it is a matter of great urgency or it will be too late.[138]

It is frequently private land that stands in the way of habitat connectivity and must be managed in a way that allows wildlife to migrate through. Ideally private-public agreements can be formed and land managed collaboratively to maintain accessible wildlife corridors. Of course, in some cases there will be landholder opposition, even where the ecological cost is substantial. In such cases, and with a high standard designed to protect property owners to the extent reasonable in such circumstances (where the public benefit is so great as to substantially outweigh the owner's interests), the ESA should have a provision for eminent domain actions.

F. CREATING A RUBRIC FOR ADAPTIVE MANAGEMENT PROGRAMS TO BE CRAFTED IN GREATER DETAIL AT THE REGULATORY LEVEL

As explained in the discussion on adaptive management above,[139] it is essential that such programs have detailed advance planning in order to minimize management discretion without sacrificing all flexibility in approaches. The cleanest and easiest way to follow such a plan is via preset "triggers" with corresponding required responses. A "trigger" is a potential ecosystem response to the initial management approach taken – a particular natural feedback – that

137. Thompson, *Biological Corridors, supra* note 44 at 708.

138. *See id.* at 710.

139. *See* Part II.A, *supra*.

managers may observe during their monitoring.[140] The time-consuming nature of designing such plans may serve as an impediment to their use, certainly if we should hope to use adaptive management throughout ESA implementation (as suggested for several areas of ESA action in this Article). For this reason, and to avoid varying quality of effort from different administrations, it could be valuable to set forth some basic requirements in the statute – not inflexible specifics but a kind of rubric for designing adaptive management plans. A set of categories of issues and concerns that must be addressed in such plans, with some basic instructions for creating them, would go a long way toward getting them actually done on the ground as well as maintaining consistent standards.

CONCLUSION

We can no longer hope to rescue imperiled species by leaving them alone. Climate change, resulting from human activity already in the past, has assured that every habitat and species will experience some degree of interference. This requires active steps to support their adaptation to the new landscape. Although the ESA has traditionally been used to keep human hands off, it can be brought into the future and utilized to support an increase in hands-on approaches to biodiversity management.

140. *See* Courtney Schultz & Martin Nie, *Decision-making Triggers, Adaptive Management, and Natural Resources Law and Planning*, 52 NAT. RESOURCES J. 443 (2012).