



Moving Beyond Science to Protect a Mammalian Migration Corridor

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Abstract: *As the discipline of conservation biology evolves and practitioners grow increasingly concerned about how to put results into achievable conservation, it is still unclear the extent to which science drives conservation outcomes, especially across rural landscapes. We addressed this issue by examining the role of science in the protection of a biological corridor. Our focus is on a North American endemic mammal reliant on long distance migration as an adaptive strategy, the pronghorn (*Antilocapra americana*) of the southern Greater Yellowstone Ecosystem. The role of science in realizing policy change, while critical as a first step, was surprisingly small relative to the role of other human dimensions. In a case study, we strategically addressed a variety of conservation needs beyond science, first by building a partnership between government and private interests and then by enhancing interest in migratory phenomena across a landscape with divergent political ideologies and economic bases. By developing awareness and even people's pride in the concept of corridor conservation, we achieved local, state, and federal acceptance for protection of a 70 km long, 2 km wide pathway for the longest terrestrial migrant in the contiguous United States. Key steps included conducting and publishing research that defined the migration corridor; fostering a variety of media coverage at local, regional, and national levels; conducting public outreach through stakeholder workshops, meetings, and presentations; and meeting with and gaining the support of elected officials. All these contributed to the eventual policy change that created the first federally protected migration corridor in the United States, which in turn stimulated additional conservation actions. On the basis of our experience, we believe conservation scientists can and should step beyond traditional research roles to assist with on-the-ground conservation by engaging in aspects of conservation that involve local communities and public policy.*

Keywords: Grand Teton National Park, policy, pronghorn, protection

Ir Más Allá de la Ciencia para Proteger un Corredor Migratorio de Mamíferos

Resumen: *Mientras la disciplina de la Biología de la Conservación evoluciona y quienes la practican cada vez están más preocupados por cómo transformar los resultados en conservación realizable, todavía no está claro el alcance que la ciencia tiene dentro de los resultados, especialmente en paisajes rurales. Abordamos este tema al examinar el papel de la ciencia en la protección de un corredor biológico. Nuestro enfoque es sobre un mamífero endémico de Norteamérica, dependiente de la migración a larga distancia como una estrategia adaptativa, el berrendo (*Antilocapra americana*) de la parte sur del ecosistema Greater Yellowstone. El papel de la ciencia en la obtención del cambio de política, un primer paso crítico, fue sorprendentemente pequeño en relación con el papel de otras dimensiones humanas. En un estudio de caso, abordamos estratégicamente una variedad de necesidades de conservación que van más allá de la ciencia, primero construyendo una colaboración entre el gobierno y los intereses privados y después aumentando el interés en los fenómenos migratorios a través de un paisaje con ideologías políticas divergentes y bases económicas. Al desarrollar la conciencia e incluso el orgullo de las personas por el concepto de la conservación de corredores, logramos la aceptación local, estatal y federal para la protección de una ruta de 70 Km de largo y 2 Km de ancho para la migración terrestre más larga de los Estados Unidos contiguos. Los pasos clave incluyeron realizar*

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y publicar investigaciones que definieron al corredor migratorio; fomentar una variedad de medios de cobertura en los niveles locales, regionales y nacionales; conducir al alcance público a través de talleres para depositarios, juntas y presentaciones; y reunirse con y obtener el apoyo de los oficiales electos. Todos estos pasos contribuyeron al eventual cambio en las políticas que crearon el primer corredor migratorio con protección federal en los Estados Unidos, que en cambio estimuló acciones de conservación adicionales. Basados en nuestra experiencia, creemos que los científicos de la conservación pueden y deben ir más allá de los papeles tradicionales de la investigación para asistir en la conservación en el lugar al involucrarse en aspectos de la conservación que involucren a las comunidades locales y a la política pública.

Palabras Clave: Berrendo, Parque Nacional Grand Teton, política, protección

Introduction

Science is at the core of understanding life and, heuristically, at the core of conservation biology (Soule 1986). But to what extent is science necessary to execute actionable conservation? We examined the complexities of this question through a case study where science led to policy changes and the protection of a migration corridor. The short answer in our opinion is that science is of limited utility to achieving relevant conservation actions, but it offers a first step. Conservation involves people, and people complicate conservation, even when science is unambiguous. Our intent here is not to belittle science, but to challenge conservation biologists to look beyond science when asking how best to move conservation forward.

The establishment and protection of biological corridors is central to practical conservation (Hilty et al. 2006, 2012). For instance, critical biodiversity cannot be protected solely in protected areas, and protected areas will never blanket most peopled regions. Further, because habitat loss and fragmentation will continue, the extent to which species of concern will have access to areas needed for their viability will be challenged increasingly. Finally, if movement routes for plants and animals are to buffer against climate change, a degree of connectivity must persist (Beier & Gregory 2012).

While the results of scientific study point to vital areas of inquiry associated with corridor biology, including components of demography, genetics, and modeling of animal movements, the topic of how to achieve connectivity looms in the realm of human dimensions. If conservation victories are to be achieved, weighty and well planned engagement with the public, agencies, and other stakeholders, and often appearances at board and ministerial or higher administrative level meetings are required (Weber & Vedder 2001).

At the plenary lecture of the 2012 North American meetings of the Society of Conservation Biology, Michael Soule, past president and a founder of SCB, was interviewed by a journalist (Hannibal 2012). When asked about successes for corridor protection, Soule acknowledged only one formal example in the United States, dating back about 5 years. Here, we used that case to detail events that worked and challenged the process

leading to the creation of the United States' first federally protected migration corridor, known colloquially as Path of the Pronghorn (POP). At a more comprehensive level, we use POP to illustrate key differences between doing ecological research in conservation and doing conservation.

Corridors in Context

Corridors have different ecological connotations. Functionally, they generally involve broad swaths of native land cover that connect reserves or wild areas. As such, they ensure some demographic stability and gene flow (Hilty et al. 2006). The public can generally understand the concept of biological corridors, especially through examples involving iconic migratory species. For instance, the public generally comprehends more easily the movement needs of individual elephants or grizzly bears than those of insects or amphibians.

In the western hemisphere, the longest terrestrial migrations south of Canada are those of pronghorn (*Antilocapra americana*) (Berger 2004), North America's sole surviving endemic ungulate (Byers 1998). In the ~100,000 km² Greater Yellowstone Ecosystem (GYE), 300–400 pronghorn move from summering ranges in Grand Teton National Park (GTNP) to winter ranges several hundred kilometers south, a lengthy round trip annual migration of up to 700 km (Fig. 1). Winter conditions in the GTNP area are not conducive to pronghorn survival; thus, a seasonal migration is required for their long-term persistence. The route traverses a variety of public and private lands with 3 noteworthy bottlenecks. Two are less than 200 m wide and the result of constrictions caused by human development. A third 1 km wide natural bottleneck occurs in an area bounded by rivers, where American Indians harvested pronghorn for at least 6000 years (Miller & Saunders 2000). Known as Trappers Point, this passage remains biologically, historically, and culturally important (Berger et al. 2006).

It appeared that, without some sort of preemptory conservation, this exceptionally long migration route (Fig. 1), a lifeline for GTNP's pronghorn herd, would be severed, as had most in the GYE (Berger et al. 2006). Despite

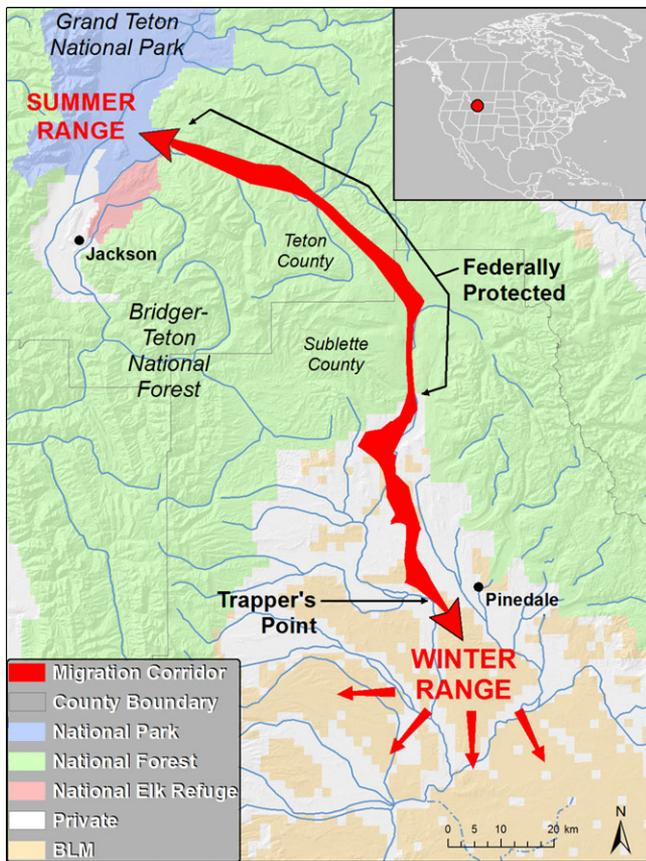


Figure 1. The Path of the Pronghorn in the western United States. The federally protected portion of the corridor is on U.S. Forest Service (Bridger-Teton) lands between Grand Teton National Park and private and Bureau of Land Management (BLM) lands to the south and traverses 2 counties.

numerous ecological studies in the region, including an agency report that documented pronghorn movements with VHF radio collars (Sawyer & Lindzey 2000), the available science at the time had done little to protect this specific migration route.

A Project to Generate Initial Data

Because inferences about the ecological scale of individual movements were limited by VHF collar data, whereby days or weeks elapsed between successive animal locations, we deployed GPS technology to describe more explicitly pronghorn migration (Supporting Information). We did this to determine precisely the extent to which pronghorn rely on a specific corridor and to evaluate threats represented by traditional land uses and expanding petroleum fields and leases across western Wyoming (Beckmann et al. 2012).

Our studies revealed pronghorn use a single, invariant migration route (Fig. 1) through the above described 3 geographic bottlenecks, a compelling basis for safeguarding

the pathway for future migrations. Scientific publication of this work played an important first step in helping raise awareness of this conservation issue and provided the credibility and standing necessary to begin negotiating for conservation action among a complex and diverse field of potential stakeholders (Table 1).

Building Support for Conservation Action

In querying how science might facilitate conservation action, important social impediments quickly emerged. At both local and national scales, apart from traditional wildlife advocates, including state and federal wildlife managers, there was little recognition of ungulate migration routes, let alone support for pronghorn conservation. This was especially true in Wyoming, where pronghorn are almost as abundant as humans (close to 500,000). Hence, the notion of doing something to protect some 300–400 migratory pronghorn in and out of a national park was not viewed as a high priority. Within Wyoming the argument that the potential severing of this migration route (Fig. 1) would likely lead to the extirpation of an important species from one of North America's 10 most visited national parks, where a fully functional predator-prey system involving all native large carnivores and ungulates still operated, carried little weight. Functionality is not a central issue to most of the public.

Although there are many paths in conservation planning (Beier and Noss 1998; Groves 2005), our initial goals were to build a public consciousness and tangible support for assuring the persistence of migrations among local stakeholders. We touted a common theme—why long distance migrations in Wyoming were worthy of national recognition. The strategy involved several elements that we deemed essential for success, including consideration of disparate cultural landscapes through which the migration route passed; dialog with energy companies active in the area; raising awareness among the conservation community through a peer-reviewed essay on migration; publication of our results about migration; meetings with elected officials; engagement with the media, and targeted presentations to the public, business groups, NGOs, and local, state, and federal agency officials (summarized in Table 1). During public presentations, we solicited local views by asking the audiences 3 questions: Do pronghorn migrations matter? If so, is protection needed? And, if needed, how best can protection be achieved?

Addressing Variation in Cultural Landscapes

Because cultural perspectives vary greatly within the geographical region of the migration route, we developed profiles of land use, business potential, education, and political leanings in the 2 primary counties (Teton and Sublette) through which pronghorn migrate (Fig. 1).

Table 1. Key stakeholders and attendees^a at nonscience meetings involving corridor protection in the southern Greater Yellowstone Ecosystem.

<i>Key stakeholders</i>	<i>Acronym</i>	<i>Status or role</i>
Bureau of Land Management ^{b,c}	BLM	federal oversight—BLM lands
Grand Teton National Park ^{b,c}	GTNP	federal oversight—NPS lands, pronghorn summering area
Greater Yellowstone Coalition ^{b,c}	GYC	NGO—conservation
Jackson Hole Conservation Alliance ^{b,c}	JHCA	NGO—conservation
National Park Service	NPS	federal oversight—parks and wildlife on park lands
Shell Exploration & Production ^{b,c}	SEPCO	private—energy development
Sublette County Commissioners ^c	SCC	county government
Sublette County Land Trust ^c	SCLT	NGO—land conservation
Teton County Commissioners ^{b,c}	TCC	county government
Upper Green River Cattleman's Association ^{b,c}	GRCA	private—livestock grazing
Upper Green River Valley Coalition ^{b,c}	UGRVC	NGO—conservation
US Fish and Wildlife Service ^{b,c}	USFWS	federal oversight—national wildlife refuges
US Forest Service ^{b,c}	USFS	federal oversight—national forests
Wildlife Conservation Society ^{b,c}	WCS	NGO—science and conservation
Wyoming Game and Fish Department ^{b,c}	WGFD	state wildlife agency
Wyoming Department of Transportation ^c	WDOT	state highway and roads agency
Wyoming Governor's Office ^{b,c}		state government
Wyoming Outdoor Council ^b	WOC	NGO—conservation

^aThe following groups not mentioned above, in addition to the public at large, also attended public hearing on corridor protection—the Pinedale Town Council, Ultra Petroleum, Wyoming Wildlife Federation, Wyoming Wildlife Trust Board, Wyoming Sportsmen for Fish & Wildlife, Green River Land Trust, and the Jackson Hole Chamber of Commerce.

^bAttended Path of the Pronghorn conservation workshop, meeting, or presentation.

^cWildlife Conservation Society conferral to discuss corridor protection.

Possessing an understanding of the social, demographic, and ecological milieu seemed essential if we were to avoid a distasteful forcing of our conservation values. Whereas Teton County has over 3 million visitors/year (due to proximity of world-class skiing and 2 iconic national parks), Sublette County is a leader in energy production and development of major natural gas reserves (Fig. 2). County similarities included total size of land area and the proportion of high school graduates. Key differences were professional and science training, work force (Berger & Beckmann 2010), food and tourist capacity, energy-related industry, natural resource use, and national election voting tendencies (Fig. 2). For instance, during the 2008 and 2012 presidential elections, nearly a 4-fold difference distinguished county support for candidates representing the country's 2 primary political parties (Fig. 2). Given such strong county-specific variation, we used the same overall message about conservation in each county but carefully avoided offending those with fundamentally dissimilar views.

Finding Support and the Difficulty of Gaining Credibility

J.B. initially approached Shell Exploration and Production Company (SEPCO) about potential funding for continued migration research in the area because they and other energy companies in western Wyoming had supported local studies on Sage Grouse (*Centrocercus urophasianus*) and mule deer (*Odocoileus hemionus*). The approach to SEPCO was through the Wildlife Conservation Soci-

ety (WCS) and was risky because WCS was generally unknown in western Wyoming. Shell expressed little interest in pronghorn or funding WCS.

Months later, however, as a consequence of events described below, SEPCO eventually asked J.B. (on behalf of WCS) to submit a proposal focused on pronghorn in gas fields. After review, SEPCO agreed to fund a 5-year WCS project on pronghorn ecology, but they funded research only on sites in and adjacent to gas fields. Although these monies were not for conservation efforts or the study of migration pathways, the funding received by WCS had positive effects. It demonstrated a collaboration between industry and a conservation NGO, which ultimately led to meetings with high level political figures (details below and summarized in Table 2).

Further, to facilitate establishment of professional standing, a paper—"Is It Acceptable to Let a Species Go Extinct in a National Park?"—was published that emphasized how activities beyond protected areas, including energy development, might jeopardize the viability of species reliant on parks (Berger 2003). The paper highlighted that National Park Service (NPS) policy is explicit about empowering park managers to protect resources even when impediments to conservation derive from areas beyond park borders. Clearly, the migration route of Grand Teton pronghorn met these criteria, and the paper challenged park supervisors throughout NPS units to do more to dampen the many threats to NPS biodiversity.

Subsequently, we defined the explicit migration routes of 10 adult female pronghorn with 11,000 position fixes from GPS collars that documented 16 migration cycles

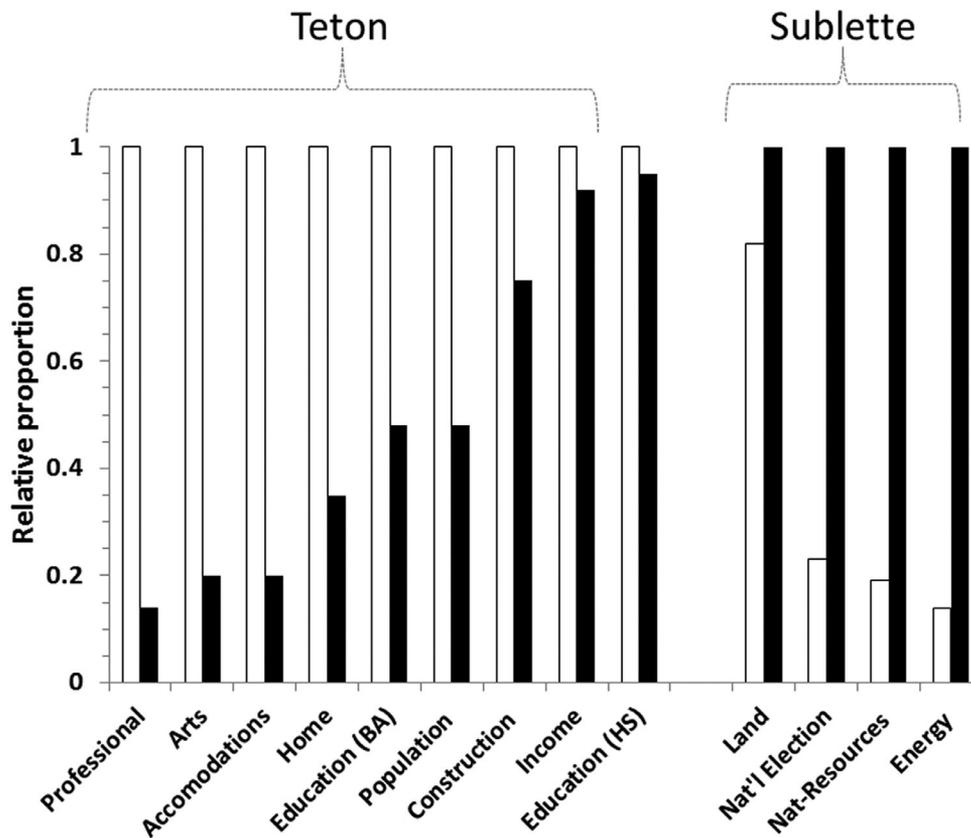


Figure 2. Teton (white) and Sublette (black) county attributes compared by setting the larger of the county values at 1 and the smaller value as a proportion of the larger (energy and nat-resources, gas, and other energy production, mining, forestry, fishing, hunting, and agriculture; national elections, average ratio of votes for Republican:Democrat presidential candidates in 2008 and 2012; land, area of the county (baseline used was for Sublette, 12,511 km²); education, >25 years old with high school and bachelor degrees or higher; income and home, median household income, and home price (baselines are for Teton, \$75,904 and \$793,542, respectively); population, baseline is for Teton (21,675); accommodations, art, and professional refer to lodging and restaurants, theater, plays, shops, and scientists, medical, and other professional personnel). All data are from 2009 unless otherwise indicated. Sources: http://www.city-data.com/county/Sublette_County-WY.html#ixzz2RmoKNj2K; http://www.city-data.com/county/Sublette_County-WY.html#ixzz2Rmne59qB; http://www.city-data.com/county/Teton_County-WY.html#ixzz2Rmf8TK1Q; http://www.city-data.com/county/Sublette_County-WY.html#ixzz2Rmod7xXe; http://www.city-data.com/county/Teton_County-WY.html#ixzz2RmdIBZqd; http://www.city-data.com/county/Teton_County-WY.html#ixzz2RmekIPAx; and <http://www.cnn.com/election/2012/results/state/WY#president>.

(Berger et al. 2006). Importantly, funding for this conservation, science-based endeavor stemmed from a private-federal partnership between WCS and NPS.

In addition to raising the migration-connectivity issue through peer-reviewed publications, J.B. and other WCS representatives arranged public meetings and workshops and presented information on challenges to conserving migrations at local, national, and global levels. These efforts required those involved to move away from science and, instead, become part-time information brokers and part-time conservation advocates. To conceptualize the place and context for resonance with the

public, the moniker POP was adopted. A broad spectrum of stakeholders was invited to attend local workshops (Table 1). At these, we began by showcasing the science of migration.

Imparting Information and Building Trust

Workshop attendees recognized the global significance of the migration, that its protection would likely avoid extirpation of pronghorn from GTNP (whose economic contribution to the local economy is well recognized), that a protected corridor could benefit other wildlife,

Table 2. Chronology of conservation milestones that promoted protection of Path of the Pronghorn in the western United States.

Year	Type	Description*
<2003	context	75% of GYE pronghorn migrations lost (Berger et al. 2006)
2003	context/ outreach	Is extinction acceptable in national parks? (Berger 2003)
2003–2004	science	GPS collar migration study (Supporting Information)
2004	media	<i>The New York Times</i> —Endangered Migration (Robbins 2004)
2006	science	Publication of POP migration research (Berger et al. 2006)
2006	science/ media	Informal digital distribution of migration route polygon
2006	outreach	First annual “Party for the Pronghorn” JHCA and local business
2006	support	Teton County Commission letter to WY governor to support migration corridor protection
2007	media	<i>The New York Times</i> commissioned editorial “Let the Antelope Roam” (Berger and Berger 2006)
2007	media	<i>Smithsonian</i> “End of the Road?” (Glick 2007)
2004–2007	outreach	WCS-led stakeholder (Table 1) workshops, meetings, presentations
2007	support	Western Governors Association Policy Resolution 07–01 to protect corridors
2008	support	Pledge of POP protection support by GTNP, NER, BTNF (GTNP, unpublished data)
2008	outreach	Migration waysides unveiled GTNP, WGFD, BTNF, NER
2008	policy change/protection	First federal protection of migration corridor in United States, POP through BTNF (BTNF 2008)
2008	protection	DOI pledges \$1 million to help further protect POP
2008 to present	protection	Continued conservation work by NGOs and private land owners

*Abbreviations: POP, Path of the Pronghorn; JHCA, Jackson Hole Conservation Alliance; WCS, Wildlife Conservation Society; GTNP, Grand Teton National Park; NER, National Elk Refuge; BTNF, Bridger-Teton National Forest; WGFD, Wyoming Game and Fish Department; DOI, United States Department of Interior.

that pronghorn were noncontroversial because, unlike wolves (*Canis lupus*) or grizzly bears (*Ursus arctos*), they did not eat livestock, that pronghorn were an icon of Wyoming and the American West, and finally that preserving migration corridors was compatible with traditional land uses. Others viewed the migration as a possible foundation for economic development, for which education opportunities existed, and acknowledged that the migration itself was of archaeological, historical, and biological significance. Further, a protected corridor could also increase private property values along the route.

Notable concerns in Sublette County were neither WCS nor the facilitators were vested in the local culture; wariness of potential federal legislation to protect the corridor and associated restrictions on current land use practices, including extractive industry development and livestock grazing; pronghorn face no immediate crisis; and lack of support by Wyoming’s congressional delegates. However, because WCS biologists had begun working on pronghorn locally with SEPCO and other industry funding, some of these concerns were tempered.

During deliberations we circumvented extolling a mainstay of conservation—that connectivity benefits multiple species and ecosystem processes. Specifically, we avoided such discussion because of clear sensitivity associated with local perceptions that conservation agen-

das aim to foster expanded ranges of wolves and grizzly bears or the federal listing of Sage Grouse as a threatened or endangered species. Further, we avoided association with groups touting the free movements of elk (*Cervus elaphus*) or bison (*Bison bison*) through corridors because, despite their iconic status, these species carried twin liabilities—possible economic damage through brucellosis transmission to livestock and from consumption of crop and standing forage (Berger & Cain 1999; Cain et al. 2012). Finally, we did not mention benefits to lesser known species, such as white-tailed jackrabbits (*Lepus townsendii*), whose movements would increase through corridors but whose supporters were ridiculed locally as bunny huggers. In other words, our focus remained solely on pronghorn because they were not controversial.

As more meetings and talks were held in both counties, we broadened our audiences and involved business councils and chambers of commerce. To increase outreach, we facilitated popular articles about POP in local papers, *National Geographic*, *Smithsonian*, *The New York Times*, *Washington Post*, and other outlets—all of which suggested that our awareness building strategy was working (Table 2).

The escalating recognition for POP coupled with funding from industry helped J.B. secure a 2005 meeting with Wyoming Governor, Dave Freudenthal. When asked if the idea of garnering protection for POP was something

his office might support, the governor expressed wariness, wondering if pronghorn were a guise to develop a migration corridor for bison and elk. When it became clear that the issue was about pronghorn only and not a thinly veiled plot for extreme efforts to conserve other migratory species, the door opened. The governor liked our argument that because Wyoming could claim the world's first national park (1872—Yellowstone), its first national monument (1906—Devils Tower), and the first national forest (1891—Shoshone), why shouldn't it also claim the first federally protected migration corridor? Pointing out that Wyoming had no statutory authority over federal land designations, Freudenthal hinted that if Sublette and Teton Counties could be convinced that protection of POP was a good idea, he would see what he could do to help.

The effect of these multiyear efforts—involvement with local groups about pronghorn migration, exposure in local media, and support by environmental NGOs and the local offices of the Wyoming Game and Fish Department (WGFD)—was that pronghorn were becoming iconic and the poster child for migration conservation. Regional NGOs (including Upper Green River Valley Coalition, Greater Yellowstone Coalition, Jackson Hole Conservation Alliance [JHCA], Wyoming Outdoor Council, and the Wilderness Society) predictably supported the conservation efforts (Table 1).

A Conservation Gambit

Strategy Building and Trade-Offs

In 2006 our efforts suffered a setback: Sublette County's distrust of some NGOs was heightened when a grazing allotment was petitioned for legal challenge, alleging that cattle on U.S. Forest Service (USFS) lands would negatively affect pronghorn migration. Consequently, the Sublette County-based Upper Green River Cattlemen's Association (GRCA) withdrew support for any conservation action involving pronghorn (A. Somers, personal communication). In response and stepping away from a de facto alliance with other NGOs, WCS asked to be subpoenaed as an expert witness to offer testimony that ecological overlap between pronghorn and cattle is small (McInnis & Vavra 1987). Importantly, the scientific standing of WCS had a positive local effect in this case, not only because of the impending litigation, but also because the GRCA and other Sublette residents realized their economic livelihoods were being considered on par with conserving pronghorn. Here, activism, science, trust, and engagement at levels involving very basic cultural values were all important ingredients in building support for POP.

Nevertheless, we deemed it important to develop a stronger plan than happenstance to bolster support in Sublette County. There, about 10% of the pronghorn migration route crossed private lands in addition to public properties. Some ranchers and home owners felt any federal legislation for POP might jeopardize their personal freedoms. Governor Freudenthal's preemptory warning that he would not get involved if Sublette County residents were not supportive became our next hurdle and a central issue that was to force an unpleasant decision on our part.

Either we (WCS) commit additional time and monies trying to garner Sublette County backing, which appeared somewhat futile after several years of effort and expenditures, or we re-direct efforts more fully to Teton County, where receptivity for park conservation issues and migrations was much stronger. By concentrating on Teton County, we hoped that a ground swell of support there might prompt Sublette County federal stewards (Bureau of Land Management [BLM]) and private land holders to be more helpful because the migrating pronghorn were a common resource. Our decision to focus on Teton County was strategic, if not desperate at that point.

Momentum and Success

In 2006 *The New York Times* published an op-ed in support of pronghorn migration (Berger & Berger 2006). Also, the Teton County Board of Commissioners and the mayor of Jackson (the Teton County seat) co-signed a letter asking Governor Freudenthal to support protection for migratory pronghorn. And, WGFD and GTNP, in conjunction with the Bridger-Teton National Forest and Wyoming Department of Transportation (WDOT), agreed to develop 4 road-side exhibits across a 100 km span of POP to commemorate and highlight the significance of the pronghorn migration. In 2007, with Freudenthal as chairman, the Western Governors Association unanimously supported Policy Resolution 07-01 to "identify key wildlife corridors and crucial wildlife habitats in the West, and conserve these lands."

Although the BLM did not officially support pronghorn protective measures, 3 other federal agencies (USFS—Bridger-Teton, USFWS—National Elk Refuge, and GTNP) did, and they co-signed a statement of support urging help to protect POP (Table 2). Teton County businesses joined with the JHCA to raise pronghorn conservation awareness by celebrating the 2007 spring arrival of migrants in a public festivity called Party for the Pronghorn. This successful endeavor was repeated annually for several years in the town of Jackson.

In May 2008, a 70-km-long pathway defined by our original studies was legally designated as America's first

federally protected migration corridor (ENS 2008) by amendment to the Bridger-Teton National Forest Plan (Hamilton 2008). Support for this effort on behalf of the American public had been strengthened by approximately 20,000 favorable public comments (K. Hamilton, personal communication). At 2 formal federal inaugurations to designate POP along the migration route (one in each county), there was much fanfare, including attendees from the petroleum industry, U.S. Department of Interior (DOI), BLM, USFS, NPS, Natural Resource Conservation Service, Wyoming state agencies, NGOs, the business community, county officials, ranchers, and the general public (Table 2).

These milestones galvanized support for additional conservation. At the Western Governor's Conference held in Teton County several weeks later, Secretary of the DOI, Dirk Kempthorne, announced a \$1 million matching grant for further protective efforts of POP and a deferment of oil or gas leases along the corridor until a comprehensive management plan for the area was completed. Sublette County's Wyoming Land Trust (formerly Green River Valley Land Trust) used the challenge grant to develop a corridor conservation campaign and a migration friendly fence design initiative to modify or rebuild 800 km of fencing along POP.

In 2010, WDOT began construction of the United States' first highway overpasses for an open-plains ungulate, a \$10 million endeavor that was completed in 2012 and now facilitates pronghorn movement across a busy federal highway (Nuwer 2012). Unfortunately, despite this solid success and the collaboration across counties, agencies, and private individuals from a wide range of interests, none of the federal lands managed by BLM had received additional protection as of 2013.

From Science to Actionable Conservation

As an ecological process migration is integral in the overall maintenance of biodiversity. Assuring its continuation through protection of critical lands is one way to enhance the more broadly based concept of biological corridors (Hilty et al. 2006, 2012)—areas central to conservation because they diminish isolation, facilitate gene flow, and increase opportunities for a fuller expression of biological interactions (Beier & Gregory 2012). We offer this essay to shed light on the role of science in the protection of a corridor for terrestrial migrants. The broader context here of course is distinguishing between what it is to do science and what it is to achieve conservation. While there is overlap, there are fundamental differences.

In our case, ecologically based research was mandatory to identify migratory routes. Prior to this, science was needed to know where migration had collapsed (Berger

2003, 2004). And, science was critical to securing the necessary credentials and subsequent funding that situated us at tables with officials to discuss migrations, corridors, and achievable solutions (Table 1; Table 2). This science approach was devoid of the nuance associated with explicit hypotheses and predictions, phraseology which so often is a turn off when speaking with nonscientists.

Scientific publications about lands or species in need of protection are common, just as admonitions about what is being lost when little is done to assure protection are. Publications, however, do not result in conservation action. Many NGOs do conservation without doing the science.

To achieve conservation usually means being on the front lines—speaking to elected officials, policy makers, agencies, and the public. Whether the topic is gorillas, large cats, or POP, people and agencies often prefer to hear directly from scientists who generate the data and are most familiar with the issues (Rabinowitz 2001; Weber & Vedder 2001). While the line between science and advocacy can be wide (Scott & Rachlow 2006, 2011), in our particular case, federal and state agencies and their associated representatives responded to the mounting calls for action appropriately, yet with caution, because they served in the public interest.

Doing conservation means crafting solutions beyond the realm of science. It means the sharing of ideas, listening, enabling local voices, building consensus, and perhaps shaping or implementing new legislation. Despite the lack of overarching receptivity by Sublette County commissioners and BLM, local pride now exists in POP (Urbigkit 2010). Indeed, the construction of highway overpasses by WDOT to facilitate pronghorn migration is indicative of a substantive investment that was largely justified by studies of migration and unabated WGFD support—all testimony to a change in attitude.

It is obvious that, because of real world complexities, no single prescriptive approach achieves conservation (Groves 2005). Our case offering is demonstrative of several key elements (Table 2). First, the development of ecological insights and publications frames issues and helps establish credibility. Second, collaborations between NPS and WCS enabled opportunities and access to other agencies and NGOs that would otherwise have been unavailable. Third, support from SEPCO and other energy producers facilitated the initial meeting with Governor Freudenthal. Fourth, protection would not have occurred without targeted public outreach and communication or without engaging county commissioners, ranchers, local and national NGOs, politicians, and state and federal agencies. The ability to be thick skinned and respond calmly to verbal and written barrages in sensitive meetings and in the media was also useful (Table 1).

Did science play a role? Yes—a critical one. But people and hence human dimensions played a larger one. If there is a lesson to be learned it is this—science and its publication are of tremendous value in defining conservation issues and getting to the table, but publishing alone, even in the most prestigious journals, is not conservation. The act of doing is. Ecological science melded with public policy can further conservation practice. In the end, however, it is only a change in human values that ultimately will facilitate more conservation.

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Supporting Information

Methods used to construct the migration polygon and polygon shape files (Appendix S1) and GIS shapefiles for plotting the polygon are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

Literature Cited

- Beckmann, J., K. Murray, R. Seidler, and J. Berger. 2012. Human-mediated shifts in animal habitat use: sequential changes in pronghorn use of a natural gas field in Greater Yellowstone. *Biological Conservation* **147**:222–233.
- Beier, P. and A. Gregory. 2012. Desperately seeking stable 50-year-old landscapes with patches and long, wide corridors. *PLOS Biology* **10**. DOI: 10.1371/journal.pbio.1001253.
- Beier, P. and R. F. Noss. 1998. Do habitat corridors provide connectivity? *Conservation Biology* **12**:1241–1252.
- Berger, J. 2003. Is it acceptable to let a species go extinct in a national park? *Conservation Biology* **17**:1451–1454.
- Berger, J. 2004. The longest mile: how to sustain long distance migration in mammals. *Conservation Biology* **18**:320–332.
- Berger, J. and J. Beckmann. 2010. Sexual predators, energy development, and conservation in the Greater Yellowstone Ecosystem. *Conservation Biology* **24**:891–896.
- Berger, J. and K. M. Berger. 2006. Let the antelope roam. Available from http://www.nytimes.com/2006/08/09/opinion/09berger.html?_r=0 (accessed November 2013).
- Berger, J. and S. L. Cain. 1999. Reproductive synchrony in brucellosis-exposed bison in the southern Greater Yellowstone Ecosystem and in non-infected populations. *Conservation Biology* **13**:357–366.
- Berger, J., S. L. Cain, and K. Berger. 2006. Connecting the dots: an invariant migration corridor links the Holocene to the present. *Biology Letters* **2**:528–531.
- Byers, J. 1998. American pronghorn: social adaptations and the ghosts of predators past. University of Chicago Press, Chicago.
- Cain, S. L., M. D. Higgs, T. J. Roffe, S. L. Monfort, and J. Berger. 2012. Using fecal progesterone and logistic regression to enhance pregnancy detection in wild ungulates: a case study with bison. *Wildlife Society Bulletin* **36**:631–640.
- ENS. 2008. Ancient pronghorn path becomes first U.S. wildlife migration corridor. Available from <http://www.ens-newswire.com/ens/jun2008/2008-06-17-091.asp> (accessed November 2013).
- Glick, D. 2007. End of the road? *Smithsonian Magazine*. Available from <http://www.smithsonianmag.com/science-nature/pronghorn.html> (accessed November 2013).
- Groves, C. 2005. Drafting a conservation blueprint: a practitioner's to planning for biodiversity. Island Press, Washington, D.C.
- Hamilton, K. 2008. Decision notice & finding of no significant impact; pronghorn migration corridor forest plan amendment. U.S. Department of Agriculture. Available from <http://www.fs.fed.us/outernet/r4/btnf/projects/2008/pronghorn/PronghornDN.pdf> (accessed July 2013).
- Hannibal, M. E. 2012. The spine of the continent. Lyons Press, Guilford, Connecticut.
- Hilty, J. A., C. C. Chester, and M. S. Cross (eds). 2012. Climate and conservation; landscape and seascape science, planning, and action. Island Press, Washington, D.C.
- Hilty, J. A., W. Z. Lidicker, and A. M. Merenlender. 2006. Corridor ecology: the science and practice of linking landscapes for biodiversity conservation. Island Press, Washington, D.C.
- McInnis, M. L., and M. Vavra. 1987. Dietary relationships among feral horses, cattle, and pronghorn in southeastern Oregon. *Journal of Range Management* **40**:661–666.
- Miller, M. E., and P. H. Saunders. 2000. The Trapper's Point Site (48SU1006): early Archaic adaptations and pronghorn procurement in the Upper Green River Basin, Wyoming. *Plain's Anthropologist* **45**:39–52.
- Nuwer, R. 2012. Safe passage for pronghorns. *New York Times*. Available from <http://green.blogs.nytimes.com/2012/10/17/safe-passage-for-pronghorns/> (accessed July 18, 2013).
- Rabinowitz, A. 2001. Beyond the last village. Island Press, Washington, D.C.
- Robbins, J. 2004. For wildlife, migration is endangered too. *New York Times*. Available from <http://www.nytimes.com/2004/03/09/science/for-wildlife-migration-is-endangered-too.html?action=click&module=Search®ion=searchResults&mabReward=relbias%3Ar&url=http%3A%2F%2Fquery.nytimes.com%2Fsearch%2Fsite%2F%23%2Fjim%2BRobbins%2BMigration%2F>
- Sawyer, H. and F. Lindzey. 2000. Jackson Hole pronghorn study: final report. Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie.
- Scott, J. M. and J. L. Rachlow. 2006. Science, policy and scientists. *Frontiers in Ecology and the Environment* **4**:68–69.
- Scott, J. M. and J. L. Rachlow. 2011. Refocusing the advocacy debate. *Conservation Biology* **25**:1–3.
- Soule, M. E. 1986. Conservation biology: the science of scarcity and diversity. Sinauer Press, Sunderland, Massachusetts.
- Urbigkit, C. 2010. Path of the pronghorn. Boyd Mills Press, Honesdale, Pennsylvania.
- Weber, W. A. and A. Vedder. 2001. In the kingdom of gorillas: fragile species in a dangerous land. Simon and Shuster, New York.