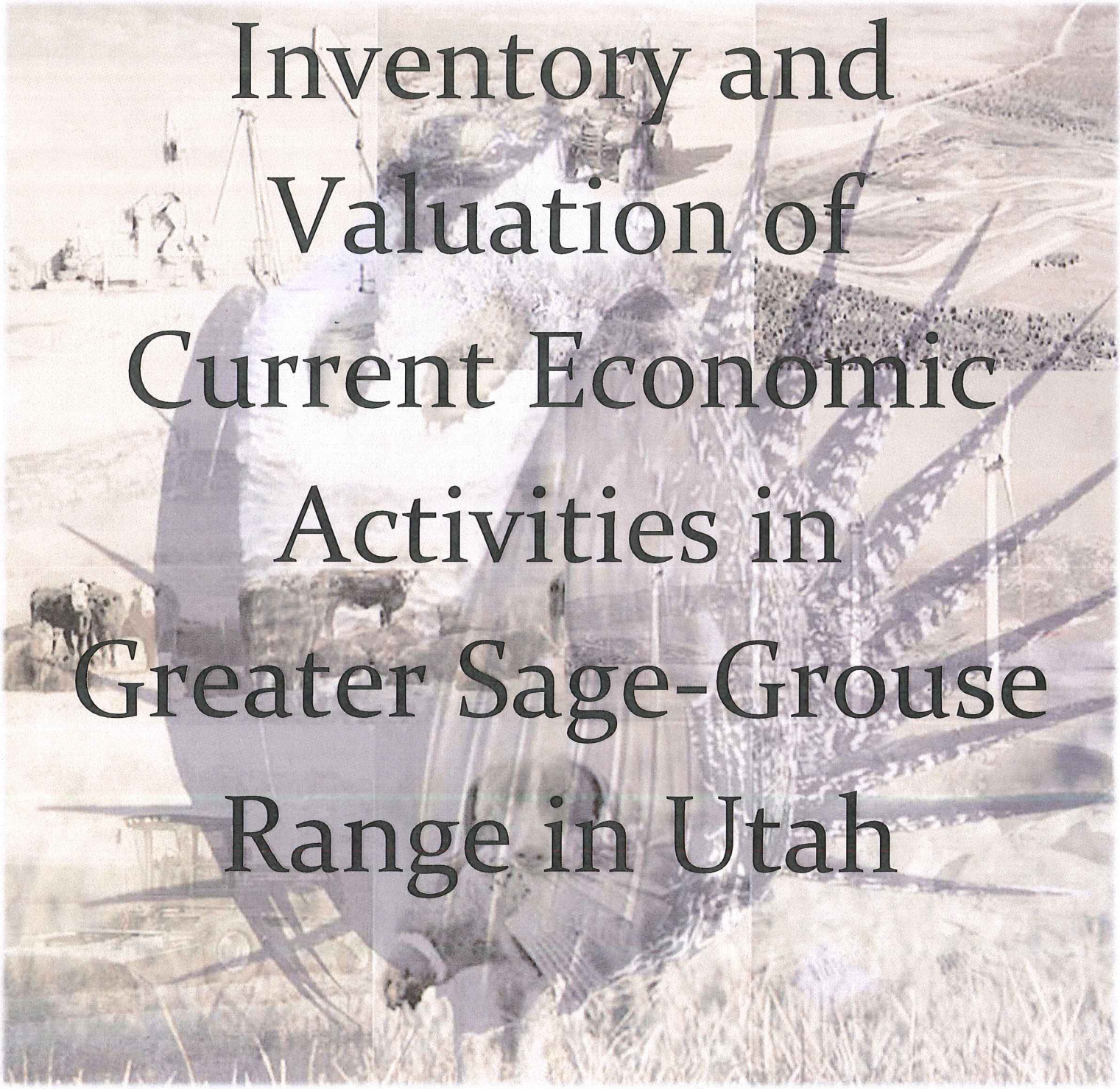

Inventory and Valuation of Current Economic Activities in Greater Sage-Grouse Range in Utah

July 2015

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Inventory and Valuation of Current Economic Activities in Greater Sage-Grouse Range in Utah

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CONTENTS

List of Tables vi

List of Figures vii

Summary ix
- Oil and Gas x
- Coal x
- Metals and Industrial Minerals xi
- Renewable Energy xi
- Grazing xii
- Farming xii
- Recreation xiii
- Private Property Values xiii

1 Overview and Threats 1
- 1.1 Endangered Species Act and Listing Process 1
- 1.2 Greater Sage-Grouse in the West 2
- 1.3 Greater Sage-Grouse in Utah 3
  - 1.3.1 U.S. Fish and Wildlife Service Current and Historical Range 4
  - 1.3.2 Sage-Grouse Management Areas Defined by the State of Utah 6
  - 1.3.3 Range Definitions for this Study: FWS Current Range, Historical-Only Range, and SGMAs 7
  - 1.3.4 Management by the State of Utah 9
- 1.4 Threats to Greater Sage-Grouse 10
  - 1.4.1 Natural Threats 10
  - 1.4.2 Human-Caused Threats 12
- Appendix 16

2 Oil and Natural Gas Production 17
- 2.1 Methodology 17
- 2.2 Wells Drilled 19
- 2.3 Oil Production Volumes 21
- 2.4 Natural Gas Production Volumes 23
- 2.5 Producing Days 25
- 2.6 Subsequent Work 27
- 2.7 Employment 28
- 2.8 Economic Contributions 30
- 2.9 Fiscal Contributions 32
- 2.10 Oil Shale 33

3 Coal 35

4 Metals and Industrial Minerals 37

5 Renewable Energy 39

6 Grazing 43

7 Farming 45

8 Recreation 51
8.1 National Forests 51
8.2 BLM Lands 54
8.3 State Parks 55
8.4 Other Lands 56
8.5 Hunting and Fishing 56
8.6 Trail-Based Recreation 58
Appendix 60

9 ESA Listing and Private Property Values 63

References 66

LIST OF TABLES

Summary Table 1 Summary of Economic Contributions of Activities in Greater Sage-Grouse Range in Utah, 2014 xiv
Table 1.1 Greater Sage-Grouse Range Acres by Landowner 8
Table 1.A1 Greater Sage-Grouse Acres by Agency 16
Table 2.1 Wells Drilled by Greater Sage-Grouse Range, 1980–2014 20
Table 2.2 Oil Production by Greater Sage-Grouse Range, 1984–2014 22
Table 2.3 Natural Gas Production by Greater Sage-Grouse Range, 1984–2014 24
Table 2.4 Producing Days by Greater Sage-Grouse Range, 1984–2014 26
Table 2.5 Subsequent Work by Greater Sage-Grouse Range, 1980–2014 28
Table 2.6 Statewide Employment in Oil and Natural Gas Sectors, 1998–2013 30
Table 2.7 Estimated Economic Contributions of Oil and Gas Activity in Greater Sage-Grouse Range, 2014 31
Table 2.8 Estimated Economic Contributions of Oil and Gas Extraction in Greater Sage-Grouse Areas, 2014 32
Table 2.9 Estimated Economic Contributions of Drilling Oil and Gas Wells in Greater Sage-Grouse Areas, 2014 32
Table 2.10 Estimated Production Values, Tax Revenues, and Royalty Revenues by Sage Grouse Range During Calendar Year 2014 32
Table 2.11 Estimated Earnings-Related Fiscal Impacts of Oil and Gas Activity in Greater Sage-Grouse Range, 2014 33
Table 2.12 Uinta Basin Potential Economic Oil Shale Resource by Greater Sage-Grouse Range 34
Table 3.1 Estimated Economic and Fiscal Effects of Coal Mining in FWS Current Greater Sage-Grouse Range, 2014 35
Table 4.1 Estimated Economic Contributions of Other Mining in Greater Sage-Grouse Range, 2014 37
Table 4.2 Estimated Fiscal Impacts of Other Mining in Greater Sage-Grouse Range, 2014 38
Table 5.1 Estimated Economic Contributions of Renewable Energy Generation in Greater Sage-Grouse Range, 2014 39
Table 5.2 Estimated Fiscal Impacts of Renewable Energy Generation in Greater Sage-Grouse Range, 2014 40
Table 6.1 Utilized AUMs in Greater Sage-Grouse Range, 2014 43
Table 6.2 Estimated Economic Contributions of Cattle and Sheep Grazing in Greater Sage-Grouse Range in Utah, 2014 44

Table 6.3 Estimated Fiscal Impacts of Cattle and Sheep Grazing in Greater Sage-Grouse Range in Utah, 2014 44
Table 7.1 Total Agricultural Land Use Acreage in Greater Sage-Grouse Range by Hydrologic Basin 45
Table 7.2a Agricultural Land Use Acreage in FWS Current Greater Sage-Grouse Range by Hydrologic Basin 47
Table 7.2b Share of Agricultural Land Use Acreage in FWS Current Greater Sage-Grouse Range by Hydrologic Basin 47
Table 7.3a Agricultural Land Use Acreage in Historical-only Greater Sage-Grouse Range by Hydrologic Basin 48
Table 7.3b Share of Agricultural Land Use Acreage in Historical-only Greater Sage-Grouse Range by Hydrologic Basin 49
Table 7.4a Agricultural Land Use Acreage in SGMAs by Hydrologic Basin 50
Table 7.4b Share of Agricultural Land Use Acreage in SGMAs by Hydrologic Basin 50
Table 8.1 Recreation Activity in Greater Sage-Grouse Range for Selected Public Lands in Utah 51
Table 8.2 Summary of Recreation Activity in Greater Sage-Grouse Range in National Forests in Utah 52
Table 8.3 U.S. Forest Service Recreation Sites in Utah 52
Table 8.4 Acres of Forest Service Lands in Utah by Greater Sage-Grouse Range 53
Table 8.5 Annual Recreation Visits to National Forests in Utah 53
Table 8.6 Economic Contribution of Spending by National Forest Visitors in Utah 54
Table 8.7 Summary of BLM Recreation Activity in Greater Sage-Grouse Range in Utah 54
Table 8.8 BLM Recreation Sites in Greater Sage-Grouse Range in Utah 54
Table 8.9 FY2013 Recreation Visits on BLM Lands in Utah 55
Table 8.10 Utah State Parks in Greater Sage-Grouse Range 55
Table 8.11 Shares of Hunting and Fishing Activity in Greater Sage-Grouse Range in Utah 57
Table 8.12 Estimated Economic Contributions of Hunting and Fishing in Greater Sage-Grouse Range in Utah 57
Table 8.13 Estimated Fiscal Impacts from Hunting and Fishing in Greater Sage-Grouse Range in Utah 58
Table 8.14 Trails and Unpaved Roads in Greater Sage-Grouse Range in Utah 59
Table 8.A1 Annual Visitor Spending in Greater Sage-Grouse Range of National Forests in Utah by Trip Type and Spending Category 60
Table 8.A2 Utah State Parks in Greater Sage-Grouse Range with 2014 Recreation Visits 61
Table 9.1 Private Lands, Greater Sage-Grouse, and Property Values in Utah 64

LIST OF FIGURES

Figure 1.1 FWS Greater Sage-Grouse Range, Including Bi-State and Columbia Basin DPSes 3
Figure 1.2 FWS Current Range for Greater Sage-Grouse in Utah 5
Figure 1.3 Historical Range for Greater Sage-Grouse in Utah 6
Figure 1.4 Sage-Grouse Management Areas in Utah 7
Figure 1.5 Revised Range for Greater Sage-Grouse in Utah 9
Figure 2.1 Active, Producing and Drilled Oil and Gas Wells in Greater Sage-Grouse Range 18
Figure 2.2 Wells Drilled by Greater Sage-Grouse Range, 1980–2014 19
Figure 2.3 Oil Production by Greater Sage-Grouse Range, 1984–2014 21
Figure 2.4 Natural Gas Production by Greater Sage-Grouse Range, 1984–2014 23

Figure 2.5 Producing Days by Greater Sage-Grouse Range, 1984–2014 25
Figure 2.6 Subsequent Work by Greater Sage-Grouse Range, 1980–2014 27
Figure 2.7 Statewide Employment in Oil and Natural Gas Sectors, 1990–2013 29
Figure 2.8 Utah's Potential Economic Oil Shale Resources and Greater Sage-Grouse Range 34
Figure 3.1 Mines in Greater Sage-Grouse Range 36
Figure 5.1 Renewable Energy Generation in Greater Sage-Grouse Range 40
Figure 7.1 Agricultural Land Use, Hydrologic Basins and Greater Sage-Grouse Range 46

SUMMARY

The U.S. Fish and Wildlife Service (FWS) is considering whether greater sage-grouse (*Centrocercus urophasianus*) warrants a range-wide (including Utah) listing under the Endangered Species Act. The Service is under court order to make a decision by September 30, 2015. FWS may return a listing-not-warranted decision, an endangered listing, or a threatened listing. Listed species are then managed by FWS. A threatened listing is more flexible than an endangered listing.

Listing of the greater sage-grouse would have unknown but potentially significant effects on current and possible future activities in areas designated as critical habitat. Because we do not know what restrictions would come into force with either a threatened or endangered listing, the purpose of this study is to identify and, where possible, put a value on the current economic activities in sage-grouse range. In most cases, we were able to estimate the employment, earnings and gross state product contributions of those activities, as well as some state and local revenue impacts. We do not consider how these activities would be affected by an ESA listing, nor how they affect greater sage-grouse and their habitat.

In order to evaluate a range of possible areas that could be affected by a listing, we used three definitions. FWS current greater sage-grouse range ("FWS current range") is that used by FWS in its 2015 Status Review. FWS current range amounts to 10.4 million acres in Utah. "Historical-only range" also comes from FWS and is based on the research of Michael A. Schroeder, research biologist for the Washington State Department of Fish and Wildlife. It excludes those portions of historical range that are also FWS current range. Excluding cities, towns and unincorporated Census-designated places, there are 9.4 million acres of historical-only range in Utah. Finally, we used the Utah Division of Wildlife Resources' 2013 Sage Grouse Management Areas ("SGMAs"). These are essentially a subset of FWS current range, covering almost 7.5 million acres and including more than 90 percent of known sage-grouse in Utah (UDWR 2013).

The Utah population of greater sage-grouse is measured by annual counts of males at leks. During 2010 to 2014, DWR counted an average of 3,682 males (Bernales, Robinson, and Blair 2015). Population levels display substantial normal fluctuations in recent years and historically.

Utah sage-grouse populations occupy habitats that are naturally fragmented based on topography. Some of these habitats have experienced additional loss and fragmentation from both natural and human causes. Wildfire, invasive plants, climate and predation are natural threats that humans may mitigate or compound. Oil, gas and renewable energy development; mining; crop and livestock agriculture; recreation; urbanization; and infrastructure installation and maintenance are human activities that may further fragment or destroy sage-grouse habitat, but like many natural threats, they are mitigable. The most significant threats in Utah are wildfire, invasive and encroaching plants, and energy development in FWS current and historical range, and wildfire and invasive and encroaching plants in SGMAs. Secondary concerns are agriculture, urbanization and infrastructure.

OIL AND GAS

In 2014 3,200 wells produced 13.4 million barrels of oil and 91.0 billion cubic feet (bcf) of gas in FWS current greater sage-grouse range. In historical-only range there were 5,042 wells producing 17.1 million barrels of oil and 175.8 bcf of gas. And in state Sage Grouse Management Areas (SGMAs) 143 wells produced 87,800 barrels of oil and 9.7 bcf of gas. There were also 378 new wells drilled (spuds) in FWS current sage-grouse range and 330 spuds in historical-only range. No new wells were drilled in SGMAs.

The estimated total economic contribution of oil and gas activity in greater sage-grouse range in 2014 consisted of 5,608 jobs with $440.9 million in earnings from FWS current sage-grouse range, 8,215 jobs with $660.5 million in earnings from historical-only range, and 205 jobs with $17.0 million in earnings from SGMAs. The estimated total value-added or gross state product contributions from activity in these three sage-grouse areas were $1,688.5 million, $2,342.0 million and $46.2 million, respectively.

In 2014 oil and natural gas production from wells located in historical-only range generated the greatest market value among the three areas, at just under $2 billion. Production within this area generated an estimated $283 million in royalty revenue to all lessors combined, with $74 million of that total received by the state, plus almost $27 million in severance tax revenues, $1.8 million in conservation fees, $20 million in property taxes, and $3.6 million in sales taxes. In contrast, the estimated value of production from wells within SGMAs was about $42 million, generating approximately $6.3 million in royalty revenues to all lessors combined, with $1.3 million of that total received by the state, $580,000 in state severance taxes, $40,000 in conservation fees, $430,000 in property taxes, and $80,000 in sales taxes.

In the Uinta Basin, under FWS current range there are an estimated 37.8 billion barrels of potentially economic oil in oil shale. Historical-only range could overlie another 19.4 billion barrels. Under SGMAs there are an estimated 0.2 billion barrels of potential economic oil from oil shale.

COAL

There are three active coal mines located in FWS current sage-grouse range: Skyline in Carbon County, SUFCO in Sevier, and Coal Hollow in Kane. Together they produced almost 11.3 million tons of coal in 2014, with a value of nearly $372.9 million.

The estimated total economic contribution of coal mining in FWS current greater sage-grouse range consists of 2,394 jobs, $132.0 million in earnings, and $433.3 million in GSP. Estimated state and county fiscal impacts associated with these mines totaled $27.6 million in 2014, comprising $10.2 million in income and sales taxes, $13.9 million from the state share of federal royalties, and $3.5 million in property taxes.

METALS AND INDUSTRIAL MINERALS

There are three industrial mineral mines in FWS current sage-grouse range producing phosphate (Simplot, in Uintah County), cement (Holcim Devil's Slide, in Morgan) and expanded shale (Utelite, in Summit). According to the Utah Geological Survey (2014), in 2013 the Simplot mine produced 3.8 million tons of phosphate, which were processed into about 1.4 million tons of phosphate concentrate and transported via pipeline to Simplot's fertilizer plant in Wyoming. The Devil's Slide quarry and plant produced a portion of 1.0 million tons of cement, and Utelite produced 129,000 tons of expanded shale. Simplot and Devil's Slide are also located in the state's SGMAs. In historical-only sage-grouse range there is the Ash Grove Leamington cement quarry and plant in Juab County; the Hidden Treasure copper, magnetite and silver mine in Beaver County; and the United States Gypsum mine in Sevier County. There was no production data available for the United States Gypsum mine, but Ash Grove Leamington produced a portion of 1.0 million tons of cement in 2013 and Hidden Treasure produced approximately 3,000 tons of copper, 14,000 tons of magnetite and 247,000 ounces of silver.

The total economic contributions of industrial mineral mining in FWS current sage-grouse range in 2014 were 932 jobs, $35.3 million in earnings, and $85.3 million in GSP. The total economic contributions of metal and industrial mineral mining in historic-only sage-grouse range in 2014 amounted to 845 jobs, $32.0 million in earnings, and $77.4 million in GSP. The total economic contributions of industrial mineral mining in SGMAs in 2014 amounted to 826 jobs, $31.3 million in earnings, and $75.6 million in GSP.

Mineral mines in FWS current sage-grouse range produced estimated fiscal impacts of $3.3 million in 2014, consisting of almost $2.5 million in state income and sales taxes and over $800,000 in local sales and property taxes. Metal and mineral mines in historical-only sage-grouse range generated almost $2.5 million in revenues for the state and over $1.0 million in revenues to counties. Activity at the two mines in SGMAs spurred estimated fiscal impacts of nearly $3.0 million: $2.2 million in state income and sales taxes and more than $777,000 in local sales and property taxes.

RENEWABLE ENERGY

There are currently two existing geothermal electrical generation plants located in greater sage-grouse range: Blundell in Beaver County is in FWS current sage-grouse range and Cove Fort in Millard County is in historical-only range. In 2014 Blundell generated 274,996 MWh of electricity and Cove Fort generated 165,107 MWh according to data from the Energy Information Administration. There are also 44 wind turbines in FWS current range and 51 turbines in historical range. Most of the turbines in FWS current range are part of Phase I of the Milford Wind Corridor in Beaver County, with one at the Tooele Army Depot. The turbines in historical-only range are part of Phases I and II of the Milford Wind Corridor in Beaver and Millard counties, nine are at the Spanish Fork Wind Park, and two are are at Camp Williams. In 2014 a combined estimated 203,385 MWh of electricity were generated from turbines located in FWS current sage-grouse range and 189,878 MWh from turbines in historical-only range.

The total economic contributions of renewable energy production in FWS current sage-grouse range comprised 138 jobs, $6.8 million in earnings, and $16.8 million in gross state product. The total eco-

nomic contributions of renewable energy production in historical-only sage-grouse range comprised 103 jobs, $5.1 million in earnings, and $12.5 million in gross state product.

For the geothermal plant and windmills in FWS current sage-grouse range, the estimated fiscal impacts in 2014 consisted of more than $455,000 of state income and sales taxes and over $2.1 million in local property and sales taxes, for a total fiscal impact of approximately $2.6 million. Geothermal and wind electricity generation in historical-only sage-grouse range in 2014 induced an estimated $361,000 in state income and sales tax revenues and almost $1.1 million in local property and sales tax revenues, for a total fiscal impact of nearly $1.5 million.

GRAZING

Just over one-quarter, 25.6 percent, of cattle animal unit months (AUMs) are estimated to be in FWS current sage-grouse range; 22.4 percent of sheep AUMs are. Fifteen percent of cattle AUMs and 20.8 percent of sheep AUMs are in historical-only range. The state's SGMAs contain an estimated 22.6 percent of cattle AUMs and 17.2 percent of sheep AUMs.

Livestock grazing in FWS current sage-grouse range supported an estimated 1,012 jobs, $34.6 million in earnings, and $52.9 million in gross state product. Grazing in historical-only sage-grouse range provided a total economic contribution of 564 jobs, $18.8 million in earnings, and $28.3 million in gross state product. Range livestock operations on federal allotments in the state's SGMAs provided a total economic contribution of 831 jobs, $27.9 million in earnings, and $42.3 million in gross state product.

Grazing in FWS current range generated an estimated $2.6 million in state income and sales tax revenues and over $300,000 in local sales tax revenues, for a total fiscal impact of nearly $3.0 million. Estimated fiscal impacts from cattle and sheep grazing in historical-only range amounted to $1.6 million, consisting of approximately $1.4 million in state revenues and over $178,000 in local revenues. Grazing in the state's SGMAs generated over $2.1 million in state tax revenues and $246,000 in local revenues, for a total estimated fiscal impact of nearly $2.4 million.

FARMING

The most prevalent agricultural land use in FWS current sage-grouse range is pasture,[1] claiming over 314,000 acres and accounting for half of the agricultural land use in FWS current range. The other main "uses" are fallow or idle land[2] (106,437 acres), alfalfa (81,471 acres), grass hay (75,018 acres) and grain and seeds (28,105 acres). With respect to the total acreage of agricultural land uses in the state, those uses with the greatest share in FWS current sage-grouse range are grass hay (32.3 percent), pasture (32.1 percent), fallow or idle land (22.1 percent), safflower (20.8 percent) and oats (17.9 percent).

[1] This is based on a water-related land use shapefile and is not related to the grazing allotments shapefile that was used for the grazing analysis.

[2] Although this is not an active use of farmland, it is generally a temporary state and the land is likely to be cropped in subsequent years.

In historical-only sage-grouse range the most prevalent agricultural land use is pasture, accounting for an estimated 414,232 acres, or 35 percent of the total agricultural acres in this habitat type. The other main uses are alfalfa (251,442 acres), fallow or idle land (226,419 acres), grain and seeds (102,677 acres) and dry land (66,553 acres). The land uses with the greatest shares of their total acreage in historical range include berries (78.8 percent), beans (75.4 percent), safflower (64.1 percent), other horticulture (57.8 percent) and oats (56.6 percent). Because it covers the most acres of agricultural land use, close to 1.2 million, historical-only sage-grouse range also encompasses the largest shares of agricultural uses' total areas: 10 of the 20 distinct land uses have more than half of their total acreage within historical range.

The largest agricultural land uses in SGMAs are pasture, with 178,754 acres; grass hay, with 52,898 acres; fallow or idle land, with 51,496 acres; alfalfa, with 45,715 acres; and grain and seeds, with 18,720 acres. The land uses with the greatest shares of their total acreage in SGMAs include grass hay (22.8 percent), safflower (19.9 percent), pasture (18.3 percent), turf farms (11.8 percent) and fallow/idle land and oats (both with 10.7 percent).

RECREATION

An estimated 15 percent of recreation visits to national forests, BLM lands, and state parks in Utah from 2009 to 2014 were in the FWS current range of greater sage-grouse, 25 percent when historical range is added. Analysis of specific recreation sites on these public lands provides more conservative estimates of recreation activity in habitat: 8 percent in FWS current range and another 6 percent in historical range outside of FWS current range. SGMAs received 11 percent of visits and contained 6 percent of recreation sites in the state.

Spending in Utah for an estimated 1.4 million hunting and fishing trips to FWS current sage-grouse range on public and private lands was approximately $193 million in 2011 (adjusted for inflation to 2014 dollars). For any type of recreation within FWS current range in national forests, visitor spending in Utah amounted to $62 million (in 2014 dollars) based on spending data collected between FY2005 and FY2012.

Based on the share of multiuse trails and unpaved roads in Utah that are within FWS current range, 4 percent to 26 percent of trail-based recreation happens in greater sage-grouse habitat. This includes hiking, biking, OHV use, cross-country skiing, and other trail-based activities.

PRIVATE PROPERTY VALUES

FWS current range of the greater sage-grouse occupies 31 percent of Utah's 11.4 million acres of private property outside of cities and other Census places. Historical-only range and SGMAs are somewhat smaller but still over 20 percent. A preliminary review of aggregate county-level data suggests some $5.7 billion in agricultural and non-primary residential property values may be located in FWS current range, 2.5 percent of the total assessed value of privately owned real property in Utah. Historical-only range and SGMAs may contain $5.2 billion and $3.9 billion, respectively, of private property.

Summary Table 1 presents the economic contributions of the above activities by habitat type. Only those activities for which we have sufficient data are included. For example, we did not have the value of crops sold from habitat areas so we could not estimate the economic contributions of farming. Therefore, a conservative estimate of activities in FWS current sage-grouse range suggests they contribute 13,000 jobs with $831 million in earnings and $2.5 billion in gross state product (value added). Activities in historical-only range support 11,000 jobs with $723 million in earnings and $2.5 billion in GSP. Finally, activities in SGMAs support almost 5,000 jobs with $165 million in earnings and $339 million in GSP.

Summary Table 1
Summary of Economic Contributions of Activities in Greater Sage-Grouse Range in Utah, 2014
(Dollar amounts in millions)

	FWS CURRENT RANGE			HISTORICAL-ONLY RANGE			SGMAs		
Activity	**Jobs**	**Earnings**	**Value Added**	**Jobs**	**Earnings**	**Value Added**	**Jobs**	**Earnings**	**Value Added**
Oil and Gas Production	4,415	$366.5	$1,584.0	7,173	$595.5	$2,250.7	205	$17.0	$46.2
Coal Mining	2,394	$132.0	$433.3	–	–	–	–	–	–
Metals and Minerals Mining	932	$35.3	$85.3	845	$32.0	$77.4	826	$31.3	$75.6
Renewable Energy Generation	138	$138.1	$138.1	103	$5.1	$12.5	–	–	–
Cattle and Sheep Grazing	1,012	$34.6	$52.9	564	$18.8	$28.3	831	$27.9	$42.3
Hunting and Fishing	4,180	$124.4	$243.1	2,412	$71.8	$140.4	2,998	$89.2	$174.3
Total	**13,071**	**$830.8**	**$2,536.6**	**11,097**	**$723.2**	**$2,509.4**	**4,861**	**$165.4**	**$338.5**

Source: BEBR analysis.

1 Overview and Threats

This chapter provides context for the analysis of activities in greater sage-grouse ranges in Utah. We discuss the status of greater sage-grouse range-wide and in Utah following a primer of policies that affect its management. Range definitions used in the remainder of the study are described and mapped. Finally, we review natural and human threats to greater sage-grouse.

1.1 Endangered Species Act and Listing Process

The Endangered Species Act of 1973 (ESA) protects listed plant and animal species on federal, state and private lands.[3] A species listed for protection under the ESA may be designated endangered or threatened. An endangered species is one "in danger of extinction throughout all or a significant portion of its range"; a threatened species is one "likely to become an endangered species within the foreseeable future."[4] A threatened listing is more flexible than an endangered listing.

The ESA prohibits the take, transport and sale of any endangered species; subject to U.S. Fish and Wildlife Service (FWS) discretion, similar prohibitions apply to threatened species. To take means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."[5] Harm encompasses an act that results in "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering" (National Marine Fisheries Service 1999).

Regarding FWS discretion for threatened species, the agency, under the authority of the Secretary of the Interior, "shall issue such regulations as he deems necessary and advisable to provide for the conservation of such species."[6] This language authorizes the so-called "4(d) rule," which allows flexibility regarding responsible land uses that conflict in some respect with the needs of a threatened species. A common type of 4(d) rule is to permit incidental take from agricultural activities covered by an approved conservation plan. The intent of incidental take provisions is to give private landowners incentives to protect threatened species by making and following conservation plans.

The ESA allows the designation of critical habitat for listed species.[7] Occupied habitat is protected by the ESA without such a designation. Critical habitat can be outside the occupied range to include potential habitat. Critical habitat protections are relevant where a federal nexus is present, such as project funding or land management.

FWS is considering whether an ESA listing is appropriate for the greater sage-grouse in Utah and most other western states. FWS may return a listing-not-warranted decision, an endangered species

[3] Within tribal lands, federal support for ESA conservation efforts are by arrangement with the sovereign nations there, and ESA regulations mainly apply where federal funding is used for projects (Sanders 2007).
[4] 16 U.S.C. 35 § 1532 (6)
[5] 16 U.S.C. 35 § 1532 (19)
[6] 16 U.S.C. 35 § 1533 (d)
[7] 16 U.S.C. 35 § 1532 (5)

listing, or a threatened listing with or without critical habitat or a 4(d) rule. Were a 4(d) rule added to a threatened species listing for greater sage-grouse, the impact in Utah would likely be minimal throughout the 50.7 percent of FWS current habitat that is on federal lands. On the other hand, a critical habitat designation would primarily be relevant on those federal lands.

Listed species are managed by FWS, whereas states retain management authority for all other wildlife within their boundaries. FWS invites input and assistance from state agencies as needed to carry out its management plans for listed species.[8]

The Secretary of the Interior has authority for listing decisions. They are to be based on the status of a species and threats to it, including habitat degradation, species overutilization, disease and predation.[9] Consideration of broader economic and social issues and tradeoffs is not required. Governor Gary Herbert has noted that an ESA listing for the greater sage-grouse "would have a significant adverse effect on the economy" (Herbert 2015, p. 3). These may arise from conflicts between habitat conservation and a variety of other land uses, including recreation, development and agriculture. If the greater sage-grouse were listed as threatened or endangered, it is likely that some land uses in its habitat in Utah would be curtailed.

1.2 GREATER SAGE-GROUSE IN THE WEST

The greater sage-grouse is an upland game species that occupies habitat in 11 states, primarily in sagebrush ecosystems (see Figure 1.1) (BLM 2013). Habitat may also include riparian and wet meadows during spring and summer and aspen ecosystems in late summer. Sagebrush leaves are the primary source of food for greater sage-grouse in the winter, but grasses, forbs and insects are important parts of the diet at other times.[10] An estimated 87 percent or more of greater sage-grouse nests in Colorado, Wyoming, southern Canada and Utah are under sagebrush (Connelly, Rinkes, and Braun 2011). Nests that are not under sagebrush are almost always under some other large bush. Nests under non-sagebrush vegetation generally have lower success rates than those under sagebrush.

Prompted by several petitions submitted in the early 2000s, FWS considered an ESA listing for the greater sage-grouse range-wide and determined in 2005 a listing was not warranted (USFWS 2010). A December 2007 decision from the U.S. district court in Idaho required FWS to reconsider its "not warranted" finding. In March 2010, FWS found a range-wide threatened or endangered listing was warranted but precluded by higher-priority listing actions. In September 2011, the D.C. district court approved a settlement agreement that bound FWS to publish a decision regarding greater sage-grouse, either to list the species or to find a listing not warranted, by September 30, 2015 (U.S. District Court for the District of Columbia 2011).

In response to the FWS process, the Bureau of Land Management and U.S. Forest Service have conducted extensive planning efforts and proposed plan amendments to address the greater sage-

[8] 16 U.S.C. 35 § 1535

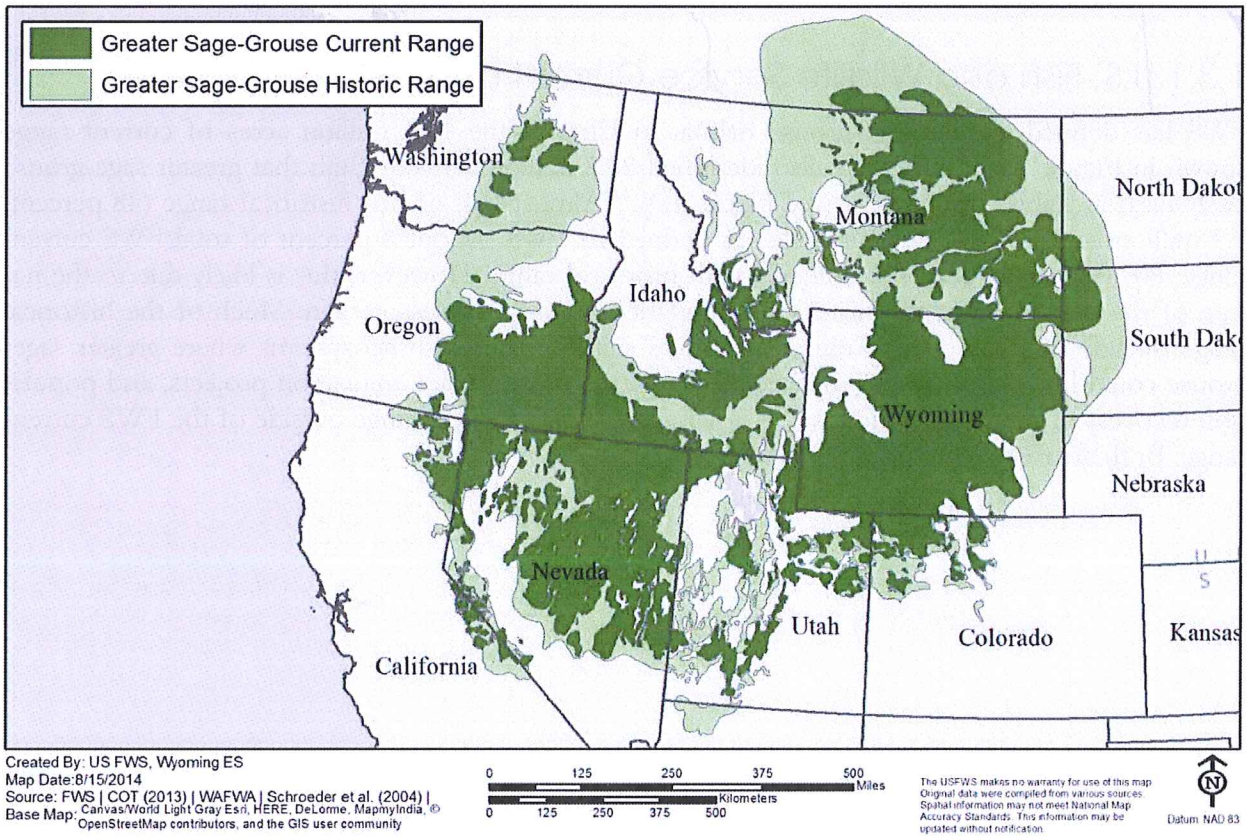
[9] 16 U.S.C. 35 § 1533 (a) (1)

[10] Forbs are plants without a stem, such as ferns, horsetails, and lycopods. Forbs are smaller than shrubs and different from grasses. *Source:* Natural Resources Conservation Service, plants.usda.gov/growth_habits_def.html.

grouse.[11] Most restrictions relate to extractive industries, improper grazing, and the use of off-highway vehicles (OHVs), while many activities are largely unaffected. Likewise, state wildlife agencies and many private and state land managers in the West have devoted resources to conserve the species, reduce the need for a listing, and anticipate listing restrictions.

There are two sage-grouse species in Utah. While the greater sage-grouse is the topic of this study, we note that the Gunnison sage-grouse, which lives in southwestern Colorado and a very small portion of Utah's San Juan County near Monticello, was listed November 2014 as a threatened species with designated critical habitat (USFWS 2014b).

Figure 1.1
FWS Greater Sage-Grouse Range, Including Bi-State and Columbia Basin DPSes



1.3 GREATER SAGE-GROUSE IN UTAH

The Utah population of greater sage-grouse is measured by annual counts of males at leks. During 2010 to 2014, DWR counted an average of 3,682 males (Bernales, Robinson, and Blair 2015). Population levels display substantial normal fluctuations in recent years and historically. Direct comparison of counts over time would be unreliable, since methods varied from year to year.[12] However, it

[11] See, for example, the "Utah Greater Sage-Grouse Draft Land Use Plan Amendment and Environmental Impact Statement" produced jointly by BLM and the Forest Service October 2013 (www.blm.gov/ut/st/en/prog/planning/SG_RMP_rev/deis.html).

[12] Coverage of greater sage-grouse counts in Utah has increased over time as previously undocumented leks (breeding grounds) were included. From 2005 to 2014, DWR staff visited an average of 313 leks annually, finding 68 percent of

appears greater sage-grouse population levels have been stable in Utah in recent decades (Messmer 2015).

Greater sage-grouse range definitions for Utah have been adapted from FWS and Utah Division of Wildlife Resources (DWR) sources for this report. We focus on the following three ranges, each of which is mapped and discussed in some detail.

- Revised current range based on FWS definitions, 10.4 million acres
- Revised historical-only range outside of current range based on FWS definitions, 9.4 million acres
- Revised 2013 Sage-Grouse Management Areas (SGMAs) based on DWR boundaries, 7.5 million acres

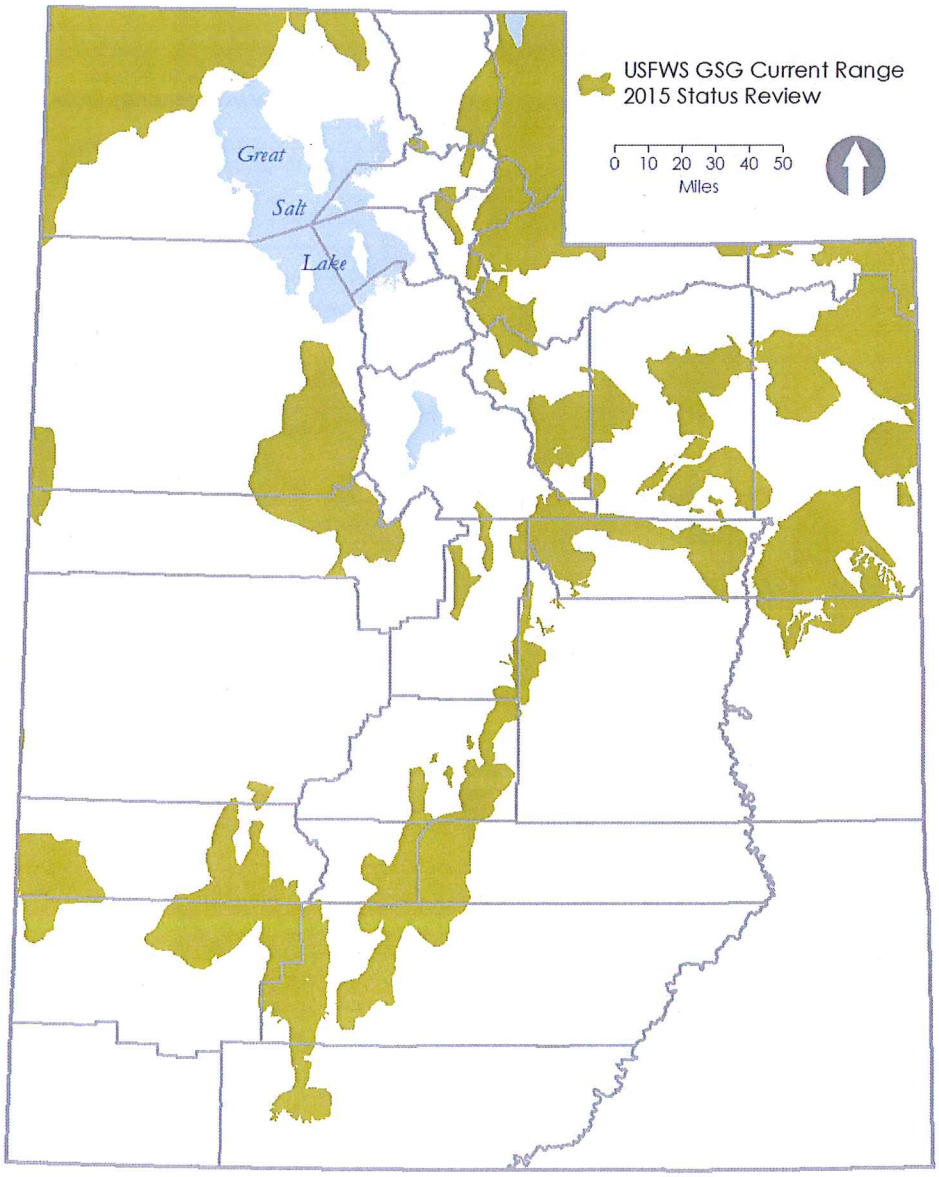
1.3.1 U.S. Fish and Wildlife Service Current and Historical Range

FWS has defined greater sage-grouse habitat in Utah as the 10.6 million acres of current range shown in Figure 1.2. The service also identified 20.2 million acres in Utah that greater sage-grouse likely used as habitat in the past (see Figure 1.3).[13] Almost half of this historical range (48 percent, 9.7 million acres) is also current range, as defined by FWS. About 8 percent of total FWS current range, 807,000 acres, does not coincide with historical range. However, this is likely due to the nature of the two datasets, the historical boundaries being much less certain. Much of the historical range outside of FWS current range still offers suitable sagebrush ecosystems where greater sage-grouse could live under proper management. Habitat preservation, mitigation projects, and population recovery efforts may include small or large areas of historical range outside of the FWS current range. Both areas are overlain in Figure 1.5.

them occupied. Compared with the period 1970 to 2004, both the number of annual visits and occupied leks increased by more than 100. The new sites added to DWR's coverage over the years have been somewhat smaller in terms of observed male attendance than those previously documented. Meanwhile, total counts have risen since the 1990s, largely due to improved thoroughness.

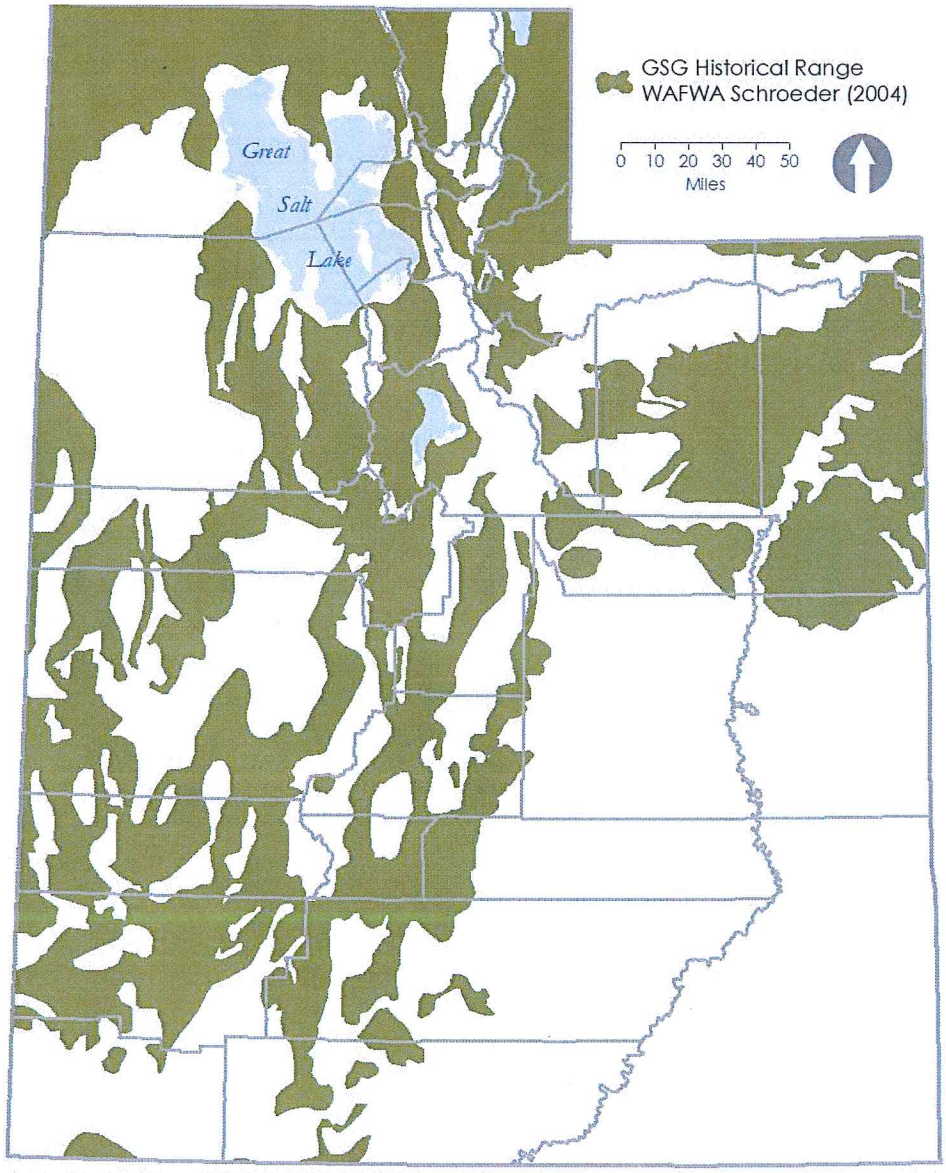
[13] The Utah Division of Wildlife Resources (DWR), which to date has jurisdiction for greater sage-grouse in Utah, also mapped its habitat in the state, distinguishing occupied and opportunity habitat. FWS and DWR habitat definitions generally correspond. FWS maps were selected for this study since the federal agency will make the ESA listing decision and would begin managing the species were a listing to occur.

Figure 1.2
FWS Current Range for Greater Sage-Grouse in Utah



Source: Jim Lindstrom, USFWS, Wyoming ES; State of Utah, SGID. Map by John Downen, BEBR | April 2015

Figure 1.3
Historical Range for Greater Sage-Grouse in Utah

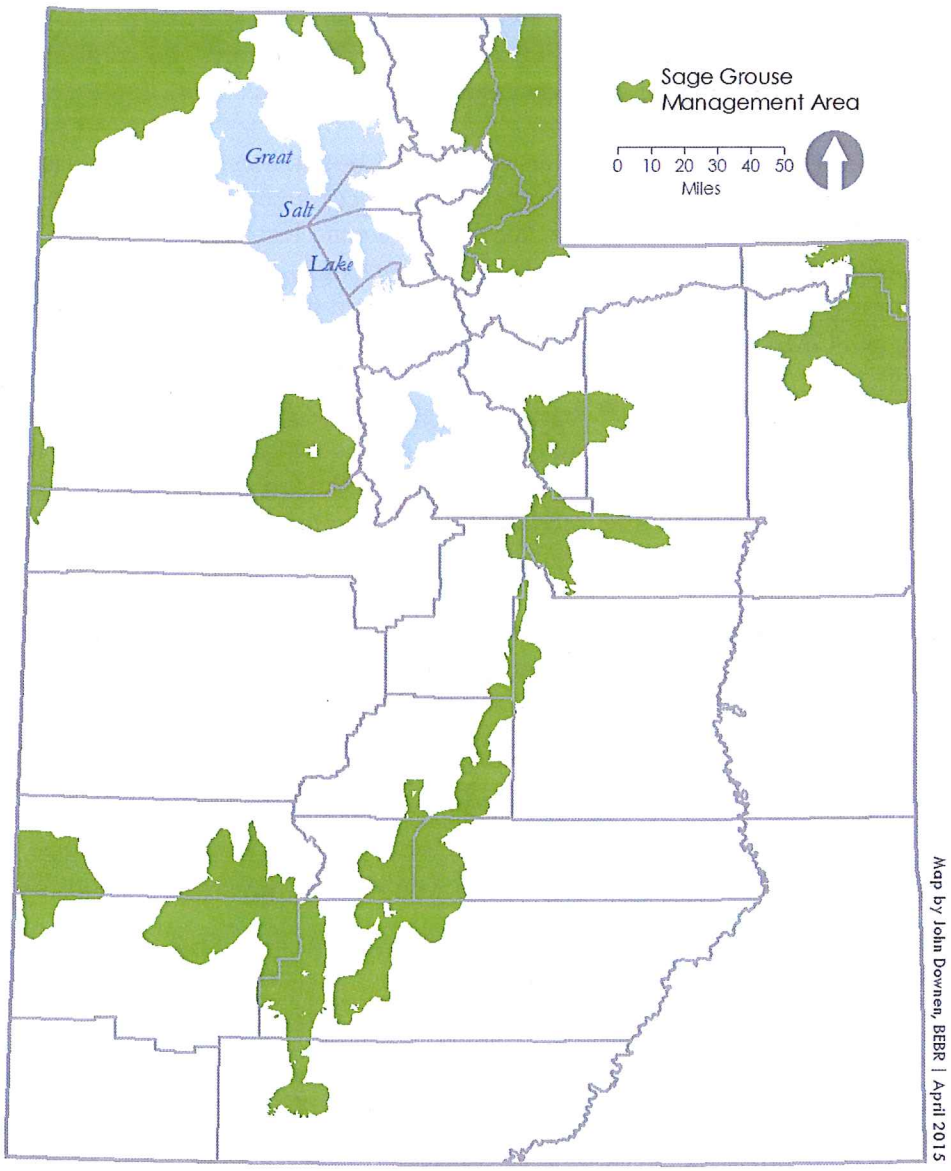


Source: Jim Lindstrom, USFWS, Wyoming ES; State of Utah, SGID. Map by John Downen, BEBR | April 2015

1.3.2 Sage-Grouse Management Areas Defined by the State of Utah

Sage-Grouse Management Areas (SGMAs) as defined by the State of Utah are the third and final area for which economic activities are analyzed in this study (see Figure 1.4). SGMAs cover most FWS current range as well as a small amount of historical range. SGMAs are the focus of ongoing population recovery goals and habitat preservation efforts by DWR, its local partners, and several federal and state agencies (UDWR 2013). They represent the state's determination of current and potential habitat areas where conservation is likely to be most successful while also avoiding undue conflicts with other environmental needs and land uses.

Figure 1.4
Sage-Grouse Management Areas in Utah



Source: Utah Division of Wildlife Resources; State of Utah, SGID.

SGMAs were created in 2002 as 13 multi-county regions that covered the entire state (UDWR 2002). By 2013 SGMA boundaries had been refined and narrowed from general regions to specific areas covering most, but not all, current range as defined by FWS, as well as some areas outside of FWS current range. DWR and Utah State University Extension have coordinated the efforts of 11 local working groups started in 1997 to help identify greater sage-grouse needs and advance strategies to protect them in each SGMA (Messmer 2015, UDWR 2009).

1.3.3 Range Definitions for this Study: FWS Current Range, Historical-Only Range, and SGMAs

For this study, we have removed populated areas from the current and historical ranges defined by FWS and from SGMAs defined by DWR. Settled areas are considered unlikely options for habitat

going forward. To be precise, we exclude 1.2 million acres of U.S. Census "places," 5.6 percent of FWS current and historical range.[14] Census places include all incorporated cities and towns, as well as "Census designated places." The latter are unincorporated areas with population concentrations—urban areas, such as Kearns and Millcreek in Salt Lake County, and rural areas throughout Utah, such as Eden in Weber County and Newcastle in Iron County.

This study analyzes economic activities within the revised boundaries for greater sage-grouse range shown in Figure 1.5. The revision involves the exclusion of cities, towns, and Census places, as mentioned, which mainly affects historical range. We also designate historical-only range as that portion of the revised historical range that is not also FWS current range. As noted earlier, only 8 percent of the FWS current range is outside of historical range (indicated in Figure 1.5 as "FWS Current Range Only"). Virtually all SGMA territory is contained within FWS current range.

In this study, economic activities in FWS current range are measured distinctly from economic activities in historical-only range, and corresponding values can be added for an estimate of total activity in FWS current and historical range. On the other hand, SGMAs overlap both FWS current and historical range, and measures of economic activity in SGMAs cannot meaningfully be added to corresponding values for FWS current or historical range.

FWS current greater sage-grouse range covers nearly one-fifth of Utah, but sage-grouse management considerations may apply to lands ranging from 13.7 percent to 36.5 percent of the state (see Table 1.1). The lower figure is for SGMAs, which are where DWR and the local working groups currently focus management efforts. The higher figure is for combined FWS current and historical range, which constitutes an upper bound for areas where economic activities could potentially be affected by FWS conservation efforts. The three greater sage-grouse areas documented in Table 1.1—as well as the implied fourth area of total FWS current and/or historical range—are the best available scenarios for the Utah geography that may be affected by a greater sage-grouse ESA listing (Martini 2015).

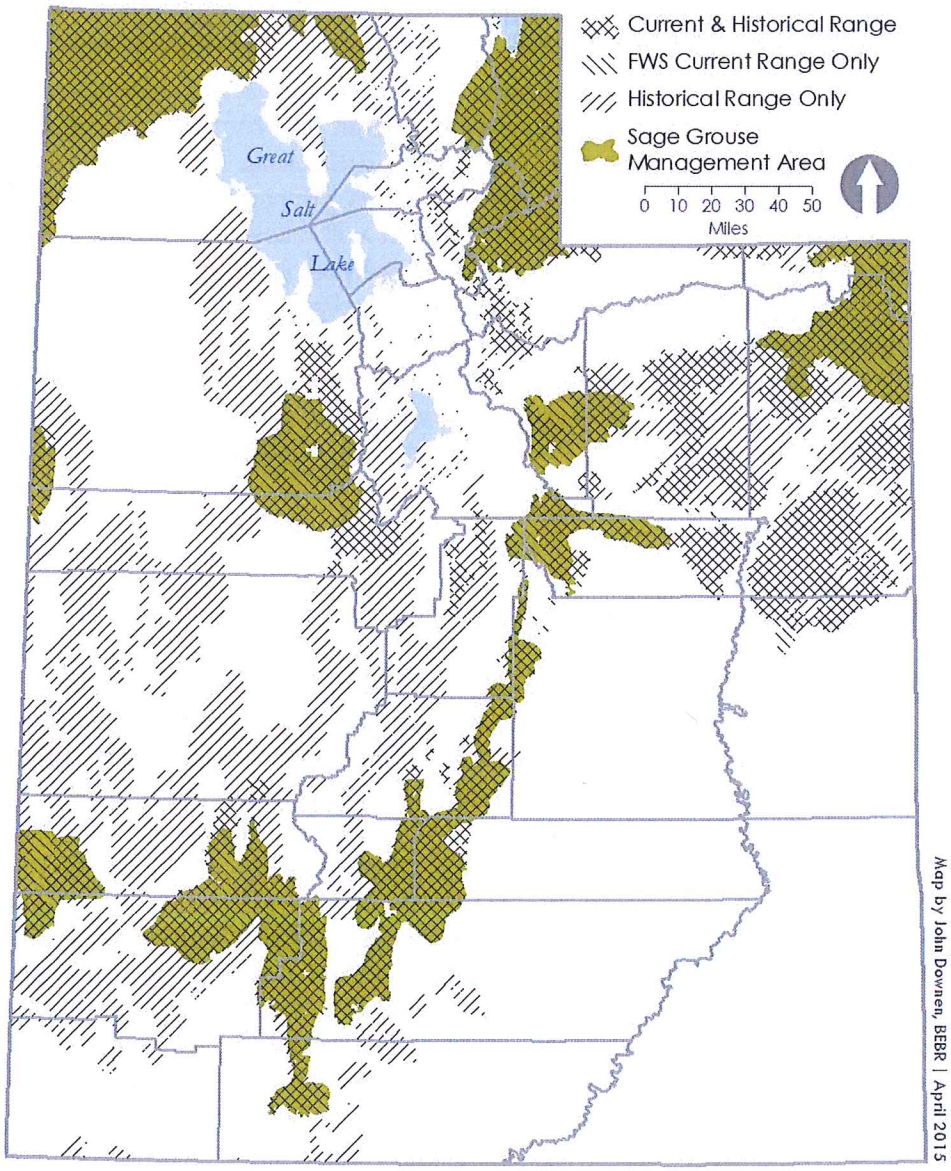
Table 1.1
Greater Sage-Grouse Range Acres by Landowner

		FWS CURRENT RANGE			HISTORICAL-ONLY RANGE			SGMAs		
Owner	All Lands	Acres	Share of Owner	Share of Range	Acres	Share of Owner	Share of Range	Acres	Share of Owner	Share of Range
Federal	35,011,196	5,285,012	15.1%	50.7%	5,295,969	15.1%	56.2%	4,146,760	11.8%	55.6%
Private	11,423,249	3,515,130	30.8%	33.7%	3,088,292	27.0%	32.8%	2,564,015	22.4%	34.4%
State	5,432,964	1,070,099	19.7%	10.3%	786,995	14.5%	8.4%	711,532	13.1%	9.5%
Tribal	2,448,628	555,385	22.7%	5.3%	244,414	10.0%	2.6%	31,970	1.3%	0.4%
Total	**54,316,036**	**10,425,625**	**19.2%**	**100%**	**9,415,669**	**17.3%**	**100%**	**7,454,276**	**13.7%**	**100%**

Note: Based on greater sage-grouse range outside cities, towns or unincorporated Census-designated places. For habitat by agency, see the Appendix, Table 1.A1. Acreage by national forest and BLM field office are available in Chapter 8, Tables 8.4 and 8.9.
Source: BEBR analysis of data from U.S. Fish and Wildlife Service, Utah Division of Wildlife Resources, and State of Utah, SGID.

[14] Cities, towns, and Census-designated places occupy 1,175,995 acres of FWS historical range, 126,585 acres of FWS current range, and a very small portion of an SGMA in Garfield County. As nearly all of the SGMAs and FWS current range are within historical range, the total area removed for this analysis is 1,177,250 acres.

Figure 1.5
Revised Range for Greater Sage-Grouse in Utah



Source: U.S. Fish & Wildlife Service; Utah Division of Wildlife Resources; State of Utah, SGID.

1.3.4 Management by the State of Utah

As previously noted, the State of Utah has management authority for greater sage-grouse and all wildlife species that are not listed as threatened or endangered (Herbert 2015). DWR issued state plans for the greater sage-grouse in 2002, 2009 and 2013 (UDWR 2002; UDWR 2009; UDWR 2013). To an extent, these incorporate FWS findings and guidelines for greater sage-grouse conservation (USFWS 2013; Herbert 2015).

Utah's management approach is to follow the DWR conservation plan to support greater sage-grouse primarily within SGMAs. The legislature and state agencies have devoted considerable resources to the species since the mid-1990s (Herbert 2015). The state recognizes that since an ESA

listing became a serious possibility, sufficient state-directed conservation progress could preclude a listing and the resulting loss of state autonomy and flexibility (Sheehan 2014). The state attributes robust populations of greater sage-grouse in 2015 to "proper stewardship" by private, state and federal land managers (Herbert 2015, p. 3).

The state expects that "activities and facilities existing within SGMAs prior to the adoption of the Conservation Plan will be allowed to continue" (Herbert 2015, p. 5). The intent is to minimize disruption to property owners: "existing rights established on private, county, city, state and federal lands should be recognized and respected" (p. 6). SGMAs will receive special attention with regards to wildfire suppression, fuels reduction, road and infrastructure planning and construction, and outdoor recreation activities and facilities. Oil, gas and mining resources should be tapped, but with appropriate measures to avoid, minimize and mitigate impacts on greater sage-grouse populations. Future disturbances are to be located in "areas already disturbed or naturally unsuitable" to the species (p. 7). State agencies are to advise and coordinate efforts to improve and restore habitat. Ongoing research is needed to monitor and improve understanding of the needs of greater sage-grouse in different parts of the state.

1.4 THREATS TO GREATER SAGE-GROUSE

Utah sage-grouse populations occupy habitats that are naturally fragmented based on topography. Some of these habitats have experienced additional loss and fragmentation from both natural and human causes. Wildfire, invasive plants, climate and predation are natural threats that humans may mitigate or compound. Oil, gas and renewable energy development; mining; crop and livestock agriculture; recreation; urbanization; and infrastructure installation and maintenance are human activities that may further fragment or destroy sage-grouse habitat, but they too are mitigable.

The most significant threats in Utah are wildfire, invasive and encroaching plants, and energy development in FWS current and historical range, and wildfire and invasive and encroaching plants in SGMAs. Secondary concerns are agriculture, urbanization and infrastructure. Other threats discussed may conflict with greater sage-grouse needs under certain circumstances. Further research beyond the scope of this study would be needed to estimate what portion of these activities is affected by current conservation approaches or would be affected by new restrictions from a possible listing. It is important to consider the variety and relative importance of influences on the species, including and besides economic activities.

1.4.1 Natural Threats

Several threats to Utah's population of greater sage-grouse can arise without human intervention: wildfire, invasive and encroaching plants, climate, and predation. Land managers and others are able to address these concerns to an extent. Two natural threats to greater sage-grouse not addressed in this section are disease and competition for resources from other wildlife (UDWR 2010). This discussion is offered as a backdrop for the following section on anthropogenic threats.

Wildfire

Wildfire and the associated spread of invasive plants are the principal threats to greater sage-grouse in the Great Basin region, which includes the western part of Utah (USFWS 2014a; Herbert 2015). Wildfire has been found to reduce lek populations and threaten their persistence (Knick et al. 2011).

Fire episodes, particularly catastrophic ones, can destroy sagebrush canopy and result in many sage-grouse fatalities, since the species is intolerant to fire (Miller et al. 2011; UDWR 2013). Vegetation recovers best where soil, moisture, topography, seed viability and other conditions are favorable (Knick et al. 2011). Regrowth is hampered by dry climates, large fires, high-intensity burns and invasive plants seeding. Landscape restoration projects accelerate recovery.

Greater sage-grouse recolonization is not automatic even when native vegetation has recovered. Their return to fire-disturbed habitat is often slow. Typical vegetation recovery times following wildfire disturbance in the West are one to three years for herbaceous growth, grasses and forbs, compared with 25 to 35 years for sagebrush (Knick et al. 2011). Livestock grazing can reduce the threat of fire by depleting and renewing the grass and forb understory (UDWR 2013).

Invasive and Encroaching Plants

Plants that are not native to a sagebrush ecosystem can degrade greater sage-grouse habitat (Miller et al. 2011). Wildlife communities dependent on sagebrush suffer from the introduction and propagation of invasive species (UDWR 2013). Vegetation treatments by land managers are advisable at early stages where this occurs. As invasive plants spread they "alter the soil and environment in a way that makes reestablishment of the native ecosystem very difficult" (UDWR 2013, p. 14). Development projects create opportunities for the spread of exotic and noxious plants (USFWS 2010) while existing construction and reclamation requirements reduce this threat from mining, drilling, recreation improvements and other developments. The most concerning invasive species in Utah is cheatgrass.

Of more than two dozen nonnative weeds, annual grasses, and other plants in Utah, cheatgrass has been the leading concern for greater sage-grouse since its introduction from Eurasia many decades ago (Miller et al. 2011; DWR 2013). An estimated 65 percent of the Great Basin region has conditions that make it susceptible to cheatgrass growth, especially following a fire (Miller et al. 2011). Cheatgrass eliminates patches of open space that greater sage-grouse need and absorbs water and nutrients that sagebrush and other native plants require. Becoming extremely flammable when it dries out during the summer, cheatgrass provides fuel for future fires, after which it seeds prolifically to recover and spread further.

At somewhat higher elevations, the encroachment of pinyon and juniper conifers also results in loss of large areas of sagebrush habitat (Miller et al. 2011). These trees are native to Utah. Their spread into sagebrush ecosystems stems from fire exclusion and livestock grazing practices going back over a century. Pinyon and juniper woodlands do not provide favorable habitat for the greater sage-grouse, and their spread into sagebrush regions threatens its population levels.

Climate

Climate change and weather extremes are important influences on sagebrush ecosystems (Miller et al. 2011). A study of 248 hens and their offspring in Utah's Piute County from 1998 to 2010 showed the presence of adequate moisture was associated with more successful reproduction of greater sage-grouse there (Caudill et al. 2014). Especially when coupled with low levels of precipitation, temperatures above historical norms are less likely to sustain enough healthy forage for robust populations of greater sage-grouse (UDWR 2013). Higher temperatures favor invasive species and increase wildfire incidence, extent and severity (USFWS 2010). Greater sage-grouse are adapted to survive snow, wind and cold, but unusually severe weather can elevate mortality (Hagen 2011). Drought and temperature extremes factor into annual population fluctuations and the long-term recovery of greater sage-grouse in the West.

Predation

Certain predators, primarily corvids and red foxes, constitute threats to greater sage-grouse in a few of Utah's SGMAs (UDWR 2013). Ravens are the principal corvid predator in Utah. The red fox targets nests and young chicks in the Strawberry Valley and other parts of the state (Baxter et al. 2007). Overall, predation has not been a primary threat to greater sage-grouse; exceptions are commonly associated with poor habitat conditions (USFWS 2014a).

Range-wide, predators for greater sage-grouse adults, juveniles and eggs include coyotes, badgers, bobcats, red foxes, ground squirrels, eagles, ravens, magpies, northern harriers and falcons (Hagen 2011). The mix and relative importance of predators varies by region. Renesting helps offset egg predation. The risk of predation decreases after the season of breeding, nesting and brood-rearing. Fences and utility poles assist avian predators by providing perches (USFWS 2010).

Utah's conservation plan provides for ongoing predator control by the Utah Department of Agriculture and Food (UDWR 2013). Efforts to curb red fox have been more effective than those targeting coyotes, in terms of improving adult survival and reproduction among greater sage-grouse in the state (Baxter et al. 2007; Hagen 2011). Corvid populations are managed by limiting external food sources, especially waste facilities and road kill. Actions to promote vegetation health and sagebrush landscapes increase sage-grouse protection from predators (UDWR 2013).

1.4.2 Human-Caused Threats

A variety of land uses may impact the greater sage-grouse and its habitat: oil and gas development, mining, renewable energy, crop and livestock agriculture, recreation, urbanization, and supporting infrastructure. These can affect land, water and air quality. Greater sage-grouse leks are more sensitive to human presence than other habitat areas, especially at dawn and dusk during the spring (USFWS 2013; Hagen 2011). For a few weeks following breeding, hens and their offspring in nearby nesting grounds are vulnerable to disturbances.

The influence of a range of human activities in greater sage-grouse habitat can be described in terms of intensity, geographic extent, duration and flexibility to accommodate sage-grouse needs. Recreation and grazing can be largely compatible with habitat needs. Grazing can offset the threat of wildfire, although overgrazing can cause lasting harm to native vegetation. Disturbances from mining and energy developments are often limited to relatively small areas. However, these installations in or near habitat, as well as expanding residential communities there, tend to increase human environmental disturbances and spawn transportation and communication network extensions. Bringing new lands under cultivation may reduce habitat, but raising crops on existing farmland is rarely a concern. For all activities, people can avoid, minimize and mitigate negative impacts by following best practices, such as avoiding leks, marking fences, consolidating road and utility corridors, restoring vegetation following development, and planning the timing of necessary disturbances to reduce interference with the life-cycle of greater sage-grouse through the four seasons.

Oil and Gas Development

Energy development is the principal threat to greater sage-grouse in the Rocky Mountain region, in particular in FWS current and historical range in northeastern Utah, though not in the state's SGMAs (USFWS 2014a; Herbert 2015). Energy development disturbances negatively impact population levels for greater sage-grouse in the vicinity (USFWS 2010). Once a project is complete and the area reclaimed, sage-grouse return gradually. Full population recovery may take two decades or longer.

Oil and gas development involves well pads, access roads, pipelines and other installations that occupy greater sage-grouse habitat or cause disruption (Knick et al. 2011). Other installations may include electrical lines, pumping stations and storage tanks. Greater sage-grouse mortality may increase from the unintended provision of perches for avian predators. Disturbances from oil and gas development, including noise and exhaust, are pronounced during drilling but diminish during the subsequent months, years or decades of normal well operation (Knick et al. 2011). Thus, continued operation in developed oil and gas fields is less concerning than exploring new fields. Greater sage-grouse communities have been known to adapt to habitat fragmentation from oil and gas development, albeit at somewhat reduced stable population levels. Post-drilling reclamation mitigates concerns from erosion and the spread of nonnative plants.

Mining

Surface and subsurface mining of minerals such as coal and copper can alter sagebrush habitats (USFWS 2010). Habitat loss may result from the storage of tailings and overburden soil and from new staging areas, roads, railroad tracks and structures. Mining may cause noise disturbances and ground shock, vegetation and topography changes, and reduced air and water quality.

Mining may reduce adult male attendance at nearby leks for a time. Hen survival rates and overall population levels generally have not been found to suffer (USFWS 2010). However, in the case of extensive surface operations, mining can negatively impact population levels for greater sage-grouse in the vicinity, at least in the short term. Sage-grouse have been found to return to leks and recover their numbers gradually after mines are closed and reclaimed.

Renewable Energy

Greater sage-grouse can be affected by developments to harness wind, geothermal and other renewable energy sources. The initial construction of access roads, wind turbines, geothermal wells, pipelines, facilities, transmission lines and other infrastructure can alter habitat and disrupt nearby sage-grouse (Knick et al. 2011). Wind turbines may reduce local nesting and brood-rearing success rates (UDWR 2013). In general, the post-installation impacts of ongoing operations at renewable energy facilities themselves are not considered problematic based on the limited research available, but associated transportation and utility network growth can be concerning. For example, a road to service a geothermal site may cause enduring habitat fragmentation. One favorable consideration is that wind and geothermal energy are substitutes for oil and gas development, a well-documented threat to the species (Knick et al. 2011).

Livestock Grazing

In Utah, livestock grazing is the most prevalent use of lands in greater sage-grouse range (Utah State University Extension 2011). Grazing activity is substantial within most SGMAs (UDWR 2013). Domestic livestock may disturb shrubs, grasses, and forbs on which greater sage-grouse depend (Knick et al. 2011). Grazing can harm vegetation and soils where resiliency and stability are doubtful, resulting in soil damage, invasive plants and disruption of historical wildfire regimes (Miller et al. 2011). Habitat integrity depends on appropriate stocking rates that are responsive to changing environmental conditions.[15] Disturbance to greater sage-grouse habitat from well-managed grazing is often slight. Any deterioration in range conditions from an ongoing livestock presence diffused over

[15] Stocking considerations include forage distribution, season duration, herbivory from native animals, demand for domestic livestock grazing, past utilization rates, rest-rotation or other range management approaches, precipitation, plant regeneration, and intended landscape conditions (Knick et al. 2011).

a large area is usually gradual and reversible. However, high livestock concentrations may denude vegetation in small areas over a short period of time, for example near water sources or mineral-nutrient blocks. Fences are a collision hazard to greater sage-grouse, but they can help limit or redirect human and animal movements.

Livestock grazing can also benefit greater sage-grouse. By depleting and renewing the grass and forb understory, moderate livestock grazing reduces wildfire incidence and spread (Knick et al. 2011). Best practices for rangeland management tend to improve greater sage-grouse habitat and maintain vegetation heterogeneity (UDWR 2013). For example, ranchers' maintenance of healthy vegetation for their livestock, including forbs and perennial grasses, benefits greater sage-grouse (Utah State University Extension 2011). Water developments and pasture irrigation for grazing may improve sage-grouse brood-rearing habitat. Overgrazing has become relatively uncommon on public lands owing to marked reductions in permitted and authorized animal unit months[16] in past decades (Knick et al. 2011).

Crop Agriculture

Cultivation of new lands usually results in the elimination of sagebrush there, vegetation essential to greater sage-grouse survival (Knick et al. 2011). Cropland shares above 25 percent are associated with an increased likelihood of local sage-grouse extirpation. Historically, prime areas with fertile soils and good water access were preferred for crop cultivation, with less demand for arid and remote lands requiring irrigation systems. Fortunately for greater sage-grouse, as much as 90 percent of sagebrush lands in the West remained unsuitable for cultivation as of the mid 1990s due to temperature, soil quality, topography and water access.

Cropland pesticides have not been identified as a significant threat to greater sage-grouse in Utah (UDWR 2013). Greater sage-grouse generally avoid cultivated croplands and other developed areas (Knick et al. 2011). When sage-grouse do enter farmland to feed on plants outside their normal diet, for example alfalfa, exposure to pesticides is possible.

Recreation

Recreation and supporting activities can impact greater sage-grouse. An FWS study of 12 sage-grouse populations in Utah identified recreation as a "present and widespread" threat to the species in 11 areas; for the remaining population, the threat was considered to be "present but localized" (USFWS 2013, pp. 16–24). While outdoor recreation is widespread in much of the state's greater sage-grouse range, the severity of recreation impacts is low in most areas (Messmer 2015). Seasonal closures address recreation impacts where they arise on public lands. Low-impact outdoor recreation activities, such as hiking, biking, climbing, rafting and camping, are generally compatible with greater sage-grouse use of land as habitat. Still, any type of human presence from recreation can disrupt normal sage-grouse behavior (USFWS 2013). In addition, new development and infrastructure from people relocating to greater sage-grouse habitat to gain better access to public lands for recreation constitute an indirect source of habitat loss and disturbance (Knick et al. 2011).

Roads, trails and camping facilities to support recreation in greater sage-grouse range tend to fragment habitat and create hazards for the birds (USFWS 2013). OHV use is of particular concern among recreation activities (UDWR 2013). Greater sage-grouse are most vulnerable to ATVs and motorcycles when the birds are nesting and to snowmobiles during winter.

[16] An animal unit month is the amount of forage needed to feed a cow and calf, a horse, or five sheep for one month. It is the metric used by the Bureau of Land Management to assign the amount of livestock allowed on the land.

The hunting of greater sage-grouse is a recreational, economic and cultural activity that could threaten the species if not carefully managed (Reese and Connelly 2011). Western states including Utah have implemented effective restrictions, and the hunting of greater sage-grouse has not been identified as a primary factor determining its population levels (Guttery et al. 2015; UDWR 2009). In recent decades, state wildlife agencies have limited greater sage-grouse hunting opportunities by implementing short hunting seasons in the fall and reducing permit issuance and bag and possession limits (Reese and Connelly 2011). Hunting species besides the greater sage-grouse within its habitat may attract a human presence that disturbs the bird (USFWS 2013). Hunting fees collected by DWR help fund sage-grouse conservation efforts.

Fishing is not identified as a threat to greater sage-grouse in Utah or other Western states in prominent conservation documents and literature reviews (USFWS 2013; Knick et al. 2011; UDWR 2013). Disruptive lek viewing can interfere with normal sage-grouse behavior, but wildlife watching is generally not considered a threat to the species.

Urbanization and Infrastructure

Urbanization is a potential threat to greater sage-grouse as residential and commercial land uses spread to new areas, prompting the development of supporting infrastructure. Economic considerations, recreation opportunities, and proximity to public lands with "natural or wilderness qualities" are common reasons for migration to rural sagebrush habitat (Knick et al. 2011, p. 212). In Utah, greater sage-grouse endangerment from such land development has been minor due to the large share of habitat protected under federal ownership.

Dispersed settlement and urbanization reconfigure resource needs in ways that affect large surrounding areas (Knick et al. 2011). For example, water, electricity, retail goods and other resources may be delivered through greater sage-grouse habitat. Water diversions may affect moisture levels in basins where greater sage-grouse live.

As they connect people and resources, roads and motorized vehicle trails can also have detrimental effects, including collisions with greater sage-grouse, noise disturbance, habitat alteration, erosion, chemical leaching, and the spread of nonnative plants (Knick et al. 2011). Less than 5 percent of sagebrush habitat for sage-grouse in the West is more than 1.5 miles from a mapped primary or secondary road. All but two of the 317 occupied leks in Utah are within one mile of some type of road (Utah AGRC 2015; UDWR 2014). More than half, 55 percent, are within 0.5 mile of a road. Leks are more likely to be located near a local, neighborhood, rural and/or unpaved road than to be located near major federal, state or local highways and roads.

APPENDIX

Table 1.A1 expands on the summary provided in Table 1.1 by providing land areas by agency by owner for greater sage-grouse habitat. BLM and the Forest Service manage 57 percent of Utah by land area, including about half of its greater sage-grouse habitat, as measured by SGMAs, FWS current range and historical-only range. Four other agencies each manage more than 40,000 acres of FWS current range.

Table 1.A1
Greater Sage-Grouse Acres by Agency

		FWS CURRENT RANGE			HISTORICAL-ONLY RANGE			SGMAs		
Agency	**Total Acres**	**Acres**	**Share of Agency**	**Share of Habitat**	**Acres**	**Share of Agency**	**Share of Habitat**	**Acres**	**Share of Agency**	**Share of Habitat**
Federal										
Bureau of Land Management	22,788,435	3,771,001	16.5%	36.2%	4,649,894	20.4%	49.4%	2,816,295	12.4%	37.8%
U.S. Forest Service	8,179,304	1,413,584	17.3%	13.6%	515,284	6.3%	5.5%	1,271,286	15.5%	17.1%
National Park Service	2,096,643	57,037	2.7%	0.5%	5,906	0.3%	0.1%	57,036	2.7%	0.8%
Department of Defense	1,812,564	40,014	2.2%	0.4%	123,512	6.8%	1.3%	0	0.0%	0.0%
U.S. Fish and Wildlife Service	129,468	415	0.3%	0.0%	353	0.3%	0.0%	392	0.3%	0.01%
Bureau of Reclamation	4,739	2,960	62.4%	0.03%	1,020	21.5%	0.01%	1,751	36.9%	0.02%
State of Utah										
School and Institutional Trust Lands	3,401,980	838,315	24.6%	8.0%	674,073	19.8%	7.2%	539,782	15.9%	7.2%
Department of Natural Resources	2,027,739	231,718	11.4%	2.2%	112,503	5.5%	1.2%	171,684	8.5%	2.3%
Department of Transportation	2,609	66	2.5%	0.0%	418	16.0%	0,0%	66	2.5%	0.0%
Private lands	11,423,249	3,515,130	30.8%	33.7%	3,088,292	27.0%	32.8%	2,564,015	22.4%	34.4%
Tribal lands	2,448,628	555,385	22.7%	5.3%	244,414	10.0%	2.6%	31,970	1.3%	0.4%
Total	**54,316,036**	**10,425,625**	**19.2%**	**100%**	**9,415,669**	**17.3%**	**100%**	**7,454,276**	**13.7%**	**100%**

Note: Land areas based on greater sage-grouse range not in cities, towns or unincorporated Census-designated places. Total of Total Acres includes some DOE and other state land without habitat.

Source: Jim Lindstrom, U.S. Fish and Wildlife Service, Wyoming Ecological Services; State of Utah, SGID.

2 OIL AND NATURAL GAS PRODUCTION

This section serves to summarize current and historical oil and natural gas activities within the three ranges defined for this study—FWS current range, that part of historical range not within FWS current range ("historical-only range"), and Sage Grouse Management Areas (SGMAs). Because all but an insignificant portion of SGMAs lies within FWS current range, activities are also summarized for that part of FWS current range not within SGMAs ("non-SGMA FWS current range"). Finally, activities are summarized for those areas of Utah not within any of these three ranges ("rest of Utah"). Thus, non-SGMA FWS current range, historical-only range, SGMAs, and rest of Utah constitute non-overlapping areas that, as a group, cover the entire state.[17]

The activities summarized include the annual counts of new oil and natural gas wells drilled since 1980, counts of major well works since 1980, counts of producing days since 1984, and annual volumes of oil and natural gas produced since 1984. The estimated market values, tax revenues, and royalty revenues generated by such activities is summarized for 2014. The number of persons employed by oil and natural gas industries is given for 1998–2013 for the entire state but not for the study areas, as such data were not available.

No claims are made regarding the extent to which the oil and natural gas activities presented in this chapter might be affected by state or federal policies regarding the greater sage-grouse.

2.1 METHODOLOGY

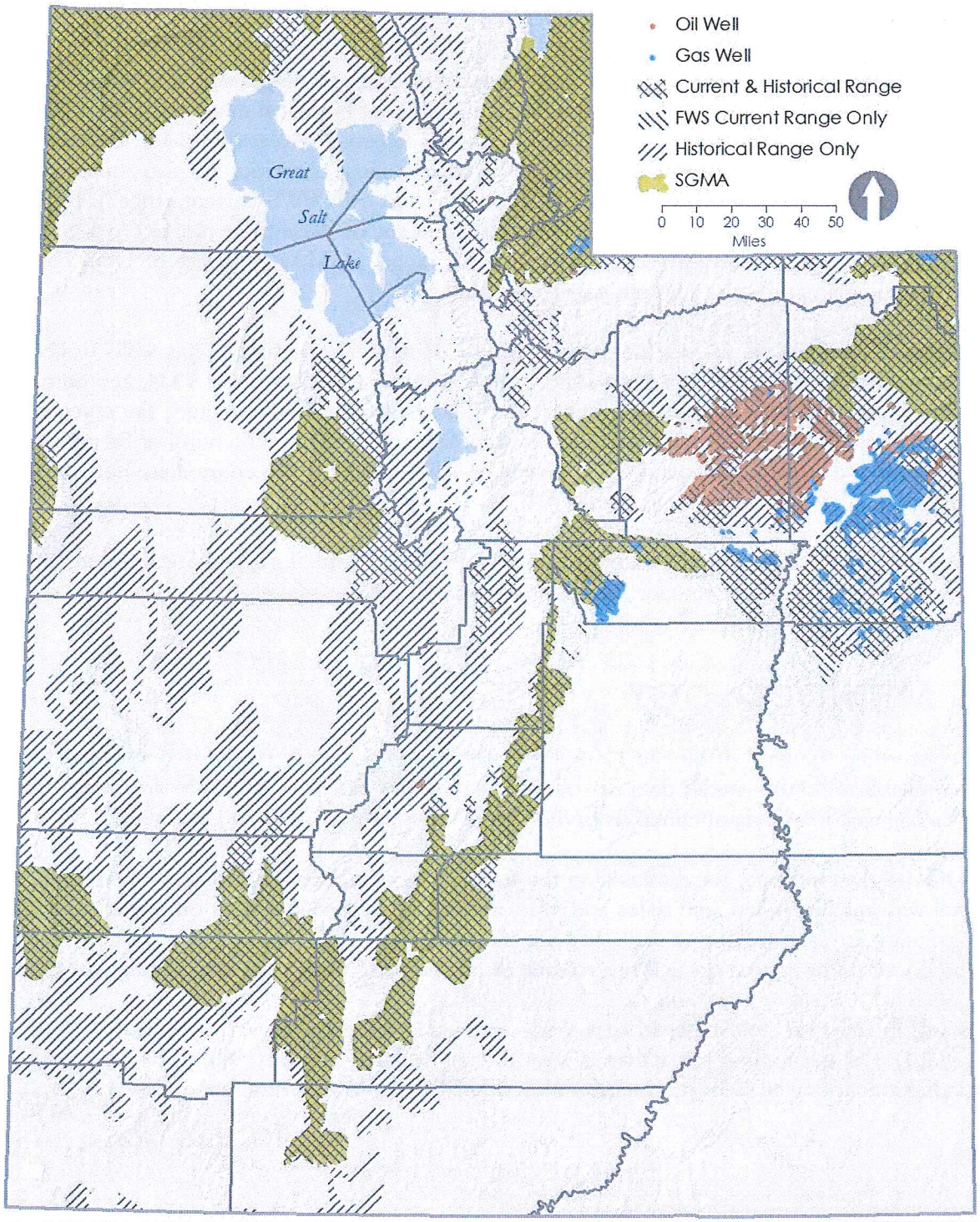
Data concerning the level of oil and natural gas activities in the study areas listed above are not directly available. For this study, data on oil and natural gas activities by study area were built by BEBR using well-level data obtained from the Utah Division of Oil, Gas and Mining (DOGM).

The DOGM data indicate, for each well in the state, the geographical coordinates of the well, when the well was initially drilled, and dates and types of well work subsequent to the initial drilling. The data specifies for each month of the well's life the number of days during that month in which the well produced oil or natural gas and the volume of oil and natural gas produced during that month.

Each well in the state was matched to a study area using the geographical coordinates of the well (Figure 2.1). Oil and natural gas activities were then aggregated by study area and by year (e.g. total oil production among all wells producing within non-SGMA FWS current range during 2014).

[17] Although a very small portion of SGMAs lies outside of FWS current range, no oil and gas activities occur on this portion.

Figure 2.1
Active, Producing and Drilled Oil and Gas Wells in Greater Sage-Grouse Range



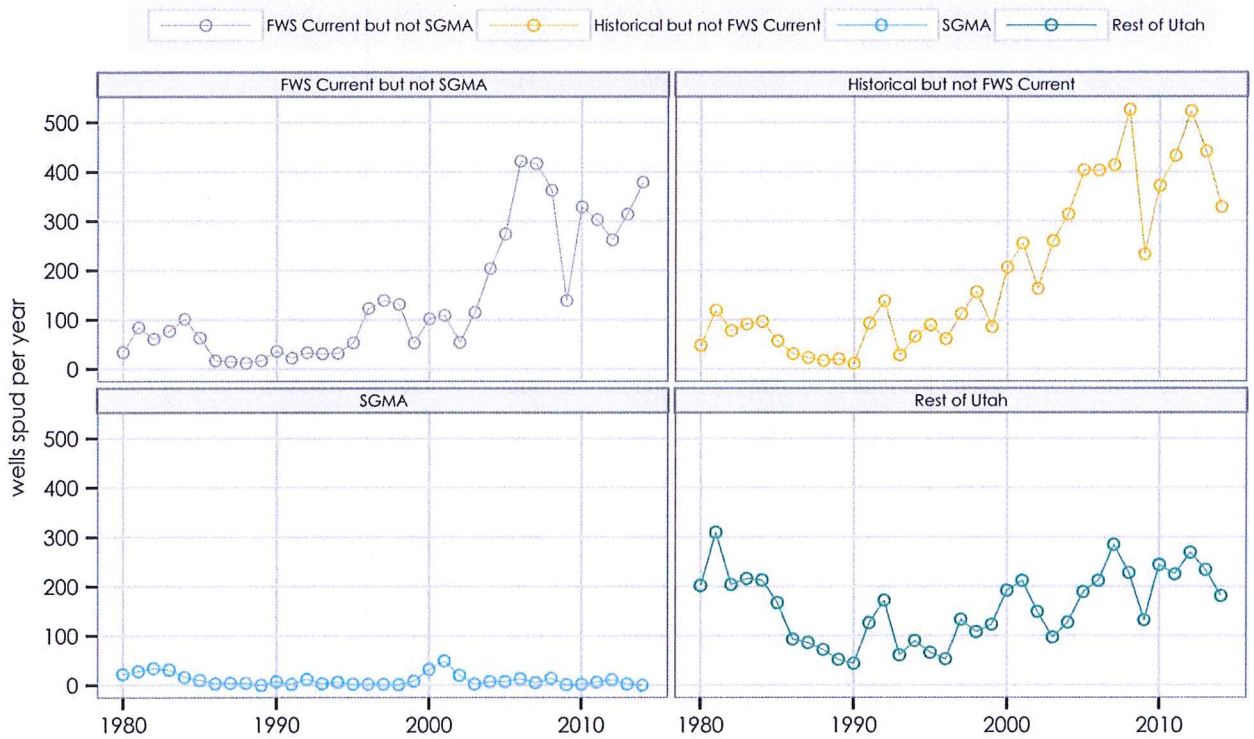
Source: USFWS; UDWR; Utah Division of Oil, Gas and Mining; State of Utah, SGID.

Map by John Downen, BEBR | April 2015

2.2 WELLS DRILLED

Figure 2.2 shows the number of oil and natural gas wells drilled during each year since 1980 by study area. One can see that the rate of drilling is similar between non-SGMA FWS current range and historical-only range, and that drilling rates within SGMAs are very low by comparison. Since SGMAs is a subset of FWS current range, and given the very low rates of drilling within SGMAs, the total of the wells drilled across the four areas is close to, but not quite equal to, the statewide count. The data graphed in Figure 2.2 are presented in Table 2.1.

Figure 2.2
Wells Drilled by Greater Sage-Grouse Range, 1980–2014



Source: BEBR analysis of data published by the Utah Division of Oil, Gas and Mining.

Table 2.1
Wells Drilled by Greater Sage-Grouse Range, 1980–2014

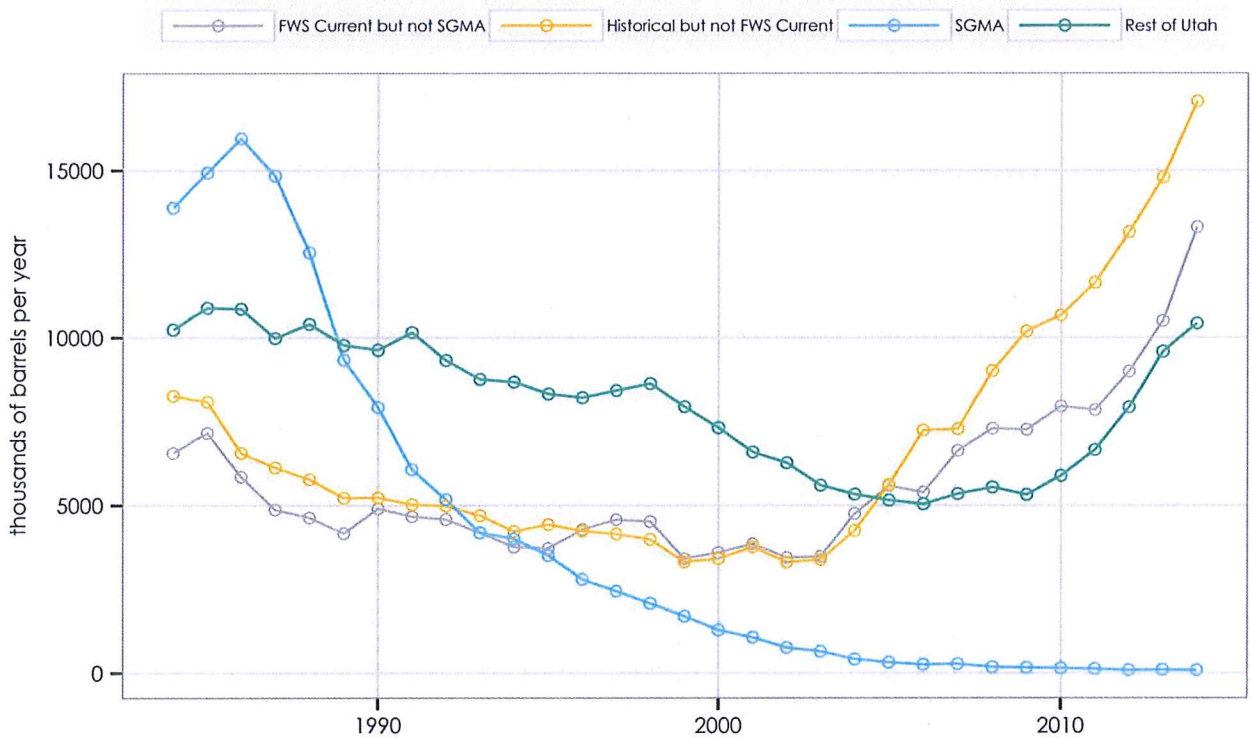
Year	FWS Current Range	SGMAs	FWS Current not SGMAs	Historical-only Range	Rest of Utah	Statewide
1980	56	22	34	47	201	304
1981	112	28	84	119	307	538
1982	95	34	61	78	201	374
1983	108	31	77	91	215	414
1984	117	16	101	95	212	424
1985	73	10	63	57	166	296
1986	20	3	17	31	92	143
1987	19	4	15	23	86	128
1988	16	4	12	17	72	105
1989	17	0	17	20	52	89
1990	43	7	36	11	44	98
1991	24	2	22	93	126	243
1992	45	12	33	138	172	355
1993	34	3	31	28	61	123
1994	38	6	32	66	90	194
1995	55	2	53	89	66	210
1996	125	2	123	61	53	239
1997	141	2	139	112	133	386
1998	132	1	131	156	108	396
1999	61	8	53	85	123	269
2000	134	32	102	206	192	532
2001	158	49	109	255	212	625
2002	74	20	54	163	149	386
2003	117	2	115	260	97	474
2004	211	7	204	314	127	652
2005	281	7	274	404	189	874
2006	435	13	422	403	212	1050
2007	422	5	417	414	285	1121
2008	377	14	363	526	228	1131
2009	140	1	139	233	132	505
2010	331	2	329	372	244	947
2011	309	6	303	433	225	967
2012	273	11	262	521	269	1063
2013	316	2	314	442	234	992
2014	378	0	378	330	181	889

Note: Statewide values are the sum of SGMAs, non-SGMA FWS current range, historical-only range, and rest of Utah, while FWS current range is, by definition, the sum of SGMAs and non-SGMA FWS current range.
Source: BEBR analysis of data from the Utah Division of Oil, Gas and Mining.

2.3 OIL PRODUCTION VOLUMES

Figure 2.3 shows, for each study area and each year since 1984, the volumes of oil production from wells located within that area. The data graphed in Figure 2.3 are presented in Table 2.2.

Figure 2.3
Oil Production by Greater Sage-Grouse Range, 1984–2014



Source: BEBR analysis of data published by the Utah Division of Oil, Gas and Mining.

One can see that while current rates of oil production from wells within SGMAs are almost insignificant on the scale of statewide production, during the 1980s more than one-third of all the oil produced in the state came from wells within SGMAs. Production from non-SGMA FWS current range and historical-only range have been and continue to be major components of statewide production.

Table 2.2
Oil Production by Greater Sage-Grouse Range, 1984–2014
(barrels)

Year	FWS Current Range	SGMAs	FWS Current not SGMAs	Historical-only Range	Rest of Utah	Statewide
1984	20,451,177	13,886,866	6,564,311	8,271,007	10,241,147	38,963,331
1985	22,095,573	14,934,126	7,161,447	8,092,505	10,891,793	41,079,871
1986	21,814,592	15,959,618	5,854,974	6,564,310	10,864,585	39,243,487
1987	19,712,177	14,837,919	4,874,258	6,131,490	9,984,869	35,828,536
1988	17,180,540	12,544,766	4,635,774	5,777,045	10,407,353	33,364,938
1989	13,508,061	9,344,106	4,163,955	5,219,851	9,776,163	28,504,075
1990	12,838,413	7,933,538	4,904,875	5,230,766	9,635,796	27,704,975
1991	10,740,953	6,074,178	4,666,775	5,028,382	10,158,304	25,927,639
1992	9,756,127	5,174,302	4,581,825	4,984,588	9,332,858	24,073,573
1993	8,363,553	4,185,602	4,177,951	4,697,159	8,765,274	21,825,986
1994	7,759,051	4,001,847	3,757,204	4,223,901	8,684,669	20,667,621
1995	7,219,312	3,502,262	3,717,050	4,427,748	8,328,588	19,975,648
1996	7,079,942	2,797,441	4,282,501	4,232,205	8,216,633	19,528,780
1997	7,015,648	2,444,884	4,570,764	4,146,151	8,430,749	19,592,548
1998	6,597,289	2,081,217	4,516,072	3,984,337	8,636,483	19,218,109
1999	5,104,291	1,697,776	3,406,515	3,309,857	7,947,604	16,361,752
2000	4,880,457	1,285,775	3,594,682	3,408,303	7,320,270	15,609,030
2001	4,916,931	1,067,530	3,849,401	3,760,057	6,591,875	15,268,863
2002	4,194,781	756,481	3,438,300	3,306,465	6,269,605	13,770,851
2003	4,116,790	646,046	3,470,744	3,382,834	5,597,713	13,097,337
2004	5,168,407	417,603	4,750,804	4,244,796	5,330,745	14,743,948
2005	5,905,443	319,302	5,586,141	5,617,503	5,153,231	16,676,177
2006	5,642,282	253,860	5,388,422	7,245,336	5,039,353	17,926,971
2007	6,907,394	271,543	6,635,851	7,283,273	5,344,639	19,535,306
2008	7,478,572	179,783	7,298,789	9,021,658	5,540,449	22,040,679
2009	7,425,661	162,769	7,262,892	10,196,699	5,319,852	22,942,212
2010	8,107,049	146,899	7,960,150	10,672,808	5,888,890	24,668,747
2011	7,976,354	123,878	7,852,476	11,647,416	6,660,948	26,284,718
2012	9,088,516	89,776	8,998,740	13,161,670	7,932,899	30,183,085
2013	10,603,580	101,057	10,502,523	14,794,569	9,588,366	34,986,515
2014	13,399,874	87,806	13,312,068	17,054,054	10,445,073	40,899,001

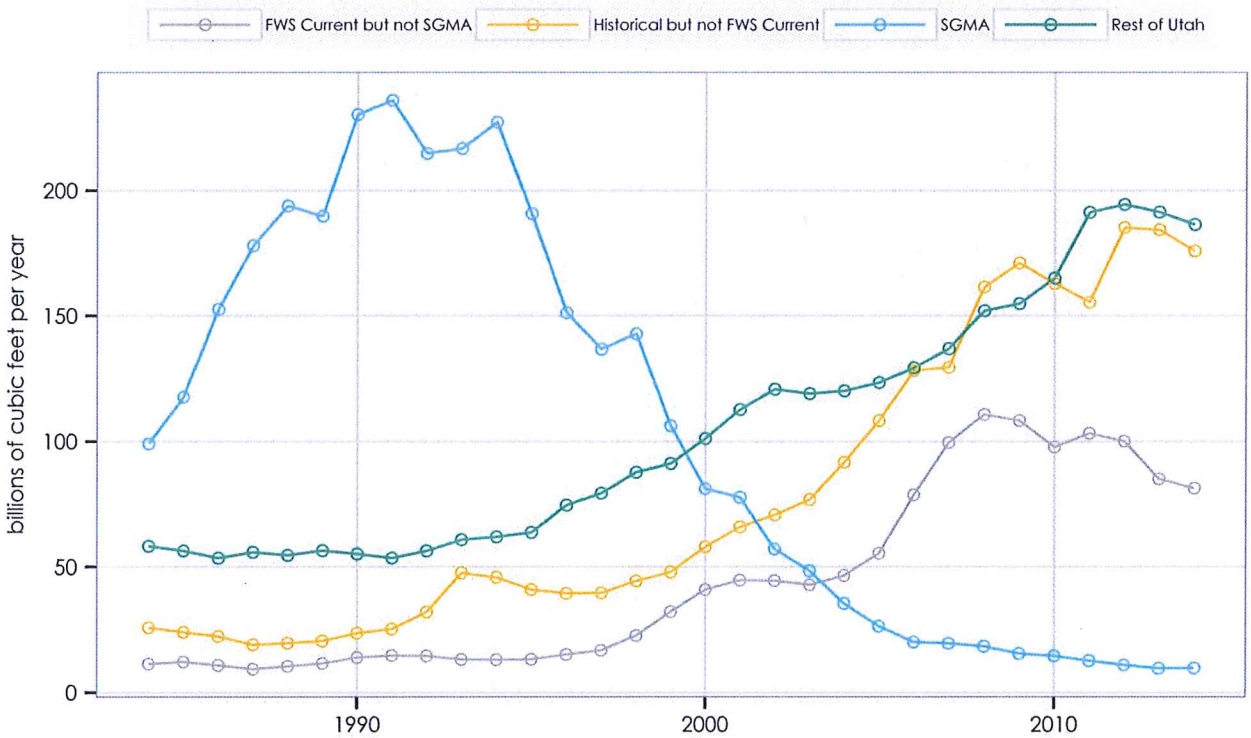
Note: Statewide values are the sum of SGMAs, non-SGMA FWS current range, historical-only range, and rest of Utah, while FWS current range is, by definition, the sum of SGMAs and non-SGMA FWS current range.

Source: BEBR analysis of data published by the Utah Division of Oil, Gas and Mining.

2.4 NATURAL GAS PRODUCTION VOLUMES

Figure 2.4 shows, for each study area and each year since 1984, the volumes of natural gas production from wells located within that area. The data graphed in Figure 2.4 are presented in Table 2.3.

Figure 2.4
Natural Gas Production by Greater Sage-Grouse Range, 1984–2014



Source: BEBR analysis of data published by the Utah Division of Oil, Gas and Mining.

As with oil production, the rate of natural gas production within SGMAs is now, but was not always, only a small portion—approximately 2 percent—of the statewide rate of production. Natural gas production within SGMAs peaked in the early 1990s, during which time such production constituted approximately two-thirds of all the natural gas produced in Utah.

As production from SGMAs has diminished, natural gas production from non-SGMA FWS current range and historical-only range have gradually increased as components of statewide production. In 1994, these two areas combined to account for 17 percent of statewide production, with more than 65 percent of statewide production coming from SGMAs. By 2004, SGMAs' share of statewide production had fallen to 12 percent and the combined shares of non-SGMA FWS current range and historical-only range had increased to 47 percent. In 2014, the shares were 2 percent and 57 percent, respectively.

Table 2.3
Natural Gas Production by Greater Sage-Grouse Range, 1984–2014
(thousands of cubic feet)

Year	FWS Current Range	SGMAs	FWS Current not SGMAs	Historical-only Range	Rest of Utah	Statewide
1984	110,391,261	99,024,729	11,366,532	25,858,934	58,195,642	194,445,837
1985	129,878,095	117,699,394	12,178,701	24,065,376	56,323,316	210,266,787
1986	163,461,350	152,631,907	10,829,443	22,378,625	53,419,310	239,259,285
1987	187,276,728	177,959,890	9,316,838	19,027,363	55,780,336	262,084,427
1988	204,294,665	193,833,929	10,460,736	19,702,357	54,581,391	278,578,413
1989	201,333,349	189,739,230	11,594,119	20,559,912	56,427,779	278,321,040
1990	244,233,523	230,293,859	13,939,664	23,701,733	55,091,574	323,026,830
1991	250,702,402	235,981,914	14,720,488	25,308,119	53,453,807	329,464,328
1992	229,391,042	214,820,719	14,570,323	32,068,434	56,303,612	317,763,088
1993	229,867,000	216,736,006	13,130,994	47,636,292	60,772,716	338,276,008
1994	240,343,175	227,290,902	13,052,273	45,910,221	61,886,408	348,139,804
1995	203,985,664	190,770,850	13,214,814	41,032,707	63,676,280	308,694,651
1996	166,356,490	151,216,115	15,140,375	39,542,162	74,540,299	280,438,951
1997	153,525,470	136,719,900	16,805,570	39,725,887	79,302,417	272,553,774
1998	165,413,012	142,755,260	22,657,752	44,458,174	87,632,060	297,503,246
1999	138,379,457	106,206,950	32,172,507	47,973,136	91,141,719	277,494,312
2000	122,108,599	81,116,084	40,992,515	57,961,508	101,099,909	281,170,016
2001	122,411,698	77,655,582	44,756,116	65,879,459	112,670,166	300,961,323
2002	101,561,994	57,000,879	44,561,115	70,703,173	120,764,912	293,030,079
2003	91,306,445	48,419,533	42,886,912	76,791,782	119,043,011	287,141,238
2004	82,034,429	35,476,283	46,558,146	91,670,527	120,125,904	293,830,860
2005	81,777,526	26,415,567	55,361,959	108,269,280	123,448,235	313,495,041
2006	98,761,154	20,100,762	78,660,392	128,236,958	129,340,833	356,338,945
2007	119,095,402	19,564,470	99,530,932	129,505,889	136,915,887	385,517,178
2008	129,094,657	18,379,483	110,715,174	161,451,476	151,978,202	442,524,335
2009	123,851,011	15,536,694	108,314,317	171,036,433	154,841,603	449,729,047
2010	112,248,453	14,527,605	97,720,848	162,908,162	164,997,342	440,153,957
2011	115,907,252	12,692,106	103,215,146	155,400,662	191,272,142	462,580,056
2012	111,062,975	10,949,391	100,113,584	185,351,440	194,421,562	490,835,977
2013	94,795,796	9,609,211	85,186,585	184,726,135	191,368,002	470,889,933
2014	91,031,405	9,735,567	81,295,838	175,808,392	186,365,036	453,204,833

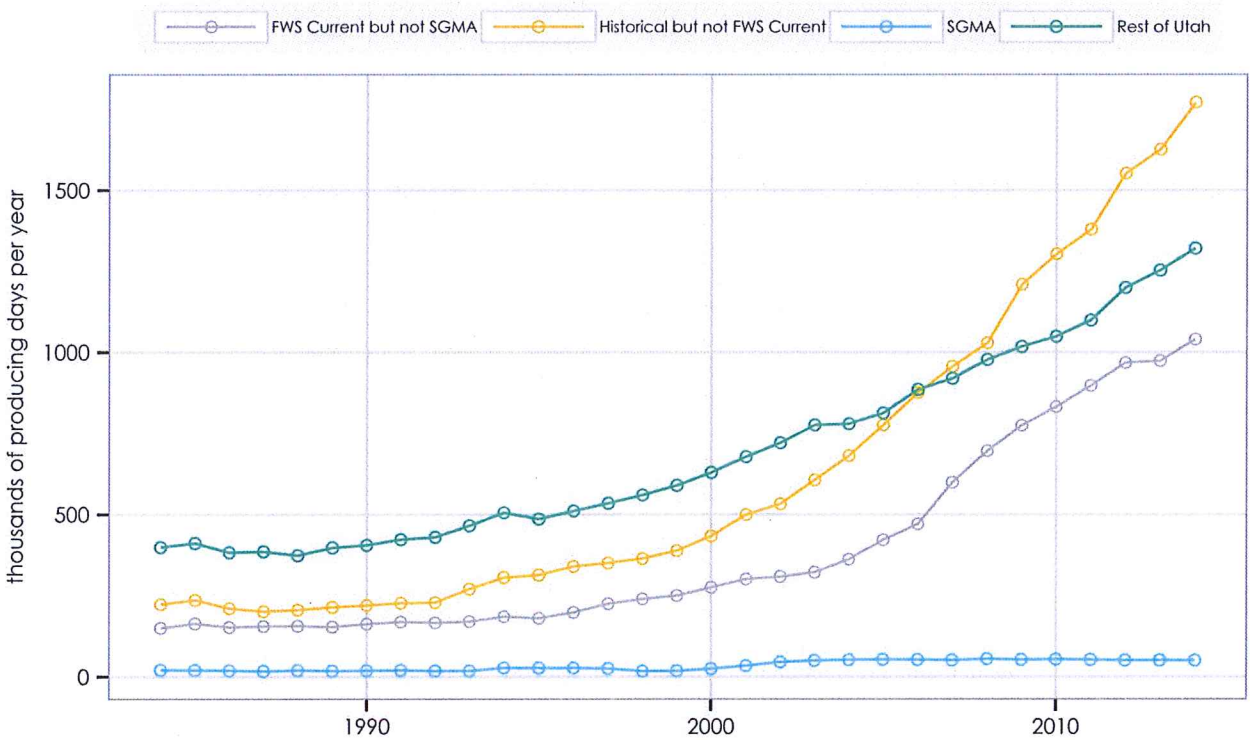
Note: Statewide values are the sum of SGMAs, non-SGMA FWS current range, historical-only range, and rest of Utah, while FWS current range is, by definition, the sum of SGMAs and non-SGMA FWS current range.

Source: BEBR analysis of data published by the Utah Division of Oil, Gas and Mining.

2.5 PRODUCING DAYS

Figure 2.5 shows, for each study area and each year since 1984, the producing days for that area and year, where producing days is the sum of the number of days all the wells in a given area, during a given year, produced oil or natural gas. The data graphed in Figure 2.5 are presented in Table 2.4.

Figure 2.5
Producing Days by Greater Sage-Grouse Range, 1984–2014



Source: BEBR analysis of data published by the Utah Division of Oil, Gas and Mining.

The number of producing days, considered alongside the oil and natural production rates shown above for SGMAs during the 1980s and 1990s, signal that very large volumes of oil and natural gas, and large shares of statewide oil and natural gas production, came from a small number of highly productive wells. In 1984, for example, 36 percent of all the oil and 51 percent of all the natural gas produced in Utah were produced from within SGMAs, whose share in statewide producing days was less than 3 percent.

Table 2.4
Producing Days by Greater Sage-Grouse Range, 1984–2014

Year	FWS Current Range	SGMAs	FWS Current not SGMAs	Historical-only Range	Rest of Utah	Statewide
1984	170,863	20,556	150,307	223,621	398,468	792,952
1985	184,180	20,238	163,942	236,739	410,812	831,731
1986	171,708	18,905	152,803	211,077	382,251	765,036
1987	172,637	16,989	155,648	201,513	384,895	759,045
1988	176,102	19,613	156,489	206,325	373,013	755,440
1989	171,437	17,755	153,682	214,727	396,953	783,117
1990	181,589	18,748	162,841	220,404	404,778	806,771
1991	189,407	20,051	169,356	227,435	422,312	839,154
1992	184,581	18,053	166,528	229,121	429,187	842,889
1993	188,451	18,041	170,410	270,793	464,927	924,171
1994	212,625	27,106	185,519	306,205	505,074	1,023,904
1995	207,435	26,739	180,696	313,663	485,484	1,006,582
1996	225,284	26,778	198,506	339,319	510,410	1,075,013
1997	250,344	25,275	225,069	350,029	534,020	1,134,393
1998	257,134	17,227	239,907	363,802	559,637	1,180,573
1999	268,222	17,944	250,278	388,228	589,148	1,245,598
2000	300,385	24,854	275,531	433,221	629,151	1,362,757
2001	335,153	33,986	301,167	499,365	677,956	1,512,474
2002	353,711	45,030	308,681	532,300	720,661	1,606,672
2003	371,171	49,699	321,472	606,483	775,768	1,753,422
2004	413,744	52,313	361,431	681,191	779,465	1,874,400
2005	474,561	53,142	421,419	776,091	812,852	2,063,504
2006	522,678	52,429	470,249	876,146	885,468	2,284,292
2007	650,043	51,215	598,828	956,567	919,692	2,526,302
2008	751,035	54,939	696,096	1,028,616	977,706	2,757,357
2009	827,315	52,719	774,596	1,209,299	1,017,143	3,053,757
2010	886,126	53,829	832,297	1,302,954	1,048,379	3,237,459
2011	950,491	52,803	897,688	1,379,233	1,098,530	3,428,254
2012	1,018,984	50,659	968,325	1,552,588	1,198,944	3,770,516
2013	1,024,634	50,721	973,913	1,626,139	1,252,636	3,903,409
2014	1,090,134	50,670	1,039,464	1,771,351	1,320,628	4,182,113

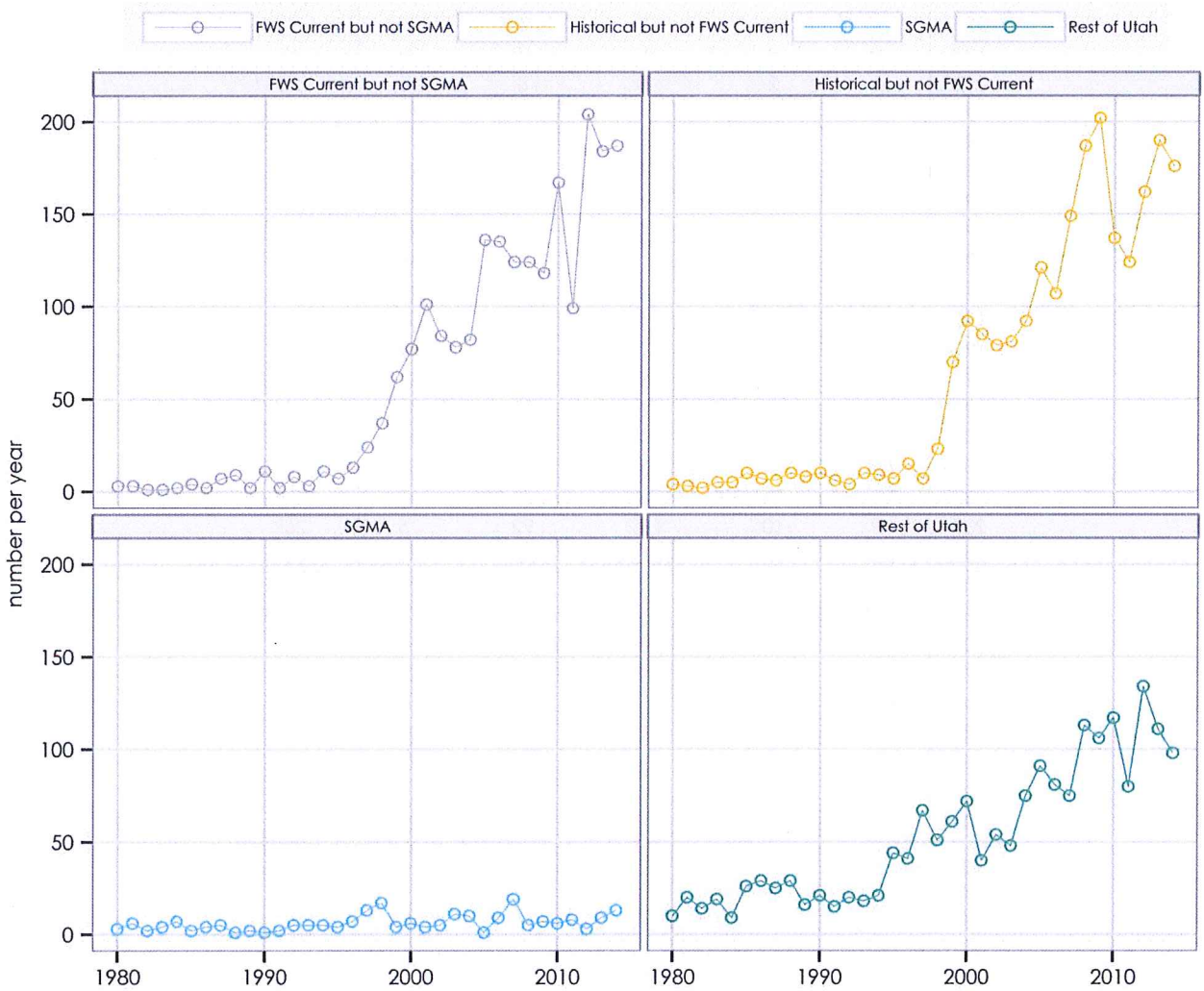
Note: Statewide values are the sum of SGMAs, non-SGMA FWS current range, historical-only range, and rest of Utah, while FWS current range is, by definition, the sum of SGMAs and non-SGMA FWS current range.

Source: BEBR analysis of data published by the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis.

2.6 SUBSEQUENT WORK

Figure 2.6 shows, for each study area, the number of subsequent well work events for each year since 1980. Subsequent well work events include operations meant to restore or enhance the productivity of the well, and the plugging and permanent abandonment of the well. The data graphed in Figure 2.6 are presented in Table 2.5.

Figure 2.6
Subsequent Work by Greater Sage-Grouse Range, 1980–2014



Source: BEBR analysis of data published by the Utah Division of Oil, Gas and Mining.

On a per-event basis, subsequent well work events are generally less expensive and shorter in duration than the initial drilling of the well. Where these events may require a few days, the initial drilling generally requires a few weeks or even a few months, depending on well depth. Nevertheless, subsequent work events are an important indicator of oil and natural gas industry activity within an area. For example, although no oil or natural gas wells were drilled within SGMAs during 2014, there were 12 subsequent work events, 9 of which were the plugging and abandonment of wells.

Table 2.5
Subsequent Work by Greater Sage-Grouse Range, 1980–2014

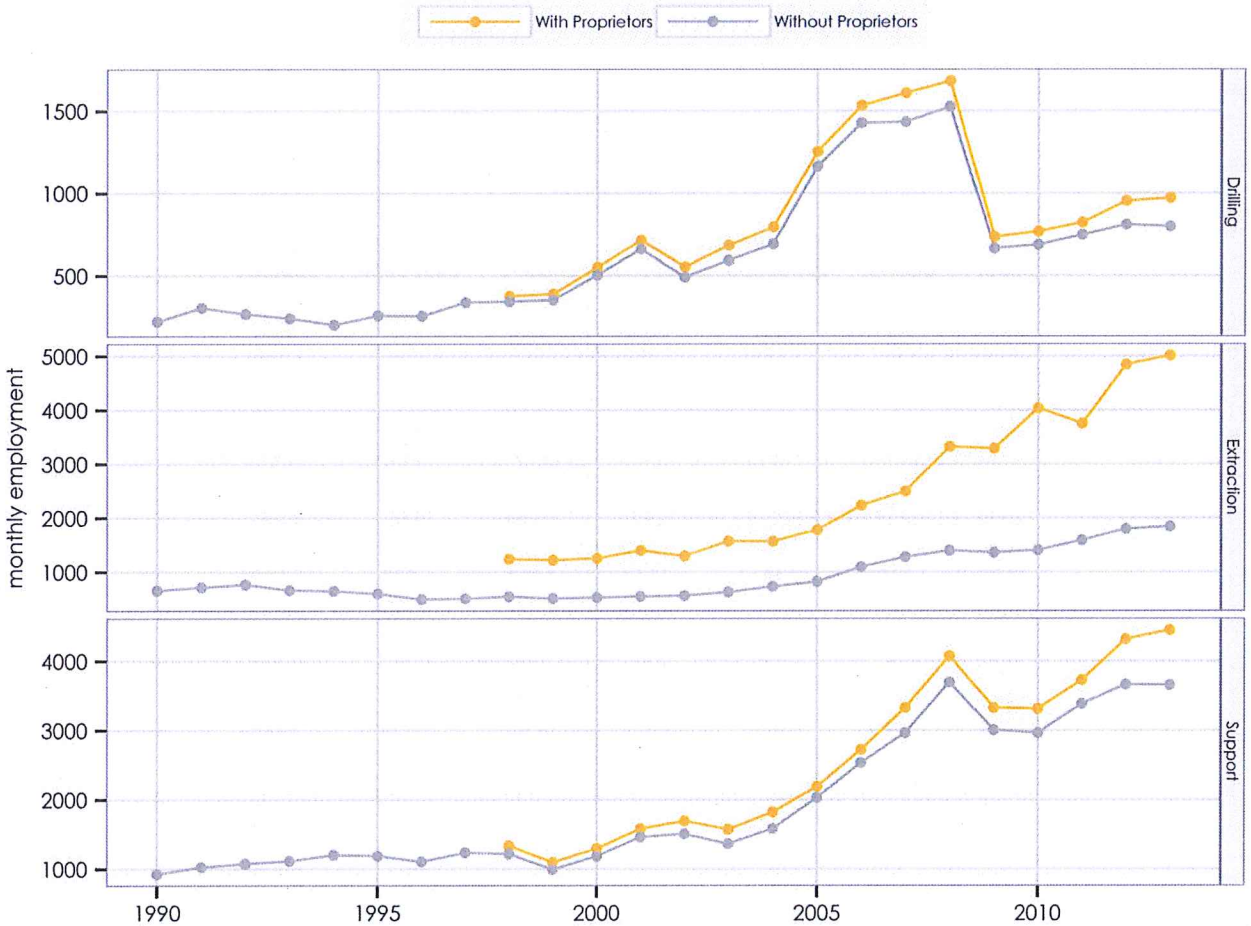
Year	FWS Current Range	SGMAs	FWS Current not SGMAs	Historical-only Range	Rest of Utah	Statewide
1980	6	3	3	4	10	20
1981	9	6	3	3	20	32
1982	3	2	1	2	14	19
1983	5	4	1	5	19	29
1984	9	7	2	5	9	23
1985	6	2	4	10	26	42
1986	6	4	2	7	29	42
1987	12	5	7	6	25	43
1988	10	1	9	10	29	49
1989	4	2	2	8	16	28
1990	12	1	11	10	21	43
1991	4	2	2	6	15	25
1992	12	5	7	4	20	36
1993	8	5	3	10	18	36
1994	16	5	11	9	21	46
1995	11	4	7	7	44	62
1996	20	7	13	15	41	76
1997	37	13	24	7	67	111
1998	54	17	37	23	51	128
1999	66	4	62	70	61	197
2000	83	6	77	92	72	247
2001	105	4	101	85	40	230
2002	89	5	84	79	54	222
2003	89	11	78	81	48	218
2004	92	10	82	92	75	259
2005	137	1	136	121	91	349
2006	144	9	135	107	81	332
2007	143	19	124	149	75	367
2008	129	5	124	187	113	429
2009	125	7	118	202	106	433
2010	173	6	167	136	117	426
2011	107	8	99	124	80	311
2012	207	3	204	162	134	503
2013	192	9	183	190	111	493
2014	200	12	188	175	96	471

Note: Statewide values are the sum of SGMAs, non-SGMA FWS current range, historical-only range, and rest of Utah, while FWS current range is, by definition, the sum of SGMAs and non-SGMA FWS current range.
Source: BEBR analysis of data published by the Utah Division of Oil, Gas and Mining.

2.7 EMPLOYMENT

Figure 2.7 shows historical employment statewide within three oil and natural gas industry sectors. The employment counts refer to average monthly employment by place of work—in this case, Utah. Within each industry, employment counts are given for two measures of employment. The first measure is from the Quarterly Census of Employment and Wages (QCEW), published by the U.S. Bureau of Labor Statistics (BLS), and does not include proprietors. The QCEW series provides detailed employment counts by industry by month, quarter and year, where the geographical place that bears the counts is the place where the employment occurs, rather than the place where the employee lives.

Figure 2.7
Statewide Employment in Oil and Natural Gas Sectors, 1990–2013



Source: BEBR analysis of data published by the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis.

A disadvantage of the QCEW measure is that it does not include sole proprietors or certain partners. Since in the oil and natural gas industries sole proprietors appear to be a significant component of the workforce, QCEW data may significantly underestimate employment for these sectors.

The second measure is derived from the QCEW series by adding to the QCEW employment counts the product of the QCEW counts and an estimate of proprietor employment as a fraction of QCEW employment. This estimate is based on a different employment data series, which is published by the U.S. Bureau of Economic Analysis (BEA). This data series includes proprietors and partners not assumed to be limited partners but lacks the industry and time detail of the QCEW data, being available only annually and only for more highly aggregated sectors. The QCEW drilling and support sectors fall within the same single BEA sector, for example. For each QCEW sector, and for each year, the QCEW counts are aggregated to the finest level of industry detail available from the BEA counts. The ratio of BEA counts to QCEW counts is then computed and applied to the QCEW counts at the original level of detail.

Figure 2.7 shows both the original QCEW counts over time for each of the three sectors as well as the inflated QCEW counts ("with proprietors") for the years 1990/1998–2013.[18] Table 2.6 shows the data used in Figure 2.7 for the years 1998–2013.

Table 2.6
Statewide Employment in Oil and Natural Gas Sectors, 1998–2013

	INCLUDING PROPRIETORS			EXCLUDING PROPRIETORS		
Year	Drilling	Extraction	Support	Drilling	Extraction	Support
1998	376	1,238	1,335	344	542	1,219
1999	389	1,221	1,096	353	511	994
2000	551	1,252	1,295	504	528	1,185
2001	714	1,399	1,580	661	547	1,461
2002	553	1,295	1,692	492	563	1,506
2003	684	1,570	1,572	593	628	1,363
2004	795	1,568	1,820	691	730	1,581
2005	1,254	1,779	2,187	1,163	822	2,027
2006	1,534	2,232	2,722	1,427	1,096	2,532
2007	1,610	2,496	3,326	1,434	1,278	2,962
2008	1,683	3,319	4,072	1,527	1,398	3,695
2009	735	3,286	3,325	665	1,361	3,006
2010	767	4,034	3,311	687	1,406	2,965
2011	822	3,751	3,726	747	1,590	3,383
2012	953	4,844	4,317	809	1,800	3,663
2013	971	5,011	4,448	798	1,842	3,656

Source: BEBR analysis of data published by the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis.

2.8 ECONOMIC CONTRIBUTIONS

In 2014 3,200 wells produced oil and gas in FWS current greater sage-grouse range; there were 5,042 producing wells in historical-only range; and 143 wells produced oil and gas in state SGMAs. There were also 378 new wells drilled (spuds) in FWS current range and 330 spuds in historical-only range. As noted above, no new wells were drilled in SGMAs (Table 2.1).

We estimated the direct employment and earnings associated with oil and gas extraction in sage-grouse range based on the ratio of total producing days of oil and gas wells in 2013 to total employment[19] in the oil and gas extraction sector. We estimated direct employment and earnings in drilling oil and gas wells in sage-grouse range based on the ratio of total new wells drilled in 2013 to total employment[20] in the drilling oil and gas wells sector. Note that this produces a conservative estimate since it does not account for other drilling activities such as reworking and reconditioning wells. Oil

[18] At the time of this study BEA data were available only for the years 1998–2013. The QCEW data were available for the years 1990–2013. Figure 2.7 shows "without proprietor" counts for the full range 1990–2013 since those are QCEW employment counts, but "with proprietors" only for the range 1998–2013 since those are based on the BEA employment counts.

[19] This was BEA's measurement of employment, which includes sole proprietors and partners not assumed to be limited partners.

[20] This used BLS's measure of employment, which counts only those covered by state unemployment insurance programs and, as such, excludes sole proprietors and partners. However, we adjusted this amount upward based on the ratio of BEA employment to BLS employment (1.217) in the parent sector, support activities for mining.

and gas extraction and drilling combined provided an estimated 1,769, 2,597 and 65 direct jobs—from activity in FWS current range, historical-only range and SGMAs, respectively—with estimated direct earnings of $173.3 million, $258.0 million and $6.6 million (Table 2.7). These jobs and earnings supported an additional 3,839, 5,618 and 140 jobs (due to activity in FWS current sage-grouse range, historical-only range and SGMAs, respectively) with associated earnings of $267.7 million, $402.5 million and $10.4 million. These additional impacts were in the firms that supply inputs to the oil and gas sector and that sell goods and services to the employees of oil and gas companies and their suppliers. Thus, the estimated total economic contribution of oil and gas activity in greater sage-grouse range in 2014 was 5,608 jobs with $440.9 million in earnings from FWS current range, 8,215 jobs with $660.5 million in earnings from historical-only range, and 205 jobs with $17.0 million in earnings from SGMAs. The estimated total value-added or gross state product contributions from activity in these three range types were $1,688.5 million, $2,342.0 million and $46.2 million, respectively.

Table 2.7
Estimated Economic Contributions of Oil and Gas Activity in Greater Sage-Grouse Range, 2014
(Dollar amounts in millions)

	Producing and New	DIRECT			INDIRECT & INDUCED			TOTAL CONTRIBUTIONS		
Range Type	Wells	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added
FWS Current Range	3,578	1,769	$173.3	$1,075.4	3,839	$267.7	$613.1	5,608	$440.9	$1,688.5
Historical-only Range	5,372	2,597	$258.0	$1,486.8	5,618	$402.5	$855.2	8,215	$660.5	$2,342.0
SGMAs	143	65	$6.6	$29.2	140	$10.4	$17.0	205	$17.0	$46.2

Source: BEBR analysis of BEA, BLS and DOGM data using BEA's RIMS II multipliers.

Note that in Uintah County, where much of the oil and gas activity in FWS current and historical range occurs, about 5 percent of the total workers in the county live out-of-state. If all of these workers are employed in the mining sector, they account for roughly 23 percent of total mining employment (the lion's share of which is oil and gas–related). Although these workers' homes are in other states, most of them probably live in Uintah County most of the time and return home only occasionally. Thus, while they no doubt send some of their earnings out-of-state, they also spend a portion of them on food, lodging, fuel and possibly entertainment and other retail purchases within the state. Therefore, the estimated earnings shown in Tables 2.7 through 2.9, and the resulting fiscal impacts in Table 2.11, may be slightly overstated.

Tables 2.8 and 2.9 show the economic contributions from the component sectors of the oil and gas industry: oil and gas extraction (Table 2.8) and drilling oil and gas wells (Table 2.9). Although there were no new wells drilled in SGMAs in 2014, there were 12 instances of "subsequent work" performed on the existing wells (Table 2.5, above), which provided a small amount of employment and earnings.

Table 2.8
Estimated Economic Contributions of Oil and Gas Extraction in Greater Sage-Grouse Areas, 2014
(Dollar amounts in millions)

		DIRECT			INDIRECT & INDUCED			TOTAL CONTRIBUTIONS		
Range Type	Producing Wells[1]	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added
FWS Current Range	3,200	1,399	$142.0	$1,000.0	3,015	$224.5	$583.9	4,415	$366.5	$1,584.0
Historical-only Range	5,042	2,274	$230.7	$1,421.0	4,899	$364.7	$829.7	7,173	$595.5	$2,250.7
SGMAs	143	65	$6.6	$29.2	140	$10.4	$17.0	205	$17.0	$46.2

1. Average number of producing wells per month.
Source: BEBR analysis of BEA and DOGM data using BEA's RIMS II multipliers.

Table 2.9
Estimated Economic Contributions of Drilling Oil and Gas Wells in Greater Sage-Grouse Areas, 2014
(Dollar amounts in millions)

		DIRECT			INDIRECT & INDUCED			TOTAL CONTRIBUTIONS		
Range Type	Wells Spudded	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added
FWS Current Range	378	370	$31.2	$75.4	824	$43.2	$29.2	1,194	$74.4	$104.6
Historical-only Range	330	323	$27.3	$65.8	719	$37.7	$25.5	1,042	$65.0	$91.3

Source: BEBR analysis of BLS and DOGM data using BEA's RIMS II multipliers.

2.9 FISCAL CONTRIBUTIONS

Table 2.10 shows estimates of the market value of oil and natural gas production, along with estimates of the various taxes and royalty payments tied to oil and natural gas production, for FWS current range, historical-only range, and SGMAs, during calendar year 2014. The production values are computed from production volumes and estimated market prices for oil and natural gas. Severance taxes, conservation fees, property taxes and sales taxes are each estimated by applying an appropriate effective tax rate to the total value of production.[21] Since SGMAs are within FWS current range, the values across areas should only be added together if SGMAs are excluded.

Table 2.10
Estimated Production Values, Tax Revenues, and Royalty Revenues by Sage Grouse Range During Calendar Year 2014
(millions of 2014 dollars)

Range Type	Value of Production	Total Royalties	Severance Taxes	Conservation Fees	Property Taxes	Sales Taxes	State Royalties
FWS Current Range	$1,364.8	$200.6	$18.9	$1.3	$13.9	$2.5	$45.6
Historical-only Range	$1,953.2	$283.3	$27.1	$1.8	$19.9	$3.6	$73.8
SGMAs	$42.1	$6.3	$0.6	$0.04	$0.4	$0.08	$1.3

Note: "State Royalties" is the sum of royalties paid to SITLA and the state's share of federal mineral royalties.
Source: BEBR analysis based on data published by the Utah Division of Oil, Gas and Mining and the Utah State Tax Commission.

[21] Effective tax rates are computed for each tax by dividing that part of the total collections of the tax attributed to oil and natural gas production by the value of oil and natural gas production, yielding a ratio that indicates the amount of tax associated with each dollar of production value. For example, if tax collections during a fiscal year equal $50,000 while the total value of production during the fiscal year equals $1,000,000, then the effective rate of that tax is 5 percent.

It can be seen that during 2014 oil and natural gas production from wells located in historical-only range generated the greatest market value among the three areas, at just under $2 billion. Production within this area generated an estimated $283 million in royalty revenue to all lessors combined, with $74 million of that total received by the state,[22] plus almost $27 million in severance tax revenues, $1.8 million in conservation fees, $20 million in property taxes, and $3.6 million in sales taxes.

The differences in values between SGMAs and those of the other two ranges is striking. As noted above and shown below, although oil and natural gas production from wells within SGMAs was once a major component of total production statewide, production within SGMAs has been in decline since the late 1980s (oil)/mid-1990s (gas), with current production volumes only a very small fraction of their highs from the 1980s and 1990s. During 2014 the estimated value of production from wells within SGMAs was about $42 million, generating approximately $6.3 million in royalty revenues to all lessors combined, with $1.3 million of that total received by the state, $580,000 in state severance taxes, $40,000 in conservation fees, $430,000 in property taxes, and $80,000 in sales taxes.

In addition to the production-related fiscal impacts, there are earnings-related fiscal impacts. These consist of estimated state income tax and state and local sales tax revenues generated by the direct, indirect and induced earnings noted above in Tables 2.7 through 2.9. The total earnings-based fiscal impacts from oil and gas activity in FWS current greater sage-grouse range were an estimated $34.1 million in 2014, comprising $31.2 million in state income and sales tax revenues and $2.9 million in local sales tax revenues (Table 2.11). The revenues from activity in historical-only range amounted to an estimated $51.4 million, consisting of $46.7 million in state revenues and over $4.6 million in local revenues. In SGMAs, the only earnings were from oil and gas extraction. These earnings generated an estimated $1.2 million in state tax revenues and $121,000 in local revenues, for a total of $1.3 million. Table 2.11 also breaks out the revenues by activity: oil and gas extraction and drilling of oil and gas wells.

Table 2.11
Estimated Earnings-Related Fiscal Impacts of Oil and Gas Activity in Greater Sage-Grouse Range, 2014

Range Type	State	Local	Total
Total Oil and Gas Activity			
FWS Current Range	$31,201,000	$2,915,000	$34,116,000
Historical-only Range	$46,738,000	$4,655,000	$51,393,000
SGMAs	$1,205,000	$121,000	$1,326,000
Oil and Gas Extraction			
FWS Current Range	$25,933,000	$2,386,000	$28,319,000
Historical-only Range	$42,139,000	$4,193,000	$46,332,000
SGMAs	$1,205,000	$121,000	$1,326,000
Drilling of Oil and Gas Wells			
FWS Current Range	$5,268,000	$529,000	$5,797,000
Historical-only Range	$4,599,000	$462,000	$5,061,000

Source: BEBR analysis.

2.10 OIL SHALE

The oil shale in Utah's Uinta Basin may contain the equivalent of 1.3 trillion barrels of oil (Boden et al. 2014). However, given the difficulty of extracting oil from oil shale and the lack of any current commercial-scale production, Vanden Berg (2008) provided a more realistic estimate of the oil shale resource in the Basin. He constrained the total resource to deposits containing at least 25 gallons per ton, that are at least 5 feet thick and under less than 3,000 feet of cover, that do not directly conflict with current conventional oil and gas activity, and that are located on BLM, SITLA, private and tribal lands (Vanden Berg 2008, p. 10). This led to an estimate of 76.7 billion barrels of "potential economic" oil.

[22] The "total received by the state" is the sum of royalties collected by SITLA and the state's share—approximately one-half—of federal royalties

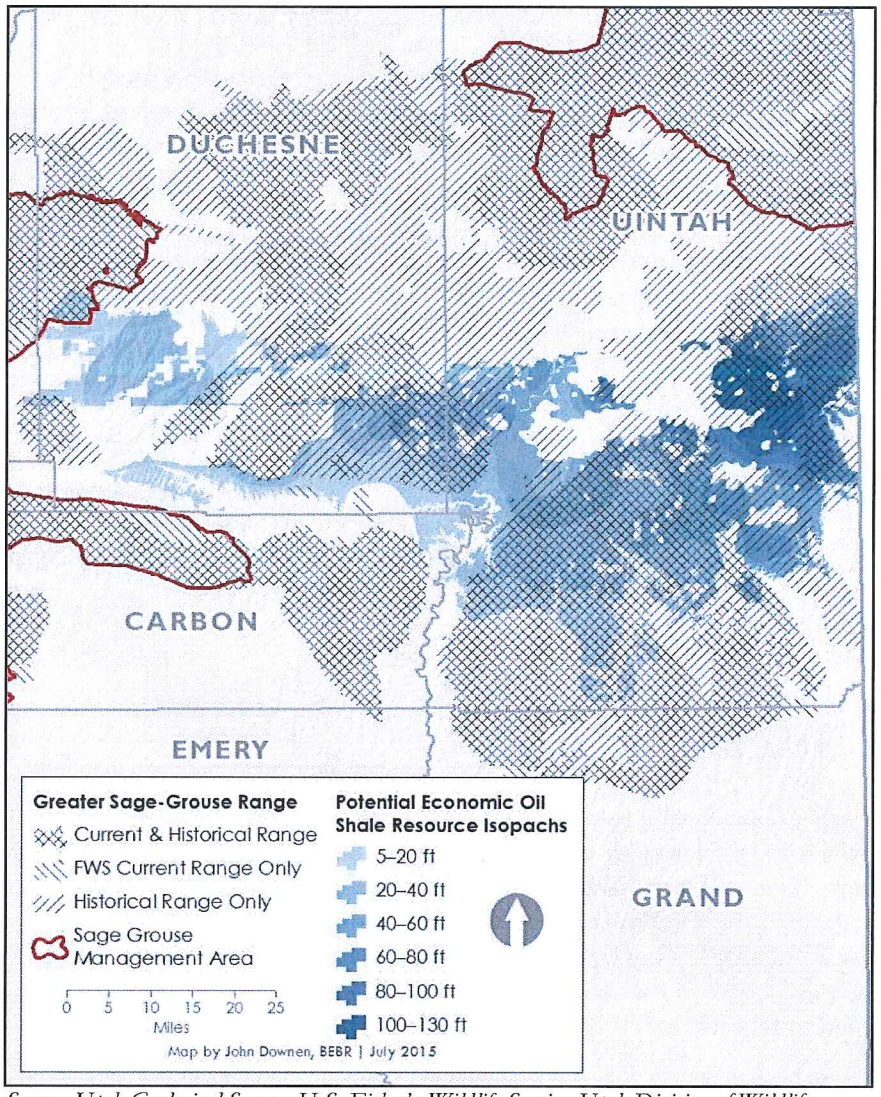
Table 2.12
Uinta Basin Potential Economic Oil Shale Resource by Greater Sage-Grouse Range
(billions of barrels)

Thickness	Total Resource	FWS Current Range	Historical-only Range	SGMAs
5–20 ft	5.3	2.5	0.7	0.2
20–40 ft	18.2	10.1	2.7	0.0
40–60 ft	19.4	10.2	5.0	0.0
60–80 ft	11.6	3.4	4.7	0.0
80–100 ft	12.3	7.5	2.3	0.0
100–130 ft	9.9	4.1	4.0	0.0
Total	76.7	37.8	19.4	0.2

Source: BEBR analysis of data from Vanden Berg (2008) using range data from U.S. Fish and Wildlife Service and Utah Division of Wildlife Resources.

Based on Vanden Berg's (2008) barrels per isopach thickness interval, we estimated the potential economic oil shale resource under each type of greater sage-grouse range (Table 2.12 and Figure 2.8). Under FWS current range there are an estimated 37.8 billion barrels of potentially economic oil in oil shale, almost half of the total potential economic resource. Historical-only range could overlie another 19.4 billion barrels. Under SGMAs there are an estimated 0.2 billion barrels of potential economic oil from oil shale.

Figure 2.8
Utah's Potential Economic Oil Shale Resources and Greater Sage-Grouse Range



Source: Utah Geological Survey; U.S. Fish & Wildlife Service; Utah Division of Wildlife Resources; State of Utah, SGID.

3 Coal

There are three active coal mines located in FWS current sage-grouse range: Skyline in Carbon County, SUFCO in Sevier, and Coal Hollow in Kane (Figure 3.1). Together they produced almost 11.3 million tons of coal in 2014, with a value of nearly $372.9 million.[23] Based on mine-level employment data from the Mine Safety and Health Administration (MSHA) and wage data from the Bureau of Labor Statistics, these three mines provided 697 direct jobs with an estimated $55.8 million in earnings, and approximately $177.4 million in value added (akin to gross state product). This activity supported an additional 1,697 full- and part-time jobs with $76.2 million in earnings, and $255.9 million in value added. The estimated total economic contribution of coal mining in FWS current greater sage-grouse range consists of 2,394 jobs, $132.0 million in earnings, and $433.3 million in value added/gross state product. Estimated state and county fiscal impacts associated with these mines totaled $27.6 million in 2014, comprising $10.2 million in income and sales taxes, $13.9 million from the state share of federal royalties, and $3.5 million in property taxes (Table 3.1).

Table 3.1
Estimated Economic and Fiscal Effects of Coal Mining in FWS Current Greater Sage-Grouse Range, 2014
(Dollar amounts in millions)

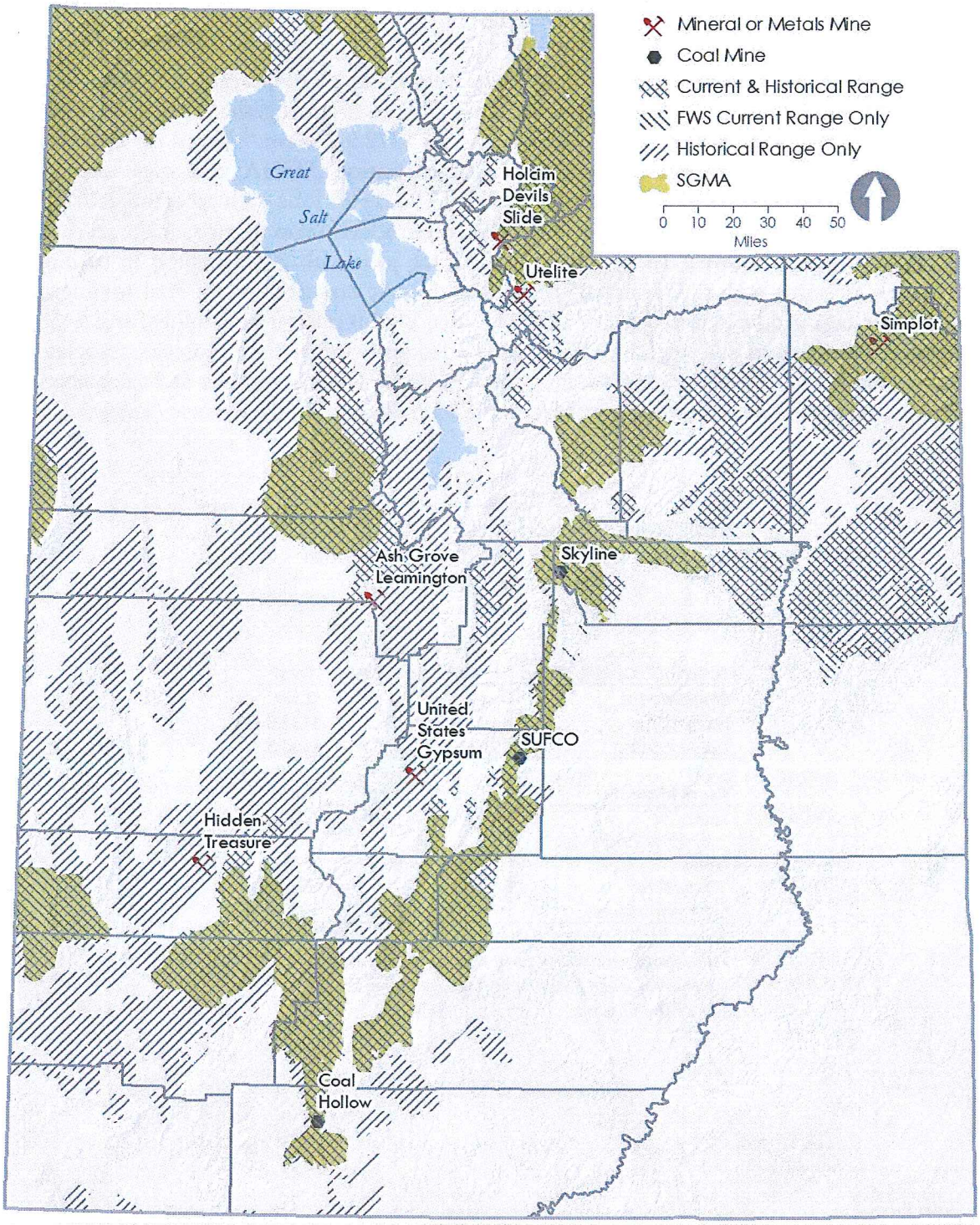
Economic Contributions	Direct	Indirect & Induced	Total
Employment	697	1,697	2,394
Earnings	$55.8	$76.2	$132.0
Value Added	$177.4	$255.9	$433.3

Fiscal Impacts	State	Local	Total
Total	$23.2	$4.3	$27.6
Income and Sales Taxes	$9.3	$0.9	$10.2
Royalties	$13.9		$13.9
Property Taxes		$3.5	$3.5

Source: BEBR analysis of data from Mine Safety and Health Administration, Department of Workforce Services, and Carbon, Kane and Sevier county treasurers using BEA's RIMS II multipliers.

[23] This is the volume of production times the "free on board" price, which is the price at the coal mine before the cost of insurance, freight and credit is added.

Figure 3.1
Mines in Greater Sage-Grouse Range



Source: USFWS; UDWR; Utah Geological Survey; State of Utah, SGID.

Map by John Downen, BEBR | April 2015

4 METALS AND INDUSTRIAL MINERALS

There are three industrial mineral mines in FWS current greater sage-grouse range producing phosphate (Simplot, in Uintah County), cement (Holcim Devil's Slide, in Morgan) and expanded shale (Utelite, in Summit) (Figure 3.1, above). According to UGS (Boden et al. 2014), in 2013 the Simplot mine produced 3.8 million tons of phosphate, which were processed into about 1.4 million tons of phosphate concentrate and transported via pipeline to Simplot's fertilizer plant in Wyoming. The Devil's Slide quarry and plant produced a portion of 1.0 million tons[24] of cement, and Utelite produced 129,000 tons of expanded shale. Simplot and Devil's Slide are also located in the state's SGMAs. In historical-only sage-grouse range there is the Ash Grove Leamington cement quarry and plant in Juab County; the Hidden Treasure copper, magnetite and silver mine in Beaver County; and the United States Gypsum mine in Sevier County. There was no production data available for the United States Gypsum mine, but Ash Grove Leamington produced a portion of 1.0 million tons[25] of cement in 2013 and Hidden Treasure produced approximately 3,000 tons of copper, 14,000 tons of magnetite and 247,000 ounces of silver.

Based on 2014 mine-level employment data from MSHA and 2013 wage data from the Bureau of Labor Statistics, we estimated the 2014 economic contributions of operations at the mines in greater sage-grouse range (Table 4.1). The industrial mineral mines in FWS current sage-grouse range provided 291 direct jobs with an estimated $14.8 million in earnings and contributed $39.4 million in value added. This activity supported an additional 641 jobs, $20.5 million in earnings, and $45.9 million in value added. The total economic contributions of industrial mineral mining in FWS current sage-grouse range in 2014 were 932 jobs, $35.3 million in earnings, and $85.3 million in value added/gross state product.

Table 4.1
Estimated Economic Contributions of Other Mining in Greater Sage-Grouse Range, 2014
(Dollar amounts in millions)

	DIRECT			INDIRECT & INDUCED			TOTAL CONTRIBUTIONS		
Range Type	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added
FWS Current Range	291	$14.8	$39.4	641	$20.5	$45.9	932	$35.3	$85.3
Historical-only Range	264	$13.4	$35.8	581	$18.6	$41.6	845	$32.0	$77.4
SGMAs	258	$13.1	$35.0	568	$18.1	$40.7	826	$31.3	$75.6

Source: BEBR analysis of data from Utah Geological Survey (shapefiles) and MSHA using BEA's RIMS II multipliers.

The metal and industrial mineral mines in historical-only sage-grouse range provided 264 direct jobs, $13.4 million in earnings, and $35.8 million in value added. Their operations supported an additional 581 jobs, $18.6 million in earnings, and $41.6 million in value added. The total economic contributions of metal and industrial mineral mining in historic-only sage-grouse range in 2014 amounted to 845 jobs, $32.0 million in earnings, and $77.4 million in value added/gross state product.

[24] According to Boden et al. (2014), "Together, Ash Grove Cement Co. and Holcim, Inc., produced more than one million [tons] of Portland cement in Utah during 2013" (p. 16).
[25] See previous note.

The industrial mineral mines in SGMAs provided 258 direct jobs, $13.1 million in earnings, and $35.0 million in value added. These activities supported an additional 568 jobs, $18.1 million in earnings, and $40.7 million in value added. The total economic contributions of industrial mineral mining in SGMAs in 2014 amounted to 826 jobs, $31.3 million in earnings, and $75.6 million in value added/gross state product.

In addition to the economic contributions of these mines, there are also local and state fiscal impacts (Table 4.2). These comprise estimated state income taxes and state and local sales taxes associated with the earnings discussed above, local property taxes on the mines and their facilities, and estimated state severance taxes based on the value of metalliferous minerals produced from the Hidden Treasure mine (in 2013). Metal and mineral mines in historical-only sage-grouse range produced the largest total fiscal impacts, with almost $2.5 million in revenues for the state and over $1.0 million in revenues to counties. The large county revenues were due mainly to property taxes paid by the Ash Grove Leamington cement quarry and plant and the Hidden Treasure mine. Mineral mines in FWS current sage-grouse range produced estimated fiscal impacts of $3.3 million in 2014, consisting of almost $2.5 million in state income and sales taxes and over $800,000 in local sales and property taxes. Activity at the two mines in SGMAs spurred estimated fiscal impacts of nearly $3.0 million: $2.2 million in state income and sales taxes and $778,000 in local sales and property taxes.

Table 4.2
Estimated Fiscal Impacts of Other Mining in Greater Sage-Grouse Range, 2014

Range Type	State	Local	Total
FWS Current Range	$2,495,000	$805,000	$3,300,000
Historical-only Range	$2,478,000	$1,043,000	$3,521,000
SGMAs	$2,212,000	$778,000	$2,990,000

Source: BEBR analysis, county treasurers of Beaver, Juab, Morgan, Sevier, Summit and Uintah counties.

5 Renewable Energy

There are currently two geothermal electrical generation plants located in greater sage-grouse range: Blundell in Beaver County is in FWS current sage-grouse range and Cove Fort in Millard County is in historical-only range (Figure 5.1). In 2014 Blundell generated 274,996 megawatt-hours (MWh) of electricity and Cove Fort generated 165,107 MWh according to data from the Energy Information Administration. There are also 44 wind turbines in FWS current range and 51 turbines in historical range. Most of the turbines in FWS current range are part of Phase 1 of the Milford Wind Corridor in Beaver County, with one at the Tooele Army Depot. Forty of the turbines in historical-only range are part of Phases 1 and 2 of the Milford Wind Corridor in Beaver and Millard counties, nine are at the Spanish Fork Wind Park, and two are are at Camp Williams. In 2014 a combined estimated 203,385 MWh of electricity were generated from turbines located in FWS current sage-grouse range and 189,878 MWh from turbines in historical-only range. (Note that this excludes generation by the three turbines on military bases, for which no data were available.)

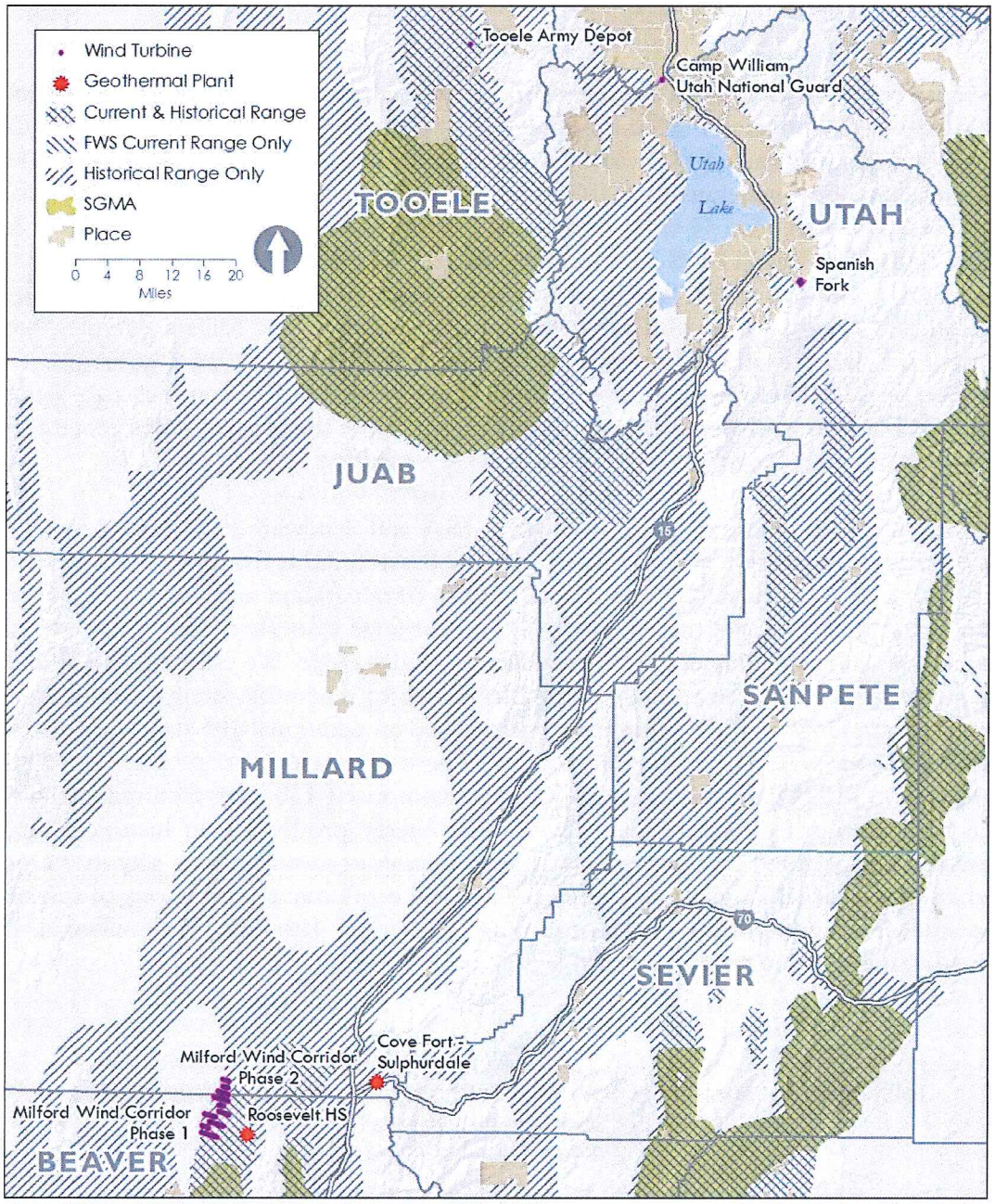
We used monthly total electricity generation from EIA and statewide employment in the electric power generation, transmission and distribution sector (NAICS 2211; from the Utah Department of Workforce Services) to calculate average jobs per MWh of generation and the average wage for the sector. We could then estimate the employment and earnings associated with electricity generated from geothermal and wind sources within greater sage-grouse range. We estimate a total of 33 direct jobs with almost $3.3 million in earnings were attributable to renewable energy production in FWS current sage-grouse range in 2014. This activity supported an additional 105 full- and part-time indirect and induced jobs with $3.6 million in earnings. The total economic contributions of renewable energy production in FWS current sage-grouse range comprised 138 jobs, $6.8 million in earnings, and $16.8 million in gross state product. Renewable energy production in historical sage-grouse range provided an estimated 25 direct jobs with $2.5 million in earnings. This activity supported an additional 78 jobs with $2.7 million in earnings. The total economic contributions of renewable energy production in historical-only sage-grouse range comprised 103 jobs, $5.1 million in earnings, and $12.5 million in gross state product (Table 5.1).

Table 5.1
Estimated Economic Contributions of Renewable Energy Generation in Greater Sage-Grouse Range, 2014
(Dollar amounts in millions)

	DIRECT			INDIRECT & INDUCED			TOTAL CONTRIBUTIONS		
Range Type	Jobs	Earnings	Value-Added*	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added
FWS Current Range	33	$3.3	$9.6	105	$3.6	$7.1	138	$6.8	$16.8
Historical-only Range	25	$2.5	$7.2	78	$2.7	$5.3	103	$5.1	$12.5

Source: BEBR analysis of data from the Energy Information Administration and Utah Department of Workforce Services using BEA's RIMS II multipliers.

Figure 5.1
Renewable Energy Generation in Greater Sage-Grouse Range



Source: USFWS; UDWR; USGS; US Census Bureau; State of Utah, SGID.

Map by John Downen, BEBR | April 2015

The state and local fiscal impacts associated with renewable energy generation in sage-grouse range consist of state income taxes and state and local sales taxes generated from the earnings contributions described above, and property taxes paid to the counties where the facilities are located. For the geothermal plant and windmills in FWS current

Table 5.2
Estimated Fiscal Impacts of Renewable Energy Generation in Greater Sage-Grouse Range, 2014

Range Type	State	Local	Total
FWS Current Range	$456,000	$2,163,000	$2,619,000
Historical-only Range	$361,000	$1,099,000	$1,460,000

Source: BEBR analysis and Beaver and Millard county treasurers.

sage-grouse range, the estimated fiscal impacts in 2014 consisted of $456,000 of state income and sales taxes and over $2.1 million in local property and sales taxes, for a total fiscal impact of approximately $2.6 million (Table 5.2). Geothermal and wind electricity generation in historical-only sage-grouse range in 2014 induced an estimated $361,000 in state income and sales tax revenues and nearly $1.1 million in local property and sales tax revenues, for a total fiscal impact of almost $1.5 million.

6 GRAZING

We conducted spatial analysis to estimate the amount of grazing activity that falls within historical and FWS current greater sage-grouse range and in Utah's SGMAs. We found the intersection of GSG ranges and federal grazing allotments, then calculated the share of each allotment that falls within GSG range. We obtained the number of active cattle and sheep animal unit months[26] (AUMs) for each allotment in the state from the BLM's Rangeland Administration System and from the Forest Service Region 4 office. We multiplied the number of BLM active cattle AUMs by 0.57 to reflect "authorized" AUMs over the 2000–2012 period, then further reduced them by 20 percent to account for authorized non-use.[27] Active Forest Service AUMs were reduced by 5 percent to account for authorized non-use. These "utilized" AUMs were then multiplied by the shares of each allotment in the different definitions of sage-grouse range to arrive at an estimate of the number of AUMs in each type of range: FWS current range, historical-only range and SGMAs (Table 6.1). For cattle, these AUMs were aggregated into three grazing regions (western, eastern and southern) and run through each region's cattle budget to estimate the associated revenues and expenditures and the resulting economic contributions of this livestock production. For sheep, we have just one budget for the whole state, which we used to estimate the revenues, expenditures and resulting economic contributions of the affected sheep operations.

Table 6.1
Utilized AUMs in Greater Sage-Grouse Range, 2014

	UTILIZED AUMs		SHARE	
Range Type	**Cattle**	**Sheep**	**Cattle**	**Sheep**
Total AUMs	902,431	220,581	100%	100%
FWS Current Range	231,311	49,438	25.6%	22.4%
Historical-only Range	135,942	45,956	15.1%	20.8%
SGMAs	203,728	37,847	22.6%	17.2%

Source: BEBR analysis of data from BLM, USFS, USFWS and Utah Division of Wildlife Resources.

From Table 6.1 we see that, at most, about one-quarter of all cattle and sheep AUMs are in any kind of sage-grouse range; in most cases the share is less. Just over one-quarter, 25.6 percent, of cattle AUMs are estimated to be in FWS current sage-grouse range; 22.4 percent of sheep AUMs are. Fifteen percent of cattle AUMs and 20.8 percent of sheep AUMs are in historical-only range. The state's SGMAs contain an estimated 22.6 percent of cattle AUMs and 17.2 percent of sheep AUMs.

Using livestock budgets developed by Utah State University Extension and data from the 2012 Census of Agriculture, we estimated cattle and sheep grazing on federal land in FWS current sage-grouse range in 2014 provided 475 direct jobs with $18.0 million in earnings and supported an additional indirect and induced 536 jobs with $16.6 million in earnings. In total, grazing in FWS current sage-grouse range supported an estimated 1,012 jobs, $34.6 million in earnings, and $52.9 million in gross state product/value added (Table 6.2). Livestock grazing in historical-only sage-grouse range provided an estimated 277 direct jobs with $9.7 million in earnings. This, in turn, supported an additional 287 jobs with $9.1 million in earnings, for a total economic contribution of 564 jobs, $18.8 million in earnings, and $28.3 million in gross state product. Finally, range livestock operations on federal allotments in the state's SGMAs provided an estimated 397 direct jobs with $14.3 million in earnings. This activity supported an additional indirect and induced 435 jobs with $13.6 million in earnings, providing a total economic contribution of 831 jobs, $27.9 million in earnings, and $42.3 million in gross state product.

[26] An animal unit month is the amount of forage needed to feed a cow and calf, a horse, or five sheep for one month.
[27] Shelley Smith, Deputy State Director Natural Resources, Bureau of Land Management. 2014. Personal Communication.

Table 6.2
Estimated Economic Contributions of Cattle and Sheep Grazing in Greater Sage-Grouse Range in Utah, 2014
(Dollar amounts in millions)

	DIRECT			INDIRECT & INDUCED			TOTAL CONTRIBUTIONS		
Range Type	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added	Jobs	Earnings	Value Added
FWS Current Range	475	$18.0	$18.1	536	$16.6	$34.7	1,012	$34.6	$52.9
Historical-only Range	277	$9.7	$9.8	287	$9.1	$18.5	564	$18.8	$28.3
SGMAs	397	$14.3	$14.3	435	$13.6	$28.0	831	$27.9	$42.3

Source: BEBR analysis of livestock budgets from Utah State University Extension Economics and habitat areas from USFWS and Utah Division of Wildlife Resources using BEA's RIMS II multipliers.

There are also state and local fiscal impacts associated with grazing in sage-grouse range (Table 6.3). The earnings contributions described above generate state income taxes and state and local sales tax revenues. The retail purchases required for the ranching operations also generate state and local sales tax revenues. In addition, a portion of the grazing fees paid to the BLM are returned to the state. Part of this revenue ($21,000) is paid to the Utah Cattlemen's Association for Public Lands Council dues and the remainder is disbursed to the state's six Taylor Grazing Act districts based on the number of authorized AUMs in each district. Grazing in FWS current range generated an estimated $2.7 million in state income and sales tax revenues and over $300,000 in local sales tax revenues and grazing fees, for a total fiscal impact of nearly $3.0 million. Estimated fiscal impacts from cattle and sheep grazing in historical-only range amounted to $1.6 million, consisting of approximately $1.4 million in state revenues and $178,000 in local revenues. Grazing in the state's SGMAs generated over $2.1 million in state tax revenues and $246,000 in local revenues, for a total estimated fiscal impact of nearly $2.4 million.

Table 6.3
Estimated Fiscal Impacts of Cattle and Sheep Grazing in Greater Sage-Grouse Range in Utah, 2014

Range Type	State	Local	Total
FWS Current Range	$2,656,000	$303,000	$2,959,000
Historical-only Range	$1,448,000	$178,000	$1,626,000
SGMAs	$2,148,000	$246,000	$2,394,000

Note: State fiscal impacts are income tax revenues and sales and gross receipts tax revenues. Local fiscal impacts are total general sales and use tax revenues and tourism restaurant tax revenues, plus BLM grazing fees distributed to grazing districts.
Source: BEBR analysis.

7 FARMING

A variety of crops are grown in FWS current and historical greater sage-grouse range and in state SGMAs. Crop acreages were calculated from the Utah Division of Water Resources' water-related land use GIS shapefiles. These are collected at the field level for the state's 12 hydrologic regions, and are updated on a rolling basis. The Jordan River and Utah Lake basins were last updated in 2014; the Weber River basin was updated in 2007 (and will be updated again in 2015); the remainder fall in between. Figure 7.1 shows statewide agricultural land use and hydrologic basins in relation to the various sage-grouse range definitions used in this study. The FWS current and historical ranges used in this analysis exclude portions inside the boundaries of cities, towns and unincorporated Census-designated places.

Table 7.1 shows total acreage[28] and shares in each sage-grouse range type by hydrologic basin. The hydrologic basins with the most agricultural acres in FWS current sage-grouse range are West Desert, with 184,258 acres; Uintah, with 131,066 acres; and Bear River, with 107,188 acres. The corresponding shares of these basins' total agricultural acreage in FWS current range are 48.3 percent, 39.9 percent and 24.0 percent, respectively. In historical-only range, the hydrologic basins with the most acreage are Sevier River, with 362,897 acres; Bear River, with 200,676 acres; and Uintah, with 165,590 acres in historical range. The corresponding shares of total acreage in these basins 63.5 percent, 45.0 percent and 50.4 percent. The hydrologic basins with the most acres in SGMAs are West Desert, with 116,774 acres; Bear River, with 102,824 acres; and Sevier River, with 53,459 acres. The corresponding shares of these basins' total acreage in SGMAs are 30.6 percent, 23.0 percent and 9.4 percent, respectively. Ignoring the different vintages of data across the hydrologic basins, approximately one-quarter of the nonurban, nonriparian land in the water-related land use files falls within FWS current sage-grouse range, 45.6 percent falls in historical-only range, and almost 14 percent falls in the state's SGMAs. Tables 7.2a through 7.4b give crop- and other agricultural land use–level details by range type and basin.

Table 7.1
Total Agricultural Land Use Acreage in Greater Sage-Grouse Range by Hydrologic Basin

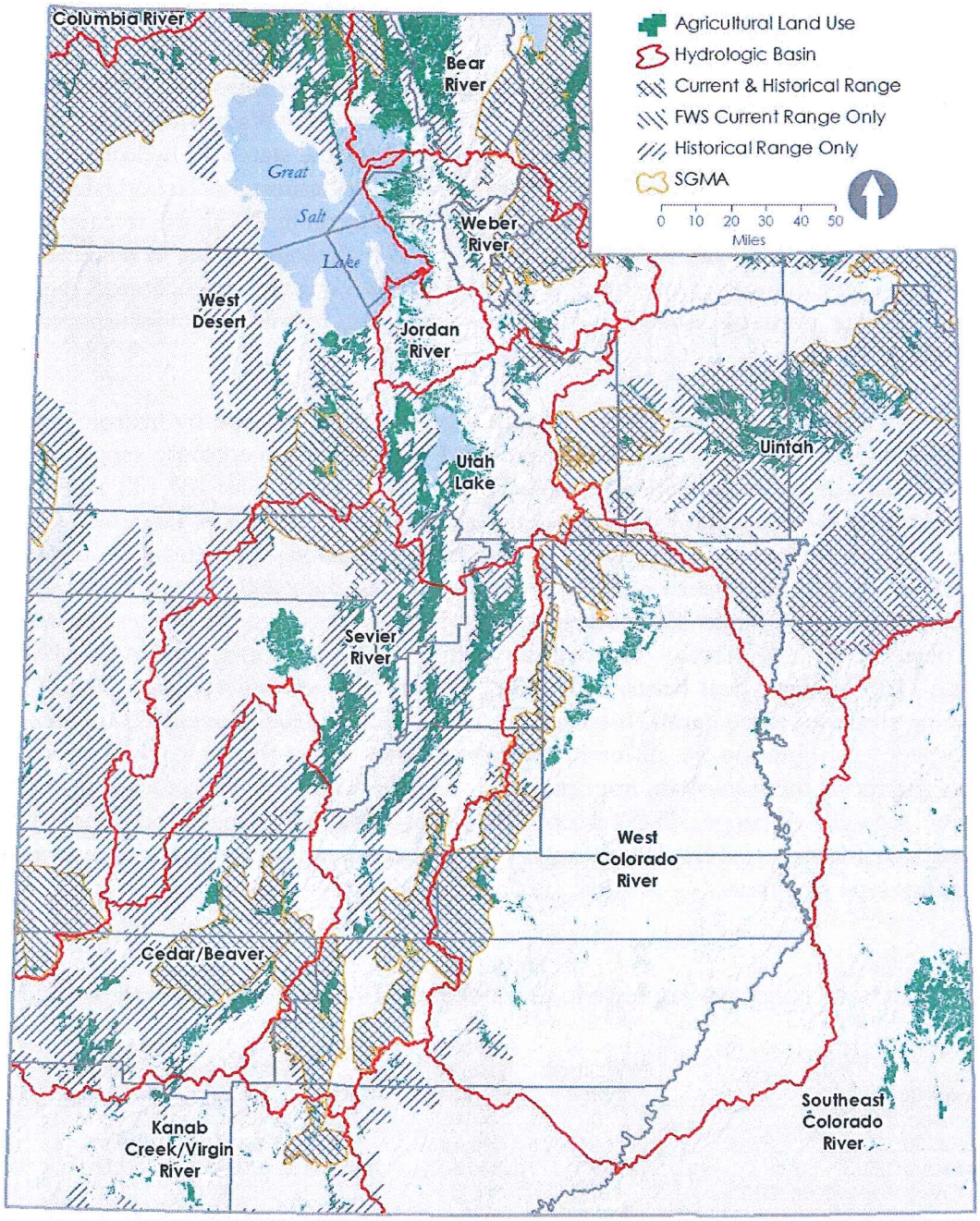
	ACRES			SHARES		
Hydrologic Basin	**FWS Current Range**	**Historical-only Range**	**SGMAs**	**FWS Current Range**	**Historical-only Range**	**SGMAs**
Jordan River, 2014	0	4,195	0	0.0%	11.5%	0.0%
Utah Lake, 2014	16,210	131,682	0	6.1%	49.5%	0.0%
Cedar Beaver, 2013	23,914	130,626	19,803	13.0%	71.0%	10.8%
Kanab Creek Virgin River, 2013	6,286	16,259	6,287	10.2%	26.3%	10.2%
Columbia River, 2012	14,183	0	14,183	100.0%	0.0%	100.0%
West Desert, 2012	184,258	125,635	116,774	48.3%	32.9%	30.6%
Uintah, 2012	131,066	165,590	23,279	39.9%	50.4%	7.1%
West Colorado River, 2011	18,020	5,778	5,131	12.2%	3.9%	3.5%
Sevier River, 2010	97,810	362,897	53,459	17.1%	63.5%	9.4%
Bear River, 2009	107,188	200,676	102,824	24.0%	45.0%	23.0%
Weber River, 2007	24,335	28,865	12,301	18.6%	22.1%	9.4%
Total*	**623,270**	**1,172,203**	**354,040**	**24.3%**	**45.6%**	**13.8%**

* Because the data for the hydrologic basins span several years and so are not strictly comparable, the total figures are only estimates.

Source: BEBR analysis of data from Division of Water Resources, USFWS and Division of Wildlife Resources.

[28] Acreage comprises nonurban, nonriparian land. All of the water-related land uses combined encompass about 6.5 million acres, of which about 1.6 million acres are water.

Figure 7.1
Agricultural Land Use, Hydrologic Basins and Greater Sage-Grouse Range



Source: USFWS; UDWR; Utah Division of Water Resources; State of Utah, SGID.

Map by John Downen, BEBR | April 2015

The most prevalent agricultural land use in FWS current sage-grouse range is pasture,[29] claiming over 314,000 acres and accounting for half of the agricultural land use in FWS current range. The other main "uses" are fallow or idle land[30] (106,437 acres), alfalfa (81,471 acres), grass hay (75,018

[29] This is based on a water-related land use shapefile and is not related to the grazing allotments shapefile that was used for the grazing analysis.

[30] Although this is not an active use of farmland, it is generally a temporary state and the land is likely to be cropped in subsequent years.

acres) and grain and seeds (28,105 acres) (Table 7.2a). Together, these five represent 97 percent of the total agricultural acres in FWS current range. With respect to the total acreage of agricultural land uses in the state, those uses with the greatest share in FWS current sage-grouse range are grass hay (52.1 percent), pasture (32.1 percent), fallow or idle land (22.1 percent), safflower (20.8 percent) and oats (17.9 percent) (Table 7.2b). Roughly one-quarter, 24.3 percent, of the state's agricultural land is in FWS current range.

Table 7.2a
Agricultural Land Use Acreage in FWS Current Greater Sage-Grouse Range by Hydrologic Basin

Land Use	Utah Lake, 2014	Cedar Beaver, 2013	Kanab Creek Virgin River, 2013	Columbia River, 2012	West Desert, 2012	Uintah, 2012	West Colorado River, 2011	Sevier River, 2010	Bear River, 2009	Weber River, 2007	Total*
Alfalfa	1,589	9,996	265	751	21,326	19,528	6,886	11,071	5,988	4,070	81,471
Corn		787			790	1,501		170		45	3,294
Dry Land	7,645										7,645
Fallow/Idle	1,754	3,627	749	4,283	44,311	28,975	4,866	6,193	9,048	2,631	106,437
Grain/Seeds	152	728	109	179	17,001	722	688	3,982	3,163	1,380	28,105
Grass Hay	1,137	1,257	23	2,519	4,115	14,470	214	8,105	39,019	4,159	75,018
Melon/Pumpkin/Squash				4				2			6
Oats	51	256			412	421	447	1,073			2,660
Orchard						24	8	246		13	291
Other Horticulture	2			5	2	5		12	14		39
Other Vegetables	2						5	1			9
Pasture	3,865	7,127	5,130	6,443	92,881	65,316	4,906	66,934	49,648	12,035	314,286
Potatoes	2					8		3	24		37
Safflower			11		2,968			16	284		3,279
Sorghum	11	136				94					240
Turf Farms					452						452
Vineyard						0.4					0.4
Total	16,210	23,914	6,286	14,183	184,258	131,066	18,020	97,810	107,188	24,335	623,270

* Because the data for the hydrologic basins span several years and so are not strictly comparable, the figures in the Total column are only estimates.
Source: BEBR analysis of data from Division of Water Resources and US Fish and Wildlife Service.

Table 7.2b
Share of Agricultural Land Use Acreage in FWS Current Greater Sage-Grouse Range by Hydrologic Basin

Land Use	Utah Lake, 2014	Cedar Beaver, 2013	Kanab Creek Virgin River, 2013	Columbia River, 2012	West Desert, 2012	Uintah, 2012	West Colorado River, 2011	Sevier River, 2010	Bear River, 2009	Weber River, 2007	Total*
Alfalfa	3.9%	15.1%	5.7%	100.0%	61.1%	30.7%	16.4%	8.2%	6.2%	14.4%	15.8%
Corn		9.9%			33.9%	20.1%		0.9%		0.6%	4.1%
Dry Land	7.3%										6.0%
Fallow/Idle	8.4%	7.4%	7.5%	100.0%	42.8%	38.0%	10.5%	6.5%	16.7%	13.8%	22.1%
Grain/Seeds	0.7%	8.2%	12.7%	100.0%	39.8%	31.8%	26.3%	11.7%	4.7%	20.9%	14.7%
Grass Hay	13.3%	39.7%	1.4%	100.0%	73.6%	51.0%	3.1%	39.6%	71.6%	34.9%	52.1%
Melon/Pumpkin/Squash				100.0%				1.2%			0.7%
Oats	2.7%	10.4%	0.0%		17.1%	36.8%	25.9%	22.0%			17.9%
Orchard						51.4%	5.9%	89.6%		2.6%	3.7%
Other Horticulture	0.3%			100.0%	8.9%	17.5%		17.2%	4.0%		2.9%
Other Vegetables	1.7%						35.4%	7.3%			0.6%
Pasture	7.7%	15.8%	11.9%	100.0%	50.8%	43.9%	11.2%	25.7%	35.8%	21.7%	32.1%
Potatoes	6.6%					57.9%		3.8%	8.0%		6.2%
Safflower			100.0%		43.8%			20.4%	3.3%		20.8%
Sorghum	53.4%	62.4%				14.9%					6.6%
Turf Farms					83.3%						11.8%
Vineyard						100.0%					1.5%
Total	6.1%	13.0%	10.2%	100.0%	48.3%	39.9%	12.2%	17.1%	24.0%	18.6%	24.3%

* Because the data for the hydrologic basins span several years and so are not strictly comparable, the figures in the Total column are only estimates.
Source: BEBR analysis of data from Division of Water Resources and US Fish and Wildlife Service.

In historical-only sage-grouse range the most prevalent agricultural land use is pasture, accounting for an estimated 414,232 acres, or 35 percent of the total agricultural acres in this range type. The other main uses are alfalfa (251,442 acres), fallow or idle land (226,419 acres), grain and seeds (102,677 acres) and dry land (66,553 acres) (Table 7.3a). These five land uses account for 90 percent of the total agricultural acres in historical-only sage-grouse range. The land uses with the greatest shares of their total acreage in historical-only range include berries (78.8 percent), beans (75.4 percent), safflower (64.1 percent), other horticulture (57.8 percent) and oats (56.6 percent) (Table 7.3b). Because it covers the most acres of agricultural land use, close to 1.2 million, historical-only sage-grouse range also encompasses the largest shares of agricultural uses' total areas: 10 of the 20 distinct land uses have more than half of their total acreage within historical-only range and almost 46 percent of all agricultural land is in historical-only range.

Table 7.3a
Agricultural Land Use Acreage in Historical-only Greater Sage-Grouse Range by Hydrologic Basin

Land Use	Jordan River, 2014	Utah Lake, 2014	Cedar Beaver, 2013	Kanab Creek Virgin River, 2013	West Desert, 2012	Uintah, 2012	West Colorado River, 2011	Sevier River, 2010	Bear River, 2009	Weber River, 2007	Total*
Alfalfa	107	18,096	46,635	882	3,934	36,612	1,260	83,831	51,529	8,555	251,442
Beans								111	20	117	247
Berries		2							77	15	94
Corn	22	6,138	5,582	390	604	5,220		12,061	10,067	1,949	42,032
Dry Land	2,022	64,532									66,553
Fallow/Idle	130	8,742	34,772	2,756	39,394	37,961	2,551	63,342	31,880	4,891	226,419
Grain/Seeds	1,839	10,516	7,322	220	18,832	1,047	42	20,860	39,758	2,241	102,677
Grass Hay	40	3,007	1,566	277	106	12,337	1,106	10,690	8,724	2,576	40,428
Melon/Pumpkin/Squash		11				1		90			101
Oats		1,243	1,850	37	1,712	627	19	2,895			8,384
Onions								19	835	44	898
Orchard		2,904	21	28		23	9	11	19	61	3,077
Other Horticulture		481			6	24		19	109	129	769
Other Vegetables		40	9			305		6	266	73	699
Pasture	34	15,878	32,408	11,594	57,332	70,891	791	167,385	49,782	8,138	414,232
Potatoes		18	130			2		52			202
Safflower		70			3,698			63	6,282	0	10,113
Sorghum			19	34	16	520		850	501	65	2,006
Tomatoes		3									3
Turf Farms		0	311	42		21		612	828	12	1,826
Total	4,195	131,682	130,626	16,259	125,635	165,590	5,778	362,897	200,676	28,865	1,172,203

* Because the data for the hydrologic basins span several years and so are not strictly comparable, the figures in the Total column are only estimates.
Source: BEBR analysis of data from Division of Water Resources and US Fish and Wildlife Service.

Table 7.3b
Share of Agricultural Land Use Acreage in Historical-only Greater Sage-Grouse Range by Hydrologic Basin

Land Use	Jordan River, 2014	Utah Lake, 2014	Cedar Beaver, 2013	Kanab Creek Virgin River, 2013	West Desert, 2012	Uintah, 2012	West Colorado River, 2011	Sevier River, 2010	Bear River, 2009	Weber River, 2007	Total*
Alfalfa	4.3%	44.6%	70.2%	18.8%	11.3%	57.6%	3.0%	62.4%	53.5%	30.2%	48.9%
Beans								93.4%	68.6%	78.7%	75.4%
Berries		9.7%							97.9%	95.9%	78.8%
Corn	9.6%	55.7%	70.5%	90.3%	25.9%	70.0%		64.4%	47.9%	27.9%	52.5%
Dry Land	9.0%	61.9%									52.5%
Fallow/Idle	8.6%	41.7%	70.7%	27.5%	38.1%	49.8%	5.5%	66.3%	58.8%	25.6%	47.1%
Grain/Seeds	35.8%	50.8%	82.9%	25.5%	44.0%	46.1%	1.6%	61.3%	58.8%	34.0%	53.6%
Grass Hay	15.3%	35.1%	49.5%	16.9%	1.9%	43.5%	16.1%	52.2%	16.0%	21.6%	28.1%
Melon/Pumpkin/Squash		3.4%				100.0%		73.4%			13.6%
Oats		64.6%	75.3%	14.4%	71.1%	54.9%	1.1%	59.3%			56.6%
Onions								100.0%	73.8%	7.3%	51.2%
Orchard		52.2%	85.5%	5.5%		48.6%	7.0%	4.2%	2.6%	11.9%	39.2%
Other Horticulture		83.5%			32.9%	82.5%		27.7%	32.3%	51.9%	57.8%
Other Vegetables		27.7%	65.3%			99.0%		32.3%	39.6%	19.6%	41.5%
Pasture	0.8%	31.6%	71.7%	27.0%	31.3%	47.7%	1.8%	64.2%	35.9%	14.7%	42.3%
Potatoes		72.0%	100.0%			14.6%		65.0%			33.9%
Safflower		31.5%			54.6%			79.6%	72.5%		64.1%
Sorghum			8.7%	12.9%	100.0%	82.5%		82.3%	57.7%	53.6%	55.4%
Tomatoes		3.5%									3.0%
Turf Farms		0.0%	100.0%	20.4%		100.0%		100.0%	95.2%	4.9%	47.6%
Total	11.5%	49.5%	71.0%	26.3%	32.9%	50.4%	3.9%	63.5%	45.0%	22.1%	45.6%

* Because the data for the hydrologic basins span several years and so are not strictly comparable, the figures in the Total column are only estimates.
Source: BEBR analysis of data from Division of Water Resources and US Fish and Wildlife Service.

At 354,000 acres, the state's SGMAs contain the least amount of agricultural land of the three sage-grouse range types analyzed. The largest agricultural land uses in SGMAs are pasture, with 178,754 acres; grass hay, with 52,898 acres; fallow or idle land, with 51,496 acres; alfalfa, with 45,715 acres; and grain and seeds, with 18,720 acres (Table 7.4a). Together, these five categories account for 98 percent of the agricultural land uses in SGMAs, with pasture alone representing half. The land uses with the greatest shares of their total acreage in SGMAs include grass hay (36.8 percent), safflower (19.9 percent), pasture (18.3 percent), turf farms (11.8 percent) and fallow/idle land and oats (both with 10.7 percent) (Table 7.4b). Just 14 percent of the state's agricultural land is in SGMAs.

Table 7.4a
Agricultural Land Use Acreage in SGMAs by Hydrologic Basin

Land Use	Cedar Beaver, 2013	Kanab Creek Virgin River, 2013	Columbia River, 2012	West Desert, 2012	Uintah, 2012	West Colorado River, 2011	Sevier River, 2010	Bear River, 2009	Weber River, 2007	Total
Alfalfa	7,533	265	751	18,249	4,911	114	6,117	5,645	2,131	45,715
Corn	446			605	24					1,075
Fallow/Idle	2,681	749	4,283	24,394	3,152	3,150	2,811	8,982	1,295	51,496
Grain/Seeds	570	109	179	12,714	395	18	538	3,175	1,022	18,720
Grass Hay	1,257	23	2,519	4,020	449	1	4,135	37,865	2,630	52,898
Melon/Pumpkin/Squash			4				2			6
Oats	256			272	63		1,002			1,593
Orchard					15					15
Other Horticulture			5	2	1			14		21
Other Vegetables							1			1
Pasture	6,925	5,130	6,443	53,228	14,268	1,848	38,853	46,836	5,223	178,754
Potatoes					1			24		25
Safflower		11		2,838				284		3,133
Sorghum	136									136
Turf Farms				452						452
Vineyard					0.4					0.4
Total	19,803	6,287	14,183	116,774	23,279	5,131	53,459	102,824	12,301	354,040

* Because the data for the hydrologic basins span several years and so are not strictly comparable, the figures in the Total column are only estimates.
Source: BEBR analysis of data from Division of Water Resources and US Fish and Wildlife Service.

Table 7.4b
Share of Agricultural Land Use Acreage in SGMAs by Hydrologic Basin

Land Use	Cedar Beaver, 2013	Kanab Creek Virgin River, 2013	Columbia River, 2012	West Desert, 2012	Uintah, 2012	West Colorado River, 2011	Sevier River, 2010	Bear River, 2009	Weber River, 2007	Total*
Alfalfa	11.3%	5.7%	100.0%	52.3%	7.7%	0.3%	4.6%	5.9%	7.5%	8.9%
Corn	5.6%			25.9%	0.3%					1.3%
Fallow/Idle	5.4%	7.5%	100.0%	23.6%	4.1%	6.8%	2.9%	16.6%	6.8%	10.7%
Grain/Seeds	6.5%	12.7%	100.0%	29.7%	17.4%	0.7%	1.6%	4.7%	15.5%	9.8%
Grass Hay	39.7%	1.4%	100.0%	71.9%	1.6%	0.01%	20.2%	69.5%	22.1%	36.8%
Melon/Pumpkin/Squash			100.0%				1.2%			0.7%
Oats	10.4%			11.3%	5.5%		20.5%			10.7%
Orchard					32.4%					0.2%
Other Horticulture			100.0%	8.9%	3.9%			4.0%		1.6%
Other Vegetables							3.9%			0.04%
Pasture	15.3%	11.9%	100.0%	29.1%	9.6%	4.2%	14.9%	33.8%	9.4%	18.3%
Potatoes					7.0%			8.0%		4.1%
Safflower		100.0%		41.9%				3.3%		19.9%
Sorghum	62.4%									3.8%
Turf Farms				83.3%						11.8%
Vineyard					100.0%					1.5%
Total	10.8%	10.2%	100.0%	30.6%	7.1%	3.5%	9.4%	23.0%	9.4%	13.8%

* Because the data for the hydrologic basins span several years and so are not strictly comparable, the figures in the Total column are only estimates.
Source: BEBR analysis of data from Division of Water Resources and US Fish and Wildlife Service.

8 RECREATION

This chapter documents participation in outdoor recreation activities within greater sage-grouse range in Utah. First, we analyze recreation of any type on lands managed by the U.S. Forest Service, Bureau of Land Management (BLM), and Utah State Parks. Then we review data on hunting, fishing and trail-based recreation on all public and private lands in the state. Where available, associated visitor spending and economic contributions are provided.

As shown in Table 8.1, an estimated 15 percent of recreation visits to national forests, BLM lands, and state parks in Utah from 2009 to 2014 were in the FWS current range of greater sage-grouse, 25 percent when historical range is added. Analysis of specific recreation sites on these public lands provides more conservative estimates of recreation activity in habitat: 8 percent in FWS current range and another 6 percent in historical range outside of FWS current habitat. The State of Utah's Sage-Grouse Management Areas (SGMAs) received 11 percent of visits and contained 6 percent of recreation sites in the state.

Table 8.1
Recreation Activity in Greater Sage-Grouse Range for Selected Public Lands in Utah

Landowner[1]	Statewide	FWS Current Range	Historical-only Range	SGMAs
Recreation Visits[2]	18.0 million	15.4%	9.3%	11.3%
Forest Service	7.1 million	15.7%	3.3%	14.8%
BLM	6.8 million	12.9%	11.0%	9.4%
State Parks	4.0 million	19.2%	17.1%	8.5%
Recreation Sites[3]	1,601	8.4%	5.6%	5.8%
Forest Service	1,097	3.4%	2.1%	3.1%
BLM	461	18.9%	11.9%	11.3%
State Parks	43	23.3%	27.9%	16.3%

1. These agencies manage three-fourths of Utah's public lands and contain at least half of greater sage-grouse habitat.
2. The most recent visitation data available are for different years from 2009 to 2014. For sources and estimation methods see Table 8.2 and Table 8.5 (Forest Service), Table 8.9 (BLM), and Table 8.A2 (State Parks).
3. Sites are not homogenous, ranging from signs and trailheads to campgrounds and parks. For sources and estimation methods see Table 8.3 (Forest Service), Table 8.8 (BLM), and Table 8.A2 (State Parks).
Source: BEBR analysis.

Spending in Utah for an estimated 1.4 million hunting and fishing trips to FWS current sage-grouse range on public and private lands was approximately $193 million in 2011 (Table 8.12). For any type of recreation within FWS current range in national forests, visitor spending in Utah amounted to $62 million based on spending data collected between FY 2005 and FY 2012 (Table 8.6). Both amounts are reported in 2014 dollars.

Based on the share of multiuse trails and unpaved roads in Utah that are within FWS current range, 4 percent to 26 percent of trail-based recreation happens in greater sage-grouse habitat (Table 8.14). This includes hiking, biking, OHV use, cross-country skiing, and other trail-based activities.

Note that these results do not imply the extent to which recreation activities addressed may be harmful to greater sage-grouse or how much change in recreation participation or spending, if any, would result from an ESA listing or another development affecting the management approach for greater sage-grouse in Utah.

8.1 NATIONAL FORESTS

Analysis of recreation sites and visits suggests that 3 percent to 16 percent of recreation activity in Utah's national forests happens within the FWS current range of greater sage-grouse (Table 8.2). Another 2.1 to 3.3 percent of recreation activity takes place in historical range outside of the FWS

current range. Recreation measures for SGMAs are similar and somewhat less than those for FWS current range. Estimates based on visits and habitat shares assume recreation is dispersed evenly throughout each forest, while estimates based on recreation sites assume all activity is concentrated at identified improved areas.

Table 8.2
Summary of Recreation Activity in Greater Sage-Grouse Range in National Forests in Utah

Estimation Method	Statewide	FWS Current Range	Historical-only Range	SGMAs
Recreation Sites[1]	1,097	3.4%	2.1%	3.1%
Recreation Visits and Habitat Shares[2]	7.1 million	15.7%	3.3%	14.8%

1. Based on the total number of recreation sites in each area (see Table 8.3)
2. Forest Service estimates of annual recreation visits to each national forest during 2009–2013 (see Table 8.5) are multiplied by the share of each forest in greater sage-grouse habitat (see Table 8.4), then summed and divided by the statewide total.
Source: BEBR analysis.

The vast majority of recreation areas on U.S. Forest Service lands in Utah are away from greater sage-grouse. As shown in Table 8.3, trailheads and campsites make up 62 percent of more than one thousand recreation sites on Forest Service lands statewide. Picnic, fishing, interpretive, and observation sites are also common. These lands also offer substantial recreation developments, such as ski resorts and visitor centers.

The most common types of recreation sites in greater sage-grouse range on Forest Service lands are, in order, campgrounds, boating or swimming areas, and trailheads. There are 60 of these are within FWS current and/or historical range. Of 1,097 mapped recreation sites, 3.4 percent are in FWS current range, and another 2.1 percent are in historical range outside of FWS current range, while 3.1 percent are within SGMAs.

Currently, forests and grasslands within seven national forests in Utah offer 1.4 million acres of greater sage-grouse habitat. On average, FWS current range amounts to 12.5 percent of lands managed by the Forest Service; only 4.1 percent of Forest Service lands lie in historical range outside of the FWS current range (Table 8.4). One-fourth of Uinta National Forest is in FWS current range; most of that is also designated as SGMAs. Dixie National Forest offers the most FWS current range and SGMA acreage of the seven at 381,000 and 377,000 acres, respectively. More than one-tenth of Fishlake National Forest is historical-only greater sage-grouse range.

Table 8.3
U.S. Forest Service Recreation Sites in Utah

Category	Statewide	FWS Current Range	Historical-only Range	SGMAs
Camping[1]	328	8	4	8
Boating or swimming	36	5	3	5
Trailhead	348	4	3	3
Picnicking	110	3	2	3
Observation site[2]	41	3	2	3
Other recreation[3]	35	4	1	3
Winter sports[4]	31	2	2	2
Interpretive site	47	2	1	2
Fishing	42	1	2	1
Day use area	36	2	1	2
Ranger station or visitor center[5]	16	2	0	1
Residence	15	1	1	1
Resort or lodge[6]	12	0	1	0
Total[7]	1,097	37	23	34

1. Camping sites include group, river, boat, horse, and other campgrounds.
2. A few scenic highways are included with observation sites.
3. Other sites are mainly dispersed or unlabeled recreation areas but also include an airport, two ATV sites, and three amphitheaters.
4. Winter sports sites accommodate alpine and cross-country skiing, as well as snow parks and snow play areas for activities such as sledding and snowmobiling.
5. This category includes two ranger stations, eight guard stations, and six visitor centers.
6. Resorts or lodges are mainly privately owned resorts, hotels and lodges, but there are also two sites for cabin or yurt rentals.
7. The total omits 21 recreation sites labelled as administrative office, dump station, fire lookout, employee cabin, or state park—three in FWS current range, one in historical-only range, and three in SGMAs.
Source: BEBR analysis and U.S. Forest Service, Region 4 Recreation Sites; U.S. Fish and Wildlife Service; Utah Division of Wildlife Resources; State of Utah, SGID.

Table 8.4
Acres of Forest Service Lands in Utah by Greater Sage-Grouse Range

National Forest[1]	Acres	FWS Current Range	Share	Historical-only Range	Share	SGMAs	Share
Ashley	1,382,346	215,054	15.6%	54,644	4.0%	123,285	8.9%
Caribou	987,216	0	0.0%	0	0.0%	0	0.0%
Dixie	1,889,106	381,220	20.2%	157,305	8.3%	377,315	20.0%
Fishlake	1,461,226	208,662	14.3%	162,764	11.1%	195,393	13.4%
Manti-LaSal	1,270,805	207,265	16.3%	33,525	2.6%	195,268	15.4%
Sawtooth	1,804,091	71,944	4.0%	0	0.0%	71,944	4.0%
Uinta	880,719	216,230	24.6%	14,627	1.7%	213,550	24.2%
Wasatch-Cache	1,615,532	111,214	6.9%	45,598	2.8%	92,536	5.7%
Total	11,291,041	1,411,589	12.5%	468,463	4.1%	1,269,290	11.2%

Note: Acreages are based on greater sage-grouse range that is not in cities, towns or unincorporated Census-designated places.
1. National forests included are those with any portion located in Utah.
Source: U.S. Fish and Wildlife Service, Utah Division of Wildlife Resources, Utah AGRC.

National forests in Utah received an estimated 7.1 million annual non-ski visits based on visitor data collected between 2009 and 2013 (Table 8.5).[31] Wasatch-Cache was the most-visited national forest in Utah, followed by Uinta National Forest. Based on the land area of each forest in greater sage-grouse range, perhaps 1.12 million visits were in FWS current range. SGMAs in national forests were estimated to receive 1.05 million visits. As noted, there is little historical range outside of the FWS current range in Utah's national forests. Historical-only range on Forest Service lands attracted an estimated 253,000 visits annually during the five years.

Spending in national forests in Utah by greater sage-grouse range type and the associated economic contributions are given in Table 8.6. These are based on spending profiles for each forest multiplied by the number of annual visitors scaled by the share of each forest in the different range types. Total spending for recreation visits to national forests statewide amounted to $329.9 million in 2011, of which an estimated $61.7 million (19 percent) was from visits to FWS current greater sage-grouse range. Just over half of visitor spending was in the retail sector. Lodging and food were the next largest sectors, combined representing one-third of the total. Economic contributions resulting from visitor spending in FWS current range include $25.2 million in earnings from 1,532 jobs, as well as $49.6 million in value-added. Corresponding figures for recreation spending and contributions in historical-only range and SGMAs are shown in Table 8.6.

Table 8.5
Annual Recreation Visits to National Forests in Utah

National Forest	Person Visits	Fiscal Year
Ashley	274,465	2012
Caribou	4,325	2010
Dixie	605,000	2009
Fishlake	337,000	2013
Manti-La Sal	344,492	2011
Sawtooth	27,930	2010
Uinta	2,655,130	2012
Wasatch-Cache	2,878,797	2012
Total	7,127,139	2009–2013

Note: Visits exclude those for which skiing was given as the primary activity. Visitors may be local or nonlocal, based on 50-mile travel distance. Shown are the most recent estimates available in the Forest Service's staggered five-year cycle. Visits correspond to federal fiscal years beginning October 1. Visits to Uinta-Wasatch-Cache National Forest were not separated in FY 2012; Uinta and Wasatch-Cache shares from FY 2007 were used to divide the FY 2012 total of 6,195,000 between the two. For national forests that are partially in Utah, U.S. Forest Service estimates of visits are adjusted by the share of each national forest in Utah.
Source: BEBR analysis of data from U.S. Forest Service, National Visitor Use Monitoring; State of Utah, SGID.

[31] Most visits to national forests for skiing are to alpine ski resorts in mountainous forests. As greater sage-grouse spend the winter in low-elevation sage-brush areas, ski visits are not likely in greater sage-grouse habitat.

Table 8.6
Economic Contribution of Spending by National Forest Visitors in Utah
(2014 dollars)

Range Type	Spending[1]	ECONOMIC CONTRIBUTIONS[2] Earnings	Jobs	Value Added
FWS Current Range	$61,733,732	$25,248,941	1,532	$49,647,003
Historical-only Range	$14,478,932	$6,072,603	936	$11,938,009
SGMAs	$58,442,895	$23,955,162	1,492	$47,103,564

1. U.S. Forest Service spending estimates for each national forest, the most recent of which are from FY 2005 to FY 2012, are multiplied by the share of each forest in Utah that is within each habitat type and adjusted for inflation based on the BLS CPI-U for the U.S. See Table 8.A1 for spending estimate details.
2. Forest Service data do not indicate how much of the spending is from out-of-state visitors to Utah. These results are economic contributions, not economic impacts. The retail trade margin, the share of retail sales revenue earned in Utah, not counting payments to wholesalers, is 30.2% based on a weighted average of all products with retail margins.
Source: U.S. Forest Service, National Visitor Use Monitoring; Bureau of Economic Analysis, Regional Input-Output Modeling System.

8.2 BLM LANDS

This section uses two approaches to document where recreation activities occur on BLM lands in Utah with respect to the greater sage-grouse. First, we analyze the location of BLM recreation sites by field office. Second, we allocate recreation visits based on land area at the field office level. As shown in Table 8.7, the second method ends up being more conservative.

Table 8.7
Summary of BLM Recreation Activity in Greater Sage-Grouse Range in Utah

Estimation Method	Statewide	FWS Current Range	Historical-only Range	SGMAs
Recreation Sites[1]	461	18.9%	11.9%	11.3%
Recreation Visits[2]	6.8 million	12.9%	11.0%	9.4%

1. See Table 8.8.
2. BLM estimates of recreation visits to each field office adjusted by the share of BLM lands in greater sage-grouse habitat (see Table 8.9).
Source: BEBR analysis.

We estimate that between 13 percent and 19 percent of recreation activity on BLM lands occurs in FWS current greater sage-grouse range. Another 11 percent or 12 percent of recreation activity is in historical-only range. Finally, 9 percent to 11 percent of recreation activity on BLM lands may happen within SGMAs.

A total of 461 recreation sites are spread across BLM's 22.8 million acres in Utah (Table 8.8). The location of these sites is a good indication of where visitors recreate on BLM lands. Of these, 19 percent are within FWS current greater sage-grouse range with another 12 percent in historical-only range for a total of 142 recreation sites in greater sage-grouse range. SGMAs contain 52 BLM recreation sites, 11 percent of the agency's total in the state.

Table 8.8
BLM Recreation Sites in Greater Sage-Grouse Range in Utah

BLM Field Office	Statewide	FWS Current Range	Historical-only Range	SGMAs
Cedar City	3	1	1	1
Fillmore	27	6	19	0
GSENM[1]	36	0	9	0
Kanab	3	0	0	0
Moab	111	0	0	0
Monticello	60	0	0	0
Price	65	0	0	0
Richfield	12	4	0	4
Salt Lake	19	9	7	8
St. George	25	0	2	0
Vernal	100	67	17	39
Total	461	87	55	52

Note: Sites include those identified as camping or recreation sites.
1. Grand Staircase-Escalante National Monument, managed by BLM.
Source: Bureau of Land Management, Facilities Asset Management System; U.S. Fish and Wildlife Service; Utah Division of Wildlife Resources.

Table 8.9
FY2013 Recreation Visits on BLM Lands in Utah

Field Office	Visits	SHARE OF AREA IN RANGE[1] FWS Current Range	Historical-only Range	SGMAs
Cedar City	433,760	37.4%	39.3%	35.8%
Fillmore	249,738	5.7%	46.2%	3.1%
GSENM[2]	759,587	1.3%	9.1%	1.3%
Kanab	342,338	31.2%	13.7%	31.2%
Moab	1,996,520	1.0%	0.1%	0.0%
Monticello	245,094	0.0%	0.0%	0.0%
Price	692,571	6.8%	0.2%	1.5%
Richfield	617,737	13.1%	11.8%	12.4%
Salt Lake	561,186	33.9%	24.3%	31.8%
St George	515,490	0.0%	5.5%	0.0%
Vernal	429,077	57.6%	26.0%	23.4%
Statewide	6,843,098	16.5%	20.4%	12.4%
Estimated Visits[3]	6,843,098	879,415	754,387	645,256
Share of Visits	100.0%	12.9%	11.0%	9.4%

1. Based on greater sage-grouse range that is not in cities, towns or unincorporated Census-designated places
2. Grand Staircase-Escalante National Monument.
3. Recreation visits in FY 2013 to BLM lands statewide for the three greater sage-grouse areas are estimated by multiplying the number of visits to each field office by the share of each field office within greater sage-grouse range or SGMAs.
Source: BEBR analysis of data from Bureau of Land Management; U.S. Fish and Wildlife Service; Utah Division of Wildlife Resources; State of Utah, SGID.

In FY 2013, BLM lands in Utah received 6.8 million recreation visits, of which an estimated 12.9 percent, 879,000 visits, are within FWS current greater sage-grouse range (Table 8.9). Another 754,000 visits, 11.0 percent of the agency's statewide total, may be in historical-only range. Finally 645,000 visits to BLM lands, 9.4 percent of the total, may be in SGMAs. These estimates assume that at the field office level, recreation visits are spread proportionally between BLM lands within and without greater sage-grouse range and SGMAs.

The Salt Lake, Cedar City, Vernal, and Kanab field offices are likely to receive the most recreation visits within greater sage-grouse range on BLM lands in Utah. As shown in Table 8.9, Moab is the most-visited of the 11 BLM field offices, receiving 29 percent of all visits, but only one percent of the field office is occupied by FWS current greater sage-grouse range. In contrast, the Salt Lake Field Office receives only 8 percent of BLM visits in the state, but one-third of BLM lands there are within FWS current range, besides another 24 percent in historical-only range.

8.3 STATE PARKS

As shown in Table 8.10, 22 of 43 state parks are at least partially within FWS current or historical-only greater sage-grouse range. Of these, six have at least 90 percent of their land area within FWS current range, five of which are also within SGMAs; another six are at least 90 percent in historical-only range. Out of 119,355 acres of state parks in Utah, about 15 percent is in FWS current range, of which 55 percent is also within SGMA boundaries. An additional 16 percent of state park lands are located in historical-only range.

Just over half of 2014 state park visitation of 4.0 million was at the 22 parks at least partially within sage-grouse range. If visitation is scaled to the share of each park's land area within the three range types, 19 percent was in FWS current range, 17 percent in historical-only range, and 8 percent was in SGMAs. Table 8.A2 in the Appendix provides more detail on the analysis supporting the summary in Table 8.10.

Table 8.10
Utah State Parks in Greater Sage-Grouse Range

Metric	Statewide	FWS Current Range	Historical-only Range	SGMAs
Number of State Parks[1]	43	10	12	7
Land Area (Acres)	119,355	18,128	18,947	9,976
Share	100%	15.2%	15.9%	8.4%
Visitation (2014)[2]	4,006,225	767,882	684,484	340,267
Share	100%	19.2%	17.1%	8.5%

1. Except for the statewide figure of 43, counts are for state parks with any acreage within greater sage-grouse habitat.
2. Visitation estimates are the sum of each state park's visitation prorated by the share of the park's land area within habitat. See Table 8.A2 in the Appendix.
Source: BEBR analysis, Utah Division of Parks and Recreation, Utah Division of Wildlife Resources, U.S. Fish and Wildlife Service.

8.4 OTHER LANDS

Most outdoor recreation in greater sage-grouse habitat in Utah occurs in the three public land types that have been the focus of this chapter. Lands managed by the Forest Service, BLM and State Parks cover 31 million acres, 57 percent of the state. These agencies manage half of the FWS current range for greater sage-grouse and a somewhat higher share of historical-only range and SGMAs, as well as most the state's non-urban recreation sites.

This study does not separately document recreation activities in greater sage-grouse habitat for private and tribal lands or lands managed by federal and state agencies besides the Forest Service, BLM, and State Parks. Reasons include management independence, data availability, the absence of large habitat areas, and the limited role of recreation. However, the sections on hunting, fishing, and trail-based activities in Utah's greater sage-grouse range pertain to all private and public lands in the state.

For example, only 3 percent of the lands managed by the National Park Service (NPS) are within FWS current or historical greater sage-grouse range (see Table 1.A1 in Chapter 1).[32] The agency manages less than 1 percent of FWS current range in the state. State lands managed by the School and Institutional Trust Lands Administration (SITLA) account for 8 percent of the FWS current range, but their management priority is to generate revenue for the trust, not provide recreational opportunities. Whether for wildlife under state authority or those with ESA listings, tribal lands have a marked degree of independence in terms of wildlife management, restrictions on land use activities, and recreation opportunities. Tribal lands hold 5 percent of the FWS current range for greater sage-grouse in Utah. Department of Defense lands are generally closed to recreation and have less land area and habitat than NPS lands. On the other hand, many people recreate on their own properties or that of friends, nonprofits, and companies. Private lands make up one-third of the FWS current range for greater sage-grouse and one-fifth of SGMAs by land area. Unfortunately, recreation on private lands in Utah is poorly documented.

8.5 HUNTING AND FISHING

So far this chapter has analyzed a fairly comprehensive range of recreation activities on three prominent types of public lands. Next we evaluate hunting, fishing, and trail-based recreation in greater sage-grouse range statewide, without regard to land ownership. These outdoor activities attract a large number of participants. Data are available to estimate where they take place with regard to greater sage-grouse range and, for hunting and fishing, how they affect Utah's economy. We do not address boating, water sports, climbing, skydiving, alpine skiing, scenic drives, and a variety of other outdoor activities that may occur in or near sage-grouse habitat.

An estimated 493,000 unique people took 5.1 million hunting or fishing trips in Utah during 2011, the most recent results from a survey carried out every five years (USFWS 2013a). Perhaps 1.4 million of these trips were in the FWS current range of greater sage-grouse, another 0.9 million to historical-only range, and 1.0 million to SGMAs that year.[33] As hunting and fishing occurs primarily on

[32] Out of 13 national monuments and parks, Dinosaur National Monument and small portions of Bryce Canyon National Park and Zion National Park are in FWS current or historical range.

[33] Estimates of hunting and fishing trips to greater sage-grouse range are based on the shares in Table 8.11 from 2011 and 2012 multiplied by the total number of trips given in the 2011 FHWAR survey.

Table 8.11
Shares of Hunting and Fishing Activity in Greater Sage-Grouse Range in Utah

Measure	FWS Current Range	Historical-only Range	SGMAs
Hunters Afield (2012)	26.5%	16.9%	19.1%
Fishing Trips (2011)	32.5%	17.0%	23.2%
Weighted Average	29.3%	16.9%	21.0%

Note: Share estimates are based on counts for the calendar year indicated. Fishing data is not available since 2011, while DWR maintains annual counts for hunters afield. These data nearly match 2011 spending data from FWS.
Source: BEBR analysis of data from Utah Division of Wildlife Resources and Jakus et al. (2013).

public lands, most of these visits would be counted in the number of visits to national forests, BLM lands, and State Parks given in Table 8.1 and discussed previously in this chapter.

To estimate hunting and fishing activity in greater sage-grouse range in Utah we looked at big-game hunters afield by DWR big-game unit, small- and upland-game hunters afield by county, and fishing trips by county. Hunters afield are the number of people who hunted a particular animal in a particular area during a year.[34] We calculated the share of each big-game unit and county that is in FWS current sage-grouse range, torical-only range or SGMAs. The fishing data were by river and lake by county, so we calculated the portion of each river and the areal share of each lake that fall within the various sage-grouse ranges. We applied these shares to the counts of hunters afield and fishing trips to estimate the proportions of hunters and anglers in each type of sage-grouse range statewide. We then used Utah expenditure data from FWS's *2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (USFWS 2013a) to estimate the expenditures by hunters and anglers that could be associated with hunting and fishing in sage-grouse range. From these expenditures we estimated their economic and fiscal contributions.

As shown in Table 8.11, an estimated 26.5 percent of hunters afield in Utah during 2012 entered the FWS current range of greater sage-grouse. Nearly one-third of fishing trips in 2011 were to destinations in FWS current range. Lesser shares of hunters afield and fishing trips were to SGMAs (21.0 percent combined) or historical-only range (16.9 percent).

The hunting season for greater sage-grouse lasts nine days in Utah, and the annual harvest has declined from 12,156 in 1992 to 1,255 in 2007 (Knick and Connelly 2011). Hunting is by permit only in four SGMAs with stable populations (UDWR 2013). Two decades ago, any hunter was allowed between three and six greater sage-grouse (Knick and Connelly 2011). Hunting fees collected by DWR help fund greater sage-grouse conservation (UDWR 2013).

Table 8.12
Estimated Economic Contributions of Hunting and Fishing in Greater Sage-Grouse Range in Utah
(Millions of 2014 dollars)

	FWS Current Range	Historical-only Range	SGMAs
2011 Total Expenditures	$193.2	$111.7	$138.6
Employment Contributions	4,180	2,412	2,998
Earnings Contributions	$124.4	$71.8	$89.2
Value-Added Contributions	$243.1	$140.4	$174.3
2011 Expenditures by Nonresidents	$47.3	$27.6	$33.9
Employment Impacts	995	580	714
Earnings Impacts	$30.7	$17.8	$22.0
Value-Added Impacts	$59.4	$34.6	$42.6

Source: BEBR analysis of data from US Fish and Wildlife Service, 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation *using BEA's RIMS II multipliers.*

Table 8.12 shows estimated hunter and angler spending on trips to greater sage-grouse range, as well as the economic contributions and impacts associated with that spending.[35] An estimated $193 million in annual ex-

[34] Hunters afield are not unique individuals, as one person may hunt in multiple areas or for multiple animals in a year. Hunters afield are distinct from hunting trips, as a person may go on several trips to hunt the same wildlife.
[35] Spending on hunting and fishing trips in Utah's national forests would already be counted in estimates of national forest visitor spending during 2009–2013 based U.S. Forest Service surveys (see Table 8.6). For hunting and fishing trips to BLM, SITLA, tribal, private and other lands in Utah, these expenditures would be unique.

penditures, almost one-fourth by nonresidents, came from hunting and fishing trips in FWS current greater sage-grouse range in Utah in 2011, adjusted for inflation to 2014 dollars. Hunting and fishing expenditures in SGMAs were $139 million, and spending in historical-only range was $112 million, both with similar shares from nonresidents. Total expenditures in FWS current range generated $124 million in earnings from 4,180 jobs and $243 million in value-added or gross state product.

Spending related to hunting and fishing in greater sage-grouse range contributes to state and local government revenues. Fiscal impacts are composed of estimated state income and state and local sales taxes generated by the earnings contributions from Table 8.12; estimated state and local sales tax revenues from restaurant, lodging, motor vehicle rental, and retail expenditures by hunters and anglers in 2011; a portion of state sales tax revenue from fishing, hunting and trapping taxable business investments from 4Q 2013 to Q3 2014; and a portion of FY2014 DWR revenues from big game application fees, fish and game licenses, hunter safety cards, and wildlife drawings. Table 8.13 shows the results of these estimates.

Annual spending by hunters and anglers in FWS current greater sage-grouse range generates an estimated $27.5 million in government revenues, of which 12 percent accrued to local governments (Table 8.13). There was an additional $15.9 million in fiscal impacts related to historical-only range. Hunting and fishing in SGMAs generated an estimated $19.6 million in state and local government revenues.

Table 8.13
Estimated Fiscal Impacts from Hunting and Fishing in Greater Sage-Grouse Range in Utah
(Millions of 2014 dollars)

	FWS Current Range	Historical-only Range	SGMAs
Total Fiscal Impacts	$27.5	$15.9	$19.6
Sales Tax Revenues	$9.5	$5.5	$6.7
DWR Fish and Game Licenses and related	$8.9	$5.1	$6.4
Earnings-Based impacts	$9.1	$5.4	$6.6
State Fiscal Impacts	$24.1	$14.0	$17.3
Sales Tax Revenues	$6.9	$4.0	$4.9
DWR Fish and Game Licenses and related	$8.9	$5.1	$6.4
Earnings-Based impacts	$8.3	$4.9	$6.0
Local Fiscal Impacts	$3.4	$1.9	$2.3
Sales Tax Revenues	$2.6	$1.5	$1.8
Earnings-Based impacts	$0.8	$0.4	$0.5

Source: BEBR analysis of data from US Fish and Wildlife Service, 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation; Utah State Tax Commission; and transparent.utah.gov (Utah Division of Wildlife Resources revenues).

8.6 TRAIL-BASED RECREATION

A variety of recreation activities in greater sage-grouse habitat occur on or near trails, such as hiking, running, biking, wildlife viewing, dispersed camping, snow shoeing, Nordic skiing, and the use of off-highway vehicles (OHVs), including ATVs, motorcycles, and snowmobiles. This section documents the location of trailheads, trails, and unpaved roads with regards to greater sage-grouse range in Utah. We lack data sufficient to estimate the share of participants in range types or the economic

contribution their spending generates. However, Table 8.14 suggests a significant portion of trail-based recreation in Utah occurs within greater sage-grouse range, perhaps 4 percent to 26 percent.

As shown in Table 8.14, about one thousand miles or more of unpaved roads, up to one-fourth of the statewide total, are within greater sage-grouse range. All but two of the 317 occupied leks in Utah are within one mile of some type of road (Utah AGRC 2015, DWR 2014). Leks are areas used by sage-grouse for breeding grounds in the spring. Much of the state's greater sage-grouse range, including the areas most sensitive to disturbance, are near roads and may be affected by visitors arriving by automobile, OHV, or lower-impact modes of transportation.

FWS current greater sage-grouse range contains 5.2 percent of 559 trailheads in Utah, as well as 16.7 percent of over 21,000 miles of mapped multiuse trails (Table 8.14).[36] Based on these measures, another 5.7 percent or 5.9 percent of trails are located in historical-only range. OHV use, hiking, biking, and other activities are likely to occur on many of the trails and roads described, as well as on other routes on private and public lands in greater sage-grouse habitat. Unfortunately, data are not available to show the distribution of recreation visits to these trails and roads or the spending of visitors.

Table 8.14
Trails and Unpaved Roads in
Greater Sage-Grouse Range in Utah

	UNPAVED ROADS[1]		MULTIUSE TRAILS[2]		TRAILHEADS	
Range Type	Miles	Share	Miles	Share	Count	Share
FWS Current Range	1,373	25.9%	3,587	16.7%	29	5.2%
Historical-only Range	1,011	19.0%	1,265	5.9%	32	5.7%
SGMAs	999	18.8%	2,877	13.4%	22	3.9%
Statewide, range or not[3]	5,310	100%	21,462	100%	559	100%

1. Unpaved roads are a type of major local roads in SGID data, a fraction of all gravel and dirt roads in the state that may admit OHVs.
2. Trails data are crowdsourced and not complete.
3. Values do not add to 100%. Differences between totals and the values for FWS current range, historical-only range, and SGMAs are the portion outside of habitat.
Source: BEBR analysis of data from State of Utah SGID and DWR.

Among the forms of trail-based recreation in greater sage-grouse range, OHV use is of particular concern to DWR and FWS. OHVs can have a greater environmental impact than other forms of trail-based recreation, and they generally travel away from major roads and sometimes off-road. The State of Utah's greater sage-grouse management plan proposes sage-grouse–aware revisions of county travel management plans and limiting OHV use to identified roads and trails in areas where sage-grouse nest or have winter habitat (UDWR 2013). According to FWS, the closure of greater sage-grouse areas to off-road vehicle use and avoidance of new road and campground construction may be advisable (USFWS 2013b).

In 2014, nearly 184,000 OHVs were registered in Utah. Of these, half were ATVs, 39 percent were off-highway motorcycles, 11 percent were snowmobiles, and less than 1 percent were off-road trucks (Utah State Tax Commission 2014a). OHV ownership was dispersed throughout the state more widely than its population. Whereas four Wasatch Front counties held 76 percent of the state's population in 2014[37] only 60 percent of OHV registrations occurred in those counties. Besides, many ATVs, motorcycles, and snowmobiles registered in urban counties may be primarily used elsewhere.

[36] For example, the Paiute ATV Trail in Beaver, Millard, Piute, and Sevier counties includes a 278-mile main loop connected to 550 miles of side trails, much of which is in or near FWS current or historical sage-grouse range. *Source:* Piute County Chamber of Commerce. *The Paiute ATV Trail Committee.* http://www.piutecounty.org/paiute-atv.html
[37] U.S. Census Bureau, American FactFinder. *Annual Estimates of the Resident Population…*, March 2015.

APPENDIX

The Forest Service provides visitor spending profiles by trip type (e.g. local, day, overnight) for each national forest (White, Goodding and Stynes 2013). Spending amounts are multiplied by the number of visitors for each trip type travelling to each forest in Utah. Visitor spending estimates for all seven forests by spending category are totaled in Table 8.A1. In Table 8.6, these total spending figures are scaled down based on habitat land areas in each forest.

Table 8.A1
Annual Visitor Spending in Greater Sage-Grouse Range of National Forests in Utah
by Trip Type and Spending Category
(2014 dollars[1])

	NONLOCAL TRIPS[3]			LOCAL TRIPS[3]				
Spending Category[1]	**Day**	**Overnight-NF[4]**	**Overnight[5]**	**Day**	**Overnight-NF[4]**	**Overnight[5]**	**Non-Primary Trips[6]**	**Total Spending**
Motel	$0	$8,918,595	$20,008,224	$0	$941,155	$233,571	$25,567,984	$55,669,529
Camping	$0	$7,981,799	$3,484,579	$0	$4,738,705	$236,946	$2,959,404	$19,401,433
Restaurant	$3,151,472	$7,431,839	$14,312,408	$8,695,977	$1,272,785	$261,503	$19,332,970	$54,458,954
Groceries	$1,847,960	$16,536,301	$10,077,179	$12,152,390	$13,094,819	$555,367	$9,818,885	$64,082,901
Gas and oil	$4,920,812	$15,689,108	$11,003,371	$24,692,914	$7,258,512	$411,287	$11,677,998	$75,654,003
Other transportation	$135,678	$482,203	$437,274	$88,822	$83,034	$5,705	$623,690	$1,856,405
Entry fees	$978,243	$2,561,045	$2,254,246	$4,161,587	$706,204	$54,309	$2,393,811	$13,109,446
Recreation and entertainment	$949,812	$2,235,897	$3,414,463	$3,128,880	$721,319	$53,586	$3,428,031	$13,931,987
Sporting goods	$624,818	$3,501,994	$2,102,513	$8,053,398	$2,228,422	$147,025	$1,369,571	$18,027,741
Souvenirs and other expenses	$629,747	$2,205,488	$3,530,938	$1,115,800	$576,551	$60,028	$5,586,754	$13,705,308
Total	$13,238,542	$67,544,270	$70,625,195	$62,089,768	$31,621,506	$2,019,328	$82,759,098	$329,897,708

1. This table provides estimates of the share of spending by national forest visitors corresponding to recreation in greater sage-grouse range in Utah. Included are Ashley, Dixie, Fishlake, Manti-LaSal, Sawtooth, Uinta, and Wasatch-Cache national forests. The most recent surveys at these forests were completed from FY 2005 to FY 2012, with amounts adjusted for inflation to 2014 dollars.
2. Spending excludes visitors whose primary activity was skiing, most of which takes place in alpine ski resorts unsuitable for greater sage-grouse habitat.
3. Whether a trip is considered local or nonlocal depends on whether visitors travelled more than 50 miles from home to visit the national forest.
4. Overnight trips where the party spent the night on the national forest
5. Overnight trips where the party spent the night outside the national forest
6. Non-primary trips have a primary purpose other than recreating on the national forest visited.

Source: BEBR analysis of data from U.S. Forest Service, National Visitor Use Monitoring.

Table 8.A2 provides visitation by state park in support of Table 8.10 in the main document.

Table 8.A2
Utah State Parks in Greater Sage-Grouse Range with
2014 Recreation Visits

		SHARE OF AREA IN RANGE		
State Park	**Visitation**	**FWS Current Range**	**Historical-only Range**	**SGMAs**
Bear Lake	213,346	82.6%	0.0%	68.5%
Deer Creek	218,886	28.6%	64.2%	0.0%
East Canyon	95,166	100.0%	0.0%	100.0%
Escalante	46,521	0.0%	99.9%	0.0%
Hyrum	50,827	0.0%	92.8%	0.0%
Jordan River OHV	91,710	0.0%	45.5%	0.0%
Jordanelle	275,225	85.5%	0.0%	0.0%
Kodachrome Basin	73,002	0.0%	100.0%	0.0%
Otter Creek	25,838	100.0%	0.0%	100.0%
Palisade[1]	100,059	0.0%	100.0%	0.0%
Piute	2,143	0.0%	100.0%	0.0%
Red Fleet	24,979	100.0%	0.0%	100.0%
Rockport	104,683	95.3%	0.0%	0.0%
Scofield	24,889	100.0%	0.0%	100.0%
Starvation	83,729	0.0%	81.6%	0.0%
Steinaker	25,024	92.8%	7.2%	92.8%
Union Pacific Rail Trail[2]	–	–	–	–
Wasatch Mountain[3]	308,087	0.0%	19.8%	0.0%
Willard Bay	227,315	0.0%	1.4%	0.0%
Yuba	99,237	0.0%	100.0%	0.0%
Total in range	**2,090,666**	**26.0%**	**27.1%**	**14.3%**
Total outside range[5] (parks not listed)	**1,915,559**	**0.0%**	**0.0%**	**0.0%**
Grand Total	**4,006,225**	**15.2%**	**15.9%**	**8.4%**
Estimated Visitation[6]	*4,006,225*	*767,882*	*684,484*	*340,267*
Visitation Shares	*100%*	*19.2%*	*17.1%*	*8.5%*

1.. Visitation includes Palisade Golf Course.
2. Visitation and land area share data are not available, although it appears portions of the 28-mile, 443-acre trail are within FWS current range, historical range, and an SGMA.
3. Visitation includes Wasatch Mountain and Soldier Hollow golf courses.
4. Values in this row are for the 20 listed parks at least partially in greater sage-grouse ranges or SGMAs.
5. The remaining 23 state parks entirely outside greater sage-grouse habitat
6. For this row, visitation to each state park is prorated by the share of the park's land area within habitat. Shares are 0% for 23 parks, given in this table for 19 parks, and missing for one park (see note 2).

Source: BEBR analysis of data from Utah Division of Parks and Recreation, Utah Division of Wildlife Resources, Utah AGRC, U.S. Fish and Wildlife Service.

9 ESA Listing and Private Property Values

Federal law governs species listed as endangered or threatened and protects their habitats across public and private lands. An ESA listing of the greater sage-grouse has the potential to affect private property values in parts of Utah. For example, across greater sage-grouse range, an ESA listing could interfere with owner choices regarding landscaping and construction or reduce the productivity of lands intended for crop agriculture or oil extraction.

FWS current range of the greater sage-grouse occupies 31 percent of Utah's 11.4 million acres of private property outside of cities and other Census places (see Table 1.1).[38] Historical-only range and SGMAs are somewhat smaller but still over 20 percent. A preliminary review of aggregate county-level data suggests some $5.7 billion in agricultural and non-primary residential property values may be located in FWS current range, 2.5 percent of the total assessed value of privately owned real property in Utah. Historical-only range and SGMAs may contain $5.2 billion and $3.9 billion, respectively, of private property.

The acreage of private property in greater sage-grouse areas varies widely by county (Table 9.1). For example, outside of Census places, no private property in Salt Lake or Washington counties is within FWS current range or SGMAs, while virtually all 367,000 acres of private land outside of Census places in Rich County are within these greater sage-grouse designations.

The market value of all real property in Utah was $228.7 billion in 2013, adjusted for inflation to 2014 dollars (Utah State Tax Commission 2014b). These values are concentrated in urban areas away from greater sage-grouse. In the absence of parcel-level valuation data for private properties in or near sage-grouse habitat, we have identified two types of property that commonly occur in greater sage-grouse habitat in the state: agricultural lands[39] and residential properties besides primary residences.[40]

Agricultural and non-primary residential lands are more likely than primary residences or commercial and industrial sites[41] to be affected by any future ESA requirements for greater sage-grouse. For example, farm and cabin resale values would depend on the freedom to carry out agricultural, recreational or other activities. Because primary residences and commercial and industrial properties are generally located in settled areas, their use is unlikely to be affected by an ESA listing. Thus, in Table 9.1, we omit market values for primary residences and commercial and industrial properties.

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[38] See Section 1.3.3 for a definition of places.

[39] Agricultural properties include buildings and lands capable of providing forage or growing crops, including unused lands. These properties may be irrigated, dryland, pasture, orchards, or meadows.

[40] Primary residences are properties under one acre where someone lived at least 183 days during the year. "Non-primary residential" in Table 9.1 includes second homes, recreational properties, and undeveloped lands. Most of these are located outside of cities, towns, and other Census places, with the possible exception of Summit County, where a significant portion of non-primary residential properties are located within established communities. Some agricultural and non-primary residential properties are in cities or other populated areas where greater sage-grouse would not be found. In that regard, taking habitat shares of the property values given in Table 9.1 may overstate values at risk in the event of an ESA listing. On the other hand, some primary residences and commercial or industrial properties are found in rural habitat areas, and Table 9.1 is conservative in omitting those.

[41] Commercial and industrial properties include stores, offices, factories, warehouses, etc.

The total assessed market value of both agricultural and non-primary residential properties in Utah was $20.3 billion in 2013, given in inflation-adjusted 2014 dollars (Table 9.1). Residential properties besides primary residences were valued at $11.5 billion; agricultural properties were valued at $8.8 billion. Amounts vary widely by county, from a combined $38 million in Juab County, where one-fourth of private lands outside of places were in FWS current range, to a combined $3.1 billion in Summit County, where 62.4 percent of these lands are in FWS current range.[42]

Table 9.1
Private Lands, Greater Sage-Grouse, and Property Values in Utah

County	Total Private Lands (Acres)	Shares of Private Land Area in... FWS Current Range	Historical-only Range	SGMAs	2013 Market Value[1] (Millions of 2014 dollars) Non-Primary Residential[2]	Agricultural[3]
Beaver	202,194	37.6%	26.9%	28.1%	$48.1	$141.5
Box Elder	1,805,862	49.5%	28.0%	44.3%	$11.5	$265.6
Cache	304,817	20.5%	58.4%	20.1%	$150.7	$468.7
Carbon	351,276	60.1%	0.0%	43.7%	$74.2	$64.3
Daggett	47,041	68.5%	30.3%	31.6%	$84.4	$17.9
Davis	24,065	0.0%	22.9%	0.0%	$62.5	$427.6
Duchesne	584,021	39.2%	39.2%	9.3%	$147.1	$258.5
Emery	223,813	4.0%	0.2%	2.0%	$16.7	$28.6
Garfield	149,987	63.8%	22.7%	63.8%	$185.5	$109.4
Grand	95,700	2.5%	0.0%	0.0%	$195.7	$122.6
Iron	719,166	9.4%	62.8%	9.4%	$421.9	$417.5
Juab	367,859	25.2%	54.4%	7.7%	$21.4	$16.3
Kane	251,911	21.1%	13.6%	20.7%	$429.7	$230.0
Millard	571,311	0.6%	58.5%	0.0%	$32.8	$137.4
Morgan	355,459	52.4%	13.8%	42.3%	$50.3	$87.8
Piute	48,017	41.0%	38.8%	41.0%	$24.9	$17.9
Rich	367,318	99.6%	0.0%	98.6%	$416.1	$135.7
Salt Lake	134,321	0.0%	23.7%	0.0%	$2,046.7	$69.9
San Juan	389,166	0.0%	0.0%	0.0%	$23.6	$74.5
Sanpete	423,654	22.0%	58.2%	2.8%	$186.5	$187.6
Sevier	221,306	18.5%	52.2%	15.1%	$50.4	$88.7
Summit	580,614	62.4%	3.9%	43.3%	$1,710.2	$1,391.4
Tooele	439,784	32.2%	27.0%	17.2%	$15.3	$233.2
Uintah	408,841	61.7%	32.8%	34.5%	$50.3	$205.8
Utah	343,053	15.2%	53.2%	13.7%	$182.9	$1,887.7
Wasatch	219,945	55.8%	15.5%	30.6%	$1,869.6	$260.9
Washington	153,558	0.0%	25.4%	0.0%	$2,235.7	$1,281.8
Wayne	51,537	40.0%	0.0%	3.3%	$77.5	$63.4
Weber	186,496	16.0%	29.0%	1.4%	$671.1	$113.4
Statewide	10,022,090	35.1%	30.8%	25.5%	$11,493.1	$8,805.6

Note: Acreage and shares in this table are for private lands outside of U.S. Census places, which consist of incorporated municipalities and unincorporated Census-designated places.
1. Market values were estimated by county and central assessors for property tax purposes. The other two real property categories, primary residences and commercial and industrial properties, are not reported here, being less common in sage-grouse habitat.
2. Residential properties in excess of one acre and those not occupied by a primary resident for more than half of 2013.
3. Lands capable of providing forage or growing crops.
Source: Utah State Tax Commission (2013) and BEBR analysis of data (shapefiles) from U.S. Fish & Wildlife Service; Utah Division of Wildlife Resources; and State of Utah, SGID.

[42] Washington County, at $3.5 billion, has greater property values of both types (agricultural and non-primary residential), but FWS has not identified any private lands as part of current greater sage-grouse range.

To clarify, this study does not establish the portion of private property values that are within greater sage-grouse range or SGMAs. While this section permits rudimentary judgments, additional research would be needed to construct precise estimates. Additionally, the section makes no representation regarding the amount by which private property values in those areas may be affected by an ESA listing. Research documenting such impacts following ESA listings of other species is lacking, and scenarios for the greater sage-grouse in Utah would be conjectural.

REFERENCES

Baxter, Rick J., Kevin D. Bunnell, Jerran T. Flinders, and Dean L. Mitchell. 2007. "Impacts of predation on greater sage-grouse in Strawberry Valley, Utah," *Transactions of the 72nd North American Wildlife and Natural Resources Conference.* www.wildlifemanagementinstitute.org/PDF/8-Impacts%20of%20Predation....pdf.

Bernales, Heather B., Jason D. Robinson, and Blair Stringham. 2015. *Utah Upland Game Annual Report 2013–14*, Utah Division of Wildlife Resources. wildlife.utah.gov/uplandgame/annual reports.

Boden, Taylor, Michael Vanden Berg, Ken Krahulec, and Andrew Rupke. 2014. *Utah's Extractive Resource Industries 2013.* Utah Geological Survey Circular 118. files.geology.utah.gov/online/c/c-118.pdf

Bureau of Land Management. 2013. *Cedar City Field Office Resource Management Plan: Analysis of the Management Situation*; www.blm.gov/epl-front-office/projects/lup/7100/42732/45531/CCFO_AMS_pdf.

Caudill, Danny, Michael R. Guttery, Brent Bibles, Terry A. Messmer, Gretchen Caudill, Erin Leone, David K. Dahlgren, and Renee Chi. 2014. "Effects of climatic variation and reproductive trade-offs vary by measure of reproductive effort in greater sage-grouse." *Ecosphere* 5(12): 154.

Connelly, John W., E. Thomas Rinkes, and Clait E. Braun. 2011. "Characteristics of Greater Sage-Grouse Habitats," in *Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and Its Habitats,* edited by Steven T. Knick and John W. Connelly, pp. 69–83. Berkeley, CA: University of California Press.

Guttery, Michael R., Terry A. Messmer, Mark W. Brunson, Jason D. Robinson, and David K. Dahlgren. 2015. "Declining populations of greater sage-grouse; hunter motivations when numbers are low." *Animal Conservation* (May 2015).

Hagen, Christian A. 2011. "Predation on Greater Sage-Grouse: Facts, Process, and Effects," in *Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and Its Habitats,* edited by Steven T. Knick and John W. Connelly, pp. 95–100. Berkeley, CA: University of California Press.

Jakus, Paul, Mary Jo Kealy, John Loomis, Nanette Nelson, Jeff Ostermiller, Cody Stanger, and Nicholas von Stackelberg. 2013. *Economic Benefits of Nutrient Reductions in Utah's Waters,* prepared for the Utah Division of Water Quality. Utah State University.

Knick, Steven T., and John W. Connelly, eds. 2011. *Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and Its Habitats.* Berkeley: University of California Press.

Knick, Steven T., Steven E. Hanser, Richard F. Miller, David A. Pyke, Michael J. Wisdom, Sean P. Finn, E. Thomas Rinkes, and Charles J. Henny. 2011. "Ecological Influence and Pathways of Land Use in Sagebrush," in *Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and Its Habitats,* edited by Steven T. Knick and John W. Connelly, pp. 203–251. Berkeley, CA: University of California Press.

Martini, Jay, Wildlife Biologist, U.S. Fish and Wildlife Service, Utah Ecological Services Field Office. Personal communication, February 24, 2015.

Messmer, Terry A., Professor, Utah State University, Department of Wildland Resources. Personal communication, July 9 and 12, 2015.

Miller, Richard F., Steven T. Knick, David A. Pyke, Cara W. Meinke, Steven E. Hanser, Michael J. Wisdom, and Ann L. Hild. 2011. "Characteristics of Sagebrush Habitats and Limitations to Long-Term Conservation," in *Greater Sage-Grouse: Ecology and Conservation of a Landscape Species*

and Its Habitats, edited by Steven T. Knick and John W. Connelly, pp. 145–184. Berkeley, CA: University of California Press.

National Marine Fisheries Service. 1999. "Endangered and Threatened Wildlife and Plants; Definition of 'Harm'," *Federal Register* 64:60727–60731, November 8, 1999. www.fws.gov/endangered/esa-library/pdf/f991108.pdf.

Reese, Kerry P., and John W. Connelly. 2011. "Harvest Management for Greater Sage-Grouse," in *Greater Sage-Grouse: Ecology and Conservation of a Landscape Species and Its Habitats,* edited by Steven T. Knick and John W. Connelly, pp. 101–111. Berkeley, CA: University of California Press.

Sanders, Marren. 2007. *Implementing the Federal Endangered Species Act in Indian Country,* Joint Occasional Papers on Native Affairs: Native Nations Institute for Leadership, Management and Policy and the Harvard Project on American Indian Economic Development. nni.arizona.edu/resources/pubs/jopna%202007_01_endangered.pdf.

Sheehan, Greg, Director, Utah Division of Wildlife Resources, panelist at *Utah's Sage-Grouse Summit,* February 19, 2014, Salt Lake City.

U.S. District Court for the District of Columbia. 2011. *WildEarth Guardians v. Salazar: Stipulated Settlement Agreement May 10, 2011.* Case 1:10-mc-00377-EGS in Endangered Species Act Section 4 Deadline Litigation. ecf.dcd.uscourts.gov/doc1/04513401230.

U.S. Fish and Wildlife Service. 2010. "Endangered and Threatened Wildlife and Plants; 12-Month Findings for Petitions to List the Greater Sage-Grouse (*Centrocercus urophasianus*) as Threatened or Endangered," *Federal Register* 75:13910–14014, March 23, 2010. www.gpo.gov/fdsys/pkg/FR-2010-03-23/pdf/2010-5132.pdf.

——. 2013a. *2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.* U.S. Department of the Interior. www.census.gov/prod/2012pubs/fhw11-nat.pdf.

——. 2013b. *Greater Sage-grouse (Centrocercus urophasianus) Conservation Objectives: Final Report.* www.fws.gov/mountain-prairie/pressrel/2013/03252013_COT.html.

——. 2014a. "Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Threatened or Endangered," *Federal Register* 79:72450–72497, December 5, 2014. www.gpo.gov/fdsys/pkg/FR-2014-12-05/pdf/2014-28536.pdf.

——. 2014b. "Endangered and Threatened Wildlife and Plants; Threatened Status for Gunnison Sage-Grouse," *Federal Register* 79:69192–69310, November 20, 2014. www.gpo.gov/fdsys/pkg/FR-2014-11-20/pdf/2014-27109.pdf.

Utah Automated Geographic Reference Center. 2015. *Road centerlines.* April 1, 2015. gis.utah.gov/data/sgid-transportation/roads-system.

Utah Division of Wildlife Resources. 2002. *Strategic Management Plan for Sage-Grouse*; wildlife.utah.gov/uplandgame/pdf/2002manplan.pdf.

——. 2009. *Utah Greater Sage-Grouse Management Plan*; wildlife.utah.gov/uplandgame/sage-grouse/pdf/management_plan_2009.pdf.

——. 2013. *Conservation Plan for Greater Sage-Grouse in Utah*; wildlife.utah.gov/uplandgame/sage-grouse/pdf/greater_sage_grouse_plan.pdf.

——. 2014. *Greater sage-grouse occupied leks*; dwrcdc.nr.utah.gov/ucdc/downloadgis/disclaim.htm.

Utah State Tax Commission. 2014a. *Off-Road Registrations by County and Vehicle Type.* Economic and Statistical Unit. tax.utah.gov/econstats/mv/registrations-2010.

——. 2014b. *Utah Property Tax 2013 Annual Statistical Report*; propertytax.utah.gov.

Utah State University Extension. 2011. *Sage-Grouse Habitat in Utah: A Guide for Landowners and Managers,* Utah Sage-grouse Community Based Conservation Program; utahcbcp.org/files/uploads/LandownerGuideSageGrouse.pdf.

Vanden Berg, Michael D., 2008, *Basin-Wide Evaluation of the Uppermost Green River Formation's Oil-Shale Resource, Uinta Basin, Utah and Colorado.* Utah Geological Survey Special Study 128.

White, Eric M., Darren B. Goodding, Daniel J. Stynes. 2013. *Estimation of National Forest Visitor Spending Averages from National Visitor Use Monitoring: Round 2.* U.S. Forest Service. www.fs.fed.us/pnw/pubs/pnw_gtr883.pdf