2010

The Legal Challenge of Protecting Animal Migrations as Phenomena of Abundance

Robert L. Fischman
Indiana University Maurer School of Law, rfischma@indiana.edu

Jeffrey B. Hyman
Indiana University Maurer School of Law, jbhyman@indiana.edu

ARTICLE

THE LEGAL CHALLENGE OF PROTECTING ANIMAL MIGRATIONS AS PHENOMENA OF ABUNDANCE

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

ABSTRACT

Animal migrations are as familiar as 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 different abundance goals for a migration. Second is transboundary coordination, which may involve international or interstate

* Professor, Indiana University Maurer School of Law and School of Public and Environmental Affairs. The authors are grateful for the research support of the Indiana University Maurer School of Law. Comments from Alejandro Camacho, Holly Doremus, Julie Lurman Joly, and the participants of the Indiana University Institute for Advanced Study animal migration conservation seminar significantly aided the authors. The authors thank Elizabeth Baldwin, Lindsey Hemly and Jeremiah Williamson for their meticulous research assistance.

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

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.

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 important conservation objectives.

One of the overlooked issues in biodiversity protection is conserving animal migrations as phenomena of abundance. Animal migrations are as familiar as the 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 endangered 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 much broader. The scientific and policy literature embraces within "biodiversity" all biotic compositional elements of the world, from genes to large assemblages, such as habitats.[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 his-

[1] *E.g.*, NAT'L 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 crossing the Serengeti; a hundred thousand 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* MONTE HUMMEL & JUSTINA C. RAY, CARIBOU AND THE NORTH 53 (2008) (discussing the ecological significance of caribou as nutrient distributors and food source); NAT'L RESEARCH COUNCIL, CUMULATIVE ENVIRONMENTAL EFFECTS OF OIL AND GAS ACTIVITIES ON ALASKA'S NORTH SLOPE (2003) (discussing all

torians have noted that the term "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 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. 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 a matter of enlightened self-interest: the ecosystem services that migrations provide, such as nutrient cycling and pest control, are valuable for human flourishing.[8] Furthermore, the opportunity to observe large numbers of

migratory animals using the refuge); Robert J. M. Crawford, *Influence of Food on Numbers Breeding, Colony Size and Fidelity to Localities of Swift Terns in South Africa's Western Cape, 1987-2000*, 26 INT'L J. WATERBIRD BIOLOGY 44 (2003) (discussing the ecological importance of sardines as a food source for Swift Terns); Jeremy David & Patti Wickens, *Management of Cape Fur Seals and Fisheries in South Africa*, *in* MARINE MAMMALS 116, 120 (Nick Gales et al. eds., 2003) (discussing the importance of South African sardine shoals as a food source for ocean mammal populations); John Pastor et al., *The Roles of Large Herbivores in Ecosystem Nutrient Cycles*, *in* LARGE HERBIVORE ECOLOGY, ECOSYSTEM DYNAMICS AND CONSERVATION 289, 293-318 (Kjell Danell et al. eds., 2006) (discussing the role of migrating ungulates in cycling nutrients in the Serengeti grazing ecosystem).

[3] *See, e.g.*, TIMOTHY J. 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 B. LINDENMAYER & JERRY F. FRANKLIN, CONSERVING FOREST BIODIVERSITY: A COMPREHENSIVE MULTISCALED APPROACH (2002). Reed Noss has usefully characterized biodiversity as having compositional, structural, and functional components. *See* Reed F. Noss, *Indicators for Monitoring Biodiversity: A Hierarchical Approach*, 4 CONSERVATION BIOLOGY 355, 356 (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. Malcolm, *Animal Migrations: Endangered Phenomena*, 31 AM. ZOOLOGIST 265 (1991); Grant Harris et al., *Global Decline in Aggregated Migrations of Large Terrestrial Mammals*, 7 ENDANGERED SPECIES RES. 55 (2009).

[6] ALDO LEOPOLD, A SAND COUNTY ALMANAC 262 (Ballantine Books 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.").

[7] *See, e.g.*, JOHN PASSMORE, MAN'S RESPONSIBILITY FOR NATURE (2d ed. 1980) (describing an environmental ethic based on stewardship, which has roots in the Judeo-Christian tradition). A helpful survey of the ethical bases for biodiversity protection is BRYAN G. NORTON, WHY PRESERVE NATURAL VARIETY? (1987).

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

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 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 Species Act (ESA), focus instead on species whose populations are

---

[9] *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 Bay 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 . . . ."); D. J. Aidley, *Questions About Migration*, *in* ANIMAL MIGRATION 1, 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."); Doug Perrine, *South Africa, Sardine Run*, *in* DIVING WITH GIANTS 74, 74-75 (Jack Johnson ed., 2006) (discussing human fascination with and emotional attraction to sardine migrations off the South African coast); *see also* Sergio Cristancho & Joanne Vining, *Culturally Defined Keystone Species*, 11 HUM. ECOLOGY REV. 153 (2004) (discussing conservation priorities based on spiritual or symbolic value). *See generally* PETER H. KAHN, JR., THE HUMAN RELATIONSHIP WITH NATURE: DEVELOPMENT AND CULTURE 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).

[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 BIOLOGY LETTERS 280 (2007).

[12] Among the important ecological functions are transporting nutrients (e.g. from the ocean to forests through salmon migration) and regulating prey populations (e.g. leaf-eating insects through bird migration). *See* David S. Wilcove, *Animal Migration: An Endangered Phenomenon?*, 24 ISSUES SCI. & TECH. 71 (2008), *available at* www.plosbiology.org; *see also* Joseph E. Merz & Peter B. Moyle, *Salmon, Wildlife, and Wine: Marine-Derived Nutrients In Human-Dominated Ecosystems Of Central California*, 16 ECOLOGICAL APPLICATIONS 999 (2006); Gary A. Polis, Wendy B. Anderson & Robert D. Holt, *Toward an Integration of Landscape and Foodweb Ecology: The Dynamics of Spatially Subsidized Food Webs*, 28 ANN. REV. ECOLOGY & SYSTEMATICS 289 (1997); 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).

diminished almost to the point of disappearance. For preventing extinctions, scarcity generally triggers a legal reaction. Conserving migration as a phenomenon of abundance, in contrast, will require a different set of thresholds for initiating action – once the populations are scarce, most of the values of migration 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 maintain abundant 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] Any one of these principles can support the conservation of animal migrations as phenomena of abundance.

This paper focuses on how law could be designed to succeed in such an effort. While we concentrate on the key difficulties of drawing up a blueprint for migration conservation, the aim of this article is to provide a broad, comprehensive review of the essential elements of a plan. In doing so, our aim is to explain the difficulties of animal migration conservation and to identify the key tools for addressing them. It is beyond the scope of this current effort to resolve all the questions involving implementation of the tools.

Many animal migrations do not have the high-flying prowess of the trans-Himalayan bar-headed goose,[17] the spectacular global sweep of the Arctic tern, which travels almost from pole to pole,[18]

---

[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 7 (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] Bar-headed geese migrate over the Himalayan mountains twice a year between wintering grounds in southern Asia and nesting grounds on the Tibetan plateau. The geese have been observed at altitudes over 30,000 feet. Stella Y. Lee et al., *Have Wing Morphology or Flight Kinematics Evolved for Extreme High Altitude Migration in the Bar-Headed Goose?,* 148 COMP. BIOCHEMISTRY & PHYSIOLOGY PART C: TOXICOLOGY & PHARMACOLOGY 324, 324 (2008); Lily Whiteman, *The High Life,* AUDUBON, Nov.-Dec. 2000, at 106, *available at* http://www.audubonmagazine.org/birds/birds0011.html.

[18] *See generally* Carsten Egevang et al., *Tracking of Arctic Terns* Sterna Paradisaea *Reveals Longest Animal Migration,* 107 PROC. NAT'L ACAD. SCI. U.S. AM. 2078; *see also* WILCOVE, *supra* note 9, at 139.

or the grandeur of the 1.3 million wildebeest tramping around the Serengeti.[19] Some reptiles and amphibians experience the peril of migration merely in crossing a road. Other significant migrations, such as pronghorn movement from winter to summer range, occur entirely within a single state.[20] The scales vary enormously and any attempt to address migration conservation needs to account for the significant spatial differences. What all migrations share is an unusual adaptive behavior.[21] This unifying characteristic further distinguishes migration conservation from imperiled species protection, since the only thing that imperiled species necessarily share is their imperilment.

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 Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention),[22] there currently exists no strong framework for identifying and protecting transboundary migrations. However, projects aimed at particular species that generate widespread enthusiasm, such as birds, point the way to a legal foundation for stronger migrations that will sustain ecological integrity across great distances.

Part II of this article describes animal migrations and explains 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 different social objectives reflected in various abundance goals. Exploring different population thresholds helps to disaggregate these different social objectives that are often confounded. This allows us to

---

19 *Id.* at 82.

20 *Id.* at 121-24.

21 *See* Mark S. Ogonowski & Courtney J. Conway, *Migratory Decisions in Birds: Extent of Genetic Versus Environmental Control*, 161 OECOLOGIA 199 (2009); *see also* Wolfgang Fiedler et al., *Using Large-Scale Data from Ringed Birds for the Investigation of Effects of Climate Change on Migrating Birds: Pitfalls and Prospects*, *in* BIRDS AND CLIMATE CHANGE 49, 51-52 (Anders P. Møller et al. eds., 2006).

22 Convention on the Conservation of Migratory Species of Wild Animals, 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.

explain what it means to protect migrations "as phenomena of abundance." 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. 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 describe a conceptual 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. A vigorous effort to conserve migrations in abundance rather than as faint echoes of past glory would also prompt fresh debate over objectives for biodiversity policy.

II. Animal Migrations: 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.[23] Both environmental and internal cues

[23] United Nations Env't Programme [UNEP], Convention on Migratory Species, Conserving Animals on the Move 1 (2003), *available at* http://www.cms.int/pdf/

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 the same time period.[24]

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.[25] 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).[26] In general, migration involves periodic movements and recurrent destinations for at least part of the journey. Movements known as ranging or dispersal, in contrast, generally cease 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.[27] Both migration and dispersal are distinguished from the typically shorter-distance and shorter-time scale movements known as foraging.[28]

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 had been called "assisted migration."[29] But it is not migration in the sense we use the term in this article because there is no return

---

en/CMS_Brochure_en.pdf. 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. Hugh Dingle & V. Alistair Drake, *What is Migration?*, 57 BIOSCIENCE 113, 114 (2007).

[24] David S. Wilcove, *Animal Migration: An Endangered Phenomenon?*, 24 ISSUES SCI. & TECH. 71 (2008); David S. Wilcove & Martin Wikelski, *Going, Going, Gone: Is Animal Migration Disappearing?*, 6 PLoS BIOLOGY 1361 (2008), *available at* www.plosbiology.org.

[25] Dingle & Drake, *supra* note 23 (describing many familiar migrations).

[26] *Id.* at 115.

[27] *Id.* at 116.

[28] 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.*

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

cycle.[30] In fact, species subject to assisted migration may not exhibit any migratory behavior at all.

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 fresh grass created in the Serengeti following the seasonal rains.[31] 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.[32] Whether a storm during a flock's sea crossing, or predators awaiting newly hatched turtles at a nursery beach, the temporal and spatial danger zones through which large concentrations of migrators pass present special vulnerabilities.

From a legal perspective, migration and dispersal 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 dispersal 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 dispersal as well.

Some animal migrations are essential to the continued existence of a species.[33] In those cases, the Endangered Species Act or other imperiled species laws may ultimately trigger legal mechanisms to sustain the behavior. In other cases, the migratory behavior is not required for the species to survive. American bison still exist despite the demise of their annual migration, and there are popula-

---

30 For this reason, the most recent literature has substituted other terms, such as "translocation," for "assisted migration." *See, e.g.*, Jonathan R. Mawdsley et al., *A Review of Climate-Change Adaptation Strategies for Wildlife Management and Biodiversity Conservation*, 23 CONSERVATION BIOLOGY 1080, 1084 (2009).

31 WILCOVE, *supra* note 9, at 4.

32 *Id.*

33 For example, the Chinese paddlefish is now possibly extinct due to the Three Gorges Dam, which blocked its migration route. *See* Ping Xie et al., *Three-Gorges Dam: Risk to Ancient Fish*, 302 SCIENCE 1149 (2003); Stefan Lovgren, *World's Largest River Fish Feared Extinct*, NAT'L GEOGRAPHIC NEWS, July 26, 2007, *available at* http://news.nationalgeographic.com/news/2007/07/070726-china-fish.html.

tions of sandhill cranes, pronghorn, and salmon that do not migrate.[34] This is the more interesting category to consider in designing a legal response to migration because it presents the stark challenge of adding a behavioral element to the goals of biodiversity protection law. If migration is not obligatory to the continued existence of a species, then extending the ecological, aesthetic, and ethical rationales for conservation will be necessary to create new law. While we have provided a sampling of those rationales in the introduction, our main focus in this paper is providing the structure for such a new law, rather than justifying the need for it. Moreover, Part III.A., *infra,* endeavors to show how law might respond to migration threats by establishing thresholds of abundance to fulfill ecosystem service, harvest, and aesthetic objectives.

This Part begins by describing the common threats to animal migration. The four main threats are the four key problems a legal design must address. Following a description of the threats, this Part illustrates the diverse applications of these challenges through three examples of migratory behavior.

A. Common Threats

Although the risks monarch butterflies face as they huddle to survive the winter in the alpine forests of Mexico are quite distinct from the Atlantic 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, and climate change.[35] 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

---

[34] *See, e.g.*, THE CRANES: STATUS SURVEY AND CONSERVATION ACTION PLAN 111 (Curt D. Meine & George W. Archibald eds., IUCN 1996) (sandhill cranes); Joel Berger, *The Last Mile: How to Sustain Long-Distance Migration in Mammals*, 18 CONSERVATION BIOLOGY 320 (2004) (bison and pronghorn); Andrew P. Hendry et al., *To Sea or Not to Sea? Anadromy Versus Non-Anadromy in Salmonids*, *in* EVOLUTION ILLUMINATED: SALMON AND THEIR RELATIVES 92 (2004) (non-migratory salmon).

[35] WILCOVE, *supra* note 9, at 5.

and feeding stops along the way.[36] 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.[37] 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.

Obstacles to migration, such as dams, buildings, towers, roads, and fences, pose a more immediate threat to migration than they do to other aspects 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. In addition to local solutions, designated corridors may be used over larger spatial scales 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-scale hunting.[38] Some of the earliest conservation law exerted control of "take," which generally includes capturing, collecting, or killing an animal.[39] 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 the ineffectiveness of formal limits on animal harvest.

The ultimate effects of climate change on particular migrations remain uncertain.[40] 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

---

[36] This is due mainly to the large concentration of individuals migrating together and the high energy demands of the journey. *See, e.g., id.* at 32- 41, 129.

[37] *Id.* at 6.

[38] This is roughly what happened to the American bison and passenger pigeon. Though bison survive, their migrations do not. *See id.* at 10-11.

[39] *See, e.g.*, 16 U.S.C. § 3371(j) (2006) (defining "taken" for the first significant federal law limiting overexploitation of a large group of animals, the Lacey Act).

[40] WILCOVE, *supra* note 9, at 7.

largest duck breeding habitat in the United States. Sea level rise will reduce coastal wetlands, which are crucial breeding and feeding sites for migratory birds and spawning areas for marine migratory species.[41]

Professor Parmesan's landmark synthesis of the ecological changes already observed from climate change paints a bleak picture of the challenges to come.[42] 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 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.[43]

For example, the timing of many spring songbird migrations through the American Midwest developed to synchronize the trip with the leafing out of oak trees. The early leaves have low concentrations of the 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.[44] However, climate change has uncoupled the migration from the leaf-out. Warming in the higher latitudes has 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 caterpil-

---

41 Robert A. Robinson et al., *Travelling Through a Warming World: Climate Change and Migratory Species*, 7 ENDANGERED SPECIES RES. 87, 89-90 (2009); J. Michael Scott et al., *National Wildlife Refuges*, *in* PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES 5-1 (Susan Herrod Julius & Jordan M. West eds., U.S. Climate Change Science Program 2008), *available at* http://www.climatescience.gov/Library/sap/sap4-4/final-report/#finalreport.

42 Camille Parmesan, *Ecological and Evolutionary Responses to Recent Climate Change*, 37 ANN. REV. ECOLOGY, EVOLUTION, & SYSTEMATICS 637 (2006).

43 *Id.* at 644.

44 WILCOVE, *supra* note 9, at 44.

lar emergence and flycatcher arrival (which depends largely on phenological cues farther south in its wintering grounds).[45] 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."[46]

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 biodiversity's resilience to the pressures of climate change.[47] In this respect, responding to climate change requires a redoubling of our commitment to the conventional conservation challenges of habitat destruction, obstacles, and overexploitation. Also, climate change will force Americans to retreat from romantic notions of historic naturalness and accept more active management of biodiversity, including migrations. Teaching cranes to migrate by leading them with human-powered, ultra-light aircraft,[48] and creating wetlands to replace migratory habitat destroyed by farming,[49] are harbingers of the increased level of intervention (and spending) that will sustain migrations in the face of climate change. Finally, the overwhelming theme of the literature on how to adapt conservation to climate change is that adaptive management will be required to continually adjust actions in response to new information. Any successful strategy for animal migration conservation must include adaptive mechanisms.

B. Illustrations

Many animal migration stories could be told to illustrate the diverse applications of the typical threats discussed in the previous section. Often, the most well-studied, and the most compelling, migration stories describe species on the brink of extinction. We do not wish to deprive such species of their well-deserved spotlight;

---

[45] *Id.* at 46.

[46] Scott, *supra* note 41, at 5-47.

[47] Carl Folke et al., *Regime Shifts, Resilience, and Biodiversity in Ecosystem Management*, 35 ANN. REV. ECOLOGY EVOLUTION & SYSTEMATICS 557 (2004); Thomas E. Lovejoy, *Conservation with a Changing Climate*, *in* CLIMATE CHANGE AND BIODIVERSITY 325, 328 (Thomas E. Lovejoy & Lee Hannah eds., 2005).

[48] David H. Ellis et al., *Motorized Migrations: The Future or Mere Fantasy?*, 53 BIOSCIENCE 260 (2003).

[49] *See, e.g.*, J. Gregory Mensik & Fred L. Paveglio, *Biological Integrity, Diversity, and Environmental Health Policy and the Attainment of Refuge Purposes: A Sacramento National Wildlife Refuge Case Study*, 44 NAT. RESOURCES J. 1161, 1170-82 (2004).

their survival may indeed depend upon concentrated media and research attention. Yet there are many other migrating species that are still too common to have captured public attention or the interest of researchers. In this paper we attempt to shine a spotlight on migration as a phenomenon worthy of conservation efforts, regardless of whether the migrating species are relatively common or on the brink of extinction. We present three illustrations of animal migrations to demonstrate the variety of spatial scales, threats, and management challenges that cut across both common and rare species.

The oceans are home to a number of highly migratory species of fish. The Atlantic bluefin tuna (*Thunnus thynnus*) migrates thousands of miles across the Atlantic Ocean, and across international management boundaries, between its foraging and spawning grounds.[50] The bluefin is highly prized in both commercial and recreational fisheries, but in the past few decades the bluefin (particularly in the western Atlantic) has declined sharply in abundance due to unsustainable fishing pressure.[51] Management of Atlantic bluefin by the International Commission for the Conservation of Atlantic Tunas (ICCAT) has been based on the premise of two principal breeding zones – one in the Gulf of Mexico and one in the Mediterranean Sea – and corresponding western and eastern Atlantic stocks.[52] Recent tagging studies, however, have challenged the bluefin management paradigm by revealing that western and eastern Atlantic bluefin mix substantially as juveniles.[53] Thus, overfishing in the eastern and central Atlantic likely jeopardizes the recovery of bluefin in the western Atlantic. The complexity of the bluefin's migratory behavior and the interdependence of the stocks and fisheries on both sides of the Atlantic make the conservation of Atlantic bluefin particularly challenging. Climate change may add to this complexity by modifying ocean currents and the locations of food supplies, forcing populations of bluefin to adapt their migration patterns to the changing environment.[54]

---

[50] Jay R. Rooker et al., *Natal Homing and Connectivity in Atlantic Bluefin Tuna Populations*, 322 SCIENCE 742 (2008); Jay R. Rooker et al., *Life History and Stock Structure of Atlantic Bluefin Tuna* (Thunnus thynnus), 15 REVS. FISHERIES SCI. 265 (2007); *see also* John J. Magnuson, Carl Safina & Michael P. Sissenwine, *Whose Fish Are They Anyway?*, 293 SCIENCE 1267 (2001).

[51] *See* Magnuson et al., *supra* note 50, at 1267.

[52] *Id.* at 1268.

[53] *See* Rooker et al., *Natal Homing*, *supra* note 50, at 744.

[54] *See, e.g.*, Adriaan D. Rijnsdorp, *Resolving the Effect of Climate Change on Fish Populations*, 66 ICES J. MARINE SCI. 1570 (2009) (developing a framework for the effects of climate change on fish populations generally).

Even species with healthier populations, such at the Atlantic bigeye (*Thunnus obesus*), a related species of tuna, face similar threats in their international, oceanic journeys.[55]

Many bird migrations rival the trans-oceanic migrations of the bluefin and bigeye in distance. New World red knots (*Calidris canutus rufa*) migrate between their wintering grounds in South America and their breeding grounds in the Canadian Arctic.[56] Like other migratory birds, the red knot relies on a network of productive stopover sites to refuel for the next leg of the journey. Delaware Bay on the eastern U.S. coast is a particularly critical stopover area for red knots: the migrating population refuels there for about two weeks each spring before the final flight to the breeding grounds.[57]

The abundance of red knots has declined sharply in the past decade.[58] The primary cause of the decline is thought to be the overharvesting and depletion of horseshoe crabs, on whose eggs the red knots rely for refueling. Now migrant red knots (as well as other shorebirds) are not able to obtain sufficient nutrition to complete the migration fit enough to survive and reproduce.[59] Although the story of the red knot is a dramatic example of the need to protect key stopover sites and associated food sources, conservation of stopover habitats is important to all birds that migrate over relatively long distances. Even urban green spaces serve as crucial stopover sites for birds migrating across metropolitan landscapes.[60]

Although intercontinental migrations of birds and fish tend to receive the most attention, many terrestrial migrants travel within a locality over quite short distances. Even on these smaller spatial scales, migrants must surmount significant hurdles. Roads are

---

[55] The Atlantic bigeye is managed both domestically by the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) and internationally by the International Commission for the Conservation of Atlantic Tunas (ICCAT). According to NMFS, Atlantic bigeye abundance has stabilized near sustainable levels after a period of rapid decline due to overfishing. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Fishwatch – U.S. Seafood Facts: Atlantic Bigeye Tuna (August 26, 2009), http://www.nmfs.noaa.gov/fishwatch/species/atl_bigeye_tuna.htm.

[56] WILCOVE, *supra* note 9, at 34-37.

[57] *Id.*

[58] *Id.* at 36; R. I. Guy Morrison, R. Kenyon Ross & Lawrence J. Niles, *Declines in Wintering Populations of Red Knots in Southern South America*, 106 CONDOR 60 (2004).

[59] Lawrence J. Niles et al., *Effects of Horseshoe Crab Harvest in Delaware Bay on Red Knots: Are Harvest Restrictions Working?*, 59 BIOSCIENCE 153 (2009).

[60] Chad L. Seewagen & Eric J. Slayton, *Mass Changes of Migratory Landbirds During Stopovers in a New York City Park*, 120 WILSON J. ORNITHOLOGY 296 (2008).

obstacles to migrating reptiles, amphibians, and other small animals.[61] The barrier effect results from direct mortality by vehicles as well as from behavioral avoidance of roadways and associated edge effects. Direct road mortality can be substantial and may reduce population sizes of amphibians.[62] In the Shawnee National Forest of southern Illinois, reptiles such as the cottonmouth migrate relatively short distances between their winter hibernation dens in upland bluffs and their summer wetland habitat. For two months during each spring and autumn the Forest Service closes the road separating these two habitats to protect the snake migration from vehicles. The road closure protects additional amphibian species also migrating between summer and winter habitats during these months.[63]

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).[64] A "trigger" is a crossing of a threshold or a precautionary benchmark that causes a legal response.

---

[61] *See* Richard T. T. Forman, *Estimate of the Area Affected Ecologically by the Road System in the United States*, 14 CONSERVATION BIOLOGY 31 (2000); David M. Marsh et al., *Forest Roads as Partial Barriers to Terrestrial Salamander Movement*, 19 CONSERVATION BIOLOGY 2004 (2005).

[62] *See* Lenore Fahrig et al., *Effect of Road Traffic on Amphibian Density*, 73 BIOLOGICAL CONSERVATION 177 (1995); Marc J. Mazerolle, *Amphibian Road Mortality in Response to Nightly Variations in Traffic Intensity*, 60 HERPETOLOGICA 45 (2004).

[63] U.S. FOREST SERV., SNAKE MIGRATION LARUE-PINE HILLS (2006), *available at* http://www.fs.fed.us/r9/forests/shawnee/recreation/rogs/snake-migration.pdf.

[64] 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).

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 animals.

A. Defining and Determining Population Triggers for Migration Protection

One of the greatest challenges that migration conservation poses to the legal mindset is maintaining the values associated with abundance. Though most migrating species have declined from their historic abundances,[65] 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 some migratory behaviors may disappear before an endangerment threshold is reached,[66] a more conservative trigger is necessary. Also, as we discuss below, the ecological value of nutrient cycling, or prey population control, provided by a migratory species may decline significantly before the species slips below an endangered threshold. Finally, "large, genetically diverse populations" will be more likely to successfully adapt to climate change.[67]

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 wilder-

---

[65] *See* Wilcove & Wikelski, *supra* note 24.

[66] The most familiar example in the United States is the American bison, a species not threatened with extinction, whose migrations have disappeared. Joel Berger, *The Last Mile: How to Sustain Long-Distance Migrations in Mammals*, 18 CONSERVATION BIOLOGY 320 (2004); *see also* Robinson et al., *supra* note 41.

[67] Robinson et al., *supra* note 41, at 96.

ness 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.[68] Game management today continues to aim for high populations of target species (or their prey).[69] That broad, ambitious vision can help us imagine what migration-protecting law would look like, even 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.[70] 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 predelineated 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,[71] these laws would continue to apply

---

[68] GIFFORD PINCHOT, BREAKING NEW GROUND 322-25 (Island Press 1987) (1947); *see also* HAYS, *supra* note 13.

[69] *See, e.g.*, ALASKA STAT. § 16.05.255 (2008) (amended 1998) (defining the objective of the state's game management program as maintaining a "sustained yield," defined as "the achievement and maintenance in perpetuity of the ability to support a high level of human harvest of game").

[70] *See* 16 U.S.C. §§ 1531, 1533 (2006).

[71] For example, the introduction to the MMPA at 16 U.S.C. § 1361(2006) 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

to these taxa even if they recovered to historic levels. In fact, many migratory waterfowl continue to be protected under the MBTA even though their migrations have recovered to historic levels. Canada and snow geese are now so abundant as to be considered pests in many places.

Trying to protect abundant populations raises a difficult question: how many animals of a particular species population are enough? In other words, with which animal migrations should the law concern itself? Professor Wilcove has argued for a migratory species threshold similar to the vulnerability threshold for endangered species developed by the World Conservation Union (IUCN), under which a species "that experiences a 30 percent or greater drop in its global population over a period of ten years or three generations (whichever is longer) is considered to be vulnerable."[72] 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 reflect social objectives and

---

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 . . . .

72 WILCOVE, *supra* note 9, at 208. 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 have 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 . . . . 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, 17 (2008).

ecological priorities. In other words, a legal protection triggered by a population decline does not answer the question of "how many are enough?"[73]

A minimalist approach would seek merely to maintain the smallest number of individuals necessary to accomplish the migratory behavior. This would be maintaining the "phenomenon of migration" rather than maintaining "migration as a phenomenon of abundance." For species that must migrate to survive, such as the Chinese paddlefish, this might be the same as the minimum demographically viable population. For other species, such as the American bison, it may require greater numbers to sustain the migration than it does to maintain the existence of the species.

To illustrate, consider the wildebeest. If 1000 animals are sufficient to instigate the migratory behavior, then maintaining the phenomenon of migration would require a threshold of only 1000 animals. However, if migrating wildebeest serve an ecological role by transferring nutrients or keeping the grasslands over a large range productive, then maintaining "migration as a phenomenon of abundance" could justify a threshold necessary for ecological viability (say, 10,000 animals migrating). Any non-migrating wildebeest do not count because they play a different ecological role. In this case we are protecting the "phenomenon of migration" and the ecological role it serves, as a package composing "abundance."

Next, we may want a sustainable harvest of migrating wildebeest, which, say, requires 100,000 animals migrating. In this case we are providing the "phenomenon of migration" and the sustainable harvest it produces. Figure 1 indicates that this is a larger population goal than ecological sustainability, which is often the case but need not necessarily be so. That will depend on the biology of the animal and ecological role it plays.

Finally, we may want the "full monty" – a thundering herd of 1,000,000 wildebeest – for aesthetic or cultural reasons.[74] The justified threshold is then 1,000,000. In this case we are protecting the

---

[73] Timothy H. Tear et al., *How Much is Enough? The Recurrent Problem of Setting Measurable Objectives in Conservation*, 55 BIOSCIENCE 835, 835 (2005); *see also* James D. Nichols & Byron K. Williams, *Monitoring for Conservation*, 21 TRENDS IN ECOLOGY & EVOLUTION 668 (2006); Eric W. Sanderson, *How Many Animals Do We Want to Save? The Many Ways of Setting Population Target Levels for Conservation*, 56 BIOSCIENCE 911, 918 (2006).

[74] The derivation of the term "the full monty" is likely from the tailoring business of Sir Montague Burton. "A complete three-piece suit, i.e. one with a waistcoat . . . would be the Full Monty." The Phrase Finder, The Full Monty, http://www.phrases.org.uk/meanings/full%20monty.html (last visited Nov. 5, 2009).

package of both the "phenomenon of migration" and the aesthetic services and values it provides. This paper deals with conservation of "migration as a phenomenon of abundance," which may come in different packages depending on the thresholds established.

1. Defining Thresholds of Abundance

Conservation scientists have considered the different thresholds of animal population abundance needed to sustain different social objectives.[75] 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.[76] Establishing a trigger for protection of nongame migratory populations while they are still relatively common will require overcoming the current tendency in conservation laws to consider abundances over minimum demographically viable population size as expendable surplus.[77]

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 the Caribbean.[78] A pri-

---

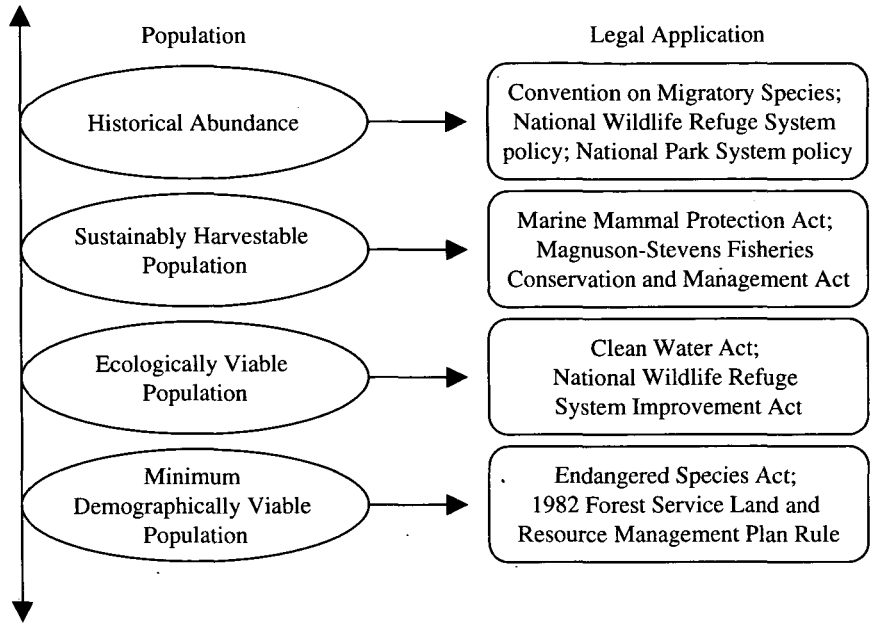
[75] Much of the discussion that follows relies on the particularly helpful analyses of Eric W. Sanderson, *supra* note 73, and Timothy H. Tear et al., *supra* note 73.

[76] National Forest System Land and Resource Management Planning, Fish and Wildlife Resource, 47 Fed. Reg. 43,026, 43,048 (Sept. 30, 1982) (codified at 36 C.F.R. § 219.19 (1983-2000)). *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).

[77] *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 [are] available for allocation to projects until the utilization is such that any future use may be likely to jeopardize a listed species").

[78] 16 U.S.C. §§ 6102–04, 6108 (2006); *see also* U.S. Fish and Wildlife Service, Division of Bird Habitat Conservation, http://www.fws.gov/birdhabitat/Grants/NMBCA/ApprovProj.shtm (last visited Dec. 14, 2009) (listing projects funded under the NMBCA by year).

FIGURE 1. CONTINUUM OF POPULATION ABUNDANCE GOALS AND ASSOCIATED LEGAL APPLICATIONS.



mary purpose of the NMBCA is to "assist in the conservation of neotropical migratory birds by supporting conservation initiatives . . . ."[79] The term "conservation," in turn, is defined as "the use of methods and procedures necessary to bring a species of neotropical migratory bird to the point at which there are sufficient populations in the wild to ensure the long-term viability of the species."[80] Although "viability of the species" is undefined, this phrase is reasonably interpreted as demographic viability, as opposed to ecological viability. Thus, a proposed project that would ensure demographic viability may be approved irrespective of whether it would maintain the population or restore it 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 fol-

[79] 16 U.S.C. § 6102 (2006).
[80] *Id.* § 6103.

lowing conservation activities to conserve migratory nongame birds:

> (3) [I]dentify 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 . . . .[81]

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 listing criteria.[82]

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[83] of an ecosystem. This number is almost always greater than the minimum demographically viable population, which has just enough individuals to keep propagating the group in a region.[84] 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 of which it is a part, i.e., for ecological effective-

---

[81] *Id.* § 2912(a).

[82] 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 . . . ." 50 C.F.R. § 83.9 (2009). 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.

[83] Biological integrity is "the ability of an environment to support and maintain a biota . . . comparable to the natural habitats of the region . . . ." James R. 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. RESOURCES J. 989, 998 (2004).

[84] The ecological function performed by some populations may contribute or be necessary to maintaining 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 AM. FISHERIES SOC'Y 371 (2003).

ness.[85] 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.[86] For many populations, the ecologically effective abundance, in turn, is probably lower than historic abundances or abundances required to support *sustainable* harvesting by humans.[87]

There are scant but significant examples of legal standards for biological integrity, which require 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."[88] 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."[89] 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.[90] The implementing policy for this legislative mandate roughly follows the scientific literature's definition of ecological

---

[85] Michael E. Soulé, 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. 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. *See* Kevin J. Gaston & Richard A. Fuller, *Biodiversity and Extinction: Losing the Common and the Widespread*, 31 PROGRESS IN PHYSICAL GEOGRAPHY 213 (2007); *see also* Gaston & Fuller, *supra* note 72, at 14-19.

[86] Soulé et al., *supra* note 85, at 1239-42; Tear et al., *supra* note 73, at 837. 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.

[87] *See, e.g.*, S. Elizabeth Alter et al., *DNA Evidence for Historic Population Size and Past Ecosystem Impacts of Gray Whales*, 104 PROC. NAT'L ACAD. SCI. 15162 (2007); Michael C. Healey, *Resilient Salmon, Resilient Fisheries for British Columbia, Canada*, 14 ECOLOGY & SOC'Y 2 (2009); 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 73, at 918.

[88] 33 U.S.C. § 1251(a) (2006).

[89] 16 U.S.C. § 668dd(a)(4)(B) (2006).

[90] Fischman, *supra* note 83, at 991.

integrity.[91] Other, more geographically limited, laws also employ the ecological integrity standard as a criterion for resource management.[92]

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 depredations from humans. This is the kind of population maintained by state fish and game agencies operating under traditional multiple-use, sustained-yield mandates.[93] The relatively extensive system for supporting migratory waterfowl, a twentieth century conservation success story, exemplifies the usefulness of this threshold.[94]

On the commercial front, the oldest U.S. laws that sought to maintain high enough populations for regular takes were concerned with marine mammals.[95] The modern incarnation of this concern is the 1972 Marine Mammal Protection Act, which seeks to protect "optimum sustainable population[s]" (OSPs) of stocks of marine mammals.[96] The MMPA actually employs two levels of protection separated by a threshold that reflects population depletion.[97] The MMPA directs the Secretary of Commerce to develop

---

[91] *Id.* at 998.

[92] *E.g.*, Steens Mountain Cooperative Management and Protection Act of 2000, Pub. L. No. 106-399, 114 Stat. 1655 (2000); Everglades National Park Protection and Expansion Act of 1989, Pub. L. No. 101-229, 103 Stat. 1946 (1989). For Professor Fischman's analysis of these statutes, see Fischman, *supra* note 83, at 1012-14.

[93] *See, e.g.*, ALASKA STAT. § 16.05.255 (2008) (amended 1998); *see supra* text accompanying note 69.

[94] 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. CANADIAN WILDLIFE SERV., U.S. FISH AND WILDLIFE SERV. & SECRETARIA DE MEDIO AMBIENTE Y RECURSOS NATURALES, NORTH AMERICAN WATERFOWL MANAGEMENT PLAN, IMPLEMENTATION FRAMEWORK: STRENGTHENING THE BIOLOGICAL FOUNDATION 19 (2004); CANADIAN WILDLIFE SERV., U.S. FISH AND WILDLIFE SERV. & SECRETARIA DE MEDIO AMBIENTE Y RECURSOS NATURALES, NORTH AMERICAN WATERFOWL MANAGEMENT PLAN, STRATEGIC GUIDANCE: STRENGTHENING THE BIOLOGICAL FOUNDATION 6 (2004).

[95] In 1870 Congress established a leasing system in a failed attempt to sustain the harvest of fur seals on Alaska's Pribilof Islands. An Act to Prevent the Extermination of Fur-Bearing Animals in Alaska, ch. 189, 16 Stat. 180 (1870).

[96] 16 U.S.C. § 1361(2) (2006).

[97] 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) (2006). 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) (2006); 50 C.F.R. § 216.3 (2009). Under agency regulations, a species is consid-

and implement conservation plans, which may incorporate take reductions and habitat protection measures, for the purpose of restoring depleted populations to their OSPs.[98] Non-depleted populations – those above the OSPs – receive less protection, and may be subject to taking regulated through a permit system.[99] The OSP is "the number of animals which will result in the maximum productivity . . . keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element."[100] This definition builds on ecological integrity to create a target population that will yield harvestable numbers. The Magnuson-Stevens Fishery Conservation and Management Act attempts to implement a similar population trigger for restrictions on over-harvested fisheries.[101]

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. The Convention on Migratory Species uses this benchmark, finding a species' conservation status to be favorable when its abundance approaches historic levels.[102] There does not appear to be a statutory analog to this threshold, though historic conditions are often considered in establishing criteria for ecological integrity.[103] As the National Wildlife Refuge System policy employing a "historic conditions" reference point acknowledges, it will often not be possible to restore populations to

---

ered to have fallen below its OSP, and is therefore "depleted," if its population level is less than sixty percent of its estimated "historical" levels. Taking and Importing of Marine Mammals, 58 Fed. Reg. 58,285 (Nov. 1, 1993); Taking of Marine Mammals Incidental to Commercial Fishing Operations—Permits, etc., 45 Fed. Reg. 72,178 (Oct. 31, 1980).

98 16 U.S.C. § 1383b(b) (2006); *see also, e.g.*, U.S. DEP'T OF COMMERCE, NOAA, NAT'L MARINE FISHERIES SERV., CONSERVATION PLAN FOR THE EASTERN PACIFIC STOCK OF NORTHERN FUR SEAL (*Callorhinus ursinus*) (2007).

99 16 U.S.C. §§ 1371–1374 (2006).

100 *Id.* § 1362(9).

101 *Id.* §§ 1801-1884. 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 156-59 (1998); David Fluharty, *Habitat Protection, Ecological Issues, and Implementation of the Sustainable Fisheries Act*, 10 ECOLOGICAL APPLICATIONS 325, 327-28 (2000).

102 In addition to abundance, the Convention also seeks to conserve and restore migrations to their historic geographic ranges. Convention on the Conservation of Migratory Species of Wild Animals art. I(1)(c)(4), 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.

103 Brian Czech, *A Chronological Frame of Reference for Ecological Integrity and Natural Conditions*, 44 NAT. RESOURCES J. 1113 (2004).

their historic abundance.[104] In most places, too much habitat modification has occurred to sustain historic numbers. And, "shifting baselines" constrict the vision of even those programs aimed at restoration.[105] Still, chronological frames of reference may usefully inform management alternatives.[106] The 2006 National Park Service's *Management Policies* contains a similar, but more vague, standard to preserve ecological "components and processes in their natural condition."[107] The policies call for restoration of "natural abundances."[108] To the extent that people value a migration for the sense of place and wild wonderment it engenders, the high threshold may be appropriate for psychological, aesthetic, or cultural reasons.

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 at ecologically 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

---

[104] 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).

[105] D. Pauly, *Anecdotes and the Shifting Baseline Syndrome of Fisheries*, 10 TRENDS ECOLOGY EVOLUTION 430 (1995). Pauly's observation that biological impoverishment across generations leads to unrealistically low estimates of historic population abundance has been widely accepted in the conservation literature. *See, e.g.*, Nancy Knowlton & Jeremy B. C. Jackson, *Shifting Baselines, Local Impacts, and Global Change on Coral Reefs*, 6 PLoS BIOLOGY 215 (2008). In the migration context, a shifting baseline can be seen in the historical abundance goal of the North American Waterfowl Management Plan, which establishes an objective of restoring and maintaining breeding population levels from the 1970s. *See supra* note 94.

[106] *See* sources cited *supra* note 105; Czech, *supra* note 103, at 1135.

[107] The policies also state that the Park Service will strive to maintain the "natural abundance" of plants and animals in the park system. U.S. DEP'T OF THE INTERIOR, NAT'L PARK SERV., MANAGEMENT POLICIES 36 (2006).

[108] *Id.* at 42.

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.[109] Holly Doremus uses the example of determining "how much of the historic range 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."[110]

Thresholds and targets for ecological viability are even more difficult to develop because of the inherent complexity in deciphering ecological relationships.[111] 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.[112]

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.[113] 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.[114] David

---

[109] 16 U.S.C. §§ 1532(6), 1533 (2006); *see* 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); 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 1383 (2006).

[110] 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 Fed'n v. Babbitt, 199 F.3d 1224, 1233-36 (10th Cir. 2000) and Defenders of Wildlife v. Sec'y, U.S. Dep't of the Interior, 354 F. Supp. 2d 1156, 1167-69 (D. Or. 2005).

[111] Soulé et al., *supra* note 85.

[112] *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 73, at 913 tbl.2.

[113] Doremus, *supra* note 110, at 438.

[114] For example, population changes need to exceed fifty percent before they are detectable using existing databases such as the International Shorebird Surveys. MANOMET CTR. FOR CONSERVATION SCIS., UNITED STATES SHOREBIRD CONSERVATION PLAN 11 (Stephen

Wilcove notes that census data for birds are scarce – "[m]ost nations or states do not have any sort of comprehensive monitoring program . . . ."[115]

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" (MIS) – even though it designed that surrogate species approach specifically to minimize data needs.[116] An explicit program mandating and funding data collection will be a necessary element of any effective law to conserve migration.[117]

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 states or from loss of necessary genetic variation.[118] 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.[119] 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,[120] which may not be available for many migrating populations.

Brown et al. eds., 2d ed. 2001), *available at* http://www.fws.gov/shorebirdplan/USShorebird/PlanDocuments.htm.

115 WILCOVE, *supra* note 9, at 21.

116 The following cases discuss, with different results, the practical problems of monitoring management indicator species: Utah Envtl. Cong. v. Bosworth, 439 F.3d 1184, 1190-94 (10th Cir. 2006); Sierra Club v. Martin, 168 F.3d 1, 6-8 (11th Cir. 1999); and Inland Empire Pub. Lands Council v. U.S. Forest Serv., 88 F.3d 754, 762-63 (9th Cir. 1996).

117 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).

118 *See* Fred Bosselman, *What Lawmakers Can Learn from Large-Scale Ecology*, 17 J. LAND USE & ENVTL. L. 207 (2002); Hunter et al., *supra* note 64; Dennis E. Jelinski, *There Is No Mother Nature—There Is No Balance of Nature: Culture, Ecology and Conservation*, 33 HUM. ECOLOGY 271 (2005); Robert V. O'Neill, *Is it Time to Bury the Ecosystem Concept?*, 82 ECOLOGY 3275 (2001).

119 Hunter et al., *supra* note 64, at 1053.

120 Dunn found using Breeding Bird Survey data that five- and ten-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,

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 some migrations. For example, the migratory route of the monarch butterfly spans three countries, ranging from central Mexico to southern Canada.[121] 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.[122] Even small-scale migrations, within a state or even a county,

Using Decline in Bird Populations to Identify Needs for Conservation Action, 16 CONSERVATION BIOLOGY 1632 (2002).

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

[122] *See* Jeffrey J. Polovina et al., *Forage and Migration Habitat of Loggerhead* (Caretta caretta) *and Olive Ridley* (Lepidochelys olivacea) *Sea Turtles in the Central North Pacific Ocean*, 13 FISHERIES OCEANOGRAPHY 36, 36 (2004); Joanna Alfaro-Shigueto et al., *First*

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.[123] We address the problems of fragmentation of ecosystems through private property boundaries in the section on land use control (III.C.2), *infra*, and focus this section on the jurisdictional challenges.

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.[124] On the other hand, because environmental law has long grappled with transboundary problems in pollution[125] and wildlife conservation,[126] a vast reservoir of experience may be applied to designing migration protection. In particular, a new generation of participatory efforts promotes 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, cooperative resource management, and ecosystem management.[127] 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 ecologi-

---

Confirmed Occurrence of Loggerhead Turtles in Peru, 103 MARINE TURTLE NEWSL. 7 (2004), *available at* http://www.seaturtle.org/mtn/archives/mtn103/mtn103p7.shtml.

123 *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).

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

125 *See, e.g.*, Georgia v. Tenn. Copper Co., 206 U.S. 230 (1907) (transboundary air pollution dispute between states).

126 *See, e.g.*, Convention for the Preservation and Protection of Fur Seals, July 7, 1911, 37 Stat. 1542, T.S. No. 564 (regulating commercial harvesting of seals that range across national boundaries).

127 Curt Meine, *This Place in Time*, *in* CONSERVATION FOR A NEW GENERATION: REDEFINING NATURAL RESOURCES MANAGEMENT 11, 19-22 (Richard L. Knight & Courtney White, eds., 2009).

cal integrity, collaborative and cooperative decision making, and adaptive management continually adjusting to the unexpected.[128]

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. Undertaking even the simplest, small steps to conserve animal migrations that, say, cross a road to travel from upland to wetland may require navigating a complex allocation of responsibility and authority. Shifting the locations of roadways during the planning stages and adopting currently underutilized technologies (such as tunnels, underpasses, and overpasses) to protect migrating reptiles and amphibians may get lost in a tangle of jurisdictions.

Tools do exist to smooth coordination between agencies. For instance, Executive Order 13,186, 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 agency) to promote the conservation of such populations.[129] 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.[130]

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 wild-

---

[128] Robert L. Fischman, *What is Natural Resources Law?*, 78 U. COLO. L. REV., 717, 741 (2007) (citing ROBERT B. KEITER, KEEPING FAITH WITH NATURE: ECOSYSTEMS, DEMOCRACY, AND AMERICA'S PUBLIC LANDS 244-48 (2003) and R. Edward Grumbine, *Reflections on "What is Ecosystem Management?,"* 11 CONSERVATION BIOLOGY 41, 44-46 (1997)).

[129] 66 Fed. Reg. 3853, 3854 (Jan. 10, 2001).

[130] 16 U.S.C. § 715i(b) (2006).

life, 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."[131] 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 (and between states and indigenous peoples, such as tribes). 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.[132] 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.

Successful interstate action to conserve waterfowl migration involves some federal information gathering through bird surveys, but mostly hinges on providing dedicated funding through a federal tax on the sale of guns and ammunition.[133] Professor Wilcove has endorsed a similar tax on binoculars and birdseed to support non-game bird migrations.[134] The funding challenge is always immense, but funding is an essential lubricant to interstate cooperation with national objectives.

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) fed-

---

131 16 U.S.C. § 2903(10) (2006).

132 *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). This problem gave rise to federal laws such as the Migratory Bird Treaty Act.

133 Federal Aid in Wildlife Restoration Act ("Pittman-Robertson Act"), 16 U.S.C. §§ 669-669i (2006); 26 U.S.C. §§ 4161, 4181 (2006); *see* Wilcove, *supra* note 12, at 78 (attributing the success of the North American Waterfowl Management Plan to the funding provided by the Pittman-Robertson Act).

134 Wilcove, *supra* note 12, at 78.

eral 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.[135] 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.[136] Dan Tarlock has argued, however, that conventional federalism principles do not effectively protect biodiversity and may in fact impede such protection.[137] 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.[138] For example, the Connecticut River Basin Atlantic Salmon Compact,[139] estab-

---

135 Sovacool, *supra* note 132.

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

137 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) [F]ederalism 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.

138 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." 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 through the U.S. Fish and Wildlife Service's website at http://www.fws.gov/laws/lawsdigest/interstatecompacts.htm.

139 Pub. L. No. 98-138, 97 Stat. 866.

lished in 1983 and reauthorized by Congress in 2002 for another twenty 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 four hundred miles from the Long Island Sound to the Canadian border, and supports over sixty other species of fish, fourteen of which are migratory. Atlantic salmon migrate over two thousand 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, 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 initiatives to conserve neotropical birds throughout the Western Hemisphere.[140]

[140] 16 U.S.C. § 6102 (2006); *see also* U.S. Fish and Wildlife Service, Division of Bird Habitat Conservation, http://www.fws.gov/birdhabitat/Grants/NMBCA/2008.shtm (last visited Dec. 14, 2009) (listing examples of funding grants under the NMBCA).

The NMBCA also expressly sets forth other mechanisms of cooperation, including information sharing, interagency collaboration and coordination on projects, and inter-party agreements.[141] 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.[142] The mechanisms of joint planning of conservation projects and information sharing are also 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.[143]

An important aspect of conserving international migrations is the disparity in wealth between the developed world and the 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 aid flowing from rich countries to poor ones. Less than twelve percent of the total money spent annually to manage protected areas supports conservation in less-developed countries.[144] David Wilcove notes that this "is not simply a reflection of the lower costs of conservation in

---

141 16 U.S.C. § 6106 (2006) 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.

142 Convention on the Conservation of Migratory Species of Wild Animals arts. III-IV, 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 (describing and providing conditions for these agreements).

143 Division of International Conservation, U.S. Fish and Wildlife Service, About WHMSI (Apr. 5, 2009), http://www.fws.gov/international/DIC/WHMSI/whmsi_about.html.

144 WILCOVE, *supra* note 9, at 205 (citing A. Balmford et al., *Global Variation in Terrestrial Conservation Costs, Conservation Benefits, and Unmet Conservation Needs*, 100 PROC. NAT'L ACAD. SCI. 1046 (2003)).

poorer versus wealthier countries; the relative shortfall in funding for protected-area management is also greater in poorer countries . . . ."[145]

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.[146] 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.[147] An example of such assistance is the U.S. Fish and Wildlife Service "Wildlife Without Borders" program, which has invested over $700,000 in projects to protect and restore monarch butterfly wintering habitat in Mexico.[148] The effort to protect butterfly wintering habitat in Mexico has also included forest management training by the U.S. Forest Service.[149]

International migration conservation, like international biodiversity protection more generally, will require some kind of financing mechanism where richer nations can assist poorer ones.[150] 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. Sewing It Together

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

---

145 *Id.*

146 Francoise Burhenne-Guilmin & Susan Casey-Lefkowitz, *The Convention on Biological Diversity: A Hard Won Global Achievement*, 3 Y.B. 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 Hemisphere*, 36 HARV. INT'L L.J. 465, 494 (1995).

147 Convention on Nature Protection and Wild Life Preservation in the Western Hemisphere art. VI, *opened for signature* Oct. 12, 1940, 56 Stat. 1354, 161 U.N.T.S. 193 (entered into force April 30, 1942).

148 U.S. Forest Service, Monarch Butterfly: North America's Migrating Insect, Conservation in North America, http://www.fs.fed.us/monarchbutterfly/conservation/index.shtml (last visited Dec. 14, 2009).

149 *Id.*

150 *See, e.g.*, 1992 U.N. Convention on Biological Diversity arts. 20-21, *concluded* June 5, 1992, 1760 U.N.T.S. 79, 31 I.L.M. 818 (creating 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).

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. Reducing barriers to movement across private land boundaries also is a frequent challenge.[151]

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 on facilitating ecological adaptation to climate change.[152] In particular, the recent U.S. government report on how the national wildlife refuge system can adapt to climate change recommends the establishment of corridors of connectivity for migrations.[153] 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. Ensuring 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.[154] 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.

---

151 *See, e.g.*, Nigel Williams, *Kept Out*, 19 CURRENT BIOLOGY 466, 466 (2009).

152 *See, e.g.*, Lee Hannah & Lara Hansen, *Designing Landscapes and Seascapes for Change*, *in* CLIMATE CHANGE AND BIODIVERSITY 329 (Thomas E. Lovejoy & Lee Hannah eds., 2005); Lee Hannah & Rod Salm, *Protected Areas Management in a Changing Climate*, *in* CLIMATE CHANGE AND BIODIVERSITY 363 (Thomas E. Lovejoy & Lee Hannah eds., 2005).

153 Scott, *supra* note 41, at 5-33.

154 NOSS & COOPERRIDER, *supra* note 4, at 150; Scott, *supra* note 41, at 5-33.

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, other migrations need to be protected from harmful activities. For instance, marine migrations face threats from shipping and petroleum development, for which abatement standards will be important. And designated marine corridors are beginning to receive attention as well.[155] While there is little private property in marine ecosystems, rights to fish quotas or even sea beds can be modified by conservation easements.[156] Also, private land activities can create runoff that impacts marine ecosystems.[157] 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.[158]

1. Corridor Designation and Habitat Acquisition

Systemic protection of habitat for many migratory populations requires identification and designation of migration routes and associated habitats.[159] 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. For those migrations that concentrate along discrete, narrow pathways or pass through bottlenecks, relocating obstacles can offer benefits at low cost if alternative sites occur nearby.[160]

---

[155] *See, e.g.*, Elise F. Granek et al., *A Blueprint for the Oceans: Implications of Two National Commission Reports for Conservation Practitioners*, 19 CONSERVATION BIOLOGY 1008, 1013 (2005) (describing calls for connected networks of marine protected areas); Callum M. Roberts et al., *Redesigning Coral Reef Conservation*, *in* CORAL REEF CONSERVATION 515, 520-21 (Isabel M. Côté & John D. Reynolds eds., 2006) (discussing connectivity and resilience for marine reserve networks).

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

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

[158] Dean L. Urban, Robert V. O'Neill & Herman H. Shugart, Jr., *Landscape Ecology*, 37 BIOSCIENCE 119 (1987).

[159] *See* 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).

[160] Erin F. Baerwald & Robert M. R. Barclay, *Geographic Variation in Activity and Fatality of Migratory Bats at Wind Energy Facilities*, 90 J. MAMMALOGY 1341 (2009)

The conservation literature has long urged the creation of corridors to reconnect landscapes suffering from habitat fragmentation.[161] Migration corridors are where stringent activity-based controls may need to be imposed. Outside of the designated corridor, there may be no need for any 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.[162] 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.[163] 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 priority corridors for federal acquisition of land for the national wildlife refuge system.[164] Marine

(migrating bats concentrate along specific routes, leading to wide variations in fatalities from wind turbines depending on the location of the energy facilities).

[161] ANDREW F. BENNETT, LINKAGES IN THE LANDSCAPE: THE ROLE OF CORRIDORS AND CONNECTIVITY IN WILDLIFE CONSERVATION 4 (2d ed. 2003); *see also, e.g.*, Paul Beier et al., *Forks in the Road: Choices in Procedures for Designing Wildland Linkages*, 22 CONSERVATION BIOLOGY 836 (2008); Hall Sawyer et al., *Identifying and Prioritizing Ungulate Migration Routes for Landscape-Level Conservation,* 19 ECOLOGICAL APPLICATIONS 2016 (2009).

[162] John H. Davidson, *The New Public Lands: Competing Models for Protecting Public Conservation Values on Privately Owned Lands*, 39 ENVTL. L. REP. 10368, 10373 (2009).

[163] North Dakota v. United States, 460 U.S. 300 (1983); United States v. Little Lake Misere Land Co., 412 U.S. 580 (1973).

[164] Fischman, *supra* note 16, at 11-12.

animal migrations may benefit from applying this design principle to the oceans.[165]

The realities of climate change, however, will drive the need to establish corridors to allow animals to adapt their migrations to new circumstances.[166] 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. Corridors themselves may need to migrate. Rolling easements for coastal habitat as sea levels rise may provide design lessons.[167]

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.[168] For instance, in 2007 the Western Governors' Association (WGA) adopted a resolution calling for identification and protection of wildlife migration corridors.[169] This protection would be achieved partly through updating federal resource management plans and removing the Energy Policy Act's categorical exclusions for NEPA review of oil and gas drilling.[170] The spike in oil and gas development over the past decade now presents perhaps the greatest risk to continued long-distance mammal migration in the region.[171] In

---

165 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 (2009).

166 *See* Hannah & Hansen, *supra* note 152; Hannah & Salm, *supra* note 152; Scott, *supra* note 153.

167 *See* Meg Caldwell & Craig Holt Segall, *No Day at the Beach: Sea Level Rise, Ecosystem Loss, and Public Access Along the California Coast*, 34 ECOLOGY L.Q. 533 (2007); James G. Titus, *Does the U.S. Government Realize that the Sea is Rising? How to Restructure Federal Programs so that Wetlands and Beaches Survive*, 30 GOLDEN GATE U. L. REV. 717, 737-39 (2000).

168 *See* Dennis Feeney et al., *Big Game Migration Corridors in Wyoming*, WYOMING OPEN SPACES (Univ. of Wyo./Wyo. Open Spaces Initiative, Laramie, Wyo.), April 2004, at B-1155, *available at* http://ces.uwyo.edu/pubs/B1155.pdf.

169 W. GOVERNORS' ASS'N, POLICY RESOLUTION 07-01, PROTECTING WILDLIFE MIGRATION CORRIDORS AND CRUCIAL WILDLIFE HABITAT IN THE WEST (2007), *available at* www.westgov.org/wga/policy/07/wildlife-corridors07-01.pdf.

170 *Id.*; *see also* W. GOVERNORS' ASS'N, WESTERN WILDLIFE HABITAT COUNCIL ESTABLISHED, (2008), *available at* http://www.westgov.org/wga/publicat/wildlife08.pdf.

171 *See* Berger, *supra* note 159, at 324-26.

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 a new conflict as the energy corridors often overlap wildlife migration corridors.[172]

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.[173] The pronghorn that summer in Jackson Hole migrate round trip distances up to 560 km annually to wintering areas in the Green River basin, and squeeze through bottlenecks as narrow as 0.1 km wide.[174] 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."[175] 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.[176] Although the Bridger-Teton effort falls far short of the proposed Yellowstone-to-Yukon corridor[177] because it is limited to the national forest lands and targets a single migratory species, designation of migration corridors on federal land is nevertheless a significant step towards conservation.[178]

---

[172] April Reese, *Western Governors Struggle to Balance Wildlife Protection, Renewables Development*, LAND LETTER, June 18, 2009.

[173] USDA FOREST SERVICE, DECISION NOTICE AND FINDING OF NO SIGNIFICANT IMPACT, PRONGHORN MIGRATION CORRIDOR FOREST PLAN AMENDMENT (2008), *available at* http://www.fs.fed.us/r4/btnf/projects/2008/pronghorn/PronghornDN.pdf.

[174] Joel Berger, Steven L. Cain & Kim Murray Berger, *Connecting the Dots: An Invariant Migration Corridor Links the Holocene to the Present*, 2 BIOLOGY LETTERS 528 (2006).

[175] USDA FOREST SERVICE, *supra* note 173, at 1.

[176] *Id.* at 1-2.

[177] *See generally* David W. Edgar, *Yellowstone to Yukon: Can it Ever Become a Reality?*, 67 U. MO. K.C. L. 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." *Id.* at 111.

[178] The USFWS manages some complexes of national wildlife refuges as wildlife corridors. *See, e.g.*, U.S. Fish and Wildlife Service, *Delmarva Conservation Corridor Project*

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.[179] 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.[180] 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.[181]

These western corridor proposals seek to regulate land use and barriers within the corridors to protect animals whose migrations can be accommodated by contiguous swaths of federal lands.[182] Restricting migration protection efforts to public lands, however,

---

Restores Habitat, Links Refuges, FISH AND WILDLIFE J., September 15, 2003, http://www.fws.gov/arsnew/print/print_report.cfm?arskey=10095; U.S. Fish and Wildlife Service, Minnesota Valley NWR and WMD: Refuge Lands, http://www.fws.gov/Midwest/MinnesotaValley/lands.html (last visited Dec. 14, 2009).

[179] Northern Rockies Ecosystem Protection Act, H.R. 980, 111th Cong. (2009); *see also* H.R. 488, 106th Cong. (1999) (earlier version of the bill).

[180] 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." H.R. 980 § 3(b).

[181] *Id.* § 203.

[182] The corridors proposed in the Northern Rockies Ecosystem Protection Act would be exclusively on federal land unless private entities volunteered to include their lands:

> (a) FEDERAL LAND MANAGEMENT AGENCIES.—This title shall apply only to National Forest System lands and lands under the jurisdiction of 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.

Id. § 204. Bradley Karkkainen has proposed that biodiversity protection efforts focus on federal landholdings. Bradley C. Karkkainen, *Biodiversity and Land*, 83 CORNELL L. REV. 1 (1997).

will not be sufficient to protect migrations generally.[183] 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,"[184] 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 access to privately owned habitat will be necessary to maintain most migrations.[185] Land trusts may play a role through conservation easements, but the problem of land use control is mostly a local government issue.[186]

Despite its pervasive importance in achieving environmental policy goals, land use control has received 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 has not seriously considered national land use control legislation since the early 1970s.[187]

---

183 *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).

184 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.

185 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 ninety percent of the total acreage of U.S. Forest Service, Bureau of Land Management, and U.S. Fish and Wildlife Service lands combined are located 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, an analogue to the currently debated Northern Rockies Ecosystem Protection Act, H.R. 980, 111th Cong. (2009) – 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.

186 Rapanos v. United States, 547 U.S. 715, 738 (2006) (characterizing land use control as a "quintessential" state and local power).

187 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 (Rich-

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.[188] Another circumstance of direct federal control may occur where adjacent private land frustrates federal environmental objectives, including conserving animal migrations across federal land.[189] Indirect land use controls are more pervasive, from federally-spurred state coastal zone restrictions under the Coastal Zone Management Act (CZMA)[190] to industrial siting restrictions due to impacts on waterways[191] or ambient air quality.[192] 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 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-

---

ard J. Lazarus & Oliver A. Houck eds., 2005); Todd A. Wildermuth, *National Land Use Planning in America, Briefly*, 26 J. LAND RESOURCES & ENVTL. L. 73 (2005).

188 16 U.S.C. § 1538(a)(1) (2006); 50 C.F.R. § 17.3 (2009).

189 *See* United States *ex rel.* Bergen v. Lawrence, 848 F.2d 1502 (10th Cir. 1988) (applying the 1885 Unlawful Inclosures Act, 43 U.S.C. §§ 1061-1066, to enjoin a fence on private lands that blocked the migratory path of pronghorn).

190 16 U.S.C. § 1455(b) (2006).

191 Discharge to impaired waters may require more stringent permit restrictions. 33 U.S.C. § 1312 (2006).

192 42 U.S.C. §§ 7501-7521 (2006) (limitations for nonattainment areas).

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.[193] This approach may be particularly useful for protecting migration corridors. In the CZMA, 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, demonstrate that land and water uses can be controlled through state establishment of standards to be implemented locally, and direct state regulation or review of all development proposals for consistency with the plan.[194] 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.[195] 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.[196] 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.[197]

The 1971 Adirondack Park Agency Act (APAA) illustrates a purely state-level approach to regulating uses on a mixture of pub-

---

193 Fischman, *supra* note 136, at 203-04.

194 16 U.S.C. § 1455 (2006).

195 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 a 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. Where a corridor contains a substantial percentage of private land, government oversight and incentive programs may be more politically effective than a command and control approach. *See also* John D. Echeverria, *Regulating Versus Paying Land Owners to Protect the Environment*, 26 J. LAND RESOURCES & ENVTL. L. 1 (2005); Robert B. Keiter, *Biodiversity Conservation and the Intermixed Ownership Problem: From Nature Reserves to Collaborative Processes*, 38 IDAHO L. REV. 301 (2002); Barton H. Thompson, Jr., *Providing Biodiversity Through Policy Diversity*, 38 IDAHO L. REV. 355 (2002).

196 33 U.S.C. § 1330 (2006).

197 *Id.*; *see also* U.S. Envtl. Prot. Agency, National Estuary Program, http://www.epa.gov/nep/ (last visited Dec. 14, 2009).

lic and private lands.[198] In 1885, New York declared the Adirondacks Forest Reserve, much of it privately owned, a protected natural area.[199] In the early 1970s, forest preserve lands constituted approximately forty percent of the six million acres of land in Adirondack Park.[200] 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 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.[201]

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."[202] To meet this obligation, the APAA establishes state regulatory controls, including shoreline development restrictions,[203] and requires review and approval of regional projects by the state Adirondack Park Agency.[204] The APAA also imposes requirements, overseen by the state agency, for local government land use programs and development approvals.[205] The APAA program conserves biodiversity by regulating private lands surrounding or interspersed within core public lands. Such an approach may be

198 N.Y. EXEC. LAW §§ 800-820 (McKinney 2005).

199 Act of May 15, 1885, 1885 N.Y. Laws 482; N.Y. COMP. CODES R. & REGS. tit. 9, § 3.119 (2009).

200 N.Y. EXEC. LAW § 801 (McKinney 2005).

201 *Id.*; *see also* Helms v. Diamond, 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 the Park).

202 N.Y. EXEC. LAW § 801 (McKinney 2005).

203 *Id.* § 806.

204 *Id.* § 809.

205 *Id.* §§ 807-08.

adapted to core migration corridors. Notwithstanding the governmental authority to protect public lands from harmful activities on nearby private lands,[206] establishing a new 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.[207]

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.[208] Kittatinny Ridge extends more than 250 miles across eleven Pennsylvania counties, and is a critical corridor of the Eastern Flyway, most notably for raptors.[209] Two-thirds of the ridge is privately owned, and is subject to housing, commercial, wind power, and mining development.[210] 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.[211] 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.[212]

---

206 The Property Clause of the U.S. Constitution, art. IV, § 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, 1248-49 (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 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).

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

208 *See* AUDUBON PENNSYLVANIA, CONSERVATION PLAN FOR THE KITTATINNY RIDGE (2006), http://pa.audubon.org/PDFs/KittatinnyConservationPlan-Apr2007.pdf.

209 *Id.* at 4.

210 *Id.* at 13, 15.

211 *Id.* at 23-26.

212 Partners in Flight – U.S., http://www.partnersinflight.org (last visited Dec. 14, 2009); *see also, e.g.*, American Bird Conservancy, Appalachian Mountains Joint Venture, http://

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 easier 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.[213] Historically, the technology-based regulatory regime in pollution control arose in response to these difficulties.[214] However, natural resources law, in part because its proprietary management component overshadows its regulatory elements, has been slow to adopt this tool.[215]

Technology-based standards in environmental law establish uniform limitations on all activities of a similar type. Although there may be some modification of the uniform, activity-based standard for special, site-specific circumstances, it must be justified as a deviation from the norm.[216] That norm coincides with a judgment

---

www.abcbirds.org/abcprograms/domestic/landscape/apmjv.html (last visited Dec. 14, 2009); American Bird Conservancy, North American Bird Conservation Initiative: "All Birds in All Habitats," http://www.abcbirds.org/abcprograms/domestic/partnerships/NABCI.html (last visited Dec. 14, 2009); Huron-Erie Corridor Initiative, http://huron-erie.org (last visited Dec. 14, 2009).

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

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

215 Robert L. Fischman, *Predictions and Prescriptions for the Endangered Species Act*, 34 ENVTL. L. 451, 475-79 (2004).

216 The presence of effects-based controls where technology-based standards prove inadequate to meet ambient environmental quality goals makes most pollution control regimes mixed systems that employ redundant protections. Though redundancy is an

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.[217]

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.[218] Fischman has argued that ESA incidental take regulation should follow this approach.[219] 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 be better described by the more inclusive term "activity-based regulation."[220] In principle, however, requiring that habitat-disturbing activities minimize impacts and employ uniform controls mirrors the approach of the more familiar technology-based limitations. One important difference, however, is that BMPs are harder to monitor and enforce than traditional technology-based limitations because the BMPs are more widely dispersed across the landscape. Permit programs, such as the Clean Water Act's dredge or fill provision,[221] offer models to help apply the general principles of harm minimization to particular settings and improve compliance.

---

important design feature, this article focuses on the activity-based rules that will be most effective for protecting migration habitat.

217 K. Shawn Smallwood & Brian Karas, *Avian and Bat Fatality Rates at Old-Generation and Repowered Wind Turbines in California*, 73 J. WILDLIFE MGMT. 1062 (2009); Scott Streater, *Impacts to Wildlife Weighed in Push Toward "Green" Energy*, LAND LETTER, Feb. 5, 2009.

218 Fischman, *supra* note 215, at 477.

219 *Id.* at 475-79; 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) [hereinafter Fischman, *Divides*].

220 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* Fischman, *Divides*, *supra* note 219, *passim*; Fischman, *supra* note 215, at 477.

221 33 U.S.C. § 1344 (2006).

The Bureau of Land Management has already adopted the BMP approach in its 2008 Wind Energy Development Policy.[222] 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."[223] As simple a design principle as limiting the height of wind turbines may yield conservation benefits.[224]

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[225] unless a permit applies.[226] 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 establish a reasonable likelihood that a particular action proximately caused

---

222 Memorandum from Dir., U.S. Dept. of the Interior, Bureau of Land Mgmt., on Wind Energy Development Policy to All Field Officials (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.

223 *Id.* at Attachment 1-6, *available at* http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2009/IM_2009-043.html (follow "1 – BLM Wind Energy Program – Policies and Best Management Practices" hyperlink).

224 *See, e.g.*, Baerwald & Barclay, *supra* note 160 (fatality rates among migratory bats vary depending on the height of the turbines).

225 The no-take provision of the MBTA does not include the specific act of "harm." 16 U.S.C. § 703 (2006). 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.

226 *See* 16 U.S.C. § 704(a) (2006) (authorizing the Secretary of the Interior 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 . . . ."); 50 C.F.R. § 13.11(d) (2009) (listing user fees for fifteen types of permits under the MBTA).

the adverse effect.[227] 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.[228] Even for a direct effect, the agency must prove that the activity in question proximately caused the prohibited injury. Proof of causation requires a demonstration of a sequence of events, uninterrupted by any intervening cause, that would have resulted in the effect (such as the 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."[229] 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.[230]

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.[231] This regulatory approach may have the capability to promote application of best practices and technologies to minimize foreseeable harms to birds.[232] But, it is costly for

---

[227] *See* Meredith Blaydes Lilley & Jeremy Firestone, *Wind Power, Wildlife, and the Migratory Bird Treaty Act: A Way Forward*, 38 ENVTL. L. 1167, 1190-92 (2008).

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

[229] Lilley & Firestone, *supra* note 227, at 1185 (citing United States v. Moon Lake Elec. Ass'n, 45 F. Supp. 2d 1070 (D. Colo. 1999)).

[230] *Id.* The courts have narrowed prosecution liability under the MBTA to activities resulting in take that is 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).

[231] 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, the 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. Lilley & Firestone, *supra* note 227, at 1197-1200.

[232] 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). Lilley & Firestone, *supra* note 227, 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, Responsibilities of Federal Agencies To Protect

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.[233]

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.[234]

Any regulation, including activity-based regulation, when imposed more stringently in certain locations because of their high habitat values, raises equity concerns. One of the big problems faced by ESA regulation is that it imposes costs disproportionately on owners of whatever habitat remains for imperiled species. The owners of the remnant habitat may rightly claim that they are punished for their good deed of conservation during the time that other landowners were destroying their habitat. Imposing highly concentrated costs of habitat protection on a small number of landowners in order to provide a broad public environmental benefit is a recipe for backlash. Public subsidies, incentive programs, and regulatory shields are common tools to address the inequities and promote cooperation. While regulation is generally necessary to prod landowners toward conservation planning, any migration conservation law should provide the flexibility for deal-making and habitat-swapping. As with any conservation effort, the larger the

---

Migratory Birds, Exec. Order No. 13,186, 66 Fed. Reg. 3853 (January 10, 2001) imposes responsibilities under the MBTA on federal agencies to protect migratory birds. *See, e.g.*, OFFICE OF LEGACY MGMT., U.S. DEP'T OF ENERGY, MIGRATORY BIRD TREATY ACT ISSUES, NATURAL RESOURCE MANAGEMENT ACTIVITIES, AND MAINTENANCE AND PROJECT ACTIVITIES AT THE ROCKY FLATS SITE, LMS/RFS/SO4511 (2008) (discussing application of best management practices to avoid and minimize impacts to migratory birds).

233 Fischman, *Divides*, *supra* note 219.

234 *Id.*

scale of the project, the greater the opportunity for flexible trade-offs.[235]

D. Harvest Controls

Harvest controls are among the very oldest and best established legal mechanisms to conserve animals.[236] 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.[237] 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.[238]

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,[239] 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.[240] As discussed *supra*, the decline of crab populations due to commer-

---

235 Robert L. Fischman & Jaelith Hall-Rivera, *A Lesson for Conservation from Pollution Control Law: Cooperative Federalism for Recovery Under the Endangered Species Act*, 27 COLUM. J. ENVTL. L. 45, 146-148 (2002).

236 Robert L. Fischman, *Law—Biological Conservation*, *in* 2 ENCYCLOPEDIA OF WORLD ENVIRONMENTAL HISTORY 765 (Krech III et al. eds., 2004).

237 Act of May 25, 1900 (Lacey Act), ch. 553, § 1, 31 Stat. 187, 187-189 (codified as amended at 16 U.S.C. §§ 701, 3371-78).

238 *See, e.g.*, Migratory Bird Treaty and Migratory Bird Treaty Act, 16 U.S.C. §§ 703-711 (2006).

239 *See, e.g.*, Jonathan H. Epstein, Pteropus vampyrus, *a Hunted Migratory Species with a Multinational Home-Range and a Need for Regional Management*, 46 J. APPLIED ECOLOGY 991 (2009).

240 *Interstate Panel Rejects Call to Halt Crab Harvest*, LAND LETTER, Sept. 4, 2008.

cial harvest is an important constraint on the ability of the red knot (and other migratory shorebirds) to complete its spring migration from South America to northern Canada.[241]

The second, more difficult problem is enforcing established harvest controls. A prime example of this challenge 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."[242] The difficulty of enforcing whale harvest controls even spurred some whale protection groups to such extreme measures as piracy and sabotage.[243] Poor compliance and enforcement are problems not only in the context of whaling, but throughout all of the global fishing industry.[244]

E. Summary

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) interjurisdictional 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, they generally fair poorly at protecting migrations as phenomena of abundance, particularly with respect to thresholds and triggers. In Part IV we propose concepts 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

---

241 *See supra* notes 56-60 and accompanying text.

242 Benjamin van Drimmelen, *The International Mismanagement of Whaling*, 10 UCLA PAC. BASIN L.J. 240, 252 (1991).

243 *Id.* at 251.

244 *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).

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 salamanders and snakes. A law to protect abundant populations also must account for the costs resulting from conflicts between animals and routine human affairs, such as agriculture.[245]

A. Migration Protection Model

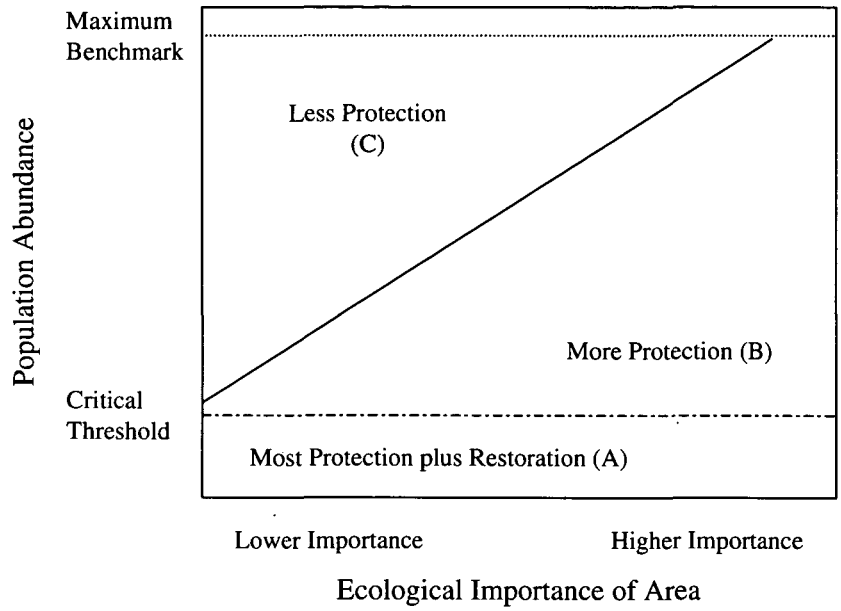
We propose adopting a conceptual model for conserving migrations as phenomena of abundance, schematically represented in Figure 2 (Migration Protection Model). The schematic illustrates how varying degrees of protection might apply to a migratory population depending on both population abundance and 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 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, we seek 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.

---

[245] For example, the USFWS fairly readily issues depredation permits under the MBTA allowing take of migratory birds responsible for injury to economic interests. *See* 50 C.F.R. § 21.41 (2009). 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.

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.[246] 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

[246] Sanderson, *supra* note 73.

population, yet probably below historic abundances or abundances required to support harvesting.[247]

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.[248] 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 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

---

247 *Id.*; *see also* Soulé et al., *supra* note 85, at 1247 (noting that recovery goals under the Endangered Species Act manifest "demographic or numerical minimalism").

248 *See, e.g.*, CORRIDOR ECOLOGY: THE SCIENCE AND PRACTICE OF LINKING LANDSCAPES FOR BIODIVERSITY CONSERVATION (Jodi A. Hilty, William Z. Lidicker, Jr. & Adina M. Merenlender eds., 2006); Rob H. G. Jongman, *Nature Conservation Planning in Europe: Developing Ecological Networks*, 32 LANDSCAPE & URB. PLANNING 169 (1995); Reed F. Noss & Larry D. Harris, *Nodes, Networks, and MUMs: Preserving Diversity at All Scales*, 10 ENVTL. MGMT. 299 (1986); John H. Roe & Arthur Georges, *Heterogeneous Wetland Complexes, Buffer Zones, and Travel Corridors: Landscape Management for Freshwater Reptiles*, 135 BIOLOGICAL CONSERVATION 67 (2007).

programs, and joint ventures may be employed.[249] 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. Variable protections for different levels of scarcity attune the intensity of conservation actions to the status of the migration. But the two tiers of protection in the ESA, represented by the distinction between the endangered and the threatened status, have produced some inconsistencies (as well as the expected flexibilities) that must be considered in designing multi-tiered triggers.[250]

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 their optimum sustainable levels.[251] 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.[252]

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

---

249 Thompson, *supra* note 195.

250 *See* Holly Doremus, *Delisting Endangered Species: An Aspirational Goal, Not a Realistic Expectation*, 30 ENVTL. L. REP. 10434, 10441 (2000); Fischman & Hall-Rivera, *supra* note 235, at 55; Daniel J. Rohlf, *Six Biological Reasons Why the Endangered Species Act Doesn't Work – And What to Do About It*, 5 CONSERVATION BIOLOGY 273 (1991).

251 16 U.S.C. § 1383b(b) (2006); *see also, e.g.*, U.S. DEP'T OF COMMERCE, NOAA, NAT'L MARINE FISHERIES SERV., CONSERVATION PLAN FOR THE EASTERN PACIFIC STOCK OF NORTHERN FUR SEAL (*Callhorinus ursinus*) (2007).

252 16 U.S.C. §§ 1371–1374 (2006).

levels of protection.[253] 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 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.[254] 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.

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 extent practicable.[255] Thus, the antidegradation policy is intended to protect existing water quality

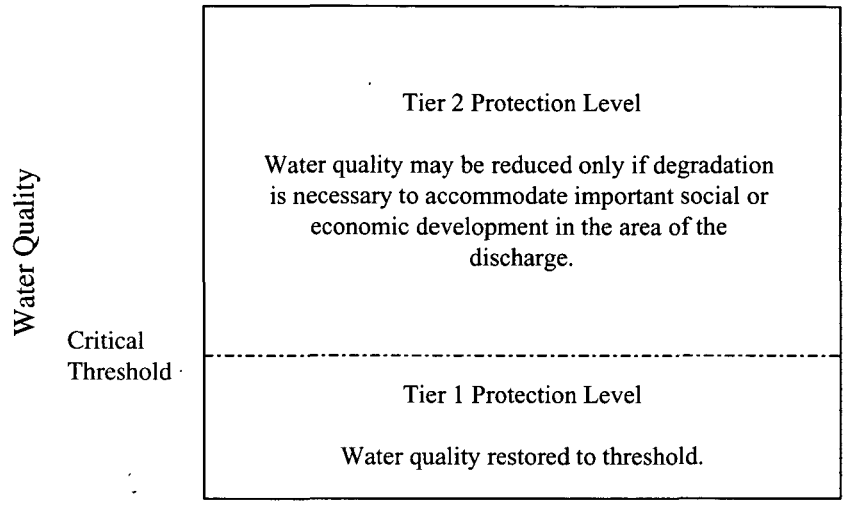
---

[253] M. O. Hammill & G. B. Stenson, *Application of the Precautionary Approach and Conservation Reference Points to Management of Atlantic Seals*, 64 ICES J. MARINE SCI. 702, 703 fig.1 (2007).

[254] *See* Memorandum from Ephraim S. King, Dir., Office of Science and Tech., to Water Mgmt. Div. Dirs., Regions 1-10, at 1 (Aug. 10, 2005), *available at* http://www.epa.gov/waterscience/standards/files/tier2.pdf.

[255] 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) (2009); ENVTL. PROT. AGENCY, WATER QUALITY STANDARDS HANDBOOK

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.



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.[256]

C. Limitations of a Multiple-Threshold Approach

The use of multiple abundance thresholds in the Migration Protection Model is problematic because of the uncertainties involved in estimating thresholds and current population sizes. Determining the correct level of protection will depend on establishing target abundances to serve as thresholds and on vigilant monitoring of abundance throughout the migratory range to ascertain when thresholds are crossed.

The multiple thresholds in the Migration Protection Model may be set to correspond to the different thresholds of population abundance needed to sustain the different social objectives discussed in Part III.A. For many migratory species, however, abun-

4-1 to -6 (2nd ed. 1994), *available at* http://www.epa.gov/waterscience/standards/handbook/index.html.

[256] 40 C.F.R. § 131.12(a)(2) (2009).

dances necessary for ecological viability, sustainable harvest, or historical restoration are mostly unknown at present. Rough estimates and rules of thumb will likely be necessary to set the thresholds until further monitoring and research improves our estimates of such triggers.[257] 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.[258] 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."[259] To meet its goals, the Plan establishes population targets.[260] 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 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).[261] 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.[262] 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

---

257 Sanderson, *supra* note 73.

258 U.S. FISH AND WILDLIFE SERV. MANUAL, MIGRATORY BIRDS, PART 721, CHAPTER 4, *available at* www.fws.gov/policy/721fw4.pdf.

259 *Id.* at 4.2(C)(2).

260 MANOMET CTR. FOR CONSERVATION SCIS., *supra* note 114, at 23-24; S. BROWN ET AL., NATIONAL SHOREBIRD CONSERVATION ASSESSMENT: SHOREBIRD CONSERVATION STATUS, CONSERVATION UNITS, POPULATION ESTIMATES, POPULATION TARGETS, AND SPECIES PRIORITIZATION 12-14 (2000), *available at* http://www.fws.gov/shorebirdplan/downloads/SHORCONS3.pdf.

261 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 CTR. FOR CONSERVATION SCIS., *supra* note 114, at 24.

262 *Id.*

ecological changes make historic benchmarks impractical as targets. Regardless of how the abundance thresholds are selected and estimated, these matters will constitute a major component of any successful migration protection law.

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 complex 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 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. It also starts a new conversation about the environmental values served by abundant populations.

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, cooperative agreements, habitat acquisition (including acquisition of easements), and activity-based regulation would create a more diversified portfolio of conservation instruments than most current programs enjoy. In particular, activity-based regulation could help prove that the lessons of pollution control can address problems on the resource management side of the environmental law divide.[263] The substantial information gaps should not preclude conservation actions that both hold promise and can serve as bases for a deeper understanding of migrations through adaptive management.

The differential triggers we recommend would initiate comprehensive protection as a legal response. The tailored response should combine corridor designations, site-specific protections and

[263] Fischman, *Divides*, *supra* note 219, at 691-93.

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 of abundant migrations 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 a model that has 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.

The experience of migratory waterfowl conservation suggests that policy-makers begin to implement our blueprint for migration conservation for other migrations capable of popular support. It is not just for sport hunting that migratory waterfowl developed a constituency. Aldo Leopold articulated another widely held value in his most popular meditation, *A Sand County Almanac*:[264] wonderment and affinity with nature, associated with the return of geese to Wisconsin in March. If not the comfortable familiarity of geese, then the heroic endurance of the kind displayed by the arctic tern may qualify other birds for the vanguard of migration conservation.[265] Outside of the avian domain, keystone, flagship, or umbrella species that migrate may convince lawmakers of migration conservation's ecological merits. Most important is to begin to plug the gaps in legal protection that fall between game and imperiled species.

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

---

[264] ALDO LEOPOLD, A SAND COUNTY ALMANAC 19 (Ballantine Books 1970) (1949).

[265] The arctic tern recently garnered political notice when the New York Times rhapsodized on its editorial page about its transpolar migration. *See* Editorial, *A Tern Around the World*, N.Y. TIMES, Jan. 21, 2010, at A38.

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 Marine Turtle Conservation Act (MTCA) 16 U.S.C. §§ 6601–6607	Requires measures to replenish any species or population diminished below its optimum sustainable population by acquiring, protecting, and improving essential habitats. 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, http://www.partnersinflight.org; 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 U.S. to fish for or to retain on board any anadromous fish in the Convention Area.