Conservation Biology

Conservation Practice and Policy

Optimism and Challenge for Science-Based Conservation of Migratory Species in and out of U.S. National Parks

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Abstract: *Public agencies sometimes seek outside guidance when capacity to achieve their mission is limited. Through a cooperative agreement and collaborations with the U.S. National Park Service (NPS), we developed recommendations for a conservation program for migratory species. Although NPS manages ~36 million hectares of land and water in 401 units, there is no centralized program to conserve wild animals reliant on NPS units that also migrate hundreds to thousands of kilometers beyond parks. Migrations are imperiled by habitat destruction, unsustainable harvest, climate change, and other impediments. A successful program to counter these challenges requires public support, national and international outreach, and flourishing migrant populations. We recommended two initial steps. First, in the short term, launch or build on a suite of projects for high-profile migratory species that can serve as proof to demonstrate the centrality of NPS units to conservation at different scales. Second, over the longer term, build new capacity to conserve migratory species. Capacity building will entail increasing the limited knowledge among park staff about how and where species or populations migrate, conditions that enable migration, and identifying species' needs and resolving them both within and beyond parks. Building capacity will also require ensuring that park superintendents and staff at all levels support conservation beyond statutory borders. Until additional diverse stakeholders and a broader American public realize what can be lost and do more to protect it and engage more with*

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Paper submitted May 29, 2012; revised manuscript accepted October 5, 2013.

DOI: 10.1111/cobi.12235

land management agencies to implement actions that facilitate conservation, long distance migrations are increasingly likely to become phenomena of the past.

Keywords: conservation, migration, national parks, planning capacity

Optimismo y Retos para la Conservación Científicamente Basada de Especies Migratorias Dentro y Fuera de Parques Nacionales de E.U.A.

Resumen: *Las agencias públicas a veces buscan ayuda externa cuando la capacidad de cumplir su misión es limitada. A través de un acuerdo cooperativo y colaboraciones con el Servicio de Parques Nacionales de E.U.A. (SPN), desarrollamos recomendaciones para un programa de conservación para especies migratorias. Aunque el SPN maneja ~36 millones de hectáreas de suelo y agua en 401 unidades, no hay un programa centralizado para conservar a la fauna silvestre que depende de unidades del SPN y que también migran a cientos y miles de kilómetros de distancia más allá de los parques. Las migraciones están en peligro por la destrucción del hábitat, la cosecha no sustentable, el cambio climático y otros impedimentos. Un programa exitoso para contrarrestar estos retos requiere de apoyo público, alcance nacional e internacional y poblaciones migrantes florecientes. Recomendamos dos pasos iniciales. Primero, a corto plazo, lanzar o crear una serie de proyectos para especies migratorias de alto perfil que pueden servir como prueba para demostrar la centralidad de las unidades del SPN para la conservación en diferentes escalas. Segundo, a largo plazo, crear una capacidad nueva para conservar a las especies migratorias. La capacidad de creación involucrará incrementar el conocimiento limitado entre los empleados de los parques sobre cómo y dónde las especies o las poblaciones migran, las condiciones que permiten la migración y la identificación de las necesidades de las especies y la resolución de esto tanto dentro como fuera de los parques. La capacidad de creación también requerirá asegurar que los superintendentes y empleados del parque en todos los niveles apoyen la conservación más allá de los límites legales. Hasta que varias partes interesadas y la mayoría del público americano no se den cuenta de lo que se puede perder y hacer más para protegerlo y se involucren más con agencias del manejo de suelo para implementar acciones que faciliten la conservación, las migraciones a larga distancia probablemente se vuelvan un fenómeno del pasado.*

Palabras Clave: capacidad de planeación, conservación, migración, parques nacionales

Introduction

When public agencies lack sufficient scientific expertise to solve problems, they sometimes seek advice from outside parties who can contribute expertise and new or innovative approaches to complex issues. Examples include U.S. state agencies asking NGOs to help map rare species, U.S. agencies asking the National Academy of Sciences to conduct scientific and economic analyses of predator control (Orians et al. 1997), and appeals for assistance from all levels of government to universities. However, when requests concern conservation, actions beyond ecological science often are necessary.

In 2008, the U.S. National Park Service (NPS) sought help while developing an action plan to conserve aerial, marine, and terrestrial populations of migrating wildlife. They requested a collaboration "to provide the NPS with a long term approach to dealing with many of the issues facing migratory species ... and an approach to assessing the number of species and critical habitat and linkages for species that spend short and long periods of time within the boundaries of our parks." We agreed to this request in part because more than 100 years ago parks were admonished for establishing boundaries that failed to provide sufficient space for the needs of migrating animals (Hague 1893) and, more recently, for not doing more to accommodate members of species that move beyond NPS statutory boundaries (Berger 2003).

Although migration is an ecological process central to maintaining biological diversity, addressing NPS's request required us to consider attitudes and behaviors of individuals, society, and agencies. Our purpose in sharing our experience is to illustrate opportunities and limitations of conservation approaches. The questions, challenges, and potential solutions we present are relevant to many agencies other than NPS in which natural resource managers must grapple with extensive movements and migration of wild animals (henceforth, wildlife).

National Parks and an Operational Definition of Migration

The NPS has over 400 units including internationally known parks such as Grand Canyon (Arizona) and Yellowstone (Wyoming, Montana, and Idaho). Collectively, NPS manages about ~36 million hectares of public lands and water for natural values. The NPS mission is "to conserve the scenery and the natural and historic objects and the wildlife therein and to ... leave them unimpaired for the enjoyment of future generations" (NPS Organic

Act 1916). Leaving the parks unimpaired is difficult because park boundaries do not move but animals do. Such dissonance leads to possible conflicts beyond protected area boundaries that involve wild species and human safety or economies.

Defining migration as the seasonal movement of the same individuals between two areas is generally accurate for species such as humpback whale (*Megaptera novaeangliae*), Arctic Tern (*Sterna paradisaea*), and Yellow Warbler (*Setophaga petechia*), and this definition is well understood by the public (Wilcove 2008). Biological complexity, however, dictates a different definition for some species (Dingle & Drake 2007). Monarch butterflies (*Danaus plexippus*) complete their northward migration across several generations (Brower 1995). Most anadromous Pacific salmon (Oncorhynchus *spp*.) migrate across freshwater, estuarine, and oceanic habitats (e.g., Gende et al. 2002). The females of numerous bat species migrate over long distances, whereas males remain behind (Medellin et al. 2009). Such diversity leads to an operational definition of migration: the cyclic movement of individuals or populations of animals across different ecosystems between seasonal ranges.

Table 1. Central challenges to conserve migration in and beyond U.S. National Park Service units illustrated by different levels of sample questions that need to be answered.

Challenges	*Sample questions*
Philosophical	What should be conserved: migration phenomena or abundance; all, or some, migrations; existing migrations or active restoration of those lost; distinct migrations or the most common ones?
Migratory baselines	Which data are critical to conservation (e.g., historic routes)? Which NPS units are central to conserving migrations? What are the ecological risks (e.g., disease, parasites)?
Ecological knowledge	What questions are relevant (e.g., why do animals migrate and how variable are migrations)? Given climate uncertainty, how should conservation move forth?
Social knowledge	How will partners be involved? Who are the stakeholders? What are attitudes within and beyond NPS units? What roles do partners play?

Need for a Migratory Species Initiative

The phenomenon of wildlife migration to and from U.S. national parks has not been central to management policies despite current recognition that migrations are disappearing (Berger 2004; Harris et al. 2009). Interest in migratory species has however existed for some 125 years. In 1883, an American Ornithologists' Union committee investigated migratory patterns of birds, largely because many of them were perceived to be in decline. In 1979, the Convention on Migratory Species, under the auspices of the United Nations Environmental Program, recognized the importance of migrations across air, land, and water and facilitated initiatives aimed at protection. The Neotropical Migratory Bird Conservation Act of 2000, administered by the U.S. Department of the Interior, now provides grants to domestic and international partners for the conservation of Neotropical migrants that breed in Canada and the United States and winter in Latin America. Scientists working in NPS units have come to realize most parks are not sufficiently large to maintain viable migratory populations of many species (Newmark 1995; National Park System Advisory Board [NPSAB] 2012). Nevertheless, progress to enhance protection for migrants beyond NPS units has been limited.

Science informs park policies and operations, and managers use scientific information to reach decisions. Public perception, however, is also a strong modulator of wildlife policies (NPSAB 2012). Wildlife watching is a major public activity, and it offers some of the best opportunities to connect the public with nature. Migratory species, including at least 300 species of Neotropical migrant birds, comprise a large proportion of the wildlife that visitors to national parks see. In coastal parks such as Everglades (Florida) and Point Reyes (California), seasonal migrations are a primary draw for visitors. In NPS units, including the Channel Islands (California), Point Reyes, and Glacier Bay (Alaska), annual whale migrations are key attractions. Each year, several million visitors to Yellowstone National Park observe North American bison (*Bison bison*), pronghorn (*Antilocapra americana*), and elk (*Cervus elaphus*)—ungulates that historically migrated to lower elevations outside the park during winter. The public invests time and money in viewing species in residence or during migration events, yet perhaps they do not appreciate the large area over which conservation action is necessary to ensure that such opportunities for watching animals in parks persist.

Challenges

The challenges of conserving migratory species that use national parks—and the reasons they are typically not emphasized in management plans—are complex and involve philosophical, ecological, and social questions (Table 1). In the absence of answers to such questions, most of which will require much work, conservation gains will be limited.

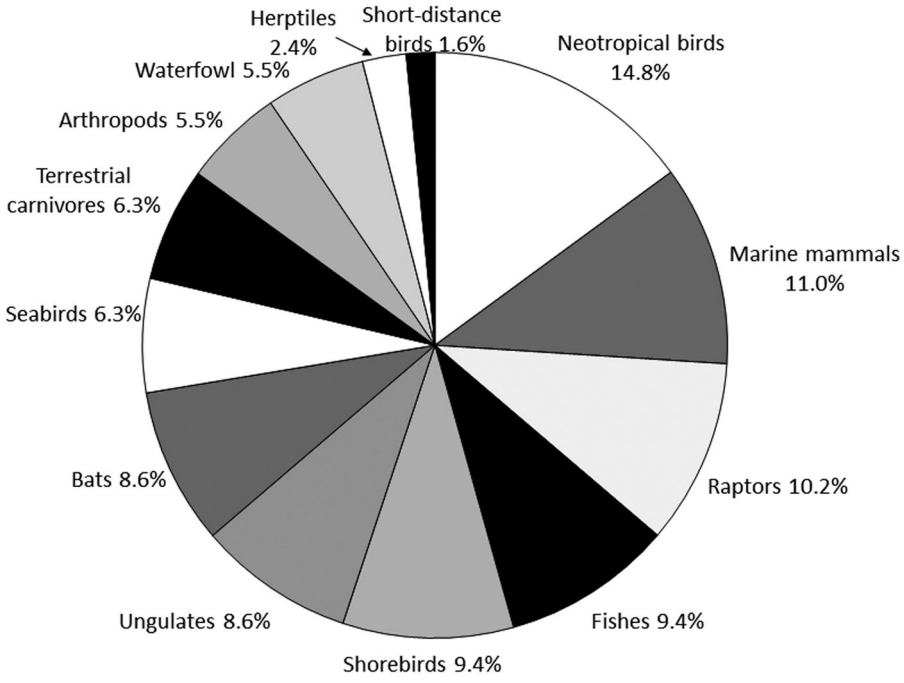

*Figure 1. Taxonomic classes of migratory species dependent on one or more U.S. national park units. Classes based on responses by National Park Service (NPS) personnel (*n = *125) to the following request: "Please list the common names of species or groups of species (Neotropical birds, etc.) whose migration is completely dependent on the NPS unit you represent, e.g., migration could not occur without this site."*

Bison are a striking example of the challenge of conserving even well-known species that move beyond a protected-area boundary. The last free-roaming populations of bison in the United States were centered in the Montana–Yellowstone region when, in 1872, Yellowstone was designated the nation's first national park. Twenty years later, when most land was still not privately owned or populated, it was already clear that even parks the size of Yellowstone (8983 km^2) were insufficient to accommodate migrations, and naturalists argued for an adjustment of park boundaries (Hague 1893; Hornaday 1913; Supporting Information). Today, bison are largely restricted by humans to the park and, due to concerns about brucellosis (a bacterial disease that affects reproduction in wildlife and livestock), economic damage to private lands, and human safety, herded back or shot if they venture beyond park borders (Plumb et al. 2009). Parks such as Badlands and Wind Cave (both in South Dakota) have built fences around areas with bison to prevent their roaming. Conservation of migrations of these and many other taxa either in or beyond national parks has never been addressed systematically.

Some aspects of the ecology of migratory species remain poorly understood. For instance, there is a deficit in knowledge of interactions among migratory species and diseases such as avian influenza, whirling disease, and sylvatic plague, which affect birds, fishes, and mammals, respectively. Diseases carried by migrants affect species that occur in parks and humans (Karesh & Cook 2005). Corridors that may facilitate migration among park units may also increase disease risks to animals or humans in parks (Hess 1996).

Building an NPS Migratory Species Initiative

Given our goal of suggesting how NPS might construct a conservation program, the Wildlife Conservation Society (WCS), led by K.E., surveyed NPS personnel to examine their knowledge of migrations and threats to them. Understanding the state of knowledge, even informally, could aid in planning a set of actions. If, for instance, much was known about migrants per se and associated threats, priority-setting exercises to address a range of mitigation measures might commence. We recruited participants in the voluntary survey through NPS administrative memoranda and internal NPS Web pages. We received responses from 125 personnel based at 154 parks, including parks within all 32 ecoregions that are part of a long-term NPS monitoring program (Vital Signs) (Fancy et al. 2009). Eighty-one percent of respondents identified themselves as biologists and 19% identified themselves as administrators. Percentages below may sum to >100% because some response categories were not mutually exclusive.

Respondents listed diverse migrant species that use the NPS units where they were based (Fig. 1) and identified migratory routes that extend beyond the boundaries of those units. Respondents also indicated that habitat loss (49%) and climate change (25%) outside of NPS boundaries may threaten viability of migratory species that use the NPS units where they were based (Fig. 2). Roads (59% of respondents) and recreation (52%) were perceived as the greatest threats to migratory species within the parks where the respondents were based. There was a nearly 4-fold difference in the perceived threat of climate change

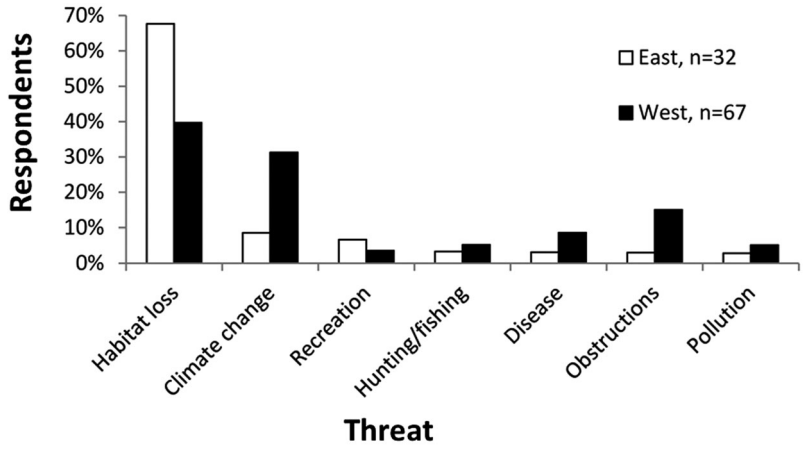

Figure 2. Percentage of respondents identifying 1 of 7 threats as the greatest threat to migratory species. Ninety-nine NPS employees in the eastern (east of 101°W) and western (west of 101°W) United States were asked to "Rank the most important threats to migratory wildlife that use your NPS unit (from 1 to 7, with 1 being the most important)." Threats are listed on the x-axis from the greatest (habitat loss) to least threat (pollution).

to migratory wildlife among responders from NPS units in the western United States (i.e., west of 101°) (31%) versus those from the eastern United States (8%). A greater percentage of respondents from the eastern (68%) than from the western (40%) United States indicated that habitat loss was the greatest threat to migratory wildlife in their units (Fig. 2). Nearly 80% of survey respondents were aware of current research aimed at identifying specific migratory pathways. In response to the question, "Are there any efforts currently underway to protect migration corridors/pathways inside or outside the NPS unit you represent?" a much smaller percentage (24%) listed examples.

When asked to share information they thought was pertinent to conservation of migratory species by the NPS, 67% of respondents noted a lack of coordinated measures to conserve migratory species within and outside park boundaries. Examples of such statements included, "We cannot protect most migratory species with our actions within our individual units. The protection must be across boundaries, region-wide, and we must expect that some migration patterns will change with climate and habitat change," and "Not enough is being done now to coordinate with neighboring state and county agencies to protect migration corridors for terrestrial (plant and animal) species, now and in the face of climate change." Other respondents pointed to the diversity of threats to migratory wildlife, from dams and fish harvest outside NPS units to absence of protection of stopover sites for birds.

Beyond NPS units, no clear infrastructure exists to facilitate migration, although the 1916 National Park Service Organic Act arguably established the necessary policy and legal mandate for doing so (Keiter 2010). Internally, recognition to cooperate beyond boundaries for the protection of migratory species is formally recognized (Management Policies 2006), and this recognition provides for NPS cooperation, including the spending of appropriated funds, outside park boundaries (Consolidated Natural Resources Act [CNRA] 2008). Moreover, clear precedence exists for NPS participation in public and private partnerships (e.g., Rivers, Trails, and Conservation Assistance Program; Wild and Scenic Rivers; Trails and Rails; National Natural Landmarks Program; and Heritage Partner Programs). In recent years, migration has been addressed through collaboration between NPS and partners. For example, in 2008 the first U.S. wildlife migration corridor was established by the U.S. Forest Service in cooperation with Grand Teton National Park in Wyoming, U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), and private landowners (Berger 2004; Berger et al. 2006). In September 2011, a partnership among Olympic National Park (Washington), Bureau of Reclamation, Lower Elwha Klallam Tribe, local and state governments, and public interest groups directed the largest dam removal in U.S. history (the 33-m Elwha dam) to restore migratory salmon populations (http://www.nps.gov/olym/naturescience/elwha-ecosystem-restoration.htm). In February 2012, agreements were reached among numerous agencies and private landowners to amend the Interagency Bison Management Plan and allow bison to migrate north from Yellowstone National Park and access 30,000 additional hectares of winter habitat (http://fwp.mt.gov/news/publicNotices/decisio Notices/pn_0555.html).

Short-Term Demonstration Projects and Feasibility of Protecting Migrations

To build on these recent partnerships and develop a migratory species initiative, we identified an opportunity for NPS and partner organizations to implement a small number of projects to improve management of migratory species or fill information gaps. Besides yielding rapid results, these pilot projects may provide transferable lessons for a more comprehensive effort and build credibility for a migratory species initiative within and outside the NPS. We proffer two examples of partnerships and a case in which a migration was protected.

The NPS and USFWS cooperated to conserve Kittlitz's Murrelet (*Brachyramphus brevirostris*), a small, rare seabird that occurs only in parts of Alaska and Russia (Day et al. 1999). About 10–30% of the world's population occurs within and adjacent to Glacier Bay, Kenai Fjords, and Wrangell-St. Elias National Parks during summer (USFWS 2005). Nearly nothing is known about the species during its 8-month (September–April) nonbreeding season (Day et al. 1999). The murrelet's movements typify high-latitude migrants that breed in Alaska's coastal parks during the summer: they arrive in early May, are most abundant in July (Kissling et al. 2011), and depart by late autumn. Anecdotal information suggests individuals migrate along the Alaska Peninsula during autumn and overwinter along the ice margins in the Bering Sea, but specific habitat, staging areas, and migratory timing and routes are virtually unknown.

Understanding migrations and winter habitat is relevant to conservation of Kittlitz's Murrelet because core populations of the species, including populations within or adjacent to U.S. national parks (van Pelt & Piatt 2003; USFWS 2005; Kissling et al. 2007), have declined. The USFWS is considering whether to propose listing the species under the Endangered Species Act. The collaboration between NPS and USFWS aims to identify factors limiting population growth by quantifying overwinter survival with the first mark-recapture effort for this species. The USFWS has deployed several satellite tags on murrelets in and near national parks that will help document migratory routes and, potentially, overwintering areas. Such information is fundamental to address threats, including those to migration routes with end points in the Bering and Chukchi Seas, where resource extraction and shipping activity are increasing.

The second pilot project was initiated in 2011 at our recommendation. The WCS, NPS, and private landowners are collaborating to deploy geolocators (small, lightweight receptors attached to an animal that logs its movements until data are downloaded after an animal is recaptured) on grassland birds. Receptors are fitted to birds in their breeding grounds and record the birds' locations, which include those along their migration routes. As a group, grassland birds have exhibited the most precipitous decline among North American birds (NABCI 2009). Declining species include Sprague's Pipit (*Anthus spragueii*), Chestnut-collared Longspur (*Calcarius ornatus*), and McCown's Longspur (*Rhynchophanes mccownii*), each of which breeds in the northern Great Plains and migrates south to wintering grounds across northern Mexico and the southwestern United States (NABCI 2009). Understanding migratory movements will help the NPS clarify the extent to which the species use their units within the Great Plains and help identify where conservation intervention is most needed. As in the murrelet example, NPS and partners have facilitated assessment of habitats beyond their boundaries as a first step for developing conservation plans.

Path of the Pronghorn, an NPS collaboration, has already resulted in unprecedented protection of a migratory species (Cohn 2010; Hannibal 2011). Pronghorn are the longest-distance terrestrial mammal migrant in the conterminous United States, and parks are too small to encompass their seasonal movements (Berger 2004). From their summer habitat in Grand Teton National Park, 300 to 400 pronghorn migrate through an invariant 2 km wide, 70 km long path to winter grounds far south of the park; one-way movements reach up to 350 km (Berger et al. 2006). Efforts to formally protect the migration corridor beyond Grand Teton culminated in a 2008 amendment to the Bridger-Teton National Forest Plan. That amendment was driven by multiple meetings among agency staff and stakeholders, and nearly 20,000 responses were received during the public comment period before its adoption. Media coverage at local, national, and international levels, coupled with public support, open commentary, and most critically local officials' attention beyond their statutory jurisdiction, resulted in the pathway's protection (Hannibal 2011).

Components of a Long-Term NPS Migratory Species Initiative

We suggested to NPS that a long-term migratory species initiative by NPS could include four components: data compilation (including research), capacity building, outreach and education, and habitat conservation and restoration. We recommended four data-compilation actions. First, identify all species that are seasonal residents in or that pass through NPS administrative units. The compilation could be hosted and maintained by the existing NPS Inventory and Monitoring Program. Second, identify habitats of migrants. Collect information on ecosystems in NPS units that provide resources for migratory species, distributions of those species, and the extent to which such ecosystems can sustain migrants without extensive management outside parks. Third, establish a basis to identify threats to migratory species inside and outside park ecosystems. Although NPS recognized formally its intention to conserve migrants across boundaries (Management Policies 2006), a stronger focus on such an effort would enable a basis for NPS to identify threats that affect migrants, from habitat loss and fragmentation to climate change (Jenni & Kery 2003; Both et al. 2006). Fourth, set priorities. Using information on migrants, threats, and habitats, prioritize migratory species and decide on next steps for engagement. Such an exercise would force decisions (Table 1) about allocation of conservation interventions among taxonomic groups and species, ecological scales and processes, and NPS units.

Building internal and external capacity is requisite for any new initiative in any organization. Although our survey demonstrated much was unknown about migrations

within parks and threats to migrations, we did not address whether park biologists and managers understand why migration affects viability. Regardless, it will be critical to maintain or develop capacity at higher administrative levels because without local, regional, and national support for a migration program within NPS, little will be achieved. It is also critical to identify external stakeholders after a suite of priority migratory species or interventions are determined. Stakeholders might include state wildlife agencies, federal agencies (e.g., BLM, U.S. Forest Service, USFWS, and Department of Defense), indigenous landholders, international partner agencies (e.g., Trilateral Committee of Wildlife and Ecosystem Conservation and Management), private landowners, and nongovernmental partners.

High-priority outreach and education actions include convening workshops to identify and develop projects with collaborators, synthesis of results and insights across the NPS and its partners, and development of educational materials. The NPS has ready and able partners in another agency within Department of the Interior, the USFWS, for which migratory species already are a priority (http://www.fws.gov/info/pocketguide/fundamentals.html) and in state wildlife agencies, many of which are transitioning from an emphasis on hunting and fishing to conservation of diverse species as identified in state wildlife action plans (www.wildlifeactionplan.org). Many of these state plans identify migratory species among species of greatest conservation need and outline strategies and actions to conserve habitats for migratory species. Finally, with an annual average of ~281 million visitors to NPS units (2008–2012) (NPS 2013), an enormous opportunity exists not only to educate the public on migrations, but also to foster development of a sense of stewardship for migratory species.

The single most important component of an NPS migratory species initiative is conservation of habitats for migratory species. We identified three actions that could be taken. First, encourage functional (not statutory) expansion of park boundaries through voluntary cooperation and develop management agreements with adjacent landowners. The fragmented system of national parks is not sufficient to maintain migratory species or processes. Establishing cooperative management action, placing lands or waters under conservation easement or lease, and working with land trusts to establish new conservation areas through fee acquisition or easement are effective and probably more feasible than expanding parks' administrative boundaries for conserving habitats of migratory species near parks.

Second, link conservation efforts for migrants with other conservation objectives. Efficiently selecting sites for conservation requires that multiple goals be pursued. For example, conservation of migration corridors might also provide habitat for rare species and contribute to their conservation (Moilanen et al. 2009). Increasing connectivity among conservation areas—one approach to address effects of climate change—may also benefit migratory species because in the absence of connected landscapes populations are more susceptible to local extirpation (Hilty et al. 2006).

Third, improve ecological management of existing park lands and waters. Sometimes migration can be maintained simply by changing management practices to assure connectivity of lands or stopover sites. For example, impediments to migration of some species can be reduced by removing dams or by temporarily closing, eliminating, or building wildlife crossings under or over migration barriers such as roads.

Finding Support for Conserving Migratory Species

Literally and symbolically, NPS lands have been among those at a historic core of wildlife protection in the United States. Yellowstone, the world's first national park, is touted internationally as an exemplar for building cooperation across landscapes to conserve some migrants (Hannibal 2011). Approaches of possible partners beyond the boundaries of formal parks also offer cause for optimism. In 2007 the Western Governors' Association unanimously passed Resolution 07–01, which asserted, "... protecting wildlife migration corridors and crucial wildlife habitat in the West ..." will be a driving goal, a strategy created in part because of effective outreach that touted migrations at state gubernatorial levels (Hannibal 2011). More recently, the USFWS has facilitated landscape conservation cooperatives (i.e., collaborations among nongovernmental organizations, universities, states, federal governments, and Native American tribal groups) that further private–federal partnerships with a tacit goal of protecting migrations (Austen 2011). Local initiatives from around the world (such as Path of the Pronghorn) also serve as models of success, and with acceptance from the local populace these may be more effective than top-down approaches to assure long-term conservation of migrants (Schaller 2012).

The action plan we presented in response to NPS's request to formulate a strategy to better conserve migrations built initially on natural science while recognizing success will not be achieved unless internal capacity is strong at high levels of NPS. All new plans require funding and, often, subtle if not dramatic changes in operations. Because funding always seems limited, real progress can stem from only a few sources. The public is the critical source because the public's voice is central in shaping policy. The NPS units attract as many visitors annually as do professional American baseball, basketball, and football games combined. If the public becomes a strong advocate for decisive action to conserve migratory wildlife,

then our recommended program may have a greater probability of being developed and implemented.

It is worthwhile to ask what has changed within NPS with respect to conservation of migratory species during the period since the request for our assistance. As outlined above, the NPS has not only participated in projects such as Partners in Flight, but also adopted pilot projects beyond their statutory boundaries on migratory marine and grassland birds to explore possibilities on how to better protect migrants. Additionally, NPS hosted workshops on migration to which NPS superintendents were invited and that some attended, and NPS built a Web site with facts about migration. Most notable perhaps was a 2-year planning effort of an independent committee of non-NPS scientists that suggested how NPS might address future science in parks. Among the committee's recommendations was that NPS work with stakeholders to enhance connectivity and to facilitate migrations beyond park boundaries (NPSAB 2012).

Conservation in the United States has changed from protection of scenic landscapes and monumental features within static parks (Runte 2010) to maintaining species and ecosystem resilience within dynamic landscapes. Change in institutions is slower than changes in understanding within the scientific community, but we believe the NPS has the potential to work productively with stakeholders to develop coordinated cross-boundary initiatives to conserve migratory species.

Acknowledgments

Our efforts were supported by initial funding from the U.S. National Park Service and facilitated by efforts at the University of Montana and the Wildlife Conservation Society. We also thank F. Camenzind, K. Leong, and H. Harlow for use of the University of Wyoming USNPS AMK Ranch facility during the workshop that resulted in this paper. The comments of four anonymous reviewers, J. Dennis, and E. Fleishman helped enormously, and we are grateful to them.

Supporting Information

A preliminary survey of migration knowledge among National Park Service Units is available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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