CHAPTER ONE

Historical Development, Principal Federal Legislation, and Current Management of Sagebrush Habitats

IMPLICATIONS FOR CONSERVATION

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Abstract. The historical disposition and development of sagebrush (*Artemisia* spp.) landscapes have resulted in land ownership mosaics and differences in environmental qualities among land managers that influence today's conservation planning. Early land-use policies following major land acquisitions from 1776 to 1867 in the western United States were designed to transfer the vast public resources to private ownership. Federal legislation enacted during the late 1800s and early 1900s encouraged development of arable regions, facilitated livestock grazing, created transportation corridors, and provided for access to minerals, coal, and petroleum. Productive lands characterized by deeper soils and access to water were transferred to private entities and converted from native habitats to agriculture. Privately owned lands are a major constituent of sagebrush landscapes in the Great Plains and Columbia Basin and are intermixed with public lands in other Sage-Grouse (*Centrocercus* spp.) Management Zones. The public still retains large areas and 70% of current sagebrush habitats. The Bureau of Land Management has responsibility for almost half of the sagebrush habitat in the United States; however, those lands are relatively unproductive and characterized by xeric environments and shallow soils. More recent legislation reflects changing public values to maintain or restore natural components, such as plants and wildlife, and minimize the impact of land uses in sagebrush landscapes. Multiple use dominates the management policy of most sagebrush habitat on public land; very little of the lands used by Greater Sage-Grouse (*Centrocercus urophasianus*) has protected status in national parks or reserves. Conserving sagebrush landscapes required by Greater Sage-Grouse and other wildlife will depend on engaging the mosaic of public agencies and private ownerships in management programs, understanding the broad diversity of habitat characteristics, and recognizing the limitations of environments supporting the majority of sagebrush habitat on public lands.

Key Words: federal government agencies, legislation, public land management, sagebrush.

Desarrollo Histórico, Legislación Federal Principal, y Manejo Actual de Hábitats de Artemisa: Implicaciones para la Conservación

Resumen. La disposición histórica y el desarrollo de territorios de sagebrush (*Artemisia* spp.) han resultado en mosaicos de propietarios y diferencias en calidades ambientales entre los administradores de tierras que influyen en los planes de conservación actuales. Las primeras políticas de uso de

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tierras que siguieron a grandes adquisiciones de tierras en 1776–1876 en el oeste de EE.UU., fueron diseñadas para transferir los vastos recursos públicos hacia una propiedad privada. La legislación federal redactada durante finales de 1800 y comienzos de 1900 estimuló el desarrollo de las regiones arables, facilitó el pastoreo de ganado, creó corredores de transporte, y subvencionó el acceso a minerales, carbón y petróleo. Las tierras productivas caracterizadas por suelos más profundos y acceso al agua fueron transferidas a las entidades privadas y transformadas de hábitats nativos a la agricultura. Tierras de propiedad privada son el principal constituyente de los territorios de artemisa en el Great Plains y en el Columbia Basin, y están mezcladas con terrenos públicos en otras zonas de manejo de sage-grouse (*Centrocercus* spp.). Siguen siendo de manejo público grandes áreas y el 70% de las áreas actuales de artemisa. El Bureau of Land Management es responsable por casi la mitad de los territorios de artemisa en los EE.UU., sin embargo, esas tierras son relativamente improductivas y caracterizadas por un medioambiente xérico (adaptado a las condiciones desérticas) y suelos poco profundos. La legislación más reciente refleja valores públicos cambiantes para mantener o restaurar los componentes naturales, tales como plantas y vida silvestre, y minimizar el impacto de uso de la tierra sobre el paisaje de artemisa. Un uso variado domina la política de manejo de la mayoría de los hábitat de artemisa en las tierras públicas; muy poco de la tierra empleada por el Greater Sage-Grouse (*Centrocercus urophasianus*) tiene el estado de especie protegida en los parques o reservas nacionales. La conservación de los paisajes de artemisa requeridos por el Greater Sage-Grouse y el resto de la vida silvestre dependerá de involucrar el mosaico de agencias públicas y propietarios privados en programas de manejo, que entiendan la amplia diversidad de características del hábitat, y que reconozcan las limitaciones que tienen los ambientes que sostienen la mayoría de los hábitats de artemisa en las tierras públicas.

Palabras Clave: agencias federales de gobierno, artemisa, gestión de tierras públicas, legislación

The mosaic of land ownerships and land uses in the western United States presents challenges for conserving large sagebrush (*Artemisia* spp.) landscapes required by Greater Sage-Grouse (*Centrocercus urophasianus*). Today's mix of ownership and administrative responsibilities is a direct result of the historical sequence of public land law policies that have guided disposition and use of sagebrush habitats since Euro-American settlement. These policies also left a landscape in which environmental characteristics and management objectives differ among ownership and management agencies, thus affecting conservation options and restoration potential.

Early settlers described an endless sea of sagebrush as they traveled westward (Frémont 1845, Young and Sparks 2002). The vast open landscapes acquired through purchases and cessions appeared to have unlimited forage for grazing livestock, minerals for mining, soils that could be converted to agriculture, and petroleum for an expanding nation's defense and infrastructure (National Research Council 1989, Flores 2001, Dombeck et al. 2003). Early policies by the federal government encouraged privatization, development, and use of these extensive lands (Bean and Rowland 1997). Resource availability (especially water for irrigation) dictated which lands were transferred to private entities, which were claimed for grazing or minerals, and which remained in the public trust (Talbert et al. 2007). But resources were not unlimited, and land-use policy increasingly recognized management and conservation beginning in the early 1900s (Clawson and Held 1957, Poling 1991). Most recently, greater demand for resources coupled with human population growth, urban development, and increasing intensity of land use are decreasing the amount of land available throughout much of the western United States for both consumptive and nonconsumptive uses (Holechek et al. 2006).

I first review the important federal legislation that has governed sagebrush habitats in the western United States through three primary periods: (1) initial acquisition, (2) disposition and transfer from public to private enterprise, and (3) management and conservation (Clawson and Held 1957, Poling 1991). These statutes guiding agricultural development, livestock grazing, and use of mineral and petroleum resources form the legal and policy foundation underlying current distribution of ownership and management of sagebrush habitats. I then describe the environmental characteristics of

sagebrush habitats within the Sage-Grouse Conservation Area (SGCA), the region containing the pre–Euro-American settlement distribution of sage-grouse (Connelly et al. 2004) relative to public and private ownership. These characteristics, a direct result of the legislative disposition of sagebrush lands, are significant components affecting conservation strategies. I focus primarily on historical use of sagebrush habitats in the United States, but have added Canadian legislation where parallel developments are relevant.

PUBLIC LAND DEVELOPMENT IN THE UNITED STATES

Land Acquisition

Sagebrush lands were contained in the territories acquired by the United States in the Louisiana Purchase (1803) and the Oregon Compromise (1846) and ceded by Mexico (1848). Consequently, the federal government became responsible for large amounts of land and resources within a short period. In addition to western lands, the Alaska Purchase in 1867 added 1,500,000 km^2 to the federal land base. Acquisitions outpaced dispositions until 1850; the total net area in the public domain has subsequently declined following this peak (Clawson and Held 1957). Lands not specifically titled to individuals or corporations remained in public ownership as part of conditions for statehood (Dombeck et al. 2003).

Land and Resource Disposition

Disposition of land and resources to the private sector became a major priority of the federal government as an encouragement for settlement and as a means to fuel national economic growth (Clawson and Held 1957). Thus, initial legislation guiding use of public lands was directed toward granting lands to states for schools, developing irrigated agriculture, providing forage for livestock, creating or improving transportation, and mining for coal and mineral resources (Table 1.1).

Agricultural Development and Land Transfer

A succession of homestead acts beginning in the 1800s initiated a series of legislative actions by the federal government to transfer resources contained on public lands to the private sector for development and agriculture. The original Homestead Act, signed by President Lincoln in 1862, allowed a person older than 21 years of age to obtain title to 160 acres (65 ha) of undeveloped land, provided the individual built a home on it and developed the land for 5 years. Sixty-five hectares of land was too small for viable agriculture business in much of the arid regions of the western United States, and subsequent homesteading acts were passed to increase the acreage of lands that could be settled and to encourage dry-land farming (Table 1.1). Approximately 1,200,000 km^2 of public lands were transferred to private ownership under the homestead acts (Ross 1984).

The Desert Land Act (1877) allowed a settler to obtain 640 acres (259 ha) at $1.25/acre, provided the lands would be irrigated within 3 years. The Carey Act (1894) transferred an additional 404,700 ha of federal lands to the states (Colorado, Nevada, and Wyoming each were awarded a total of 809,371 ha, and Idaho received a total of 1,214,057 ha), on the condition that the lands were irrigated for agriculture. States then could pass 65-ha tracts to private ownership.

The Dominion Lands Act (1872) promoted a similar pattern of development in the prairies in western Canada. A male farmer who was a born or naturalized British subject could purchase 65 ha of land for $10 (female farmers could buy the same amount of land for up to $5,000), provided he agreed to cultivate at least 16.25 ha and build a permanent dwelling within 3 years. Unlike the American Homestead Act, a Canadian farmer could purchase the adjacent lot for the same price, thus doubling the size of his landholding. The Dominion Lands Act also established cadastral surveys similar to the United States Land Ordinance (1785) that gridded the land into townships consisting of 36 sections.

Railroads

Large amounts of land were also granted to private companies to build railroads connecting eastern and western states. The Pacific Railway Act of 1862 facilitated building a railroad and telegraph line connecting the Pacific Coast and Missouri. The Union Pacific Railroad and the Central Pacific Railroad were granted 25.9 km^2 under the 1862 act to be distributed in alternate sections on each side for every 1.6 km of completed track (Table 1.1). A subsequent amendment in 1864 increased the land area given to railroad companies to 51.8 km^2 for each mile of track completed (note the private railway corridor through predominantly public

TABLE 1.1

Principal federal legislation governing the management and use of public lands containing sagebrush in the United States.

Size of areas are given in acres to correspond with units of the original cadastral surveys (1 acre = 0.4047 ha). Laws are grouped in the United States Code (USC) under Titles 16 (Conservation), 30 (Mineral Lands and Mining) and 43 (Public Lands).

Year	Legislative act	Citation	Land use
1785	Land Ordinance Act	Continental Congress XXVIII, 375–381	Established the grid system of townships and sections for the Public Land Survey System that facilitated land sales. Section 16 of each township was to be given the states for public schools.
1862	Homestead Act	37th Congress, Chapter 75, 12, Stat. 392	Permitted entry on 160 acres (65 ha) provided the settler built a home, lived on the land, made improvements, and farmed it for 5 years.
1862	Pacific Railway Act	U.S. Statutes at Large, 12, 489 ff.	Granted the right of way through public lands for constructing a railroad connecting the Pacific Ocean and the Missouri River. The Union Pacific and Central Pacific railroad companies were to receive 10 mi^2 (26 km^2) of land distributed on each side for every 1 mi (1.6 km) of completed track.
1864	Pacific Railway Act	U.S. Statutes at Large, 13, 356 ff.	Increased the lands distributed to the railroad companies to total 20 mi^2 (52 km^2) for each mile of track completed.
1872	General Mining Act	30 USC 21–54	Declared that all valuable mineral deposits on lands belonging to the United States were free and open for purchase. Anyone could stake a claim at no cost. The holder of a claim has exclusive rights to mine and remove minerals. No royalty is paid to the U.S. on minerals. A mining claim conveys title to surface rights as well as minerals. Mineral lands containing oil, gas, coal, phosphate, potash, nitrate, oil shale, and asphaltic mineral can be homesteaded or sold but the federal government retains mineral rights.
1877	Desert Land Act	43 USC 321–339	Permitted entry on 640 acres (259 ha) at $1.25/acre provided the lands would be irrigated within 3 years.
1885	Unlawful Inclosures of Public Lands Act	43 USC 1061–1066	Made private fencing of public ranges illegal.
1891	Forest Reserve Act	26 Stat. 1103	Gave the president authority to withdraw public lands covered by timber as reservations. Established the first national forests.
1894	Carey Act	43 USC 641	Provided for 404,685 ha of federal lands in each state to be transferred to the state or to the actual settlers (limited to 65 ha each) provided that the lands could be irrigated. Colorado, Nevada, and Wyoming were each awarded an additional 404,685 ha and Idaho an additional 809,372 ha under subsequent amendments.

TABLE 1.1 (*continued*)

Year	Legislative act	Citation	Land use
1897	USDA Forest Service Organic Administration Act	16 USC 475	Restricted the president's authority to withdraw public lands for forest reserves. Identified the primary purposes for forest reserves as forest protection, secure water flows, and supplying timber. Established grazing management and gave the U.S. Department of the Interior's General Land Office the right to regulate occupancy and use on forest reserves.
1897	Oil Placer Act	29 Stat. 526	Extended the rights under the General Mining Act to include exploration and extraction of petroleum reserves.
1905	Transfer Act	33 Stat. 628	Transferred the national forest reserves from the Department of the Interior's General Land Office to the Department of Agriculture. Created the U.S. Forest Service from the Division of Forestry.
1906	Act for the Preservation of American Antiquities	16 USC 431–433	Permitted the president of the United States to restrict use on public lands owned by the federal government having historical significance without congressional approval.
1909	Enlarged Homestead Act	43 USC 218–221	Permitted entry to 320 acres (130 ha) for dry-land farming. Homesteaders could live within 20 miles (32 km) of the land if no suitable water supplies were available.
1912	Three-Year Homestead Act	37 Stat. 123–125	Reduced the occupancy period from 5 to 3 years.
1916	Stock Raising Homestead Act	43 USC 299	Permitted entry to 640 acres (259 ha) that had been designated for grazing. Federal government retained subsurface rights to minerals and coal.
1920	Mineral Leasing Act	41 Stat. 437	Directed management of the energy resources on federal lands to be developed by leasing exploration and development rights. Rather than transferring the public domain, the law retained public lands by the United States but allowed economic development of resources.
1929	Migratory Bird Conservation Act	16 USC 715	Established a commission to review and approve land and water area proposed by the Secretary of the Interior for purchase or rental for wildlife protection. Has been used primarily to establish waterfowl refuges.
1934	Taylor Grazing Act	43 USC 315–316	Established grazing fees and districts. Lands were classified as to their best use. Federal government recognized the need to care for the land and take into account the people who use it.
1945	Reorganization Act	28 USC 403	Section 403 of the Act merged the Grazing Service and the General Land Office to form the Bureau of Land Management within the U.S. Department of the Interior in 1946.

TABLE 1.1 (*continued*)

TABLE 1.1 (CONTINUED)

Year	Legislative act	Citation	Land use
1954	Recreation and Public Purposes Act	43 USC 869	Authorized the sale or lease of public lands to states, state agencies, other political subdivisions, or nonprofit organizations for recreational or public uses (campgrounds, parks, fairgrounds, landfills, and historic monuments).
1960	Multiple-Use Sustained Yield Act	16 USC 528–531	Directed that national forests be managed for multiple use and sustained yield. Multiple use meant the relative values of all resources should be considered, not necessarily the uses (or combination) that provide the greatest economic return or yield of production.
1960	Sikes Act	16 USC 670a–670o	Provided for cooperation by the U.S. Departments of the Interior and Defense with state agencies in planning, development, and maintenance of fish and wildlife resources on military reservations.
1964	Wilderness Act	16 USC 1131–1136	Recognized the need for protection and preservation of lands in their natural condition. A wilderness was defined as an area, generally >5000 acres (2,000 ha), of underdeveloped federal land retaining its primeval condition without permanent improvements, such as roads, or human habitation. These lands were to be protected and managed to preserve the natural character for future generations.
1964	Classification and Multiple Use Act	43 USC 1411–1418	Directed that natural resource lands under the authority of the U.S. Department of the Interior be managed under the principles of multiple use consistent with the Taylor Grazing Act.
1969	National Environmental Policy Act	42 USC 4321–4347	Federal agencies must consider the impact of their actions on the quality of the environment.
1971	Wild Free-Roaming Horses and Burros Act	26 USC 1331–1340	Stated that wild free-roaming horses and burros were a symbol of the western landscape. Gave the Secretary of the Interior the authority to control the proliferation of free-roaming horses and burros.
1972	Executive Order 11644	37 Fed. Reg. 2877	Directed federal agencies to identify areas where off-road vehicles can be used (or prohibited) and required that roads or trails be located to minimize harassment of wildlife or damage to habitat.

TABLE 1.1 (*continued*)

Year	Legislative act	Citation	Land use
1973	Endangered Species Act	16 USC 1531–1543	Provided for protection of endangered (any species in danger of extinction across all or a significant portion of its range) and threatened species (any species likely to become endangered) as well as for critical habitats. Recognized that species ranges included distinct geographic populations. Section 4 delineated the criteria and procedures for listing a species. Section 7 required federal agencies to consult the U.S. Fish and Wildlife Service to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Section 9 prohibited any person under the jurisdiction of the United States to take (harm, harass, hunt, wound, kill, trap, capture, etc.) an endangered species.
1974	Federal Noxious Weed Act	7 USC 2801	Gave the Secretary of Agriculture the authority over entry into and movement within the United States by noxious weeds. Defined noxious weed as a living plant of foreign origin that can (in)directly injure not only agricultural interests but also the fish and wildlife resources of the United States.
1974	Sikes Act Extension	16 USC 670g–670o	Required Departments of the Interior and Agriculture to manage lands to help protect state-listed species of concern.
1975	Energy Policy and Conservation Act	42 USC 6201–6202	Developed the provisions to stabilize the energy supply through creation of the Strategic Petroleum Reserve, establish energy conservation programs and regulatory mechanisms, increase the supply of fossil fuels in the United States through price incentives and production requirements, reduce the demand for petroleum products and natural gas by making coal a more feasible alternative, assure the reliability of energy data, and conserve water by improving the water efficiency of certain plumbing products and appliances.
1976	Federal Land Policy and Management Act	43 USC 1701–1784	Public lands must be managed for multiple use and sustained yield and maintain quality of land. Directed that a portion of grazing fees should be returned for range improvements. The United States must receive fair market values for the use of public lands and resources unless otherwise provided for by statute.
1976	Executive Order 11987	Exec. Order No. 11987 2(a)	Directed federal agencies to restrict introduction of exotic species (those not naturally occurring within the United States) into lands under their administration.

TABLE 1.1 (*continued*)

TABLE 1.1 (CONTINUED)

Year	Legislative act	Citation	Land use
1977	Surface Mining and Reclamation Act	30 USC 1201–1328	Required that adverse impacts on fish, wildlife, and related environmental values be minimized. Recognized the need for reclamation of coal and other surface mining areas.
1978	Public Rangelands Improvement Act	43 USC 1901–1908	Provided for restoration of damaged rangelands, and recognized the need for a policy of inventory and monitoring. Established a formula for calculating grazing fees.
1985	Food Security Act	16 USC 3831–3836	Established the Conservation Reserve Program. Farmers enrolled in the program receive annual payments to set aside lands for at least 10 years and plant permanent cover, such as grasses, perennial forbs, and trees. The Secretary of Agriculture, through the National Resources Conservation Service, administers the program.
1990	Food, Agriculture, Conservation, and Trade Act	16 USC 3831	Expanded the lands that could be included in the Conservation Reserve Program to highly erodible or marginal croplands on which cultivation would damage water or environmental qualities.
1990	Federal Noxious Weed Act (amendment)	7 USC 2801	Extended the 1974 provisions to Department of the Interior and required each federal land management agency to fund programs in cooperation with states to control undesirable plants. Defined "undesirable" plants as to include noxious, harmful, injurious, or poisonous species.
1999	Executive Order 13112	CFR 64:6183–6186	Federal agencies were required to prevent introduction, provide for control, and minimize the impacts of invasive species. Defined invasive species as an "alien" (not native to a given ecosystem) whose introduction or presence is capable of causing harm to the economy, environment, or human health.
2000	Energy Policy and Conservation Act (reauthorization)	PL 106–469	Called for an inventory of all onshore federal lands to identify and estimate oil and gas reserves and the extent or nature of any restrictions or impediments to the development of such resources.
2005	Energy Policy Act	PL 109–058	Broad-based legislation designed to promote alternative fuel technologies, such as wind and solar energy, increase coal and biofuels production, and develop nuclear energy.
2007	Energy Security and Independence Act	PL 110–140	Provided for increased use of biofuels and required a 40% increase in fuel economy by automobiles by 2020.

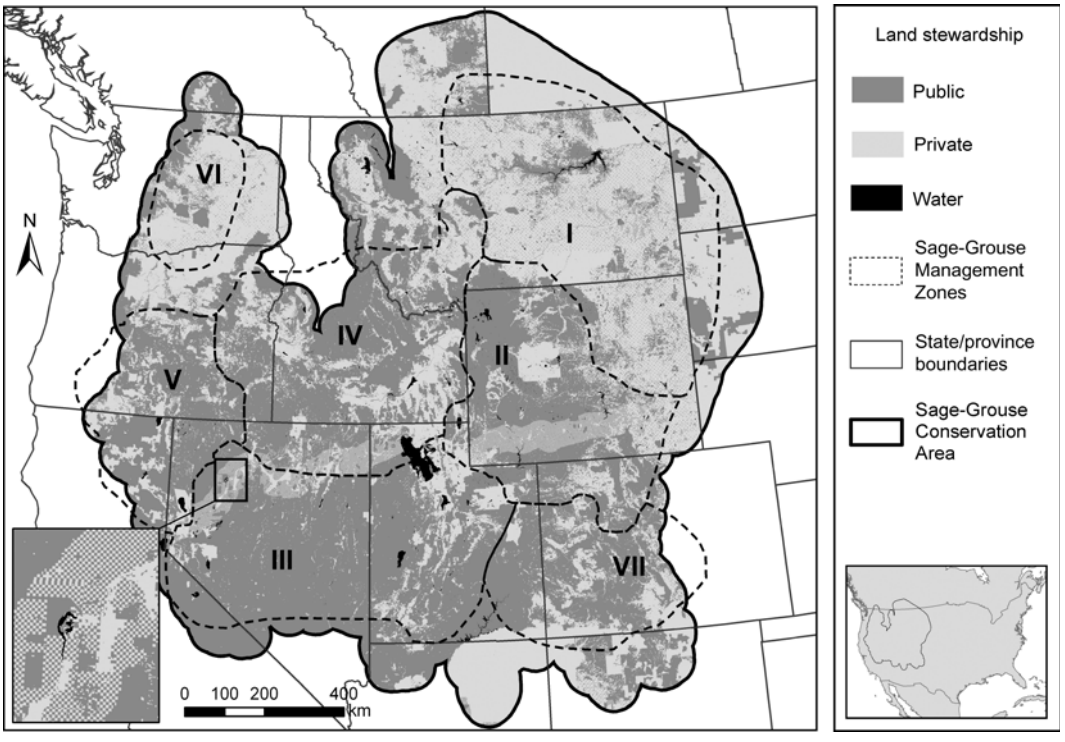

Figure 1.1. Distribution of public and private lands within the Sage-Grouse Conservation Area (Connelly et al. 2004). Land ownership information was compiled from state GAP analysis programs, the U.S. Department of the Interior (USDI) Geological Survey National Land Cover Database, USDI Bureau of Land Management, and individual state sources. Sage-Grouse Management Zones are listed in Table 1.2.

lands and checkerboard ownership in southern Wyoming, northern Utah, and Nevada; Fig. 1.1). Similarly, the Canadian Pacific Railway Company was granted 100,000 km^2 in alternating sections (1.6 km) to build a railroad across Canada. The Canadian Pacific Railway Company could replace land not suited for settlement by selecting other lands vested in the Canadian government (Innis 1923).

Livestock Grazing

The livestock industry expanded rapidly during the mid- to late 1800s, facilitated by establishment of railroads that connected open ranges with markets and transported people seeking opportunities in the western United States (Holechek 1981). Little effort was directed toward grazing restrictions or land management because the federal government was attempting to dispose of public lands at this time (Lieurance 1979, Ross 2006). Large ranching enterprises capitalized on free use of vast expanses of unfenced rangelands and forage (Box 1990, Flores 2001, Young and Sparks 2002, West 2003a).

Mineral and Energy Resources

The primary legislation governing mining and minerals has remained unchanged since passage of the General Mining Act of 1872 (Table 1.1). Discoverers had the right to extract gold, silver, and other valuable deposits under the General Mining Act by staking a claim to lands in the federal public domain. The federal government did not require royalties to be paid on minerals mined and sold from claims because miners and industry were important to settling western lands. The Oil Placer Act, passed in 1897, further extended the General Mining Act to include disposition of petroleum resources on public lands, which were declared free and open to exploration and purchase.

Management and Conservation

Legislation that guided separate development of land uses was enacted concurrently but not systematically, often creating conflicts over appropriate purposes for public lands that have resulted in

today's multiple-use policies (National Research Council 1989, Bean and Rowland 1997). The prevailing attitude that public lands were best transferred to private citizens during the early period of territory acquisition and settlement was also changing by the mid-1900s, concurrent with an increasing awareness of conservation, preservation, and later environmental issues (Dombeck et al. 2003). The importance of nonconsumptive purposes began to dominate legislation beginning in the 1960s. Conflicts with traditional uses of public lands were to be resolved by land management agencies through land-use planning (Holechek 1981, Ross 2006).

Livestock Grazing

Unrestricted grazing coupled with increasing and unsustainable numbers of livestock, particularly on higher-elevation rangelands used during summer, resulted in conflicts among cattle and sheep grazers and calls for regulation (Carpenter 1981, Poling 1991, Donahue 1999). A series of legislative actions beginning in 1891 created forest reserves, regulated grazing on public lands, developed permit and fee systems, and delegated responsibility for administrating public land grazing to the U.S. Forest Service (USFS) in the Department of Agriculture and to the Grazing Service in the Department of the Interior (Donahue 1999). The Organic Act of 1897 (Table 1.1) gave the USFS the right to manage grazing on forest reserves. Subsequently, permits were established to graze a specified number of animals exclusively on tracts within the forest system.

The Taylor Grazing Act of 1934 (Table 1.1), the first statute to govern management of unreserved and unappropriated lands in the public domain, was enacted to achieve orderly use of rangelands and allow for their regeneration (Lieurance 1979, Poling 1991, Bean and Rowland 1997). The Taylor Grazing Act of 1934 terminated the open range policies that still existed on non-USFS lands and authorized the Secretary of the Interior to establish grazing districts of vacant, unappropriated, and unreserved land from any parts of the public domain, excluding Alaska, which were not national forests, parks, and monuments; Indian reservations; railroad grant lands; or revested Coos Bay Wagon Road grant lands, and which were valuable chiefly for grazing and raising forage crops (Taylor Grazing Act: 43 USC 315–316). The Secretary of the Interior was also authorized to issue permits to graze livestock upon annual payment of fees, of which a portion was returned to individual states. Public lands not reserved or withdrawn as refuges were designated as national resource lands and placed under the jurisdiction of the federal Grazing Service. The Grazing Service was merged with the General Land Office to form the Bureau of Land Management (BLM) in 1946.

Mineral and Energy Resources

The rate at which lands were being claimed by private interests within 10 years after passing the General Mining Act and Oil Placer Act threatened to remove petroleum reserves from the federal government at the same time that national dependence on oil was increasing (Costigan 1912). The Pickett Act was passed in 1910 to allow the president to withdraw any public lands of the United States from settlement or exploration and prevent loss of federal control over petroleum reserves.

The Mineral Leasing Act, passed in 1920, retained public lands in the federal trust but authorized leasing for coal, phosphates, oil, and natural gas. Thus, Congress now managed these resources on federal lands rather than transferring ownership to private enterprise (National Research Council 1989). The BLM is the principal administrator of the Mineral Leasing Act. Royalties were to be paid to the United States on gross revenues of extracted resources; half of the total went into the Reclamation Fund, and almost 40% was to be passed to individual states. Revenues derived from the Mineral Leasing Act may be an important source of revenue in some state budgets (Poling 1991).

The Energy Policy and Conservation Act of 1975 (Table 1.1) emphasized the need to stabilize the supply of energy and develop fossil fuels on federal public lands. The reauthorization of the Energy Policy and Conservation Act in 2000 directed the United States Departments of Agriculture, Energy, and the Interior to inventory all onshore oil and gas reserves and identify impediments to the development of those resources. Most of the onshore natural gas and much of the oil under federal ownership within the 48 contiguous states is contained in five geologic basins: (1) Uinta-Piceance of Colorado and Utah, (2) southwestern Wyoming (Greater Green River Basin), (3) San Juan Basin of New Mexico and Colorado,

(4) Montana Thrust Belt, and (5) Powder River Basin of Wyoming and Montana (United States Departments of the Interior, Agriculture, and Energy 2003). These geological basins span a large portion of sagebrush habitats in the eastern regions of the SGCA.

Multiple Use and Conservation

The Multiple Use and Sustained Yield Act passed in 1960 (Table 1.1) directed that national forests were to be managed for fish, wildlife, and outdoor recreation in addition to traditional uses such as timber or grazing. Furthermore, relative values of all uses or commodities were to be considered, not only those that provided the greatest dollar or unit of return. Sustained yield meant that annual production of renewable resources should be maintained in perpetuity without impairment of the productivity of the land (Multiple Use and Sustained Yield Act: Sec. 4 [16 USC 531(b)]). The Classification and Multiple Use Act of 1964 extended this policy to lands managed by the United States Department of the Interior. The Secretary of the Interior also had the authority to classify lands according to the best purpose for retention in the federal trust or disposition to private enterprise. Management now included fish, wildlife, and recreation interests, although both multiple-use acts were to be consistent with and not supersede the Organic Act (1897) governing lands managed by the USFS and the Taylor Grazing Act (1934) for lands under BLM management (Bean and Rowland 1997).

The Federal Land Policy and Management Act in 1976 (Table 1.1) directed that public lands were no longer to be disposed of but were now to be retained under control of the federal government and managed for multiple uses and sustained yield, and with fair market value received for their resources (Ross 2006). Land-use planning, involving public participation and based on an inventory of resources within a tract or area, was to be implemented to guide management. Homesteading was no longer allowed after passage of the Federal Land Policy and Management Act in 1976. Provisions in the Federal Land Policy and Management Act also halted unnecessary and undue degradation of public lands during mining activities that had been allowed under the 1872 Mining Law. The Federal Land Policy and Management Act further established that wildlife, fish, and natural scenic, scientific, and historical values be considered in long-term needs for future generations for renewable and nonrenewable resources (Federal Land Policy and Management Act: Sec. 103 [43 USC. 1702]). Half of the grazing fees were to be used for rangeland improvements. Land management agencies now could legally reduce consumptive uses, such as grazing, to meet long-term needs of wildlife and fish. The secretaries of the Interior and Agriculture were given authority to withdraw federal lands for wildlife protection, as well as for other public values. Further, the secretaries had the authority to prohibit hunting or fishing on public lands under their stewardship to protect declining populations (Bean and Rowland 1997).

The Public Rangelands Improvement Act of 1978 provided for restoration of damaged lands, established a policy of inventory and monitoring, and required periodic reporting of conditions and trends of lands to the secretaries of the Interior and Agriculture (Table 1.1). At least 80% of the appropriated funding for the act was to be used for on-ground range rehabilitation and improvements. The act also established fees tied to forage value and costs of production rather than to market value of the land that would be paid by users to the secretaries of the Interior or Agriculture.

The importance of minimizing damage from nonconsumptive and traditional uses, protecting wilderness or areas of significant historical or natural value, and ensuring survival of plant and wildlife was legally mandated in three principal conservation measures. The Wilderness Act (1964) explicitly recognized the need to protect areas from permanent human encroachment and use, and the need to preserve those places for future generations. The National Environmental Policy Act (1969) required an assessment of potential impacts of any activity or land use that could affect the environment prior to approval. The Endangered Species Act (1973) required an assessment, review, or consultation on the potential for management actions to adversely impact species, their habitats, or the quality of their environments; the intent of the Endangered Species Act is to prevent a species' extinction without a mandated balancing of other goals.

Species and their habitats in Canada are protected primarily under the Canada Wildlife Act (1972) and the Species at Risk Act (2002) as part of a broader program to protect biodiversity. The Canada Wildlife Act (Statutes of Canada 1985, c. W-9, s. 1) allows wildlife areas to be created or managed to protect or conserve wildlife, particularly species at risk. The Species at Risk Act (Statutes of Canada 2002, c. 29) established an independent committee of experts to assess and identify species at risk, provided for action plans to identify specific conservation actions to benefit endangered and threatened species, and provided for protection of listed species and their habitats (Canada Gazette 2003).

The Sikes Act (1960) and its extension (1974) provided the foundation for cooperative effort between federal land management agencies and state wildlife agencies (Table 1.1). Under the Sikes Acts, federal agencies, including BLM, could manage habitat to protect wildlife species, such as Greater Sage-Grouse, listed by states as sensitive or of conservation concern.

The increased recreational use of public lands has resulted in efforts to control its effects, particularly from off-road vehicles (Wilson 2008). Cooperative agreements established between federal and state agencies to protect fish and wildlife resources under the Sikes Act also required control of off-road vehicle traffic (Sikes Act: Sec. 670h.3.e). Executive Order 11644 (Nixon 1972) directed federal agencies to identify areas where off-road vehicles could be used or prohibited, and required that areas and trails be located to minimize the effects on wildlife or their habitat.

Fifteen national monuments administered within BLM's National Landscape Conservation System were established by President Clinton beginning in 1996 under the Antiquities Act (Dombeck et al. 2003). The Antiquities Act of 1906 (Table 1.1) gave the president authority to restrict use on public lands having historical, archeological, and cultural significance without congressional approval. Traditional uses, including livestock grazing, were allowed to continue on these national monuments (Ross 2006). Congress can set aside other lands designated as wilderness areas under the Wilderness Act (1964) to restrict commercial uses, motorized and mechanical transport, and permanent roads and structures in order to preserve their wilderness character.

CHARACTERISTICS OF SAGEBRUSH HABITATS BY MANAGEMENT AND OWNERSHIP

Sagebrush land cover within the SGCA covers 486,770 km^2 and is distributed across 13 states and three provinces. Almost all of the current distribution of Greater Sage-Grouse and sagebrush is within the western United States; <2% extends into Canada. Greater Sage-Grouse currently occupy about half of their historical distribution range-wide (Schroeder et al. 2004) and 10% of their historical range in Canada (Aldridge and Brigham 2003).

Seven management zones have been delineated for sage-grouse (Fig. 1.1) (Stiver et al. 2006) based on similarities in sagebrush environments within zones (Miller et al., this volume, chapter 10). The largest total area of sagebrush is within the Wyoming Basin and Snake River Plain (Table 1.2); these two management zones plus the Northern Great Basin also have the largest proportion of their total area dominated by sagebrush habitat.

Approximately 30% (150,186 km^2) of all sagebrush habitat in the SGCA is privately owned (Table 1.3). The greatest proportion of privately owned sagebrush habitat is in the Great Plains and Columbia Basin management zones (Fig. 1.1). Privately owned lands were consistently characterized by deeper soils and greater available water capacity—the ability of soils to store water that is available to plants—within soils in each management zone in comparison to public lands (Table 1.4). Private landholdings generally are located in valley bottoms, which have greater access to water (Fig. 1.2).

Federal agencies in the United States are responsible for almost two-thirds of the sagebrush landscape (Table 1.3, Fig. 1.3). The BLM is the principal public management agency and is responsible for 51% of sagebrush habitat in the United States (Table 1.3). Lands managed by the BLM contain higher amounts of sagebrush within the landscape (represented by the proportion of sagebrush within 5- and 18-km radii) compared to private lands. However, these lands are characterized by shallow soils, lower soil water capacity, and lower annual precipitation within each Sage-Grouse Management Zone (Table 1.4).

The USFS manages 8% of the sagebrush habitats in the United States, most of which are

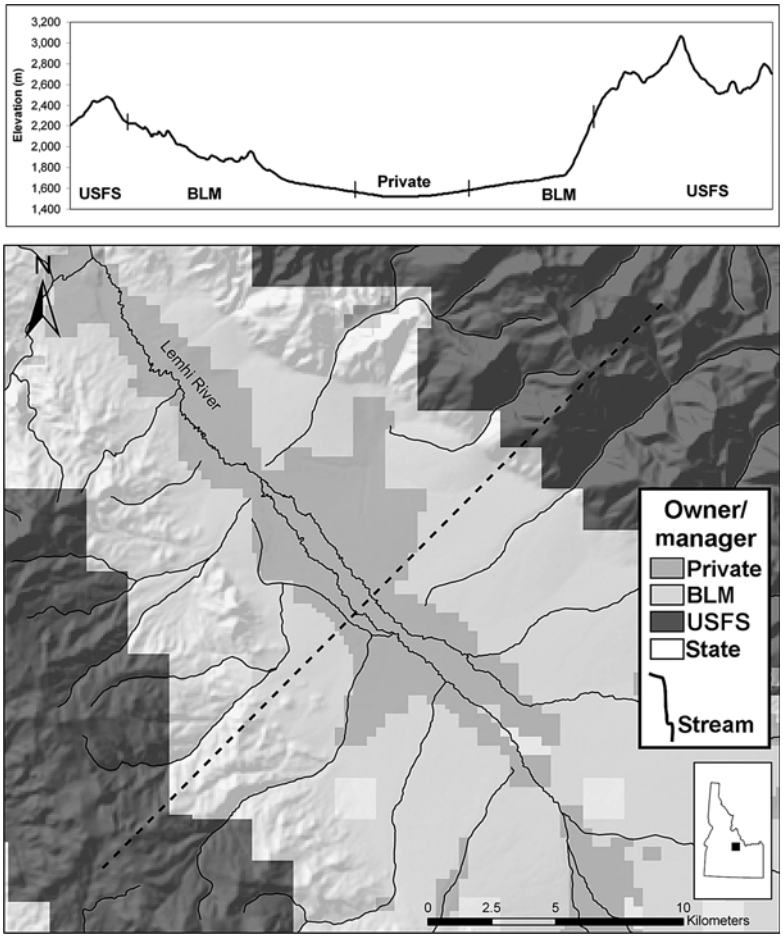

Figure 1.2. Elevational gradient (top) among land ownerships (bottom) in southeastern Idaho.

TABLE 1.2

Area statistics (km²) for Sage-Grouse Management Zones.

Sage-Grouse Management Zone	Area	Sage-Grouse Conservation Area		
		Area	Sagebrush[a]	(%)
Great Plains SMZ I	352,343	352,257	50,927	(14)
Wyoming Basin SMZ II	241,986	241,943	109,013	(45)
Southern Great Basin SMZ III	319,221	319,189	93,788	(29)
Snake River Plain SMZ IV	316,833	302,389	136,574	(43)
Northern Great Basin SMZ V	159,918	144,654	65,593	(41)
Columbia Basin SMZ VI	64,341	64,337	13,271	(21)
Colorado Plateau SMZ VII[b]	157,927	143,535	17,604	(11)
Totals	1,612,569	1,568,304	486,770	(100)

[a] Sagebrush communities include: intermountain basins big sagebrush shrubland, intermountain basins big sagebrush steppe, *Artemisia tridentata* ssp. *wyomingensis* shrub herbaceous alliance, Colorado Plateau mixed low sagebrush shrubland, Columbia Plateau scabland shrubland, Wyoming basin low sagebrush shrubland, Great Basin xeric mixed sagebrush shrubland, Columbia Plateau low sagebrush steppe, Columbia Plateau low sagebrush steppe, inter-mountain basins montane sagebrush steppe, *Artemisia tridentata* ssp. *vaseyana* shrubland alliance.

[b] The Colorado Plateau Management Zone includes Greater Sage-Grouse and Gunnison Sage-Grouse (*Centrocercus minimus*).

TABLE 1.3

Sagebrush area (km² and %) by management authority and ownership of sagebrush lands within Sage-Grouse Management Zones.

Totals for sagebrush area by management zone are in Table 1.2. Specific agencies include the USDI Bureau of Land Management (BLM), USDA Forest Service (FS), USDI Bureau of Indian Affairs (BIA), USDI Fish and Wildlife Service (FWS), and USDI National Park Service (NPS).

	Sagebrush management and ownership[a]															
	Private		BLM		FS		BIA		FWS		NPS		Other federal agencies[b]		State	
Sage-Grouse Management Zone	km²	(%)	km²	(%)	km²	(%)	km²	(%)	km²	(%)	km²	(%)	km²	%	km²	(%)
Great Plains	33,365	(66)	8,682	(17)	1,037	(2)	1,979	(4)	916	(2)	22	(0)	601	(0)	3,662	(4)
Wyoming Basin	37,962	(35)	53,384	(49)	4,315	(4)	4,394	(4)	201	(0)	1,265	(1)	0	(0)	7,250	(1)
Southern Great Basin	12,102	(13)	66,890	(71)	9,522	(10)	931	(1)	37	(0)	134	(0)	62	(0)	2,495	(6)
Snake River Plain	39,211	(29)	71,477	(52)	14,229	(10)	1,640	(1)	114	(0)	119	(0)	7	(0)	7,390	(6)
Northern Great Basin	13,504	(21)	40,550	(62)	6,356	(10)	614	(1)	3,161	(5)	137	(0)	314	(0)	900	(8)
Columbia Basin	7,774	(59)	716	(5)	285	(2)	1,521	(11)	306	(2)	21	(0)	10	(0)	1,472	(0)
Colorado Plateau	6,268	(36)	7,427	(42)	1,078	(6)	1,535	(9)	1	(0)	137	(1)	0	(0)	1,088	(7)
Totals	150,186	(31)	249,127	(51)	36,823	(8)	12,613	(3)	4,735	(1)	1,835	(0)	491	(0)	24,257	(5)

[a] Summary statistics derived in a Geographic Information System from individual state or province coverages of land ownership and management authority.

[b] Other federal agencies included U.S. Department of Defense, U.S. Department of Energy, and USDI Bureau of Reclamation.

TABLE 1.4

Environmental characteristics of lands within the Sage-Grouse Conversation Area under private and public ownership and by management authority for the USDI Bureau of Land Management (BLM) and USDA Forest Service (USFS) within Sage-Grouse Management Zones.

Sage-Grouse Management Zone and owner/manager	Sagebrush cover (%)[a]		Annual precipitation[b]	Elevation[c]	Soil		Available water capacity	Soil depth
	5-km	18-km	cm	m	Salinity[d]	pH[d]	cm[d]	cm[d]
Great Plains								
BLM	24	22	34	1,028	3.56	6.8	13	90
Private	14	14	37	1,089	2.82	7.0	16	107
USFS	5	6	52	1,553	1.81	5.9	12	94
Wyoming Basin								
BLM	64	62	31	1,991	2.42	6.8	13	98
Private	53	52	38	2,025	1.76	6.8	15	113
USFS	9	14	79	2,716	0.34	5.2	10	100
Southern Great Basin								
BLM	36	34	27	1,772	2.91	6.7	10	108
Private	25	26	36	1,729	3.24	7.1	15	126
USFS	21	25	56	2,467	0.70	5.8	9	90
Snake River Plain								
BLM	68	65	34	1,566	1.36	6.1	10	100
Private	41	41	40	1,505	1.51	6.8	16	123
USFS	20	26	76	2,124	0.33	5.2	10	102
Northern Great Basin								
BLM	69	66	32	1,536	1.75	5.8	13	92
Private	36	36	46	1,397	1.26	6.0	16	112
USFS	18	21	72	1,626	0.16	5.2	12	112
Columbia Basin								
BLM	40	28	27	520	0.35	6.3	13	101
Private	21	22	31	507	0.44	6.6	18	120
USFS	5	7	91	1,287	0.04	5.4	11	119
Colorado Plateau								
BLM	17	16	33	1,941	1.36	5.9	10	81
Private	16	15	41	2,316	1.53	6.6	14	116
USFS	3	6	71	3,017	0.25	5.3	12	112

[a] Calculated from a moving window analysis of a Geographic Information System coverage summing percent land cover of sagebrush within 5- and 18-km radius of each grid cell (Knick et al., this volume, chapter 12).

[b] Elevation (m) was ascertained from digital elevation models.

[c] Annual precipitation (cm) was estimated from PRISM models (Daly et al. 1994).

[d] Soil properties were obtained from the STATSGO soils database (United States Department of Agriculture 1995). Available water capacity was the total depth (cm) of available water in the soil profile. Soil pH represented the maximum value for soil reaction of the surface soil layer. Salinity (millimhos per centimeter) was measured as electrical conductivity of the soil in a saturated paste.

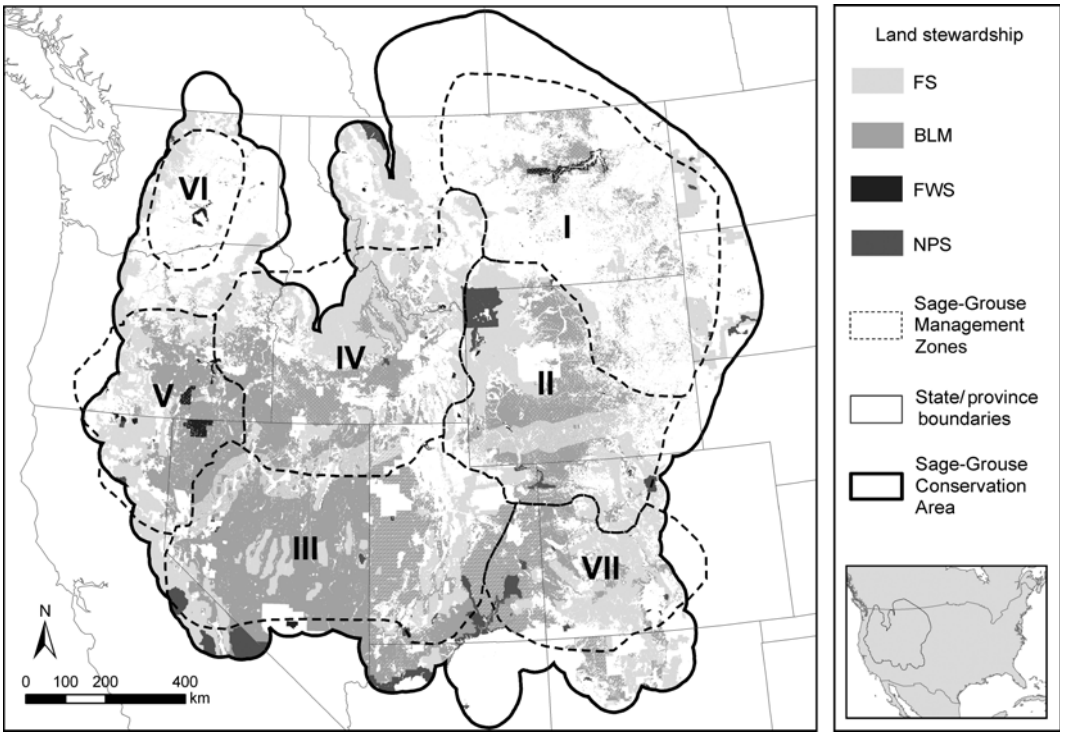

Figure 1.3. Distribution of sagebrush lands by public agency within the Sage Grouse Conservation Area in the United States and Canada. Sage-Grouse Management Zones are listed in Table 1.2.

located on boundaries of the dominant sagebrush regions (Figs. 1.2, 1.3). Lands managed by the USFS are usually at the highest elevations (Fig. 1.2) and receive the most precipitation (Table 1.4). Lands managed by the USFS also tend to be steeper and rockier than BLM or private lands.

Other federal agencies, including the United States Department of Defense, the United States Department of Energy, and the United States Department of the Interior (including the Bureau of Indian Affairs, the Fish and Wildlife Service, and the National Park Service), manage <1% of the sagebrush lands within the United States (Table 1.3). State agencies manage 5% of the total landscape dominated by sagebrush in the United States, with the greatest proportion in the Northern Great Basin Management Zone (Table 1.3).

A small portion (<1%) of the area currently occupied by Greater Sage-Grouse lies within wilderness or protected areas (Fig. 1.4). Similarly, little sagebrush habitat is legally protected from conversion of land cover (Fig. 1.5) (Stoms et al. 1998, Scott et al. 2001, Wright et al. 2001, Knick et al. 2003). Only the National Wildlife Refuge System, developed under the Migratory Bird Conservation Act (1929), was established for the purpose of wildlife conservation (Bean and Rowland 1997); little of the current sagebrush distribution is contained on refuges, which were located in areas that benefited waterfowl and other migratory birds. National parks were established primarily to preserve unique scenic or wilderness values (Clawson and Held 1957).

CONSERVATION IMPLICATIONS

Our ability to manage and conserve sagebrush habitats today has been strongly influenced by actions taken more than 100 years ago that encouraged settlement, transferred public land to private entities for agricultural development, governed livestock use, facilitated resource extraction, and shaped federal land-use policy. The system of land surveys established under the Land Ordinance of 1785 resulted in rectangular grids to map landholdings. The checkerboard mosaic of landholdings that exists today resulted from

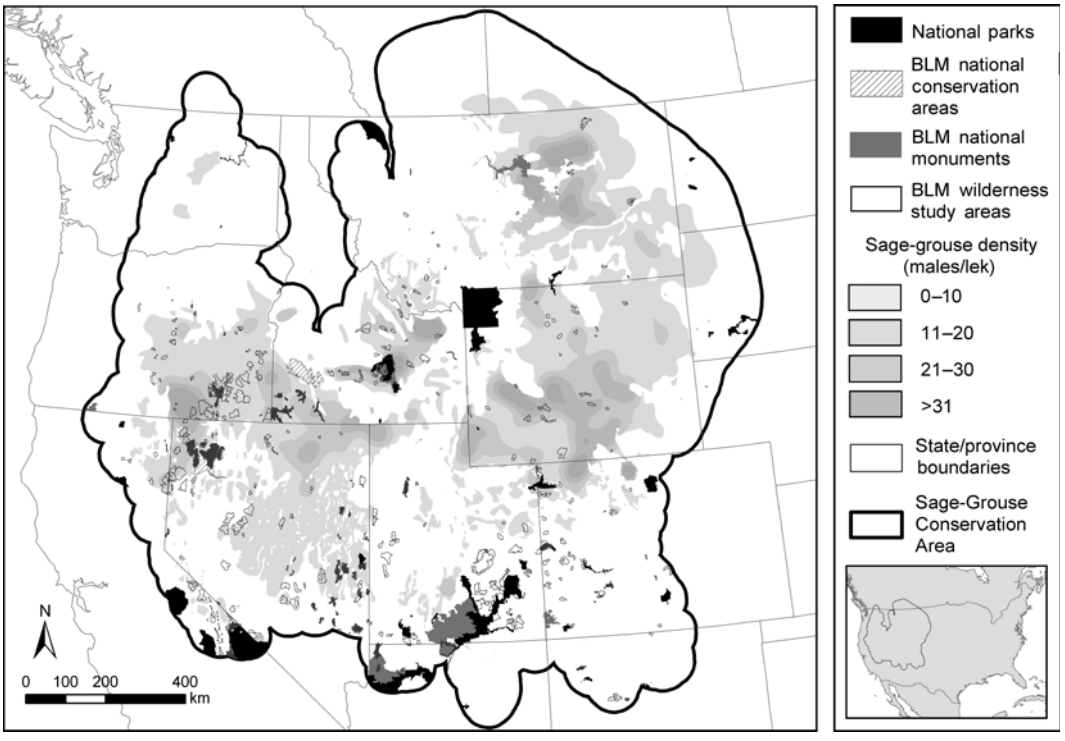

Figure 1.4. Distribution of Greater Sage-Grouse populations relative to federal wilderness and protected areas within the Sage-Grouse Conservation Area. Only sagebrush lands within United States national parks are legally protected from conversion of natural land cover and maintained in a natural state (Categories S1, S2 of Scott et al. 1993). Historical land uses, such as livestock grazing, are permitted in other wilderness or conservation areas. Contoured estimates of Greater Sage-Grouse numbers were developed by contouring counts from individual lek surveys conducted in 2003 (Fig. 13.1 of Connelly et al. 2004).

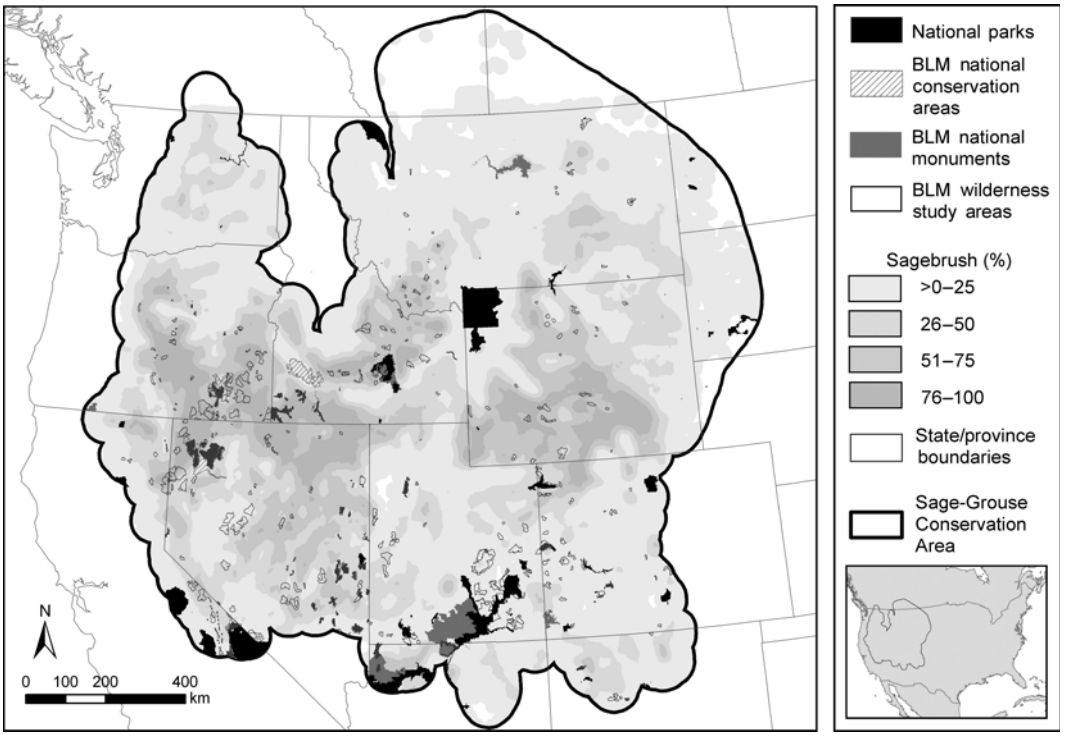

Figure 1.5. Distribution of sagebrush habitats relative to federal wilderness and protected areas within the Sage-Grouse Conservation Area. Only sagebrush lands within United States national parks are legally protected from conversion of natural land cover and maintained in a natural state (Categories S1, S2 of Scott et al. 1993). Historical land uses, such as livestock grazing, are permitted in other wilderness or conservation areas.

deeding land to private enterprises and giving incentives to states and railroad companies to develop the western United States. Ownership boundaries that may not follow geographic or topographical features can complicate management of landscape processes (Clawson and Held 1957).

Strategies among public agencies are also potential sources of conflict. Federal agencies primarily concerned with habitat management planning for multiple uses and sustained yield may pursue different goals than state agencies mandated with managing wildlife. Thus, current land-use planning will need to include multiple partners and objectives to manage the large landscapes used by Greater Sage-Grouse (Forbis et al. 2006). Establishment of local working groups across much of the SGCA represents a primary effort to link public and private interests (Hemker and Braun 2001, Stiver et al. 2006).

Differences in sagebrush habitats relative to public or private ownership largely influence the current and future status of these landscapes (Talbert et al. 2007). Legislation passed to encourage settlement during the late 1800s and early 1900s resulted in highly productive regions deeded to private enterprise. Lands converted to agriculture were concentrated in regions having deep, fertile soils and water for irrigation (Scott et al. 2001). An estimated 420,000 km^2 of shrub steppe existed in Washington state prior to settlement in the 19th century (Dobler et al. 1996). Summer fallowing had started by 1879, and by 1920, 80% of southeastern Washington was under cultivation (Buss and Dziedic 1955). Only 170,000 km^2 of shrub steppe across the state was present in 1986 (Dobler et al. 1996). Agriculture has replaced 75% of the shrub steppe in deep soils in eastern Washington but only 15% in shallow soils (Vander Haegen et al. 2000). In mountainous regions, valley bottoms with access to water often were claimed by private enterprise, leaving steeper, rockier hills in federal ownership (Fig. 1.2) (Clawson and Held 1957, Leu et al. 2008). Private grazing lands in southern Wyoming, Colorado, and northern New Mexico had more productive soils, shallower slopes, and greater water availability compared to adjacent public lands managed by BLM or the USFS (Talbert et al. 2007). The human footprint, a collective measure of anthropogenic use, was greatest in high-productivity regions, defined by deep soils, high precipitation, and shallow topographic terrain (Leu et al. 2008). This disproportionate loss of more-productive regions to agriculture or from diversion of water for irrigation or other consumptive purposes carries disproportionate impact to sagebrush landscapes and their capacity to maintain themselves by leaving regions that are more sensitive to disturbance and less able to recover.

Almost two-thirds of the total sagebrush distribution in the United States still remains within the public ownership. However, lands managed by BLM, which represent half of the total distribution of sagebrush, are relatively unproductive and are characterized by shallow soils in xeric environments. Thus, because BLM has responsibility for a large percentage of sagebrush habitats, management and restoration actions on large proportions of sagebrush-dominated landscapes in the SGCA will be conducted on lands that are less resistant to disturbance, have lower resilience in recovering from an increasing amount of disturbance, and are highly susceptible to invasion by exotic plant species (Miller et al., this volume, chapter 10).

Potential challenges and solutions to long-term conservation and management actions also differ because environmental qualities of sagebrush habitats vary among land management agencies (McIver and Starr 2001, Wisdom et al. 2005b). Treatments by the USFS to control the expansion of pinyon (*Pinus* spp.) and juniper (*Juniperus* spp.) will be conducted on sites at higher elevations receiving greater precipitation and having relatively short recovery periods. In contrast, management actions by BLM will occur primarily in lower elevation regions with little precipitation, long recovery periods, and threat of invasion by exotic plants. Recovery to a sagebrush-dominated landscape may require more than 100 years in these areas (Hemstrom et al. 2002). Because thresholds may have been crossed on these lands, recovery to a previous ecological state may not occur at all or may be complicated by significant potential for invasion by exotic plants (West 1996, Hemstrom et al. 2002, Meinke et al. 2009, Pyke, this volume, chapter 23).

Almost all sagebrush habitat in primary regions for Greater Sage-Grouse is undergoing use and resource development (Knick et al. 2003, Wisdom et al. 2005a, Holechek 2007, Knick et al., this volume, chapter 12). Wildlife conservation is not the exclusive or dominant objective on any major federal lands, except for the National Wildlife

Refuge System (Bean and Rowland 1997). Consequently, conservation objectives often compete with commodity production and nonconsumptive uses, such as recreation involving off-road vehicles, under the multiple-use mandate. Challenges to land uses increasingly are brought under the National Environmental Policy Act (1969) or to protect plants and animals through the Endangered Species Act (1973) (Bean and Rowland 1997, Quigley 2005). Petitions to list Greater Sage-Grouse (United States Department of the Interior 2005b), restrictions on land use, and wilderness designations across sagebrush lands have significant implications for energy, national security, grazing, and recreation interests (Wambolt et al. 2002, Holechek 2007).

Conservation of grass and shrublands is a concern beyond sagebrush habitats in the SGCA. Temperate grasslands, savannahs, and shrublands represent the least protected biomes: 5% of their total global area receives protection (Brooks et al. 2004b). Land use would need to be restricted on 50,000 km^2 of sagebrush habitats if 10% of the total geographic area, a minimum target to conserve species distributions (Svancara et al. 2005), is to be protected across the SGCA or set aside in a reserve system (Bock et al. 1993). Much larger areas, ranging from 33 to 75% of the range-wide distribution, may be necessary to conserve biodiversity and ecosystem integrity (Soulé and Sanjayan 1998). Extensive restrictions are unlikely because of the resource value of these lands for nonconsumptive and traditional uses. Thus, a large proportion of sagebrush habitat will continue to be managed for multiple purposes. Ultimately, our ability to develop long-term conservation strategies that maintain or increase populations of Greater Sage-Grouse will depend on involving a wide array of interests and perspectives in managing a broad diversity of uses for sagebrush habitats.

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