

adaptation

Adaptation Case Studies in the Western United States

**Intersection of Federal and
State Authority for Conserving
the Greater Sage Grouse and the
Colorado River Water Supply**

Joel Smith
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*Stratus Consulting, Inc.
Boulder, CO*

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GEORGETOWN CLIMATE CENTER
A Leading Resource for State and Federal Policy

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Foreword

Resource managers in the western U.S. states, like many of their counterparts, are struggling to adapt to changes brought about by climate change. These changes include greater frequency of fires, larger spring floods from early snowmelt, and more severe summer droughts. And the challenges the changes bring are superimposed upon existing stressors such as population growth, competing demands for limited resources, habitat degradation, and conventional pollution. Managing wildlife and natural resources with these challenges in mind can be daunting, especially with the complex legal regimes and competing responsibilities across levels of government. State and federal land and resource managers must do the best they can to cope with changing circumstances. In order to inform their decisions, the Georgetown Climate Center commissioned this report by a team well-versed in expected climate change impacts in the west.

This report examines two case studies of western adaptation. One concerns the protection of a unique, ground-dwelling bird: the greater sage grouse. The second involves managing water resources in the Colorado River basin. These case studies provide unique opportunities to consider the various roles of state and federal government entities. Joel Smith and his colleagues provide an important historical and practical perspective on why adapting to anticipated changes in this region is challenging. The Endangered Species Act currently protects critical habitats of threatened or endangered species, but what happens if climate-induced changes drive vulnerable species to areas outside their traditional range? Might species or habitats currently managed by states come under federal control? The case of the sage grouse, which has not yet been declared an endangered or threatened species, is examined in detail. A “listing” of this species would have major implications for land use management in the northern Rockies by increasing the role of the federal government in the region.

Allocation of water supplies in the arid West is complex and involves a mix of responsibilities. States have authority to allocate water within their borders. However, there are also requirements regarding the sharing of water between states. The Colorado Compact guarantees a minimum amount of water to states in the lower Colorado River basin from states in the Upper Basin. While states using water from the Colorado can negotiate the allocation of water amongst themselves, should they fail to do so, the federal government can intervene.

These two topics, management of wildlife and water resources, provide rich opportunities for consideration of new governance paradigms. Moreover, even without changes in governance, the authors identify creative actions states are taking within current authorities. Indeed, a key finding of this report is that existing authorities already provide a tremendous opportunity for states and their federal partners to address climate impacts today.

We appreciate the support of our adaptation funders, Rockefeller Foundation and Kresge Foundation, and our core supporters, Rockefeller Brothers’ Fund and the Emily Hall Tremaine Foundation, who make our work possible.

Vicki Arroyo, Executive Director

Peter Byrne, Faculty Director

Contents

Chapter 1	Introduction	1
	References	2
Chapter 2	Conservation of the Greater Sage Grouse in Wyoming	3
	Background: Conservation Status of the Greater Sage Grouse and Potential Threats from Climate Change	3
	State and Federal Roles in Wildlife Management	5
	Sage Grouse Conservation in Wyoming	7
	<i>The core area approach</i>	7
	<i>Engaging private landowners in sage grouse conservation</i>	8
	Potential Sage Grouse Conservation Strategies under Climate Change	8
	<i>Limitations of existing policies and authorities</i>	8
	<i>Existing coordination mechanisms that can facilitate adaptation</i>	9
	Discussion	11
	References	12
Chapter 3	Colorado River Water Supplies in Colorado	15
	Overview of the Colorado River Basin	15
	State and Federal Management and Regulation of Water Supplies	17
	<i>Building, maintaining, and operating infrastructure</i>	17
	<i>Allocating water</i>	18
	<i>Developing principles and guidelines for design and operation of river basin plans and projects</i>	19
	Overview of Colorado Water Law and the Colorado River Basin	19
	Roles of the Federal Government, State Government, and Other Entities in Managing the Colorado River Basin	20
	<i>Federal role</i>	20
	<i>State role</i>	20
	<i>Other entity roles</i>	21
	Potential Consequences of Socioeconomic and Climate Changes on the Colorado River Basin	21
	Discussion	22
	References	23
Chapter 4	Conclusions	25
	States Already Manage Resources Adaptively	25
	Threat of Federal Action Acts as a Motivator for States	26
	Limits to Federal Action May Force States to Address Climate Change	26
	Decision-making Flexibility and Formal Legal Authority	27
	References	27

List of Figures

FIGURE 1	Greater Sage Grouse (Male & Female)	3
FIGURE 2	Sage Grouse Habitat	4
FIGURE 3	Upper & Lower Colorado River Basin	16

1. Introduction

Adaptation is a crucial element of responding to the challenges of climate change

because some climate change impacts are already being felt and additional adverse impacts are unavoidable (Parry et al., 2007; Karl et al., 2009; Solomon et al., 2009). However, significant questions remain about how to adapt, when to adapt, and who should adapt. One of the most significant questions is: what role can different levels of government most effectively play in adapting to climate change and under what circumstances? Recently, efforts have been made to analyze how the federal government might play an effective role in adaptation (GAO, 2009; CEQ, 2010; Smith et al., 2010) and how adaptation can support local governments and municipalities (Brunner and Lynch, 2010). The role of states, however, has not been closely evaluated, even though many states have initiated significant adaptation planning efforts (e.g., Maryland Commission on Climate Change, 2008; Alaska Adaptation Advisory Group, 2010).

Many impacts of a changing climate play out at the local level where fundamental differences in policy exist, relating to social, physical, climatological, and political matters. For example, adapting to rising sea levels in New York City may require very different policy responses than in New Orleans. Similarly, adaptation to changing precipitation regimes in snowpack-reliant municipalities in the Rocky Mountain West may differ substantially from adaptation measures undertaken in groundwater-reliant municipalities in Florida. The federal government also plays an important role in adaptation to climate change, especially for federally owned or managed properties, federal government operations, and as a provider of financial and technical resources. In reality, all levels of government must be considered in order to understand the most effective intervention for any given climate change impact. This report focuses on states because of their significance in setting policy in climate-sensitive sectors and their critical linkage between the federal government and local governments and municipalities.

This report uses two case studies to examine the potential role of states in adapting to climate change: Wyoming's management and conservation of the greater sage grouse and Colorado's management and regulation of Colorado River water supplies. These two cases were not selected to be representative or comprehensive. Rather, they were selected as two examples of very different climate impacts for which the state plays a significant governance role. This report should not be approached as prescriptive and final, but rather as exploratory and tentative.

These two cases provide an initial exploratory investigation of the governance issues that states may face as they address climate change impacts. They focus on the authorities states have in adapting to climate change relative to authorities of the federal government. Some preliminary conclusions are drawn from these two case studies about the potential role of states in reducing resource vulnerability and adapting to climate change. Note that this report focuses on the potential role of state governments. It does not address whether states have the financial and technical resources or the political will to address climate change adaptation in managing resources in each case.

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2. Conservation of the Greater Sage Grouse in Wyoming

In this case study, we examine how climate change may affect state wildlife management by focusing on conservation of the greater sage grouse (*Centrocercus urophasianus*). Many entities, including the federal government, state governments, and nongovernmental organizations (NGOs), have begun to recognize that climate change may significantly alter the effectiveness of current conservation and restoration interventions. Thus, climate change may have significant implications for the legal authorities and management practices of state and federal governments in their management of wildlife, particularly in preserving endangered species. Novel strategies and tools may be needed to preserve wildlife under future climate conditions where migration patterns, ecological interactions, disturbance regimes, and the physical location of species or ecosystems may change. Below, we focus on efforts to conserve the greater sage grouse in Wyoming in order to illustrate some of the challenges--and potential solutions--for state efforts to manage wildlife under changing climatic conditions. The greater sage grouse presents a particularly interesting case because its habitat spans large areas of land with valuable extractive resource potential across multiple states. Furthermore, the greater sage grouse is not yet listed under the Endangered Species Act (ESA). This creates an interesting governance situation where many parties, including the State of Wyoming, are motivated to address the conservation of the greater sage grouse proactively to avoid an ESA listing and accompanying land use restrictions imposed by the federal government.

FIGURE 1: *Greater Sage Grouse (Male & Female)*



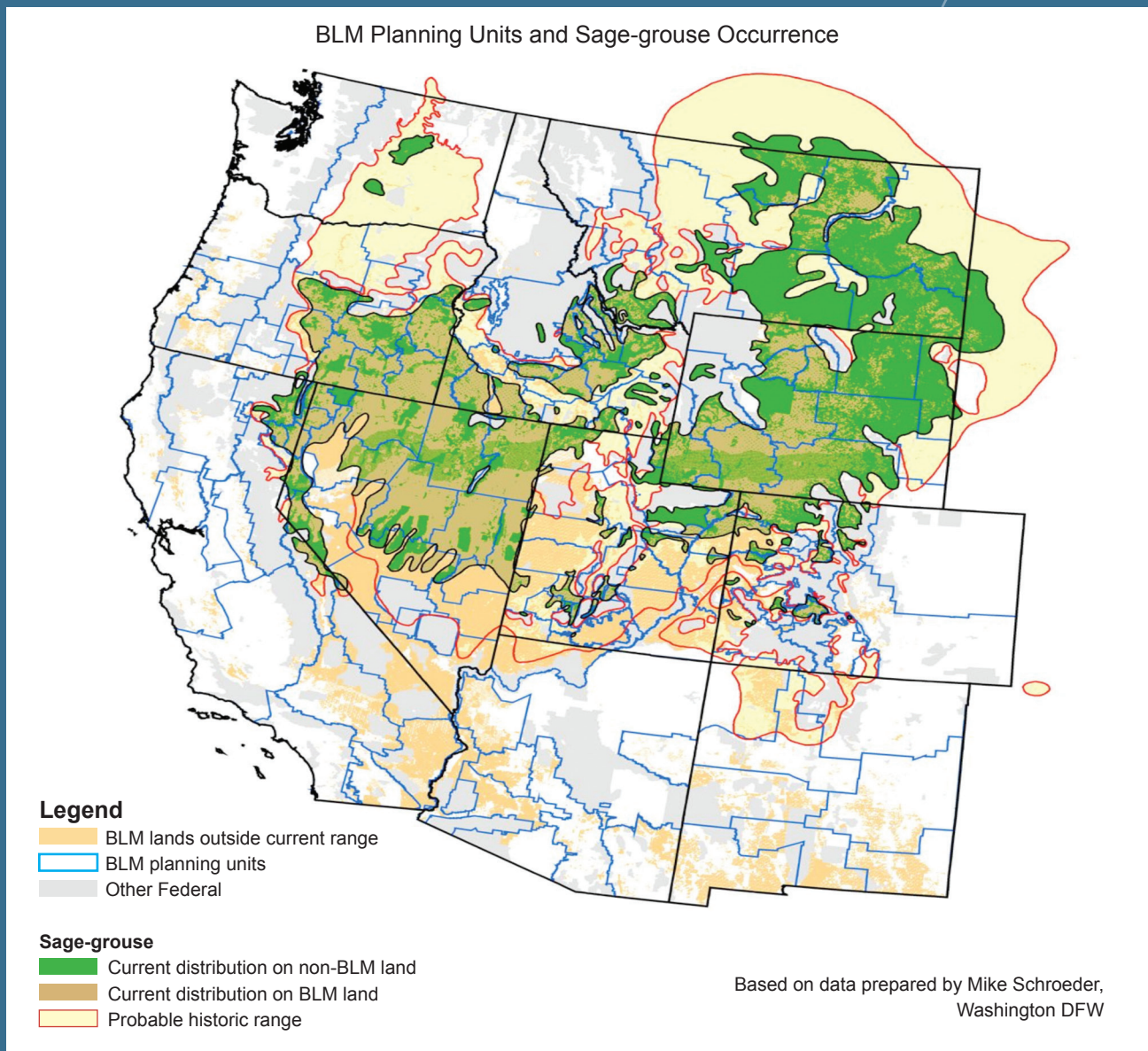
Photo: *Images in the Wild*, Prescott Valley, AZ

Background: Conservation Status of the Greater Sage Grouse and Potential Threats from Climate Change

The greater sage grouse depend on specific species of sagebrush (*Artemisia* spp.), including Wyoming big sagebrush (*A. tridentata* ssp. *wyomingensis*), mountain big sagebrush (*A. t.* ssp. *vaseyana*), and big basin sagebrush (*A. t.* ssp. *tridentata*) (USFWS, 2010a). The sage grouse use different areas of a landscape throughout the year for breeding, nesting, rearing young, and overwintering. They are known to return to the same areas year after year for these activities, even if the habitat is no longer valuable (USFWS, 2010a). The sage grouse are also very sensitive to human activity – the presence of roads or oil and gas development within 4 to 5 kilometers can significantly affect sage grouse breeding and nesting activities (Christiansen and Bohne, 2008; Johnson et al., Undated).

Sagebrush-dominated landscapes, which cover substantial portions of western North America, are increasingly threatened by a number of human-related disturbances, including habitat conversion to other land use types, overgrazing, energy development, introduction of invasive species, and road traffic (Knick and Connelly, Undated). These disturbances have caused sagebrush ecosystems to decline in size, decrease in quality, and become more fragmented, which threatens the persistence of species that are dependent on sagebrush (Knick and Connelly, Undated).

FIGURE 2: *Greater Sage Grouse Habitat*



Source: BLM, 2010

The dependence of the sage grouse on increasingly fragmented sagebrush habitat, combined with its strong site fidelity and sensitivity to disturbance, has led to widespread declines of the sage grouse over the past few decades. The sage grouse is now absent from almost half of its estimated original distribution area (Knick and Connelly, Undated).

Although the sage grouse is in decline and potentially threatened with extinction, it still occupies a large geographic range in 11 states (California, Colorado, Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming; see Figure 1) and two Canadian provinces (Alberta and Saskatchewan). Of all the states, Wyoming is estimated to have the largest population of the sage grouse, and the largest total area of sagebrush lies within the Wyoming Basin and the Snake River Plain (Knick, Undated). Wyoming will thus play a critical role in determining the fate of the sage grouse.

The sage grouse could be adversely affected by the potential impacts of future climate change. According to the U.S. Global Change Research Program, Wyoming may experience significant increases in temperature – summer temperatures may rise by as much as 8 to 10°F by 2100 (Karl et al., 2009). Precipitation patterns may also change, although projections for this region are uncertain (IPCC, 2007). Even if precipitation patterns do not change significantly, it is likely that the expected increases in average temperatures and in the frequency of hot days will lead to more water stress in late summer and early fall and, in turn, to increased risk of fire (IPCC, 2007; Karl et al., 2009).

These changes in climate may have significant effects on sagebrush ecosystems and the sage grouse. For example, sagebrush is sensitive to fire. It does not resprout after fire; rather, new seeds must be deposited for sagebrush to reestablish (Miller et al., Undated). Thus, increases in wildfire extent, frequency, and intensity are very likely to reduce sagebrush habitat. This dynamic will be exacerbated by the threat of cheatgrass (*Bromus tectorum*), an invasive species highly adapted to fire. When cheatgrass establishes after a fire, it produces high fuel loads that burn frequently, which prevents sagebrush from reestablishing after a burn. An increase in winter and spring temperatures may also affect sagebrush by allowing frost-sensitive species, currently limited in their northern distribution, to establish in sagebrush habitat (Miller et al., Undated). Modeling efforts suggest that the geographic range of big sagebrush (*Artemisia tridentata*) will contract significantly and move northward and upward in elevation (Shafer et al., 2001; Miller et al., Undated).

In the following section, we describe (1) the role of federal and state governments in managing wildlife, including the sage grouse; (2) current sage grouse conservation strategies and policies being pursued by the State of Wyoming; and (3) how efforts to adapt sage grouse conservation efforts in response to projected climate changes could be hindered or facilitated by existing authorities and coordination mechanisms.

State and Federal Roles in Wildlife Management

Wyoming, as with all states, has the primary responsibility for managing wildlife within its borders (Association of Fish and Wildlife Action Plans, 2007). States are wildlife trustees and have policing powers over all wildlife, even wildlife located on federal land (Wyoming Game and Fish Department, 2002). The Wyoming statute, Title 23 – Game and Fish, details the authorities that the state has to manage wildlife. In Wyoming, wildlife management efforts are coordinated through the Wyoming Game and Fish Commission, which has the ability to conduct the following activities, among others:

- Fix season and bag limits of wildlife, excluding bird or animal predators or protected birds or animals;¹
- Acquire lands and waters in the name of Wyoming for hunting, fishing, or managing or protecting wildlife;
- Exercise control over undesirable and protected species; and
- Enter into cooperative agreements with federal agencies, corporations, associations, individuals, and landowners for the development of state control of wildlife management projects.

Although the state has the primary role for managing wildlife, the U.S. Supreme Court has determined that the Constitution provides support for the development of federal wildlife law, and when federal law conflicts with state law, federal law takes precedence (Bean and Rowland, 1997). The federal government currently plays critical roles in managing wildlife, including, but not limited to:

- Regulating commercial fishing;
- Managing wildlife on federal lands;
- Funding state wildlife programs; and
- Protecting endangered species, migratory birds, and species of interest.

The legal tool by which the federal government could regulate the greater sage grouse is the ESA. Enacted in 1973, the ESA was intended “to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species” [16 U.S.C. § 1631(b)]. The U.S. Fish and Wildlife Service (USFWS) has been delegated the authority to determine which terrestrial or freshwater species warrant listing, and the National Marine Fisheries Service is responsible for listing decisions related to marine species and most anadromous fish (USFWS, 2010b).

To determine whether a species is threatened or endangered, USFWS considers five factors:

1. The present or threatened destruction, modification, or curtailment of its habitat or range;
2. Overutilization for commercial, recreational, scientific, or educational purposes;

¹ Note that because the greater sage grouse is not yet listed under the ESA, it is not a “protected bird” and thus falls under the authority of the state.

3. Disease or predation;
4. Inadequacy of existing regulatory mechanisms; and
5. Other natural or human-caused factors affecting its continued existence.

The widespread decline of the sage grouse has led numerous entities to file petitions with the USFWS to list it under the ESA. In 2005, the USFWS announced that the greater sage grouse listing was “not warranted,” a decision that was overturned by the U.S. District Court of Ohio in 2007 (U.S. District Court, 2007). On March 23, 2010, after reconsidering, the USFWS determined that listing the sage grouse was warranted but precluded by higher-priority listing actions (USFWS, 2010a). Essentially, there is sufficient threat to list the sage grouse as threatened or endangered, but other species are closer to extinction and are a higher priority for the limited resources of the USFWS. Even though the sage grouse is not currently listed under the ESA, it is a species of high conservation concern in all areas in which it still resides.

If a species is listed as threatened or endangered, it becomes unlawful to “take” that animal without a permit. Take is defined as to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.” Habitat modification or destruction and impairing essential behavioral patterns (e.g., breeding) are included in the definition of harm (USFWS, 2009). The federal protection provided through ESA supersedes state authorities to manage wildlife, and all activities that may result in taking an endangered species must be permitted by the USFWS. In Wyoming, for example, listing of the greater sage grouse could prevent the use of sage grouse habitat for lucrative oil and gas exploration activities. This loss of authority over economically significant state resources provides a strong motivator for states to conserve the greater sage grouse in order to avoid an ESA listing and the consequent loss of state authority.

Sage Grouse Conservation in Wyoming

As noted above, Wyoming provides important habitat for the sage grouse and harbors large populations of the species, which are distributed throughout the state. As with the national trend, the sage grouse are in decline in Wyoming due to a number of factors, including grazing, invasive species, wildfire, habitat conversion to other land uses, and, perhaps most critically, oil and gas development (Naugle et al., Undated). Below, we describe a key strategy for conserving the sage grouse (i.e., the core area approach) and critical issues related to state and federal authorities that will influence its effectiveness. We also describe some of the incentives that are being pursued to encourage sage grouse conservation on private land.

The core area approach

Wyoming has taken a lead role in trying to slow or reverse the decline in sage grouse. In 2008, then-Governor of Wyoming, David Freudenthal, issued an executive order that established a conservation plan for the sage grouse (State of Wyoming, 2008). The key to the strategy was identifying “core areas” of large-scale, continuous sage grouse habitat that would be protected from further development. The core areas were identified through a collaborative process with scientists and stakeholders. Although the core areas do not capture the current highest densities of birds, they are areas that both contain appropriate habitat and are not highly developed (Ostlind, 2010).

A primary motive behind Wyoming's proactive conservation efforts is its hope that the sage grouse listing under ESA will be deemed unnecessary. As noted above, one factor that the USFWS considers when determining whether to list a species is the adequacy of existing regulatory mechanisms. Wyoming is hoping that the measures outlined in the governor's executive order will help lead the USFWS to decide that current conservation measures are likely sufficient to prevent the extinction of the sage grouse.

Although many have lauded the efforts of Wyoming, there are some critical weaknesses in the approach that the state is utilizing. First, although the governor has the power to issue such executive orders, these orders do not carry the legal weight of legislation or regulation (Ostlind, 2010). Second, the governor's executive order is most influential on state lands. The Wyoming Game and Fish Department published recommendations for sage grouse management based on the executive order (game and fish guidelines), but these recommendations only apply to land owned by the state, which comprises about 1% of the sagebrush habitat in Wyoming (Knick, Undated). The federal government owns the largest amount of sagebrush habitat in the state, with about half of the sage grouse habitat in the Wyoming Basin located on U.S. Bureau of Land Management (BLM) lands (Knick, Undated).

The limited ability of the state to dictate the management of wildlife on federal lands is potentially critical. BLM was given a mandate to promote multiple uses of its land, including energy development and grazing, through the Federal Land Policy and Management Act of 1976 (Naugle et al., Undated). Thus, its management goals may conflict with the state's desires to provide better protection for the sage grouse, and much of the fate of the sage grouse rests in federal hands. Although BLM has provided guidance regarding oil and gas development that is consistent with the governor's executive order (BLM, 2009a, 2009b), there is still a high level of discretion in implementing the core area approach. It remains to be seen whether the core area strategy will, in fact, result in improved conservation of the sage grouse (Ostlind, 2010).

Engaging private landowners in sage grouse conservation

The state's conservation strategy also recognizes the need to engage private landowners in efforts to protect sagebrush habitat. About 35% of the sagebrush habitat in the Wyoming Basin is located on private lands (Knick, Undated). Economic incentives can be provided to landowners through various mechanisms, including conservation easements. Conservation easements are legally binding agreements that limit certain types of activities (e.g., development) from occurring on a property in perpetuity (Nature Conservancy, 2003). Easements reduce property values, which in turn reduces taxes for the landowner. Regulatory incentives can also be provided to landowners for conserving sagebrush habitat through Candidate Conservation Agreements with Assurances (CCAAs) under the ESA. Through a CCAA, a landowner can voluntarily submit a management plan that articulates measures the landowner will take to preserve habitat for an unlisted species. If the species in question becomes listed, the landowner will have no legal obligations beyond the measures outlined in the plan to protect the species habitat (USFWS, 2002). Individuals can enter into CCAAs with the USFWS, but Wyoming is pursuing an umbrella CCAA with the USFWS, which would make it much easier for landowners to enter into such agreements. The umbrella CCAA would only cover grazing, but other sectors are expected to be added in the future (Ostlind, 2010).

Potential Sage Grouse Conservation Strategies under Climate Change

Conservation of the sage grouse in Wyoming is quite challenging. Climate change, which may result in changes in the quality, location, and dynamics of sagebrush habitat, will introduce additional challenges. Below, we discuss key issues that may arise when trying to adapt conservation strategies or to apply existing wildlife management authorities in a changing climate. We also describe existing coordination mechanisms that may serve to facilitate efforts to adapt wildlife management to climate change.

Limitations of existing policies and authorities

There is one key limitation with respect to climate adaptation that is common to existing state and federal policies and authorities regarding wildlife management – the assumption that wildlife habitat will be static. The fact that habitat may change in character or geography under climate change has serious implications for both state policies and federal authorities.

In the case of Wyoming’s current core area approach, the strategy is to set aside core areas in which the sage grouse can reside in relative peace, without disturbances associated with development. Furthermore, incentives are being provided to further develop noncore areas, which can help satisfy stakeholders who are now excluded from developing in core areas. However, climate change could lead to a change in the habitat currently designated as core. If that habitat becomes degraded or changes significantly, it may no longer be suitable for supporting large populations of the sage grouse. Alternatively, if areas that have been designated as noncore become more physically favorable to sagebrush growth and persistence, these areas may become significantly more valuable to the sage grouse than areas now labeled as core.

The strategy to set aside separate zones of habitat for sage grouse conservation and development remains sound, particularly when compared to allowing a haphazard approach to development. However, states could consider using their existing authority to allow for more flexibility when adapting their conservation strategies to a changing climate. For example, the process of identifying core areas for conservation could include setting aside areas that, even though not currently critical for the sage grouse, might be in the future. Although it would be extremely difficult to identify which areas might be best suited for the sage grouse in the future, one potential strategy would be to “hedge bets” and secure areas at varying latitudes and elevations to ensure future flexibility. An adaptation of plans in real time as conditions evolve would also be within the state’s authority, but this approach is unlikely to be effective for at least two reasons. First, areas that might be best suited to the sage grouse in the future may be heavily developed before habitat shifts occur, which would preclude revision of core/noncore areas. Second, stakeholders who have invested significant time and resources to ensure their access to noncore areas may not be amenable to future closures of these areas.

The assumption of static habitat also affects the potential effectiveness of federal authorities to protect endangered species under the ESA. The ESA provides for federal designation of “critical habitat” areas that are essential for conservation of a given species. The USFWS tends to designate critical habitat in areas that are currently occupied

by the endangered species in question (Sylvia Fallon, Biologist, Natural Resources Defense Council, personal communication, May 1, 2010). In some cases, the USFWS has designated unoccupied habitat as critical, but such habitat has been within the historic range of the species (DOI Task Force on Climate Change, 2009).

Designation of critical habitat that has not been part of the historical range of a species (i.e., habitat that may be needed for the species under climate change) would be unprecedented and is unlikely to occur given current ESA authorities (DOI Task Force on Climate Change, 2009). Thus, should the sage grouse eventually be listed under the ESA, designating potential future “critical habitat” via the ESA would not likely be pursued.

Existing coordination mechanisms that can facilitate adaptation

Although some barriers to climate change adaptation exist in state and federal conservation policies, strategies, and authorities, there are also a number of existing coordination mechanisms that could be used to facilitate efforts to adapt sage grouse conservation, and wildlife conservation in general, to climate change. Below, we briefly describe some key mechanisms that are being used to coordinate conservation efforts among states, the federal government, and other stakeholders. In each description, we explain how these mechanisms could facilitate adaptation.

Western Governor’s Association (WGA) Wildlife Corridors Initiative. WGA has taken on an important leadership role in pushing for state coordination of conservation efforts. In February 2007, WGA approved resolution 07-01, Protecting Wildlife Migration Corridors and Crucial Wildlife Habitat in the West, which describe the importance of wildlife habitat and corridors to western states and calls for coordination among states and stakeholders to conserve them (WGA, 2008). To implement the resolution, WGA launched its Wildlife Corridors Initiative. Six working groups were formed and charged with developing findings and recommendations about key habitats and corridors to conserve and recommendations about how to achieve that conservation. One working group is tackling climate change and will develop recommendations on how to facilitate wildlife movement across large geographical areas as climate changes. By highlighting the need for habitat movement and the potential actions that states can take together to connect wildlife habitat and allow for species range shifts, this initiative can clearly facilitate efforts to adapt wildlife conservation to a changing climate.

Development of State Wildlife Action Plans (SWAPs). Through the Wildlife Conservation and Restoration Program and the State Wildlife Grants Program, Congress appropriated funds to prevent fish and wildlife from becoming endangered. Each state and territory can access these funds by developing statewide, comprehensive conservation strategies, which are currently referred to as SWAPs. A major aim of the SWAPs is to help engage stakeholders in understanding key conservation concerns and in developing related actions (Association of Fish and Wildlife Agencies, 2007). The SWAP developed by Wyoming accomplished this aim, engaging a wide range of actors from state and federal agencies, academic institutions, farming organizations, and environmental organizations (Wyoming Game and Fish Department, 2005). Although the initial versions of most SWAPs did not address the threat of climate change, guidance has been issued by the USFWS to help SWAP developers integrate climate change impacts and adaptation into their plans. If Wyoming integrates climate change into its SWAP, this could be an important avenue through which key climate change impacts on the sage grouse and other wildlife are highlighted and through which related conservation strategies could be developed.

Cooperative Conservation Partnership Initiative (CCPI). The 2008 Farm Bill established the CCPI, which is a way to align funding provided through Natural Resource Conservation Service (NRCS) programs with the resources of partnering organizations to protect valuable wildlife and natural resources. The CCPI does not provide funding itself. Rather, partner entities (e.g., states, academic institutions, NGOs) can propose specific geographic areas that will be targeted for specific conservation interventions. If approved, producers in the targeted area can apply for financial and technical assistance through NRCS programs, such as the Conservation Reserve Program, the Environmental Quality Incentives Program, or the Wildlife Habitat Incentive Program. CCPI can help ensure that NRCS programs are targeting areas of high conservation concern and that key stakeholders are aware of and coordinating their efforts. Although climate change adaptation does not seem to be a major focus of the CCPI, these partnerships provide an opportunity to adaptively manage wildlife habitat under climate change when the climate change issue becomes more critical for wildlife management. For example, if it became clear that sagebrush habitat outside of a core area² was likely to be critical for the species in the future, a partnering organization could propose a CCPI project in that area. Incentives could be provided to producers to conserve habitat in the area, and state and federal entities could be engaged to coordinate conservation efforts in the same location.

Western Association of Fish and Wildlife Agencies (WAFWA). WAFWA was established in 1922, when the role of the federal government in managing wildlife was still being determined. A number of western states felt that their sovereignty was being threatened by federal efforts to assert management authority over fish and game. Consequently, they banded together to combat these federal efforts (Western Association of Fish and Wildlife Agencies, 2010). After states were clearly established as the primary managers of resident game and fish, the association began to broaden its focus. It began to serve as a forum for exchanging information related to scientific research, management practices, and policies (Western Association of Fish and Wildlife Agencies, 2010). WAFWA has also coordinated regional conservation efforts through memoranda of understanding among member organizations. In fact, WAFWA was pivotal in conjunction with several states wildlife agencies, and federal agencies in developing the Sage Grouse Habitat Conservation Strategy (Connelly et al., 2004), which involved input from a large number of western states. Under climate change, as noted by the WGA above, coordination among states will be critical to protecting habitat not only where species reside now but where they may reside in the future. WAFWA may be an important mechanism through which states can exchange ideas about adaptation strategies and may be crucial in ensuring that states are connecting habitats and habitat corridors across borders.

Discussion

States take the lead in wildlife management until or unless a species is of special concern and its management is addressed through a federal law, such as the ESA. However, given that many species of concern have habitat ranges that cross state borders, it is often necessary for states to coordinate conservation efforts with other states and even federal entities. This is the case for the greater sage grouse, which spans numerous states in the West. States are motivated by many reasons to proactively conserve such declining species, including potentially avoiding an ESA listing and the consequent loss of state authority and potential economic impacts.

² Although “core areas” are currently a management designation for the State of Wyoming, the concept has received much attention by other states and the federal government, and its implementation in other states is anticipated.

First, it should be noted that states have the authority to make significant progress on their own to prepare for climate change impacts on species of concern. For example, the core area approach has been implemented within the State of Wyoming only. This approach could be modified to take into account the potential impacts of climate change, for example, by protecting corridors between core areas or protecting a diversity of habitat types to account for potential shifts in vegetation patterns. However, state action in isolation does face constraints, such as the need to address habitat on federally owned and managed land, as well as sensitive species that may cross state borders either now or in a climate-altered future. Because of these and other constraints, coordination – both among states and between states and their federal counterparts – is desirable and perhaps necessary to adequately protect some sensitive species.

The mechanisms that have been put in place for species such as the greater sage grouse allow states to coordinate across broad landscapes, including management of suitable habitat that lie in several states. These multi-state coordination mechanisms can help alleviate constraints of managing wildlife within a single state, while also enabling conservation planning that is more likely to be deemed effective by the USFWS to conserve a declining species. Although these coordination mechanisms are not currently used to manage climate-induced changes in species migration patterns, ecological interactions, disturbance regimes, and the physical location of suitable habitat, they do provide a forum for such future discussions.

Essentially, there is a favorable synergy between the need for coordination mechanisms for interstate species conservation and the need for tools to incorporate climate change considerations into wildlife management. Because states have a compelling interest to avoid species listings under the ESA, they have an incentive to act proactively when addressing the conservation of declining species. To ensure that any conservation strategies and plans work both now and in the future, wildlife managers may be motivated to consider climate change impacts on wildlife management and appropriate conservation actions to adapt to such changes. Ironically, after a species is listed under the ESA, opportunities to proactively address changing species dynamics may be more constrained. One ESA mechanism that can be used to conserve species, the designation of critical habitat, typically has been used only if the species in question currently occupies that habitat or if that habitat is part of the species' historic range. This aspect of the ESA would thus not likely provide the flexibility needed to consider climate change-induced shifts in habitats or ecological dynamics and to protect habitat that may be critical to a species in the future.

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3. Colorado River Water Supplies in Colorado

This case study focuses on potential impacts of climate change on the State of Colorado's management and regulation of the Colorado River water supplies. The Colorado River and Colorado's role in managing water supplies serve as a good case study of the authorities state governments and the federal government have in managing water resources. The governance dimension of this case study is quite different from that of sage grouse conservation (see Chapter 2) because of differing federal and state legal authorities, institutional actors, and the nature of the resource.

The Colorado River creates one of the most contentious water allocation situations in the country. Water from the river is used by seven arid and semi-arid southwestern states and northwestern Mexico. The Southwest has seen rapid population growth, especially since World War II, which has put more pressure on the basin through increased demand for water. Population growth is projected to continue, which could further increase demand for water from the river.

Climate change is expected to make the water supply and demand situation in future decades even more contentious than it is now. All climate models project increased temperatures for the Southwest, and most models project decreased precipitation (Christensen et al., 2007; Seager et al., 2007). These changes are likely to reduce the availability of water supplies while demand rises.

Section 3.1 begins with an overview of the Colorado River Basin, Section 3.2 provides an introduction to state and federal management and regulation of water supplies in the United States, Section 3.3 discusses Colorado's water law and provides a history of the Colorado River Basin, and Section 3.4 highlights the roles of the federal government, state governments, and other entities in managing water supply in the Colorado River Basin. Section 3.5 provides an overview of the potential consequences of socioeconomic and climate changes on the Colorado River Basin, and Section 3.6 includes a discussion about the adequacy of existing state, federal, and municipal entities to address climate change impacts in the future.

Overview of the Colorado River Basin

The Colorado River Basin covers more than 240,000 square miles, including portions of seven western states and part of northwestern Mexico (NRC, 2007; Figure 3), and has a mean annual flow of about 15 million acre-feet. The river is effectively oversubscribed because very little flow reaches the Sea of Cortez in Mexico. Agriculture is the major consumer of Colorado River water (USGS, 2009). The water is also used for domestic and industrial purposes. Instream uses include hydropower production, habitat for aquatic ecosystems, and recreation.

State and federal laws have played a dominant role in managing the Colorado River and determining who gets what share of its water. Perhaps the most important legal agreement affecting water allocation is the Colorado River Compact of 1922 (hereafter, the Compact). Among other things, the Compact divided the Colorado River Basin into the Upper Basin (Colorado, Wyoming, Utah, and New Mexico) and the Lower Basin (Arizona, California, and Nevada). The Lower Basin states are guaranteed an average annual flow of 7.5 million acre-feet per year over a 10-year period. Based on historical rainfall patterns, as understood in 1922, this provided for a roughly equal division of Colorado River water between the Upper and Lower basins. However, the Compact was negotiated during the relatively wet early 20th century,³ and its fixed allocation requirement did not account for long-term changes in supply and demand. The Lower Basin states can issue a Compact Call to demand that the required allocation to them be met by the Upper Basin states if deliveries are below required amounts. Under the Compact, the states in each region divide their 7.5 million acre-feet per year among themselves, although subsequent federal legislation was required to determine state allocations as described in the following section.

This Compact was the first of many to form the Law of the River. This law is a legal and institutional framework that includes the following components: the 1922 Colorado River Compact, the 1928 Boulder Canyon Project Act, the 1944 Mexico-United States Treaty, the 1948 Upper Colorado River Basin Compact, the Colorado River Storage Project Act of 1956, the 1963 U.S. Supreme Court decision *Arizona v. California*, the 1968 Colorado River Basin Project Act, the 1973 Minute 242 agreement between Mexico and the United States, the 1992 Grand Canyon Protection Act, and other statutes, court decisions and decrees, contracts, and administrative decisions (NRC, 2007).



Source: NRC, 2007.

³ The Compact was negotiated assuming a long-term average of 16.4 million acre-feet per year. However, subsequent analysis indicates that the long-term average flow of the Colorado River is between 13.2 and 14.3 million acre-feet per year (Hidalgo et al., 2000; Woodhouse et al., 2006). This translates to 12.8% to 19.5% less water than the Compact assumed.

The current specific annual allotments to Lower Basin states were established in 1928 as part of the Boulder Canyon Project Act as follows: California – 58.7%, Arizona – 37.3%, and Nevada – 4%. The current specific annual allotments to Upper Basin states were established in 1948 as part of the Upper Colorado River Basin Compact as follows: Colorado – 51.75%, Utah – 23.0%, Wyoming – 14.0%, and New Mexico – 11.25%; the portion of Arizona that lies within the Upper Colorado River Basin was allocated 50,000 acre-feet annually, or approximately 0.7% of Upper Basin allocation.

In December 2007, after eight years of drought – the first long-term drought in the modern history of the Colorado River – interim guidelines for allocating Colorado River water during water shortage events were signed by the Secretary of the Interior. The intent of these guidelines was to provide enough time for water system operators to gain experience with water shortage conditions. The guidelines set out specific reduced water allocations for all states under three tiers of increasingly severe shortage conditions based upon the water level in Lake Mead – one of two major reservoirs managed jointly on the Colorado River.

State and Federal Management and Regulation of Water Supplies

The roles that the state and federal governments have in management and regulation of water supplies can be divided into three areas: (1) building, maintaining, and operating infrastructure for water supply projects – largely a federal role authorized by the Water Resources Act (WRA) of 1958; (2) allocating water – largely a state role authorized by a variety of state statutes and regulations; and (3) developing standard principles and guidelines for river basin planning and infrastructure design and operations – largely a federal role authorized by the WRA of 1965 and the Water Resources Development Act (WRDA) of 2007. Each role is described below. Climate change is currently being considered only in the third role, developing principles and guidelines for river basin planning.

In most cases, states have jurisdiction over the management of water resources. Even so, there are some instances where the federal government has jurisdiction.

Building, maintaining, and operating infrastructure

Under the WRA of 1958, the provision of water for domestic, municipal, industrial, and other purposes is primarily a state and local responsibility [Public Law (PL) 85-500 §301(a)]. The federal government [e.g., the U.S. Army Corps of Engineers (USACE) or the U.S. Bureau of Reclamation (USBR)] assists states and local interests by developing water supplies associated with construction, maintenance, and operation of federal navigation; flood control; irrigation; and multiple-purpose projects [PL 85-500 §301(a)]. Furthermore, the WRA of 1958 states that “storage may be included in any reservoir project surveyed, planned, constructed or to be planned, surveyed and/or constructed by the Corps of Engineers or the Bureau of Reclamation to impound water for present or anticipated future demand or need for municipal or industrial water” provided that the state or local interests pay the cost [PL 85-500 §301(b)].

The USBR operates most of the larger water control structures on the Colorado River and its tributaries. The Hoover Dam, near Las Vegas, Nevada, impounds Lake Mead, and the Glen Canyon Dam, located just south of the Arizona-Utah border, impounds Lake Powell. These are the two largest dams along the Colorado River. Other major facilities and projects within the basin include the Flaming Gorge Dam in Wyoming, the Colorado-Big Thompson Project,

the Central Utah Project, the Aspinall Unit (which includes Blue Mesa, Crystal, and Morrow Point dams) on the Gunnison River in Colorado, Navajo Dam in New Mexico, the Central Arizona Project's Hayden-Rhodes Aqueduct, the Salt River Project in Arizona, Parker Dam and the Metropolitan Water District of Southern California's Colorado River Aqueduct, Imperial Dam and the All-American Canal serving the Imperial Valley in southern California, and the Morelos Dam immediately south of the Mexico-U.S. border (NRC, 2007).

Allocating water

The federal role in the allocation of water rights is limited; states have primary responsibility for determining how water is allocated within their boundaries. Due to the relatively arid nature of the western United States, water rights in western states are different from those in the relatively wet eastern states. The doctrine for water allocation used by most western states is known as prior appropriation, and it functions as a real property right to a specific quantity of water as long as that water is used for beneficial purposes. Furthermore, water rights are allocated by a fundamental maxim that states, "first in time, first in right." However, there are large variations from state to state in how this doctrine has evolved. The federal government has generally steered clear of any involvement in the allocation of water rights. For example, according to the Clean Water Act (CWA), "the authority of each state to allocate quantities of water within its jurisdiction shall not be superseded, abrogated, or otherwise impaired" and nothing "shall be construed to supersede or abrogate rights to quantities of water which have been established by any State" [33 U.S.C. § 1251 (g)]. Below we discuss the importance of this authority for climate change adaptation.

One notable exception to this rule is the allocation of Colorado River water among the states as described above. This interstate allocation has evolved through a series of interstate compacts, federal statutes, Supreme Court decisions, and other federal-level actions. In fact, the Secretary of the Interior has been delegated authority to oversee the allocation of water among the seven states that use Colorado River water. Although the Law of the River determines how much water is allocated between states, it plays no role in the allocation of that water within a state.

Conflicts between states over use or allocation of water can be solved in one of three ways: (1) direct legislation by Congress, (2) lawsuits between states under applicable federal laws such as the Colorado River Compact, and (3) compacts between states. Formal compacts between states require congressional approval.

A long and sustained drought or a long-term decrease in runoff in the Colorado River Basin could trigger a "call" under the Compact. Such a call could curtail water use in the Upper Basin. There is a formula for allocating water among Upper Basin states. As with prior appropriations for allocating water within Colorado, the formula could be used to allocate water in times of shortage among the states.

Recent history suggests how allocation of reduced water supplies among the Colorado River Basin states could be addressed. The severe drought in the early part of the last decade prompted the U.S. Secretary of the Interior to ask the Colorado River Basin states to develop a plan for managing droughts in the river. The Secretary said that if the states did not develop such a plan, the Interior Department would impose one on them under the authority vested in the Secretary by the Boulder Canyon Project Act of 1928, the 1963 U.S. Supreme Court decision *Arizona v. California*, the 2006 Consolidated Decree of the U.S. Supreme Court, the Colorado River Basin Project Act of 1968, and other applicable provisions of federal law. The states, with federal coordination, came to a consensus that

included coordinated management of Lakes Powell and Mead, water conservation, and an agreement to attempt to negotiate future controversies before resorting to litigation. The agreement could be used to manage a long-term reduction in flow and avoid a Compact Call or it could be used to negotiate management of the reduced water supplies.

Developing principles and guidelines for design and operation of river basin plans and projects

The WRA of 1965 created the U.S. Water Resource Council, an independent executive agency of the U.S. government, to establish principles, standards, and procedures for preparing regional or river basin plans and for evaluating federal water and related land resources projects (42 U.S.C. 1962a-2). The Water Resource Council first published these principles and guidelines in 1973, with a subsequent revision in 1983. Since then, the Water Resource Council has essentially been defunct.

Under the WRDA of 2007, the Secretary of the Army is required to promulgate principles and guidelines for a regional- or watershed-based approach to water resource management [PL 110-114 §2031(b)(3)(D)], incorporating integrated water resources management and adaptive management concepts [PL 110-114 §2031(b)(3)(E)]. The purpose of these principles and guidelines is to guide national water resources planning for federal agencies (e.g., USACE, USBR, NRCS). The WRDA of 2007 directs the Secretary of the Army to revise the 1983 principles and guidelines [PL 110-114 §2031]. The first draft of revised principles and guidelines were published in September 2008 (73 FR 52960).

The proposed principles and guidelines specifically state that the impacts and potential effects of climate change should be evaluated for federal agency water resources planning (USACE, 2008). The Council on Environmental Quality recently updated these guidelines and added the need to address risk and uncertainty, including the effects of climate change and future development (CEQ, 2009). Additionally, these revised guidelines recommend that actions be taken to inform the public about how climate change may affect future flood and storm events (CEQ, 2009).

Overview of Colorado Water Law and the Colorado River Basin

Colorado allocates the water within its borders, including Colorado River water, based on a prior appropriations doctrine. Under this doctrine, “a water right is a right to the use of the water; the right is acquired by appropriation; and an appropriation is the act of diverting water from its source and applying it to a beneficial use” (The Water Information Program, 2010b). A water right under this doctrine is often limited to a specific amount of water at a specific location that is used for a specific use (sometimes at a specific time). In Colorado, the appropriation water right system is also referred to as a “first in time, first in right” doctrine (The Water Information Program, 2010a) because the appropriation system is based on the seniority of the water right; senior water rights (water put to beneficial use in earlier years) have priority over junior water rights (water put to use in later years). A senior right can initiate a “call” under state law to force junior water rights holders to provide the senior rights holder water in years of shortage. Some critics have suggested that the Colorado prior appropriations doctrine may be an impediment to adaptation because it discourages the efficient use of limited water resources, among other reasons. Note that the decision to use a prior appropriations system is made by the State of Colorado and the state has sole authority over the decision, including the ability to modify the doctrine.

Roles of the Federal Government, State Government, and Other Entities in Managing the Colorado River Basin

Federal role

The role of the federal government in Colorado River Basin water supply issues is limited. USBR coordinates the planning, construction, and implementation of numerous water diversion and storage projects in the western United States. It also manages existing reservoirs along the Colorado River that were financed using federal funding (The Water Information Program, 2010b).

If the seven states that signed the Compact fail to resolve issues according to the terms and conditions of the Compact, they could face federal intervention to resolve the differences (CRWCD, 2008). The Secretary of the Interior has authority to intervene in Colorado River water management under the Boulder Canyon Project Act of 1928, the 1963 U.S. Supreme Court decision *Arizona v. California*, the 2006 Consolidated Decree of the U.S. Supreme Court, the Colorado River Basin Project Act of 1968, and other applicable provisions of federal law.

State role

In Colorado, the Colorado Water Conservation Board, part of the Colorado Department of Natural Resources (DNR), oversees water supply protection, flood protection, water supply planning and finance, stream and lake protection and conservation, and drought planning. Another agency within the DNR, the Colorado Division of Water Resources, is responsible for the legal administration of Colorado's water resources, including water rights issues, wetlands protection, and endangered species recovery.

Additionally, various local and regional water districts operate under state authority for specific purposes. For example, the Colorado River Water Conservation District (CRWCD) was chartered by the Colorado General Assembly in 1937 to be “the appropriate agency for the conservation, use and development of the water resources of the Colorado River and its principal tributaries in Colorado” (CRWCD, 2010a). The CRWCD, which includes the 15 West Slope counties⁴ in which the majority of the state's Colorado River Basin exists, has an important role in allocating water supplies on a regional basis within the state. Other local entities also play a role in managing Colorado River water. For example, the Northern Colorado Water Conservation District (under state authority) is the local entity that contracts with the federal government to manage the Colorado-Big Thompson Project. Water from the Colorado River, which is stored in a series of reservoirs on Colorado's West Slope, is diverted under the Rocky Mountains through a 13-mile tunnel for use in the district's seven-county service area on the East Slope.⁵

⁴ These counties are Moffat, Routt, Grand, Eagle, Summit, Pitkin, Gunnison, Rio Blanco, Garfield, Mesa, Ouray, Delta, and portions of Montrose, Saguache, and Hinsdale. The district covers approximately 29,000 square miles, roughly 28% of the land area of Colorado (CRWCD, 2010a).

⁵ The Northern Colorado Water Conservancy District encompasses 1.6 million acres in portions of Boulder, Larimer, Weld, Broomfield, Morgan, Logan, Washington, and Sedgwick counties (NCWCD, 2010).

Other entity roles

Other public entities such as municipalities and utilities have a role in the management of water resources, including Colorado River water in particular. One example is the Shoshone Agreement. Xcel Energy, which owns the Shoshone Hydroelectric Plant (the Plant; located in Colorado east of where the Gunnison River joins the Colorado), entered into a temporary franchise agreement in 2006 with the City and County of Denver to allow Denver to “dictate a reduction in the Shoshone Plant’s water right” during times of anticipated summer drought (CRWCD, 2010b). The Plant has two water rights: a senior right for 1,250 cubic feet per second (cfs), with a priority date of 1905, and a more junior right for 158 cfs, with a 1941 priority. Under the agreement, the Plant will reduce its “call” on the river during times of water shortages. Xcel Energy was effectively forced to agree to these call restrictions because Xcel Energy must periodically renew its franchise agreement with the City of Denver to use its rights-of-way. Downstream West Slope communities were included in the most recent 2006 renegotiation of the franchise agreement, giving a voice to other interests downstream of the Denver diversions, even though this is not legally required. Although this agreement is not permanent and will be revisited at the next franchise renegotiation, it is an example of how stakeholders can work together to address water shortages in the Colorado River.

Potential Consequences of Socioeconomic and Climate Changes in the Colorado River Basin

Among some western states (Colorado, Arizona, California, Idaho, Nevada, Texas, and Utah), Colorado is ranked as the third fastest-growing state and is projected to double its population from 4.8 million in 2005 to a projected 8.7–10.3 million in 2050 (Center for Systems Integration, 2010). Populations in other states using Colorado River water are also projected to expand. For example, the population of California is projected to increase from 36 million to 60 million by 2050 (Reuters, 2007). In addition, other demands on water supplies (e.g., tribal settlements and mandated instream flows for environmental conservation or endangered species) could grow in the future (NRC, 2007). These trends will lead to more stress on the state’s water resources.

Key impacts of climate change for Colorado include the following (Ray et al., 2008):

- Climate models project Colorado will warm by about 2.5°F by 2025, relative to the 1950–1999 baseline, and by about 4°F by 2050;
- Winter projections show fewer extreme cold months, more extreme warm months, and more strings of consecutive warm winters;
- No consistent long-term trends in annual precipitation have been detected;
- Change in annual precipitation is uncertain, although it is likely that decreases are more likely in southwestern Colorado than in northeastern Colorado (AECOM, 2010);
- A slight increase in the proportion of precipitation falling as rain rather than snow is expected; and
- Models project a decline in lower elevation (below 8,200 feet) snowpack by the mid-21st century.

Discussion

If climate change does reduce water supplies and increase demand in the Southwest as projected, adaptation will likely follow one or both of two basic strategies: increasing supplies or decreasing demand. The states will likely play the central role in adaptation, regardless of the combination of strategies used. However, there could be some federal involvement through implementation of the ESA and water quality legislation.

Because states have primary responsibility for water allocation within their boundaries, any reduction in available water to meet current or future demands will be managed under state authority.⁶ Under Colorado's prior appropriations doctrine, a large reduction in runoff and no adaptive action could entail limiting water deliveries to the most senior rights holders and cutting off deliveries to junior rights holders. As noted, Colorado, like many western states, has had its largest population growth in recent decades, and significant population growth is projected for future decades among growing communities, many of which have junior water rights. Senior water rights holders typically include mining, some agriculture, and older municipalities. Newer municipalities or those whose recent growth has exceeded their historical rights either have junior (lesser) rights or insufficient rights to meet current needs. For example, the City of Aurora, with a current population of just over 300,000 (U.S. Census Bureau, 2010), has a relatively junior water right (Lowrey et al., 2009) and would receive little water in dry years under strict enforcement of prior appropriations. It is difficult to imagine that cities such as Aurora would bear the brunt of decreased water supplies, while more senior water rights holders would experience a relatively small or no reduction in water supplies.

The second major option for adaptation is to enhance supplies. This has historically been the province of the federal government for extremely large projects, such as Hoover and Glen Canyon dams, which were conceived and built in an era when water running to the sea was perceived as a waste of resources (Reisner, 1987). Indeed, in recent decades, the federal government has reduced its role in building water supply infrastructure, "leaving the state and its localities with the challenge to supply water for its increasing population and economic activities" (Center for Systems Integration, 2010).

Many other smaller supply enhancement projects could be developed. Many of these could be approved and funded by state or municipal authorities. For example, projects to divert water from the Colorado River to Front Range communities east of the Rocky Mountains could be built. These projects would fall under the jurisdiction of the state (although such projects will still be subject to the Law of the River and federal laws such as the CWA, the ESA, and the National Environmental Policy Act). Other projects, such as enlarging existing state or utility-managed reservoirs, conjunctive use,⁷ desalination, and water reuse,⁸ could arise from state or municipal government initiatives.

⁶ The federal government could get involved in state water management decisions if they result in listing of species under the ESA or violation of the CWA or Safe Drinking Water Act (SDWA).

⁷ Conjunctive use entails storing water during high runoff periods in groundwater aquifers for use in the dry season.

⁸ Water reuse entails the use of municipal wastewater typically for irrigation and other nonpotable purposes

Recently, there has been more use of nonstructural approaches to reallocate or enhance water supplies. This has included the lease, sale, or transfer of water from agriculture to municipal uses (NRC, 2007). For example, one interesting example of such a transfer was the City of Aurora, which made an agreement with farmers in the Arkansas River Basin to pay for and obtain their water during droughts. Essentially, irrigation water in the Arkansas River is used by municipalities in dry periods.

Even though the states have primary authority over supply and use of water, the federal government could still be significantly involved in decisions regarding the Colorado River. A species in the Colorado River that is listed under the ESA could bring federal authority to bear on water allocation decisions by the state by requiring the maintenance of instream flows for habitat and species preservation. Violations of the CWA or SDWA also could bring the federal government in to oversee actions to redress the violations. However, these interventions would involve a limited role for the federal government in water allocation. A situation similar to the supply management agreement negotiated in 2007 might involve a larger role for the federal government. In this 2007 agreement, the threat of federal action brought states to the negotiating table. The federal government might play a similar role in allocating a long-term reduction in Colorado River water.

Climate change and socioeconomic changes such as population growth seem likely to encourage innovative solutions to reducing water supplies such as the sharing agreement between Aurora and the farmers of the Arkansas River or between Xcel Energy and Denver Water. These solutions are likely to be developed at the state and municipal levels. The federal government, however, may have to intervene if states are unable to work out agreements on how to allocate reduced supplies from rivers such as the Colorado.

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4. Conclusions

In this report, we examined the potential legal role of states in adapting to climate change using two case studies: Wyoming's management and conservation of the greater sage grouse and Colorado's management and regulation of Colorado River water supplies. The primary lesson is that states have adequate legal authority to begin considering climate change in their resource management decisions. Although this authority is not yet commonly used to address climate change, states appear to have significant flexibility in implementing laws and regulations as well as management practices to account for climate change.

It should be noted that this report only examined the formal legal authorities that states have when considering the effects of climate change on their resource management decisions. Many other policy issues are critical when making decisions in support of adaptation, including technical capacity, financial resources, and political will (Smith et al., 2009). These issues, and others, are critical to fully understanding the potential role of states in adapting to climate change, but they are beyond the scope of this report.

States Already Manage Resources Adaptively

One critical observation is that in both case studies, the states have already taken action to manage the resource in question consistent with adapting to climate change. This generally was not done because of climate change, but because of other concerns in managing the resource, from declines in populations of species that cross traditional jurisdictional boundaries to long-term droughts putting pressure on water supplies. As these problems were identified, states found innovative ways to address them.

Wyoming is now working with other states with suitable habitat to develop landscape-scale conservation strategies that ensure preservation of the greater sage grouse and minimize the likelihood of an ESA listing. There is a favorable synergy between the need for coordination of interstate species conservation mechanisms and the need for tools to incorporate climate change considerations into wildlife management.

For water supplies from the Colorado River, Colorado has allowed flexibility in water laws for different water rights holders to engage in agreements that they find mutually beneficial without endangering their property rights. Innovative solutions to water supply shortages, such as the sharing agreement between Aurora and the farmers of the Arkansas River or between Xcel Energy and Denver Water, have paved a pathway to manage water supplies adaptively under a changing climate.

Threat of Federal Action Acts as a Motivator for States

A second critical observation is that the threat of federal action often motivates states to take more creative or innovative approaches to managing a resource. Whatever barriers prevent states from effectively managing resources appear to be removed when states are faced with a loss of authority or potential economic impacts from federal action. The same motivation that encouraged Wyoming and Colorado to remain flexible in their resource management for non-climate change-related issues may also persuade states to proactively address climate change impacts on the resources over which they have authority.

States have a compelling interest to avoid species listings under the ESA for two primary reasons: they lose authority when ESA mandates become effective and there are potential significant economic consequences to the designation of critical habitat that may have a high economic value. For example, Wyoming acted proactively to address the conservation of the sage grouse as a declining species. While ensuring that any conservation strategies and plans work both now and in the future, wildlife managers may be motivated to consider climate change impacts on wildlife management and appropriate conservation actions to adapt to such changes.

Even though states have primary authority over the development of supplies and allocation of water, the federal government could still be significantly involved in decisions regarding the Colorado River. For example, a species along the Colorado River that is listed under the ESA could bring federal authority to bear on water allocation decisions by the states. In addition, violations of the CWA or SDWA could bring the federal government in to oversee actions to redress the violations. In the case of interstate disagreement over the Colorado River Compact during the drought of 2002, the states came to agreement only after they were faced with the possibility of the Secretary of the Interior renegotiating the terms of the Compact unilaterally. As noted previously, states generally want to keep the federal government out of decisions over which states have authority. In turn, states are likely to seriously consider proactive action when addressing climate change impacts that could put them out of compliance with federal statutes.

Limits to Federal Action May Force States to Address Climate Change

A third critical observation is that the federal government may be limited in its ability to provide solutions to the impacts of climate change, forcing states into an active policy-making role. For example, after a species is listed under ESA, opportunities to address changing species dynamics may be more constrained. One ESA mechanism that can be used to conserve species, the designation of critical habitat, typically has been used only if the species in question currently occupies that habitat or if that habitat is part of the species' historic range. Thus, this aspect of the ESA would not likely provide the flexibility needed to consider climate change-induced shifts in habitats or ecological dynamics and to protect habitat that may be critical to a species in the future.

The federal government historically has been involved in large water supply projects. However, in recent decades, the federal government has reduced its role in building water supply infrastructure, “leaving the state and its localities with the challenge to supply water for its increasing population and economic activities” (Center for Systems Integration, 2010). Although the federal government still operates and manages significant water infrastructure, the WRA of 1958 mandated the supply of water as primarily a state and local responsibility. In other words, the federal government’s primary role in developing new water supply projects now comes in the form of ensuring that environmental impacts are minimized through relatively inflexible tools such as the National Environmental Policy Act, the Clean Water Act, and the Safe Drinking Water Act. Furthermore, over the last four decades, there has been a paradigm shift away from large projects that exploit natural resources toward conservation of such resources and solutions that are more attuned with protecting environmental values. Facing this new reality, states and municipalities have begun looking at nonstructural solutions to increasing available water supplies in order to increase the flexibility of their water supply portfolio while avoiding inflexible federal mandates to the extent possible.

Decision-making Flexibility and Formal Legal Authority

A final observation is that formal authority under the law is rarely a constraining factor when considering climate change in resource management. Authority is only one facet of the decision-making and policy processes. In many circumstances, states, municipalities, and even the federal government have found innovative ways to work within existing authorities to improve resource management. This same creativity can be used to incorporate climate change into resource management under existing authorities.

Wyoming showed flexibility under existing authority when it established its “core areas” approach and coordinated with other states on sage grouse conservation and management. Similarly, Colorado showed flexibility in its water law regime when it allowed temporary agreements between water rights holders in order to meet critical water demands without endangering those water property rights. By using creative mechanisms under existing authorities, Colorado and Wyoming were able to manage their resources more effectively. This implies that there is significant room to incorporate climate change under existing authorities within a state. Climate change could also be incorporated through innovative partnerships (both formal and informal) between states and municipalities, states and other states, and even states and the federal government, as was demonstrated in the water shortage agreement on the Colorado River.

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