August 4, 2009

The Legal Challenge of Protecting Animal Migrations

Robert L. Fischman

The Legal Challenge of Protecting Animal Migrations

Robert L. Fischman and Jeffrey B. Hyman

ABSTRACT

Animal migrations are as familiar as the sign of geese in the sky on a fall afternoon and as mysterious as the peregrinations of sea turtles across thousands of miles of open ocean. This article discusses the distinguishing attributes of animal migrations, why they are important to biodiversity conservation, and the legal challenges posed by migration conservation. In particular, the article focuses on those aspects of migration conservation that existing law, dominated by imperiled species protection, fails to address. It consequently suggests law reforms that would better conserve animal migrations. A step toward serious legal efforts to protect the process and function of migration would represent significant broadening of the current framework for biodiversity protection policy.

This article begins by describing animal migrations and explaining the common threats that raise conservation concerns. Any successful strategy for protecting migration will need to address habitat destruction, human-created obstacles, overexploitation (i.e., hunting and fishing), and climate change. The article examines the four key legal elements of a conservation strategy. The first is the establishment of differential thresholds of action responsive to the degree of risk to a migration. Second is transboundary coordination, which may involve international or interstate agreements, depending on the scale of the migration. Third is the protection of migration connectivity. Effective connectivity requires designation of corridors. Within the corridors, legal activity should concentrate on acquisition of habitat as well as activity-based regulation of habitat-disturbing practices. Fourth is controlling commercial and recreational harvests of migrating animals or the species on which the migrations rely. Finally, the article presents a theoretical model that tailors a place-based legal response to both migratory population abundance and the ecological importance of habitat. Application of the model would result in variable levels of legal protection to minimize unnecessary costs and optimize the benefit of conservation efforts. Existing attempts to conserve migrations using variable levels of protection compose a mixed record from which we extract lessons.

The Legal Challenge of Protecting Animal Migrations

Robert L. Fischman[*] and Jeffrey B. Hyman[**]

---

[*] Professor of Law, Indiana University Maurer School of Law. The authors are grateful for the research support of the Indiana University Maurer School of Law. The authors thank Lindsey Hemly and Jeremiah Williamson for their meticulous research assistance.

[**] Staff Attorney, Conservation Law Center and Adjunct Professor, Indiana University Maurer School of Law.

I. INTRODUCTION

The current legal approach to maintaining and restoring biodiversity has many shortcomings. One of the chief problems is that imperiled species on the brink of extinction consume almost all attention (and resources). This "emergency room" response to the biodiversity crisis is necessary to begin reversing the disturbing decline in biodiversity. However, its predominance in the public mind, the courts, and administrative procedure eclipses other policy priorities.

One of the overlooked issues in biodiversity protection is conserving animal migrations. Animal migrations are as familiar as the sign of geese in the sky on a fall afternoon and as mysterious as the peregrinations of sea turtles across thousands of miles of open ocean. This article discusses the distinguishing attributes of animal migrations, why they are important to biodiversity conservation, and the legal challenges posed by migration conservation. In particular, the article focuses on those aspects of migration conservation that existing law, dominated by imperiled species protection, fails to address. It consequently suggests law reforms that would better conserve animal migrations.

Though species diversity dominates the popular conception of biodiversity, the term is actually quite broader. The scientific and policy literature embraces within biodiversity all biotic compositional elements of the world, from genes to large assemblages, such as ecosystems.[1] Limiting the definition of biodiversity to just the compositional elements of nature has the practical merit of making the concept relatively concrete, specific, and measurable. However, such a limitation excludes some of the most emotionally resonant and ecologically important spectacles of nature.[2] Intellectual historians have noted that the term

---

[1] A standard reference illustrating this perspective is NATIONAL RESEARCH COUNCIL, PERSPECTIVES ON BIODIVERSITY: VALUING ITS ROLE IN AN EVERCHANGING WORLD 20-21 (1999).

[2] Such spectacles include millions of wildebeest, zebras, gazelles and buffalos semiannually

"biodiversity" answers the evolving needs of the conservation community to describe what to value in nature.[3] Animal migrations certainly qualify under this elastic definition. Indeed, most scholarly definitions of biodiversity include ecological processes and functions,[4] such as migration.

But, with the exception of birds, there is scant systematic legal concern about conserving the migration phenomenon. A step toward serious legal efforts to protect the process and function of migration would represent significant broadening of the current framework for biodiversity protection policy. Alas, migrations are already greatly diminished from their historic profusion.[5] Though lawmakers may support migration conservation as a matter of Leopoldian aesthetics[6] or other ethics,[7] protection is also matter of enlightened self-interest:

---

crossing the Serengeti; thousands of caribou and hundreds of thousands of birds traversing the Arctic National Wildlife Refuge; and shoals of fish miles long migrating along South Africa's east coast. *See,* KYELL DANELL ET AL., LARGE HERBIVORE ECOLOGY, ECOSYSTEM DYNAMICS AND CONSERVATION 293-318 (2006) (discussing the role of migrating ungulates in cycling nutrients in the Serengeti grazing ecosystem); NATIONAL RESEARCH COUNCIL, CUMULATIVE ENVIRONMENTAL EFFECTS OF OIL AND GAS ACTIVITIES ON ALASKA'S NORTH SLOPE (2003) (discussing all migratory animals using the refuge); MONTE HUMMEL & JUSTINA C. RAY, CARIBOU AND THE NORTH 53 (2008) (discussing the ecological significance of caribou as nutrient distributors and food source); Robert J. M. Crawford, *Influence of Food on Numbers Breeding, Colony Size and Fidelity to Localities of Swift Terns in South Africa*, 26 INT'L J. WATERBIRD BIOLOGY 44 (2003) (discussing the ecological importance of sardines as a food source for Swift Terns); and NICK GALES ET AL., MARINE MAMMALS 120 (2003) (discussing the importance of South African sardine shoals as a food source for ocean mammal populations).

[3] *See, e.g.,* TIMOTHY FARNHAM, SAVING NATURE'S LEGACY: ORIGINS OF THE IDEA OF BIOLOGICAL DIVERSITY 3 (2007).

[4] *Id.* at 5. An intermediate step in the inclusiveness continuum of biodiversity involves consideration of ecological structures such as standing dead trees (snags), which helped make the case for conservation of old-growth forests. *See, e.g.,* DAVID LINDENMAYER, CONSERVING FOREST BIODIVERSITY: A COMPREHENSIVE MULTISCALED APPROACH (2002). Reed Noss has usefully characterized biodiversity as having compositional, structural, and functional components. *Indicators for Monitoring Biodiversity: A Hierarchical Approach*, 4 CONSERVATION BIOLOGY 355 (1990); *see also* REED F. NOSS & ALLEN Y. COOPERRIDER, SAVING NATURE'S LEGACY: PROTECTING AND RESTORING BIODIVERSITY (1994).

[5] *See generally* Lincoln P. Brower & Stephen B. Malcom, *Animal Migrations: Endangered Phenomena*, 31 AMER. ZOOL. 265 (1991); Grant Harris et al., *Global Decline in Aggregated Migrations of Large Terrestrial Mammals*, 7 ENDANGERED SPECIES RESEARCH 55 (2009).

[6] ALDO LEOPOLD, A SAND COUNTY ALMANAC 262 (1970, 1949) ("A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.").

the ecosystem services migrations provide, such as nutrient cycling, are valuable for human flourishing.[8] Furthermore, the opportunity to observe large numbers of animals migrating together has important psychological value to humans.[9] Yet, to date, these concerns have failed to translate into effective legal action.

Though imperiled species legislation covers some migrating species, such as right whales and piping plovers, most migrations receive no special legal protection. This is largely because migration is generally a "phenomenon of abundance."[10] Many migrating animal populations likely require large numbers to instigate migration or to succeed in their journeys,[11] and to fulfill their ecological functions.[12] Imperiled species laws, such as the U.S. Endangered

---

[7] *See, e.g.,* JOHN PASSMORE, MAN'S RESPONSIBILITY FOR NATURE (1980) (describing an environmental ethic based on stewardship, which has roots in the Judeo-Christian tradition). The best survey of the ethical bases for biodiversity protection is BRYAN NORTON, WHY PRESERVE NATURAL VARIETY? (1987).

[8] *See generally* NATIONAL RESEARCH COUNCIL, VALUING ECOSYSTEM SERVICES (2005).

[9] *See* PETER H. KAHN, JR., HUMAN WELL-BEING, NATURAL LANDSCAPES AND WILDLIFE IN URBAN AREAS: A REVIEW 13-17 (1999) (summarizing research demonstrating improvements in psychological well-being resulting from exposure to natural landscapes and affiliation with animals); Lawrence St. Leger, *Health and Nature—New Challenges for Health Promotion*, 18 HEALTH PROMOTION INT'L 173, 174 (2003) (explaining that viewing flora and fauna and exposure to nature can enhance psychological health). *See also* Sergio Cristancho & Joanne Vining, *Culturally Defined Keystone Species*, 11 HUMAN ECOLOGY REV. 153 (2004) (discussing conservation priorities based on spiritual or symbolic value). *See, e.g.,* DAVID S. WILCOVE, NO WAY HOME: THE DECLINE OF THE WORLD'S GREAT ANIMAL MIGRATIONS 12, 40 (2007) ("[A]lmost every aspect of migration inspires awe: the incredible journeys migratory animals undertake and the hardships they face along the way; the complex mechanisms they use to navigate across the land and through the skies and seas...") ("I first witnessed the shorebird congregation in Delaware By in 1987 . . . . What I encountered was extraordinary. . . . The sex and gluttony were both there, along with great beauty. I felt as though I had stepped into the shoes of John James Audubon, back into an era of wilderness and abundant wildlife . . . ."); JACK JACKSON, DIVING WITH GIANTS 74-75 (2006) (discussing human fascination with and emotional attraction to sardine migrations off the South African coast); D.J. Aidley, *Questions About Migration, in* ANIMAL MIGRATION 7 (D.J. Aidley ed. 1981) ("But perhaps the main reason for the interest of zoologists in migration is less logical but more pervasive. Migrants are often beautiful, they may journey great distances to faraway places, they act as though they were adventurous, intrepid, free, as though they solved their problems by taking action. They stir the imagination.").

[10] WILCOVE, *supra* note 9, at 10.

[11] *See, e.g.,* Kristine L. Grayson & Henry M. Wilbur, *Sex- and Context-Dependent Migration in a Pond-Breeding Amphibian*, 90 ECOLOGY 306 (2009); Caz M. Taylor & D. Ryan Norris, *Predicting Conditions for Migration: Effects of Density Dependence and Habitat Quality,* 3 BIOL. LETT. 280 (2007).

[12] Joseph E. Merz & Peter B. Moyle, *Salmon, Wildlife, And Wine: Marine-Derived Nutrients In*

Species Act ("ESA"), focus instead on species whose populations are diminished almost to the point of disappearance. For preventing extinctions, scarcity generally triggers a legal reaction. Conserving migrations, in contrast, will require a different set of thresholds for initiating action – once the populations are scarce, most migrations are already lost.

Using rarity to trigger legal protection is not the only paradigm in biological conservation. The sustained-yield principle that guided the Progressive Movement's conservation program promised perpetual abundance of nature's bounty.[13] And, in the United States, the monumental scenery that prompted the creation of the national parks more than a century ago[14] illustrates a preservation tradition that values the inspirational in nature.[15] Creating a new set of legal tools to conserve animal migrations may tap into these deep currents of American identity. International commitments to conserve migrations will likely emerge from the *lingua franca* of science and valuation of ecological services.[16]

Many animal migrations do not have the continental sweep of the Arctic tern, which travels almost from pole to pole,[17] or the grandeur of the 1.3 million wildebeest following their range around the Serengeti.[18] Some frogs and snakes experience the peril of migration in crossing a road. Other significant migrations, such as the pronghorn movement from winter to summer range, occur entirely

---

Human-Dominated Ecosystems Of Central California, 16 ECOLOGICAL APPLICATIONS 999 (2006); Øystein Varpe, Øyvind Fiksen, & Aril Slotte, *Meta-Ecosystems and Biological Energy Transport from Ocean to Coast: the Ecological Importance of Herring Migration*, 146 OECOLOGIA 443 (2005); *see also* Gary A. Polis, Wendy B. Anderson, & Robert D. Holt, *Toward an Integration o Landscape and Foodweb Ecology: The Dynamics of Spatially Subsidized Food Webs*, 28 ANN. REV. ECOLOGY & SYSTEMATICS 289 (1997).

[13] SAMUEL P. HAYS, CONSERVATION AND THE GOSPEL OF EFFICIENCY: THE PROGRESSIVE CONSERVATION MOVEMENT 1890-1920 (1959).

[14] ALFRED RUNTE, NATIONAL PARKS: THE AMERICAN EXPERIENCE 5 (2d ed. 1987).

[15] JOSEPH L. SAX, MOUNTAINS WITHOUT HANDRAILS (1980).

[16] Robert L. Fischman, *The Significance of National Wildlife Refuges in the Development of U.S. Conservation Policy,* 21 J. LAND USE & ENVTL. L. 1, 21 (2005).

[17] WILCOVE, *supra* note 9, at 139.

[18] *Id.* at 82.

within a single state.[19] The scales vary enormously and any attempt to address migration conservation needs to account for the significant spatial differences.

Protecting migrations typically involves some sort of inter-jurisdictional challenge. Within a state or watershed, such challenges may be driven by divisions of authority between, say, a road-maintaining agency and a wetlands regulating agency. At larger scales, many challenges to migration require international coordination. Notwithstanding the 1979 Bonn Convention on the Conservation of Migratory Species of Wild Animals,[20] there currently exists no strong framework for identifying and protecting transboundary migrations. However, projects aimed at particular species, such as birds, that generate widespread enthusiasm, point the way to a legal foundation for stronger migrations that will sustain ecological integrity across great distances.

This article begins in Part II by describing animal migrations and explaining the common threats that raise conservation concerns. Any successful strategy for protecting migration will need to address habitat destruction, human-created obstacles, overexploitation (*i.e.*, hunting and fishing), and climate change. Part III examines the four key legal elements of a conservation strategy. The first is the establishment of differential thresholds of action responsive to the degree of risk to a migration. Second is transboundary coordination, which may involve international or interstate agreements, depending on the scale of the migration. Third is the protection of migration connectivity. Effective connectivity requires designation of corridors. Within the corridors, legal activity should concentrate on acquisition of habitat as well as activity-based regulation of habitat-disturbing practices. Fourth is controlling commercial and recreational harvests of migrating

---

[19] *Id.* at 121-24.

[20] June 23, 1979, 19 I.L.M. 15, 1651 U.N.T.S. 28395, *available at* http://www.cms.int/pdf/convtxt/cms_convtxt_english.pdf.

animals or the species on which the migrations rely. Part III surveys existing legal approaches to protecting migration and discusses the ways in which they fall short of effectiveness. It also highlights some tools that can be strengthened or extended to improve conservation outcomes for migrating animals.

Part IV presents a new design for comprehensive migration protection laws and programs. We present a theoretical model that tailors a place-based legal response to both migratory population abundance and the ecological importance of habitat. Application of the model would result in variable levels of legal protection to minimize unnecessary costs and optimize the benefit of conservation efforts. Existing attempts to conserve migrations using variable levels of protection compose a mixed record from which we extract lessons.

We conclude with some general thoughts about how to improve that record. Climate change complicates the path toward law reform, but many actions that would safeguard migrations also improve the resilience of ecosystems to adapt to climatic instability. There are many details of a new legal program over which reasonable minds can differ. But the existing neglect of migration conservation provides tremendous potential for significant gains.

II. THE ANIMAL MIGRATION PHENOMENON: CHARACTERISTICS AND THREATS

A wide variety of nearly ten thousand bird, fish, mammal, reptile, amphibian, insect, and other invertebrate species move relatively long distances in search of favorable resources for feeding, sheltering, and breeding.[21] Both environmental and internal cues trigger these long-distance movements. Animals display an astonishing array of migratory behaviors. But one common attribute stands out as the most important feature of migration: an *abundance* of animals moving during

---

[21] CONVENTION ON MIGRATORY SPECIES, CONSERVING ANIMALS ON THE MOVE (2003), *available at* http://www.cms.int/pdf/en/CMS_Brochure_en.pdf.

the same time period.[22]

The yearly round-trip movements of birds, ungulates, and whales, and the periodic return of sea turtles to beaches for egg laying are among the most familiar migrations.[23] Some animals complete only a single migration cycle in their lifetime (e.g., Pacific salmon), and others complete only part of a cycle (e.g., monarch butterflies).[24] In general, migration involves periodic movements and recurrent destinations for at least part of the journey. Ranging or dispersal, in contrast, generally ceases once a suitable new home range is found – for example, young birds and mammals range to find space away from their parents to avoid competition and inbreeding. Both migration and ranging are distinguished from the typically shorter-distance and shorter-time scale movements labeled as foraging.[25]

Climate change has raised the conservation prospect of moving certain endemic species that are isolated by mountains, roads, and other human developments. As their existing habitats become inhospitable for their needs, some isolated species will disappear if not translocated to more suitable habitat. This translocation has come to be called "assisted migration."[26] But it is not migration in the sense we use the term in this article because there is no return cycle. In fact, species subject to assisted migration may not exhibit any migratory behavior at all.

---

[22] Hugh Dingle & V. Alistair Drake, *What is Migration?*, 57 BIOSCIENCE 113 (2007).

[23] Migration is an adaptation driven by the transitory availability and changing location of resources, and involves movement of populations of animals between areas where conditions are alternately favorable or unfavorable for feeding, sheltering, and reproducing. *Id.*

[24] Dingle & Drake, *supra* note 22.

[25] Not all foraging movements are short distance, however. An extended foraging behavior called commuting involves relatively long journeys to spatially separated resources. Dramatic examples include the mass daily vertical movements of plankton through the water column and the several-thousand-kilometer foraging round trips extending over several days made by albatrosses (*Diomedea* spp.) and other seabirds between nesting islands and food locales. *Id.*

[26] Jason S. McLachlan et al., *A Framework for Debate of Assisted Migration in an Era of Climate Change*, 21 CONSERVATION BIOLOGY 297 (2007); Julie Lurman Joly & Nell Fuller, *Advising Noah: A Legal Analysis of Assisted Migration*, 39 ENVTL. L. REPORTER 10413 (2009).

In his recent book, Princeton ecologist David Wilcove identifies the profit and peril in migration. On one hand, migration enables animals to avail themselves of "abundant but ephemeral resources," such as summer clouds of mosquitoes in the boreal forests or temporary pasture created in the Serengeti following the seasonal rains.[27] But the cost of the opportunity to exploit these resources is danger. Migration exposes animals to periods of high risk, particularly as they expend energy to engage in their journeys.[28] Whether a storm during a flock's sea crossing, or predators awaiting newly hatched turtles at a nursery beach, the temporal and spatial bottlenecks through which large concentrations of migrators pass present special dangers.

From a legal perspective, migration and ranging raise similar difficulties in conservation policy because of two shared characteristics. First, long distance movements often cross jurisdictional boundaries, such as county, state, and national borders, as well as boundaries of federal, state, and private land ownership, thus exposing animals to a wide variety of threats and discontinuous protection regimes. Second, migration and ranging often involve large numbers of individuals from relatively abundant populations. In this paper we are concerned with legal mechanisms to protect animals that typically take part in movements with these attributes. While we will address migration specifically, our analyses and conclusions for migration will likely apply to ranging as well.

Although the risks monarch butterflies face as they huddle to survive the winter in the alpine forests of Mexico are quite distinct from the right whales' passage through the busy shipping lanes of the U.S. Atlantic coast, there are some common dangers. Professor Wilcove classifies threats to migration into four broad categories: habitat destruction, human-created obstacles, overexploitation,

---

[27] WILCOVE, *supra* note 9, at 4.
[28] *Id.*

and climate change.[29] Protecting migrations ultimately requires that all of these threats be controlled. For example, removing barriers along the migration route will fail to protect a migratory population if its nesting or overwintering areas are converted to inhospitable land uses or cease to supply the necessary resources at the required time.

Habitat destruction is a problem familiar to anyone involved in endangered species protection. Migratory animals are particularly vulnerable to adverse modification of their destinations and resting/feeding stops along the way. For instance, familiar songbirds of summer in the United States face declines because their forested winter ranges are shrinking as trees are cut to create agricultural fields.[30] Though not a novel problem in conservation, the strong economic currents driving habitat destruction make it notoriously resistant to the relatively weak incentives of environmental law.

Obstructions to migration, such as dams, buildings, towers, roads, and fences present a threat more distinctive to migration than to other elements of biodiversity. The decline in salmon runs, though arising from multiple causes, owes much of its magnitude to physical barriers blocking passage along rivers for spawning. Any legal response will need to consider how barriers to migration may be mitigated or eliminated. Design standards, siting evaluations, and best practices are among the tools that may be deployed to reduce the threat posed by obstructions. The flipside to obstructions is designated corridors to maintain key pathways for animal migrations.

Overexploitation of migratory animals occurs when their commercial or recreational value creates too much downward pressure on populations. Because migratory animals congregate in great concentrations during their travels, they are particularly vulnerable to extirpation- or extinction-scale hunting. This is roughly

---

[29] WILCOVE, *supra* note 9, at 5.
[30] *Id.* at 6.

what happened to the American bison and passenger pigeon. Though bison survive, their migrations do not. Some of the earliest conservation law exerted control of "take," which generally includes capturing, collecting, or killing an animal.[31] Across the globe, the overexploitation threat is the one most easily regulated and thoroughly addressed. It nonetheless remains a serious problem for many migratory species, such as the Siberian crane and the Atlantic cod. As always, legal analysis must be attentive to the gap between authority and implementation. Austere budgets, competing law enforcement priorities, and lack of will all contribute to many ineffective but formal limits on animal harvest.

The ultimate effects of climate change on particular migrations remain uncertain.[32] Nonetheless, current predictions are grim. For instance, projected drying of the "prairie pothole" region of the upper Great Plains will significantly reduce the productivity of the largest duck breeding habitat in the United States. Sea level rise will reduce coastal wetland areas, which are crucial breeding and feeding sites for migratory birds, and spawning areas for marine migratory species.[33]

Professor Parmesan's landmark synthesis of the ecological changes already observed from climate change paints a bleak picture of the challenges to come.[34] In addition to the high-altitude, high-latitude, and sea level habitats that are disappearing from warming and rising ocean elevations, there are also phenological changes that are disrupting migrations. Phenology is the study of the timing of natural events. For migrations, the key adverse impact from climate

---

[31] *See, e.g.,* 16 U.S.C. § 3371(i) (defining "taken" for the first significant federal law limiting overexploitation of a large group of animals, the Lacey Act).
[32] WILCOVE, *supra* note 9, at 7.
[33] J.M. Scott et al., *National Wildlife Refuges*, *in* PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES 5-32 (U.S. Climate Change Science Program Synthesis and Assessment Product 4.4) (2008) (*available at*: http://www.climatescience.gov/Library/sap/sap4-4/final-report/#finalreport).
[34] Camille Parmesan, *Ecological and Evolutionary Responses to Recent Climate Change*, 37 ANN. REV. ECOLOGY, EVOLUTION, & SYSTEMATICS 637 (2006).

change is not the absolute shifts in the timing of an event such as an insect hatch, a forest stand leafing out, or a first freeze. Instead it is the asynchronous changes across migratory routes as higher latitudes experience greater deviations from historic norms. This unraveling of the coordinated timing of predators and their prey, and herbivores and their plants, may devastate migrations.[35]

For example, the timing of many spring songbird migrations through the American Midwest depends on the leafing out of oak trees. The early leaves have low concentrations of chemicals that protect them against insects, so a variety of moths lay their eggs on the new leaves, producing a "bounty of caterpillars" that the birds feed on as they pass through.[36] However, recent changes in climate have advanced the timing of leaf-out for the trees in Minnesota relative to the emergence of leaves further south in Illinois. The songbirds, therefore, arrive in Minnesota too late to eat the easily caught, young caterpillars. This means less food for migrants (and more defoliation for the trees). A study in the Netherlands has documented a ninety percent drop in the population of pied flycatchers in those parts of the country with the greatest divergence between caterpillar emergence and flycatcher arrival (which depends largely on phenological cues farther south in its wintering grounds).[37] A recent report analyzing adaptation options for federal conservation lands makes the general observation that the "primary climate challenge to migratory waterfowl is that resource availability may become spatially or temporally decoupled from need."[38] Though the uncertainties and scale of climate change may tempt some with resignation, it is important to understand that reducing conventional stressors that cause biodiversity decline is a key method of improving the resilience of biodiversity to

---

[35] *Id.* at 644.
[36] WILCOVE, *supra* note 9, at 44.
[37] *Id.* at 46.
[38] J.M. Scott et al., *supra* note 33, at 5-89.

survive climate change.[39] The remainder of this article focuses on how law can play a critical role in reducing these stressors.

III. ELEMENTS OF A LEGAL RESPONSE TO THREATS

The threats to animal migration present distinct challenges for any comprehensive legal response. No single threat presents an attribute unique to migrations. But, in combination, the attributes of the migration conservation problem make a response particularly difficult. The first element of a legal response must be to identify migrations on which to focus attention and resources. This Part discusses how the law might trigger protection based on declines in migratory animal population abundance. The problem of establishing a threshold for legal protection has vexed extinction prevention programs, generating lessons for migration conservation. In this paper we use the term "threshold" to refer to a defined level of abundance, risk, rate of decline, or other benchmark that, if crossed, portends a shift from a desirable state to an alternative state (e.g., a shift from a migratory behavior to a nonmigratory behavior).[40] A "trigger" is the crossing of a threshold or a precautionary benchmark that causes a legal response.

This Part then addresses three other attributes that will raise difficult challenges for legal innovation: inter-jurisdictional cooperation; protection of migratory pathway connectivity using corridor designation, habitat acquisition, land use controls, and activity-based standards; and regulation of harvest (i.e., hunting and fishing). Throughout our analysis of legal issues we discuss existing laws to identify useful tools and limitations. Appendix 1 contains a table summarizing the key methods existing U.S. law employs to conserve migratory

---

[39]Thomas E. Lovejoy, *Conservation with a Changing Climate, in* CLIMATE CHANGE AND BIODIVERSITY 325, 328 (Thomas E. Lovejoy & Lee Hanna eds. 2005).

[40] Our definition is consistent with the existing scientific literature. *See* Malcolm L. Hunter et al., *Thresholds and the Mismatch between Environmental Laws and Ecosystems*, 23 CONSERVATION BIOLOGY 1053, 1053 (2009).

animals.

A. Defining and Determining Population Triggers for Migration Protection

One of the greatest challenges that migration conservation poses to the legal mindset is that it is fundamentally about maintaining abundance. Though most migrating species have declined from their historic abundances, they continue to depend on transient food or habitat to sustain their migratory behaviors. Some migratory species have declined to such a great extent that they are on the verge of extinction, but many important cases involve migratory groups that have not yet become quite that scarce. Once on the brink of extinction, the species will likely be covered by endangered species laws, such as the ESA. At that point, additional legal protection is unlikely to make a significant difference. The true challenge of migration conservation, therefore, is to sustain abundance before it declines to the point of species (or subspecies, or evolutionarily significant unit) imperilment. Because many migratory behaviors may disappear before an endangerment threshold is reached, a more conservative trigger is necessary.

Apart from the biological imperative, a program aimed at abundance would help revive a venerable conservation tradition. Since the 1960s, when conservation turned to protecting the last wilderness areas, undammed rivers, imperiled species, and other increasingly scarce elements of the biosphere, the focus of nature protection law has progressively narrowed. Migration lawmaking would hark back to the multiple-use, sustained-yield tradition of managing the environment for abundance. Gifford Pinchot's vision was not to protect the last, best specimens of timber. It was to manage vast numbers of timber stands so that they could be used and enjoyed in a variety of ways.[41] That broad, ambitious vision can help us imagine what migration-protecting law would look like, even

---

[41] Gifford Pinchot, Breaking New Ground 322-325 (1947, Island Press 1987 reprint); Hays, *supra* note 13.

for migrations of species, such as bats and warblers, that are valued for non-consumptive uses and ecosystem services only**.**

Triggers in current conservation laws are either abundance-dependent or abundance-independent. An abundance-dependent trigger initiates a law's coverage when population abundance, or a surrogate for abundance, falls below a particular threshold. The law does not apply to the population until that threshold is crossed. For example, the requirements of the ESA do not apply to a population until the risk of extinction is severe enough to warrant listing under the Act.[42] An abundance-independent trigger initiates a law's coverage independent of any threshold of abundance. The law applies simply by virtue of the population belonging to a pre-delineated category of animals worthy of protection. For example, base protections of the Marine Mammal Protection Act ("MMPA") and Migratory Bird Treaty Act ("MBTA") apply to marine mammals and migratory birds, respectively, regardless of population abundance. Although the MMPA and the MBTA were passed in part to protect species and populations already deemed to be low in abundance or at risk of extinction,[43] these laws would continue to apply to these taxa even if they recovered to historic levels.

Trying to protect abundant populations raises the difficult question of how many animals of a particular species population are enough? In other words, with which animal migrations should the law concern itself? Professor Wilcove takes

---

[42] *See* 16 U.S.C. §§ 1531, 1533.

[43] For example, the introduction to the MMPA at 16 U.S.C. § 1361 provides:

> The Congress finds that–
>
> (1) certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of man's activities;
>
> (2) such species and population stocks should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part, and, consistent with this major objective, they should not be permitted to diminish below their optimum sustainable population. Further measures should be immediately taken to replenish any species or population stock which has already diminished below that population. In particular, efforts should be made to protect essential habitats, including the rookeries, mating grounds, and areas of similar significance for each species of marine mammal from the adverse effect of man's actions[.]

a stab at this challenge and proposes special protection for any migratory animal "that experiences a 30% drop in its global population over a period of ten years or three generations (whichever is longer)."[44] A relatively simple algorithm always has the merit of providing a bright line delineating protected resources. However, establishing the baseline randomly (at the beginning of a ten-year period) and relying on a percentage drop without reference to biological criteria related to the actual migration may result in skewed priorities.

Professor Wilcove's suggested trigger for protecting migrations is an extension of the risk-based IUCN system for classifying threatened species.[45] The rate of decline in abundance is an empirical indicator of the risk of falling below some threshold, usually extinction, and can be an early warning mechanism intended to avoid the future harm. Other early-warning indicators of population risk include the severity of habitat loss or range constriction. A risk-based trigger, however, does not by itself indicate a desired target of abundance. Without further specification, a rapid drop in population abundance may trigger a conservation response to maintain the population at its abundance after the drop, to recover the population to its abundance prior to the drop, or to ensure that the population does not fall below a minimum viable population in the future. The alternative chosen should strive to reflect social objectives and ecological priorities. In other words, a legal protection triggered by a population decline

---

[44] WILCOVE, *supra* note 9, at 208.

[45] The IUCN Red List categories and criteria in general are intended to indicate the likelihood of a species going extinct under prevailing circumstances. Georgina M. Mace et al. *Quantification of Extinction Risk: IUCN's System for Classifying Threatened Species*, 22 CONSERVATION BIOLOGY 1424 (2008). Gaston and Fuller also suggested such an indicator of risk for abundant populations ("Given the importance of common species for natural ecosystem structure and function, it would seem sensible for conservation to identify not only those (typically rare) species that are at the greatest risk of extinction, but also those that are suffering marked population depletions (Box 3). Indeed, one might envisage a categorization of species based on their level of population depletion that in some ways mirrors the existing IUCN (The World Conservation Union) approach to threat listing."). Kevin J. Gaston & Richard A. Fuller, *Commonness, Population Depletion and Conservation Biology*, 23 TRENDS IN ECOLOGY & EVOLUTION 14 (2008).

does not answer the question of "how many are enough?"[46]

1. Defining Thresholds of Abundance

Conservation scientists have considered the different thresholds of animal population abundance needed to sustain different social objectives.[47] Figure 1 shows the continuum of the population targets and matches them to legal applications. The lowest population numbers are those necessary to maintain a minimum demographically viable unit such as a species, a subspecies, or a distinct population segment. These are the thresholds to which extinction or extirpation laws, such as the ESA, attend. The 1982 U.S. Forest Service interpretation of its organic act's mandate for diversity also relied on this threshold to limit certain national forest activities that would harm animals.[48] Triggering protections for nongame migratory populations while they are still relatively common will need to overcome the current tendency in conservation laws to consider abundances over minimum demographically viable population size as expendable surplus.[49]

---

[46] Eric W. Sanderson, *How Many Animals Do We Want to Save? The Many Ways of Setting Population Target Levels for Conservation*, 56 BIOSCIENCE 911 (2006); Timothy H. Tear et al., *How Much is Enough? The Recurrent Problem of Setting Measurable Objectives in Conservation*, 55 BIOSCIENCE 835 (2005); James D. Nichols & Byron K. Williams, *Monitoring for Conservation*, 21 TRENDS IN ECOLOGY & EVOLUTION 668 (2006).

[47] Much of the discussion that follows relies on the particularly helpful analyses of Eric W. Sanderson, *supra* note 46, and Timothy H. Tear et al., *supra* note 46.

[48] 36 C.F.R. § 219.19 (1982-2001). *See* Robert L. Glicksman, *Bridging Data Gaps through Modeling and Evaluation of Surrogates: Use of the Best Available Science to Protect Biological Diversity under the National Forest Management Act*, 83 IND. L. J. 465 (2008).

[49] *See, e.g.,* Associate Solicitor, Conservation and Wildlife, Cumulative Effects Under the Endangered Species Act (Aug. 27, 1981) (reprinted in ROBERT L. FISCHMAN & MARK S. SQUILLACE, ENVIRONMENTAL DECISIONMAKING 342, 344-45 (3d ed. 2000)) (providing the justification for ESA section 7 regulation allowing federal projects to consume the "resource cushion" that represents the "remaining natural resources which is available for allocation to projects until the utilization is such that any future use may be likely to jeopardize a listed species.").

Population Goal	Legal Application
Historical Abundance	National Wildlife Refuge System policy; National Park System policy
Sustainably Harvestable Population	Marine Mammal Protection Act; Magnuson-Stevens Fisheries Conservation and Management Act
Ecologically Viable Population	Clean Water Act; National Wildlife Refuge System Improvement Act
Minimum Demographically Viable Population	Endangered Species Act; 1982 Forest Service Land and Resource Management Plan Rule

Figure 1. Continuum of population abundance goals and associated legal applications.

Another example of the common demographic viability threshold in U.S. law explicitly addresses migratory birds but fails to ensure continued migrations. The Neotropical Migratory Bird Conservation Act ("NMBCA") authorizes the United States Fish and Wildlife Service ("USFWS") to dispense funds from a Conservation Fund to applicants who obtain approval for conservation initiatives in the U.S., Canada, Latin America, and Caribbean.[50] A primary purpose of the NMBCA is to "assist in the conservation of neotropical migratory birds by supporting conservation initiatives."[51] The term "conservation," in turn, is defined as "the use of methods and procedures necessary to bring a species of

---

[50] 16 U.S.C. §§ 6102–04, 6108. *See also* http://www.fws.gov/birdhabitat/Grants/NMBCA /index.shtm for a list of projects, by year, funded under the NMBCA.
[51] 16 U.S.C. § 6102.

neotropical migratory bird to the point at which there are sufficient populations in the wild to ensure the long-term viability of the species."[52] Although "viability of the species" is undefined, this phrase is reasonably interpreted as demographic viability, as opposed to ecological or behavioral viability. Thus, a proposed project that would ensure demographic viability may be approved irrespective of whether it would maintain or restore the population to a higher level of abundance.

Other relevant statutes link triggers to the ESA viability thresholds. The Fish and Wildlife Conservation Act ("FWCA"), commonly known as the Nongame Act, employs cost sharing to encourage states to develop, revise, and implement conservation plans for nongame fish and wildlife, including migratory nongame birds. The statute directs the Secretary of Interior to undertake the following conservation activities to conserve migratory nongame birds: "(3) identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973 . . . , (4) identify conservation actions to assure that species, subspecies, and populations of migratory nongame birds identified under paragraph (3) do not reach the point at which the measures provided pursuant to the [Endangered Species Act] become necessary."[53] The FWCA thus mandates that conservation actions are to be selected based in large part on their ability to reduce extinction risk. The statute links the threshold for triggering funding of projects to the ESA's minimum viable population size.[54]

---

[52] 16 U.S.C. § 6103.
[53] 16 U.S.C. § 2912(a).
[54] The FWCA regulations, as opposed to the statute, are less clearly linked to demographic viability. A conservation plan submitted for approval must "seek to optimize population levels, population distributions, and human benefits while taking fully into account the effects on non-target species and user groups," and "utilize methods and procedures which will, to the maximum extent practicable, ensure the well-being and enhancement of the plan species."[54] Because the regulations do not define "optimize" and "well-being," the FWCA threshold is more ambiguous than the thresholds currently used in the ESA, MMPA, and NMBCA.

The next highest threshold for triggering conservation measures is ecological viability, or the number of animals in a taxon necessary to maintain the biological integrity[55] of an ecosystem. This number is almost always greater than a minimally viable population, which has just enough individuals to keep propagating the group in a region.[56] The abundance necessary for a minimum demographically viable population may not be sufficient for the population to be a significantly functioning element in the ecosystem in which it is a part, i.e**.,** for ecological effectiveness.[57] For example, the number of Pacific Northwest salmon required to sustain landscape-level nutrient cycling, or the number of sea otters necessary to maintain Pacific coast kelp beds, may be much larger than the number required to avoid extinction.[58] For many populations, the ecologically effective abundance, in turn, is probably lower than historic abundances or

---

[55] Biological integrity is "the ability of an environment to support and maintain a biota . . . comparable to the natural habitats of the region." James Karr, *Measuring Biological Integrity: Lessons from Streams*, *in* ECOLOGICAL INTEGRITY AND THE MANAGEMENT OF ECOSYSTEMS 83, 85 (Stephen Woodley et al. eds. 1993). Though there are some differences between biological and ecological integrity, they are not significant for our current purposes. *See* Robert L. Fischman, *The Meanings of Biological Integrity, Diversity, and Environmental Health*, 44 NAT. RES. J. 989, 998 (2004).

[56] The ecological function performed by some populations may contribute or be necessary to maintain their own demographic viability. *See* Mark S. Wipfli, John P. Hudson, John P. Caouette, & Dominic T. Chaloner, *Marine Subsidies in Freshwater Ecosystems: Salmon Carcasses Increase the Growth Rates of Stream-Resident Salmonids*, 132 TRANSACTIONS AMERICAN FISHERIES SOC'Y 371 (2003).

[57] Michael E. Soule, James A. Estes, Joel Berger, & Carlos Martinez Del Rio, *Ecological Effectiveness: Conservation Goals for Interactive Species*, 17 CONSERVATION BIOLOGY 1238 (2003). The importance of conserving populations while still at relatively high abundances is not limited to migratory populations. Gaston and Fuller have called for conservation tools to identify and alleviate declines in common and widespread species in general to complement those tools already in place that focus on rare and restricted range species. *See* Kevin J. Gaston & Richard A. Fuller, *Biodiversity and Extinction: Losing the common and the widespread*, 31 PROGRESS IN PHYSICAL GEOGRAPHY 213 (2007). Even relatively small proportional declines in the abundance of common species can significantly disrupt ecosystem structure, function and services, without necessarily threatening the global persistence of those species in the short term. *Id*. *See also* Gaston & Fuller, *supra* note 45, at 14-19.

[58] Tear et al., *supra* note 46, at 837; Soule et al., *supra* note 57. Population abundance can be raised above the minimum viability level by reducing sources of mortality, increasing the density or spatial extent of habitat and resources, or increasing reproductive success.

abundances required to support harvesting by humans.[59]

There are scant but significant examples of legal standards for biological integrity, which requires ecologically viable populations. Congress sought to incorporate the concern about maintaining a higher-than-minimal abundance of biodiversity into water quality standards when it enacted the 1972 Clean Water Act to "restore and maintain the chemical, physical, and biological integrity" of the nation's waters.[60] As a result, the integrity threshold is most well developed in the aquatic context. The most significant legal use of the ecological integrity threshold for a broad range of wildlife is in management of the national wildlife refuges, which must maintain "biological integrity, diversity, and environmental health."[61] Congress intended to incorporate into the mission of the refuge system relatively new understandings of the relationship between species populations and ecosystem functioning on a broad spatial and temporal scale.[62] The implementing policy for this legislative mandate roughly follows the scientific literature's definition of ecological integrity.[63] Other, more geographically limited, laws also employ the ecological integrity standard as a criterion for resource management.[64]

The next most abundant population threshold is one that permits some kind of sustainable use, usually a "take," or harvest. The harvest may be for recreational use, such as fishing or hunting, or it may be for commerce, usually fishing. The basic idea is that populations must be sufficiently robust to survive regular

---

[59] *See, e.g.,* S. Elizabeth Alter et al., *DNA Evidence for Historic Population Size and Past Ecosystem Impacts of Gray Whales*, 104 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES 15162 (2007); Michael C. Healey, *Resilient Salmon, Resilient Fisheries for British Columbia, Canada*, 14 ECOLOGY & SOC'Y 2 (2009); *and* Robert Serrouya et al., *A Synthesis of Scale-Dependent Ecology of the Endangered Mountain Caribou in British Columbia, Canada*, 28 RANGIFER 33 (2008). *See generally* Sanderson, *supra* note 46, at 918.
[60] 33 U.S.C. § 1251(a).
[61] 16 U.S.C. § 6688dd(a)(4)(B).
[62] Fischman, *supra* note 55.
[63] *Id*. at 998.
[64] For example, Everglades National Park Protection and Expansion Act of 1989, Pub. L. No. 101-229, 103 Stat. 1946 (1989); and Steens Mountain Cooperative Management and Protection Act of 2000, Pub. L. No. 106-399, 114 Stat. 1655 (2000). For Professor Fischman's analysis of these statutes, *see* Fischman, *supra* note 55, at 1012-13.

depredations from humans. This is the kind of population maintained by state fish and game agencies operating under traditional multiple-use, sustained-yield mandates. The relatively extensive system for supporting migratory waterfowl, a twentieth century conservation success story, exemplifies the usefulness of this threshold.[65]

On the commercial front, the oldest U.S. laws that sought to maintain high enough populations for regular takes were concerned with marine mammals.[66] The modern incarnation of this concern is the 1972 Marine Mammal Protection Act, which seeks to protect "optimum sustainable populations" ("OSPs") of stocks of marine mammals.[67] The MMPA actually employs two levels of protection separated by a threshold that reflects population depletion.[68] The MMPA directs the Secretary of Commerce to develop and implement conservation plans, which may incorporate take reductions and habitat protection measures, for the purpose of restoring depleted populations to their OSPs.[69] Non-

---

[65] The population abundance targets for protecting harvested populations, such as ducks, will typically be associated with maximum or optimum sustained yield or historic levels of abundance. For example, the North American Waterfowl Management Plan has set 1970s average breeding population levels as objectives for duck abundance. North American Waterfowl Management Plan, Plan Committee. 2004. North American Waterfowl Management Plan 2004. Strategic Guidance: Strengthening the Biological Foundation. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Ambiente y Recursos Naturales, 22 pp.; North American Waterfowl Management Plan, Plan Committee. 2004. North American Waterfowl Management Plan 2004. Implementation Framework: Strengthening the Biological Foundation. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Ambiente y Recursos Naturales, 106 pp.

[66] In 1870 Congress established a leasing system in a failed attempt to sustain the harvest of fur seals on Alaska's Pribilof Islands. Act of July 1, 1870, ch. 189, 16 Stat. 180.

[67] 16 U.S.C. § 1361(2).

[68] Depleted" is a term of art under the MMPA, and means that a species or population stock has fallen "below its optimum sustainable population." 16 U.S.C. § 1362(1)(A). The optimum sustainable population ("OSP") is a range of population levels between maximum net productivity and the carrying capacity of the habitat. 16 U.S.C. § 1362(9); 50 C.F.R. § 216.3. Under agency regulations, a species is considered to have fallen below its OSP, and is therefore "depleted," if its population level is less than 60 percent of its estimated "historic" levels. 58 Fed.Reg. 58285 (1993); 45 Fed.Reg. 72178 (1980).

[69] 16 U.S.C. § 1383(b). *See also* U.S. DEPARTMENT OF COMMERCE, NOAA, NATIONAL MARINE FISHERIES SERVICE, CONSERVATION PLAN FOR THE EASTERN PACIFIC STOCK OF NORTHERN FUR SEAL, (DECEMBER 2007)

depleted populations – those above the OSPs – receive less protection, and may be subject to taking regulated through a permit system.[70] The OSP is "the number of animals which will result in the maximum productivity . . . keeping in mind the optimum carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element."[71] This definition builds on ecological integrity to create a target population that will yield harvestable numbers. The Magnuson-Stevens Fisheries Conservation and Management Act attempts to implement a similar population trigger for restrictions on over-harvested fisheries.[72]

The final metric for population targets in the conservation literature is the historic abundance of animals in an area. The historic benchmark seeks to capture the ecological mix prior to human dominance of the landscape. There does not appear to be a statutory analog to this threshold, though historic conditions are often considered in establishing criteria for ecological integrity.[73] As the National Wildlife Refuge System policy employing a "historic conditions" reference point acknowledges, it will often not be possible to restore populations to their historic abundance.[74] In most places, too much habitat modification has occurred to sustain historic numbers. Still, chronological frames of reference may usefully inform management alternatives.[75] The 2006 National Park System "management policies" contain a similar, but more vague, standard to preserve ecological

---

[70] 16 U.S.C. §§ 1371–1374.
[71] 16 U.S.C. § 1362(9).
[72] 16 U.S.C. §§ 1801-1882. A vast literature describes the failure of the Act to achieve its population goals, largely because of the decision-making framework. *See, e.g.,* ROBERT JAY WILDER, LISTENING TO THE SEA: THE POLITICS OF IMPROVING ENVIRONMENTAL PROTECTION 159 (1998) *and* David Fluharty, *Habitat Protection, Ecological Issues, and Implementation of the Sustainable Fisheries Act*, 10 ECOLOGICAL APPLICATIONS 325, 327-28 (2000).
[73] Brian Czech, *A Chronological Frame of Reference for Ecological Integrity and Natural Conditions*, 44 NAT. RES. J. 1113 (2004).
[74] U.S. Fish and Wildlife Service, Policy on Maintaining the Biological Integrity, Diversity, and Environmental Health of the National Wildlife Refuge System, 66 Fed. Reg. 3810, 3811-12 (Jan. 16, 2001) (explaining 601 F.W. 3.12).
[75] *Id.*; Czech, *supra* note 73.

"components and processes in their natural condition."[76] The policies call for restoration of "natural abundances."[77]

To protect migration as a phenomenon of abundance, population and habitat protections must be triggered at relatively high thresholds of abundance. Most existing approaches to conserving migratory animals are deficient because the thresholds and triggers focus on minimum demographic viability. This minimal approach is the most common in U.S. law and best illustrated by the ESA, NMBCA, and FWCA triggers that fail to sustain migratory populations above minimum demographically viable levels.

2. Applying Thresholds to Trigger Conservation Actions

Establishing a legal or biological threshold for conservation action is only the beginning of a difficult process that has at least two more steps. First, some agency must set threshold abundances for particular migrations. This represents an enormous challenge. All of the laws discussed in this section come up short when implemented with respect to actual groups of animals. No matter how specific a statutory definition, there are confounding value judgments that attend its application. For instance, a widely perceived limitation of the ESA is that the statute provides no guidance on the criteria for designating a population as "in danger of extinction" (e.g., *X* probability of extinction or *Y* percent decline over *Z* years), even though the choices of *X*, *Y*, and *Z* are fundamentally policy choices.[78] Holly Doremus uses the example of determining "how much of the historic range

---

[76] U.S. Department of the Interior, National Park Service, Management Policies § 4.1 (2006). The also states that the Park Service will strive to maintain the "natural abundance" of plants and animals in the park system. *Id*.

[77] *Id.* at § 4.4.1.

[78] 16 U.S.C. §§ 1532, 1533. John A. Vucetich, Michael P. Nelson, & Michael K. Phillips, *The Normative Dimension and Legal Meaning of Endangered and Recovery in the U.S. Endangered Species Act*, 20 CONSERVATION BIOLOGY 1390 (2006); Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science isn't Always Better Policy*, 75 WASH. U. L.Q. 1029, 1117 (1997).

of the gray wolf must be occupied before the wolf can be removed" from ESA protection to illustrate "value choices rather than objective interpretation of empirical data."[79]

Thresholds and targets for ecological viability are even more difficult to develop because of the inherent complexity in deciphering ecological relationships.[80] The uncertainties that arise in recreating a historic population, as well as the dramatic ecological changes over the modern era, confound efforts to employ the historic benchmark.[81]

The second step in using a threshold to trigger conservation action requires an actual estimate of the population abundance of any given migration. As Professor Doremus observes, existing data are always "limited and equivocal," requiring choices of interpretive preferences.[82] Abundances of animal populations, especially those not subject to hunting or fishing, are almost always highly uncertain. Without a strong constituency or funding base, surveys of nongame species are few and irregular.[83] David Wilcove notes that census data for birds are scarce – "most nations or states do not have any sort of comprehensive monitoring program."[84]

---

[79] Holly Doremus, *The Purposes, Effects, and Future of the Endangered Species Act's Best Available Science Mandate*, 34 ENVTL. L. 397, 438-39 (2004). Courts have struggled with this issue as well. For example, see Wyo. Farm Bureau Federation v. Babbitt, 199 F.3d 1224, 1233-36 (10th Cir. 2000) and Defenders of Wildlife v. Sec'y, U.S. Dept. of the Interior, 354 F. Supp. 2d 1156, 1167-69 (D. Or. 2005).

[80] Soule et al., *supra* note 57.

[81] *See, e.g.,* Helene Marsh et al., *Historical Marine Population Estimates: Triggers or Targets for Conservation? The Dugong Case Study*, 15 ECOLOGICAL APPLICATIONS 481 (2005). These uncertainties in estimating thresholds mean that conservation responses are triggered either too soon or too late relative to the true threshold. Rules of thumb can be used to estimate thresholds until more detailed research and analyses can be performed. *See* Sanderson, *supra* note 46, at Table 2.

[82] Doremus, *supra* note 79, at 438.

[83] For example, population changes need to exceed 50% before they are detectable using existing databases such as the International Shorebird Surveys. Manomet Center for Conservation Sciences, The U.S. Shorebird Conservation Plan 11 (S. Brown et al. eds., 2d ed. 2001), *available at* http://www.fws.gov/shorebirdplan/USShorebird/ PlanDocuments.htm.

[84] WILCOVE, *supra* note 910, at 21.

Even when agencies have specific monitoring responsibilities, the fiscal realities of determining existing populations are daunting. In implementing its viability criterion, the U.S. Forest Service found itself without the means to survey populations of its "management indicator species" – even though it designed that surrogate species approach specifically to minimize data needs.[85] An explicit program mandating and funding data collection will be a necessary element of any effective law to conserve migration.[86]

The uncertainties and data gaps in estimating abundances of populations make it difficult to determine when conservation responses should be triggered, with potentially serious implications. If depletion of population abundance below the threshold cannot be accurately detected, opportunities for recovery may be lost because of irreversible shifts between alternative stable states and other nonlinear dynamics that may compromise resilience.[87] Moreover, lack of trend data may make it difficult to determine if crossing an abundance threshold is temporary or permanent. Population abundances are often marked by high variability and instability.[88] Whether a drop in abundance reflects a temporary change within acceptable bounds of variability or a long-term decline is difficult to determine without long-term trend data,[89] which may not be available for many migrating

---

[85] The following cases discuss, with different results, the practical problems of monitoring management indicator species: Utah Envtl. Congress v. Bosworth, 439 F.3d 1184 (10th Cir. 2006); Sierra Club v. Martin, 168 F.3d 1 (11th Cir. 1999); and Inland Empire Public Lands Council v. U.S. Forest Svc., 88 F.3d 754 (9th Cir. 1996).

[86] Professor Doremus details several other elements of information supply that require attention to ensure that resource management decisions have the data support they need. Holly Doremus, *Data Gaps in Natural Resource Management: Sniffing for Leaks Along the Information Pipeline*, 83 IND. L.J. 407 (2008).

[87] Hunter et al., *supra* note 40; Robert V. O'Neill, *Is it Time to Bury the Ecosystem Concept?*, 82 ECOLOGY 3275 (2001); Fred Bosselman, *What Lawmakers Can Learn from Large-Scale Ecology*, 17 J. LAND USE & ENVTL. L. 207 (2002); Dennis E. Jelinski, *There Is No Mother Nature, There Is No Balance of Nature: Culture, Ecology and Conservation*, 33 HUMAN ECOLOGY 271 (2005).

[88] Hunter et al., *supra* note 40.

[89] Dunn found using Breeding Bird Survey data that 5- and 10-year trends were not very effective in predicting continued decline in the following decade; one-third to over one-half of species considered had positive trends in the following decade. Erica Dunn, *Using Decline in Bird Populations to Identify Needs for Conservation Action*, 16 CONSERVATION BIOLOGY 1632 (2002).

populations.

In this article we address migration conservation in its broadest sense, incorporating the multiple goals discussed above: to protect, generally in order of increasing population abundance, (a) the demographic viability of species populations that exhibit migratory behaviors, (b) the process of animals moving in migrations and the ecological functions supported by migrating animals, (c) the harvesting of migrating animals by humans, and (d) the psychological and aesthetic value placed by humans on mass animal migrations. To some extent, these different goals require different legal responses. The Endangered Species Act (with its take prohibition, habitat conservation planning, and critical habitat designation) may be a sufficient legal mechanism for the first level of protection. But the ESA will generally not be sufficient to protect the ecological viability of a population. A law safeguarding ecological functions and integrity could, in theory, be similar to the ESA with refined definitions and thresholds of viability, but a more politically realistic alternative would require new legislation with a mixture of sticks and carrots to protect migration pathways on public and private lands. Conserving the psychological and aesthetic values of migration – especially the awe-inspiring spectacles – is likely to require an additional legal response that codifies and reflects a high valuation of abundance. The added benefit of pursuing this latter goal is that conserving migration as a phenomenon of abundance will most likely also protect the other goals sought for migrating species.

B. TRANSBOUNDARY CONSIDERATIONS

Many conservation problems require inter-jurisdictional cooperation, but, few can match the transboundary range of migrations. For example, the migratory route of the monarch butterfly spans three countries, ranging from southern

Mexico to southern Canada.[90] The Pacific loggerhead turtle has been seen as far north as Alaska and as far south as Chile, with nesting grounds on Japan's coast and feeding grounds off of the west coast of Mexico.[91] Even small-scale migrations, within a state or even a county, may raise exceedingly difficult coordination issues. For instance, snakes migrating between winter uplands and breeding wetlands may pass through regulatory as well as property boundaries. Though many wetlands receive special protection under state laws and the federal Clean Water Act, the relationship between wetlands used as breeding grounds and the availability of seasonal upland habitat generally falls outside of legal protections and the principal objectives of conservation programs.[92]

The vast differences in the scale of transboundary migrations mean that only broad generalizations characterize the problem. There are no universal rules, only categories of helpful and detrimental approaches.[93] On the other hand, because environmental law has long grappled with transboundary problems in pollution[94] and wildlife conservation,[95] a vast reservoir of experience may be applied to designing migration protection. In particular, a new generation of policy analysts have categorized successful efforts to promote interagency and cross-boundary coordination for conservation objectives. Curt Meine describes these participatory approaches within the conservation movement as particularly promising signs of progress: watershed management, land trust networks,

---

[90] Luis A. Bojórquez-Tapia et al., *Mapping Expert Knowledge: Redesigning the Monarch Butterfly Biosphere Reserve*, 17 CONSERVATION BIOLOGY 367 (2003).

[91] Milani Chaloupka et al., *Is Climate Change Affecting the Population Dynamics of the Endangered Pacific Loggerhead Sea Turtle?*, 356 J. EXPERIMENTAL MARINE BIOLOGY & ECOLOGY 136 (2008).

[92] *See, e.g.,* John H. Roe et al., *Wetland and Upland Use Patterns in Semi-Aquatic Snakes: Implications for Wetland Conservation*, 23 WETLANDS 1003 (2003).

[93] Jonathan Adams, *Parks and Protected Areas: Conserving Lands Across Administrative Boundaries, in* CONSERVATION FOR A NEW GENERATION: REDEFINING NATURAL RESOURCES MANAGEMENT 61, 69 (R.L. Knight & C. White eds. 2009).

[94] For example, *Georgia v. Tennessee Copper Co.*, 206 U.S. 230 (1907) (transboundary air pollution dispute between states).

[95] *See, e.g.,* The Fur Seal Treaty of 1911 regulating commercial harvesting of seals that range across national boundaries. 37 Stat. 1542, T.S. No. 564.

cooperative resource management, and ecosystem management.[96] As the broadest and newest category, ecosystem management embraces most of the current thinking about how to conserve wildlife across boundaries. In particular, ecosystem management emphasizes three elements critical to successful transboundary coordination: maintenance of ecological integrity, collaborative and cooperative decision making, and adaptive management continually adjusting to the unexpected.[97]

Three cross-boundary events are common to migrations: (1) migration across jurisdictions of agencies; (2) migration across state boundaries; and (3) migration across national borders.

1. CROSSING AGENCY JURISDICTIONS

Most migrations are likely to cross the jurisdictions of two or more federal, state, or local agencies. Agencies often have different mandates and constituencies, and these differences make cooperation challenging. The most successful instances of interagency cooperation are likely to occur when cooperation is driven by legislation that designates a lead agency and spells out mechanisms of interagency cooperation, such as interagency agreements or funding directives.

For example, Executive Order 13186, which clarifies the responsibilities of federal agencies under the MBTA, requires each federal agency taking an action likely to have a negative effect on migratory bird populations to develop and implement a memorandum of understanding ("MOU") with the USFWS (the lead

---

[96] Curt Meine, *This Place in Time*, *in* CONSERVATION FOR A NEW GENERATION: REDEFINING NATURAL RESOURCES MANAGEMENT, *supra* note 93, at 11, 19-22.

[97] Robert L. Fischman, *What is Natural Resources Law?*, 78 U. COLO. L. REV., 717, 745 (2007) (*citing* R. Edward Grumbine, *Reflections on "What is Ecosystem Management?"*, 11 CONSERVATION BIOLOGY 41, 44-46 (1997) *and* ROBERT B. KEITER, KEEPING FAITH WITH NATURE: ECOSYSTEMS, DEMOCRACY, AND AMERICA'S PUBLIC LANDS 244-48 (2003)).

agency) to promote the conservation of such populations.[98] The Migratory Bird Conservation Act ("MBCA") authorizes, but does not require, the Secretary of Interior to "enter into agreements with public and private agencies" for the purpose of protecting migratory birds.[99]

Another approach is to simply require that agencies cooperate or consult with other agencies. For example, the FWCA, which provides funding to states to develop conservation plans for wildlife, requires that a state agency, when developing, revising, or implementing a conservation plan approvable by the Secretary of Interior, "consult, as appropriate, with Federal agencies, and other State agencies . . . in order to minimize duplication of efforts and to ensure that the best information is available to all such agencies."[100] Although the law does not specify the scope of consultation, the law provides a financial incentive for interagency cooperation. Both of these approaches rely on agency vigilance to succeed.

2. CROSSING STATE BOUNDARIES

Protecting migrations that cross state lines will require cooperation among states. When regulation within one state would provide uncompensated benefits to residents of other states, which is a likely outcome for some long-distance migrations, the states lack full incentive to regulate.[101] Thus, individual state action to protect migration corridors, for example, will be politically difficult unless either the federal government provides mandates or incentives for collective action or the states voluntarily cooperate in the form of an agreement or compact.

---

[98] 66 Fed. Reg. 3853, 3854 (January 10, 2001).
[99] 16 U.S.C. § 715i.
[100] 16 U.S.C. § 2903(10).
[101] *See, e.g.*, Benjamin K. Sovacool, *The Best of Both Worlds: Environmental Federalism and the Need for Federal Action on Renewable Energy and Climate Change*, 27 STAN. ENVTL. L. J. 397, 419 (2008).

Commentators have taken several different approaches to unpacking the role of the federal government in orchestrating state actors. Benjamin Sovacool categorizes six general approaches to federalism roughly in order of decreasing state autonomy: (1) federal incentives for voluntary state programs, (2) loosely structured cooperative partnership agreements, (3) devolved federalism or federal transfer of authority to approved states, (4) centralized federalism, (5) federal action authority with state input, and (6) preemption.[102] Robert Fischman distills the field into three categories, in roughly the same order of decreasing state autonomy: federal deference to state process, state favoritism in federal process, and place-based collaboration.[103] Dan Tarlock has argued, however, that conventional federalism principles do not effectively protect biodiversity and may in fact impede such protection.[104] A mixture of several of these approaches may be appropriate for implementing migration protections.

Alternatively, states may cooperate under either an interstate compact with the force of law or a non-binding multistate agreement. If an agreement is deemed covered by the Compact Clause of the U.S. Constitution, the agreement is transformed into federal law and becomes enforceable in federal court once all cooperating states ratify the compact and Congress consents.[105] For example, the

---

[102] *Id.*

[103] Robert L. Fischman, *Cooperative Federalism and Natural Resources Law*, 14 N.Y.U. ENVTL. L.J. 179 (2005).

[104] A. Dan Tarlock, *Biodiversity Federalism*, 54 MD. L. REV. 1315 (1995). Tarlock gives five reasons to explain the misfit between conventional federalism principles and biodiversity protection: "(1) federalism often impedes the protection of biodiversity because the political boundaries of the federal system do not match ecosystem boundaries; (2) many of the implementation problems involve conflicts among different federal agency mandates, a subject outside the scope of traditional federalism jurisprudence; (3) many of the constitutional values sought to be protected by federalism, specifically those protecting private property and individual liberty interests, are difficult to adapt to biodiversity protection; (4) federalism jurisprudence is neutral with respect to biodiversity maintenance and thus Supreme Court decisions and doctrines are as likely to hinder as promote it; and (5) the demands of biodiversity protection exceed the effective ability, as opposed to the constitutional authority, of the national government to achieve effective protection without state and local cooperation in the experiment." *Id.* at 1330-31.

[105] The Compact Clause of the U.S. Constitution provides: "No state shall, without the consent of Congress, . . . enter into any agreement or compact with another state, or with a foreign power."

Connecticut River Basin Atlantic Salmon Compact,[106] established in 1983 and reauthorized by Congress in 2002 for another 20 years, provides congressional consent for the States of Connecticut, Massachusetts, New Hampshire, and Vermont to enter into a compact for restoring Atlantic salmon in the Connecticut River Basin. The Connecticut River is the longest river in New England, stretching over 400 miles from the Long Island Sound to the Canadian border, and supports over 60 other species of fish, 14 of which are migratory. Atlantic salmon migrate over 2,000 miles between the United States to Greenland and back during their lifetime. The goal of the Compact is to restore Atlantic salmon in the Connecticut River in numbers as near as possible to their historical abundance. For this purpose the Compact established a commission, composed of ten commissioners representing four state agencies, the public, and two federal agencies (Commerce and Interior), to guide a joint interstate program for stocking, protection, management, research, and regulation. The commission has the power to do, among other things, the following: draft and recommend legislation to the governors of the signatory states; recommend stocking programs, management procedures, and research projects; promulgate regulations governing Atlantic salmon fishing in the mainstem Connecticut River; issue a fishing license; accept gifts, state grants, and federal funds; consult with and advise the pertinent administrative agencies; act as a coordinating body; and employ and discharge personnel as may be required to carry out the provisions of the Compact. Such enforceable and stable agreements established under the Compact Clause, so long as they provide for adequate scope of authority, funding,

---

U.S. CONST. art. I, §10, cl. 3. This provision does not apply to every possible agreement or compact between states, but only to such agreements tending to increase the political power in the states and which may encroach on or interfere with the supremacy of the United States. *See, e.g.*, *U.S. Steel Corp. v. Multistate Tax Comm'n*, 434 U.S. 452, 468-73 (1978). Descriptions of interstate compacts related to natural resource conservation are available at http://www.fws.gov/laws/lawsdigest/interstatecompacts.htm.

[106] Pub. L. No. 98-138.

flexibility, and standards for decision making and resolving disputes, are likely to be more effective for protecting long-distance migrations than unenforceable, voluntary agreements.

3. CROSSING NATIONAL BORDERS

A common mechanism used by existing federal conservation laws to promote cross-national cooperation is to authorize the transfer of funds from the U.S. to countries that are important ecologically but less able to fund conservation projects. For example, the NMBCA supports and funds conservation initiatives to conserve neotropical birds throughout the Western Hemisphere.[107]

The NMBCA also expressly sets forth other mechanisms of cooperation, including information sharing, interagency collaboration and coordination on projects, and inter-party agreements.[108] The use of agreements to foster cooperation is vital to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), which differentiates between relatively informal MOUs and more formal legally-binding agreements.[109] The mechanisms of joint planning of conservation projects and information sharing are also

---

[107] 16 U.S.C. § 6102. Examples of funding grants under the NMBCA available at http://www.fws.giv/birdhabitat/Grants/NMBCA/2008.shtm.

[108] 16 U.S.C. § 6106 states as follows:

> (a) In general. In carrying out this Act [16 U.S.C. §§ 6101 *et seq*.], the Secretary shall –
>
> (1) support and coordinate existing efforts to conserve neotropical migratory bird species, through –
>
> (A) facilitating meetings among persons involved in such efforts;
>
> (B) promoting the exchange of information among such persons;
>
> (C) developing and entering into agreements with other Federal agencies, foreign, State, and local governmental agencies, and nongovernmental organizations; and
>
> (D) conducting such other activities as the Secretary considers to be appropriate; and
>
> (2) coordinate activities and projects under this Act [16 USCS §§ 6101 et seq.] with existing efforts in order to enhance conservation of neotropical migratory bird species.

[109] Articles IV and V of the Bonn Convention describe and provide guidelines for agreements, *available at* http://www.cms.int/pdf/convtxt/cms_convtxt_english.pdf.

important to the Western Hemisphere Migratory Species Initiative ("WHMSI"), which seeks to form a coalition of nations and conservation groups with the goal of conserving migratory wildlife in the Western Hemisphere.[110]

An important aspect of conserving international migrations is the disparity in wealth between the North (roughly, the developed world) and South (less developed nations). Southern nations, which tend to be poorer, have a greater physical role to play in conservation and thus a larger burden to bear. Any serious effort to address migrations across the development divide will require funding from North to South. Less than twelve percent of the total money spent annually to manage protected areas occurs in less-developed countries.[111] David Wilcove notes that this "is not simply a reflection of the lower costs of conservation in poorer versus wealthier countries; the relative shortfall in funding for protected-area management is also greater in poorer countries."[112]

A number of contexts highlight the need for aid to underdeveloped countries' conservation efforts. For instance, developed nations agreed in negotiations for the Convention on Biological Diversity that undeveloped countries need not assume conservation obligations unless developed countries commit additional financial resources.[113] Similarly, but less precisely, the Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere requires parties to provide "proper assistance" in conservation efforts.[114] An example of such assistance is the U.S. Fish and Wildlife Service "Wildlife Without Borders"

---

[110] *Available at* http://www.fws.gov/international/DIC/WHMSI/whmsi_about.html.
[111] WILCOVE, *supra* note 9, at 205 (*citing* A. Balmford et al., *Global Variation in Terrestrial Conservation Costs, Conservation Benefits, and Unmet Conservation Needs*, 100 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES 1046 (2003)).
[112] *Id.*
[113] Francoise Burhenne-Guilmin & Susan Casey-Lefkowitz, *The Convention on Biological Diversity: A Hard-Won Global Achievement,* 3 YEARBOOK INT'L ENVTL. L. 43, 56 (1992). *See also* Kathleen Rogers & James A. Moore, *Revitalizing the Convention on Nature Protection and Wild Life Preservation in the Western Hemishpere*, 36 HARV. INT'L L.J. 465, 473 (1995).
[114] The Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere, opened for signature October 12, 1940, 56 Stat. 1354, 161 U.N.T.S. 193 (entered into force April 30, 1942).

program, which has invested over $700,000 in projects to protect and restore monarch butterfly wintering habitat in Mexico.[115] The effort to protect butterfly wintering habitat in Mexico has also included forest management training by the U.S. Forest Service.[116]

International migration conservation, like international biodiversity protection more generally, will require some kind of financing mechanism where richer nations can assist poorer ones.[117] The practical effectiveness of collecting and wisely spending project money will have a greater impact on animal migrations than general international agreements, such as the 1979 Bonn Convention.

4. CONCLUSION

The transboundary coordination challenge for migration conservation is not unique, but it is particularly acute. Nonetheless, a relatively rich literature evaluating experiments in cross-border cooperation and landscape-level management offers many suggestions for addressing animal migration concerns. Attention to scale and social equity will be needed to prompt greater progress on this attribute.

Solutions to transboundary challenges must include retaining and enhancing connectivity among habitats used by migrating animals. Improving connectivity is an important theme in the literature facilitating ecological adaptation to climate change.[118] In particular, the recent U.S. government report on how the national

---

[115] U.S. FOREST SERVICE, MONARCH BUTTERFLY: AMERICA'S MIGRATING INSECT, http://www.fs.fed.us/monarchbutterfly/conservation/index.shtml (last visited July 28, 2009).
[116] *Id.* at *U.S. Forest Service International Programs.*
[117] Articles 20 & 21 of the 1992 U.N. Convention on Biological Diversity, 1760 U.N.T.S. 79, created a financial mechanism, now known as the Global Environment Facility, to collect money from developed countries to spend in less-developed nations in exchange for emphasizing biodiversity protection.
[118] *See, e.g.,* Lee Hannah & Lara Hansen, *Designing Landscapes and Seascapes for Change, in* CLIMATE CHANGE AND BIODIVERSITY, *supra* note 39, at 329; Lee Hannah & Rod Salm, *Protected Areas Management in a Changing Climate, in* CLIMATE CHANGE AND BIODIVERSITY, *supra* note

wildlife refuge system can adapt to climate change recommends the establishment of corridors of connectivity for migrations.[119] Funding for corridor acquisition presents an opportunity to address both the maintenance of existing migrations and the viability of species as their habitats shift or disappear with climate change. Insuring that animals can move through the landscape across boundaries, therefore, links to the next element of the legal response, particularly reducing barriers and protecting migration corridors.

C. PROTECTING MIGRATION CONNECTIVITY

Connectivity refers to the linkages among habitats that facilitate migration and promote resilience in the face of ecological change.[120] Migrating animals are often the vehicles connecting dispersed habitat, transferring nutrients, energy, and other biological resources. But, migrations themselves require paths that support the journey, and this section examines three legal tools essential to maintaining the linkages along migration routes. The first subsection addresses corridor design and habitat acquisition. The second subsection discusses the regulatory constraints and the subsidies/incentives needed for a balanced approach to reducing migration barriers on private lands. The third subsection turns to design and abatement standards for particular activities on private lands that might otherwise impede migration Drawing from the lessons of pollution control law, we suggest activity-based, or "best management practice," standards.

While connectivity is important for all migrations, this section focuses on those animals that traverse privately owned land for at least part of their migration. Still, marine migrations need to be protected from harmful activities,

---

39, at 363.
[119] J. Michael Scott et al., *National Wildlife Refuges, in* PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES 33 (S.H. Julius et al. eds. 2008), *available at* http://www.climatescience.gov/Library/sap/sap4-4/final-report/#finalreport.
[120] *Id.*; NOSS & COOPERRIDER, *supra* note 4, at 150.

such as shipping and petroleum development, for which uniform abatement standards will be important. And designated marine corridors are beginning to receive attention as well.[121] While there is little private property in marine ecosystems, rights to fish quotas or even sea beds can be modified by conservation easements just like terrestrial property.[122] Also, terrestrial activities can create runoff that impacts marine ecosystems.[123] In the end, a landscape approach is necessary to promote connectivity in all three media – land, air, and water – at spatial scales applicable to particular species.[124]

1. CORRIDOR DESIGNATION AND HABITAT ACQUISITION

Systemic protection of habitat for migratory populations requires identification and designation of migration routes and associated habitats.[125] Corridors may be designated at the federal, regional, state, or local level, depending partly on the spatial scale of the migrations to be protected. Corridor designation is only the first step, however, in protecting migrations. Corridors provide targets for mitigating barriers, acquiring property interests, and enhancing habitat.

The conservation literature has long urged the adoption of corridors to

---

[121] *See, e.g.,* Callum M. Roberts et al., *Redesigning Coral Reef Conservation, in* CORAL REEF CONSERVATION 515, 520-21 (Isabel M. Cote & John D. Reynolds eds. 2006) (discussing connectivity and resilience for marine reserve networks); Elise F. Granek et al., *A Blueprint for the Oceans: Implications of Two National Commission Reports for Conservation Practitioners*, 19 CONSERVATION BIOLOGY 1008, 1011 (2005) (describing calls for connected networks of marine protected areas).

[122] Michael W. Beck et al., *New Tools for Marine Conservation: The Leasing and Ownership of Submerged Lands*, 18 CONSERVATION BIOLOGY 1214 (2004).

[123] *See* Robert H. Richmond et al., *Watersheds and Coral Reefs: Conservation Science, Policy, and Implementation*, 57 BIOSCIENCE 598 (2007).

[124] Dean Urban, Robert V. O'Neill, & Herman H. Shugart, Jr., *Landscape Ecology*, 37 BIOSCIENCE 37119 (1987).

[125] Joel Berger, *The Last Mile: How to Sustain Long-Distance Migration in Mammals*, 18 CONSERVATION BIOLOGY 320 (2004) (a network of national migration corridors can help preserve large mammal migrations). Of course, the location, design, and potential benefits of movement corridors must be justified with data. Daniel Simberloff, James A. Farr, James Cox, & David W. Mehlman, *Movement Corridors: Conservation Bargains or Poor Investments?*, 6 CONSERVATION BIOLOGY 493 (1992).

reconnect landscapes suffering from habitat fragmentation.[126] Corridors for stringent activity-based controls need to be designated in those places where an animal migration is expected to occur. Outside of the designated corridor, there may be no need for the controls. There will be places where a core protected zone of acquired habitat can be paired with a buffer zone of activity-based limitations. In other areas, social equity may demand outright purchase of property rights where the costs of complying with activity-based controls would be prohibitive.

Acquisition of habitat in corridors will rarely require purchase of a full fee simple absolute. Instead, seasonal habitat provision or limitations on just some potential activities on the site may be obtained through conservation easements. The purchase of easements to provide migratory waterfowl habitat has been one of the signal successes of twentieth century conservation in the United States.[127] The experience with waterfowl should serve as a template for conserving other animal migrations. While some easement terms might be common to those property interests purchased by hundreds of private land conservancies around the country, others may be tailored to the peculiarities of a particular migration. The federal government may create new kinds of property through purchase, as it has in waterfowl habitat to prohibit such activities as prairie pothole drainage.[128] Defining new kinds of affirmative easements through federal law may open the door to more widespread use by nongovernmental organizations interested in migratory wildlife protection.

The design of some corridors will conform to existing migration geography. Again, waterfowl conservation offers an example, where the flyways established

---

[126] A.F. BENNETT, LINKAGES IN THE LANDSCAPE: THE ROLE OF CORRIDORS AND CONNECTIVITY IN WILDLIFE CONSERVATION (2d ed. 2003); Paul Beier et al., *Forks in the Road: Choices in Procedures for Designing Wildland Linkages*, 22 CONSERVATION BIOLOGY 836 (2008).
[127] John Davidson, *The New Public Lands: Competing Models for Protecting Public Conservation Values on Privately Owned Lands*, 39 ENVTL. L. REP. 10368 (2009).
[128] North Dakota v. Untied States, 460 U.S. 300 (1983); United States v. Little Lake Misere Land Co., 41 U.S. 580 (1973).

priority corridors for federal acquisition of land for the national wildlife refuge system.[129] Marine animal migrations may benefit from applying this design principle to the oceans.[130]

The realities of climate change, however, will drive the need to establish corridors to allow animals to adapt their migrations to new circumstances.[131] Some of the threats discussed in Part II of this article will call for preserving opportunities in places upslope or farther north than current habitat. The more difficult future corridors to predict will respond to the phenological changes disrupting existing migrations through asynchronous changes in habitat. While existing scientific tools are inadequate to this task, the challenge is important enough that a legal response to migration conservation should build in adaptive management experiments to explore effective approaches.

Several current efforts have, with varying success, sought to protect land corridors for migrating animals. Notable efforts have focused on wildlife migration in the Rocky Mountain region.[132] For instance, in 2007 the Western Governors' Association ("WGA") adopted a resolution calling for identification and protection of wildlife migration corridors.[133] This protection would be achieved partly through updating federal resource management plans and removal of the Energy Policy Act's categorical exclusions for NEPA review of oil and gas drilling.[134] The spike in oil and gas development over the past decade now

---

[129] Fischman, *supra* note 16, at 11-12.
[130] For example, NOAA's "Ship Strike Reduction Strategy" rule imposes speed limits on large vessels traveling in the priority migratory corridors of the endangered North Atlantic right whale. 50 C.F.R. § 224.105.
[131] *See* notes 118 and 119 *supra*.
[132] *See* Dennis Feeney et al., *Big Game Migration Corridors in Wyoming*, University of Wyoming, Wyoming Open Space Initiative Newsletter, April 2004, B-1155.
[133] Western Governors' Association Policy Resolution 07-01, Protecting Wildlife Migration Corridors and Crucial Wildlife Habitat in the West, February 27, 2007, Washington, D.C., *available at* http://www.westgov.org/wga/policy/07/index.htm.
[134] *Id. See also* Western Governors' Association, Western Wildlife Habitat Council Established, Jackson, Wyoming, June 29, 2008, *available at* http://www.westgov.org/wga/publicat/wildlife08.pdf.

presents perhaps the greatest risk of losing long-distance mammal migration in the region.[135] In addition, the development of new electricity transmission corridors to carry solar- and wind-generated power from federal public lands to cities and other large consumers raises an emerging new conflict as the energy corridors often overlap wildlife migration corridors.[136]

Consistent with the WGA's corridor resolution, in 2008 the Bridger-Teton National Forest in Wyoming amended its land and resource management plan by designating a Pronghorn Migration Corridor. The pronghorn that summer in Jackson Hole migrate round trip distances up to 550 km annually to wintering areas in the Green River basin, and squeeze through bottlenecks as narrow as 0.1 km wide.[137] A significant portion of the full migration route is within the Bridger-Teton National Forest. The new amendment protects the corridor with the following standard: "All projects, activities, and infrastructure authorized in the designated Pronghorn Migration Corridor will be designed, timed and/or located to allow continued successful migration of the pronghorn that summer in Jackson Hole and winter in the Green River basin." But the plan amendment does not remove any current forest plan direction for the area encompassed by the corridor and makes no decisions about the compatibility of specific uses with the pronghorn migration; it simply designates the corridor and requires that all uses be found to allow continued migration before they are authorized.[138] Although the Bridger-Teton effort falls far short of the proposed Yellowstone-to-Yukon corridor[139] because it is limited to the national forest lands and targets a single

---

[135] *See* Berger, *supra* note 125.
[136] April Reese, *Western Governors Struggle to Balance Wildlife Protection, Renewables Development*, 10 LAND LETTER, June 18, 2009, at 9.
[137] *Id.*
[138] Decision Notice and Finding of No Significant Impact, Pronghorn Migration Corridor Forest Plan Amendment, USDA Forest Service, Bridger-Teton National Forest Wyoming, May 31, 2008. *See also* Joel Berger, Steven L. Cain, & Kim Murray Berger. 2006. *Connecting the Dots: An Invariant Migration Corridor Links the Holocene to the Present*. 2 BIOLOGY LETTERS 528.
[139] David W. Edgar, *Yellowstone to Yukon: Can it Ever Become a Reality?*, 67 U. MO. K.C. L.

migratory species, designation of migration corridors on federal land is nevertheless a significant step towards conservation.[140]

Along these same lines, the proposed federal Northern Rockies Ecosystem Protection Act would impose regulations within a wildlife corridor constructed by piecing together federal lands under the jurisdiction of the Department of Interior.[141] The bill proposes to designate certain national forest lands and public lands in Idaho, Montana, Oregon, Washington, and Wyoming as wilderness, wild and scenic rivers, wildland recovery areas, and biological connecting corridors.[142] The portions of the biological connecting corridors not designated as wilderness are to be designated as "special corridor management areas" and are to be managed according to the Multiple-Use Sustained-Yield Act of 1960 and other applicable laws such that (1) even-aged silvicultural management and timber harvesting is prohibited, (2) subject to valid existing rights, mining, oil, and gas exploration and development and new road construction or reconstruction is prohibited, and (3) road densities must not exceed 0.25 miles per square mile of land.[143]

These western corridor proposals seek to regulate land use and barriers within the corridors to protect animals whose migrations can be accommodated

---

REV. 111 (1998) (The "Yellowstone to Yukon" project, referred to as "Y2Y," involves the creation of a 1,800-mile corridor spanning the northern Rocky Mountains in the U.S. and extending over the Canadian Rockies, into Yukon Territory. "The purpose of this project is to provide large North American carnivores with a protected 'conduit' which will be utilized by these large predators (including the grizzly bear, gray wolf and wolverine) as an enlarged, protected migratory route).

[140] The USFWS manages some complexes of national wildlife refuges as wildlife corridors. *See, e.g.*, USFWS Minnesota Valley National Wildlife Refuge Corridor, *available at* http://www.fws.gov/Midwest/MinnesotaValley/lands.html); USFWS Delmarva Conservation Corridor Project, FISH & WILDLIFE JOURNAL, Region 5, September 15, 2003.

[141] Northern Rockies Ecosystem Protection Act, 2009 H.R. 980, 111 H.R. 980. *See also* 1999 H.R. 488, 106 H.R. 488, for an earlier version of the bill.

[142] The purpose of the designation, among other things, is to "protect the ecological integrity and contiguity of major wild land ecosystems and their interconnecting corridors" and to "protect and maintain biological and native species diversity and dispersal throughout the Northern Rockies Bioregion." *Id*. at Sec. 3(b).

[143] *Id*. at Sec. 203.

by contiguous swaths of federal lands.[144] Restricting migration protection efforts to public lands, however, will not be sufficient to protect migrations generally.[145] The law must address private land use and barriers within designated corridors.

2. LAND USE CONTROLS TO PROTECT HABITAT

Just as "all politics is local,"[146] all conservation must attend to protection and management of particular habitat. For terrestrial habitat, local land use control will often be the most precise tool for ensuring that migratory animals are able to feed, rest, and nest. Though national wildlife refuges and other public land reserves can secure key areas, some control of private land use will be necessary to maintain most migrations.[147] Land trusts may play a role through conservation easements, but the problem of land use control is mostly a local government

---

[144] The corridors proposed in the Northern Rockies Ecosystem Protection Act would be exclusively on federal land unless private entities volunteered to include their lands. *See id.* at Sec. 204. ("(a) Federal Land Management Agencies.--This title shall apply only to National Forest System lands and lands under the jurisdiction of the the Bureau of Land Management and the United States Fish and Wildlife Service. (b) Private Land and Landowners.--Private lands are not affected by this title. No private landowner whose lands are adjacent to the designated connecting corridors shall be compelled, under any circumstances, to comply with this title. However, private landowners may enter into cooperative agreements with the Federal Government on a willing participant or willing seller basis to include their land in a biological connecting corridor."). Bradley Karkkainen has proposed that biodiversity protection efforts focus on federal landholdings. Bradley C. Karkkainen, *Biodiversity and Land*, 83 CORNELL L. REV. 1 (1997).

[145] *See, e.g.*, David Farrier, *Conserving Biodiversity on Private Land: Incentives for Management or Compensation for Lost Expectations*, 19 HARV. ENVTL. L. REV. 303 (1995) (discussing biodiversity protection).

[146] This phrase is typically associated with former House Speaker Thomas "Tip" O'Neill. William Safire, *7 More in '94*, N.Y. TIMES, Nov. 4, 1993, at A27.

[147] Control of private land use is particularly important for the eastern U.S. which contains a smaller percentage of public land than the western U.S. Approximately 90 percent of the total acreage of U.S. Forest Service, Bureau of Land Management, and U.S. Fish & Wildlife Service lands combined occur in the western U.S. (excluding Alaska) [calculated from agency reports as 331,619,441 acres in the western U.S. (U.S. Forest Service regions 1-6) and 31,563,714 acres in the eastern U.S. (U.S. Forest Service regions 8-9)]. Thus, the currently debated Northern Rockies Ecosystem Protection Act (2009 H.R. 980, 111 H.R. 980), which, to restore and maintain animal movements in the Northern Rockies, would designate certain federal lands in the States of Idaho, Montana, Oregon, Washington, and Wyoming as wilderness, wild and scenic rivers, wildland recovery areas, and biological connecting corridors, would probably not be feasible for the eastern U.S.

issue.[148]

Despite its pervasive importance in achieving environmental policy goals, land use control has received surprising little attention from lawmakers in the United States. One reason is the relatively strong role that individual autonomy and expectation for economic profit play in American real property law. Another is that the national government dominates environmental law, and federal lawmakers are loath to interfere directly with the traditional prerogatives of local governments. Congress seriously considered national land use control legislation in the early 1970s, but not since.[149]

Nonetheless, almost all environmental regulation exerts some control over land use. Direct land use controls apply in certain cases where significant habitat modification would injure species listed under the ESA.[150] Indirect land use controls are more pervasive, from federally-spurred state coastal zone restrictions under the Coastal Zone Management Act ("CZMA")[151] to industrial siting restrictions due to impacts on waterways[152] or ambient air quality.[153] Still, the application of constraints on private land use remains among the very most controversial aspects of federal environmental law.

As a matter of design, laws and programs aiming to protect habitat for migration will need to strike a balance between national (or international) coordination and local implementation. Generally, land use controls for wildlife

---

[148] Rapanos v. United States, 126 S. Ct. 2208, 2224 (2006) (characterizing land use control as a "quintessential" state/local power).
[149] Noreen Lyday, THE LAW OF THE LAND: DEBATING NATIONAL LAND USE LEGISLATION 1970-75 (1976); Jayne E. Daly, *A Glimpse of the Past—A Vision for the Future: Senator Henry M. Jackson and National Land Use Legislation,* 28 URB. LAW. 7 (1996); Carol M. Rose, *The Story of Lucas, in* ENVIRONMENTAL LAW STORIES 237, 245-249 (Richard J. Lazarus & Oliver A. Houck eds. 2005).
[150] 16 U.S.C. § 1538(a)(1); 50 C.F.R. § 17.3.
[151] 16 U.S.C. § 1455b.
[152] Discharge to impaired waters may require more stringent permit restrictions. 33 U.S.C. § 1312. Air pollution emissions in areas of the country where ambient air quality fails to meet national standards may require more stringent permit restrictions. 42 U.S.C. § 7503.
[153] 42 U.S.C. §§ 7501-7521 (limitations for nonattainment areas).

conservation focus on a mix of positive incentives through grants, subsidies, and property purchases. But, the ESA illustrates that some regulatory restrictions may spur habitat conservation planning that can secure habitat. Programs for endangered species protection offer landowners a range of inducements, but most comprehensive efforts to protect habitat on private lands begin with a prohibition or restriction that brings private landowners to the negotiating table. It may be necessary for the federal government to prod states and local governments to implement some restrictions as sticks to balance a program of carrots for securing habitat.

Three options for controlling land use within migration corridors containing a mix of public and private lands dominate the existing legal programs: (1) the federal government cooperates with states under a federalism model; (2) state governments regulate independently of the federal government, acting individually or within multistate agreements or compacts; and (3) governments or public-private partnerships use incentives to influence local governments to regulate land uses through zoning or similar mechanisms. The remainder of this subsection describes examples of each of these approaches.

The CZMA employs Fischman's "federal deference to state process" approach to cooperative federalism.[154] This approach may be particularly useful for protecting migration corridors. In this approach the federal government encourages coastal states to develop management plans governing coastal zone land uses in exchange for federal aid and cooperation in implementing the program. The plans must be consistent with federal policies, define permissible land and water uses, identify areas of particular concern, and demonstrate that land and water uses can be controlled through state establishment of standards to be implemented locally, direct state regulation or review of all development

---

[154] Fischman, *supra* note 103.

proposals for consistency with the plan.[155] J. B. Ruhl has proposed that a CZMA-like approach to a unified federal biodiversity conservation program for nonfederal lands holds greater promise for protecting biodiversity than competing models of regulation.[156] The Clean Water Act's National Estuary Program is another federally-driven collaborative program that involves cooperation with state and local governments as well as private entities.[157] Under this program, the federal government funds and facilitates the development of conservation and management plans to address environmental and resource depletion problems within designated estuaries.[158]

The 1971 Adirondack Park Agency Act ("APAA") illustrates a purely state-level approach to regulating uses on a mixture of public and private lands.[159] In 1885, New York declared the Adirondacks Forest Reserve, much of it privately owned, as a protected natural area.[160] In the early 1970s, forest preserve lands constituted approximately forty percent of the six million acres of land in Adirondack Park.[161] The APAA's statement of findings and purpose expressly recognizes the problem of managing a mix of public and private land within a regional and state context:

> In the past the Adirondack environment has been enhanced by the

---

[155] 16 U.S.C. § 1455.
[156] J. B. Ruhl, *Biodiversity Conservation and the Ever-Expanding Web of Federal Laws Regulating Nonfederal Lands: Time for Something Completely Different?*, 66 U. COLO. L. REV. 555 (1995). Ruhl proposes Biological Resource Zone management planning process overseen by the federal government but implemented by state and local governments. Such an approach could work for designating and protecting migration corridors. Government oversight and incentive programs may be more politically effective than a command and control approach where a corridor contains a substantial percentage of private land. *See also* John D. Echeverria, *Regulating Versus Paying Land Owners to Protect the Environment*, 26 J. LAND RESOURCES & ENVTL. L. 1 (2005); Barton H. Thompson, Jr., *Providing Biodiversity through Policy Diversity*, 38 IDAHO L. REV. 355 (2002); Robert B. Keiter, *Biodiversity Conservation and the Intermixed Ownership Problem: From Nature Reserves to Collaborative Processes*, 38 IDAHO L. REV. 301 (2002).
[157] 33 U.S.C. § 1330.
[158] *Id*. *See also* http://www.epa.gov/nep/.
[159] N.Y. EXEC. LAW §§ 800 to 820 (McKinney 2005).
[160] Act of May 15, 1885, 1885 N.Y. Laws ch. 283; N.Y. Comp. Codes R. & Regs. tit. 9, §3.119.
[161] N.Y. EXEC. LAW at § 801.

> intermingling of public and private land. A unique pattern of private land use has developed which has not only complemented the forest preserve holdings but also has provided an outlet for development of supporting facilities necessary to the proper use and enjoyment of the unique wild forest atmosphere of the park. This fruitful relationship is now jeopardized by the threat of unregulated development on such private lands. Local governments in the Adirondack park find it increasingly difficult to cope with the unrelenting pressures for development being brought to bear on the area, and to exercise their discretionary powers to create an effective land use and development control framework.[162]

The law creates "an obligation to insure that contemporary and projected future pressures on the park resources are provided for within a land use control framework which recognizes not only matters of local concern but also those of regional and state concern."[163] To meet this obligation, the APAA establishes state regulatory controls, including shoreline development restrictions[164] and requires review and approval of regional projects by the state Adirondack park agency.[165] The APAA also imposes requirements, overseen by the state agency, for local government land use programs and development approvals.[166] The APAA program conserves biodiversity by regulating private lands surrounding or interspersed within core public lands. Such an approach may be adapted to core migration corridors. Notwithstanding the governmental authority to protect public lands from harmful activities on nearby private lands,[167] establishing a new

---

[162] *Id*. *See also* Helms v. Diamond, 76 Misc.2d 253, 349 N.Y.S.2d 917 (1973) (the basic function and concern of Adirondack Park Agency is with use and development of private lands within Park).
[163] *Id*.
[164] *Id*. at § 806.
[165] *Id*. at § 809.
[166] *Id*. at §§ 807-08.
[167] The Property Clause of the U.S. Constitution, Art. IV, Sec. 3, Cl 2, to some extent not yet fully delineated, allows the federal government to regulate activities on private land if the regulated activities threaten the designated purposes of the public land. Minnesota v. Block, 660 F.2d 1240 (8th Cir. 1981); *see also* Kleppe v. New Mexico, 426 U.S. 529 (1976) (stating that regulations under the Property Clause may have some effect on private lands not otherwise under federal control, although not deciding the question of the permissible reach under the Property Clause

corridor containing a relatively large proportion of private land, and then regulating development within that corridor, will be politically difficult, even at the state level.[168]

A non-regulatory (and possibly less threatening) approach to protecting a wildlife corridor comprising both public and private lands is to use public-private partnerships to influence local governments. This approach is illustrated by the Kittatinny Ridge Conservation Corridor Project.[169] Kittatinny Ridge extends more than 250 miles and crosses 11 Pennsylvania counties, and is a critical corridor of the Eastern Flyway, most notably for raptors.[170] Two-thirds of the ridge is privately owned, and is subject to housing, commercial, wind power, and mining development.[171] The coalition of governmental and private entities that constitute the corridor project seek, among other things, to work with local governments to enact or strengthen natural resource protection plans and ordinances that apply to the corridor, help land trusts and agencies purchase conservation easements on private lands, and expand the corridor to other states.[172] Other non-regulatory bird conservation initiatives and joint ventures, such as "Partners in Flight," also apply a spatially-explicit, regional-scale landscape approach to conservation.[173]

---

over private lands to protect wild free-roaming horses and burros that have strayed from public land); Columbia River Gorge United v. Yeutter, 960 F.2d 110 (9th Cir. 1992) (stating in dicta that Supreme Court decisions have upheld federal regulation of non-federal land where the regulated activity on the non-federal land affected the federal land); Peter A. Appel, *The Power of Congress "Without Limitation": The Property Clause and Federal Regulation of Private Property*, 86 MINN. L. REV. 1 (2001).

[168] Dan Tarlock, *Land Use Regulation: The Weak Link in Environmental Protection*, 82 WASH. L. REV. 651 (2007).

[169] *See* Audubon Pennsylvania, Conservation Plan for the Kittatinny Ridge, December 2006, *available at* http://pa.audubon.org/PDFs/KittatinnyConservationPlan-Apr2007.pdf.

[170] *Id*.

[171] *Id*.

[172] *Id*.

[173] Partners in Flight (*available at* http://www.pwrc.usgs.gov/PIF/); USFWS Huron-Erie Corridor Initiative (*available at* http://www.fws.gov/Midwest/alpena/Habitat.html); North American Bird Conservation Initiative (*available at* http://www.abcbirds.org/abcprograms/domestic/partnerships/NABCI.html); Appalachian Mountains Joint Venture (*available at* http://www.abcbirds.org/

3. STANDARDS TO REDUCE AND MITIGATE BARRIERS

Once a migration corridor is designated and a regulatory approach chosen, land-use controls to reduce barriers and enhance connectivity present a difficult legal design problem. Any program for comprehensive conservation of animal migration should heed the lesson from pollution control law: uniform, activity-based standards are more effective to implement than fine-tuned, effects-based regulation. Effects-based regulation seeks to control only those activities that can be shown to cause an individual injury to the environment. The ESA prohibition on just those activities that result in actual injury to listed species is a good example of the effects-based approach, which is common in resource management. The major problem with this approach is that it is typically beyond the ability of any agency or organization to show precisely how a particular activity in a particular place causes a particular biological harm. The causative relationship is either too complex to show or the information is too expensive to discover.

The "data gaps" between what effects-based regulation demands and what scientists and agencies supply is widely discussed in the literature.[174] Historically, the technology-based regulatory regime in pollution control arose in response to these difficulties.[175] However, natural resources law, in part because its proprietary management component overshadows its regulatory elements, has been slow to adopt this tool.[176]

Technology-based standards in environmental law establish uniform limitations on all activities of a similar type. Although there may be some

---

abcprograms/ domestic/landscape/apmjv.html).

[174] *See, e.g.,* Symposium*, Missing Information: The Scientific Data Gap in Conservation and Chemical Regulation,* 83 IND. L.J. 399 (2008).

[175] Wendy E. Wagner, *The Triumph of Technology–Based Standards*, 2000 U. ILL. L. REV. 83; Oliver A. Houck, *Of BATs, Birds, and B-A-T: The Convergent Evolution of Environmental Law*, 63 MISS. L.J. 403 (1994).

[176] Robert L. Fischman, *Predictions and Prescriptions for the Endangered Species Act,* 34 ENVTL. L. 451, 475-479 (2004).

modification of the uniform, activity-based standard for special, site-specific circumstances, it must be justified as a deviation from the norm. That norm coincides with a judgment that people engaged in environmentally harmful activities should do what they feasibly can to minimize their impacts. In pollution control law, those limitations on behavior generally require the application of a particular abatement technology. Wind farm development is a good candidate for technology-based standards to protect winged migrators, such as bats.[177]

More often in habitat conservation, however, the analogous application may be less technologically sophisticated. For nonpoint source control, the limiting principle is called "best management practices" ("BMPs"). Among the approaches falling in this category that might find their way into standards to mitigate barriers to migration are riparian buffer zones, slash management, hedgerows, tillage limitations, stormwater abatement, and residential clustering.[178] Fischman has argued that ESA incidental take regulation should follow this approach.[179] For the same reasons, these uniform-across-activities standards are much more likely to achieve effective mitigation of migration barriers. Because many controls will not involve expensive or cutting-edge technology, the application of this approach to conservation may best be called activity-based regulation.[180] The principle of requiring that habitat-disturbing activities minimize impacts and employ uniform controls, however, is the same as the more familiar technology-based limitations.

The Bureau of Land Management has already adopted the BMP approach in

---

[177] Scott Streater, *Impacts to Wildlife Weighted in Push Toward "Green" Energy*, LAND LETTER, Feb. 5, 2009.
[178] Fischman, *supra* note 176, at 477.
[179] *Id*. at 475-479; Robert L. Fischman, *The Divides of Environmental Law and the Problem of Harm in the Endangered Species Act,* 83 IND. L.J. 661, 691-92 (2008).
[180] Professor Fischman adopted the term "activity-based" controls or regulation in applying the technology-based, best management practices approach of pollution control to resource management. *See id.*; Fischman, *supra* note 176.

its 2008 Wind Energy Development Policy.[181] The BMPs include monitoring, design, and operation standards. One standard condition for permitting turbines on public lands requires wind power operators to "determine the presence of bat colonies and avoid placing turbines near known bat hibernation, breeding, and maternity/nursery colonies; in known migration corridors; or in known flight paths between colonies and feeding areas."[182]

Unfortunately, most conservation laws use effects-based approaches to control land use and potentially injurious activities. The quintessential effects-based approach is the no-take provision, versions of which underpin the ESA, MBTA, and MMPA. Although no-take provisions are useful, particularly to protect species from harvesting, they have limited effectiveness for protecting migrations from unintended impacts incidental to otherwise lawful activities.

In the MBTA, as in other no-take laws, the occurrence of certain adverse effects to a protected animal triggers a legal response[183] unless a permit applies.[184] On its face, the MBTA prohibits unauthorized take; thus, the death of even a single migratory bird may constitute a criminal offense. However, the enforcement agency – the USFWS – implements no protections unless it can

---

[181] U.S. Dept. of the Interior, Bureau of Land management, Wind Energy Development Policy, Instruction Memo. No. 2009-043 (Dec. 19, 2008), *available at* http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2009/IM_2009-043.html.

[182] *Id.* at Attachment 1-6 ("Best Management Practices"), *available at* http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/im attachments/2009.Par.34083.File.dat/IM2009-043_att1.pdf.

[183] The no-take provision of the MBTA does not include the specific act of "harm." 16 U.S.C. § 703. For the purposes of this article, we define an effects-based approach to mean a legal response triggered only on upon a showing of probable cause linking an action to some specific harm (*e.g.*, killing) to a particular animal. Therefore the MBTA does employ an effects-based standard in the sense we mean it.

[184] *See* 16 U.S.C. § 704(a) of the MBTA for authorization to "determine when, to what extent, if at all, and by what means, it is compatible with the terms of the conventions to allow hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any such bird, or any part, nest, or egg thereof, and to adopt suitable regulations permitting and governing the same . . ." and 50 C.F.R. 13.11(d), listing user fees for fifteen types of permits under the MBTA.

establish a reasonable likelihood that a particular action proximately caused the adverse effect.[185] To establish liability, or for the threat of liability to have a deterrent effect, the adverse effect must be of a type that can be successfully prosecuted. Courts have concluded that harm to birds caused indirectly by habitat modification alone does not impose liability under the MBTA, unlike under the ESA.[186] Even for a direct effect, the agency must prove that the activity in question proximately caused the prohibited injury. Proof of causation includes a demonstration of a sequence of events, uninterrupted by any intervening cause that would have resulted in the effect, such as death of a bird, and without which the effect would not have happened. The effect also must have been "reasonably anticipated or foreseen as a natural consequence of the wrongful act."[187] Under the courts' interpretation of the proximate cause requirement, direct killing of birds by collisions with cars, for example, would not be sufficient to impose liability under the MBTA.[188]

The MBTA's effects-based approach seeks to control only those activities that result in actual injury. The USFWS may attempt to leverage the threat of prosecution in order to address incidental habitat destruction.[189] This regulatory approach may have the capability to promote application of best practices and

---

[185] *See* Meredith Blaydes Lilley & Jeremy Firestone, *Wind Power, Wildlife, and the Migratory Bird Treaty Act: A Way Forward*, 38 ENVTL. L. 1167, 1192 (2008).

[186] *Id.* at 1193–94 (citing Seattle Audubon Soc'y v. Evans, 952 F.2d 297 (9th Cir. 1991) and City of Sausalito v. O'Neill, 386 F.3d 1186 (9th Cir. 2004)).

[187] Lilley & Firestone, *supra* note 185, at 1185 (citing United States v. Moon Lake Electrical Ass'n, 45 F. Supp. 2d 1070 (D. Colo. 1999)).

[188] *Id.* The courts have narrowed prosecution liability under the MBTA to activities resulting in take that are both direct and reasonably foreseeable. Courts have found that liability can attach mainly in two incidental-take contexts: take that is incidental to a dangerous activity (*e.g.*, pesticide production or application) and take resulting from the failure to implement inexpensive, avoidance measures (*e.g.*, power line operation).

[189] In deciding whether to prosecute a taking the USFWS must weigh factors such as the seriousness of the transgression, the type and quality of available proof, and the deterrent value of prosecuting. According to Lilley and Firestone, USFWS is much more likely to prosecute when entities fail to implement measures to prevent reasonably foreseeable, significant, and easily preventable incidental take of migratory birds. *See* Lilley & Firestone, *supra* note 185, at 1197-1200.

technologies to minimize foreseeable harms to birds.[190] But, it is costly for the agency to implement, limited in the scope of protections possible, and of uncertain regulatory effect. Adding an ESA-like incidental take permit requirement onto the MBTA would not entirely solve the habitat conservation problem because it would still rest on the case-by-case causation of harm.[191]

A better alternative is the activity-based approach. It would look at aggregate effects of activities within a corridor rather than find case-by-case marginal harms. For example, within corridors the siting and design of barriers would be implemented through a mandatory set of standards, developed at the federal or state level. A proposal for a potentially harmful activity would trigger a set of standards and limitations appropriate to the type of action and intended to avoid or minimize impacts to migratory animals. This activity-based approach is prospective: siting and design standards would be based on an assessment of risks and intended to prevent harm. Most importantly, this approach would not require case-by-case proof of causation.[192]

D. HARVEST CONTROLS

Harvest controls are among the very oldest and best established legal

---

[190] For various activities resulting in the reasonable expectation that potentially significant bird deaths will result, USFWS has issued guidance documents (for example, for communication towers and wind power facilities). *See* Lilley & Firestone, *supra* note 185, at 1198 n.229. The USFWS can use the threat of prosecution under the MBTA to promote the implementation of such technical standards. According to Lilley and Firestone, regulated entities will most likely not be subject to USFWS prosecution so long as they take reasonable steps to implement these guidelines and demonstrate good-faith efforts to reduce their siting and operational impacts. Moreover, MIGRATORY BIRD EXECUTIVE ORDER 13,186 (JANUARY 10, 2001) imposes responsibilities under the MBTA on federal agencies to protect migratory birds. *See, e.g.*, U.S. DEPARTMENT OF ENERGY, OFFICE OF LEGACY MANAGEMENT, MIGRATORY BIRD TREATY ACT ISSUES, NATURAL RESOURCE MANAGEMENT ACTIVITIES, AND MAINTENANCE AND PROJECT ACTIVITIES AT THE ROCKY FLATS SITE, LMS/RFS/SO4511 (SEPT. 2008), discussing application of best management practices to avoid and minimize impacts to migratory birds.

[191] Fischman, *supra* note 179.

[192] *Id.*

mechanisms to conserve animals.[193] These controls, also called "take limitations," have brought back healthy populations of game species from the brink of extirpation around the world. Among the harvest control tools useful to migration are limitations on who may hunt, seasons for hunting, methods of hunting, and the kinds of individual animals that may be taken. Often permits are employed to implement these limits in particular circumstances. The first multi-species federal law protecting wildlife across the country, the 1900 Lacey Act, sought to improve enforcement of state harvest controls.[194] The need for better enforcement to put paper protections into practice will continue to be a focus for migration conservation law. Coordination across international boundaries, explored in section B, *infra*, will continue to drive international agreements, and implementing statutes, as it has for over a hundred years.[195]

The first step in establishing harvest control is to identify which species and what threats from exploitation need to be addressed. Because migrations represent unusual concentrations of animals, they tend to be disproportionately subject to harvest pressure. While many of the migrations facing problems from over-harvest are outside of the United States, there remain problems in all countries to control takes to preserve abundant migrations. For instance, in the Delaware Bay, the federal commission governing marine harvests has repeatedly failed to tighten controls on harvests of horseshoe crabs, widely used as commercial fishing bait.[196] The decline of crab populations due to commercial harvest is an important constraint on the ability of the red knot to complete its spring migration from southern South America to northern Canada. Virtually the entire population of red knots stops at the Delaware Bay to rest and feed before

---

[193] Robert L. Fischman, *Law—Biological Conservation, in* ENCYCLOPEDIA OF WORLD ENVIRONMENTAL HISTORY 765 (Krech et al. eds. 2004).
[194] 16 U.S.C. §§ 701, 3371-78.
[195] *See, e.g.,* Migratory Bird Treaty and Migratory Bird Treaty Act, 16 U.S.C. §§ 703-711.
[196] *Interstate Panel Rejects Call to Halt Crab Harvest*, LAND LETTER, Sept. 5, 2008.

undertaking the final segment of their migration. The birds' nourishment depends on horseshoe crabs migrating from the continental shelf to lay billions of eggs along the Delaware shore.[197]

The second, more difficult problem is enforcing established harvest controls. A prime example of the challenges of enforcing established harvest controls occurs in the context of whaling. The International Whaling Commission establishes harvest limits, yet those limits are frequently ignored. The United States has on several occasions attempted to use economic sanctions to enforce whale harvest limits, but "[i]n the majority of cases, sanctions were threatened but subsequent negotiations resulted in either reduced actions or none at all."[198] The difficulty of enforcing whale harvest controls even spurred some whale protection groups to such extreme measures as piracy and sabotage.[199] Poor compliance and enforcement are problems not only in the context of whaling, but throughout all of the global fishing industry.[200]

E. CONCLUSION

This Part presented four elements of a legal response necessary to address the main threats to animal migrations: (1) thresholds and triggers for conservation protections and benefits; (2) inter-jurisdictional cooperation and coordination; (3) protection of migration connectivity; and (4) regulation of commercial and recreational harvest. We conclude from our analysis that although existing laws and programs offer some useful approaches to these elements, these approaches generally fair poorly at protecting migrations as phenomena of abundance, particularly with respect to thresholds and triggers. In Part IV we propose a

---

[197] WILCOVE, *supra* note 9, at 34-39.
[198] Benjamin van Drimmelen, *The International Mismanagement of Whaling*, 10 UCLA PAC. BASIN L.J. 240, 252 (1991).
[199] *Id.* at 251.
[200] *See generally* Zachary Tyler, *Saving Fisheries on the High Seas: The Use of Trade Sanctions to Force Compliance with Multilateral Fisheries Agreements*, 20 TUL. ENVTL. L.J. 43, 51-81 (2006).

conceptual model for a comprehensive migration protection law that addresses these shortcomings.

IV. CONCEPTS FOR A COMPREHENSIVE MIGRATION PROTECTION LAW

This Part presents a conceptual model for a law intended to protect migrations as phenomena of abundance. Such a model must address harvested populations such as geese and salmon, as well as nongame populations such as bats. It must also cover animals that migrate across continents, such as songbirds and sea turtles, as well as those that migrate over short distances, such as land turtles and snakes. A law based on the model to protect abundant populations must account for the costs of high abundances of some populations, including conflicts with routine human affairs, such as agriculture.[201]

A. MIGRATION PROTECTION MODEL

We propose adopting a conceptual model for conserving migrations as phenomena of abundance, schematically represented in Figure 2 (the "Migration Protection Model"). The schematic illustrates how varying degrees of protection might apply to a migratory population depending on both population abundance and the attributes of habitat involved. In brief, the vertical axis is a continuum of abundance, bounded at the top by a maximum benchmark (such as historic abundance) and at the bottom by zero, and including a critical threshold. The horizontal axis reflects the differing ecological value of habitat areas for the migratory population, such as might occur along a cross-section from marginal to core breeding or corridor habitat. Threshold lines and curves separate the

---

[201] For example, the USFWS fairly readily issues depredation permits under the MBTA allowing take of migratory birds responsible for injury to economic interests. 50 C.F.R. § 21.41. An effort to mandate abundance thresholds at historic or maximum levels may in practice be undermined for many species when weighed against the socio-economic benefits of allowing a reduction in abundance.

graphical space into regions (labeled A, B, and C) representing different regulatory regimes and tactics for coordinating jurisdictions, maintaining migration connectivity, and controlling harvest.

Figure 2 applies to a single population, although models for individual populations can be combined into a landscape approach to protecting multiple migratory populations using common habitats and corridors. This conceptual model is not intended to solve the problem of replacing the single species approach to conservation with a multiple species approach. Rather, the model seeks to promote a flexible approach to protecting migrations as phenomena of abundance. The model has a major advantage over many existing conservation approaches: it incorporates both the differential thresholds of abundance as well as the place-specific variation in value of habitat. It provides the foundation for legal reforms with the flexibility to reduce social and political resistance to relatively high abundances of animals.

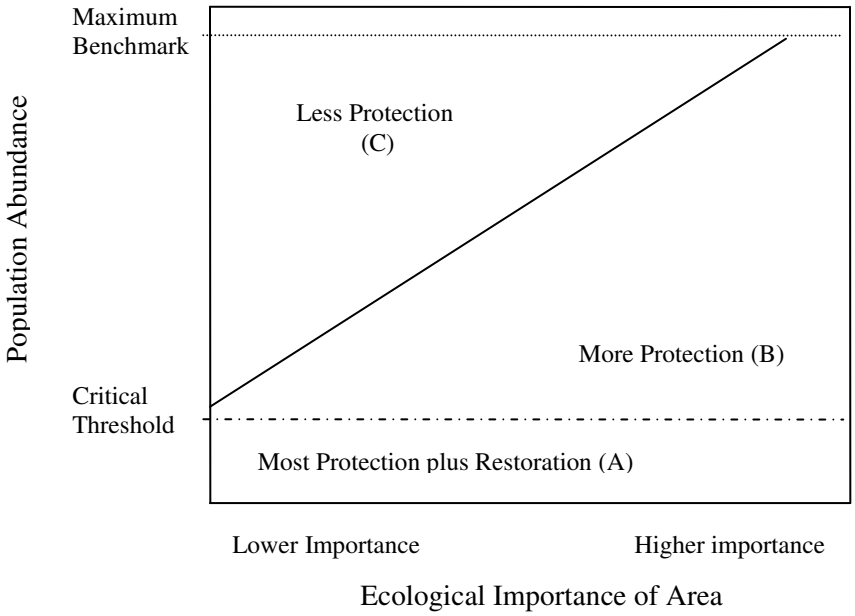

Figure 2. Conceptual model of migration protection law showing differential levels of activity-based protection and regulation as a function of population abundance and the ecological importance of the area to migrants, for a single population.

On the vertical abundance axis, protections and regulations are first triggered when the population's abundance falls below the maximum benchmark. The benchmark may be the maximum population abundance recorded or estimated, an estimate of current carrying capacity, or a range of abundances reflecting the historic or "natural" range of variability in the population's size. This threshold of abundance protects the aesthetic grandeur of migrations championed by Wilcove as well as sustainable harvested populations.

The lower critical threshold protects the abundance necessary to maintain the migratory population's functional role in the landscape and ecosystem, in addition

to the individual and social behaviors of migrants.[202] For some migratory species, but not all, this critical threshold is likely to be well above the minimum demographically viable population size associated with an imperiled population, yet probably below historic abundances or abundances required to support harvesting.[203]

On the horizontal axis, the value of a location is highest for core habitat areas. A migratory corridor may be designed with a central core pathway and an outer buffer on each side of the core area.[204] Breeding, wintering, movement, and stopover areas, whether within or outside of a designated corridor, may contain habitats of differing quality, thus allowing differentiation of core versus buffer habitat.

A primary feature of the model is that different thresholds trigger different levels of regulation. The protections are most stringent and comprehensive when population abundance is below the lower critical threshold (region A in Figure 2). For populations below the critical threshold, protections over the entire range of habitat areas would be set in motion to restore the population at least to the critical threshold in the short term. For example, aggressive habitat acquisitions, stringent barrier siting restrictions, and strong transboundary coordination may be required.

Protections and regulations are somewhat less restrictive above the critical threshold at relatively low population abundances as well as at the highest-value

---

[202] Sanderson, *supra* note 46.
[203] *Id. See also* Soule et al., *supra* note 57, at 1247 (noting that recovery goals under the Endangered Species Act manifest "demographic or numerical minimalism.").
[204] *See, e.g.,* CORRIDOR ECOLOGY: THE SCIENCE AND PRACTICE OF LINKING LANDSCAPES FOR BIODIVERSITY CONSERVATION (Jody A. Hilty, William Z. Lidicker, Jr., & Adena M. Merenlender eds. 2006); John H. Roe & Arthur Georges, *Heterogeneous Wetland Complexes, Buffer Zones, and Travel Corridors: Landscape Management for Freshwater Reptiles*, 135 BIOLOGICAL CONSERVATION 67 (2007); R. Jongman, *Nature Conservation Planning in Europe – Developing Ecological Networks*, 32 LANDSCAPE & URBAN PLANNING 169 (1995); Reed F. Noss & Larry D. Harris, *Nodes, Networks, and MUMs: Preserving Diversity at All Scales*, 10 ENVTL. MGMT. 299 (1986).

locations for all abundances (region B in Figure 2). In these locations or at these abundances, land-use controls can be less stringent and more flexible than in region A. For example, potentially harmful activities may be permitted if properly justified and if the impacts are minimized using best available technologies and best management practices. The larger the domain of the legal program, the greater the opportunity for trade-offs between areas.

Finally, protections and regulations are the least restrictive at relatively high abundances and in lower-value locations outside key habitat areas (region C in Figure 2). For example, in region C greater use of flexible federal-state cooperative schemes, incentive programs, and joint ventures may be employed.[205] The precise location of the boundary that separates regions B and C will be informed by biology, but also influenced by social and policy concerns.

The essence of the Migration Protection Model is that it values abundances currently at historic or carrying-capacity levels but allows potentially harmful activities in some locations and under some circumstances. Unlike a simple threshold and trigger which provides no protection above a critical threshold and full protection below, multiple abundance thresholds allow for a more nuanced and wider range of valuations and responses. In no case does the model leave the population without some level of protection.

B. Existing Approaches Using Variable Protection Levels

The use of thresholds to create different levels of protection and regulation is not a new concept in conservation. For example, as discussed *infra*, the MMPA employs two levels of protection separated by a single threshold that reflects population depletion. Below the threshold of depletion, the Secretary of Commerce must implement conservation plans to restore depleted populations to

---

[205] Thompson, *supra* note 156.

their optimum sustainable levels.[206] Non-depleted populations – those within the zone of optimum sustainable population – receive less protection, and may be subject to taking regulated through a permit system.[207]

Hammill and Stenson suggest an approach to managing harvested populations of Atlantic seals (where data are relatively available) that uses three abundance thresholds to trigger different levels of protection.[208] The thresholds are set at different percentages of the maximum abundance seen or estimated. When the population is above the upper or "buffer" threshold (e.g., 70% of maximum), management actions are based on a mixture of ecosystem and socio-economic considerations. When the abundance drops below the upper threshold, risk-averse conservation measures are implemented with the objective of returning the population to the upper threshold. When the population size drops below the middle threshold (e.g., 50% of maximum abundance), "substantial conservation measures," held to a more demanding likelihood of success, are triggered. When the population falls below the third and lowest "critical" threshold (e.g., 30% of maximum), all harvesting is suspended until the population can be recovered. As with the MMPA, the stringency of conservation actions depends on the level of population abundance.

Finally, a practical single-threshold approach is used in the federal antidegradation policy implemented under the Clean Water Act. The first two "tiers" of protection under the policy are illustrated in Figure 3. A fundamental attribute of antidegradation policy is protection of existing high water quality above the critical threshold of minimum water quality criteria. This attribute is

---

[206] 16 U.S.C. § 1383(b). *See also* U.S. DEPARTMENT OF COMMERCE, NOAA, NATIONAL MARINE FISHERIES SERVICE, CONSERVATION PLAN FOR THE EASTERN PACIFIC STOCK OF NORTHERN FUR SEAL, (DECEMBER 2007).
[207] 16 U.S.C. §§ 1371–1374.
[208] M. O. Hammill & G. B. Stenson, *Application of the Precautionary Approach and Conservation Reference Points to Management of Atlantic Seals*, 64 ICES J. MARINE SCIENCE 702, at Table 1 (2007).

often expressed in terms of the capacity of high quality waterbodies to assimilate pollution. The Environmental Protection Agency values this capacity as a resource to be protected.[209] The water quality protection scheme implemented depends on whether the waterbody is above or below the critical threshold. If existing water quality is below the threshold, no further degradation is allowed and the water quality must be restored at least to the threshold level.

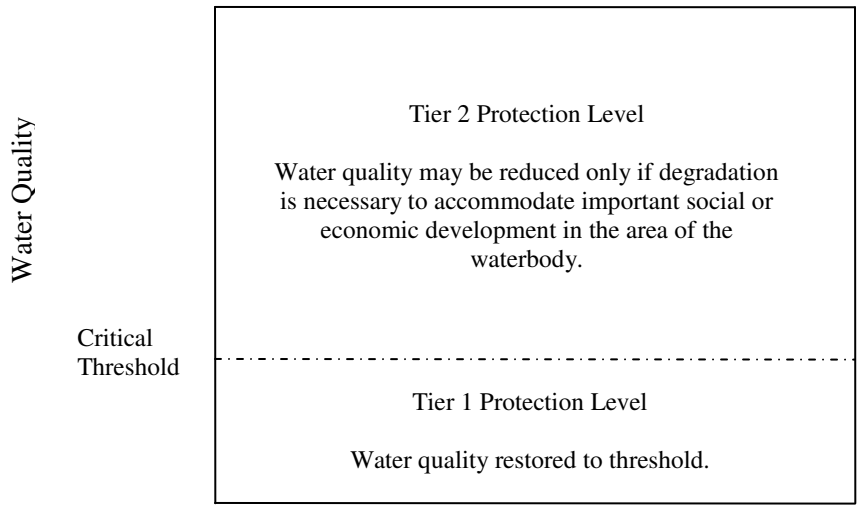

Figure 3. Schematic of the single-threshold approach to protecting water quality used by the antidegradation policy of the Clean Water Act. Water quality above the critical threshold is sufficient to support the designated uses of the waterbody.

If water quality is above the threshold, the policy allows for degradation to satisfy important social and economic demands so long as alternatives to the proposed degradation are considered and the degradation is minimized to the

---

[209] *See* Memorandum from Ephraim S. King, Director, Office of Science and Technology, to Water Management Division Directors, Regions 1-10 1 (Aug. 10, 2005), *available at* http://www.epa.gov/waterscience/standards/files/tier2.pdf.

extent practicable.[210] Thus, the antidegradation policy is intended to protect existing water quality even when well above minimum threshold levels, but this protection is flexible so that polluting activities deemed socially or economically important may continue or commence.[211]

C. LIMITATIONS OF A MULTIPLE-THRESHOLD APPROACH

The use of multiple abundance thresholds in the Migration Protection Model is somewhat problematic because of the uncertainties in estimates of thresholds and current population sizes. Rough estimates and rules of thumb will likely be necessary to set these thresholds before monitoring programs can provide the needed data.[212] For example, the U.S. Shorebird Conservation Plan, a cooperative planning effort authorized by the FWCA and the MBTA, uses such an approach to set thresholds while also placing a high value on commonness and abundance of migratory animals.[213] The Plan's national goal for migratory shorebirds is to "stabilize populations of all shorebird species known or suspected of being in decline due to limiting factors occurring within the U.S., while ensuring that common species are also protected from future threats."[214] To meet its goals, the Plan establishes population targets.[215] Although the Plan acknowledges that, due to lack of species-specific information, for most shorebird species it is not possible to establish scientifically supported population targets known to achieve

---

[210] Tier 1 protections are implemented when water quality is below the critical threshold in an effort to raise the water quality at least to the threshold level. *See* 40 C.F.R. § 131.12(a)(1); ENVIRONMENTAL PROTECTION AGENCY, WATER QUALITY STANDARDS HANDBOOK 4-1 to -6 (2nd ed. 1994), *available at* http://www.epa.gov/waterscience/standards/handbook/index.html.
[211] 40 C.F.R. § 131.12(a)(2).
[212] Sanderson, *supra* note 46.
[213] U.S. FISH AND WILDLIFE SERVICE MANUAL PART 721, CHAPTER 4, a*vailable at* www.fws.gov/policy/ 721fw4.html.
[214] *Id*.
[215] Manomet Center for Conservation Sciences, *supra* note 83; S. Brown et al., National Shorebird Conservation Assessment: Shorebird Conservation Status, Conservation Units, Population Estimates, Population Targets, and Species Prioritization (2000), Manomet Center for Conservation Sciences, *available at* http://www.Manomet.org/USSCP/files.htm.

stable and self-sustaining populations, the Plan's working group nevertheless set tentative population targets for different classes of species' populations. For species' populations known or thought to be declining but not listed under the ESA, the long-term goal is to restore the population to the level estimated to have existed in the year when population trend analysis began (for most species in the early 1970's).[216] For populations not declining, the long-term goal is to maintain the population at current levels, even if that target is thought to be at historic (i.e., pre-1800) levels.[217] The Plan, by setting restoration targets at estimates of 1970's abundances and maintenance targets at estimates of current abundances, may represent a feasible approach to valuing abundance in high value areas when uncertainties are large or where ecological changes make historic benchmarks impractical as targets.

V. CONCLUSION

Establishing a new legal regime to conserve the great animal migrations of the world, or even the nation, is a daunting challenge. So much ground has already been lost. Climate change will surely turn some migrations into basket cases. The legal regime has already failed at solving problems far more limited in scope.

Yet, migration conservation offers some exciting possibilities for achieving progress. It is a rare opportunity to create law for an unaddressed problem and get it right. Though migration presents a particularly wicked constellation of problems, no single threat to animal migrations is unprecedented. Success in maintaining and restoring migrations will provide tools applicable to a vast array of conservation problems, from endangered species recovery to sustaining

---

[216] This target level was calculated by using the known rate of decline, and back calculating the population size to the year when data were first collected, using the current population estimate as the starting point. For many species, these restoration targets are extremely conservative because historical declines are thought to have been large, but monitoring data are available only recently. *See* Manomet Center for Conservation Sciences, *supra* note 83, at 24.

[217] *Id.*

ecological integrity of refuges and aquatic habitats. A legal approach to migration that incorporates our ideas of differential responses to different population thresholds and values of habitat would offer a more nuanced and effective example to apply in other wildlife contexts. Establishing better inter-jurisdiction coordination would open doors to further cooperation for a diverse range of environmental projects. Protecting habitat through a mix of private land use controls, habitat acquisition (including acquisition of easements), and activity-based regulation would present to conservationists a broader spectrum of successful instruments than do most current programs. In particular, activity-based regulation could help prove that the lessons of pollution control can attend to problems on the resource management side of the environmental law divide.[218]

The differential triggers we recommend would initiate comprehensive protection as a legal response. The tailored response should combine corridor designations, site-specific protections and acquisition, and uniform activity-based regulation with a broad strategic overview necessary to maximize habitat connectivity and coordinate measures across boundaries. Moreover, a comprehensive approach could be applied to a wide variety of migratory species by capitalizing on the commonalities among them in the threats they face and the legal responses necessary for their protection.

While we recommend a sober examination of the depleted state of animal migrations and the challenges facing effective responses, despair is neither justified nor helpful. One of the great conservation success stories of the past century is the recovery of migratory waterfowl. At least for a popular game species, conservation is possible. Close monitoring, inter-jurisdiction coordination, a rich menu of tools to protect and connect habitat, and strict control of harvest all converge to sustain waterfowl migration in North America. This is

---

[218] Fischman, *The Divides of Environmental Law and the Problem of Harm in the Endangered Species Act, supra* note 179, at 691-93.

a model that has at least something to offer most migration problems. It is a model that garners strong, widespread political support. With the refinements we suggest, it can point the way forward.

Climate change will test the limits of any response to migration conservation. But, adaptive application of the approach we propose will begin to show which migrations will continue to be feasible and how they can be safeguarded. Climate change subjects all elements and processes within the domain of biodiversity to new risks and uncertainties. The lessons learned from applying legal conservation tools to animal migration will help reduce the stressors that make species and ecosystems more vulnerable to steep declines from the global changes occurring.

APPENDIX 1: Key federal conservation programs addressing migratory animals

Federal Conservation Law	Description
Habitat Conservation Approaches	
Coastal Zone Management Act ("CZMA") 16 U.S.C. §§ 1451–1466	Provides funds to coastal states to help them preserve or restore specific areas, acquire interests in land, and develop and implement measures to control nonpoint source pollution.
Fish and Wildlife Conservation Act ("FWCA") 16 U.S.C. §§ 2901–2912	Provides financial and technical assistance to states to develop, revise, and implement conservation plans for nongame fish and wildlife; requires identification of lands and waters in the U.S. and Western Hemisphere whose protection, management, or acquisition will foster conservation of migratory nongame birds.
Marine Mammal Protection Act ("MMPA") 16 U.S.C. §§ 1361–1423h	Requires measures to replenish any species or population diminished below its optimum sustainable population by acquiring, protecting, and improving essential habitats.
Marine Turtle Conservation Act ("MTCA") 16 U.S.C. §§ 6601–6607	Supports and provides financial resources for projects conserving marine turtles and their nesting habitats.
Migratory Bird Conservation Act ("MBCA") 16 U.S.C. §§ 715–715s	Provides for purchase or rental of areas recommended by the Secretary of Interior for protection.
Neotropical Migratory Bird Conservation Act ("NMBCA") 16 U.S.C. §§ 6101–6109	Provides for protection and management of neotropical migratory bird populations and their habitats.
Partners in Flight (*available at* http://www.pwrc.usgs.gov/PIF/); U.S. Shorebird Conservation Plan (*available at* http://www.fws.gov/shorebirdplan/); North American Waterfowl Management Plan (*available at* http://www.fws.gov/birdhabitat/NAWMP/index.shtm)	Provides for protection and management of migratory bird populations and their habitats.
Take Prohibition Approaches	
Bald and Golden Eagle Protection Act ("BGEPA") 16 U.S.C. §§ 668–668d	Prohibits taking of any bald or golden eagle without a permit.
Endangered Species Act ("ESA") 16 U.S.C. §§ 1531–1544	Prohibits taking of any endangered species of fish or wildlife listed under the Act without a permit.
Marine Mammal Protection Act ("MMPA") 16 U.S.C. §§ 1361–1423h	Prohibits taking of any marine mammal without a permit, and establishing a moratorium on the taking and importation of marine mammals.
Migratory Bird Treaty Act ("MBTA") 16 U.S.C. §§ 703–712	Prohibits taking of birds of designated species except as permitted by regulations.
North Pacific Anadromous Stocks Act ("NPASA") 16 U.S.C. §§ 5001–5012	Prohibits any person or fishing vessel subject to the jurisdiction of the United States to fish for or to retain on board any anadromous fish in the Convention Area.