

# **Migrants across Air, Land, and Water:**

## **Framing Science to Achieve Conservation for National Park Lands**



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**Attn: Elaine Leslie, National Park Service**

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## Executive Summary

Migratory animals provide a challenging problem for conservation, as the scale of their seasonal movements transcends any capacity of a protected area network to manage and protect them. The National Park Service (NPS) is taking on this urgent and important challenge by developing an NPS Migration Program. Key to this initiative is the ability of NPS to engage beyond their holdings both nationally and internationally, and to collaborate and take leadership on the conservation of key migratory wildlife that spend part of their year in NPS units.

In developing this program, NPS must build up a new capacity to engage migratory wildlife, develop effective outreach to engage the American public, and research key attributes of migratory species life histories in order to implement effective management and engage in the conservation of such species across their migratory pathways. A September 2009 science committee workshop with experts on migratory animal ecology and conservation was held in Grand Teton National Park to develop a scientific framework for preserving migration and migratory species managed by the NPS. The workshop assisted in establishing a scientific basis for the new NPS Migration Program, prioritized key migratory topics for conservation, and identified the role for restoration of migration in certain species.

The workshop was informed by a 2009 survey of NPS park and regional staff, which reflected a fragmentary knowledge about migrants and their conservation. A clear need for action and outreach within and beyond NPS staff is critical to the success of this nascent program. A detailed roster of “proof-of-concept” wildlife migration projects was proffered to help jump-start this novel and ambitious program. Next proposed steps include building park and regional capacity and coordination, several workshops to further engage federal and other stakeholders, nationally and internationally, to identify ways to collaboratively manage key wildlife species across their migratory range, and a workshop to identify how best to outreach to the American public the importance and excitement of this precedent-setting program of NPS. In addition, this program will also implement the June 2009 Joint Inter Departmental Memorandum of Understanding Regarding coordination among federal agencies and states in identification and uniform mapping of wildlife corridors and crucial habitat and address critical components of the 2<sup>nd</sup> Century Report

By implementing programmatic activities with some of the proposed “proof-of-concept” migratory species in the near-future, NPS will lead and *learn* by doing. In doing so, NPS will be in a better position to fully engage the American and international public and stakeholders in seeking meaningful conservation actions for an emergent roster of NPS Priority Migratory Species.

# What is Migration? A Working Definition

Migration is seemingly easy to define—the seasonal movements of individuals from area *X* to *Y*, and then the return from *Y* to *X*. While this depiction is easily the most recognized and the one best understood by the public, it is not adequate to represent all migratory phenomena. Grey Whales, Bar-tailed Godwits, and Yellow Warblers are familiar examples whose migratory movements well conform to the above depiction. More complex however are the migrations of Monarch Butterflies, anadromous fishes, or some marine mammals. Monarch Butterflies complete their migration across several generations. Anadromous fish hatch in fresh water, spend one to several years in the ocean growing, and return to their natal freshwater streams to breed (and in the case of most Pacific Salmon, to die). Elephant Seals effectively migrate from terrestrial haul-out sites twice a year to engage in long feeding bouts in distant regions of the ocean; the two migrations account for giving birth and later for molting. Such complexity and diversity of migrations among animals means perhaps that no one succinct definition accounts for the phenomena of migration. Nonetheless, our working definition is as follows:

*“Migration is the seasonal movement of animals (individuals, populations) across different land- or seascapes that may differ by sex, age, or environmental conditions; yet the core pattern of movement returns to a central area, either by individuals or across generations”*

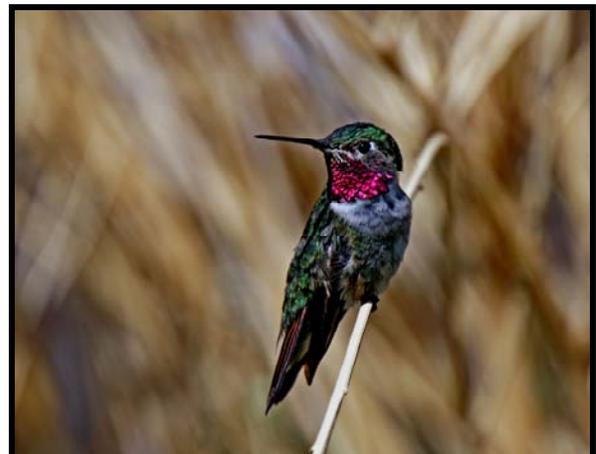
## I. Introduction

This summary document is aimed at developing first steps in a comprehensive strategy to bolster the ability of the U.S. National Park Service and other stakeholders to conserve America’s migratory wildlife. In particular, we emphasize results of a 2009 workshop and outline and justify a plan to initiate 1) pilot projects, and 2) next steps to identify how best to address issues that impede national and international wildlife migrations within, beyond, and across National Park Service lands.

Much has been written about the science and biological importance of migration, especially in sustaining viable populations and ecological processes. With more than 300 million Americans however, and massive challenges to protecting habitats, monitoring what we have and what has been lost, and understanding effects of fragmentation, roads, fences, and dams, easy solutions will never be forthcoming. Nevertheless, the public, both nationally and internationally, have recognized the importance of such movements, connectivity, and migration as evident by policy actions on behalf of migratory birds and other species.

### *The Spectacle of Migration*

From Monarch Butterflies to Caribou, to Arctic Terns, and to Humpback Whales, animal



Broad-tailed Hummingbird (*Selasphorus platycercus*) migrates from Mexico to breed in the Rocky Mountain States. Conserving species like this is at the core of the new NPS Migration Program.

migrations are among the most spectacular and inspiring feats of nature. The annual synchronized movements of millions of migrating individuals, young and old, traversing hostile environments in a journey that has repeated itself for thousands of generations, captivates the public imagination like few wildlife phenomena. Animal migration is a survival strategy for tracking seasonal food resources, escaping dry seasons, avoiding harsh winters, or evading heavy predation during vulnerable reproductive periods. Characterized by sheer numbers and predictable timing, migration as a spectacle is a tribute to wild nature.

Because migrations concentrate high animal numbers—both temporally and spatially—migratory species often have strong ecological influences, affecting system dynamics and shaping the animal and plant communities with which they have co-evolved. Migratory species play many important ecological roles. They serve as seasonally abundant predators (many raptor species), grazers (Wildebeest, Bison, Pronghorn, Caribou), prey (salmon, waterfowl, many ungulate species), pollinators (Monarch Butterflies, Lesser Long-Nosed Bats, Mexican Long-Tongued Bats), and seed dispersers (many bird, bat, and ungulate species). Migrating animals also link the dynamics of ecosystems across the globe. Habitat changes affecting migration routes or population numbers on a migratory species' wintering grounds may subsequently impact community dynamics on breeding grounds thousands of kilometers distant.

### ***The Conservation Challenge of Migration***

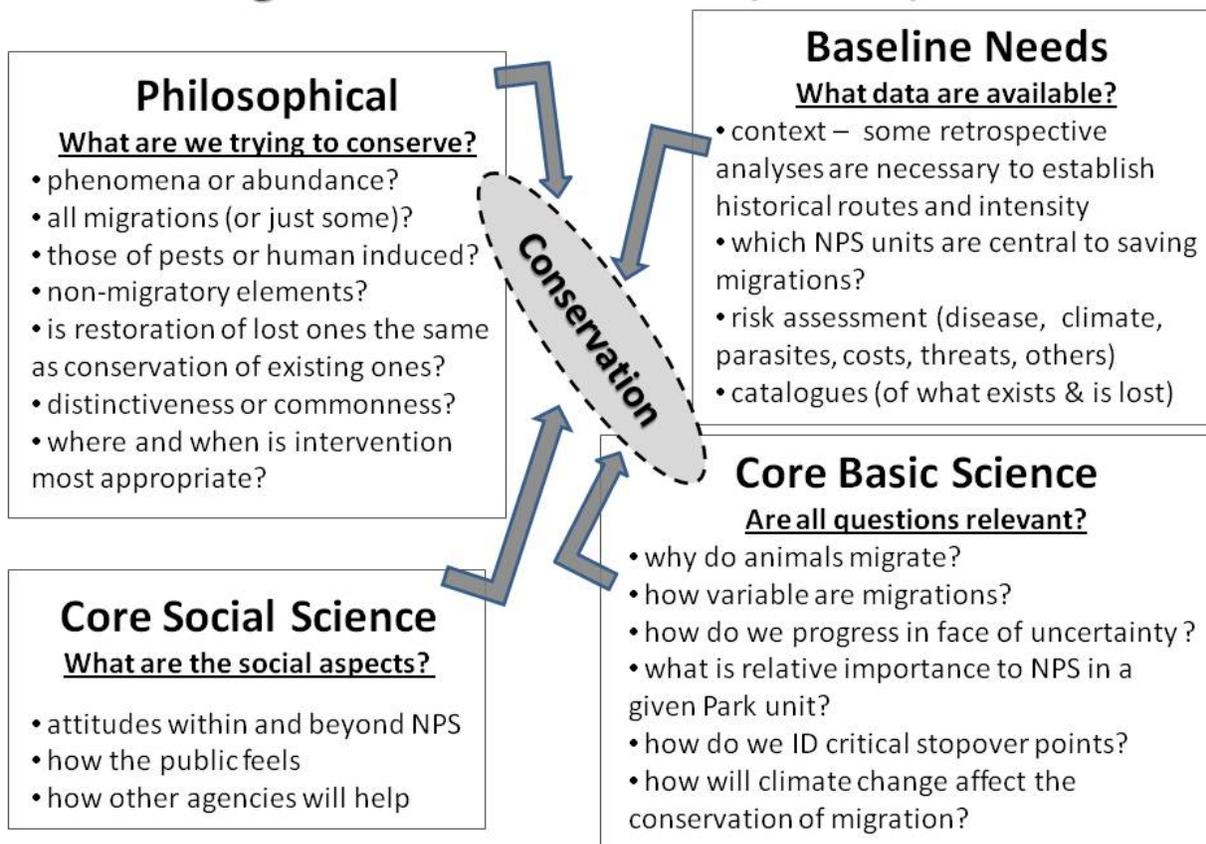
Worldwide, the historical role of migrations and migratory species in shaping ecosystem function and global biodiversity has greatly diminished or altogether disappeared. Many of the factors driving these losses are familiar—hunting and overharvesting, environmental contaminants, exotic invasives, habitat loss and fragmentation, and climate change. Compared to other species, however, migratory species may be more vulnerable to anthropogenic impacts because they use different habitats at different times of the year, and additionally require connecting travel routes. The loss or degradation of any of these habitats or migration routes can greatly reduce the persistence or ecological role of a migratory species. In eastern and southern Africa, for example, increased agricultural expansion and fencing over the past several decades have disrupted migration routes for many ungulates. These disruptions have been implicated in the sudden decline (by 70–95%) of Wildebeest and Hartebeest populations over the span of just 8–20 years. Several migratory bird species that winter in sub-Saharan Africa and breed in Britain have declined 40–70% in recent decades, including the Turtle Dove, Whinchat, Wood Warbler, Pied Flycatcher, and Nightingale. The causes of these declines are still unclear, but closely related resident species have maintained stable populations.

The factors that render migratory species so important for ecosystem function serve to complicate their conservation—disjunct habitat needs spanning jurisdictional boundaries, specific but often expansive migration routes, and long-distance movements that complicate research on the demographic consequences of human activities. Furthermore, if migrations and the ecological function of migratory species are phenomena of abundance, conservation efforts should focus on protecting the species while it is still plentiful. Conservation of migratory species must therefore be a highly coordinated, proactive effort with cooperation among governments, institutions, and individuals.

Myriad views exist concerning migration as an explicit conservation target. The issues are broad—they range from specific data needs to biological ignorance, and from the social sciences to the philosophy of conservation. While it is clear that to *save* a species’ migration, conservation efforts must target that species, at a broader level it is less certain if a programmatic focus should be aimed at species, processes, or sites. Furthermore, philosophical issues and framing are far from trivial (Figure 1).

If a species’ migration is lost but not the species itself, to what extent should efforts focus on conserving migration? Bison are exemplary in this instance. The species is not in trouble, but few places persist where Bison still migrate in excess of 50 kilometers. Other philosophical dilemmas concern whether conservation programs should be aimed at rare or at abundant migrations, at big or little species, and whether or not they should be centered on migrations understood first and foremost by the public. Indeed, given the lack of information on migrations, should ecological function be a central conservation tenet? A sampling of these fundamental concerns is outlined in Figure 1.

## To Save Migrations: Uncertainties, Needs, Directions



*Figure 1. Relationship of key questions about migration to conservation*

## ***A Public and a NPS Perspective***

The U.S. National Park Service, on behalf of the American people, was created almost a century ago to administer federal lands with a mission to “*conserve the scenery and the natural and historic objects and the wild life therein and to ... leave them unimpaired for the enjoyment of future generations*” (The National Park Service Organic Act, 1916). With this mandate, the National Park Service has done a spectacular job. NPS currently administers almost 400 Parks spanning 84 million acres in every state except Delaware, and in four U.S. territories (American Samoa, Guam, Puerto Rico, and the Virgin Islands). A 2001 NPS survey reported that one in every three adult Americans had visited an NPS unit within the past two years. Wildlife watching is a major activity for these Park visitors. For many Americans, U.S. National Parks provide their best opportunities to connect with nature and to observe wildlife in relatively undisturbed settings.

As our country continues to urbanize, we depend more and more on the NPS to safeguard our natural treasures for current and future generations. But it is increasingly clear that the NPS cannot achieve its mission through good ecological stewardship targeting only Park lands. This reality is particularly obvious for conservation of the many migratory species that inhabit or transit through U.S. National Parks seasonally. In its 2001 report “Rethinking the National Parks for the 21<sup>st</sup> Century”, the National Park System Advisory Board envisioned an expanded role for the National Park Service to play, as trustees of the nation’s natural resources:

*“Actions to preserve biodiversity cannot be limited to park areas, for parks are often parts of larger ecosystems that encompass them. To encourage ecological stewardship outside the parks, the Service should cooperate extensively with its neighbors—federal agencies, states, counties, cities, tribes, the private sector, even other countries. Parks cannot survive as islands of biodiversity. They need to be linked with other natural areas through wildlife migratory corridors and greenways.”*

Embracing the challenge of these bold words, the U.S. National Park Service is initiating an NPS Migration Program to ensure the persistence of migratory species and their spectacular journeys for the enjoyment of future generations of Park visitors. Migratory species make up a surprisingly large proportion of the wildlife species that visitors see in U.S. National Parks. Included in this category are at least 300 Neotropical migrating birds (K. Ellison, internal NPS report, 2009, unpubl). For some Parks, seasonal migrations are a primary draw for visitors. Everglades National Park, Point Reyes National Seashore, Big Bend National Park, and many coastal National Parks are favored observation points for fall and spring bird migrations. Channel Islands National Park, Point Reyes National Seashore, and Glacier Bay National Park are well-known whale-watching hotspots. Visitors gather at Padre Island and Canaveral National Seashores to observe nesting sea turtles, and at Carlsbad Caverns National Park to watch Mexican free-tailed bats on their nocturnal hunts. Millions of visitors flock to Yellowstone National Park each year to see Bison, Pronghorn, and Elk—species that migrate to lower elevations outside the Park every winter.

The vision of an NPS Migration Program, implemented at a Washington Support Office Programmatic level and carried out through parks and regions, is to serve as an active partner in national and international efforts to protect, restore, and manage shared migratory species and

their habitats. Toward this end, project cooperators identified several “essential steps” for initiating and improving the Park Service’s management of migratory species. Outlined below and in the previously submitted Scope of Work for this program, these essential steps served as a springboard for Workshop discussions on a long-term NPS strategy for preserving migrations and migratory species.

### ***NPS Vision, Priorities and a Migration Program***

Three recent documents are profoundly shaping the present and near-future directions and vision of the National Park Service: “Advancing the National Park Idea” (2009), National Parks Second Century Commission Report; “Advancing the National Park Idea: Committee Reports (2009), National Parks Second Century Commission; and “2009 Report” (January 2010), United States Department of Interior establish the context, a series of priorities, and the scientific, cultural, and management template for NPS into the future. Together, these documents frame how NPS is expected to build from its historical legacy and “extend the benefits of the national park idea in society” (Commission Report).

The scientific elements of the NPS Migration Program, developed in this document, are both informed and inspired by the recent documents of the National Parks Second Century Commission (NPSCC) and the Department of Interior. Though none of the reports specifically identify a migration program as such, the need for protection of migratory species and their corridors in need of conservation is evident in all. Specifically, by identifying the need to enhance the NPS history of international engagement and to “connect parks with the broader ecosystems on which they depend” (pg. 46, Commission Report), it is clear that a programmatic effort with migration is needed. The emphasis of international engagement by NPS in light of the “responsibility for protection of critical habitats for migratory species” (pg. 26, Ibid) makes clear that the long-held recognition that protected areas alone cannot conserve migratory species. In calling for a “National Conservation Strategy” (NPSCC Committee Reports, pg. 11), the report stresses that “strategic connections must be shared across federal agencies and by willing private landowners”. Finally, the Department of Interior Report notes (pg. 23) that the emerging threat of climate change will likely affect migration patterns of key wildlife species, and in so doing reminds us of the literal moving target challenge of engaging migration for conservation. We feel that in developing a NPS Migration Program, we are not only responding to priorities laid out in these reports, but that further this program could take leadership in many of the very aspirational directions laid out in the reports. Clearly the vision that infuses the NPSCC Report, that of creating collaborative models and corridors of conservation which would expand the park system so as to foster ecosystem connectivity through stewardship and citizen service, are laid forth in this document among the crucial next steps in building a scientifically credible migration program.

## II. Essential Steps

The steps necessary for improving NPS management of migratory species fall into three categories: 1) institutional capacity building, 2) outreach and education, and 3) research. These and subsequent steps needed to build an NPS Migration Program are summarized in Table 1.

### *Institutional Capacity Building*

- **Make the NPS survey concerning migratory wildlife conservation widely available to NPS staff, and publish it in a peer-reviewed journal.** The survey is a **first step in identifying NPS staff perspectives and perceived priorities on migratory wildlife crossing NPS units.** There are interesting regional differences in opinion and priorities. This survey helps identify the starting points internally for communication among staff, and for general readers affords interesting perspectives on the conservation of migratory wildlife as viewed by the federal agency most involved in land and wildlife protection.
- **Convene an NPS priority setting exercise: Priority Migratory Species.** From the outcomes of surveying the roster of migratory wildlife in NPS units, described below under Research, the NPS should commit to an exercise in identifying priority migratory species to be specifically engaged by the NPS Migration Program. With such a prioritized list would be a sense of the needed research on these species to assist in the development of the overall program.
- **Identify the key stakeholders/landowners resulting from the identification of the Priority Migratory Species.** The potential universe of stakeholders for migratory wildlife, particularly for international species, is immense. Yet the key stakeholders/landowners will be clearly identifiable once a suite of Priority Migratory Species is determined. Clearly, that roster will include federal agencies (e.g., BLM, USFS, and USFWS), the States and their wildlife agencies, and a miscellany of international partner agencies and private landowners.
- **Integrate migratory species concerns into NPS management, operations, and planning efforts.** For the Priority Migratory Species, and for migratory wildlife moving across NPS units in general, there needs to be developed general guidelines of management. These management guidelines in turn need to be integrated into the Operations and Planning sides of NPS. Finally, the NPS should consider co-management agreements with other federal or international agencies for Priority Migratory Species.

### *Outreach and Education*

- **Develop a series (two to four) of workshops intended to facilitate and create collaborative and management relationships among the most important national and international stakeholders of migratory wildlife.** Working to understand how best to collaboratively manage and conserve migratory wildlife moving across the complicated mosaic of land ownerships nationally and internationally means affording

considerable attention to establishing understanding and consensus. Perhaps one workshop dedicated to inter-federal agency collaboration (e.g., between NPS and BLM, USFS, USFWS), another dedicated to a consortium of (U.S.) State wildlife partners, and another dedicated to forging international collaborations among agency wildlife groups would be appropriate starting points.

- **Create dialogue among social scientists and NPS managers.** Such dialogue would be concerned with developing strategic outreach materials and messages about the NPS Migration Program and what it means to the American public. Such materials would not only share information, but should encourage collaboration and cooperation across private landowners.
- **Coordinate the input and output of migratory species research and conservation programs across NPS units and with program partners.** The NPS should concern itself with the sharing of information about this program, the various projects completed or underway, and the important developments of it in a consistent and dynamic way. This is no small task, as it involves gathering information across stakeholders and keeping a sense of common purpose and enterprise alive and well.
- **Develop outreach programs and educational materials** such as brochures and web-based products to inspire the public and to communicate program messages to target audiences.
- **Raise awareness of the human impact on and threats to the habitats of migratory species.** It will be very important for NPS to engage the television and newspaper media of the ongoing threats to migratory wildlife due to habitat loss, pollution, and invasive animals and plants. In effect, NPS needs a media campaign to involve all in the relevance of migratory species conservation, and the complicated set of issues to address concerning such species throughout their migratory cycles.

## *Research*

- **Fully review the migratory animal diversity across NPS units (and the U.S. broadly).** Perhaps surprisingly, there is no single-source, thorough accounting of migratory animals in North America (or elsewhere). Given that the NPS is creating a program on this very issue, they should take leadership in seeing through the creation of this product. From there, NPS could sort those species that reside for part of the year in, or pass through, NPS units.
- **Catalog what research and monitoring NPS is currently doing regarding migratory species.** Such a compilation will help indicate what is known and not known about the species identified above, as it applies to NPS units currently.
- **Identify key migratory species habitats within the National Park system.** Which of the habitats in NPS units are most important for migratory species? How much management consideration of these habitats addresses concerns for migratory species versus those of resident species? Will the identification of Priority Migratory Species change any management patterns across NPS units?

- **Which migratory species have been included as part of Park performance measures for species of management concern?** This issue, related to the habitat use concern above, helps understand if and how the addition of Priority Migratory Species will significantly affect how NPS units measure their performance internally.
- **Identify the key long-term and short-term research and monitoring needs for Priority Migratory Species in the National Park system.** Here we emphasize the need to understand and monitor the Priority Migratory Species identified, and as such learn if and how NPS is indeed making progress with the conservation of these species. We see an important need for the gap analysis implied above, and also the imperative need to monitor these species in order to learn whether or not the NPS Migration Program is indeed making a difference for such migrants.
- **Identify key threats to the Priority Migratory Species inside and outside National Parks.** This is the new and challenging aspect of developing an NPS Migration Program, the explicit recognition that the NPS is seeking to conserve migrants across their ranges, inside and outside the management units of the NPS. Identifying threats outside Park units for a migratory species is the first step in working with stakeholders to identify solutions and intervene on behalf of the conservation of migratory animals.

## **Building Blocks of an NPS Migration Program**

### **Develop NPS Internal Capacity**

- *Make the NPS survey concerning migratory wildlife conservation widely available to NPS staff, and attempt to publish it in a peer-reviewed journal.*
- *Convene an NPS priority setting exercise: Priority Migratory Species.*
- *Identify the key stakeholders/landowners resulting from the identification of the Priority Migratory Species.*
- *Integrate migratory species concerns into NPS management, operations, and planning efforts.*

### **Outreach and Education**

- *Develop a series (two to four) of workshops intended to facilitate and create collaborative and management relationships among the most important national and international stakeholders of migratory wildlife.*
- *Create a workshop among social scientists and NPS managers.*
- *Coordinate the input and output of migratory species research and conservation programs across NPS units and with program partners.*
- *Develop outreach programs and educational materials.*
- *Raise awareness of the human impact on and threats to the habitats of migratory species.*

### **Research**

- *Fully review the migratory animal diversity across NPS units (and the U.S. broadly).*
- *Catalog what research and monitoring NPS is currently doing regarding migratory species.*
- *Identify key migratory species habitats within the National Park system.*
- *Which migratory species have been included as part of Park performance measures for species of management concern?*
- *Identify the key long-term and short-term research and monitoring needs for Priority Migratory Species in the National Park system.*
- *Identify key threats to the Priority Migratory Species inside and outside National Parks.*
- *Launch a set of “proof-of-concept” migration projects (learn by doing)*
- *Write and publish a “BioScience”-like review paper of the challenge and need for migratory wildlife conservation (intellectual foundation of program)*

**Table 1.** Summary of “next steps” for building an NPS Migration Program

### III. Workshop Overview

A workshop titled, “Migrants across Air, Land, and Water: Framing Science to Achieve Conservation for National Park Lands” was convened in September 14–18, 2009. Held at the AMK-NPS-University of Wyoming Research Station in Grand Teton National Park, it brought together a science committee consisting of 18 experts representing differing geographies, backgrounds (federal, university, NGO), and taxa-specific expertise regarding migratory wildlife conservation and research (see Appendix I for workshop participants; Appendix II for workshop agenda).

#### *Objectives and Approach*

The workshop goal—“**To develop a scientific framework for preserving migration and migratory species across 83+ million acres of lands managed by the National Park Service**”—encompassed three key objectives:

- 1) **Prioritize key issues.** For instance, what does it mean to preserve a migration? Is conserving a species the same as conserving migration? What if we retain the presence of a species but it fails to migrate—have we achieved our goal? Should the restoration of migration be included as part of an overall strategy to conserve migrations?
- 2) **Establish a scientific basis for what an NPS Migration Program should look like.** Considerations were to: *i*) determine key conservation issues, *ii*) identify primary research issues, *iii*) establish which species (representative taxa or species *per se*?) should be targets if we can’t ‘save’ all, and *iv*) identify potential major collaborators beyond NPS.
- 3) **Identify and outline potential “proof-of-concept” projects** (what are these, how are they to be selected, and for how long?) for an envisioned NPS program focused on protecting migratory wildlife beyond the protected borders of NPS holdings.

With respect to the first objective, the above questions were of both rhetoric and heuristic intent. For instance, a migration might easily be considered protected for the long term if its chances to continue meet an arbitrary period (e.g., 99 years) and is assigned a high probability of persistence (e.g., 90%). However, our intent was not to derive or offer taxa- or species-specific values or to assess vulnerability on a geographical basis. Instead, we intended to formulate discussion and agreement about the critical issues necessary for identifying biological needs and next steps to implement on-the-ground and programmatic conservation. Nevertheless, in our “proof-of-concept” exemplar projects, we point out the value of recognizing impediments to migration and showcase a project designed to conserve migration vis-à-vis restoration (Bighorn Sheep).

The second objective, regarding the establishment of a scientific basis for an emerging NPS Migration Program, is developed throughout this report. Three of the four “boxes” in Figure 1 represent scientific issues addressed directly and indirectly throughout workshop discussions and many of these are more fully fleshed out in this document. For the important considerations (key

conservation issues, primary research issues, which species are the targets, and identifying collaborators) identified, the best and most direct answers arise when a particular migratory species is identified.

For example, if the NPS identified the Western Arctic Caribou Herd in Alaska as a target (which occurs in the NPS units, Cape Krusenstern National Monument and Bering Land Bridge National Preserve), then the key conservation issues would include understanding the effect of climate mediated changes on their vegetation across their migration and concerns about the loss of summer ice on the coastal plain where caribou have sought refuge from mosquitoes. Research needs would include an attempt to understand why caribou herd population size fluctuates through time, and what are the key drivers of such changes? The relevant “unit” —the herd designation—would clearly be the target, as, say differentiated from the Teshekpuk Lake Caribou Herd to the east. Stakeholders would necessarily be Inupiat Eskimos dependent on the herd for subsistence, Alaska Department of Fish and Game, USFWS, USGS, and the BLM, which administers the immense National Petroleum Reserve that encompasses their calving grounds. As mining interests and oil development plans are growing in this region, there are stakeholders to be identified from industry as well.

These would obviously be a whole different suite of issues and stakeholders than would be true if the identified migrant were, say, American Golden Plovers, which utilize much of the same geography as caribou for breeding grounds, yet migrate from southern South America. There the change in scale and inclusion of international stakeholders would clearly necessitate a whole new engagement and strategy for conservation. The point, as obvious as it is profound, is that the migratory species and their geography define (broadly) the issues and the likely stakeholders. The important challenge for NPS, given the species that arise as Priority Migratory Wildlife, is to drill down within those immense migratory geographies and identify, per species, the relevant issues of conservation and the required stakeholders needed to intervene on behalf of the migrants. The outlines of how to do so, and how to get started, are touched on here (see also Table 1), but the real work and engagement begin with the identification of migratory species to be engaged by NPS.

### ***Framing the Issues***

This section outlines key issues about ecological processes and associated uncertainties and problems associated with migrations. While key questions have been outlined in Figure 1, we summarize five points highly relevant to NPS actions on migratory species conservation:

- 1) Animals move. Park boundaries do not.** The twin challenges of wildlife mobility and fixed Park boundaries test our abilities to protect ecological and biodiversity integrity associated with protected areas. To protect migrations will be among one of the chief future challenges of NPS given that migration occurs in three media—air, land, and water. Jurisdictional matters and legislation have essentially fixed the lands available as refuges. Animals, on the other hand, often require large spaces, and often these are disjunct. Since animals move/migrate (for many reasons) and are likely to continue to do so as climate modifies habitat, it is clear that Parks alone will never be sufficient to contain migrants.

Hence, any sensible plan to develop protection for migrations must think broadly, both at an NPS scale and beyond. NPS cannot do this alone. State, federal, and international partners will be required as will more local stakeholders. As recognized in the recent release of the 2009 Second Century Commission Report on National Parks (SCCRNP), the solutions to problems as well as meeting bold visions will require creativity and commitment. Not only will humans, habitat loss, and physical impediments force challenges, but as recognized in the SCCRNP any solutions will require that government bodies, educational institutions, businesses, and nonprofit organizations work together creating corridors for conservation and stewardship, especially because “...*global climate change is rearranging wildlife habitat, pushing ranges northward in the lowlands and upward in mountain regions, sometimes forcing species outside the boundaries of parks designed to protect them.*”

In many areas of the U.S., NPS units are administered in ways that differ from nearby lands owned or administered by other federal, state, county, municipal, or non-profit organizations. While these various units may have different missions, jurisdictions, ownership patterns and uses, their overall contiguous nature creates a much greater ecological whole than the sum of their individual parts. Such mismatch among various missions, while understandable from policy and legal perspectives, often do little to achieve the perpetuation of migrations.

- 2) **Changing Philosophies, Evolving Mandates.** Like all agencies, the NPS responds to public pressure, to changing values, and to improved knowledge. Change is slow, yet it is reflected in new policies, by recognition of threats, and initiatives. Understanding how NPS has changed its views of conservation is relevant to gauging the potential for recognition of migration as a central challenge within the NPS.

The NPS has a long history of management within borders, one which reflects changing views on the purpose and use of National Parks. Early ideologies, beginning with Yellowstone in 1872, were more of a fortress mentality and began with a military model. In 1893, Arnold Hague noted boundary issues and migration as he commented upon Elk migration: “Let Congress readjust the (Yellowstone) boundaries in the best interests... (animals)”. Over time, NPS and public interest in adjudication of borders has ebbed and flowed dependent upon the needs to be good neighbors with adjacent landholders and public interest and policy from afar. With time it has also become clear that ecological phenomena transcend boundaries, and extra-boundary threats have and can strongly compromise the Park mission associated with the 1916 Organic Act. Among the notable changes and challenges were the Clean Air Act, water rights issues, mining, mosquito abatement, stream flow, and air pollution. Several partnerships intended to promote external thinking (Park Flight, cooperative resource protection outside borders, etc.) have been developed.

That philosophies have changed is not surprising, but serious attempts to put migration on the NPS radar have languished until recently. Despite Hague’s 1893 (above) admonishment about movement beyond borders, it was almost 90 years before migration again circled back to Parks with respect to threats beyond NPS borders. In the NPS

“State of the Parks—1980: A Report to Congress” first attempt to survey threats to Parks, more than 50% of threats considered were regarded as external; migratory species were mentioned only indirectly in the context that DDT in Mexico affected the bats of Carlsbad Caverns.

- 3) Geographical Knowledge of Migration within NPS Units.** Prior to the Workshop, a migration survey was distributed to all NPS units. Responses from 154 NPS staff across all 32 NPS Vital Signs monitoring ecoregions were analyzed. Eighty-one percent of respondents were biologists. NPS staff offered their perceptions on the importance of migrations, identified migratory species, and outlined pathways and threats to migrations, as well as commonalities among these elements. Further, NPS staff identified a diverse array of migrants that use many ancient pathways. Outside of Parks, most respondents identified habitat loss (49%) and climate change (25%) as the top threats to migratory species. Within Parks, roads (59%) and recreation (52%, non-exclusive categories) were perceived as the most common threats. About 80% of survey participants were aware of current efforts to protect migratory corridors.

In summary, knowledge about migratory species among NPS staff is apparent. Yet, most information is fragmentary, and direction is needed to fill gaps in knowledge evenly across NPS units as well as to coordinate efforts aimed at protecting migrants. Among the information needs, three stand out (see Figure 1): *i*) a rigorous assessment of what exists and what has been lost; *ii*) analyses of threats and causes of losses; and *iii*) a repository of knowledge that is cross cutting thematically, taxonomically, historically, and site specific. An additional arena would include conservation strategies, including the role of adjacent lands, policy options, and funding. Beyond efforts to acquire biological information, there is a need for action and outreach both within and beyond NPS staff. Public engagement is crucial.

- 4) The Complexities of Nuance and Ecological Process.** All land surfaces, especially small and fragmented ones, are challenged by forces beyond borders. To the extent possible NPS units are tasked with the expectation of maintaining ecological integrity, yet migration presents challenges.

First, disease and associated global health programs affect National Parks in countless ways. Avian influenza, whirling disease, and the plague are three of many health-related challenges confronted by Parks via air, land, and water migrants. Corridors that may facilitate migration and connect disparate units may accentuate disease risks.

Second, a complex relationship exists between plants and their pollinators. The migrations of at least three endangered bats that use NPS lands in the southwest U.S. are dependent upon flowering plants for food. The agave is one such plant, and—in Mexico in particular—it is central to the production of Tequila, a multi-billion dollar industry. The protection of plants outside NPS units and beyond the sovereign U.S. border is important for ecological integrity in NPS units.

Third, NPS management policies (2006) state that NPS “...will strive to protect the full range of genetic types (*genotypes*) of native plant and animal populations in the parks by

*perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity.”* Thus, the NPS mandate to maintain genetic diversity can extend to protect migration, a primary source of genetic diversity.

- 5) **Climate Change.** The evolution of migratory behavior in animals was in large part driven by changing climates in Earth’s history. Volant and highly mobile animals escaped increasingly temperate clines by moving towards the tropics in the winter by evolving migratory habits. Our current changing climate is thought to pose particular problems for wildlife, as the rate of change is likely to be greater than at other times and thus there is little capacity for adaptation, in the evolutionary sense. For migratory wildlife, a “double whammy” with the current changing climate is in the offing. Migrants are facing often dissimilar changes due to climate on both their wintering and their summering landscapes. For example, Arctic shorebirds are experiencing earlier and earlier springs in their tundra breeding habitats, necessitating earlier arrival dates from wintering grounds. For those that winter in southern estuaries, they risk inundation of that habitat by the rising ocean levels.

The conservation context for our protected areas is complicated by climate change. In general, animals and plants are moving northward in the Northern Hemisphere due to our warming climate. Protected areas are of course fixed in space. The near future of climate mediated effects on protected areas includes consideration of species increasingly “lost” to the north, and different species “gained” from the south. For the NPS, it means dramatic shifts of distribution of the very species that protection was to be afforded. These patterns indicate all the more need for NPS and partners to work toward the protection of migratory species inside and outside NPS units, as the changing climate makes all species moving targets in time and space.

## **IV. “Proof-of-Concept” Exemplars**

We used break-out groups to develop a mock exercise with the goal of identifying migratory species (or units) in each major migratory arena—air, land, and water (Table 2). We discussed planning in terms of the next 5–10 years with the following general goals:

- 1) To maintain and restore migratory processes for “key” NPS species;
- 2) To build awareness and support for migration conservation in key constituencies inside and outside NPS; and
- 3) To integrate the NPS Migration Program with other NPS programs, especially recommendations of the National Parks Second Century Commission.

To facilitate the creation of an NPS Migration Program, we formulated a series of strategies toward achieving these goals through a learning exercise, as in adaptive management, through implementing a few “proof-of-concept” projects:

- 1) Launch a set of “proof-of-concept” migration projects;
- 2) Develop an information base and a geographic approach to planning (GAP) analysis for migratory processes and threats to processes for NPS units;
- 3) Engage the public: Design and launch a migration awareness program aimed at specific constituencies;
- 4) Engage other federal agencies: Explore interest in a broader interagency-NGO migration initiative;
- 5) Engage the States: Identify key migration corridors/processes and migratory wildlife priorities in State Wildlife Action Plans (SWAPs); and
- 6) Based on “proof-of-concept” projects, their resulting information bases, and related initiatives, learn lessons from them; adapt; and design longer-term strategies.

We subsequently developed nine exemplar “proof-of-concept” projects for implementation. These are described in the following section (see also Table 2).

In advance of launching a particular “proof-of-concept” project, the NPS should ensure the following are in place:

- 1) A full analysis has been used to establish specific goals;
- 2) Stakeholder engagement has been initiated;
- 3) Key external factors affecting the targeted migration have been identified; and
- 4) Budgets have been developed to support the full project.

In our collective effort to identify “proof-of-concept” species, we endeavored to ensure that the species chosen were the result of a process that resulted in different kinds of diversity. Our groups were tasked with identifying migratory examples from air (insects, bats, or birds), land (mammals or herps), and water (fish, turtles, and marine mammals). We also addressed the need for taxonomic (vertebrate) diversity, and of having migrants with both short- and long-distance migrations (thus, national and international). We required that examples were feasible examples, that species or migratory populations of them had clear conservation concerns, and were from all regions with NPS units (avoiding a western bias where most of the NPS units are).

Regarding taxonomic diversity, we required that our final list was represented by fish and reptiles (and possibly insects), as it would most certainly be represented by birds and mammals. We felt such diversity necessary, as it goes toward engaging the public and stakeholders more fully in the broad phenomenon of migration. Feasibility was a subjective discussion, yet was vetted by experts familiar with both research and conservation. The particular criteria of “feasibility” were discussed differently with different species, but all discussions centered around a presumed capacity to “make a difference” in the conservation of migration of a particular taxon, and that such success could be achieved in a 3–5 year framework.

Accounting for both short- and long-distance migrants meant discussions and challenges proportional to the scale of a migratory system. Short-distance migrations mean full engagement in all the habitats and with all the relevant managers and land owners across the entire range of such a migrant, while long-distance migrants require attention to key geographies within the migration path, and key stakeholders that could make a difference to the conservation effort. The latter category, long-distance migrants, brought interesting challenges and discussions concerning international stakeholders and the novel challenge for NPS to not only reach outside their units in the United States, but also to reach across continents and oceans to international agencies.

The species chosen were not necessarily Threatened or Endangered in the United States, but were clearly included as they had demonstrable conservation issues with their migrations requiring attention. Interestingly, the species in question may not have been of serious conservation concern, but their migration (lost historically or currently in peril) could be. This latter distinction is very interesting and powerful: we concerned ourselves with the conservation of a phenomenon—the migration itself—beyond the typical species conservation considerations. The choice of a particular species would then give rise to discussions about which the relevant stakeholders likely were for the migrant in question, and what the particular conservation challenges were to the species.

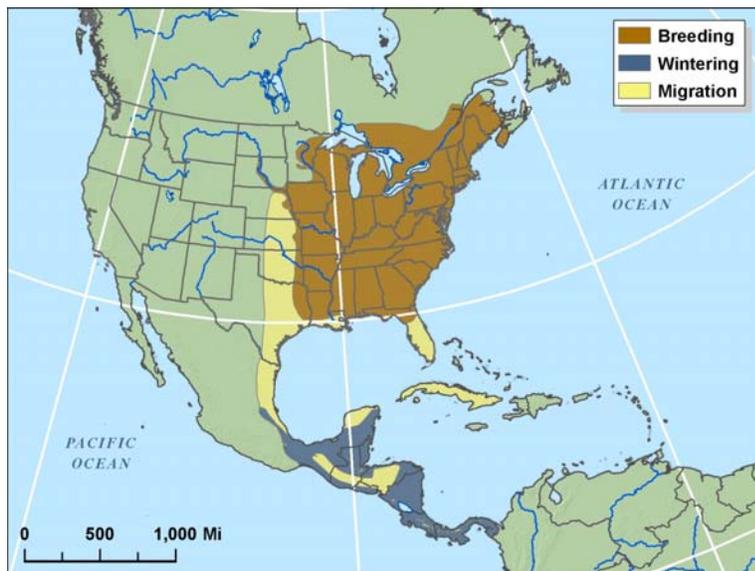
Working in three break-out groups, each group put forth several “proof-of-concept” projects for an envisioned NPS program focused on protecting migratory wildlife beyond the protected borders of NPS holdings. We stressed short-term successes because of our interest in bringing a positive element forth with conservation outcomes rather than an approach that emphasized science for the sake of science. Overall, we emphasized the need for tangible success in 3–5 years and actions that could raise the profile of target migrants to the public.

<b>SPECIES</b>	<b>SCALE OF MIGRATION</b>	<b>U.S. STATUS OR TREND</b>	<b>INTERNATIONAL?</b>	<b>NPS GEOGRAPHY</b>
<b>AERIAL MIGRANTS</b>				
<b>Wood Thrush, <i>Hylocichla mustelina</i></b>	2,000 km	Common, but Declining	Yes	Eastern U.S.
<b>Desert Pollinator Bats: Lesser Long-nosed Bat, <i>Leptonycteris yerbabuenae</i> / Mexican Long-tongued Bat, <i>Choreonycteris mexicana</i> / Mexican Long-nosed Bat, <i>Leptonycteris nivalis</i></b>	100's-1,000 km	Threatened & Endangered	Yes	Southwestern U.S.
<b>Grassland Birds: Sprague's Pipit, <i>Anthus spragueii</i> / Chestnut-collared Longspur, <i>Calcarius ornatus</i> / Baird's Sparrow, <i>Ammodramus bairdii</i></b>	1,000 km	Special Concern & ESA Candidate	Yes	Central U.S.
<b>TERRESTRIAL MIGRANTS</b>				
<b>Pronghorn, <i>Antilocapra americana</i></b>	100 km	Migrations Disappearing	Yes	Central & Western U.S.
<b>Bighorn Sheep, <i>Ovis canadensis</i></b>	10's-100's km	Migrations Disappearing	Yes	Western U.S.
<b>AQUATIC MIGRANTS</b>				
<b>Sturgeon: Atlantic/Gulf Sturgeon, <i>Acipenser oxyrinchus</i> / Shortnose Sturgeon, <i>Acipenser brevirostrum</i></b>	100's to 1,000 km	Special Concern & Endangered	No	Coastal Eastern U.S.
<b>Leatherback Turtle, <i>Dermochelys coriacea</i></b>	10,000 km	Endangered	Yes	Coastal Eastern & Western U.S., AK, HI
<b>Blue Whale, <i>Balaenoptera musculus</i></b>	8,000 km	Endangered	Yes	Coastal U.S., AK, HI
<b>Humpback Whale, <i>Megaptera novaeangliae</i></b>	8,000 km	Endangered	Yes	Coastal U.S., AK, HI

*Table 2. Exemplars of proposed “proof-of-concept” project species*

## ***Aerial Migrants “Proof-of-Concept” Projects***

The **Wood Thrush** (*Hylocichla mustelina*) is a common and well-known songbird in the eastern U.S. during the spring breeding season, wintering in Mexico and Central America (Figure 2). Having declined 43% since 1966, the Wood Thrush has become a symbol of the decline of Neotropical songbirds of eastern North America. The Wood Thrush can act as an umbrella species of management for similar migratory bird species. Despite being a relatively common species, information on long-term declines is lacking. Forest fragmentation on both breeding and wintering grounds has been identified as responsible for many declines; however, virtually nothing is known about migratory stop-over sites and their importance. Recent research has also suggested that factors such as acid rain may have contributed to the decline of Wood Thrush by reducing the availability of calcium-rich prey, and hence, reducing egg production.



***Figure 2. Distribution and breeding ranges of Wood Thrush***

The three **desert pollinator bats** proposed for “proof-of-concept” projects are the Lesser Long-nosed Bat (*Leptonycteris yerbabuena*), Mexican Long-tongued Bat (*Choreonycteris Mexicana*), and Mexican Long-nosed Bat (*Leptonycteris nivalis*) (Figure 3). These species are vital pollinators in desert systems and their distribution in space and time depends heavily on the phenology of desert plants, and hence, are sensitive to the timing of rainfall as well as human activities such as agricultural production. The agave industry has a substantial impact on these bats. Essentially, no plants are allowed to flower—the commercial practice is to cut all flower buds. This practice creates a relatively barren (devoid of nectar sources) landscape for the bats. In certain locations and periods of the year such a nectar source could be crucial, particularly during migration.

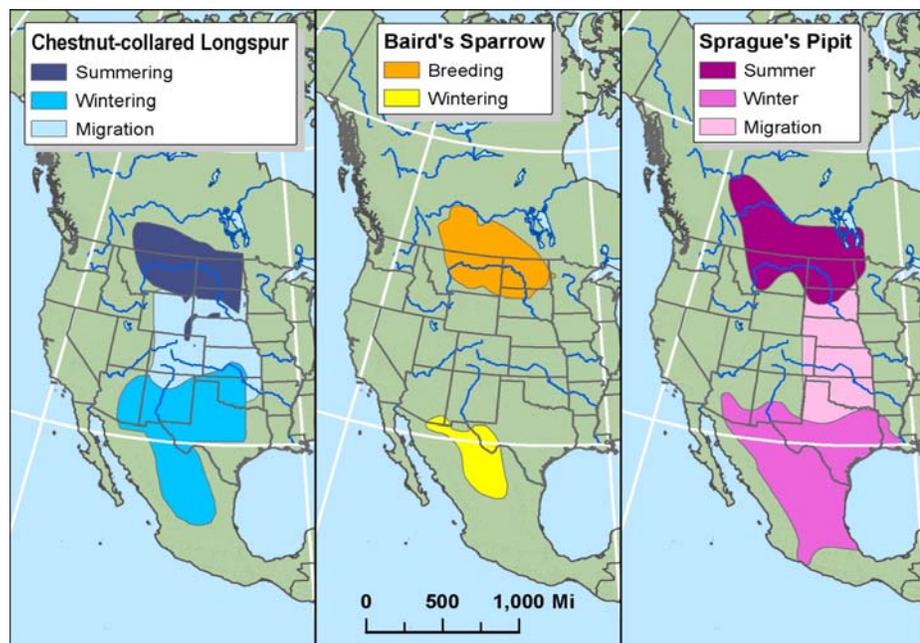
Much remains to be learned about the timing and routes of migration used by these migratory bat species. In particular, large population fluctuations (0-10,000 individuals) at caves are cause for concern. Other pressing questions include how and what caves are used, and whether the sexes complete separate migrations.

**Figure 3.**  
*Distribution of 3  
desert pollinator  
bat species*



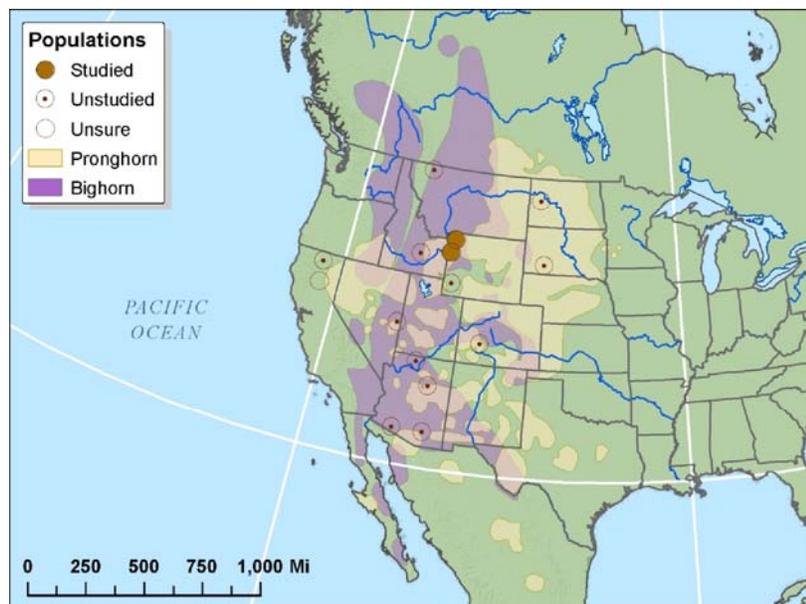
**Grassland birds** are the most highly imperiled group of North American birds, and they migrate primarily within North America—from the northern Great Plains breeding grounds to wintering areas in the desert southwest U.S. and northern Mexico. Their migratory geography transcends several NPS units. Grassland birds are obligate grassland nesters. Hence, they are greatly impacted by grassland management practices, primarily livestock grazing. Historically, grassland habitats were largely created and maintained by bison—still a common species at several NPS holdings. Three grassland bird species were suggested as targets for “proof-of-concept” projects: Sprague’s Pipit (*Anthus spragueii*), Chestnut-collared Longspur (*Calcarius ornatus*), and Baird’s Sparrow (*Ammodramus bairdii*) (Figure 4). Very little is known about the indirect (or direct) interaction between grazing by bison and the capacity of this grazer to affect the conservation of these migrants, but their historical association suggests they have strong ecological ties.

**Figure 4. Breeding  
and wintering ranges  
of 3 grassland bird  
species**



## ***Terrestrial Migrants “Proof-of-Concept” Projects***

**Pronghorn** (*Antilocapra americana*) are North America’s only endemic ungulate with some 20 million years of evolution concentrated solely in North America. After decades of heavy market hunting in the 1900’s, populations are recovering modestly. Many Pronghorn migrate seasonally to escape harsh winter conditions (deep snow) to access food. Several migrations pass through bottlenecks not wider than 200 meters, to the extent that localized changes in land use can sever a migratory pathway. More than 15 NPS holdings are used by Pronghorn. Of these, migratory pathways have been identified for only two populations (brown circles in Figure 5).



***Figure 5. Distribution of Pronghorn and Bighorn Sheep in western U.S. Dotted circles reflect NPS units where studies on specific challenges to and distances of Pronghorn migration are lacking. Brown circles reflect studies of marked Pronghorn.***

**Bighorn Sheep** (*Ovis canadensis*) populations were drastically reduced by market hunters in the late 1800’s. Several thousand individuals persist across the species range (Figure 5). Historically, Bighorn Sheep made traditional migrations to lower elevations during winter. However, many of these migrations have been lost due human settlements at low elevation, habitat disturbance and fragmentation, and complications due to livestock grazing. As a consequence, numerous populations have become small and geographically isolated.

The Bighorn Sheep population in Grand Teton National Park (GTNP) is illustrative. Once migrating to low elevations and connected with other herds, the Bighorns of GTNP now suffer reduced genetic diversity, winter at elevations up to 10,000–11,000 feet, and no longer access milder conditions at lower elevation sites. It is possible that these sheep might re-institute their traditional migrations on the west slope of GTNP but it would require a substantive effort in which human “sheep walkers” train the sheep to re-learn historic migration routes. While such innovative approaches might be feasible for these isolated GTNP Bighorn Sheep, the broader

issue concerns the extent to which restoration should be considered vital to a program aimed at protecting migrations. Our Working Group felt that individual-specific cases such as this appropriately target the maintenance of and protection of migration—whether by augmentation or manipulation.

### ***Aquatic Migrants “Proof-of-Concept” Projects***

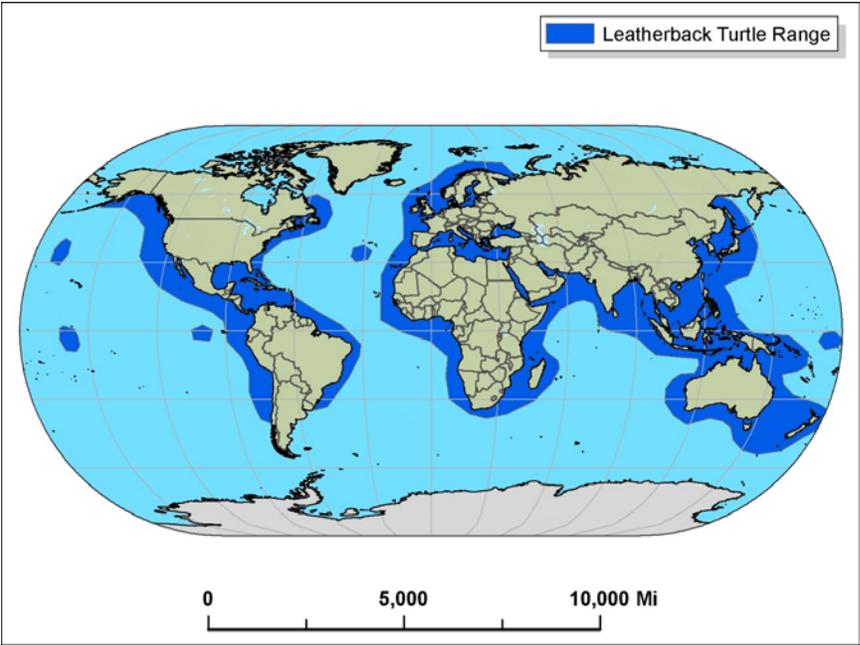
The **Atlantic/Gulf Sturgeon** (*Acipenser oxyrinchus*) and **Shortnose Sturgeon** (*Acipenser brevirostrum*) belong to one of the oldest Orders of bony fish, dating back 200 million years. Both species are anadromous bottom-feeders that occur along the eastern U.S. (Figure 6).



***Figure 6. Distribution of Atlantic/Gulf and Shortnose Sturgeon***

Dams and alterations in water flow negatively impact these species, both of which serve as indicator species for water quality and riparian and estuarine health. This is particularly so because their life cycle requires connectivity across oceanic and riparian biomes.

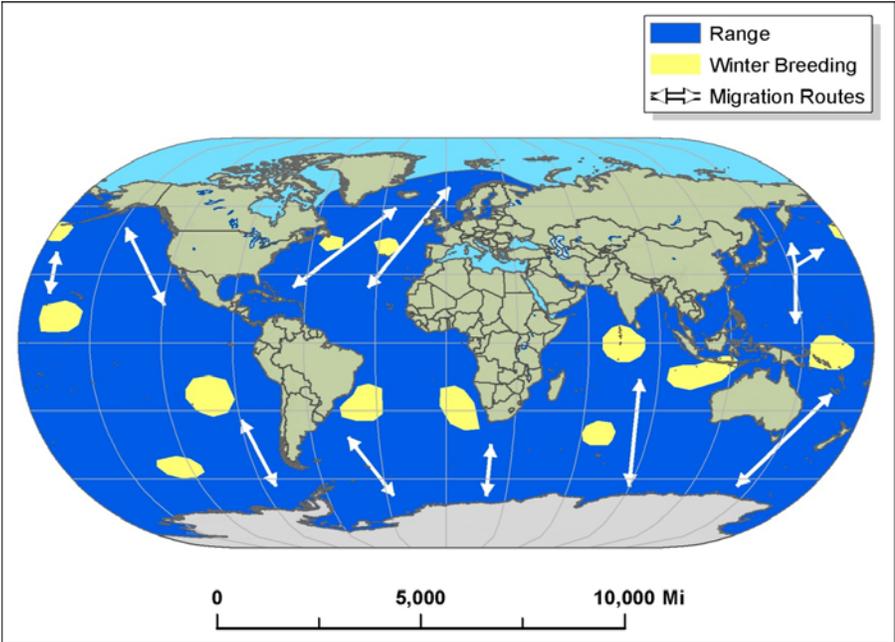
The **Leatherback Turtle** (*Dermochelys coriacea*) is the fourth largest modern reptile and performs roundtrip migrations of up to 20,000 km. Leatherback Turtles are widely distributed (Figure 7). However, since the 1980’s this species has declined from an estimated 115,000 to approximately 30,000 individuals. Major threats to this species include harvesting of eggs and adults, stray fishing gear, and ocean pollution—particularly plastic bags that are mistaken for jellyfish and ingested. An uncertain but growing concern for conservation of leatherback and other sea turtle species is the potential impact of global warming on shorelines. Substantial sea turtle nesting habitat construction may be required as water levels rise, particularly along Florida’s coast.



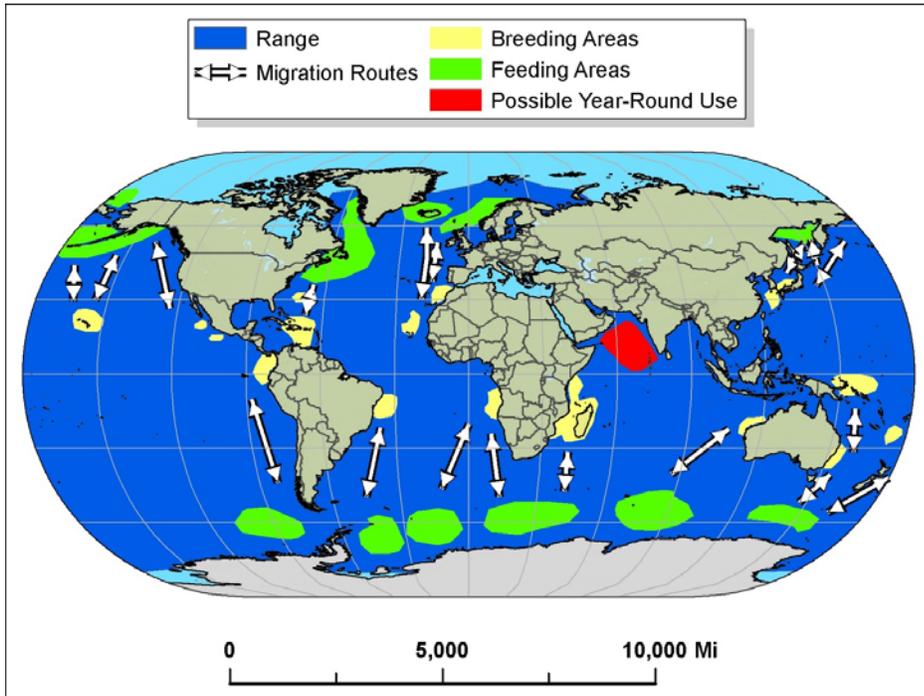
*Figure 7. Leatherback Turtle species range*

**Blue Whales** (*Balaenoptera musculus*) were decimated by whaling (from hundreds of thousands to now around 5,000) and recovery has been slow. These whales, the largest mammals on the planet, migrate the greatest distances (>8,000 km) among mammals (Figure 8). Blue Whales use Hawaiian and Alaskan NPS holdings and 14 National Marine Sanctuaries. Threats to whale migration include shipping traffic, poorly managed whale tourism, fishing gear, underwater construction and potentially, sonar interference and decompression.

*Figure 8. Blue Whale distribution and migration routes*



During the 20<sup>th</sup> century, hunting reduced **Humpback Whale** (*Megaptera novaeangliae*) population numbers by more than 90%. Humpback Whales have been recovering since the 1970's. However, threats such as collisions with ships, entanglement in fishing gear, hunting, and noise pollution persist. Humpback Whales typically migrate 25,000 km per year between breeding and feeding grounds (Figure 9).



*Figure 9. Humpback Whale distribution and migration routes*

In sum, repeated common challenges confront the migrations of most of our selected species. Our aerial migrants (birds and bats) make clear the innumerable challenges associated with migrations covering large distances with the common problem being our ignorance of exactly where these species stop-over during migration and thus what conservation actions are needed en route. Pronghorn and Bighorn Sheep face encroachment, fencing, and land use practices beyond the borders of NPS units that have either made difficult or severed migration routes. Aquatic migrants share vulnerabilities to harvesting and adrift fishing gear. The Humpback and Blue Whales certainly overlap in many life history attributes; however, the Leatherback Turtle also shares a similar scope of migration distances and threats to migration.

## V. Synthesis and Recommendations

The clear and emergent consensus of this workshop was that 1) the time is right and the timing essential for the creation of effective means for conserving migratory wildlife and 2) the National Park Service is the right and historically most important organization to take leadership on this crucial issue. The NPS rightly deserves credit for establishing and effectively demonstrating the importance of protected area management for wildlife conservation worldwide. Yet, migratory wildlife species have been poorly served by this structure, as significant portions of their life history often lie outside protected areas. The scale of this issue is truly international: whales, birds, and sea turtles transcend cross-continental and oceanic geographies in dramatic ways due to their migrations. The workshop focused on establishing a scientific framework for the emerging NPS Migration Program, including the identification of “proof-of-concept” projects involving migratory animals across air, land, and water. Many details of identifying priorities of species and geographies, programmatic structure, administration, and collaboration (within NPS and among diverse institutions) lie ahead for NPS in developing this program (see Table 1).

The starting points for the development of an NPS Migration Program are evident and familiar, yet essential. There needs to be a full accounting of just what the species are across NPS units that migrate. This list is likely much the same as a full accounting of North American migrants. Such an accounting does not yet exist, and so NPS needs to take leadership here. From that examination, NPS then needs to prioritize exactly which species will make up the core of this new program. The “proof-of-concept” migratory species that we identified in the workshop setting reveal relevant starting points for consideration of how to prioritize. Our emphasis was on creating a diversity of migrants to fully engage the NPS and the public on the breadth of the phenomenon of migration. Engaging workshop participants in developing a “Bio-Science” like review paper of the science needed for, and the complex conservation requirements of, engaging migratory wildlife, is clearly warranted. Such a peer-reviewed paper would stand as the intellectual foundation of the NPS Migration Program. There are many research papers on migration. There are many calls for the conservation of migratory species in need. There is to date no prescriptive treatment of how to do so. NPS should support such an effort.

The development of “proof-of-concept” pilot projects was not meant as a rhetorical exercise. NPS needs to take on some of these projects and fully engage in them so as to learn by doing. The candidate projects offered are likely among those that NPS would eventually prioritize. All programmatic issues, including those of research, those of stakeholder engagement, those of identifying conservation goals relevant to the conservation of the migratory species or of the migration itself, are as complicated and diverse as the species chosen. It seems imperative that NPS adaptively manage their new Migration Program by learning from a few “proof-of-concept” projects. We suggest taking on one each from the air, land, and water categories.

Workshops lead to more workshops. This is inevitable in launching important programs like the NPS Migration Program. Because this program will need to reach beyond NPS unit boundaries to fully engage in the conservation requirements of migratory wildlife, we see a clear need to engage and collaborate with major stakeholders, and so coordinate future programmatic activities with them. We identified a need to have one workshop each with U.S. federal agencies involved

in land and wildlife management, a workshop with a consortium of state wildlife agencies (meshing with their priorities of migratory wildlife), and finally, a workshop to engage the major international stakeholders. The messaging across these workshops should be consistent. Such workshops would simultaneously assist NPS in developing this program, but also should solidify the leadership position of NPS with the conservation of migratory wildlife. Finally, we see the need for a separate workshop to engage social scientists to help NPS develop a strategic approach to outreach the core messages and intents of the NPS Migration Program. The primary audience of such outreach should be the American public. The American public should recognize and embrace the need and challenge of creating and implementing a migratory program that reaches out nationally and internationally across perceived boundaries.

A core legacy of the NPS is the creation of Parks (protected areas) where wildlife find refuge and where wildlife conservation started in the United States, and where an inspired model was launched and applied worldwide. The NPS has a new opportunity here to create a new and inspiring program for the conservation of migratory wildlife, borne on the recognition that our worldwide network of protected areas are insufficient to fully conserve migratory wildlife. Here, for the first time, wildlife conservation efforts can reach across national and international boundaries to achieve conservation, where the geographies of need and engagement are defined by the very migratory species we seek to conserve. Migratory wildlife have found ways to move across such perceived boundaries; the time is now for the NPS to lead and create a future for migratory wildlife by extending their reach outside parks and engage fully where the migrants go.

**Appendix I: Workshop Participants**

**Appendix II: Workshop Agenda**

## Workshop Participants

NAME	ORGANIZATION / TITLE
Joel Berger	University of Montana & Wildlife Conservation Society / Craighead Chair of Wildlife Conservation
Steve Cain	U.S. National Park Service / Senior Wildlife Biologist (Grand Teton National Park)
Ellen Cheng	University of Montana & Wildlife Conservation Society / Ph.D. Candidate
Peter Dratch	U.S. National Park Service / Endangered Species Program Manager
Kevin Ellison	Wildlife Conservation Society / Conservation Scientist
John Francis	National Geographic Society / Vice President for Research, Conservation, and Exploration
Bert Frost	U.S. National Park Service / Chief Scientist and Associate Director for Natural Resource Stewardship and Science
Scott Gende	U.S. National Park Service / Coastal Ecologist
Craig Groves	The Nature Conservancy / Director of Conservation Methods for Conservation Science Division
William Karesh	Wildlife Conservation Society / Director of Field Veterinary Program
Elaine Leslie	U.S. National Park Service / Deputy Chief, Operations, for Biological Resource Management Division
Gary Machlis	U.S. National Park Service / Science Advisor to the Director
Rodrigo Medellin	National Autonomous University of Mexico / Senior Investigator
Reed Noss	University of Central Florida / David-Shine Professor of Conservation Biology
Kent Redford	Wildlife Conservation Society / Director of Wildlife Conservation Society Institute and Vice President of Conservation Strategy
Michael Soukup	U.S. National Park Service / Associate Director for Natural Resource Stewardship and Science (Retired)
David Wilcove	Princeton University / Professor of Evolutionary Biology, Ecology and Public Affairs
Steve Zack	Wildlife Conservation Society / Conservation Scientist

*Workshop participants are shown in photos (next page), from left to right:*

**FIRST ROW**      *Gary Machlis, Reed Noss, Joel Berger, Steve Zack, Kent Redford*

**SECOND ROW**    *Kevin Ellison, Elaine Leslie, David Wilcove (top), Peter Dratch (bottom), Michael Soukup,  
Craig Groves*

**THIRD ROW**     *John Francis (top), Rodrigo Medellin (bottom), William Karesh, Bert Frost, Scott Gende  
(top), Ellen Cheng (bottom), Steve Cain*



## Appendix II: Workshop Agenda

### Migrants Across Air, Land, and Water

#### Framing Science to Achieve Conservation for National Park Lands

#### A Workshop in the Tetons—September 14–18, 2009

##### Monday Evening – September 14 (Jackson Lake Lodge, Osprey Room)

6:00	Brief Remarks	<i>Joel Berger &amp; Steve Cain</i>
6:05	Welcome	<i>Mary Gibson Scott</i>
6:15	Introductions	
6:35	Review of Objectives	<i>Steve Zack &amp; Joel Berger</i>
7:00	America's Best Idea and Our National Heritage	<i>Bert Frost</i>

##### Tuesday – September 15 – The Domain of Migration (AMK Ranch)

	<i>logistics by Kevin Ellison &amp; Ellen Cheng</i>	
8:15	Welcome & Review of Agenda	<i>Kent Redford</i>

##### *NPS Framing of Issues*

8:25	2020 Vision: Connecting to the Preservation, Stewardship and Future of our Nation's Wildlife	<i>Elaine Leslie</i>
8:45	Braving New Worlds: Past and Future Significance of the National Park Boundary to Management and Beast	<i>Michael Soukup</i>
9:05	Migration Conservation or Not: Losses, Gains and Potentials for Grand Teton National Park	<i>Steve Cain</i>
9:25	The Importance of NPS Lands to Migrating Wildlife: A Geographic Synopsis	<i>Kevin Ellison</i>
9:45	Q & A About Morning & Talking Points	<i>Kent Redford</i>
10:10	BREAK	

##### *By Air, Water and Land*

10:30	Conservation Challenges for Aerial Migrants	<i>David Wilcove</i>
10:50	Conserving Ocean Migrants is Easy!!! (Except they are Invisible, Move Long Distances, and Travel Through the Aquatic Equivalent of Waziristan)	<i>Scott Gende</i>
11:10	Conservation Challenges for Terrestrial Migrants	<i>Joel Berger</i>
11:30	Q & A & Talking Points – Different Taxa, Common Challenges: True or False?	<i>Kent Redford</i>
12:00	LUNCH	

##### *Processes*

1:00	Bats, Agaves and Tequila: A Migration Connection as an Ecosystem Service	<i>Rodrigo Medellin</i>
1:20	Challenges to Healthy Migrations	<i>William Karesh</i>
1:40	Molecular Genetics and Migration: A Valuable View or a Late-Breaking Curve?	<i>Peter Dratch</i>

- 2:00 Climate Change, Migration and Conservation *Steve Zack*
- 2:20 BREAK
- 2:45 Movement Ecology Across Space and Time *Reed Noss*
- 3:05 Q & A & Talking Points: What Should NPS Take to Heart? *Kent Redford*
- 4:20 Break-Out Groups: Overview and Assignments for Tomorrow  
*Kent Redford & Joel Berger*

### **Wednesday – September 16 – NPS Priorities for Migratory Species (AMK Ranch)**

*logistics by Kevin Ellison & Ellen Cheng*

- 7:00 Field Trip (Grand Teton National Park—Two Options) *Steve Cain & WCS*
- 12:00 LUNCH
- 1:00 Group Discussion: Criteria for Migrants, Do We Rescue Species in Need or Common Ones?
- 2:00 Three Break-Out Groups\*—Tasks & Assignments *Kent Redford*
- 2:05 \*Choosing NPS Candidate Species from the Criteria Adopted Above
- 3:05 \*Determining Core Science & Conservation Issues for NPS Species
- 4:00 BREAK
- 4:20 Design a Showcase Project for 2 Species (& You/Your Group Will Do a Presentation the Next Day)

### **Thursday – September 17 – Designing a Successful Future for Migration (AMK Ranch)**

*logistics by Kevin Ellison & Ellen Cheng*

- 8:15 Break-Out groups Meet to Finalize Presentations
- 8:45 Presentations Begin (Leader is not a Presenter, and Each Group has Two Different Presenters)
- 10:30 BREAK
- 10:50 Designing a Migration Conservation Initiative in the National Park Service  
*Craig Groves*
- 11:10 Conservation Initiative Discussion
- 11:30 Migrations Coverage at National Geographic—Past and Future *John Francis*
- 11:50 Q & A & Talking Points: Outreach & Communication Writ Larger *Kent Redford*
- 12:15 LUNCH

#### *Launching NPS Migration: First Steps*

- 1:00 Wrap-Up Discussion & Consideration of Next Steps
- 3:15 Final Suggestions from Participants
- BREAK
- 3:40 Last Business
- 5:40
- 6:00
- 6:40 DINNER—Keynote Speaker – Dr. Gary Machlis, NPS, and Science Adviser to the Director

### **Appendix III**

Rocky Mountains Cooperative Ecosystem Studies Unit (RM-CESU)  
RM-CESU Cooperative Agreement Number: (WASO) **H2380040001**

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#### PROJECT COVER SHEET

Title of Project: National Park Service Migratory Species Workshop and Program Design

Name of Park/NPS Unit: Biological Resource Management Division, Natural Resource Program Center

Name of University Partner: University of Montana

NPS KEY OFFICIAL/ATR:

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COST OF PROJECT:

Direct Cost: \$57,130

Indirect Cost (17.5% CESU overhead): \$ 9,998

Total Cost: \$67,128

NPS ACCOUNT NUMBER and FUND SOURCE:

\$33,128. 2301-8111-NNS NPS NRPP Servicewide Funds

\$10,000 19462-0001-RZZ HFC-08-164-53

PROJECT SCHEDULE, FINAL PRODUCTS, AND PAYMENTS:

Date of Project Initiation: September 15, 2008

List of Products:

Phase I

Strategy session with PI and NPS technical contact

Identify national expertise and contacts for terrestrial, avian and freshwater and marine species

## Phase II

Workshop Location, Date, Duration, and Logistical Arrangements

Workshop Convened

Identification of top priority species, issues, research

Framework for NPS Migratory Species Program Designed

Final Recommendations and Presentations Compiled and delivered to NPS Technical Contact

Provide scientific data for educational information-brochures, web products

## Phase III

Recommendations for priority research projects and management application

Projects identified

Projects Implemented

Payment Schedule: Payment of regular invoices from the University, as received by the NPS.

Invoices are payable only if the reports and/or products have been received and approved by the NPS key official. The NPS will withhold payment of the final 10% of project funds until the NPS Key Official receives and approves the final report and/or project deliverables. The NPS will not pay invoices for less than \$200, unless it is the last invoice to close the project account.

Due Date for Final Report and/or Products:

Phase I:

April 30, 2009

Phase II

December 31, 2010

Phase III

July 1, 2013

End Date of Project: July 1, 2013

#### CONTRIBUTION OF PROJECT TO OBJECTIVES OF CESU:

The NPS RM-CESU Research Coordinator indicates, by initials here, that this project contributes to the purpose of the CESU and is consistent with the approved Mission Statement, Strategic and/or Annual Work Plan.

/s/ Initialed by Kathy Tonnessen, RM-CESU Research Coordinator, on

#### ATTACHMENTS

Attach, to this project cover sheet: 1) a Scope of Work that includes a detailed budget, list of products, and project schedule; and 2) Attachment Form 4.9.

#### FINAL REPORT

Upon project completion, the NPS park/unit must submit a copy of the final deliverables and/or final report (electronic copy required; paper copy optional) to the NPS RM-CESU Research Coordinator and to the RM-CESU host university (The University of Montana). Send electronic copies to [rmcesu@forestry.umt.edu](mailto:rmcesu@forestry.umt.edu) and/or [kathy\\_tonnessen@nps.gov](mailto:kathy_tonnessen@nps.gov). Mail paper copies to RM-CESU, The University of Montana, College of Forestry and Conservation, Missoula, MT 59812.

In addition, send a copy of the final report to the NPS Technical Information Center, which is the official repository for all NPS technical reports: National Park Service, Technical Information Center, P.O. Box 25287, Denver, CO 80225.

## RM-CESU CONTACTS

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## Purpose:

Our principal objective is to develop a strategy designed to provide the National Park Service (NPS) with a long term approach to dealing with many of the issues facing migratory species. NPS needs a strategic approach to assessing the number of species and critical habitat and linkages for species that spend a short and long periods of time within the boundaries of our parks. NPS also needs to acknowledge that parks are major attractants for our visitors because these species are present. Based on park Visitor Services Project (VSP) surveys, many visitors spend their time viewing wildlife. Without these resources visitors may seek alternative areas to invest their recreational time resulting in a loss of revenues and perhaps even loss of support for the parks.

In addition the NPS mission requires the preservation and protection of the resources of the parks. While NPS is not responsible for those resources outside our boundaries, NPS is dependent upon the management skills of others, partnerships, and the good fortunes of the traveling species being able to return to the parks. It is critical that NPS work closely with our neighbors who host these species, whether the migratory species move a short distance or thousands of miles as some of these shared species are known to move. It is critical that NPS has the scientific information and identifies the appropriate areas of focus as well as convene a cadre of professionals in the field of migratory species to design a short and long term framework that the NPS can build upon.

## Background:

From Ruby-throated hummingbirds to eels to humpback whales, many of the wildlife species found in U.S. national parks are migratory—they use the habitats of the national park system for important parts of their life histories, but they also spend a significant portion of their lives outside the boundaries of national parks. Indeed, many species may spend more of their lives outside rather than inside national park units. While some of these migrations may be to sites just a few miles outside national parks, many species migrate thousands of miles annually, crossing not just park boundaries, but international borders as well. Migratory Species: For the

purpose of this strategy, a migratory species is one which “uses” national park habitats for breeding, migrating, or wintering, leaves the park at a fairly predictable point (in most cases seasonally), and returns to the park at a later point in time, usually the following year.

NPS is the manager of over 83 million acres of terrestrial and aquatic habitat, much of which is important to migratory species. The variety of migratory species found in national parks is impressive. For example, over 300 species of Neotropical migratory birds are known to occur in national parks, and additional bird species use NPS sites for breeding, migration and wintering habitat. While many people are familiar with the phenomenon of bird migration, fewer realize that a much greater diversity of animal species also migrates regularly. Habitats found within the national park system important to migratory species include sea turtle breeding beaches, pronghorn, resting and breeding areas for seals and sea lions, salmon spawning areas, breeding and hibernation caves for migratory bats, calving areas and migration corridors for caribou, and numerous sites important to migratory insects.

The National Audubon Society and the American Bird Conservancy have designated over 60 NPS units as “Important Bird Areas” (IBAs) These NPS units have been selected because they contain habitat that supports species of conservation concern or are of importance to migratory birds as either breeding areas, stopover sites used during migration, or as wintering habitat. These include such diverse NPS units as Dry Tortugas National Park, Acadia National Park and Point Reyes National Seashore. The NPS also manages 72 coastal and marine sites, with over 3 million acres of submerged lands and waters and over 4,600 miles of coastline, much of it important to migratory marine species.

Migratory species pose a unique challenge to managers of national parks. In the 1916 National Park Service Organic Act, the NPS is instructed that the primary purpose of national parks is to “conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.” This gives the NPS a clear mandate to conserve wildlife living within the boundaries of a particular park. It says nothing specifically about what the NPS should do to ensure that species that migrate to, from and through national parks will be “unimpaired.” The Organic Act was, of course, written in a time when the links between wildlife populations inside and outside national parks was not understood and when the external threats facing parks currently were barely imagined.

Even today, when “external threats” to the national parks are discussed, they typically refer to threats occurring in the immediate proximity to a particular park or threats with a more immediately recognizable impact on a park—encroaching development, water and air pollution, etc. Rarely are threats that migratory species face hundreds or thousands of miles from a national park acknowledged as impacting the park’s ecology as well.

Today, the threats to migratory species outside (and sometimes inside) national parks are well documented: habitat loss and fragmentation, pesticides, overharvesting, invasive species, collisions with buildings and communication towers, and many more. These threats to migratory species pose an ever increasing challenge to the ability of the NPS (and others) to carry out its mission to preserve park resources.

Managing even “resident” species has proven to be difficult in many national parks, where the NPS has nearly complete control over the species’ habitat. Preserving migratory species in the national parks is significantly more complicated, because this requires NPS collaboration with other agencies, organizations and even countries. Coordination with adjacent landowners is essential, but truly effective action to preserve migratory species requires collaboration at all levels and partnerships between government agencies and non-governmental organizations, including international partnerships.

The NPS stands to gain much from increasing its involvement in efforts to preserve migratory species. The work done by the NPS within parks to protect the habitat used by the great diversity of migratory species is also enhanced through collaborative actions with other organizations.

For the last few decades, a variety of partnerships and other institutional arrangements has been developed to better coordinate efforts to preserve and/or manage migratory species. These include Partners in Flight, the North American Bird Conservation Initiative, Fishery Management Councils, the North American Pollinator Protection Campaign, and others. These have helped facilitate collaboration between government agencies and non-governmental organizations, particularly with migratory bird conservation. However, the National Park Service’s participation in these partnerships has generally been uncoordinated and sporadic, making it difficult for NPS to incorporate its concerns into these partnerships. For the NPS to have a greater role in

protecting the parks' migratory species, it needs to become much more active in these partnerships on a programmatic level.

### Migratory Species: Values and Threats

“Actions to preserve biodiversity cannot be limited to park areas, for parks are often parts of larger ecosystems that encompass them. To encourage ecological stewardship outside the parks, the Service should cooperate extensively with its neighbors – federal agencies, states, counties, cities, tribes, the private sector, even other countries. Parks cannot survive as islands of biodiversity. They need to be linked with other natural areas through wildlife migratory corridors and greenways. These connections can only be created through partnerships. The National Park Service should be an active participant in a national effort to create such connections.” From *Rethinking the National Parks for the 21<sup>st</sup> Century*, National Park System Advisory Board, 2001

Many migratory species play important roles in the ecological integrity of national parks. They serve as both important predators (often on insect “pests”) and as food for other animals (e.g. salmon which provide important food resources for bears and other species); they pollinate a wide diversity of plants; and they act as dispersal agents for many types of seeds. More generally, various migratory species are used as indicators of overall ecosystem health. In many cases migratory species serve as keystone species in national parks, such as salmon in Alaskan parks. Without these keystone species and the ecosystem services they provide, the long-term ecological health of many national parks would be jeopardized.

### Recreation

Bird and wildlife related activities are a significant component of recreation for a large section of the American public, and an important reason why many visitors come to national parks. More than 80 million residents of the United States participate annually in wildlife related recreation; more than 60 million of them watch and enjoy birds. The NPS Visitor Services Project (VSP) surveys park visitors about their activities during park visits. While the results of these surveys must be considered with care, as they are essentially “snapshots” taken of a small segment of a

park's visitation during a specific timeframe, they do indicate that wildlife watching is an important part of the national park "experience" for many visitors. Consider these examples:

- Surveys at several parks indicate that bird watching is an activity of interest to many visitors; for example, at Everglades National Park, 73% of visitors surveyed indicated that bird watching was an activity in which they participated during their visit (the most commonly listed activity at that park).
- At Channel Islands National Park, the most commonly listed activity was marine mammal watching—45% of visitors listed that as an activity in which they participated.
- The more general category of wildlife watching was listed as an activity by even higher percentages of respondents at several parks—93% at Yellowstone National Park, and 88% at Grand Teton National Park, for example.

While these surveys do not break out the migratory species from the overall wildlife/bird watching categories, many of the wildlife species that visitors observe in national parks are migratory. For example, 60% of Yellowstone National Park's breeding bird species are Neotropical migrants. At Great Smoky Mountains National Park, 180 of the 240 birds regularly found in the park are migratory. Quite a few national parks are well-known in the birding community as excellent areas to observe migratory birds, including Everglades, Chiricahua, Big Bend, Point Reyes, Gateway (Jamaica Bay) and many of the coastal parks. (I would say we should include New Jersey Coastal Heritage Trail Route as it incorporates Cape May, one of the most famous migration sites, though most people don't know it is included within an NPS unit.) Kennesaw Mountain National Battlefield, though established primarily to protect its historical resources, is also well-known as one of the premier birding destinations in the Southeast and attracts birds and birders in impressive numbers.

Other national parks are well-known for different types of migratory species. Humpback and other whale species thrill visitors to Glacier Bay National Park. Marine mammals (whales, seals, sea lions) also attract many visitors at Point Reyes National Seashore and Channel Islands National Park, as do sea turtles at Padre Island National Seashore. A major attraction at Carlsbad Caverns is the nightly "bat flight" during the summer months, when thousands of migratory Mexican free-tailed bats leave the cave for their nocturnal hunt. Many of the pronghorn and elk

observed by summer visitors to Yellowstone National Park migrate out of the park to lower elevations every winter.

## Economic Benefits

Quantifying the economic benefits that result from the “ecosystem services” (e.g., clean air and water, pollination, pest control, etc.) provided by parks and other protected areas is an emerging area of research. Some migratory species clearly have a role in the provision of ecosystem services, particularly in the area of pollination and pest control. While the quantification of the economic benefits of ecosystem services is very complicated and evolving, there is at least one area in which the economic benefits derived from migratory species has been calculated with some precision – the economics of bird watching. The U.S. Fish and Wildlife Service estimated that, in 2001, bird watching alone provided over \$85 billion in economic benefits to the nation. This figure does not include the economic benefits provided by other forms of migratory wildlife watching – whale watching at Glacier Bay, Cabrillo or Channel Islands, for example, bat watching at Carlsbad Caverns, or sea turtle watching at nesting sites at places like Padre Island and Canaveral National Seashores. The loss of migratory birds and other species could potentially have negative impacts on the communities and businesses surrounding the parks which are dependent on the maintenance of healthy parks.

The populations of many different migratory species have declined significantly (including many species of Neotropical migratory birds, bats, monarch butterflies, and sea turtles) over the last couple decades. These declines are due to a number of threats that are still extant today, and are threatening a natural phenomenon that has evolved over millions of years. These threats include:

- Direct loss of habitat, including stopover sites
- Habitat fragmentation (which often leads to increased predation, parasitism)
- Pesticide and herbicide use
- Hunting and overharvesting of migratory species and their food sources
- Impediments to movement—fences, dams, buildings, lights, communication towers, etc.
- Contaminants
- Invasive exotic species (predation by cats and rats, competition for nesting areas and food, and diseases)

## NPS Migratory Species Program

The NPS currently has one partnership contract that focuses on migratory species. This is the Park Flight Migratory Bird Program, through which the NPS has implemented projects for migratory bird monitoring and education in U.S. national parks and Latin American protected areas, brought Latin American biologists and park managers to U.S. national parks for training and exchange opportunities, provided technical assistance to parks and protected areas in Latin America, established links with various bird conservation organizations and partnerships, and increased NPS participation in International Migratory Bird Day and other bird conservation activities.

Other NPS work on migratory species has been coordinated at the park level. In particular, individual parks have conducted projects related to migratory birds. A smaller number of parks have worked on a host of other migratory species including mammals, sea turtles, salmon, insects and others.

However, there has been very little overall coordination of these activities at the national or even regional level, making it much more difficult for the NPS to play a constructive and influential role in the major partnerships that are the key decision-makers and priority setters in migratory species conservation.

To help ensure that future generations of migratory species return to national parks, and to ensure that future generations of visitors can enjoy these species, an NPS Migratory Species Strategy at a WASO Programmatic level is required.

This program will protect and enhance opportunities for the enjoyment of migratory species in the National Park system, and increase awareness of the importance of migratory species for their intrinsic, ecological, recreational and economic significance, and to increase recognition of the critical role migratory species play in connecting NPS units and other areas.

## Vision

By 2010, the NPS, in furtherance of its mission, will be an active partner in national and international efforts to protect, restore and manage shared migratory species and their habitats.

Essential steps in improving the NPS's management of migratory species include:

- The acquisition of information about which migratory species occur in the national parks, where they migrate through and to, and the conservation requirements of migratory species. It is also important to have a good understanding of what research, inventory and monitoring, management, and restoration of migratory species is currently taking place in the national park system, and beyond our boundaries
- Working with partners, develop a comprehensive, user-friendly database of migratory species that breed, migrate through, or winter in NPS sites that identifies the non-NPS areas that host these species when not in the national park system. This database will be linked to the "NPSpecies" database currently being developed. As knowledge about where specific populations or individuals migrate, this will be integrated into the database. The database will indicate which species are classified as Threatened or Endangered, watchlist, species of special concern, CEC list, etc, and will also catalog what NPS sites are identified as Important Bird Areas (IBAs) or are otherwise identified as priority habitat for migratory species. This database will provide vital information as the NPS looks to establish partnerships with areas that host shared species.
- Catalog what NPS is currently doing regarding migratory species. These could include Inventory and Monitoring efforts, Breeding Bird Surveys, Monitoring Avian Productivity and Survival (MAPS) stations and other banding programs, point count data, breeding bird atlases, Investigators' Annual Reports for research, management actions, restoration efforts, educational and interpretive activities, etc. Also catalog which parks and/or NPS employees are involved in Park Flight, Partners in Flight, Bird Conservation Region efforts, Joint Ventures, Fishery Management Councils, etc., and/or are members of species specialist groups, scientific advisory boards, etc. This should also include cataloging the specific planning documents parks may have for migratory species (e.g., Avian Conservation Plans), and which parks have incorporated migratory species into their General Management Plans, etc. The individuals responsible for conducting these

projects—NPS employees, contractors, researchers, volunteers, etc.—will also be identified.

- Identify key migratory species habitat within the national park system. This should include the identification of both entire parks that have been designated as important to migratory species as well as specific areas within individual national parks of particular high importance for migratory species (e.g. sea turtle nesting sites, caves of high importance for migratory bats, etc.). This will facilitate the setting of priorities for migratory species conservation efforts.
- Coordinate with parks and other program areas to determine those migratory species which have been included as part of park performance measures for species of management concern.
- Identify the key long-term and short-term research and monitoring needs for migratory species in the national park system. For both long-lived species such as sea turtles and marine mammals and to gain a better understanding of trends in populations of migratory species, long-term monitoring is essential.
- Work with partners, increase research into conservation requirements for migratory species. The key threats to migratory species in and outside national parks will be identified.
- Work with various partners, increase research that identifies the specific areas to where migratory species found in the national park system migrate. This may include such techniques as satellite transmitters, DNA genetic studies, isotope analysis, etc.
- Integrate migratory species concerns into NPS management, operations and planning efforts and develop educational materials such as brochures, web-based products to ensure communicate to target audiences

## Scope of Work

The University will:

1. Collaborate with Biological Resource Management Division staff to establish a date, location, and duration of a scientific workshop to convene a cadre of nationally recognized scientists-experts in the field of migratory species and their habitats.

### Phase I

Strategy session with PI and NPS Technical Contact

Identify national expertise and contacts for terrestrial, avian and freshwater and marine species

### Phase II

Workshop Location, Date, Duration, and Logistical Arrangements

Workshop Convened

Identification of top priority species, issues, research

Framework for NPS Migratory Species Program Designed

Final Papers and Presentations Compiled and delivered to Key Official

Provide scientific data for educational information-brochures, web products

### Phase III

Recommendations for priority research projects and management application

Projects identified

Projects Implemented and final reports received by July 1, 2013.

The NPS will

1. Collaborate with the cooperator to:

### Phase I

Strategy session with PI and NPS

Identify national expertise and contacts for terrestrial, avian and freshwater and marine species

### Phase II

Workshop Location, Date, Duration, and Logistical Arrangements

Workshop Convened

Identification of top priority species, issues, research

Framework for NPS Migratory Species Program Designed

Final Papers and Presentations Compiled and delivered to Key Official

Provide scientific data for educational information-brochures, web products

### Phase III

Recommendations for priority research projects and management application

Projects identified

Projects Implemented and completed by July 1, 2013

### Products:

1. Symposium/conference to be held in 2010 with date, location, duration, presenters to be determined during the project duration.
2. Compilation of final papers, presentations, and other materials presented at conference to the park.

Schedule:

Due Date for Final Report and/or Products:

Phase I:

April 30, 2009

Phase II

December 31, 2010

Phase III

July 1, 2013

End Date of Project: July 1, 2013