CAN THE ESA ADDRESS THE THREATS OF ATMOSPHERIC NITROGEN DEPOSITION? INSIGHTS FROM THE CASE OF THE BAY CHECKERSPOT BUTTERFLY

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The Bay Checkerspot Butterfly reached its threatened status largely as a result of habitat loss through development. The species now benefits from the habitat protection powers of the Endangered Species Act, yet the biggest new hazard to the survival of remaining Bay Checkerspot Butterfly populations may come from atmospheric nitrogen deposition. Driven by combustion and agricultural emissions, such deposition is an important cause of change in ecosystem structure and function, including potentially critical changes in the remaining Bay Checkerspot Butterfly habitat. We use the Bay Checkerspot Butterfly case to examine whether the Endangered Species Act, as it currently stands, is capable of protecting endangered species from the newly appreciated, remote-origin threat of nitrogen deposition. We employ legal analysis that builds on relevant case law to determine whether the limitations on harmful activities as set by sections 7 and 9 of the Endangered Species Act can be applied to the emissions that cause nitrogen deposition. As part of the analysis, we juxtapose our case with a similar case that has become quite salient in recent discussions of conservation law: the case for using the Endangered Species Act to help control greenhouse gas emissions.

Our findings leave us cautiously optimistic that the take and jeopardy prohibitions of the Endangered Species Act could be fruitfully leveraged against existing federal and state air quality and emission control programs to help improve the protection of nitrogen-sensitive species and ecosystems.

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I. INTRODUCTION

In many ways, the Bay Checkerspot Butterfly ("checkerspot") is a perfect illustration of both the accomplishments and the shortfalls of federal species protection. The checkerspot, the species behind Paul Ehrlich's development of the metapopulation concept,[1] was listed as threatened in 1987.[2] Like many other species, its initial decline was attributed to habitat degradation and loss caused by grazing and development in the increasingly populous San Francisco Bay Area.[3] While the Endangered Species Act ("ESA" or "the Act") has secured important protections for the checkerspot, helping

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[1] *See, e.g.*, ON THE WINGS OF CHECKERSPOTS: A MODEL SYSTEM FOR POPULATION BIOLOGY (Paul R. Ehrlich & Ilkka Hanski eds., 2004); Paul R. Ehrlich & Dennis D. Murphy, *Conservation Lessons from Long-Term Studies of Checkerspot Butterflies*, 1 CONSERVATION BIOLOGY 122 (1987); Susan Harrison et al., *Distribution of the Bay Checkerspot Butterfly,* Euphydryas editha bayensis*: Evidence for a Metapopulation Model*, 132 THE AMERICAN NATURALIST 360 (1988). A metapopulation dynamic means that a group of spatially distinct populations occasionally exchange individuals and can occupy sites that vary from year to year. U.S. FISH & WILDLIFE SERV., BAY CHECKERSPOT BUTTERFLY, 5-YEAR REVIEW: SUMMARY AND EVALUATION 2 (2009). Thus, presently unoccupied sites can still be part of the checkerspot habitat. *See id.*

[2] Determination of Threatened Status for the Bay Checkerspot Butterfly, 52 Fed. Reg. 35,366, 35,366 (Sept. 18, 1987) (codified at 50 C.F.R. pt. 17); *See also* U.S. FISH & WILDLIFE SERV., *supra* note 1, at 3.

[3] *See* U.S. FISH & WILDLIFE SERV., RECOVERY PLAN FOR SERPENTINE SOIL SPECIES OF THE SAN FRANCISCO BAY AREA II-189–91 (1998); Dennis D. Murphy & Stuart B. Weiss, *Ecological Studies and the Conservation of the Bay Checkerspot Butterfly,* Euphydryas editha bayensis, 46 BIOLOGICAL CONSERVATION 183, 188–92 (1988).

to shield it against some of the threats of habitat loss and habitat degradation,[4] a growing body of ecological knowledge points to a different factor — atmospheric nitrogen deposition — as a likely major cause of ongoing habitat degradation and of the species' continued struggle.[5] Atmospheric nitrogen, and most importantly, emission-source nitrogen, is depositing on the checkerspot's serpentine grassland habitat and enabling the invasion of this habitat by non-native grasses; the nitrogen-assisted non-natives are displacing native serpentine plants, including the native forb plants on which the habitat-restricted checkerspot depends for food and for successful completion of its reproductive cycle.[6] The question that logically emerges in this context is whether the ESA is capable of protecting the checkerspot and its serpentine grassland habitat from the newly identified threat of anthropogenic nitrogen emissions and nitrogen deposition.

A look across the terrestrial and aquatic ecosystems of the United States suggests that the checkerspot is far from the only imperiled species suffering from the negative effects of increasing nitrogen deposition.[7] The damaging effects of high nitrogen loading can be seen in numerous ecosystems,[8] and nitrogen deposition is often associated with "considerable declines in biodiversity and loss of rare or protected species" on both local and regional

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[4] *See, e.g.*, U.S. FISH & WILDLIFE SERV., *supra* note 1, at 17; *see also Saving the Bay Checkerspot Butterfly*, CTR. FOR BIOLOGICAL DIVERSITY, http://www.biologicaldiversity.org/species/invertebrates/Bay_checkerspot_butterfly/ (last visited Mar. 27, 2011).

[5] *See* Michael J. Bean, *Overcoming Unintended Consequences of Endangered Species Regulation*, 38 IDAHO L. REV. 409, 410 (2002); STUART B. WEISS, IMPACTS OF NITROGEN DEPOSITION ON CALIFORNIA ECOSYSTEMS AND BIODIVERSITY (2006) [hereinafter WEISS, IMPACTS OF NITROGEN DEPOSITION]; Stuart B. Weiss, *Cars, Cows, and Checkerspot Butterflies: Nitrogen Deposition and Management of Nutrient-Poor Grasslands for a Threatened Species*, 13 CONSERVATION BIOLOGY 1476 (1999) [hereinafter Weiss, *Cars, Cows, and Checkerspot Butterflies*].

[6] U.S. FISH & WILDLIFE SERV., *supra* note 1, at 14–15; U.S. FISH & WILDLIFE SERV., *supra* note 3, at II-195; Susan Harrison & Joshua H. Viers, *Serpentine Grasslands, in* CALIFORNIA GRASSLANDS: ECOLOGY AND MANAGEMENT 145, 153–54 (Mark R. Stromberg et al., eds., 2007); Laura F. Huenneke et al., *Effects of Soil Resources on Plant Invasion and Community Structure in Californian Serpentine Grassland*, 71 ECOLOGY 478, at 478, 488–89 (1990); WEISS, IMPACTS OF NITROGEN DEPOSITION, *supra* note 5; Weiss, *Cars, Cows, and Checkerspot Butterflies*, *supra* note 5; *see also* Dennis D. Murphy et al., *Introducing Checkerspots: Taxonomy and Ecology*, *in* ON THE WINGS OF CHECKERSPOTS: A MODEL SYSTEM FOR POPULATION BIOLOGY, *supra* note 1, at 26; Murphy & Weiss, *supra* note 3, at 197.

[7] *See* Mark E. Fenn et al., *Ecological Effects of Nitrogen Deposition in the Western United States*, 53 BIOSCIENCE 404, at 405, 417 (2003) [hereinafter Fenn et al., *Ecological Effects*]; Mark E. Fenn et al., *Nitrogen Excess in North American Ecosystems: Predisposing Factors, Ecosystem Responses, and Management Strategies*, 8 ECOLOGICAL APPLICATIONS 706, at 706, 721 (1998); Gareth K. Phoenix et al., *Atmospheric Nitrogen Deposition in World Biodiversity Hotspots: The Need for a Greater Global Perspective in Assessing N Deposition Impacts*, 12 GLOBAL CHANGE BIOLOGY 470, at 471 (2006).

[8] It can be seen in particular in those ecosystems exposed to high rates of atmospheric nitrogen deposition for several decades. *See, e.g.*, Roland Bobbink et al., *The Effects of Air-Borne Nitrogen Pollutants on Species Diversity in Natural and Semi-Natural European Vegetation*, 86 J. ECOLOGY 717, 731 (1998) [hereinafter Bobbink et al., *Air-Borne Nitrogen Pollutants*]; Roland Bobbink & Leon P. M. Lamers, *Effects of Increased Nitrogen Deposition, in* AIR POLLUTION AND PLANT LIFE 201–05 (J.N.B. Bell & Michael Treshow, eds., 2002).

scales.[9] While the precise consequences of nitrogen deposition have yet to be rigorously quantified, nitrogen deposition is projected as one of the greatest drivers of global biodiversity loss over the coming century, along with land use change and climate change.[10] And much like GHG-induced climate change, nitrogen deposition presents a remote, emissions-related cause of ecological disruption that threatens imperiled species and their remaining habitats.

This Article uses the checkerspot as a case study for a broader examination of whether the ESA, as it currently stands, can help protect listed species from the somewhat indirect, yet increasingly significant threat of atmospheric nitrogen deposition. The case of the checkerspot presents a valuable opportunity to analyze both the limits and potential of the ESA to deal with nitrogen deposition: the detrimental effects of such deposition were an important element in a recent U.S. Fish and Wildlife Service ("FWS") proposal to change the checkerspot's status from "threatened" to "endangered."[11] This proposed reclassification, which identifies impacts from nitrogen deposition as the most significant current threat to the checkerspot, raises two questions: (1) whether the nitrogen emissions responsible for such deposition can be considered taking of listed wildlife in violation of section 9 of the ESA, and (2) if so, who should be held responsible for such taking. It also puts a spotlight on federal actions that cause, regulate, or authorize nitrogen emissions, because section 7 of the Act requires federal agencies to ensure that none of their actions jeopardize the continued existence of listed species or degrade their critical habitat.[12]

We raise these questions with full awareness that there are numerous causes of listed species decline — such as edge effects or the disruption of

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[9] Phoenix et al., *supra* note 7, at 471; *see also* Roland Bobbink et al., *Global Assessment of Nitrogen Deposition Effects on Terrestrial Plant Diversity: A Synthesis*, 20 Ecological Applications 30, 41, 43, 51 (2010) [hereinafter Bobbink et al., *Global Assessment*]. The population of the threatened desert tortoise of the southwestern U.S. deserts has declined due to grazing pressure, habitat destruction, drought, disease, and a declining food base. Invasive grasses able to utilize additional nitrogen from deposition now outcompete native forbs, reducing the nutritional quality of vegetation available to the tortoise. *See* Kenneth A. Nagy, Brian T. Henen, & Devesh B. Vyas, *Nutritional Quality of Native and Introduced Food Plants of Wild Desert Tortoises*, 32 J. Herpetology 260, 262–64 (1998).

[10] Johan Rockström et al., *A Safe Operating Space for Humanity*, 461 Nature 472, 472 (2009); Osvaldo E. Sala et al., *Global Biodiversity Scenarios for the Year 2100*, 287 Science 1770, 1770 (2000).

[11] U.S. Fish & Wildlife Serv., *supra* note 1, at 14–15, 31.

[12] 16 U.S.C. § 1536 (2006). The checkerspot case is further compelling as a context for examining the ability of the ESA to offer protections against nitrogen deposition because the mechanisms of nitrogen impact on the checkerspot — and the causal chain that links nitrogen emissions to the harmful impacts on remaining checkerspot populations — are likely more complex than those encountered in many other cases of nitrogen deposition damage to habitats or species. Consequently, if it can be shown that ESA protections, specifically those in section 7 and section 9, extend to the checkerspot with regard to emission-source nitrogen deposition, then the case for using the ESA to address nitrogen deposition harms on other listed species could be stronger.

fire cycles — that remain largely beyond the reach of the ESA.[13] We also acknowledge that extending existing statutes and regulations too far beyond their normal scope could prove ineffective or even counterproductive.[14] Nonetheless, we work in a world where newly understood disturbance mechanisms can threaten the past achievements of species and habitat protection, and where creating dedicated new policies to address each new disturbance is often impractical, politically difficult, or both. We therefore believe it is worth exploring the species and habitat protection versatility of well-established and highly successful legal and regulatory tools such as the ESA. It is especially important to examine their potential capacity to deal with new or newly recognized threats.

Our interest in the capacity of the ESA to help deal with the significant and pervasive issue of nitrogen emissions and nitrogen deposition has been further strengthened by recent legal discussions on the potential for (and appropriateness of) using the ESA to force reductions in GHG emissions, given the impacts of GHG-driven climate change on a growing number of federally listed species.[15] In the course of our analysis, we engage these discussions, examining key similarities and differences between the ESA case against GHG emissions and climate change on the one hand, and the ESA case against nitrogen emissions and nitrogen deposition on the other.

Part II summarizes current knowledge of the ways that nitrogen deposition affects habitats and species, with particular emphasis on remaining checkerspot populations and their serpentine grassland habitat. It also introduces the principal anthropogenic sources of nitrogen deposition on checkerspot habitat. Part III provides a brief overview of the ESA. Part IV addresses the first of two key questions that underpin our analysis: whether nitrogen deposition, and the nitrogen emissions behind it, can be classified

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[13] *See* Michael J. Bean, *The Endangered Species Act and Private Land: Four Lessons Learned from the Past Quarter Century*, 28 Envtl. L. Rep. (Envtl. Law Inst.) 10,701, 10,705 (1998); Bean, *supra* note 5, at 412–14; J. B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B.U. L. Rev. 1, 14–16 (2008) [hereinafter Ruhl, *Climate Change*].

[14] *See* Donald C. Baur, *Comment on* Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future, 39 Envtl. L. Rep. (Envtl. Law Inst.) 10,746, 10,747–48 (2009); J. B. Ruhl, *Keeping the Endangered Species Act Relevant*, 19 Duke Envtl. L. & Pol'y F. 275, 275, 279–80 (2009) [hereinafter Ruhl, *Endangered Species Act*].

[15] For discussion of GHG emissions and the ESA, see Robert Meltz, Cong. Research Serv., RS22906, Use of the Polar Bear Listing to Force Reduction of Greenhouse Gas Emissions: The Legal Arguments (2008), *available at* http://nepinstitute.org/get/CRS_Reports/CRS_Climate_and_Environment/Other_Greenhouse_Gas_Emissions/Use_of_the_Polar_Bear_listing_to_force_reduction_of_Greenhouse_Gas_Emissions.pdf; Baur, *supra* note 14; Matthew Gerhart, *Climate Change and the Endangered Species Act: The Difficulty Of Proving Causation*, 36 Ecology L.Q. 167 (2009); Wm. Robert Irvin, *Comment on* Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future, 39 Envtl. L. Rep. (Envtl. Law Inst.) 10,750 (2009); Sarah Jane Morath, *The Endangered Species Act: A New Avenue for Climate Change Litigation*, 29 Pub. Land & Resources L. Rev. 24 (2008); Ruhl, *Climate Change*, *supra* note 13; Ruhl, *Endangered Species Act*, *supra* note 14, at 276–77; and 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).

and prosecuted as a violation of the take prohibition of the ESA. Put differently, do nitrogen emissions cause the type of habitat modification that can qualify as harm under section 9 of the ESA? If so, how would a court or regulator go about attributing the responsibility for such harm, given the numerous stationary and mobile sources of such emissions? In addition to building on relevant case law, we tackle these questions through a comparison between the ESA case against nitrogen deposition and the ESA case against GHG emissions, specifically the possibility of restricting GHG emissions as a prohibited take of polar bears and other climate-change-afflicted threatened and endangered species. Part V addresses the second key question in our analysis: whether and how the mandates and prohibitions of ESA section 7 apply to federal actions that cause or permit nitrogen emissions.

The similarities and differences that emerge from juxtaposing the case of nitrogen deposition with that of GHGs suggest there are more robust legal and practical arguments for using the ESA to help control nitrogen emissions than there are for leveraging the ESA in the policy and regulatory struggle against GHG emissions and climate change.

In Part VI, the Article ultimately concludes that while it will be quite challenging to show that nitrogen emissions, nitrogen deposition, and the resulting modification of checkerspot habitat constitute harm and prohibited take of checkerspots under section 9 of the Act, such a showing is not altogether implausible. The Article also concludes that the use of section 9 as a way to address nitrogen emission impacts on sensitive species and ecosystems should be considerably facilitated by two key factors. First, the ultimate responsibility for most offending emissions lies with a relatively small number of federal and state air quality and pollution control agencies, rather than with potentially countless individual and corporate actors (whose ability to legally emit is effectively contingent on some form of license from these agencies). Second, unlike GHGs, nitrogen emissions and ambient nitrogen stay fairly regional in their movements and impact.

Finally, the Article notes that the greatest value of the ESA as a tool for mitigating the impacts of nitrogen deposition may ultimately come from section 7, and particularly from section 7's potential to prod the U.S. Environmental Protection Agency ("EPA") into considering the species and habitat implications of nitrogen emissions when it sets ambient air quality standards under the Clean Air Act ("CAA"). Section 7 may also have a latent capacity to motivate EPA to seek productive new ways of working with the states in order to minimize the practical and administrative hurdles of improving protections for nitrogen-sensitive habitats and species.

II. Nitrogen Deposition and Its Impacts on the Threatened Checkerspot

A. *Ecological Impacts of Nitrogen Deposition*

In the last century, human activity has introduced an unprecedented amount of biologically available nitrogen into the environment. This trend is expected to continue over the coming decades.[16] Introduction of biologically available nitrogen results from several types of activities, most importantly fossil fuel combustion, intensive animal agriculture, artificial production of nitrogen fertilizer, and the cultivation of nitrogen-fixing legumes.[17] Only recently have we started to understand the ecological impacts of such human-caused nitrogen deposition, impacts that reach across a wide variety of taxa and ecosystem types including lichens, mycorrhizae, forests, grasslands, arid and semi-arid deserts, and alpine ecosystems.[18] Across these systems, worldwide, the generation and redistribution of biologically available nitrogen is altering ecosystem functions and the composition of natural plant assemblages.[19] Increased atmospheric deposition of biologically available nitrogen can increase the availability of nutrients, promoting increased carbon sequestration and plant growth.[20] At the same time, however, increased nitrogen deposition often changes the competitive interactions among plants, leading to a reduction in biodiversity and an increase in vulnerability to invasion by non-native species. Nitrogen accumulation in excess of biological demand can also disrupt ecosystem functioning by causing soil and water acidification, increasing the loss of nutrients from the soil, and causing nutrient imbalances in vegetation.[21] Such disruptions can clearly be seen in the case of the checkerspot's serpentine habitat.

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[16] James N. Galloway et al., *Nitrogen Cycles: Past, Present, and Future*, 70 Biogeochemistry 153, 153–55 (2004); James N. Galloway et al., *Transformation of the Nitrogen Cycle: Recent Trends, Questions, and Potential Solutions*, 320 Sci. 889, 889–90 (2008).

[17] *See* Peter M. Vitousek et al., *Human Alteration of the Global Nitrogen Cycle: Sources and Consequences*, 7 Ecological Applications 737, 738–39 (1997).

[18] *See* Bobbink et al., *Global Assessment*, *supra* note 9, at 32.

[19] These alterations are occurring through growth-stimulating as well as phytotoxic effects. *Id.* at 53; Roland Bobbink & Jan G. M. Roelofs, *Nitrogen Critical Loads for Natural and Semi-Natural Ecosystems: The Empirical Approach*, 85 Water Air and Soil Pollution 2413, 2415–16 (1995); Peter J. Lea, *Oxides of Nitrogen and Ozone: Can Our Plants Survive?* 139 New Phytologist 25 (1998); J. Pearson & A. Soares, *A Hypothesis of Plant Susceptibility to Atmospheric Pollution Based on Intrinsic Nitrogen Metabolism: Why Acidity Really Is the Problem*, 85 Water Air and Soil Pollution 1227, 1231–32 (1995); Vitousek et al., *supra* note 17, at 737; Alan R. Wellburn, *Why Are Atmospheric Oxides of Nitrogen Usually Phytotoxic and Not Alternative Fertilizers?* 115 New Phytologist 395, 395 (1990).

[20] Nitrogen-based fertilizers are used in agriculture for this very reason. For the plant growth impacts of nitrogen deposition in natural ecosystems, see, for example, Peter A. Beedlow et al., *Rising Atmospheric CO_2 and Carbon Sequestration in Forests*, 2 Frontiers in Ecology & the Env't 315 (2004).

[21] Gregory P. Asner et al., *The Decoupling of Terrestrial Carbon and Nitrogen Cycles*, 47 BioScience 226 (1997); Bobbink et al., *Air-Borne Nitrogen Pollutants*, *supra* note 8; Frank S. Gilliam, *Response of the Herbaceous Layer of Forest Ecosystems to Excess Nitrogen Deposition*, 94 J. Ecology 1176 (2006); Phoenix et al., *supra* note 7; Vitousek et al., *supra* note 17;

B. The Impacts of Nitrogen Deposition on Bay Area Serpentine Grasslands and Their Threatened Checkerspot Inhabitants

The checkerspots' historical range spanned the entire San Francisco Bay Area, stretching from San Bruno Mountain to Mount Diablo to Coyote Reservoir, across seven Bay Area counties.[22] However, following local extinctions of checkerspot populations driven by habitat degradation and loss from grazing and development, the checkerspot range is currently much smaller; it is, in fact, restricted to one Bay Area county: Santa Clara County.[23] Extremely habitat-limited, the checkerspot is found solely in Bay Area serpentine grasslands; the checkerspot's habitat, then, is precisely the type of ecosystem most vulnerable to increases in nitrogen deposition.[24] Such increases are currently being produced by fossil fuel emissions in the growing San Francisco Bay Area.[25]

The sensitivity of serpentine grasslands to nitrogen deposition is due to the fact that serpentine-derived soils are characterized by relatively low ratios of calcium to magnesium and low nutrient availability.[26] As such, these soils support edaphically isolated communities of unique plant and animal species, and are generally able to resist invasion by the non-native and invasive plant species that are prevalent throughout other California grasslands.[27] The addition of soil nitrogen in serpentine ecosystems, however, has been found to facilitate the invasion and dominance of non-native annual grasses in patches of serpentine habitat originally dominated by native annual forbs.[28] In other words, excess nitrogen deposition can alter plant communities and habitats by facilitating the encroachment of fast growing non-native species that can then overwhelm or exclude the slower growing native plants.

Decline in native species diversity, in turn, can have cascading effects on herbivore populations, such as the remaining checkerspot populations,

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Charles T. Driscoll et al., *Nitrogen Pollution in the Northeastern United States: Sources, Effects, and Management Options*, 53 BIOSCIENCE 357 (2003).

[22] U.S. FISH & WILDLIFE SERV., *supra* note 1, at 2; *see also* Dennis D. Murphy & Paul R. Ehrlich, *Two California Checkerspot Butterfly Subspecies: One New, One on the Verge of Extinction*, 34 JOURNAL OF THE LEPIDOPTERISTS' SOCIETY 316, 316–18 (1980).

[23] U.S. FISH & WILDLIFE SERV., *supra* note 1, at 2.

[24] *See* Weiss, *Cars, Cows, and Checkerspot Butterflies*, *supra* note 5, at 1483–85; U.S. FISH & WILDLIFE SERV., *supra* note 3, at 175–82, 193–95; U.S. FISH & WILDLIFE SERV., *supra* note 1, at 10–11, 13.

[25] Mark E. Fenn et al., *Nitrogen Emissions, Deposition, and Monitoring in the Western United States*, 53 BIOSCIENCE 391, 395–96 (2003); PUBLIC DRAFT, SANTA CLARA VALLEY HABITAT PLAN, App. E at E-1–E-3 (December 17, 2010) , *available at* http://www.scv-habitatplan.org/www/site/alias__default/341/public_draft_habitat_plan.aspx.

[26] Kathleen M. Kay et al., *Plant Speciation*, *in* SERPENTINE: THE EVOLUTION AND ECOLOGY OF A MODEL SYSTEM 71, 73–75 (Susan Harrison & Nishanta Rajakaruna eds., 2011).

[27] U.S. FISH & WILDLIFE SERV., supra note 1, at 10–11; Huenneke et al., *supra* note 6, at 479.

[28] Huenneke et al., *supra* note 6, at 478.

which depend on native plants.[29] The primary larval host plant for the checkerspot is a small annual forb — a native dwarf plantain (*Plantago erecta*) — but checkerspot larvae can also take some advantage of two secondary host plants, denseflower Indian paintbrush (*Castilleja densiflora*) and exserted Indian paintbrush (*Castilleja exserta*), since these remain edible longer than the plantain.[30]

Key for the subsequent discussion, the checkerspot has a complex, multi-stage life cycle whose successful completion depends on the availability of habitat and resources — most importantly, the availability of the host plants that serve for oviposition and larval food during the early stages of larval development. Once checkerspot larvae, which are oviposited on the native plantain, reach the fourth stage of larval development, they enter a dormancy stage and stay dormant for the summer season.[31] Successfully reaching the dormancy stage significantly depends on the availability of sufficient food resources from the native host plants.[32] The checkerspot larvae are further reliant on host plants for food as they break out of the dormancy stage and continue to feed until they pupate and eventually become adult butterflies.[33] This makes any nitrogen-driven displacement of native host plants (most importantly, the dwarf plantain) a potential threat to the successful completion of the checkerspot's reproductive cycle, and therefore, to the continued existence of this already threatened species.

At the same time, a growing body of ecological evidence suggests that nitrogen deposition, much of it from regional fossil fuel emissions,[34] is a key factor behind the rapid recent invasion of the highly diverse Bay Area serpentine ecosystems by exotic annual grasses.[35] This nitrogen-aided invasion of exotic annual grasses is progressively eliminating rare and endemic serpentine species, including several federally listed plant species as well as the dwarf plantain (the primary food source for checkerspot larvae).[36]

C. *Sources of Nitrogen Deposition on Bay Area Serpentine Grasslands*

The nitrogen emissions responsible for nitrogen deposition of the nutrient-poor serpentine grasslands come from a range of sources, including power plants, boilers, stationary turbines and engines, motor vehicles, and

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[29] WEISS, IMPACTS OF NITROGEN DEPOSITION, *supra* note 5, at 51; Bobbink et al., *Global Assessment*, *supra* note 9, at 38.

[30] Michael C. Singer, *Complex Components of Habitat Suitability within a Butterfly Colony*, 176 SCIENCE 75 (1972); Murphy & Ehrlich, *supra* note 22 at 316–17; Weiss, *Cars, Cows, and Checkerspot Butterflies*, *supra* note 5, at 1478; U.S. FISH & WILDLIFE SERV., *supra* note 1, at 2.

[31] U.S. FISH & WILDLIFE SERV., *supra* note 1, at 2, 7–9.

[32] *See, e.g.*, Murphy & Weiss, *supra* note 3, at 189; U.S. FISH & WILDLIFE SERV., *supra* note 1, at 6–9.

[33] *Id.*

[34] *See* Weiss, *Cars, Cows, and Checkerspot Butterflies*, *supra* note 5, at 1476.

[35] *Id.* at 1483.

[36] *Id.*

agricultural activities.[37] These emissions primarily include the ongoing rise in atmospheric nitrogen oxides ("NO_x") from fossil fuel combustion, and especially nitrogen dioxide ("NO_2") — a criteria pollutant regulated under the CAA — and ammonia gases ("NH_x") from agricultural emissions and animal husbandry.[38] In the airshed relevant to serpentine grasslands and their checkerspot inhabitants, however, ammonia ("NH_3") is emitted in significant amounts from motor vehicles: ammonia is currently an unregulated byproduct of three-way catalytic converters, which were introduced to abate combustion-source emissions of pollutants like carbon monoxide, hydrocarbons, and nitric oxide.[39] Together, these emissions have significantly increased the input of both wet and dry nitrogen deposition (in the form of precipitation and gaseous deposition, respectively) to typically nitrogen-limited serpentine grassland ecosystems.[40]

In areas in the vicinity of checkerspot habitat, an estimated 42% of nitrogen deposition comes from gaseous dry deposition of NO_x, 48% originates from by-products of atmospheric NO_x transformations (particulate nitrate and nitric acid vapor), while the remaining 10% comes from NH_x.[41] Some of the emissions responsible for nitrogen deposition on checkerspot habitat come from outside Santa Clara county (where the remaining checkerspot populations are exclusively found). Modeled estimates suggest that the remainder of Bay Area counties contribute 11% of such nitrogen deposition, while nitrogen-emitting activities in the rest of California and portions of Nevada are considered responsible for 26% of current atmospheric deposition.[42]

Importantly, the observed nitrogen-driven changes to the checkerspot serpentine habitat have largely occurred in a context of long-term compliance with federal and state air quality standards for NO_x. That is, the observed negative impacts on the checkerspot and its serpentine habitat are occurring in a context where regulated nitrogen emissions have been within the parameters of what EPA has determined as acceptable under the CAA

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[37] Public Draft, Santa Clara Valley Habitat Plan, *supra* note 25, at App. E, E-79–E-81.

[38] EPA, Integrated Science Assessment For Oxides Of Nitrogen And Sulfur - Ecological Criteria, Final Report, at 2-2–2-7 (2008).

[39] *See, e.g.*, Gary A. Bishop et al., *On-Road Emission Measurements of Reactive Nitrogen Compounds from Three California Cities*, 44 Envtl. Sci. Tech. 3616, 3616 (2010); A.J. Kean et al., *Trends in On-Road Vehicle Emissions of Ammonia*, 43 Atmospheric Env't 1565, 1565 (2009).

[40] *See* Fenn et al., *Ecological Effects*, *supra* note 7, at 416. Both NO_x and NH_x pollutants have relatively short atmospheric lifetimes (hours to days) and are typically deposited locally near point sources of pollution, but both are also capable of being converted to longer-lived forms and transported across regional scales. *See* Fenn et al., *supra* note 25, at 398–99.

[41] Current emissions estimates do not yet take into account several contributing point and non-point sources, such as off-road vehicles, small area sources, and agricultural and animal husbandry emissions. Fenn et al., *supra* note 25, at 401; EPA, *supra* note 38, at 2-2-2-7.

[42] Public Draft, Santa Clara Valley Habitat Plan, *supra* note 25, Appendix E at E-2.

and also within the parameters of the somewhat stricter ambient standards set by the California Air Resources Board ("CARB").[43]

III. The Endangered Species Act: A Brief Overview

The opening sections of the ESA offer an unambiguous statement of the congressional purpose behind the statute. The Act is intended to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" and "to provide a program for the conservation of such endangered species and threatened species."[44]

Although many historical analyses suggest that at the time of the ESA's passage Congress was not fully aware of the statute's actual scope and implications, or the numerous regulatory and legal controversies that its implementation would set into motion, the ESA has become a key pillar of United States conservation policy. In addition to its direct species protection value, the ESA has been used as a tool to combat suburban and exurban sprawl into wildlands and open space and as a tool to nudge conservation-beneficial land use planning.[45] It also holds some important (if arguably insufficient) potential to help protect biodiversity on working landscapes,[46] and it has aided in the protection of working seascapes.[47] Indeed, hardly a discussion of the ESA goes by without mention of its status as "the pit bull of environmental

[43] *See* Primary National Ambient Air Quality Standards for Nitrogen Dioxide, 75 Fed. Reg. 6474, 6476 (Feb. 9, 2010) (to be codified at 40 C.F.R. pts. 50, 58) ("Currently there are no areas in the United States that are designated as nonattainment of the NO_2 NAAQS."); Calif. Air Res. Bd., Chronology of State Nitrogen Dioxide Designations (2010), *available at* http://www.arb.ca.gov/desig/changes/no2.pdf; Calif. Air Res. Bd., 2010 Area Designations for State Ambient Air Quality Standards Nitrogen Dioxide (2010), *available at* http://www.arb.ca.gov/desig/adm/adm.htm; *Air Quality Standards and Attainment Status*, Bay Area Air Quality Mgmt. Dist., http://www.arb.ca.gov/desig/adm/2010/state_no2.pdf (last visited Feb. 28, 2011) (on file with the Harvard Law School Library). There is currently no data, however, on the extent of compliance with EPA's newly introduced short-term, one-hour NO_2 standard, in force since January 22, 2010. *See* Primary National Ambient Air Quality Standards for Nitrogen Dioxide, 75 Fed. Reg. 6474 (Feb. 9 2010). It is entirely possible that areas which have been in compliance with the long-standing (and essentially less strict) annual NO_2 standard of 53 parts per billion will need to make further adjustments in their current emission controls in order to comply with the stricter new NO_2 standard.

[44] 16 U.S.C. § 1531(b) (2006).

[45] *See* Thomas A. Scott et al., *Land Use Planning*, *in* 2 The Endangered Species Act at Thirty 206, 216–17 (J. Michael Scott et al. eds., 2006); Karen Donovan, *HCPs – Important Tools for Conserving Habitat and Species*, *in* Endangered Species Act: Law, Policy, and Perspectives 319 (Donald C. Baur & Wm. Robert Irvin eds., 2002); *see also* Stephanie Pincetl, *Conservation Planning in the West, Problems, New Strategies and Entrenched Obstacles*, 37 Geoforum 246, 250–51 (2006).

[46] Burton H. Thompson Jr., *Managing the Working Landscape*, *in* 1 The Endangered Species Act at Thirty 101, 124–25 (J. Michael Scott et al. eds., 2006).

[47] *See* Paul R. Armsworth et al., *Working Seascapes*, *in* 2 The Endangered Species Act at Thirty, *supra* note 45, at 244, 251–55.

laws,"[48] even if normative judgments as to whether this pit-bullishness is a good thing or a bad thing tend to vary.

At its core, the ESA provides several key mechanisms for the protection of imperiled species and the ecosystems on which they depend. First, in order to benefit from the ESA's protection, a species has to be listed by one of the implementing agencies — the FWS or NOAA's National Marine Fisheries Service ("NMFS")[49] — as threatened or endangered.[50] Once a species has been listed as threatened or endangered, it gets specific protections under sections 7 and 9 of the ESA. Section 7 of the ESA requires each federal agency to ensure that its actions do not jeopardize the continued existence of threatened or endangered species or adversely modify the designated critical habitat of such species.[51] Agencies are to do so in consultation with the FWS or NMFS.[52] Section 7 also establishes affirmative duties for species protection, asking federal agencies to "utilize their authorities in furtherance of the purposes of [the ESA] by carrying out programs for the conservation of endangered species and threatened species."[53]

Section 9, meanwhile, prohibits the take of listed wildlife[54] by private actors and government agencies alike, which has potentially far-reaching practical consequences given the broad definition of "take"[55] and the numer-

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[48] The metaphor was originally coined by Don Barry, an Assistant Secretary for Fish, Wildlife, and Parks in the Department of the Interior. Bean, *supra* note 13, at 10701.

[49] The FWS and NMFS share responsibility for administering the ESA. 50 C.F.R. § 402.01(b) (2010).

[50] An endangered species is defined in the ESA as "any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this chapter would present an overwhelming and overriding risk to man." 16 U.S.C. § 1532(6) (2006). A threatened species is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.S.C. § 1532(20) (2006). The criteria for listing species as threatened or endangered, as well as mandates for recovery planning and the designation of critical habitat for listed species are provided in section 4 of the ESA. 16 U.S.C. § 1533 (2006). Section 4 also enables citizens to petition the agency for the listing or delisting of species. 16 U.S.C. § 1533(b)(3)(A) (2006).

[51] 16 U.S.C. § 1536(a)(2) (2006).

[52] *Id.*

[53] 16 U.S.C. § 1536(a)(1) (2006). For further discussion of the importance and conservation potential of these frequently overlooked section 7(a)(1) provisions, see J.B. Ruhl, *Section 7(a)(1) of the "New" Endangered Species Act: Rediscovering and Redefining the Untapped Power of Federal Agencies' Duty to Conserve Species*, 25 ENVTL. L. 1107 (1995).

[54] 16 U.S.C. § 1538(a)(1) (2006). Plants get much weaker protections under section 9. 16 U.S.C. § 1538(a)(2) (2006). For more detail, see *infra* notes 68–72 and accompanying text.

[55] The statute defines a "take" of listed wildlife to mean harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting such wildlife — and/or attempting to engage in any such conduct. 16 U.S.C. § 1532(19) (2006). The FWS regulations interpret the term broadly, noting that "harm in the definition of 'take' in the [Endangered Species] Act means an act which actually kills or injures wildlife. Such acts may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." 50 C.F.R. § 17.3 (2010).

ous actions — including many otherwise ordinary land uses — that could lead to a prohibited take.

Some exemptions from the categorical prohibitions set forth in sections 7 and 9 are laid out in section 10 of the Act.[56] Most important among these is the take exemption in section 10(a),[57] introduced as part of the 1982 ESA amendments. Created at the request of a "coalition of developers, municipal governments, and a local environmental organization,"[58] section 10 has introduced opportunities for reconciling the needs of species and habitat protections with the needs of economic use and development.[59] Specifically, section 10(a) establishes conditions for permitting some incidental take of listed wildlife.[60] A take of listed wildlife can be permitted only if it is incidental to, and not the purpose of, an otherwise lawful activity and would "not appreciably reduce the likelihood of the survival and recovery of the species" in the wild.[61] Section 10(a) also sets up a process for the permitting of such incidental take — a process which requires the preparation of a conservation plan by the private and government actors whose activities are expected to produce such a take.[62] The plan has to be approved by the FWS or NMFS, who each have a fair amount of discretion to impose additional terms and conditions.[63]

IV. Nitrogen Deposition as a Prohibited Take of Checkerspots?

Does the long-standing if relatively unnoticed phenomenon of nitrogen deposition on Bay Area serpentine grasslands represent a violation of key

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[56] 16 U.S.C. § 1539 (2006).

[57] 16 U.S.C. § 1539(a) (2006).

[58] Robert L. Fischman & Jaelith Hall-Rivera, *A Lesson for Conservation from Pollution Control Law: Cooperative Federalism for Recovery Under the Endangered Species Act*, 27 Colum. J. Envtl. L. 45, 69 (2002).

[59] Donovan, *supra* note 45 at 320–21; Fischman & Hall-Rivera, *supra* note 58, at 75–76; *see also* Blaine I. Green, *The Endangered Species Act and Fifth Amendment Takings: Constitutional Limits of Species Protection*, 15 Yale J. on Reg. 329, 332–33, 367–75 (1998).

[60] 16 U.S.C. 1539(a) (2006).

[61] 16 U.S.C. § 1539(a)(2)(B) (2006)

[62] *See* 16 U.S.C. § 1539(a)(1) (2006). Also, take is only permitted after the FWS approves the conservation plan prepared by the permit applicant. Incidental take permits are essentially issued in exchange for preparing and funding the implementation of a conservation plan for the species affected by the proposed activity. Conservation plans must specify the likely species impact of the proposed incidental taking, the alternatives to the proposed take and reasons why the alternatives are not feasible, the steps that the applicant will take to minimize and mitigate the impacts resulting from his/her taking of listed wildlife, the funding that will be made available to take such mitigation steps, and any other measures that the FWS considers necessary. 16 U.S.C. § 1539(a)(2) (2006).

[63] For details on the implementation and implications of section 10(a) incidental take and habitat conservation planning provisions, see Karin P. Sheldon, *Habitat Conservation Planning: Addressing the Achilles Heel of the Endangered Species Act*, 6 N.Y.U. Envtl. L.J. 279 (1998), John F. Turner & Jason C. Rylander, *Conserving Endangered Species on Private Lands*, 32 Land & Water L. Rev. 571, 577–84 (1997), and Craig W. Thomas, Bureaucratic Landscapes: Interagency Cooperation and the Preservation of Biodiversity 193–226 (2003).

provisions of the ESA? This section examines the impacts of nitrogen deposition against the ESA prohibition on taking of listed species. Specifically, this section aims to situate the impacts of nitrogen deposition within the highly contested legal territory of take via habitat modification. First, it highlights key points of contention regarding the practical application of the "take" prohibition established in section 9 of the ESA. It then considers the implications of such ongoing legal controversies for the question of whether nitrogen deposition is a form of prohibited harm of checkerspots. Finally, it evaluates the legal and practical plausibility of treating nitrogen deposition as a prohibited take of checkerspots, in part by comparing the case of the checkerspot to another recently developed ESA case that considers GHG emissions as a possible take of threatened polar bears and other listed species whose habitats are degraded by GHG-driven climate change.[64]

Current government efforts have considered protecting the checkerspot from the effects of nitrogen deposition. However, these efforts have retained focus on the traditional regulation of direct harm to habitats. The plausibility of considering nitrogen deposition as harm, and thus a prohibited take, of checkerspots is implicit in the content of the regional Santa Clara Valley Habitat Plan ("SCV HP"), developed over the past several years by a coalition of government agencies in the Santa Clara Valley.[65] The SCV HP considers nitrogen deposition and its checkerspot consequences in quite some detail.[66] However, the primary focus of the SCV HP is on anticipating, minimizing, and mitigating harm to listed species as a result of added future development, rather than addressing nitrogen emissions associated with current development and related activities.[67] This focus limits the reach and significance of any precedent that might be set by the SCV HP. Further, the SCV HP cannot reach nitrogen emissions that occur outside the planning area but still deposit on serpentine grasslands within the area. The analysis in this Article, focusing on the threat to the checkerspot from nitrogen depo-

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[64] The subject of some lively and thoughtful legal discussion since the polar bear's listing in 2008, the ESA case against GHG emissions has been thoughtfully and thoroughly considered by several legal scholars and practitioners. *See* sources cited *supra* note 15.

[65] Partners include Santa Clara County, the Santa Clara Valley Transportation Authority, the Santa Clara Valley Water District, and the cities of Gilroy, San Jose, and Morgan Hill. *See Project Partners*, Santa Clara Valley Habitat Plan, http://www.scv-habitatplan.org/www/site/alias__default/297/project_partners.aspx (last visited Feb. 7, 2011).

[66] Public Draft, Santa Clara Valley Habitat Plan, *supra* note 25, at 4-74–4-76.

[67] The SCV HP recognizes that increases in vehicle trips associated with projected future development will increase nitrogen deposition, which negatively impacts covered species. The chain of connection between development, vehicle trips, nitrogen emissions, nitrogen deposition, and modification of covered species' habitats is part — though certainly not all — of the justification for imposing the development fees that are both a major component of the SCV HP and a major source of its funding. None of the discussions in the SCV HP explicitly classify the indirect effects of nitrogen deposition as a prohibited take, but the plan does seem to have been written with an awareness that nitrogen deposition associated with covered activities might prevent the success of the plan's conservation goals. Public Draft, Santa Clara Valley Habitat Plan, *supra* note 25, Chapt. 4 at 4-3, 4-32, 4-63, 4-66–4-68, 4-73–4-75, 4-110 & app. E, E-1–E-3.

sition and how the ESA applies to this danger, is important and timely because it fills this gap in the existing analysis.

A. *"Harm" and "Take" Under the Current ESA Regime*

Section 9 of the ESA prohibits the taking of any endangered species of fish and wildlife.[68] This prohibition applies to the actions of private individuals and businesses as well as those of government agencies and employees.[69] It protects endangered species of fish and wildlife regardless of whether they are found on public or private lands. The FWS has passed regulations that further extend these section 9 protections to threatened species.[70] The statute defines a "take" to include harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting such wildlife or attempting to engage in any such conduct.[71]

Most aspects of the statutory definition of take are fairly uncontroversial. Little disagreement has, for example, occurred when it comes to gauging whether or not a particular act qualifies as an instance of hunting, shooting, or trapping. The question of what it means to harm a listed species in ways prohibited by the statute, on the other hand, has produced the deepest, longest standing, and still incompletely resolved disagreements. The meaning of "harm" has thus become the crux of disputes about the reach — and practical application — of section 9 protections. At the heart of the controversy is the issue of harm via habitat modification. This is the precise issue at stake in the checkerspot case. The FWS regulations specify that "*harm* in the definition of 'take' in the [Endangered Species] Act means an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering."[72]

What does this spell for the checkerspot? As discussed in Part II above, current ecological knowledge strongly supports the significance of nitrogen deposition for the profound alteration of nutrient poor serpentine grasslands — the only remaining checkerspot habitat — by invading non-native

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[68] 16 U.S.C. § 1538(a) (2006).

[69] 16 U.S.C. §§ 1532(B), 1538(A) (2006).

[70] 50 C.F.R. § 17.31(a) (2010). NMFS, on the other hand, stipulates protections for the threatened species under its jurisdiction on a case-by-case basis. *See* 50 C.F.R. § 223.201–11 (2010). Both agencies' authority to extend further protections to threatened species stems from section 4(d) of the ESA. 16 U.S.C. § 1533(d) (2006). It is important to note that the "take" prohibition does not generally apply to listed plants. The ESA makes the taking of listed plants unlawful on federal lands; taking of listed plants on private land is unlawful only if it is already prohibited under state species protection laws or regulations. 16 U.S.C. § 1538(a)(2)(B) (2006). That is, section 9 of the ESA is intended to help enforce state plant protection laws, but does not itself provide equivalent protection for plants. Plants are, on the other hand, treated the same as fish and wildlife under section 7 of the ESA. *See* 16 U.S.C. § 1536 (2006).

[71] 16 U.S.C. § 1532(19) (2006).

[72] 50 C.F.R. § 17.3 (2010) (emphasis added).

grasses. The nitrogen-aided non-native grasses have been observed to displace the dwarf plantain on which the checkerspot depends for oviposition and on which checkerspot larvae largely depend for food.[73] Such nitrogen-aided invasive grass displacement of larval host plants has, in turn, been observed to produce increased larval mortality and dramatic declines in checkerspot populations.[74]

Another potential result of nitrogen deposition on checkerspot habitat may be increased competition among checkerspot individuals for the remaining suitable habitat — including competition for food and plants on which to lay their eggs. Related, although as yet undocumented due to the ethical and logistical challenges of using listed species for research, there is the possibility that host plant displacement and habitat loss may also lead to foregone or thwarted oviposition by checkerspot adults: since checkerspots need to lay their eggs on plantain, not finding enough individual plantains means that checkerspots may not lay their eggs at all, or that they lay them on the wrong species, where the larvae will die from starvation.

In other words, nitrogen deposition is detrimental to the checkerspot's serpentine habitat, and is ultimately bad for the checkerspot itself. Indeed, the impact of nitrogen-driven habitat change has been, in the FWS's own assessment, an important factor in the continued decline of remaining checkerspot populations.[75]

Can current patterns of nitrogen emissions and deposition be considered a prohibited take of protected checkerspots? Based on the series of nitrogen impacts on checkerspot habitat and checkerspot behavior, the answer may seem quite simple: yes. However, determining whether the effects of nitrogen emissions on checkerspot habitat can be considered a "harm" involves the question of whether a particular habitat modification constitutes the type of injury to listed wildlife that is proscribed under section 9. Always contested, the questions of what constitutes proscribed injury and what constitutes prohibited harm have prompted pitched legal battles even when the habitat modification in question has been fairly direct.[76] The existence of harm through habitat modification becomes proportionately more difficult to establish, and so potentially more controversial, when the habitat-related harm occurs through a complex and indirect chain of causation, such as the loss of Arctic sea ice driven by climate change or the change in high altitude

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[73] *See* Huenneke et al., *supra* note 6, at 488–89; Weiss, *Cars, Cows, and Checkerspot Butterflies*, *supra* note 5, at 1479–85; U.S. Fish & Wildlife Serv., *supra* note 1, at 2, 10–11, 13–15.

[74] *See* Weiss, *Cars, Cows, and Checkerspot Butterflies*, *supra* note 5, at 1479–80; U.S. Fish & Wildlife Serv., *supra* note 1, at 7–9; Public Draft, Santa Clara Valley Habitat Plan, *supra* note 25, app. D, at 3.

[75] *See* U.S. Fish & Wildlife Serv., *supra* note 1, at 14–15.

[76] *See, e.g.*, Bean, *supra* note 13, at 10,703 (discussing *United States v. West Coast Forest Res. Ltd. P'ship*, No. 96-1575-HO, 1997 WL 33100698 (D. Or. Jul. 28, 1997) and *Defenders of Wildlife v. Bernal*, 204 F.3d 920 (9th Cir. 2000)).

montane habitats[77] — or the complex chain of causation detailed above in the checkerspot case.

The legal task of showing harm through habitat modification becomes even more difficult when it comes to tracing the precise causal links between the macro-scale phenomena known to be responsible for habitat modification — for example, climate change and nitrogen deposition — and the micro-scale acts of individual emitters, which are ultimately behind such macro-scale phenomena.[78] Determining whether nitrogen emissions and nitrogen deposition can be reasonably treated as a prohibited take of checkerspots ultimately requires us to gauge whether the habitat impacts of nitrogen deposition meet the *legal* standard for harm through habitat modification — a standard that is potentially stricter and therefore more difficult to satisfy than a *biological* standard for harm.[79]

B. Habitat Modification as a Source of Harm to Protected Wildlife

Interpretations of harm under the ESA have varied over time and across various courts and agencies. The FWS regulations that define harm to include some forms of habitat modification have been on the books since 1975, and the variation in judicial interpretations of these provisions is almost as old. At the opposite ends of such interpretations stand cases like *Sierra Club v. Froehlke*[80] and *Palila v. Hawaii Department of Land & Natural Resources* ("*Palila I*").[81] It was the Ninth Circuit's broad interpretation of harm via habitat modification in *Palila I*[82] that prompted the FWS to

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[77] *See, e.g.*, MELTZ, *supra* note 15, at 3; Ruhl, *Climate Change*, *supra* note 13, at 3–6; Ruhl, *Endangered Species Act*, *supra* note 14, at 275; Gerhart, *supra* note 15, at 169.

[78] *See infra* notes 122–124 and accompanying text. For further discussion of the challenges attending attempts at linking macro-scale phenomena causing habitat change to the micro-scale individual acts cumulatively triggering such macro-scale phenomena, see generally Gerhart, *supra* note 15, and Ruhl, *Climate Change*, *supra* note 13.

[79] *See* Alan M. Glen & Craig M. Douglas, *Taking Species: Difficult Questions of Proximity and Degree*, 16 NAT. RESOURCES & ENV'T 65, 65–66 (2001); *see also* Robert L. Fischman, *The Divides of Environmental Law and the Problem of Harm in the Endangered Species Act*, 83 IND. L.J. 661, 684–90 (2008).

[80] Sierra Club v. Froehlke, 392 F. Supp. 130 (E.D. Mo. 1975), *aff'd*, 534 F.2d 1289 (8th Cir. 1976). In *Sierra Club v. Froehlke*, one of the earliest cases involving the question of harm via habitat modification, the Eighth Circuit found that the construction of a dam and reservoir, which would flood subterranean caverns inhabited by the endangered Indiana bat, was not a violation of section 9 since the dam was clearly not *intended* to harass or harm the bats. *Id.* at 1304. In that court's view, no intentionality meant no harm occurred regardless of the fact that endangered bats would die. *See also* Kenneth J. Plante & Andrew J. Baumann, Babbit v. Sweet Home Chapter of Communities for a Great Oregon*: Preserving the "Critical Link" Between Habitat Modification and the "Taking" of an Endangered Species*, 20 NOVA L. REV. 748, 753–56 (1996).

[81] Palila v. Hawaii Dep't of Land & Natural Res. *(Palila I)*, 471 F. Supp. 985 (D. Haw. 1979), *aff'd*, 639 F.2d 495 (9th Cir. 1981). In *Palila I*, the courts found that the destruction of mamane-naio forests, as caused by the grazing of feral sheep and goats, was a prohibited take of the endangered palila bird, since the already–declining palila populations relied on the mamane-naio forests for food and nesting. *Palila I*, 471 F.Supp. at 995.

[82] *Id.* Commonly referred to as *Palila I* in the ESA literature, since an almost identical issue was re-litigated in *Palila v. Hawaii Dep't of Land & Natural Res. (Palila II)* after the

revise its regulatory definition of harm. This 1981 revision (which produced the current definition of harm)[83] was born out of the FWS's concern that the *Palila I* decision could be read to imply that habitat modification alone — without associated injury to the species — can be considered harm and thus a prohibited take.[84] Intended to eliminate the possibility for any such interpretation, the new FWS definition reads, "harm in the definition of 'take' in the [Endangered Species] Act means an act which *actually* kills or injures wildlife. Such act[s] may include significant habitat modification or degradation where it *actually* kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering."[85]

In the now-famous case of *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, the Supreme Court upheld the 1981 regulatory clarification.[86] While the plaintiffs in the *Sweet Home* case challenged the very notion that habitat modification can constitute a prohibited take of listed wildlife, and thus challenged the validity of the FWS 1981 harm regulation,[87] the Supreme Court's 6-3 decision to uphold the regulation was built on an analysis of the proper scope and interpretation of the challenged regulation.[88]

FWS promulgated a new definition of harm in 1981. 649 F. Supp. 1070 (D. Haw. 1986), *aff'd*, 852 F.2d 1106 (9th Cir. 1988).

[83] 50 C.F.R. § 17.3 (2010).

[84] *See* Plante & Baumann, *supra* note 80, at 764–65.

[85] 50 C.F.R. § 17.3 (2010) (emphasis added). Interestingly, the *Palila I* case was shortly re-tried under this new definition and under almost identical circumstances, except this time, it was introduced mouflon sheep (rather than the feral sheep and goats removed after *Palila I*) that were grazing the palila habitat into destruction and helping nudge the palila closer to extinction. The second time around, the case generated the same ruling, since the district court hearing the case saw in the new definition nothing more than a clarification/reinforcement of a proposition it considered already well-established under the old definition — namely, that habitat modification has to result in injury to protected wildlife before it becomes prohibited take. *Palila II*, 649 F. Supp. at 1075, 1082. Notably, the *Palila II* court ruled that habitat modification which could result in extinction does constitute harm — and so a prohibited "take," regardless of whether such habitat modification has caused the death of individual members from the protected species — and it found that mouflon grazing was producing precisely this type of habitat modification. *Id.* at 1075, 1078. The Ninth Circuit affirmed this District Court ruling, thereby putting *Palila II* on the list of most discussed and most controversial ESA cases. 852 F.2d 1106.

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

[87] The *Sweet Home* plaintiffs claimed that, in including habitat modification as part of the regulatory definition of "harm," the FWS had exceeded its ESA authority. *Id.* at 693.

[88] A detailed discussion of the *Sweet Home* opinion is outside the scope of the current paper, especially since a number of thoughtful and thorough analysts have long since beaten us to the task. *See, e.g.*, Kevin D. Batt, *Above All, Do No Harm: Sweet Home and Section Nine of the Endangered Species Act*, 75 B.U. L. REV. 1177 (1995); Lawrence R. Liebesman & Steven G. Davison, *Takings of Wildlife Under the Endangered Species Act after* Babbitt v. Sweet Home Chapter of Communities for a Great Oregon, 5 U. BALT. J. ENVTL. L. 137 (1995); Richard A. Epstein, Babbitt v Sweet Home Chapters of Oregon*: The Law and Economics of Habitat Preservation*, 5 SUP. CT. ECON. REV. 1 (1997); Fiona Powell, *Defining Harm Under the Endangered Species Act: Implications of* Babbitt v. Sweet Home, 33 AM. BUS. L. J. 131 (1995); Patrick J. Beirne, Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*: The Supreme Court Places the Endangered Species Act in "Harm's" Way*, 23 N. KY. L. REV. 81 (1995); Steven G. Davison, *The Aftermath of* Sweet Home Chapter*: Modification of Wildlife Habitat as a Prohibited Taking in Violation of the Endangered Species Act*, 27

In the end, however, the *Sweet Home* decision has not made it much easier to distinguish between the kinds of habitat modification that injure protected wildlife sufficiently to qualify as harm and the kinds of habitat modification that remain outside the scope of the section 9 take prohibition.[89] A clear and vivid illustration of the legal and regulatory ambiguity that continues to surround the reach of the harm prohibition can, for example, be found in a recent ABA deskbook on the ESA.[90] Two adjacent chapters in this authoritative legal volume offer appreciably different readings of the *Sweet Home* decision, complete with diverging accounts of whether and how *Sweet Home* defines — or redefines — the meaning of harm via habitat modification.

In one chapter, Sean Skaggs[91] presents the *Sweet Home* decision as strengthening, rather than circumscribing, the reach of section 9 protections.[92] He views the decision as an important part in a larger continuum of broad judicial interpretation of harm. His analysis considers many of the cases where courts found that listed wildlife was not harmed by habitat modification as cases of weak evidence of wildlife injury, rather than cases indicating progressively stricter judicial standards for harm via habitat modification. It includes both pre- and post-*Sweet Home* cases such as *Morrill v. Lujan*,[93] *American Bald Eagle v. Bhatti*,[94] and *Hawksbill Sea Turtle v. Federal Emergency Management Agency*.[95]

Skaggs also questions the idea that in a post-*Sweet Home* world, population-level effects — such as overall population declines of protected wildlife that are attributable to habitat destruction — are insufficient evidence of harm; he essentially rejects the idea that individual animals must be shown to be killed or tangibly injured by a habitat modification before the habitat modification becomes a prohibited take.[96]

WM. & MARY ENVTL. L. & POL'Y REV. 541 (2003). What our analysis aims to emphasize is the uncertainty that still remains even after *Sweet Home* regarding which kinds of habitat modification can be considered prohibited harm and which cannot.

[89] *See, e.g.*, Davison, *supra*, note 88; Liebesman and Davison, *supra* note 88; Bean, *supra* note 13; Fischman, *supra* note 79, at 684–85 n.146 and accompanying text; Steven P. Quarles & Thomas R. Lundquist, *When Do Land Use Activities "Take" Listed Wildlife Under ESA Section 9 and the "Harm" Regulation?*, *in* ENDANGERED SPECIES ACT: LAW, POLICY, AND PERSPECTIVES, *supra* note 45, at 207; *see also* Amy L. Stein, *State Fish Stocking Programs at Risk: Takings Under the Endangered Species Act*, 20 DUKE ENVTL. L. & POL'Y F. 63 (2010).

[90] ENDANGERED SPECIES ACT: LAW, POLICY, AND PERSPECTIVES, *supra* note 45.

[91] Counselor to the Assistant Secretary for Fish and Wildlife and Parks, U.S. Department of the Interior at the time of publication of his chapter in the ABA volume. Sean C. Skaggs, *Judicial Interpretation of Section 9 of the Endangered Species Act Before and After* Sweet Home*: More of the Same*, in ENDANGERED SPECIES ACT: LAW, POLICY, AND PERSPECTIVES, *supra* note 45, at 253.

[92] *Id.*

[93] 802 F. Supp. 424 (S.D. Ala. 1992).

[94] 9 F.3d 163 (1st Cir. 1993).

[95] 11 F. Supp. 2d 529 (D. V.I. 1998).

[96] Skaggs, *supra* note 91, at 276.

By contrast, in the second chapter, Steven Quarles and Thomsas R. Lundquist[97] interpret *Sweet Home* as a decision that limits the scope of take via habitat modification.[98] According to Quarles and Lundquist, to harm listed wildlife means to (1) proximately cause (2) the death or tangible actual injury to (3) an identifiable member of a listed wildlife species.[99] They specifically insist that a significant impairment of essential behavioral patterns — such as might often result from habitat modification or destruction that displaces protected wildlife from traditional breeding, feeding, or sheltering grounds — cannot constitute wildlife injury in and of itself.[100] They also insist on a fairly direct link between a habitat-altering activity and species injury before an activity is to be scrutinized as prohibited take.[101]

Yet contrary to the view proffered by Quarles and Lundquist, the *Sweet Home* majority looks to the legislative history of the ESA as an indication of congressional intent that "take" should "apply broadly to cover *indirect* as well as *purposeful* actions."[102] Especially significant for the present discussion, Justice O'Connor's concurrence also states that "*Proximate causation depends to a great extent on considerations of the fairness of imposing liability for remote consequences.*"[103] Finally, and very critical for the question at the center of this Article, the *Sweet Home* majority opinion concludes with a note on the difficulty of measuring the vastly varied array of public and private activities against the harm prohibitions of section 9, commenting on the wisdom of leaving such measuring to the agencies and the courts:

> The proper interpretation of a term such as "harm" involves a complex policy choice. . . . In the elaboration and enforcement of the ESA, the Secretary and all persons who must comply with the law will confront difficult questions of *proximity* and *degree*; for,

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[97] Both with the Washington, DC, law firm of Crowell & Moring LLP at the time of publication of their chapter in the ABA volume, Quarles and Lundquist represented the landowner interests in *Sweet Home*, as well as in a number of the cases discussed in their chapter. Quarles & Lundquist, *supra* note 89.

[98] *Id.* at 208. In constructing this argument, Quarles and Lundquist rely on the preamble of the 1981 FWS regulation that defines "harm" and on the government's testimony during the *Sweet Home* trial. *Id.* at 215–17. They do, however, recognize and lament the fact that the *Sweet Home* decision has failed to produce true consistency and uniformity to the application of section 9 in actual practice. *Id.* at 208. The way that such different reads of the *Sweet Home* ruling can remain simultaneously plausible is through ongoing differences among legal scholars and practitioners regarding the parts of the *Sweet Home* opinion that are properly seen as binding precedent and those that should be regarded as mere dicta. It is partly by considering a much greater portion of the majority opinion as binding precedent than Skaggs does that Quarles and Lundquist arrive at their view of *Sweet Home* as a decision that circumscribes the meaning of "take" via habitat modification in several important ways.

[99] *Id.* at 214–15.

[100] *Id.* at 216.

[101] *Id.* at 237–38.

[102] *Sweet Home*, 515 U.S. at 704 (emphasis added). Justice O'Connor's concurrence does not exclude indirect causation either — it only excludes causal arguments which fall under the categories of the unforeseeable and "the bizarre," as represented in extreme cases like *Palsgraf* v. *Long Island R. Co.*, 162 N.E. 99 (N.Y. 1928).

[103] *Sweet Home*, 515 U.S. at 713 (emphasis added).

> as all recognize, the Act encompasses a vast range of economic and social enterprises and endeavors. These questions must be addressed in the usual course of the law, through case-by-case resolution and adjudication.[104]

How then should the checkerspot case be situated within the still-uncertain legal terrain of take via habitat modification? One way to answer this question is to start with narrower interpretations of the *Sweet Home* opinion and of harm through habitat modification as the benchmark for evaluating the plausibility and robustness of a possible case for nitrogen deposition as a take of threatened checkerspots. This is the approach taken in the next subsection. It is important to keep in mind, however, the fact that the Supreme Court has ultimately left decisions to lower courts as to whether or not a particular instance of habitat modification constitutes harm and a prohibited take. Thus, not all courts will be applying the most stringent legal standard possible for harm through habitat modification, a standard which could be difficult or impossible to meet through existing or obtainable scientific data.[105]

C. *Situating Nitrogen Deposition in the Uncertain Legal Terrain of Take via Habitat Modification*

Three principal challenges can be expected to arise in response to a legal claim that nitrogen emissions and the resulting nitrogen deposition constitute a prohibited "take" of threatened checkerspots. First, nitrogen emissions and the resulting nitrogen deposition may not be considered a significant enough cause of the invasion-driven modification of checkerspot serpentine habitat, and checkerspot harm resulting from nitrogen-driven habitat alteration may not be seen as sufficiently foreseeable to be legally actionable. In other words, it is unclear whether a court would see nitrogen emissions as a proximate cause of checkerspot harm given the nature and extent of their contribution to the degradation of checkerspot habitat. Second, even if nitrogen emissions and the resulting nitrogen deposition are established as a significant enough factor in the degradation of the checkerspot's remaining serpentine habitats, courts or agencies may not find that such nitrogen-related habitat modification has been conclusively shown to result in the death of individual checkerspots, or in injury to individual checkerspots sufficient to constitute harm, and thus constitute a prohibited take. Third, the presumably offending nitrogen deposition results from the actions of a large number of fairly small emitters. Therefore the individual contribution of each emitter to the habitat modification is fairly small. Even if nitrogen emissions are shown to be the proximate cause of harm to the checkerspot, it might not be possible to establish liability in this context,

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[104] *Id.* at 708.

[105] *See, e.g.*, Robert L. Fischman, *The Divides of Environmental Law and the Problem of Harm in the Endangered Species Act*, 83 Ind. L.J. 661, 687–92 (2008).

given that determining the contribution of individual emitters to the ultimate species injury may be difficult, and given that many of the individual contributions that cumulate to alter checkerspot habitat may by themselves be considered too small to be a significant cause of the resulting harm.

The first potential challenge to a claim of nitrogen emissions and deposition as a prohibited take of checkerspots is largely left outside the present discussion because it hinges on an empirical question beyond the scope of this Article. An ongoing ecological investigation is working to quantify with much greater precision the already observed relationship between nitrogen emissions, nitrogen deposition, non-native grass invasion, and changes in native plant communities.[106] As a result, this question may be resolved in the short to medium term. For the purposes of the current discussion, we assume that such future research will further confirm the trends and relationships observed so far — that it will more solidly establish the significance of emissions-origin nitrogen deposition as a key source of detrimental alteration of the checkerspot's only remaining habitats. This assumption is reasonable based on evidence obtained so far.[107] This prospective view is also warranted for reasons beyond the particulars of the checkerspot case because it is often the case in environmental and resource policy that the emergence of fairly clear and conclusive scientific understanding outpaces the development of commensurate conservation policy action.

Admittedly, however, posing the question in this way constitutes a considerable oversimplification of the actual challenges involved in bringing the ESA to the aid of imperiled species in general, and the nitrogen-afflicted checkerspot in particular. The above framing of the issue is an oversimplification because, when it comes to deploying ESA protections against habitat-related threats to listed species, the arguably most significant obstacle comes from the fact that the ESA may set a *legal* standard for harm that requires more certainty than ecological research can actually produce. This legal standard may be quite difficult to meet even in cases where ecological evidence clearly points to listed wildlife being harmed by changes to its habitat.[108] Still, it is an oversimplification that we largely accept for the purposes of the present discussion.

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[106] The following studies are currently in progress: Dena M. Vallano et al., *Historical Reconstruction of Anthropogenic N Inputs into a Bay Area Serpentine Ecosystem Using Tree Ring ä15N Analysis* (publication expected May 2011); Jae Pasari et al., *Understanding the Relative Importance of Changing Soil N and Other Soil Characteristics to Native and Exotic Plant Species Composition in Serpentine Grasslands* (results expected 2010); Paul C. Selmants et al., *Influence of Atmospheric Nitrogen Dioxide (NO_2) and Ammonia (NH_3) on Plant N Status and Performance of Key Species in a Serpentine Grassland Ecosystem* (publication expected May 2011).

[107] *See generally* Huenneke et al. *supra* note 6; Weiss, *Cars, Cows, and Checkerspot Butterflies*, *supra* note 5; Erika S. Zavaleta et al., *Grassland Responses to Three Years of Elevated Temperature, CO_2, Precipitation, and N Deposition*, 73 ECOLOGICAL MONOGRAPHS 585, 600–01 (2003).

[108] *See* Fischman, *supra* note 105, at 684–90.

The second potential challenge is also difficult to fully address within the scope of this Article. In the case of the checkerspot, incontrovertible links between nitrogen-driven habitat changes and the injury and death of individual checkerspots — the kinds of incontrovertible links demanded by proponents of a strict legal standard — are difficult to establish precisely because the checkerspot is already so rare; too rare, for instance, for ecological research to be able to compare and experimentally manipulate the rates of larval survival in plots with and without added nitrogen deposition.[109]

Narrow interpretations of the ESA's harm prohibition therefore produce situations that are unlikely to be resolved through further or better designed ecological research or the continuous filling of remaining evidentiary and knowledge gaps.[110] They present situations that may be resolvable only through legal ingenuity and entrepreneurship, or through statutory and regulatory reform.

Promisingly for the potential of using the ESA to protect the checkerspot, not all courts have applied as stringent of a legal standard for harm as the strict interpreters discussed above,[111] and the Supreme Court majority in *Sweet Home* leaves it to the lower courts to tackle the "difficult questions of proximity and degree"[112] — the difficult questions of when habitat modification should be considered a prohibited take. In sum, then, both some further ecological research and some legal ingenuity may be required to build a case for nitrogen emissions (and nitrogen deposition) as a form of prohibited take of checkerspots.

Assuming that a combination of legal ingenuity and ecological research succeeds in establishing that emissions-origin nitrogen deposition is responsible for causing prohibited harm to checkerspots, however, the third potential challenge still remains to be answered in order to build a robust section 9 case for the restriction of nitrogen emissions: namely, the question of who is

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[109] The ecological task of comparing larval mortalities in nitrogen-affected and unaffected habitats is doubly compounded by the checkerspot's rarity. Technically, there is the issue of naturally high mortality rates among larvae in the pre-dormancy stage (mortality rates upwards of 95 percent) and the difficulty of controlling for other factors if larval mortalities are compared among distant sites experiencing different nitrogen deposition. *See* U.S. Fish & Wildlife Serv., *supra* note 1, at 6. Practically, directly testing checkerspot population responses to a manipulated nitrogen addition would require enormous areas to be intensively fertilized to match the scale at which checkerspots move, which may further increase the risk of extinction. *See, e.g.*, Public Draft, Santa Clara Valley Habitat Plan, *supra* note 25, app. D at 12. Documenting foregone oviposition and other disruptions of checkerspot reproduction would also pose significant — and potentially insurmountable — evidentiary challenges, if this is indeed the evidence required by a court in order to show that checkerspot individuals were harmed as a result of habitat modification.

[110] This is in addition to the fact that perfect knowledge (or scientific certainty) is unreasonable to expect in most science-based policy and regulatory decisions, including decisions affecting threatened and endangered species. *See, e.g.*, Fischman, *supra* note 105, at 661, 684–92; Holly Doremus, *Science and Controversy*, *in* 2 The Endangered Species Act at Thirty, *supra* note 45, at 97, 100–03.

[111] *See supra* notes 98–101 and accompanying text.

[112] *See* Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 708 (1995).

to be held responsible for the newly identified checkerspot take via nitrogen-driven habitat modification. What remains are the key questions regarding attributing liability and gauging the potential for effective injunctive relief to prevent further harm to the checkerspot.

It is here that a comparison of the checkerspot case with the ESA case against GHG emissions, and specifically with the ESA case against GHG impacts on the threatened polar bear, offers particularly useful insight. This comparison explicitly speaks to the plausibility of raising a take challenge against nitrogen emissions and suggests a potentially fruitful strategy for raising such a section 9 challenge. GHG emissions present a number of significant challenges when it comes to attributing causation and liability for harm to listed wildlife related to climate change. Still, a number of legal scholars and practitioners have seen potential for raising a section 9 challenge against major US emitters of GHGs. Below, we argue that the challenges of attributing liability and causation in the nitrogen emissions/checkerspot case are considerably more manageable than those in the GHG case.

D. GHGs, Climate Change, and Polar Bears v. Nitrogen Emissions, Nitrogen Deposition, and Checkerspots

In a context where growing numbers of species, including many imperiled species, are expected to become increasingly affected by the various consequences of climate change,[113] the possibility of using the ESA to help tackle GHG emissions has become the subject of recent discussion among legal scholars and practitioners.[114] The polar bear — a species of iconic status that is particularly prone to habitat loss resulting from climate change — frequently appears as a "model organism" in such discussions.

The ESA case against GHG impacts on the threatened polar bear and the ESA case against nitrogen impacts on the threatened checkerspot are quite similar in a number of important ways. Polar bear populations have, over time, been affected by the combined pressures of hunting, pollution, oil and gas development, and climate change.[115] Increasingly, climate change is recognized as the principal threat to the long-term survival of the spe-

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[113] *See* F. Stuart Chapin et al., *Consequences of Changing Biodiversity*, 405 NATURE 234, 234 (2000); John F. McLaughlin et al., *Climate Change Hastens Population Extinctions*, 99 PROC. NAT'L. ACAD. SCI. 6070, 6070 (2002); Sala et al., *supra* note 10, at 1771; Chris D. Thomas et al., *Extinction Risk from Climate Change*, 427 NATURE 145, 145 (2004); David Tilman & Clarence Lehman, *Human-Caused Environmental Change: Impacts on Plant Diversity and Evolution*, 98 PROC. NAT'L. ACAD. SCI. 5433, 5433 (2001).

[114] *See* articles cited *supra* note 15.

[115] *See* Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Polar Bear (*Ursus maritimus*) Throughout Its Range, 73 Fed. Reg. 28,212, 28,212 (May 15, 2008); EUGENE H. BUCK ET AL., CONG. RESEARCH SERV., RL 33941, POLAR BEARS: PROPOSED LISTING UNDER THE ENDANGERED SPECIES ACT 4 (2007), *available at* http://www.fas.org/sgp/crs/misc/RL33941.pdf; SCOTT SCHLIEBE ET AL., U.S. FISH & WILDLIFE SERV., RANGE-WIDE STATUS REVIEW OF THE POLAR BEAR (*Ursus maritimus*) 108–09 (2006) (discussing effect of hunting on polar bear populations); Ian Stirling, *Polar Bears and Oil: Ecological*

cies.[116] On May 15, 2008, the FWS listed the polar bear as threatened.[117] The listing, which followed a petition and subsequent litigation,[118] was based on concerns over the loss of sea ice habitat driven by climate change.[119] The bears depend on sea ice for hunting, resting, mating, seasonal movements, and travel to terrestrial denning areas.[120]

Both the polar bear and the checkerspot case involve a dynamic of harm by remote emissions which injure threatened wildlife through a complex chain of causation that involves significant alterations of habitat and consequent interference with essential behavioral patterns such as feeding, breeding, and sheltering. Moreover, from an ESA section 9 perspective, the polar bear case presents the same types of evidentiary challenges as the checkerspot case when it comes to linking remote emissions to the harm experienced by the protected wildlife.[121] The challenges of attributing re-

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Perspectives, *in* SEA MAMMALS AND OIL: CONFRONTING THE RISKS, 223, 228–30 (Joseph R. Geraci & David J. St. Aubin, eds., 1990).

[116] *See* ARCTIC CLIMATE IMPACT ASSESSMENT (ACIA), IMPACTS OF A WARMING CLIMATE: ARCTIC CLIMATE IMPACT ASSESSMENT 58 (2004), *available at* http://amap.no/acia/; MELTZ, *supra* note 15, at 2; SCHLIEBE ET AL., *supra* note 115, at 72; U.S. GEOLOGICAL SURVEY, EXECUTIVE SUMMARY, USGS SCIENCE TO INFORM U.S. FISH & WILDLIFE SERVICE DECISION MAKING ON POLAR BEARS 2 (2007), *available at* http://www.usgs.gov/newsroom/special/polar_bears/; Andrew E. Derocher, Nicholas J. Lunn & Ian Stirling, *Polar Bears in a Warming Climate*, 44 INTEGRATIVE & COMP. BIOLOGY 163, 163 (2004).

[117] *See* Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Polar Bear (*Ursus maritimus*) Throughout Its Range, 73 Fed. Reg. 28,212 (May 15, 2008).

[118] Ctr. for Biological Diversity, Petition to List the Polar Bear (*Ursus maritimus*) as a Threatened Species Under the Endangered Species Act (February 16, 2005), *available at* http://www.biologicaldiversity.org/species/mammals/polar_bear/pdfs/15976_7338.pdf. For details on the litigation that followed the initial petition, see BUCK ET AL., *supra* note 115, at 8.

[119] The decision to list the bear was justified by loss of sea ice habitat, and the administration relied on scientific research pointing to climate change as the cause of sea ice loss to make this case. Ironically, the listing makes absolutely no mention of climate change as the driver of habitat loss and threats to the polar bear. *See* Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Polar Bear (Ursus maritimus) Throughout Its Range, 73 Fed. Reg. 28,212–28,303; Brendan R. Cummings & Kassie R. Siegel, Ursus maritimus*: Polar Bears on Thin Ice*, 22 NAT. RESOURCES & ENV'T 3, 3 (2007).

[120] Ian Stirling & Andrew E. Derocher, *Possible Impacts of Climatic Warming on Polar Bears*, 46 ARCTIC 240, 241 (1993); Steven C. Amstrup, *Polar Bear (*Ursus maritimus*)*, *in* WILD MAMMALS OF NORTH AMERICA: BIOLOGY, MANAGEMENT, AND CONSERVATION 587, 592–96 (George A. Feldhamer et al. eds., 2003). At the same time as it impairs food access and diminishes food availability, for example, decline in sea ice habitat caused by climate change increases the bears' energy requirements, as they travel through fragmented sea ice and open water. *See, e.g.*, Derocher et al., *supra* note 116, at 167. Unsurprisingly, reduced ice presence has been related to declines in polar bear physical condition and reproduction. *See* SCHLIEBE ET AL., *supra* note 115, at 74. Leading polar bear researchers, as well as recent research led by the USGS, have established the seriousness of extinction threats from climate change, concluding that projected sea ice declines should cause the loss of about two thirds of the world's polar bear population by mid-century. *See* U.S. GEOLOGICAL SURVEY, *supra* note 116, at 2.

[121] Polar bear injuries stemming from sea ice loss-related changes in breeding, feeding, and sheltering patterns have yet to be documented with a level of certainty that would satisfy narrow interpreters of harm via habitat modification. It is similarly difficult to conclusively attribute the observed deaths of four polar bears who drowned in trying to reach increasingly distant sea ice to the growing concentrations of GHGs in the atmosphere. *See* Charles Monnett & Jeffrey S. Gleason, *Observations of Mortality Associated with Extended Open-Water Swim-*

sponsibility (and liability) for emissions-triggered habitat modification, however, turn out to be much more significant in the polar bear case than in the checkerspot case.

First, it is difficult to establish that any of the individual GHG sources located within the jurisdictional reach of the ESA contribute to climate change significantly enough to cause actual, detectable changes in the polar bear's sea ice habitat. Thus, even if we know that climate change is the cumulative effect of the GHGs from different emitters — climate change that has been linked to polar bear injuries and deaths — the significance of individual United States emitters' contributions to these injuries remains difficult to quantify.[122]

This difficulty is further compounded by the long residence times of GHGs in the atmosphere. Such long residence times make it possible for any GHG emitters that find themselves as defendants in a polar bear take case to argue that past rather than present emissions are in fact responsible for the presently experienced advances in climate change and their impacts on listed polar bears. Long GHG residence times also make it even harder to disaggregate the contribution of individual GHG emitters to any observed polar bear injuries.[123]

Finally, it is prohibitively difficult to trace the path of emissions from a specific, individual source through the atmosphere. Together with long residence times, this knowledge deficiency makes the attribution of any liability for harming protected wildlife a particularly fraught enterprise. To paraphrase Matthew Gerhart's helpful practical grounding of these issues, it will be very hard for a plaintiff to demonstrate that a coal plant in Ohio is violating section 9 because it releases carbon dioxide, which contributes to global warming, which causes disappearance of the sea ice, which has caused polar bears to drown in open water.[124]

Despite these difficulties in showing causation and attributing liability for climate change-triggered harm to polar bears, the Bush Administration viewed a legal challenge accusing major GHG emitters of taking polar bears in violation of section 9 of the ESA as plausible enough to warrant the promulgation of a rule that essentially exempts GHG emitting activities from the take provisions of ESA section 9.[125] In the context of the broader policy battle to reduce GHG emissions, legal scholars and practitioners have also seen a section 9 take challenge as plausible enough to caution against the launching of such a challenge, raising concerns about the ultimate inability

ming by Polar Bears in the Alaskan Beaufort Sea, 29 Polar Biology 681, 681 (2006). For more details on the yet to be filled evidentiary gaps in a polar bear taking case against GHG emitters, see, for example Gerhart, *supra* note 15, 173.

[122] *See* Gerhart, *supra* note 15, at 198; Meltz, *supra* note 15, at 3.

[123] *See* Gerhart, *supra* note 15, at 198.

[124] *See id.*, at 169; *see also* Ruhl, *Endangered Species Act*, *supra* note 14, at 284 n.44.

[125] Specifically, the special rule states that "[n]one of the prohibitions of § 17.31 of this part apply to any taking of polar bears that is incidental to, but not the purpose of, carrying out an otherwise lawful activity within the United States, except for any incidental taking caused by activities in areas . . . within the current range of the polar bear." 50 C.F.R. § 17.40(q)(4).

of the ESA to meaningfully address the GHG problem,[126] as well as about the potential of any attempted extension of the act to backfire politically.[127]

In comparison to the GHG example, responsibility for offending nitrogen emissions in the checkerspot case should be easier to attribute. This is partly because the dynamics of nitrogen deposition are much simpler than the dynamics of GHG-driven climate change. Long-distance transport of biologically reactive nitrogen is negligible and residence times for nitrogen in the atmosphere are relatively short.[128] Furthermore, nitrogen deposition is generally traceable to a range of emitters on a regional scale.[129] That is, the population of nitrogen emitters responsible for a particular harmful instance of nitrogen deposition is much more geographically circumscribed, and as a result, these emitters are much easier to define.

Most importantly, attributing responsibility for an emissions-triggered take is easier in the checkerspot case because tracing the nitrogen contributions of individual major emitters and assessing their share of responsibility for the alteration of checkerspot habitat should not be necessary to build a robust take case against nitrogen emissions. The regulation of nitrogen emissions under existing federal and state air quality statutes arguably means that a plaintiff in a section 9 case aimed at stopping nitrogen-related take of checkerspots would not need to target individual stationary and mobile emitters. Rather, following the precedent established by cases such as *Defenders of Wildlife v. EPA*[130] and *Strahan v. Coxe*,[131] a plaintiff could target the federal and state agencies that have discretionary authority over setting ambient air quality standards for emissions of reactive nitrogen compounds and over the regulation and permitting of nitrogen emissions from stationary and mobile sources. It is arguably those agencies, rather than individual emitters, that are ultimately responsible for the overall amount of regional nitrogen emissions, and so are responsible for the overall amount of nitrogen deposition and resultant harm to the checkerspot.[132]

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[126] Ruhl, *Endangered Species Act*, *supra* note 14, at 289; Baur, *supra* note 14, at 10747.

[127] Ruhl, *Climate Change*, *supra* note 13, at 41, 60.

[128] *See, e.g.*, Fenn et al., *supra* note 25, at 394–95

[129] *See, e.g.*, *id.* (noting that nitrogen can be traced via atmospheric modeling and regional air pollutant monitoring).

[130] 882 F.2d 1294 (8th Cir. 1989).

[131] 127 F.3d 155 (1st Cir. 1997).

[132] Combustion-origin NH_3 emissions from stationary and mobile sources remain unregulated, making it harder to apply the same type of ESA leverage as for NO_x. *See* Bishop et al., *supra* note 39, at 3616. NH_3 (and other nitrogen as well as non-nitrogen emissions) from large animal feeding operations are, however, increasingly coming under (arguably long overdue) CAA scrutiny for future regulation. *See, e.g.*, R.W. Pinder et al., *Ammonia Emission Controls as a Cost-Effective Strategy for Reducing Atmospheric Particulate Matter in the Eastern United States*, 41 ENVTL. SCI. & TECH. 380, 384–85 (2007). The regulation of such agricultural ammonia emissions has already begun in Idaho and in some of the most heavily impacted air districts in California, such as the South Coast Air Quality Management District. *See* CLAUDIA COPELAND, CONG. RESEARCH SERV., RL 32948, AIR QUALITY ISSUES AND ANIMAL AGRICULTURE: A PRIMER 11–15 (2010), *available at* http://www.nationalaglawcenter.org/assets/crs/RL32948.pdf; Jeff El-Hajj, *Confined Animal Feeding Operations in California: Current Regulatory Schemes and What Must Be Done to Improve Them*, 15 HASTINGS W.-NW. J.

The precise apportionment of liability among EPA and the state regulatory agencies with parallel responsibilities for air quality standards and emission controls is beyond the scope of this Article. It is, however, important to note that the extent of agency liability for harmful nitrogen emissions will depend on the extent of discretionary authority that an agency has over relevant standard-setting and emissions permitting decisions. For example, to the extent that both CARB and EPA have discretionary authority to set California air quality standards for NO_x and other nitrogen emissions (such as NH_3) and to regulate mobile source emissions, each of the agencies could be seen as responsible for the deposition impacts of nitrogen emissions on listed species like the checkerspot.[133] Similarly, responsibility would extend to relevant Air Quality Management Districts, such as the Bay Area Air Quality Management District ("BAAQMD"), which is in charge of emissions permitting in the region where most of the nitrogen emissions impacting checkerspot habitat and affecting the threatened checkerspot originate. On the one hand, to the extent that the BAAQMD has discretionary authority over the permitting of individual stationary source emitters within its jurisdiction, it can — and arguably should — be held responsible for the listed species impacts of the nitrogen emissions it issues permits for.[134] On the other hand, to the extent that many state-level emission control activities, for both mobile and stationary sources, are driven by the desire to comply with discretionary federal EPA ambient air quality standards for NOx, and to the extent that the nitrogen-driven modification of checkerspot habitat occurred in the context of long-term compliance with EPA's ambient standard, a considerable amount of the responsibility for a checkerspot take via nitrogen-driven habitat modification may ultimately rest with EPA. Liability apportionment between responsible regulatory agencies can prove quite complex in practice.

ENVTL. L. & POL'Y 349, 362–65 (2009); *see also* Sarah C. Wilson, *Hogwash! Why Industrial Animal Agriculture is Not Beyond the Scope of Clean Air Act Regulation*, 24 PACE ENVTL. L. REV. 439, 459–66 (2007); S. Coast Air Quality Mgmt. Dist., Rule 1127, Emission Reductions from Livestock Waste (2004), *available at* http://www.aqmd.gov/rules/reg/reg11/r1127.pdf. Further, starting to regulate both combustion- and livestock- source NH_3 under the CAA is being discussed as a way to control the formation of particulate matter. NH_3 is a precursor to the formation of fine particulates ("$PM_{2.5}$"), which EPA already regulates as a criteria pollutant, through the imposition of a National Ambient Air Quality Standard — a standard which many areas in the country are currently having trouble attaining. *See* Pinder et al., *supra*, at 380.

[133] For details on (1) the division of federal-state responsibilities for air quality control in general, and mobile source emissions regulation in particular, and (2) the extent of discretionary authority that EPA and CARB have over the setting of mobile source standards, see, for example, NAT'L RESEARCH COUNCIL, STATE AND FEDERAL STANDARDS FOR MOBILE SOURCE EMISSIONS 65–113 (2006).

[134] For further details on the workings of cooperative federalism under the CAA, *see infra* notes 157–172, 196–198 and accompanying text. *See generally* NAT'L RESEARCH COUNCIL, *supra* note 133, at 65–113; John P. Dwyer, *Environmental Federalism: The Practice of Federalism Under The Clean Air Act*, 54 MD. L. REV. 1183 (1995); Arnold W. Reitze, Jr., *Air Quality Protection Using State Implementation Plans — Thirty-Seven Years of Increasing Complexity*, 15 VILL. ENVTL. L.J. 209 (2004).

Another critical difference between the GHG/polar bear case and the nitrogen/checkerspot case which makes the checkerspot easier to regulate is the regulatory situation of nitrogen as opposed to GHGs. Namely, even if GHG emissions were federally regulated by a single agency, this agency would still not have power over all of the emitters responsible for climate change and the climate-change-driven destruction of polar bear habitat because so many of these emitters are located outside the United States. And even if responsibility for offending GHG emissions could be attributed to a single regulatory agency, rather than the vast number of individual GHG emitters, the viability of a take challenge against the agency would still depend on the ability to show that a change in the agency's regulatory actions could appreciably reduce the extent or rate of climate change. This is a significant burden of proof, even if meeting it has arguably become more plausible in the aftermath of *Massachusetts v. EPA*.[135] No such problems are foreseeable with nitrogen, where emissions are deposited regionally, and are thus largely within the control of federal and state agencies. In sum, it should be considerably easier (and much more practicable) to establish both causation and liability in the checkerspot case.

In evaluating prospects of a take challenge against agencies responsible for the harmful nitrogen deposition by virtue of their responsibilities for regulating nitrogen emissions, it is also important to apply the fairness standard advanced by Justice O'Connor's concurring opinion in *Sweet Home*.[136] To the extent that decisions about proximate causation are determined by the fairness of imposing liability for remote consequences, it is useful to consider whether it is fair and reasonable to hold air quality or emissions control agencies (at the federal and state level) liable for the serpentine habitat decline and checkerspot injuries occurring as a result of nitrogen deposition.

The comparison with the GHG/polar bear case is once again particularly helpful in approaching this question. For example, using the ESA to leverage GHG reductions by going after individual large emitters poses some significant questions about fairness, especially since such use of the ESA is clearly strategic. ESA litigation against GHGs can be seen as a way to create annoyance and regulatory uncertainty for a significant number of large emitters — annoyance and uncertainty that might just become large enough to make a national climate/GHG policy seem preferable to the alternative, thereby inducing major emitters to support a uniform policy. Under this view, ESA litigation against GHG emitters is essentially a way of nudging US climate policy forward, rather than an actual, practical way of stopping harm to listed species.

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[135] 549 U.S. 497 (2007). For a more detailed discussion on the relevance of *Massachusetts v. EPA* to the case of leveraging the ESA for control of GHG emissions, see MELTZ, *supra* note 15, at 3; Gerhart, *supra* note 15, at 189; *see also* Ruhl, *Climate Change*, *supra* note 13, at 9–11, 45–46.

[136] Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 713 (1995) (O'Connor, J., concurring).

Conversely, leveraging the ESA to get federal and state agencies to better consider the ecological implications of their air quality and emissions regulations seems hardly unfair, especially when we take into account the fact that such agencies already have explicit mandates to protect ecosystems as well as human health in making their regulatory decisions.[137]

V. The Section 7 Jeopardy and Critical Habitat Standards and EPA Regulation of Nitrogen Emissions Under the CAA

The possibility that nitrogen deposition constitutes a prohibited take of checkerspots has implications for the implementation of Section 7 of the ESA as well. Section 7 requires each federal agency to ensure that its actions do not jeopardize the continued existence of any threatened or endangered species or adversely modify the designated critical habitat of such species.[138] Section 7 adds an affirmative species protection duty to the primary mandates and overall obligations of federal agencies.

The FWS regulations define jeopardizing the continued existence of a listed species to mean engaging in an action that reasonably would be expected to *directly* or *indirectly* reduce the likelihood of *survival* and *recovery* of a listed species in the wild.[139] An agency action is, in turn, considered destruction or adverse modification of critical habitat if it produces a "*direct* or *indirect* alteration that appreciably diminishes the value of critical habitat for both the *survival* and *recovery* of a listed species."[140]

Agency actions covered by the section 7 jeopardy and critical habitat provisions are defined broadly to include "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies."[141] Importantly, then, federal agency activities covered under the section 7 jeopardy prohibition include not only projects directly conducted by the agencies themselves, like the construction of highways, seawalls, and water works, or the operation of a federal facility, but also any regulatory, permitting, licensing, leasing, contracting, grant-making, or other activities that can result in modifications of "land, water, or air."[142]

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137 42 U.S.C. §§ 7409(b), 7602(h) (2006).

138 16 U.S.C. § 1536(a)(2) (2006). After *Tennessee Valley Authority v. Hill*, 437 U.S. 153 (1978), Congress amended the ESA to allow agencies to seek exemption from the jeopardy prohibition through the Endangered Species Committee, but, in reality, appeals to the Committee for such exemptions are exceedingly rare. *See* Patrick Parenteau, *The Exemption Process and the "God Squad"*, *in* Endangered Species Act: Law, Policy, and Perspectives, *supra* note 45, at 132, 143.

139 50 C.F.R. § 402.02 (2010).

140 *Id.* (emphasis added).

141 *Id.*

142 *Id.* Courts have also interpreted the meaning of agency actions quite broadly for the purposes of section 7 consultation and jeopardy avoidance requirements. *See* Marilyn Averill, *Protecting Species Through Interagency Cooperation*, *in* Endangered Species Act: Law, Policy, and Perspectives, *supra* note 45, at 90–91.

Federal agencies are expected to ensure that none of their numerous actions would jeopardize the continued existence of a listed species or adversely modify its designated critical habitat through consultation with the FWS or NMFS.[143] Under section 7, then, a federal agency embarking on a regulatory action is required to consider the effects of such action on any ESA-listed species within the action area.[144] If the agency, in informal consultation with the FWS or NMFS, determines that its intended action may adversely affect a listed species or critical habitat, then the agency is required to enter into a formal consultation with the FWS or NMFS. Formal consultation culminates with a Biological Opinion ("BO") in which FWS and NMFS state their findings as to the effects of the proposed action on listed species and their critical habitat. In reality, jeopardy findings are quite rare, and projects being stopped because of listed species jeopardy are rarer still.[145] In the infrequent occasions when the FWS does conclude that an agency action as proposed will result in jeopardy to a listed species, it usually offers "reasonable and prudent alternatives" which the agency can then incorporate into its project planning and execution in order to avoid such jeopardy.[146]

Some legal scholars have described section 7 as "the most robust command-and-control weapon in the arsenal of environmental law"[147] and see the outcomes of section 7 consultations as "exceptionally dispositive of fed-

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[143] 50 C.F.R. § 402.01(b) (2010).

[144] For details on the consultation requirements and process, see U.S. Fish & Wildlife Serv. & Nat'l Marine Fisheries Serv., Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act (1998). For specific discussion of how "action area" can be interpreted in a context of remote, emissions-origin threats, see Gerhart, *supra* note 15, at 173–77.

[145] *See, e.g.*, U.S. Gov't Accountability Office, GAO-92-131BR, Endangered Species Act: Types and Number of Implementing Actions (1992); U.S. Gov't Accountability Office, GAO-04-93, Endangered Species: More Federal Management Attention Is Needed to Improve the Consultation Process 7, 49, 50, 56–57 (2004); *see also* Christopher E. Williams, *The Cost of Continued Existence: Assessing the Impacts of Section 7 on Federal Agencies, Private Actors, and Endangered Species*, *in* Endangered Species Act: Law, Policy, and Perspectives, *supra* note 45, at 179; Oliver A. Houck, *The Endangered Species Act and Its Implementation by the U.S. Departments of Interior and Commerce*, 64 U. Colo. L. Rev. 277, 301, 311, 317–18 (1993).

[146] If the agency action subject to section 7 consultation is expected to result in some take of listed wildlife, the FWS BO may include an incidental take statement, which insulates the agency (or the private applicant for an agency permit) from liability under section 9 by formally permitting a certain specified — and limited — amount of species take. Incidental take statements are only issued as part of a BO if the take resulting from the activities of federal agencies or their permittees is not causing jeopardy to the affected species, and if they are accompanied by the specification of reasonable and prudent measures to minimize the impacts of agency (or permittee) actions on the listed species affected. What this also means, though, is that if an agency such as EPA fails to conduct section 7 consultation for its regulatory actions, it is also failing to secure an incidental take permit; this leaves the agency vulnerable to section 9 litigation should its regulatory actions result in direct or habitat related harm to listed wildlife.

[147] Laurence M. Bogert, *The Endangered Species Act and Categorical Statutory Commands after* National Association of Homebuilders v. Defenders of Wildlife, 44 Idaho L. Rev.

eral (and, in certain circumstances, private) activity interfacing with species listed under the ESA."[148]

A close look at the range of practical experience does not necessarily bear out the "dispositive" notion,[149] but section 7 is nonetheless important. Even if it seldom halts or changes federal projects and regulations,[150] it can still force both federal agencies and applicants for federal permits to consider the needs and well-being of listed species at the early stages of project planning and regulatory action. It can thereby offer threatened and endangered species an added level of protection.[151]

A. *Section 7 Requirements, Nitrogen Emissions, and Nitrogen Deposition*

Section 7 focuses on the impacts of federal agency actions on both the survival and recovery of listed species. Considering that the checkerspot is about to be reclassified from threatened to endangered partly due to nitrogen-driven alterations of its habitat,[152] any federal agency action appreciably contributing to nitrogen emissions that deposit on checkerspot habitat should require section 7 scrutiny and consultation. In fact, given the mechanisms of nitrogen impact on the checkerspot and its serpentine habitat, section 7 provides multiple triggers for scrutiny of federal actions that contribute to nitrogen emissions that deposit on checkerspot habitat.

First, showing that the habitat modifications triggered by nitrogen emissions and the resultant nitrogen deposition reduce the likelihood of checkerspot survival and recovery may turn out to be easier, in ecological terms, than showing death or injury of identifiable checkerspot individuals. That is, showing that nitrogen deposition causes jeopardy to the checkerspot may be easier than showing that nitrogen deposition causes prohibited take of checkerspots. Second, given the mounting ecological evidence that nitrogen emissions (and resulting nitrogen deposition) are indirectly, but likely adversely, modifying the serpentine grasslands that contain all of the designated critical habitat of the checkerspot, the critical habitat provision of section 7 may come into play.[153] Third, the nitrogen-driven modification of the checker-

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543, 545 (2008) (citing WILLIAM H. ROGERS JR., ENVIRONMENTAL LAW, § 9.9, at 997 (2d ed. 1994)).

[148] *Id.*

[149] *See, e.g.*, U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-09-550, ENDANGERED SPECIES ACT: THE U.S. FISH AND WILDLIFE SERVICE HAS INCOMPLETE INFORMATION ABOUT EFFECTS ON LISTED SPECIES FROM SECTION 7 CONSULTATIONS (2009); Mary Jane Angelo, *The Killing Fields: Reducing the Casualties in the Battle Between U.S. Species Protection Law and U.S. Pesticide Law*, 32 HARV. ENVTL. L. REV. 95 (2008); *see also supra* note 145 and accompanying text.

[150] *See, e.g.*, Averill, *supra* note 142, at 107–08; Williams, *supra* note 145, at 184–87.

[151] Averill, *supra* note 142, at 107–08.

[152] U.S. FISH & WILDLIFE SERV., *supra* note 1, at 13–15, 16–19, 24, 26–27.

[153] Critical habitat for the checkerspot was proposed in 2000, Proposed Designation of Critical Habitat for the Bay Checkerspot Butterfly, 65 Fed. Reg. 61,218 (proposed Oct. 16, 2000), designated in 2001, Final Determination of Critical Habitat for the Bay Checkerspot Butterfly, 66 Fed. Reg. 21,449 (April 30, 2001), and revised in 2008, Designation of Critical

spot's serpentine habitat involves the disadvantaging and displacement of native plant species in a context where several native plants are listed as federally threatened or endangered.[154] Section 7 scrutiny may thus be triggered by nitrogen effects on listed plants as well.[155]

In this context, there are a considerable number and variety of federal agency actions — from highway funding and construction to the design and promulgation of emissions trading schemes — which may trigger section 7 consultation and require scrutiny against its jeopardy and critical habitat standards. Indeed, any agency actions that regulate, authorize, fund, or otherwise contribute to substantial emissions of nitrogen in the vicinity of checkerspots and their nitrogen-sensitive serpentine habitats should trigger section 7 scrutiny and consultation. The same obviously applies to agency actions that contribute to nitrogen emissions in the vicinity of any nitrogen-sensitive listed species or the nitrogen-sensitive critical habitats of listed species.

In the rest of this section, we focus on federal air quality and emissions control regulations, given their major significance in determining amounts of nitrogen deposition on checkerspot habitat and beyond. Further, and equally as important, adjusting federal emission controls and federal air quality standards in response to section 7 leverage from the ESA should be quite practicable and indeed is arguably overdue. Given the tremendous complexity of the regulatory regime created by the CAA, we selectively emphasize some of the more relevant air quality and emission control actions across several different scales of EPA regulatory intervention. At the same time, we endeavor to conduct our analysis in a way that allows for its extension to other regulatory actions with a bearing on nitrogen emissions, including actions by EPA and other federal agencies and actions under the CAA or other statutory authorities.[156]

Habitat for the Bay Checkerspot Butterfly, 73 Fed. Reg. 50,405 (Aug. 26, 2008) (codified at 50 C.F.R. pt. 17). For a summary of the litigation that prompted this revision and the changes in checkerspot population between the two critical habitat designations, see Designation of Critical Habitat for the Bay Checkerspot Butterfly, 73 Fed. Reg. 50,405 (Aug. 26, 2008).

[154] Current research on Bay Area serpentine grasslands is aimed at more rigorously quantifying the effects of nitrogen deposition on native serpentine grassland plants, including listed plant species. The latter include the Santa Clara Valley dudleya (*Dudleya setchellii*), Metcalf Canyon jewelflower (*Streptanthus albidus ssp. albidus*), Tiburon Indian paintbrush (*Castilleja affinis ssp. neglecta*), and coyote ceanothus (*Ceanothus ferrisae*). *See* Donald Mayall, *Protecting Coyote Ridge*, 36 FREMONTIA: J. CAL. NATIVE PLANT SOC'Y, 12, 15 (Winter 2008).

[155] Unlike the take prohibition of section 9, which only shields listed wildlife, the jeopardy and critical habitat prohibitions of section 7 are designed to protect both plant and wildlife species listed as federally threatened or endangered. To the extent, of course, that the presence of federally listed plant species in the checkerspot's serpentine habitat provides a trigger for scrutiny and perhaps modification of federal actions affecting nitrogen emissions (and nitrogen deposition), the checkerspot can be expected to benefit. Further, any reductions in nitrogen emissions and so ambient concentrations and nitrogen deposition, regardless of which particular ESA trigger brings them about, should be beneficial to serpentine ecosystems and other nitrogen-sensitive systems or species in the affected region.

[156] Other federal standard setting activities, such as the setting of CAFE standards, may also call for section 7 scrutiny. NH_3 emissions, for example, are shown to have a strong dependence on model year and vehicle-specific power (vehicle-specific power being a proxy

The rest of this section considers the challenges and potential of applying section 7 requirements to several types of EPA regulatory actions with a direct bearing on nitrogen emissions, ambient nitrogen concentrations, and nitrogen deposition on checkerspot habitat, including: emissions permitting for new sources, the setting of National Ambient Air Quality Standards ("NAAQS"), and the approval of State Implementation Plans ("SIPs"). This section further discusses the likelihood that such leveraging of the ESA against the CAA could produce meaningful reductions in nitrogen emissions and nitrogen deposition on checkerspot habitat.

B. Section 7 Consultation for EPA Regulations of Nitrogen Emissions Under the CAA

In accord with the practice of cooperative federalism established under the CAA, states make a number of important regulatory decisions regarding the permitting and control of nitrogen emissions. For example, while EPA controls emissions from new and modified sources through nationally uniform new source performance standards[157] and requirements for new source review,[158] emissions limitations for existing sources are left to the states' relatively unfettered discretion.[159] In our case, California is also the only state allowed by the CAA to set vehicle emission standards that exceed federal standards.[160]

States exercise much of their regulatory discretion in the context of air quality planning, which culminates in a SIP that requires EPA approval before it can enter into force.[161] EPA approval, in turn, depends on whether the range of discretionary emission control, transportation control, vehicle inspection and other measures stipulated in a SIP cumulate in a way that

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variable for engine load that has been shown to be highly correlated with emissions). *See* Bishop et al., *supra* note 39, at 3616, 3619.

[157] 42 U.S.C. § 7411 (2006).

[158] 42 U.S.C. §§ 7470–7479, §§ 7501–7515 (2006); *see also* ARNOLD W. REITZE, AIR POLLUTION CONTROL LAW: COMPLIANCE AND ENFORCEMENT 177–99 (2001); Bernard F. Hawkins, Jr. & Mary Ellen Ternes, *The New Source Review Program: Prevention of Significant Deterioration and Nonattainment New Source Review*, *in* THE CLEAN AIR ACT HANDBOOK, 131, 131–34 (Robert J. Martineau, Jr. & David P. Novello eds., 2d ed. 2001).

[159] 42 U.S.C. § 7410(a)(2) (2006). For a more detailed breakdown of federal and state regulatory responsibilities under the CAA, see, for example, REITZE, *supra* note 158, at 56–59 and Dwyer, *supra* note 134, at 1190–1216.

[160] 42 U.S.C. § 7543 (2006). This occurred by virtue of a California pre-1967 vehicle emission regulation being grandfathered into the predecessor of the CAA of 1970, the Air Quality Act of 1967, Pub. L. No. 90-148, 81 Stat. 485. The waiver of federal preemption over California vehicle emission standards has essentially stayed intact since then. For further details, see Michael J. Horowitz, *Regulation of Mobile Sources: Motor Vehicles, Nonroad Engines, and Aircraft*, *in* THE CLEAN AIR ACT HANDBOOK, *supra* note 158, at 323.

[161] 42 U.S.C. § 7410(a) (2006); *see also* Reitze, *supra* note 134, at 211–12.

ensures attainment of NAAQS[162] for NO_2[163] standards that are set by the EPA.[164]

Within the CAA context of cooperative federalism, EPA retains authority over a range of regulatory decisions that are significant in affecting nitrogen deposition on regional and national scales. These are the regulatory decisions that invite section 7 scrutiny. Although state air quality and emission control regulations generally remain outside the reach of section 7's jeopardy and critical habitat requirements,[165] any state actions that affect nitrogen emissions and nitrogen deposition on checkerspot habitat can still fall within section 9's take prohibitions.

C. Section 7 Consultation for Permitting New Sources of Nitrogen Emissions

There is already some limited precedent of section 7 consultation regarding the regulation of nitrogen emissions in the vicinity of nitrogen-sensitive checkerspot habitat. This precedent was established in the context of CAA permitting for a new natural gas power plant — the Metcalf Energy Center — in South San Jose. The Metcalf Energy Center, as proposed, was found to have NO_x emission potential significant enough to qualify it as a major new source under the CAA.[166] Together with the facility's location in the BAAQMD, a region with long-term attainment of NAAQS for NO_2,[167] this meant that Metcalf's developers had to obtain a CAA prevention of significant deterioration permit ("PSD permit") before construction of the power plant could begin.[168]

The BAAQMD, which handled the Metcalf permitting, is a state agency acting as a delegate of EPA, and accordingly sets emission standards for major new sources.[169] All PSD permits, including those issued by delegated

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[162] 42 U.S.C. § 7410 (2006). *See infra* notes 178–185 and accompanying text for details on NAAQS and how they fit within the broader scheme of air quality and emissions control under the CAA.

[163] NAAQS are set by EPA for NO_2 and five other criteria pollutants. *See id.*

[164] 40 C.F.R. § 50.4–17 (2010). Section 116 of the CAA, however, allows states to adopt more stringent air quality standards than the federal ones. *See* 42 U.S.C. § 7416 (2006).

[165] This includes state regulations developed to implement CAA mandates as well as air quality and nitrogen emission controls imposed through state law and regulation.

[166] *See* 42 U.S.C. § 7479 (2006); *see also* Order Denying Review of Metcalf Energy Center PSD Permit No. 99-AFC-3, PSD Appeal Nos. 01-07 and 01-08 (EPA Envtl. Appeals Board Aug. 10, 2001), at 5–6; EPA, DRAFT NEW SOURCE REVIEW WORKSHOP MANUAL A.22–A.23 (1990).

[167] *But see infra* note 186.

[168] *See* 42 U.S.C. §§ 7470-79 (2006); *see also* U.S. FISH AND WILDLIFE SERV., BIOLOGICAL OPINION IN THE FORMAL ENDANGERED SPECIES CONSULTATION ON THE PREVENTION OF SIGNIFICANT DETERIORATION PERMIT FOR THE PROPOSED METCALF ENERGY CENTER, SAN JOSE, SANTA CLARA COUNTY, CALIFORNIA 1–3 (2001) [hereinafter METCALF BO].

[169] BAAQMD is authorized to make PSD permitting decisions for new and modified stationary sources of air pollution in the San Francisco Bay area of California pursuant to a delegation agreement with EPA Region IX. *See* 40 C.F.R. § 52.21(u) (2010); 56 Fed. Reg. 4,944 (Feb. 7, 1991); *see also* EPA, BAY AREA AIR QUALITY MANAGEMENT DISTRICT AGREE-

states, are considered by EPA to be federal actions for the purposes of ESA section 7.[170] As a result, EPA initiated formal consultation with the FWS regarding the effects of Metcalf's PSD permit on the numerous listed species found in the vicinity of the proposed power plant.[171] The effects of nitrogen emissions on the checkerspot were considered as part of this consultation.[172]

The resultant BO found that nitrogen (both NO_x and NH_3) discharged from the power plant's exhaust stacks would precipitate onto adjacent checkerspot serpentine habitats.[173] However, the BO concluded that the emissions, as limited by the permit, are not likely to jeopardize the continued existence of the checkerspot or the listed serpentine plant species.[174] This is hardly a surprise when we consider that the limitations of existing modeling capacity prevent us from gauging the contribution of an individual nitrogen emitter to the broader nitrogen-driven disruption of serpentine habitats and species.[175] What this ultimately means, though, is that section 7 consultation over individual emission permits — such as PSD permits for new facilities — is likely an inadequate tool when it comes to shielding the checkerspot or other nitrogen-sensitive habitats and species from the threats of nitrogen emissions. The regulatory action through which EPA affects checkerspot and its serpentine habitat most is, arguably, the setting of NAAQS for NO_2.

D. EPA's NAAQS for NO_2

NAAQS are intended to protect public health and welfare.[176] They consist of nationally uniform limits that EPA sets on the ambient concentrations of the most ubiquitous and universally problematic air pollutants (also known as criteria pollutants).[177] EPA designated and currently regulates six criteria pollutants, including NO_2, carbon monoxide, ozone, particulate matter, sulphur dioxide, and lead.[178] NAAQS for these six pollutants are to be

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MENT FOR LIMITED DELEGATION OF AUTHORITY TO ISSUE AND MODIFY PREVENTION OF SIGNIFICANT DETERIORATION PERMITS SUBJECT TO 40 C.F.R. 52.21 (2006).

[170] *See, e.g.*, EPA, *supra* note 166, at 5; Order Denying Review, PSD Appeal Nos. 1-07 and 1-08.

[171] The consultation was initiated by EPA Region IX on March 24, 2000. *See* METCALF BO, *supra* note 168, at 1163.

[172] *See id.* at 23–24, 26–27.

[173] *Id.* at 7–8, 23–24, 29.

[174] *Id.* at 27–28. Interestingly, the Metcalf BO includes the following statement as part of its incidental take permitting: "Take in the form of harm of all bay checkerspot individuals due to nitrogen deposition on 3,176 acres of habitat will become exempt from the prohibitions described under section 9 of the Act for indirect impacts associated with the project." *Id.* at 29. This is notable because it suggests that the FWS has previously thought of nitrogen as a possible source of harm and a take of checkerspots.

[175] *See* TONNESEN ET AL., ASSESSMENT OF NITROGEN DEPOSITION: MODELING AND HABITAT ASSESSMENT 3 (2007).

[176] 42 U.S.C. § 7409(b) (2006).

[177] 42 U.S.C. §§ 7408–09 (2006); *see also* Richard E. Ayers & Mary Rose Kornreich, *Setting National Ambient Air Quality Standards*, *in* THE CLEAN AIR ACT HANDBOOK, *supra* note 158, at 13, 13–14.

[178] 40 C.F.R. pt. 50 (2010); *see also* REITZE, *supra* note 158, at 33–49.

reviewed and updated every 5 years, although this has hardly ever been the case in actual practice.[179]

The level at which at which EPA sets NAAQS for NO_2 has immediate significance in determining the overall levels of nitrogen emissions and deposition on ecosystems nationwide. The CAA, in fact, explicitly acknowledges the ecological implications of NAAQS by instructing EPA to set both primary NAAQS that protect public health[180] and secondary NAAQS that protect public welfare;[181] secondary NAAQS are defined to include protection from pollutant effects on water, soils, crops, vegetation, wildlife, and economic values.[182]

With the exception of SO_2, for which the secondary standard is marginally stricter than the primary one,[183] the primary and secondary NAAQS for each criteria pollutant have always been set at the same level. EPA devotes the bulk of its regulatory energy to developing primary standards that can shield against the human health consequences of air pollution, and then simply adopts the primary standard to serve as a secondary one.[184]

In the case of NO_2, EPA has done this in spite of growing evidence that the primary standard is insufficient to protect ecosystems and species, including ESA-listed species and their habitats.[185] This is precisely the kind of situation that section 7 consultation is positioned to arbitrate and address, especially since EPA has not only discretion, but also a mandate to set NAAQS at levels that protect soils and wildlife. The need for and the value of section 7 consultation in the setting of NAAQS for NO_2 becomes even more apparent when we consider that EPA has, in the past, declined to revise NAAQS for NO_2. Until a few months ago, the standard remained effectively unchanged since its initial promulgation in 1971.[186] EPA considered it adequate to "protect vegetation and materials from the direct effects of NO_2."[187]

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[179] 42 U.S.C. § 7409(d) (2006); *see also* Reitze, *supra* note 158, at 42.
[180] 42 U.S.C. § 7409(b)(1) (2006).
[181] 42 U.S.C. § 7409(b)(2) (2006).
[182] 42 U.S.C. § 7602(h) (2006).
[183] *See* Reitze, *supra* note 158, at 38.
[184] *See id.* at 37–38.
[185] Fenn et al., *Ecological Effects*, *supra* note 7, at 411–16.
[186] *See* Reitze, *supra* note 158, at 42; Primary National Ambient Air Quality Standards for Nitrogen Dioxide, 75 Fed. Reg. 6474 (Feb. 9, 2010) (to be codified at 40 C.F.R. pts. 50, 58). On February 9, 2010, EPA introduced a stricter NAAQS for NO_2. The new NAAQS adds a short-term, one-hour daily maximum for ambient NO_2 concentrations to the existing annual average of allowable NO_2 concentrations. *See id.* There is, as yet, no data on the extent of compliance with this new standard. In other words, we do not yet have the data to determine (1) whether the relevant California air quality districts (i.e., districts within the airshed of relevance to the checkerspot) are in compliance with the new standard, or (2) whether the new standard will enable any appreciable extra protection to California serpentine grasslands and their checkerspot inhabitants.
[187] Reitze, *supra* note 158, at 42. Not only was EPA not considering anything beyond direct effects, but also past reviews of NAAQS for NO_2 were only conducted because NGOs sued to compel the agency to comply with the periodic NAAQS review required under the CAA. *See id.*

EPA regulatory decisions on the setting of NAAQS for NO_x, including any EPA decision to set the secondary standard at the same level as the primary one, are therefore obvious candidates for section 7 jeopardy and critical habitat consultation. Furthermore, to the extent that EPA practice has effectively mooted secondary NAAQS by making them the same as the primary ones,[188] it may be most appropriate for EPA to consult the FWS when it conducts the required 5-year review and revision of the primary NAAQS for NO_x.

Regardless of how the demarcation between primary and secondary NAAQS is handled in the future, the nationwide uniformity of NAAQS will make section 7 consultation over the setting of these standards a fairly complex, or at least labor- and data-intensive process. The consultation will have to consider the impact of a proposed NO_2 NAAQS on all listed species and their designated critical habitat. This will require knowledge of the sensitivity of listed species and their habitat to additional nitrogen deposition, including but not limited to the calculation of critical loads for nitrogen for the ecosystems where listed plant and wildlife species are found. Once such data is considered, EPA might end up having to set the primary or secondary NAAQS for NO_2 low enough to protect the most nitrogen-sensitive listed species and critical habitats. This is obviously a non-trivial task.

E. SIPs and the Control of Nitrogen Impacts on Listed Species

In this situation, EPA consultation over the permitting of individual emitters is insufficient to address the full extent of emission impacts on the more nitrogen-sensitive listed species.[189] Consultation over the setting of NAAQS for NO_2, while technically well-positioned to accomplish improved protection of listed species and their critical habitats, also presents some significant practical challenges.

In this context, the design and implementation of SIPs stands out as a potentially more practical way to ensure that air quality in general, and NO_x emissions in particular, do not jeopardize listed species or damage their habitats. This is because the CAA rules for SIP design give states significant flexibility in deciding on the specifics of emissions control regulations.[190] These specifics include the exact conditions stipulated in emissions permits, the use and nature of transportation planning and transportation control measures, and the distribution of regulatory burdens among different types of

[188] *Id.* at 16, 37–38; Ayers & Kornreich, *supra* note 177, at 17.

[189] Many individual permits are administered by state air quality agencies, but EPA still considers CAA permitting of new sources — permitting which it has largely delegated to the states — to be a federal action for the purposes of ESA section 7 consultation. *See, e.g.*, Bogert, *supra* note 147, at 583 n.212.

[190] As long as a SIP can ensure the attainment of the relevant NAAQS, the state agencies designing and implementing the SIP have considerable discretion as to the nature, mix, and specifics of the planning and regulatory measures that go into such a plan. *See* 42 U.S.C. § 7410 (2006).

sources and different emitters.[191] SIP planning thereby presents good opportunities for tailoring emissions controls to the specifics of regional air quality needs, including the need to give nitrogen-sensitive species and their critical habitats greater protection from emissions of adjacent and upwind sources.

However, EPA itself has very little control over the content of SIPs or the SIP planning process. EPA does, on the other hand, have the authority to approve or deny state SIPs.[192] Given the now known potential of nitrogen emissions to jeopardize listed species and their critical habitat, it would be logical for EPA to consult with the FWS prior to deciding whether to approve or deny a SIP dealing with the control and regulation of NOx. It would also seem that where nitrogen-sensitive threatened and or endangered species are present in a SIP planning area, EPA and the FWS should use section 7 consultation to pressure state air quality agencies, such as CARB and the BAAQMD, to include in their SIPs the kinds of regionally tailored measures that can improve the protection of species against nitrogen-driven jeopardy or critical habitat modification.

A recent Supreme Court decision, however, effectively takes away EPA's ability to consult with the FWS regarding SIP approval. In *National Association of Home Builders v. Defenders of Wildlife*,[193] the Supreme Court ruled that ESA section 7 requirements apply only to discretionary agency actions. When an agency is required to act by statute, the Court reasoned, it lacks the power to "insure that such an action will not jeopardize listed species," and should therefore not be expected to do so.[194] The Court's analysis in *Home Builders* leaves little doubt that EPA approval of a state SIP that meets all the CAA SIP requirements is precisely the kind of non-discretionary agency action that the Court considers exempt from section 7 requirements.[195] In sum, compared to the ratcheting up of NAAQS for NO_2, strict but regionally tailored emission controls imposed through SIPs may be a more practical way of protecting the most nitrogen-sensitive among listed habitats and species. Yet after *Home Builders*, EPA is legally precluded from leveraging its SIP approval authority to push for such controls. Section 7 has the clear statutory and regulatory potential to help address the growing species, habitat, and ecosystem threats of nitrogen deposition and to do so by leveraging key provisions of the ESA against federal regulatory activities taking place under the CAA. However, the practical difficulties with NAAQS and the legal difficulties with SIP approval show that important aspects of translating regulatory leverage into actual regulatory and management practice still need to be worked out.

This situation perhaps helps to further underscore the importance of having some recourse to section 9 in the search for solutions to the problems

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[191] *See* Reitze, *supra* note 134, at 212–14; Dwyer, *supra* note 134, at 1198–1200.

[192] 42 U.S.C. § 7410(k) (2006).

[193] 551 U.S. 644 (2007).

[194] *Id.* at 647. *See* Bogert, *supra* note 147, at 567–68.

[195] None of the CAA SIP requirements deals with the impact of SIP planning on ESA-listed species. 42 U.S.C. § 7410a(2)(A)–(M) (2006).

that nitrogen deposition poses for the checkerspot and other nitrogen sensitive species and ecosystems. Since the section 9 take prohibition applies to federal and state agencies alike, it is perhaps somewhere within section 9 that the incentives can be found which will prompt or force state air quality and emissions control agencies to tailor their SIPs — and other state-level air quality regulations — in ways that are responsive to the different species and ecosystem tolerances towards nitrogen deposition. In other words, section 9 might provide incentives for states to act in ways that help mitigate the threats of nitrogen deposition to listed species while also helping avoid the potentially cumbersome regulatory task of tailoring all air quality standards to the sensitivity thresholds of the most sensitive habitats and species (a situation that, as discussed above, may occur if section 7 leverage is applied to EPA's setting NAAQS).

Alternatively, caught between the "incisors" of section 9[196] and the increasingly clear yet potentially difficult to follow requirements of section 7 (requirements with regard to NAAQS), EPA might be motivated to seek new ways of collaborating with the states to arrive at methods of controlling nitrogen emissions and ambient levels that are regionally tailored, practically sensible, and simultaneously compliant with the relevant mandates of the ESA and the CAA.

VI. The Pros and Cons of Leveraging the ESA as a Tool for Reducing Ecologically Harmful Nitrogen Emissions

To determine the wisdom of leveraging the ESA to attain reductions in harmful nitrogen emissions, it is ultimately important to consider not only the more technical side of the statute's regulatory versatility, but also the likely political and practical consequences of such strategic leveraging.

In doing so, we begin once again by drawing a comparison between the nitrogen emissions and the GHG emissions cases. In spite of the clear and momentous impacts of climate change on imperiled species, prominent ESA scholars have advanced some important objections against using the ESA to regulate GHG emissions.[197] Such objections are prompted by concern that using the ESA as a control on GHGs will not only be legally and practically difficult, but also ultimately ineffective in shielding listed species against climate change. Further, regardless of the ultimate legal and ecological success of such endeavors, attempting to leverage the ESA in this way is expected to produce more backlash against the statute, while also directing

[196] *See* Paul Boudreaux, *Understanding "Take" in the Endangered Species Act*, 34 Ariz. St. L.J. 733, 733 (2002) ("If the federal Endangered Species Act . . . is the pit bull of the environmental statutes because of the power of its commands, then the Act's take prohibition would seem to be the dog's incisors.").

[197] *See, e.g.*, Ruhl, *Endangered Species Act*, *supra* note 14, at 275, 279–80, 289; Baur, *supra* note 14.

scarce agency resources away from areas where aggressive ESA implementation would likely produce the greatest species and conservation benefits.[198]

Notably, J.B. Ruhl concludes his extensive analysis of the ESA's limits in protecting imperiled species from the impacts of climate change by stating:

> Going for the jugular by regulating greenhouse gas emissions is *not* where the ESA can be of most help to imperiled species. There is little to be gained for the FWS or for climate threatened species by having the agency go down this road. The agency has no explicit authority to do so, does not have the expertise to do so, and would risk undermining the political viability of the ESA by doing so. Rather, the FWS can provide expert assistance to the agencies more appropriately charged with regulating GHG emissions, such as the EPA, by advising them about the effects of climate change on species.[199]

At the same time, the analysis we have offered suggests that nitrogen emissions and nitrogen deposition present a case that is sufficiently different from that of GHG emissions and climate change — a case where extending ESA provisions to address the habitat and species impacts of nitrogen emissions has the promise to be both much less legally difficult and much more effective from a conservation standpoint than a similar extension in the GHG case.

This is partly because the task of proving causation, while by far not trivial, is more easily surmountable in the context of nitrogen emissions, nitrogen deposition, and checkerspot injuries than it is in the context of GHG emissions, climate change, and polar bear harm. In both cases, there is a daunting causal challenge to link the impacts of macro-scale phenomena all the way back to the individual, micro-scale acts of emissions ultimately (if cumulatively) responsible for such macro-scale phenomena.[200] In the nitrogen case, this challenge is largely obviated by the aggregation of emissions responsibility within a small number of federal and state regulatory agencies. These agencies are responsible for controlling and permitting nitrogen emissions through a combination of ambient and technological standards, regional planning, and individual permitting. The existence of a separate and well-established regulatory framework for the control of air quality and nitrogen emissions, and the flexibility agencies have for their regulatory ac-

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[198] *See* Ruhl, *Climate Change*, *supra* note 13, at 58–62; Ruhl, *Endangered Species Act*, *supra* note 14, at 275, 279–80, 289; Baur, *supra* note 14; *see also* John Kostyack & Dan Rohlf, *Conserving Endangered Species in an Era of Global Warming*, 38 Envtl. L. Rep. (Envtl. Law Inst.) 10,203, 10,212 (2008) (providing a set of detailed recommendations for implementation by the ESA to address climate change effects).

[199] Ruhl, *Climate Change*, *supra* note 13, at 59.

[200] See Ruhl, *Climate Change*, *supra* note 13, at 46–47, and Gerhart, *supra* note 15, at 189–95, for a detailed discussion of the seriousness of these challenges in the context of climate change.

tions under that framework are what ultimately allow for such aggregation of responsibility. This framework and flexibility should enable a successful leveraging of ESA provisions against harmful nitrogen emissions. Comparable conditions are conspicuously absent in the GHG case.

Together with the physical dynamics of nitrogen transport and deposition,[201] this aggregation of responsibility for nitrogen emissions should also make the ESA a lot more effective in attaining meaningful protections for the checkerspot. Unlike in the GHG case, the vast majority of the offending nitrogen emissions are fully within the jurisdiction and regulatory control of a relatively small number of federal and state agencies, which are in a position to regulate such emissions to better protect listed species that are particularly vulnerable. A nudge from the ESA toward stricter NAAQS, for example, could provide these agencies with the impetus to do so. Using the ESA to address the problem of nitrogen deposition will, to a significant extent, entail the leveraging of its section 7 and section 9 provisions against existing air quality statutes, and against the federal and state agencies responsible for implementing these statutes.

This also means that leveraging the ESA to regulate the nitrogen emissions responsible for harming listed species will not require the FWS to deal with something it lacks the experience and expertise to address. That is, leveraging the ESA to help the checkerspot and other listed species affected by nitrogen deposition will not be putting the FWS (or NMFS) in the business of regulating emissions and air quality. Rather, a successful ESA case against nitrogen emissions will compel the FWS to work with EPA and state air quality agencies to ensure that the ambient air quality standards and nitrogen emission regulations that such agencies are promulgating under already existing statutory mandates are developed with the protection of listed species in mind. This is something which the FWS should have both the authority and expertise to do.

What would a court finding nitrogen emissions as a prohibited take of checkerspots produce in terms of changes and adjustments to current air quality and emissions regulations or regulatory practices? And what can section 7 consultations over NAAQS, emissions trading programs, or technology-based emission standards for NO_x be expected to produce, in terms of recommendations and protections in the FWS BOs? Many of the details will have to be ironed out in the course of actual practice. Further, it is possible that regardless of the practical, on-the-ground changes it manages or fails to produce, a successful legal challenge against nitrogen emissions, leveraging ESA against federal and state air quality and nitrogen emissions regulations and regulators, would still bring about another round of perilous anti-ESA backlash.

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[201] These dynamics entail relatively short residence time of biologically reactive nitrogen in the atmosphere, as well as local and regional — rather than global — transport of such reactive nitrogen prior to deposition.

Yet, in considering whether it is worth acting to deploy the ESA's regulatory potential towards addressing an increasingly important, if chronically underemphasized threat to listed species (and ecosystems more broadly), we side with Robert Irvin. Irvin looks at the much greater challenge (and greater unknown) of using the ESA to address the GHG drivers of climate change to conclude that "[t]o arbitrarily decide that the ESA should not be used to consider the impacts of greenhouse gas pollution on polar bears or other species imperiled by climate change is to ignore the *law's potential to stimulate creative solutions to seemingly intractable problems*."[202] Ditto for the increasingly significant and increasingly troubling impacts of nitrogen pollution.

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[202] Irvin, *supra* note 15, at 10,751 (emphasis added).