SYMPOSIUM ESSAY

MIGRATION CONSERVATION: A VIEW FROM ABOVE

BY

ROBERT L. FISCHMAN*

The extinction prevention focus of natural resources policy diverts attention from important issues of ecological integrity and adaptation to climate change. Animal migration conservation serves as a bridge from the imperiled species problem to the more spatially and temporally difficult problems surrounding climate change adaptation. Conserving abundant animal migrations both strengthens the resilience of the ecosystems in which they function and tests the resilience of social institutions responsible for adaptation. This essay synthesizes the findings of a two-year, interdisciplinary study of animal migration conservation. It also introduces the articles that follow in this symposium issue, which is a result of the study.

* Professor of Law and Harry T. Ice Faculty Fellow, Maurer School of Law, and Adjunct Professor, School of Public and Environmental Affairs, Indiana University. In addition to the authors of articles in this symposium, I thank my close collaborators, Vicky Meretsky and Jeff Hyman, and my research assistant, Elizabeth Baldwin, for enriching my thinking about animal migration conservation. I am also grateful for the generous financial support of the following Indiana University units: the Maurer School of Law, the Institute for Advanced Study, the School of Public and Environmental Affairs, and the Center for Research in Environmental Sciences.

I. THE IMPORTANCE OF ANIMAL MIGRATION CONSERVATION

Animal migrations are widely appreciated as among the most awe-inspiring spectacles of nature. Yet, they are hardly recognized in the law of biodiversity protection. Migration as a phenomenon, and the migratory species of all taxa that display this fascinating behavior, are disappearing all over the world with attendant loss of ecosystem functions and social values. The decline of migrations is a sadly familiar tale in conservation literature: compelling evidence reveals that large-scale migrations are succumbing to the pressures of habitat modification, prey disappearance, hunting pressures, barriers to movement, and pollution. The diverse animals that migrate, including butterflies, salmon, sea turtles, bats, and songbirds, are struggling to continue a tenuous yet important adaptation.

Extinction prevention programs employ population thresholds that may be inadequate to preserve migratory behavior. So, we may retain bison, whooping cranes, and salmon, but lose the suite of benefits migrations provide. Besides the subjective human experience, animal migrations cycle nutrients and facilitate other ecological processes. Many promote ecosystem resilience that enhances the ability of natural systems to recover from disturbances and stresses, including some manifestations of climate change.[1]

There are two primary reasons why conservation of migratory species does not always preserve actual migrations. The first is habitat loss or migration route barriers that thwart movement. This is why connectivity linking breeding sites, travel paths, wintering areas, and key sources of food across landscapes is a key challenge for conserving animal migrations. Connectivity is also critical for effective adaptation to climate change, which will spur species to disperse into new regions.[2] In that respect, successful efforts to maintain animal migrations may create templates for improving ecological resilience as climate change accelerates. One important theme of this symposium is that conserving migrations will offer lessons applicable to the problem of climate change adaptation.

The second reason is that some species require populations well above minimum-viable, survival levels in order to engage in migration.[3] The rationale for preserving migratory behavior, therefore, must go beyond the rationale of preventing extinction. Keeping common species common is a traditional justification for conservation actions, particularly for programs aimed at sustained yield.[4] Maintaining abundant migrations forestalls the difficult triage decisions of recovering imperiled species and provides greater ecological services and resilience to landscapes. Abundant

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[1] Jakob Lundberg & Fredrik Moberg, *Mobile Link Organisms and Ecosystem Functioning: Implications for Ecosystem Resilience and Management*, 6 ECOSYSTEMS 87, 88 (2003).

[2] Meade Krosby et al., *Ecological Connectivity for a Changing Climate*, 24 CONSERVATION BIOLOGY 1686, 1686 (2010).

[3] *E.g.*, Sepideh Bazazi et al., *Nutritional State and Collective Motion: From Individuals to Mass Migration*, 278 PROC. OF THE ROYAL SOC'Y B 356 (2011).

[4] *E.g.*, Phil Taylor, *Enviros Concerned About New Planning Rule's Impact on Species*, GREENWIRE, Feb. 11, 2011, http://www.eenews.net/Greenwire/2011/02/11/4 (last visited Apr. 9, 2011).

migrations are increasingly rare. So, paradoxically, the conventional motivations for preserving wondrous but rare aspects of nature would also support some of the migration conservation agenda.

Suppose that law and policy were to wholeheartedly embrace a conservation goal of maintaining ecological functions and processes to supplement the ecological elements (e.g., imperiled species, coastal wetlands) on which existing programs focus. The conservation challenge of protecting *all* migrations would nevertheless be insurmountable. Yet the research reflected in this symposium can be used to set priorities. Generally, resources should be devoted to two kinds of migrations: 1) those involving sufficiently large populations as to be important shapers of ecosystems; and 2) motivators of conservation among the public.

It is a truth universally acknowledged that complex conservation challenges require collaboration.[5] However, as with Jane Austen's aphorism, confident declarations often belie vexing difficulties in their execution. Management of animal migrations raises two kinds of collaboration challenges. First, it requires scientists, lawyers, policymakers, and resource managers to work together across disciplinary boundaries. Too often, for instance, the research agenda of natural scientists fails to match up with the information needs of resource managers. Second, conservation of roaming creatures requires coordination across governmental boundaries, administrative jurisdictions, and property lines.

This symposium on animal migration conservation makes important contributions to promoting both kinds of collaboration. Indeed, this collection of articles may serve as a model for addressing a wide range of collaboration challenges. Animal migration conservation raises all of the complex difficulties that characterize what is special about environmental law[6] and that inspired resource managers to adopt ecosystem management.[7] Better understanding the challenges of and innovations in migration protection will also inform the full spectrum of large-scale conservation problems raised by climate change.

Of course, the basis for conservation policy should be solid scientific research. But, despite recent advances in technology, the migratory pathways and winter ranges of many species remain unknown. This raises the stakes for designing standards and programs that can be effective even without precise information. Waiting for better information is a chronic delay tactic in environmental law, and often exacerbates a problem as resource scarcity increases and degrees of management freedom diminish.

Law has always tailored its approaches in response to different information challenges. The common law of property responded to the "secret, occult and concealed" movements of groundwater by imposing a

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[5] *Cf.* JANE AUSTEN, PRIDE AND PREJUDICE 1 (1813) ("It is a truth universally acknowledged, that a single man in possession of a good fortune, must be in want of a wife.").

[6] *See* RICHARD J. LAZARUS, MAKING OF ENVIRONMENTAL LAW 5–15 (2004).

[7] R. Edward Grumbine, *What Is Ecosystem Management?*, 8 CONSERVATION BIOLOGY 27, 28 (1994).

rule of capture because any other rule would mire in "hopeless uncertainty."[8] In the past half-century, improved monitoring and modeling substantially sharpened predictions of groundwater movement. As a result, many states have shifted to a different rule requiring equitable sharing of groundwater.[9]

We may well be on the cusp of a similar change in migration conservation. Longstanding mysteries of animal movement are yielding to tracking and mapping innovations. In 1768, Samuel Johnson noted to Boswell that swallows wintered under water.[10] Despite the progress made in the subsequent quarter millennium, for most migrations our conservation policies must be robust to uncertainties about the details of the migratory behavior. We must simultaneously pursue research to pin down the spatial, temporal, and demographic details of migrations while we reform conservation policy to make better guesses about practices that will sustain migratory behavior. While scientists work to understand migrations in greater detail, law and policy must coarsely prioritize resources and safeguard the elements of animal migrations. Effects-based limits on activities that impede migrations may simply require too much information to succeed. Activity-based regulation, though it may be overinclusive, has proven more robust in safeguarding environmental quality over a wide range of circumstances.[11] Other migration protections can emerge from existing programs, such as environmental impact analysis. But, gaps remain in the legal framework for promoting conservation collaborations. While birds and marine mammals enjoy special statutory protections, other migrating taxa—such as insects and bats—have almost no monitoring and support. As adaptation to climate change increasingly dominates conservation projects, migration maintenance should receive special priority because of its tenuous current condition and because of its vanguard role in securing connectivity.

What we do already understand is that migrations are not fixed. They shift and even disappear over fairly short time spans in response to environmental changes. And, even within a species, migration is neither monolithic nor invariant. Some populations may migrate while others do not, and some individuals may migrate at different times and to different places. There may be no clear lines separating migrations from each other, just as there may be no bright distinctions between subspecies. Some animal migrations hew to a narrow band of movement, while others travel in a broad, dispersed front. We can expect a similar continuum in behavior and response to greater magnitudes of climate change. Conserving abundant

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8 Frazier v. Brown, 12 Ohio St. 294, 311 (Ohio 1861).

9 *See, e.g.*, Cline v. Am. Aggregates Corp., 474 N.E.2d 324, 327 (Ohio 1984).

10 Barry Baldwin, *Johnson's Conglobulating Swallows*, 41 NOTES & QUERIES 199 (June 1994). The origin of this belief dates to at least a claim of a Swedish archbishop in 1555. ROBIN BAKER, THE MYSTERY OF MIGRATION 9 (1980). Aristotle came closer to understanding migration with his observation that some creatures move south in the winter to keep warm. Indeed, he observed that "all creatures are fatter in migrating." *Id.* at 8.

11 *See* 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); Robert L. Fischman & Jeffrey B. Hyman, *The Legal Challenge of Protecting Migrations as Phenomena of Abundance*, 28 VA. ENVTL. L.J. 173, 222–27 (2010).

migrations now—before their populations slip into endangered species programs—will afford greater adaptive flexibility in an uncertain future.

II. THE SYMPOSIUM ARTICLES

The articles in this symposium arise from a two-year program coordinated at Indiana University. A group of biologists, social scientists, and lawyers started meeting monthly to discuss the interdisciplinary problems of animal migration conservation. We began in 2009 with a series of seminars in which we would invite a scholar to share research and help us relate it to some broader aspect of migration policy. After a year of seminars, most of the participants had ideas for papers based on our discussions. Also, many of our researcher guests were interested in advancing our goal of a comprehensive, interdisciplinary treatment of animal migration conservation. To improve the papers and foster cross-disciplinary discourse, we convened a workshop in October 2010.

The articles printed in the following pages represent the collective encouragement and criticism from the workshop, seminars, and countless conversations reacting to comments, assertions, and assumptions. In addition to the article authors, Professors David Wilcove of Princeton University and John Terborgh of Duke University contributed their ideas to the workshop. The resulting articles fall into three somewhat overlapping categories: a scientific research agenda, law and policy reform, and collaboration case studies. Irrespective of their pigeonhole, the articles all attempt to engage policy makers, resource managers, and scientists on the key issues facing migration conservation.

A. Scientific Research Agenda

Without understanding the nature of migrations, and how they respond to environmental change, conservation can do no better than trial and error. Even more critically, the science of migrations can inform priorities so that policymaking optimizes social benefits. In the first contribution, Professor Ellen Ketterson, Jonathan Atwell, and Dawn O'Neal, distill years of Dark-eyed Junco research. Their findings show that migration is a dynamic phenomenon that may vary substantially among closely related species, subspecies, populations, or even among individuals within a population. Moreover, this variation is sensitive to environmental change. Just as the Endangered Species Act[12] protects some taxa which may not have biologically distinct boundaries separating them from other taxa, a migration protection law may create categories that do not precisely correspond with scientific understandings. Intentional habitat alteration and inadvertent climate change will alter the demographics of migrating species, and sometimes even induce sedentary behavior. Food supplementation, competitor management, and floral alteration could aid breeding animals

12 Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2006).

whose ranges shift maladaptively or who have mis-timed their migrations so that they no longer arrive with emerging food supplies.

In the next article, Smithsonian ornithologist, Peter Marra, teams up with two lawyers, Professor David Hunter and Anne Perrault, to describe migratory connectivity and its relationship to migration conservation. Migratory connectivity is the linkages among breeding sites, migration routes, wintering areas, and other key places of conservation significance for individuals or populations of a species. As one might expect, conditions at one site, such as a wintering area, may affect breeding success at a later time and at a far-distant site in an animal's summer range. Marra and his co-authors argue, therefore, that understanding migratory connectivity is essential for conservation of migratory animals. Despite exciting new technology that has revolutionized the study of migratory connectivity, our state of knowledge for most species is poor. In urging greater investment in research to pin down migratory connectivity, the article reveals how more finely detailed information would improve the effectiveness of such existing legal tools as the Endangered Species Act, environmental impact analysis, standing for challenging agency actions, and international law. Perhaps the most innovative use of scientific information proposed in this article is site-specific conservation through social connectivity. Building on successful collaborations through such programs as Partners in Flight, the article shows how better information about migratory connectivity can link people and institutions—especially nongovernmental organization (NGOs)—across migration routes to work together.

Paul Cryan, a pioneer in understanding bat migrations, shows that, for all we have yet to learn about birds, we know even less about other animal migrants. The rise of renewable wind power in the last five years creates a new urgency to study obstacles and connectivity in bat migrations. Recent research generates some alarming statistics about wind turbines causing measurable declines in migratory bats. Regulation of wind turbines could help both the science and conservation of bat migrations through 1) disclosure of fatalities; 2) monitoring requirements; 3) operational restrictions, such as limiting low speed rotations at certain times of year; and 4) siting rules that avoid bottleneck locations for migrating bats.

Two biologists, Professors Heather Reynolds and Keith Clay, then turn our attention to the ecological values that support calls for maintaining abundant populations of migrants, as opposed to simply protecting migrating species on the brink of extinction. They use the United Nations Millennium Ecosystem Assessment framework to classify the services migrating animals provide to humans. Reynolds and Clay draw upon existing literature to categorize four different types of ecosystem services: supporting, provisioning, regulating, and cultural. They illustrate how migrations supply these services with a discussion of Serengeti ungulates, Pacific salmon, Long-nosed bats and hummingbirds, manatees, and migratory birds. Though it is possible for migrations to spread disease, the overwhelming weight of the evidence is that the services are an enormous net benefit to humankind. Through their synthesis of the ecosystem services

literature, Reynolds and Clay point to future research that can better quantify the human uses of animal migrations so that conservation policy can prioritize those offering the greatest value.

Finally, no discussion of a research agenda would be complete without addressing climate change. Thomas Moore illustrates the difficulties that a migratory population will face in adapting to climatic shifts. He explains how climate change could disrupt migrations by altering habitat, changing resource (e.g., food) availability, increasing ecological disturbance, changing phenology (timing of seasonal patterns), and blocking migrations. Any research agenda must consider these unprecedented transformations. He also highlights the importance of research to target species and management techniques that can assist migrants responding to environmental alterations.

B. Law and Policy Reform

Law and policy reform is the bread and butter of legal scholarship normally addressed in the pages of this law review. The contributors of papers in this category build on work Professor Jeffrey Hyman and I recently published to outline the legal challenges of animal migration conservation.[13] The attorneys of Indiana University's Conservation Law Clinic take up one of the suggestions from that earlier article in arguing for and devising elements of statutory reform to protect migrations as phenomena of abundance. Using three different animal migrations involving a bird, a mammal, and an insect, they illustrate why existing U.S. national law is inadequate to the task of conserving the abundant migrations. They then lay out the design for new legislation that would raise the priority, authorize agency actions, speed collaborative solutions, and clarify the rationale for migration conservation.

The next article is perhaps the best example of interdisciplinary collaboration in this issue. Professor Vicky Meretsky, Jonathan Atwell, and Professor Jeffrey Hyman team up to compare how three disciplines—science, law, and resource management—divide up the domain of animal migration conservation. The article begins by documenting the astonishing diversity among migrations. Animals differ widely, for instance, in why, how, and when they migrate. Conservation actions should respond to a number of factors, including whether the migration occurs in a narrow band or a broad front. In contrast, neither the legal categories nor the management tools for conservation correspond to the dimensions along which the biologists classify migrations. Perhaps the most significant disparity is between the information generated by science and the information needed by managers engaged in conservation. The authors suggest ways to bridge many of the gaps between the approaches of scientists, lawyers, and managers. The principal gaps occur spatially, along migratory routes; jurisdictionally, between agencies and political divisions (including nations); and taxonomically, between certain groups of species (such as marine

[13] *See generally* Fischman & Hyman, *supra* note 11.

mammals) that receive comprehensive management and others (such as bats) which do not. The recommendations include coordination of research funding, better monitoring of non-imperiled migratory species, establishment of targets for abundance, and grant programs to steer existing conservation programs toward greater attention to migrations.

Large-scale migration conservation demands international cooperation, but there are few existing treaties that provide good frameworks for such efforts. The most important example of such an international agreement is the Convention on Migratory Species. Elizabeth Baldwin reviews the structure and implementation of this treaty, which focuses on Eastern Hemisphere migrations. The treaty covers all migratory species but encourages specific agreements, or less formal memoranda of understanding, on groups of related or individual migrations. Baldwin's analysis shows how the treaty balances broad participation with conservation stringency. She illustrates this and other trade-offs in agreement and memorandum design through case studies of the Wadden Seal Agreement, the African-Eurasian Waterbird Agreement, and the African Marine Turtles Memorandum. As with many conservation programs, austere funding often undermines the ambition of these efforts.

The final contribution to the law and policy reform portion of the symposium employs game theory to consider how to secure effective migration conservation. Economist Kathleen Miller explores how strategic optimization can lead to agreements on coordinated conservation actions, and also how to ensure that parties will actually carry out their obligations. In game theory, every participant's decisions depend on the expected actions and reactions of the other relevant actors. The article explores how to design an appropriate set of incentives for each of the decision-making entities so that they channel their actions towards mutually satisfactory and environmentally responsible outcomes. A changing climate can complicate this task by altering the migratory behavior or reproductive success of the animals that a policy or agreement attempts to manage. The authors illustrate their approach with three transboundary migration case studies of: north Pacific fur seals, Atlantic bluefin tuna and eastern African wildebeests.

C. Collaboration Case Studies

The final section addresses the lessons that emerge from actual experiments in collaboration. David Cherney examines the 170-mile Wyoming migration route for pronghorn antelope between Jackson and the Upper Green River Basin. In a 2009 article, he and Susan G. Clark described attempts of public agencies, private ranchers, and NGOs as ineffective, leading to "policy gridlock."[14] In this symposium he revisits the case study, with its fragmented ownership (and geographic bottlenecks for migrating pronghorn) and complex political landscape (and decision making

[14] David N. Cherney & Susan G. Clark, *The American West's Longest Large Mammal Migration: Clarifying and Securing the Common Interest*, 42 POL'Y SCI. 95, 108 (2009).

bottlenecks). His surprising conclusion is that collaboration among all stakeholders is not necessary to significantly safeguard the migration. In particular, recent developments resulted in two separate initiatives. Environmental groups persuaded the Forest Service to create a "Path of the Pronghorn," a largely symbolic national forest designation that fails to address the key threats to the migration: rural housing, natural gas development, and ranch fencing. At the same time, the Upper Green River Valley Land Trust initiated a program to remove migration barriers by funding the replacement of dense barbwire fences with wildlife-friendly fences that do not impede the pronghorn. With little fanfare, the fencing program provided a policy solution by disconnecting with the politics of public land and natural gas management. Sometimes parallel but unconnected initiatives can overcome political gridlock for migration conservation.

Professor Jamison Colburn presents the next case study, examining the Kittatinny Ridge corridor that supports numerous bird migrations. This vast corridor of forested acres lies amidst a densely settled area containing over 1.5 million people. In 2001, over one hundred Pennsylvania communities joined with the Audubon Society and dozens of other NGOs (including land trusts) to create the Kittatinny Coalition, with nebulous conservation objectives. In this case, the kind of decentralized, opportunistic conservation projects that yielded success for the pronghorn have failed to add up to more than the sum of their parts. Instead, the over-abundance of low-value and low-impact conservation fails to contribute to landscape-scale objectives. Professor Colburn blames, in part, a lack of diversity and imagination in conservation institutions and methods. Underlying law, including tax and property rules, creates a set of incentives that make large-scale conservation difficult to coordinate in a decentralized fashion. Indeed, he finds that ecological fragmentation can be exacerbated by haphazard acquisition of conservation easements.

Finally, in what may well be the single most important contribution to this symposium, Professor Steven L. Yaffee distills twenty years of experience evaluating ecosystem-based management (EBM) and applies it to migration conservation. He lays out key factors that support EBM success: motivation, organization, resources, adaptability, legitimacy, and energy. These are the same factors that can build the incentives and capacity for migration conservation. This brings the symposium back around to the social connectivity that Marra, Hunter, and Perrault highlight as a critical benefit of improved spatial mapping of migrations. A better understanding of biological connections can support the institutional connections and grassroots projects that Yaffee identifies as critical. Professor Yaffee's lifecycle narrative of EBM collaboration suggests that social connectivity may be particularly important to initiate conservation actions through early steps of communication, before trust and ecological change follow. Yaffee also connects to the law and policy reform article by the Conservation Law Clinic attorneys that bemoans the weakness of the current legal regime in failing to provide binding triggers for action. Yaffee agrees that legal mandates are an important part of the incentive structure that motivates

EBM collaborations. But, even in the absence of significant legal reform, EBM's role in shifting attention from single-species or resource-output goals to larger-scale, more complex, ecological objectives in management offers lessons for migration conservation.

III. CONCLUSION

There is no single solution to protecting migratory animals, but a portfolio approach that reflects independent, decentralized, and incremental conservation efforts can make substantial progress. Safeguarding the future of impressive spectacles of large-scale migrations in the face of impending climate change demands innovative actions. As ecosystem managers attempt to promote resilience, the health of migrations may serve as an indicator of progress. Alas, no informed observer foresees in the next several years comprehensive legislation or regulation to promote continental-scale resilience to climate change or conservation of animal migrations across taxa. Therefore, both challenges will require close monitoring of a multitude of individual, site- and taxon-specific projects. If we can make polycentric solutions work for migration conservation, we will be sharpening the policy tools for adaptation to climate change. Without a silver bullet, we must employ a shotgun approach.

Promoting animal migration conservation requires greater public awareness of the problem and the methods available to reverse the decline. One important priority is more comprehensive cataloging of migrations in decline or under threat, and better mapping of migratory animal routes and key habitats throughout the annual cycle. The spatial documentation of migratory connectivity, in particular, holds great promise to help *people* connect their actions and the wildlife they observe to new places and partners. Institutions (especially NGOs) that bridge jurisdictions involved in parts of a migrating species's lifecycle should play an increasingly important role. This is a good starting point for marrying biological resilience with institutional resilience—and migratory species can serve as a metric for success.

While comprehensive statutes are neither a sufficient response to the decline in animal migrations nor a realistic prospect, collaborations across geographic and administrative jurisdictions often require sticks as well as carrots. For example, in the United States, the Endangered Species Act has often prompted coordinated conservation in order for diverse stakeholders to avoid the draconian consequences of illegal takes or findings of species jeopardy. A similar legal trigger will be needed to prompt collaboration prior to species imperilment and must include international cooperation. So, in addition to better maps showing the migratory linkage between far-flung habitats, we need to label migrations that will receive high conservation priority. Nations, states, and NGOs maintain lists to focus attention on imperiled species. A similar list could highlight the "rare abundance" of certain migrations that deserve our attention for their density-mediated movements as well as for the ecological services they provide.

Legal approaches that demand information demonstrating the relationship between individual actions and consequent effects on wildlife seldom abate cumulative harms. Uniform, activity-based regulation or best-practices standards are more effective tools to mitigate injury to wildlife. Protecting habitat without attending to trophic relationships will fall short of migration conservation. Red Knots in Delaware Bay need resting beaches, but they also require limits on horseshoe crab fishing in order to feed. Similarly, reef protection without the ecological functions of migrating animals will fail to maintain the ecological integrity that is the ultimate goal of most refuges.

The variation and plasticity of migrations require special attention in developing a conservation strategy robust to climate change. Research and management will need to target habitat for protection based on predicted future conditions as well as current needs. Also, minimizing anthropogenic stressors will generally maximize a migration's resilience to climate change. Reducing anthropogenic changes to food and water availability and obstacles to travel is an important aim for both legal control and voluntary collaborations. Finally, as more species become conservation-reliant,[15] research and management will need to experiment with the best methods to assist migrants whose routes or timing may no longer optimize breeding success.

The social dimension of the migration conservation problem requires decentralized efforts with many variations tailored to local cultures. Strengthening social connectivity through better migration maps may help. But, in some circumstances, disparate communities may have to pursue management in their own ways, at their own pace, as the pronghorn case study illustrates. While there is no substitute for money and mandates coming from central authorities to leverage collaboration, strictly top-down approaches to complex, or "wicked," environmental problems generally flounder in practice.[16] The scale of the animal migration conservation problem requires a diverse array of support from individuals, businesses, communities, and NGOs. Any successful animal migration policy will provide information, incentives, and support to these groups.

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[15] J. Michael Scott et al., *Conservation-Reliant Species and the Future of Conservation*, 3 CONSERVATION LETTERS 91, 92 (2010).

[16] *See generally* J.B. Ruhl & James Salzman, *Climate Change, Dead Zones, and Massive Problems in the Administrative State: A Guide for Whittling Away*, 98 CALIF. L. REV. 59, 63–65 (2010) (surveying the problems that arise when using top-down approaches to resolve complex environmental problems).