MORGAN-SUMMIT GREATER SAGE-GROUSE (*CENTROCERCUS UROPHASIANUS*) LOCAL CONSERVATION PLAN

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Morgan-Summit Adaptive Resource Management Local Working Group

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Utah State University Extension
UMC 5230
Logan, Utah 84322-5230

and

Jack H. Berryman Institute
UMC 5230
Logan, Utah 84322-5230

and

Utah Division of Wildlife Resources
1594 W. North Temple
Salt Lake City, Utah 84116

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Morgan-Summit Greater Sage-grouse (*Centrocercus urophasianus*)
Local Conservation Plan

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I. Executive Summary

The Morgan-Summit Greater Sage-grouse Conservation Plan (Plan) is the culmination of a year-long effort by the Morgan-Summit Adaptive Resource Management Local Working Group (MSARM). MSARM members include representatives from state and federal land management and resource agencies, as well as private landowners. MSARM formed in 2005 to proactively manage Greater Sage-grouse (*Centrocercus urophasianus*) populations and their habitats in response to increasing concern about the status of sage-grouse populations rangewide and within their local area. The impetus for the writing of this Plan came from a mandate by the Utah Division of Wildlife Resources (UDWR) in their Statewide Strategic Management Plan, passed by the Wildlife Board in 2002.

The Plan will provide an assessment of the status of Morgan and Summit Counties sage-grouse population. The intent of the Plan is to provide guidance and recommendations to meet the overall goal of maintaining and, where possible, increasing sage-grouse populations and improving habitat conditions in Morgan and Summit Counties. The Plan is designed to meet the guidelines set forth by the United States Fish and Wildlife Service (USFWS) in their Policy for Evaluation of Conservation Efforts (PECE) standards.

The Plan directly and indirectly addresses the five USFWS listing factors as they apply to Greater Sage-grouse in Morgan and Summit Counties. Recommendations and guidance suggested within the Plan can be adopted by all MSARM partners on a voluntary basis. MSARM encourages participation and adoption of these practices, where applicable, by private landowners in the local area. Participation by private landowners and consideration of landowner needs are critical for management of sage-grouse populations and habitat located on private lands and will be instrumental in meeting the overall goals of the Plan. True success will only be achieved by managing on a landscape scale. The Plan provides an opportunity to promote ecologically sound management of private and public lands for sage-grouse without impinging on private property rights.

Information contained in the Plan is based on a thorough review of the published and unpublished literature relevant to sage-grouse and sagebrush habitats, and also on the intimate, local knowledge possessed by MSARM partners who live and work in the area. Because a wealth of general information exists about sage-grouse and is available in published documents (Connelly et al. 2000, Connelly et al. 2004), we provide only a brief overview of general sage-grouse ecology and try instead to focus on conditions and issues specific to Morgan and Summit Counties. Knowledge gaps are also identified.

MSARM analyzed threats currently or potentially affecting sage-grouse and sagebrush habitats in Morgan and Summit Counties. The Threat Analysis, combined with recommended strategies and actions, provides a framework for implementation of the Plan over the next ten years by MSARM partners. Implementation will be conducted within an adaptive resource management framework. As relevant information from a local and rangewide perspective becomes available, it will be used to modify and refine management strategies, priorities, and general understanding of sage-grouse ecology in the area. Annual evaluation and reporting performed by MSARM, will track progress on the objectives outlined in this Plan.

II. Introduction

A. Purpose

The mission of the Morgan-Summit Adaptive Resource Management Sage-grouse Conservation Plan is to aid in reaching the goal of maintaining and improving current abundance and viability of Greater Sage-grouse (*Centrocercus urophasianus*) populations and their habitat in Morgan and Summit Counties. Implementation of the Plan will take into consideration historic land uses and long-term social and economic issues. The Plan will help to meet this goal by providing management solutions based on local or compatible data and research to the extent practical. In addition, MSARM hopes to develop management solutions that will result in diverse and productive sagebrush habitat for sage-grouse, while simultaneously recognizing that healthy sagebrush habitats are valuable to the existence of other species. The Plan will identify management areas, key local issues, conservation strategies, population information, research and monitoring needs, and support long term funding. Adaptive management will be used to maintain the Plan as a continuously evolving document. The Plan will coordinate development of project proposals with the Northern Region Utah Partners for Conservation and Development Regional Team to maintain and enhance sage-grouse habitat.

This Plan was called for in, and builds upon, the Utah Greater Sage-grouse Strategic Management Plan (Strategic Plan), passed by the Utah Wildlife Board in 2002. The Strategic Plan was developed by the Utah Greater Sage-grouse Working Group, which included representatives from state and federal natural resource agencies, and local conservation organizations concerned with the health and proper management of Greater Sage-grouse and sagebrush-steppe ecosystems throughout Utah. The primary purpose of the Strategic Plan was to address declining populations of sage-grouse and to develop a framework for agencies to work within. Further, the Strategic Plan identifies certain management units throughout the state where Adaptive Resource Management Local Working Groups could be organized to identify local issues and implement local adaptive resource management plans. These groups will work collaboratively to address declining sage-grouse populations, and the loss, degradation, and fragmentation of sagebrush steppe communities, with the end goal of protecting and conserving these and other natural resources.

The Plan is designed to meet the guidelines set forth by the USFWS in their PECE standards. The USFWS uses PECE standards as a guideline to evaluate whether conservation plans will be considered when making listing and listing priority decisions. The Plan was written to address the USFWS five Listing Factors which are:

1. Present or threatened destruction, modification, or curtailment of its habitat or range
2. Over-utilization for commercial, recreational, scientific, or educational purposes
3. Disease or predation
4. Authorities and inadequacy of existing regulatory mechanisms
5. Other natural or man-made factors affecting its continued existence

The Plan directly and indirectly address the five USFWS listing factors as they apply to Greater Sage-grouse (hereafter referred to as sage-grouse) in Morgan and Summit Counties. In addition, the Plan will identify issues, potential strategies, and provide for implementation of proposed conservation actions. The Plan is neither a National Environmental Policy Act (NEPA) decision

document, nor a federal or state recovery plan. Any Candidate Conservation Agreement with Assurances developed by the UDWR will be based on the Plan, but will include the NEPA process. Use of this plan by agencies, private enterprise, and private individuals is strictly voluntary. State and federal resource management agencies involved with sage-grouse management, however, are required to manage sage-grouse populations and habitat by various state and federal statutes and policies. The information contained in the Plan is intended to serve as a set of guidelines for those state and federal agencies to maintain and enhance sage-grouse habitat and sage-grouse populations in Morgan and Summit Counties. Participation by private landowners and consideration of landowner needs, are critical for management of sage-grouse populations and habitat located on private lands and will be of great importance to meet the overall goals of the Plan. True success will only be achieved by managing on a landscape scale. The Plan provides an opportunity to promote ecologically sound management of private and public lands for sage-grouse, without impinging on private property rights.

It is the intent of MSARM that this Plan be read and interpreted in its entirety. If the reader reads only isolated sections of this Plan, single statements may be taken out of context or misinterpreted.

B. Goals and Scope

The goals of the Plan are separated into two categories: Assessment Goals and Strategy Goals. The goals are not listed in any particular order.

Assessment Goals:

The Plan will provide an assessment of the status of the sage-grouse population in Morgan and Summit Counties by accomplishing the following goals:

1. Estimate current population size and evaluate population trends; estimate amount and condition of habitat.
2. Identify research needs and knowledge gaps.
3. Determine population and habitat needs for the future.
4. Identify and discuss threats that have potential to impact sage-grouse in Morgan and Summit Counties, especially those associated with the five USFWS Listing Factors.

Strategy Goals:

The intent of the Plan is to maintain and, where possible, increase sage-grouse populations and improve habitat conditions in Morgan and Summit Counties by carrying out the following goals:

1. Incorporate management strategies from state and federal agency partners, local governments, and established rangewide conservation and management guidelines (Connelly et al. 2000, Connelly et al. 2004).
2. Increase effective communication with all potential stakeholders in Morgan and Summit Counties and the state of Utah, through outreach, information distribution, and education.
3. Address and prioritize threats to aid in prioritizing management solutions.
4. Identify and pursue funding sources, or support partners in their pursuance of funding for projects that will help achieve specific strategies and actions.

Scope

This Plan is designed to span multiple land ownerships and multiple land uses throughout the defined geographic area. It is hoped that through implementation of this adaptive plan, specific conservation issues will be addressed, implemented, and monitored across geographic and political boundaries to increase consistency of the practices implemented and information collected. The assessment and strategies described herein are specific to Morgan and Summit Counties, and were developed with the unique ecological, social, and economic concerns of that area in mind. A detailed description of the Morgan-Summit Resource Area is provided later in the Plan.

C. Plan Duration

The Plan was designed and written to be a dynamic document that can adapt with the needs of the local sage-grouse population, habitats, and local community as necessary. MSARM will re-evaluate sage-grouse populations and habitats, and will review progress on strategies listed in the Plan as per the Standard Operating Procedures (SOP) (Appendix A). The Plan was written to support conservation actions over a ten-year period. Early termination of the Plan would occur if the sage-grouse was listed under the Endangered Species Act (ESA) or if sage-grouse were removed from the UDWRs Sensitive Species list. Species on the Sensitive Species list include species that are federally listed, are candidates for federal listing, or for which there is "credible scientific evidence to substantiate a threat to continued population viability" (Utah Division of Wildlife Resources 2005).

D. Morgan-Summit Adaptive Resource Management Local Working Group

As a result of the Strategic Plan, the MSARM was formed in 2005 and has worked consistently and cooperatively toward the completion and implementation of the Plan since that time. MSARM was organized and facilitated by Sarah G. Lupis of Utah's Community-Based Conservation Program (CBCP), a collaborative partnership between the UDWR and Utah State University Extension Services, with support from the Jack H. Berryman Institute. Ms. Lupis also served as the technical writer and compiler of the Plan itself. MSARM is comprised of state and federal agency personnel, representatives from local government, non-profit organizations, academic institutions, private industry, and private individuals. The agencies, organizations, and individuals who contributed to the Plan through their participation in MSARM are listed in Table 1. When 'we' or 'our' is used in the Plan, it refers to MSARM.

The role of MSARM participants is to guide the development of the Plan and to represent their agencies. After completion of the plan, MSARM participants will continue to meet to update the Plan, and through an adaptive process incorporate the results of research and monitoring efforts, new information, and lessons learned. Guidance for continued operation of MSARM can be found in the SOP (Appendix A). The director of the UDWR has the ultimate authority for the Plan.

Prior to writing the Plan, we reviewed several local sage-grouse conservation plans, statewide plans, and rangewide plans and assessments (UDWR 2002, Armentrout et al. 2004, Lincoln County Sage-grouse Technical Review Team 2004, Northwest Colorado Greater Sage-Grouse

Working Group 2004), to determine the most appropriate structure and content. In addition, a thorough literature review was conducted to ensure that the Plan contained the most recent information available on sage-grouse ecology, life history, and habitat requirements. Annual working group meetings, work plans, and accomplishment reports will monitor progress toward meeting the goals of the Plan. The Plan is intended to be an evolving document. Incorporating principles of adaptive management and changing as new information arises, will help to ensure success of the Plan and MSARM.

Table 1. Morgan-Summit Adaptive Resource Management Local Working Group partners.

Bureau of Land Management (BLM)
Farm Bureau Federation
Farm Services Agency (FSA)
Morgan County Council
Natural Resource Conservation Service (NRCS)
Summit County Commission
Summit County Grazers
The Nature Conservancy (TNC)
USDA Forest Service (USFS)
USDA Wildlife Services (WS)
U.S. Fish and Wildlife Service (USFWS)
Utah Division of Wildlife Resources (UDWR)
Utah School and Institutional Trust Lands Administration (SITLA)
Utah State University Extension (USU/EXT)

Management strategies and recommendations described in the Plan will be periodically updated to incorporate results of research efforts, new information, and the results of management actions through annual reviews and progress reports.

MSARM operates through an open public process based on consensus decision making. For decisions regarding the Plan, consensus was reached by participating members and/or those present at the time the decision was made. Sections 5 and 6 of the ESA, direct state and federal agencies to cooperate in developing conservation activities that protect candidate species. Because the responsibility lies with state and federal agencies, ultimately decisions are limited to them. However, all agencies felt that it was important to involve the public in the decision-making and planning process to the greatest extent possible. The importance of public–private partnerships was highlighted in the Statewide Strategic Management Plan (UDWR 2002):

> "An important part of solving the habitat management problems that face sage-grouse, is to work together closely so that all landowners and land managers are aware of the needs of local populations and how to meet them."

MSARM provided regular opportunities for public involvement, participation, and comment on the Plan. Regular meetings were scheduled to meet the needs of the greatest number of MSARM participants possible. Meetings were announced by direct mailings, on the CBCP website

(www.extension.usu.edu/cbcp), via email, and through personal phone calls and invitations. During the planning process, MSARM met at least every other month and often monthly. Meeting minutes and critical updates were provided via email, direct mailing, and on the CBCP website. In addition, an annual community forum was held to update the local community on MSARMs activities and solicit participation and comment from local stakeholders. Annual forums were announced in a similar fashion as regular meetings. The CBCP provided informational material to County Extension offices for display and distribution to the local community, and CBCP personnel met regularly with County governments (commissions and councils) to update them on MSARMs activities and Plan progress. The final draft of the Plan was made available to all potential stakeholders that MSARM was aware of, and comments were encouraged.

E. Socioeconomic Considerations Including Consequences of Federal Listing

Communities in the Intermountain West are reflective of diverse and complicated relationships between natural resource extraction industries (agriculture, minerals, energy development, etc.), landownership (private vs. public), and local, state, and federal laws and regulations. These rural communities are reflective of cyclic (boom/bust) economies and global economics that drive commodity prices. In order to be successful, management recommendations and solutions designed to improve sage-grouse populations and habitats must reflect and be sensitive to local socioeconomic issues.

State and federal agencies will coordinate with local landowners, county, and local governments to develop solutions that will meet ecological requirements while maintaining social and economic values of the local community to the greatest extent possible. Participation by local stakeholders in the planning process has helped to ensure that recommendations and guidelines presented in the Plan will meet the needs of the local community. In many instances, cooperation between landowners and agencies results in more useful and cost-effective habitat improvement projects that ultimately benefit both sage-grouse and local interests.

Listing the sage-grouse under the provisions of ESA could have a variety of local impacts. Activities potentially affected include noxious weed control, maintenance of rights of way, subdivisions and land development, livestock grazing management, big game wildlife management, and recreational land use. Broadly applying ‘take’ regulations under ESA could have a significant local impact. There will likely be an increase in bureaucratic processes in environmental permitting and compliance. Ultimately, the listing could result in slowed growth and the elimination of new projects because of the increased cost of environmental permitting and compliance.

In the event of listing, this Plan, along with other local conservation plans, statewide conservation plans, and rangewide conservation assessments and strategies will be used by the USFWS to develop a federal recovery plan. Should these events transpire, the USFWS would also strive to consider social and economic needs to the maximum extent possible. In the July 1, 1994 Federal Register (59 FR 34272) the USFWS issued a policy to involve stakeholders in the preparation of federal recovery plans to help minimize the social and economic impacts of implementing recovery actions.

F. Management and Legal Authorities

Existing state, federal, and county regulations offer protection to sage-grouse in the Uintah Basin. State laws restrict possession of individual birds. Funding programs in Utah support population and habitat conservation and monitoring activities. Federal agencies including the Bureau of Land Management (BLM), U.S. Forest Service (USFS), National Park Service (NPS), Natural Resources Conservation Service (NRCS), and USFWS have laws, regulations, policies, and funding programs that authorize and support conservation efforts. In Morgan and Summit Counties, some provisions for wildlife or sage-grouse conservation or management are already in place.

Utah Division of Wildlife Resources (UDWR)

Title 23 of the Utah Code is the Wildlife Resources Code of Utah and provides the UDWR with the powers, duties, rights, and responsibilities to protect, propagate, manage, conserve, and distribute wildlife throughout the state. Section 23-13-3 declares that wildlife existing within the state, not held by private ownership and legally acquired, is property of the state. Sections 23-14-18 and 23-14-19 authorize the Utah Wildlife Board to prescribe rules and regulations for the taking and/or possession of protected wildlife.

The UDWRs wildlife management philosophy is captured in its Mission Statement, Strategic Plan, and Comprehensive Wildlife Conservation Strategy (CWCS) approved in 2005 (also known as the Utah Wildlife Action Plan). The mission of the Division of Wildlife Resources is "…to serve the people of Utah as trustee and guardian of the state's wildlife, and to ensure its future and values through management, protection, conservation and education." There are three goals associated with this mission. The resource goal states that the UDWR intends to, "Expand wildlife populations and conserve sensitive species by protecting and improving wildlife habitat." The UDWR 2005-2015 Strategic Plan calls for focusing efforts on increasing the abundance, distribution, and range for species of conservation need by sustaining and restoring habitat functions. A ten-year, 2005-2015 Comprehensive Wildlife Strategy (a.k.a. Utah Wildlife Action Plan) was approved in 2005 to address species and habitat of greatest conservation need, priorities for conservation, and actions and future implementation opportunities through partnerships.

Sage-grouse are classified as a "State Species of Concern" and are among the terrestrial species identified as being in the second tier (i.e., Tier II) of three priority categories of species identified in the CWCS. Approximately 60 species across 5 taxa in Utah are identified as being potentially petitioned for placement on the ESA defined Threatened and/or Endangered Species list.

Counties

The Morgan and Summit County Commissions serve as the executive and legislative branches of local government. They have the authority to:

1. Protect and promote the health, welfare, and safety of the people of Morgan and Summit counties.
2. Regulate land use, land planning, and quality and protection of natural resources,
3. Adopt regulations and policies to exercise such authorities, including the review and approval or denial of proposed activities and uses of land and natural resources (Summit County Code 2005).

The Summit County Code (2005, as amended) makes the following statements relevant to protection of wildlife in the county (Summit County Code 2005, 11-2-4-G):

> G. Wildlife, Range Areas, Migration Corridors: Care shall be taken to ensure that development shall not significantly affect wildlife birthing areas, critical winter range areas, and migration corridors.

Natural Resources Conservation Service (NRCS)

The United States Department of Agriculture (USDA) NRCS has authority to conserve sage-grouse through:
1. The Soil Conservation and Domestic Allotment Act of 1936, as amended (P.L. 74-46).
2. The Department of Agriculture reorganization Act of 1994 (P.L. 409-354; 7 U.S.C. 6962).
3. The Farm Security and Rural Investment Act (Farm Bill) of 2002 (P.L. 107-171).

The NRCS and Farm Service Agency (FSA) jointly implement programs which provide landowners with technical and financial assistance to restore and protect grassland, rangeland, pastureland, shrub land and certain other lands, through long-term agreements and easements.

The USDA NRCS offers help to private landowners through the 2002 Farm Bill programs to improve their range and pasture land for sage-grouse habitat. These practices include watershed practices on their private lands, such as water developments and fencing for prescribed grazing to improve livestock distribution. Vegetative or brush management practices with the seeding of introduced and native species of grasses and forbs for forage improvement to benefit both wildlife and domestic animals. Other Farm Bill programs include wildlife enhancement, conservation easements, watershed and riparian programs and programs to reduce soil erosion.

Bureau of Land Management (BLM)

The United Sates Department of Interior (USDI) BLM has authority for conservation of sage-grouse through:
1. The Federal Land Management Policy Act (FLMPA) of 1976 (43 U.S.C. 1701 et seq., 90 stat. 2743; PL 94-579)
2. The Sikes Act, Title II (16 U.S.C. 670 et seq.), as amended
3. The BLM Manual 6840, Special Status Species Management

Specifically, the FLMPA guidance on sensitive species authorizes that "the public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, and environmental, air, and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals…(43 U.S.C. 1701 Sec. 102 (a) (8))."

The 6840 Manual defines Special Status Species as "…any species which is listed, or proposed for listing, as threatened or endangered by the U.S. Fish and Wildlife Service or National Marine Fisheries Service under the provisions of the Endangered Species Act; any species designated by the U.S. Fish and Wildlife Service as a 'listed', 'candidate', 'sensitive' or 'species of concern',

and any species which is listed by the State in a category implying potential danger of extinction." The Manual provides for the BLM to implement management plans that conserve these species and their habitats, and to ensure that actions authorize, funded, or carried out by the BLM do not contribute to the need for the species to become listed under provisions of the ESA. In addition, the USFWS Policy: State-Federal Relationships (43CFR part 24.4 (c)) contends that the Secretary of the Interior is responsible for the management of non-wilderness BLM lands for multiple uses, including the conservation of fish and wildlife populations. Finally, the BLM provides conservation guidelines for management of sage-grouse on BLM lands in the National Sage-grouse Habitat Conservation Strategy (BLM 2005).

School and Institutional Trust Lands Administration (SITLA)

SITLA was created in 1994 to manage twelve real estate trusts granted to the state at statehood (1896) to Utah by the United States federal government. SITLA is an independent agency of the state government established to manage those lands for the support of common schools and other beneficiary institutions, under the Utah Enabling Act (Title 53C-School and Institutional Trust Lands Management Act).

Title to these trust lands is vested in the state as trustee to be administered for the financial support of the trust beneficiaries. As trustee, SITLA must manage the lands and revenues generated from the lands in the most prudent and profitable manner possible, and not for any purpose inconsistent with the best interest of the trust beneficiaries. The trust principles impose fiduciary duties upon the state, including a duty of undivided loyalty to, and a strict requirement to administer the trust corpus for the exclusive benefit of, the trust beneficiaries. The beneficiaries do not include other governmental institutions or agencies, the public at large, or the general welfare of the state. SITLA must be concerned with both incomes for the current beneficiaries, and the preservation of the trust corpus for future beneficiaries, which requires a balancing of short and long-term interests so that long-term benefits are not lost in an effort to maximize short-term gains. SITLA has no jurisdiction over wildlife populations on trust lands. Management of rangelands is addressed in Section 53C-5-101 of the School and Institutional Trust Lands Management Act, which states: 1) The director is responsible for the efficient management of all range resources on lands under the director's administration, consistent with his fiduciary duties of financial support to the beneficiaries; and 2) This Management shall be based on sound resource management principles.

United States Forest Service (USFS)

The USFS has authority for conservation of sage-grouse though:

1. The Multiple-Use Sustained Yield Act (MUSY) of 1960 (P.L. 86-517, 74 Stat. 215, 16 U.S.C. 528, 528-531)
2. The Sikes Act of 1960 (P.L. 86-797, 74 Stat. 1052, 16 U.S.C 670 et seq., as amended)
3. The Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (P.L. 93-378, 88 Stat. 476, as amended; 16 U.S.C. 1600, 1600-1614)
4. The National Forest Management Act (NFMA) of 1976 (P.L. 94-588, 90 Stat. 2949, 16 U.S.C. 472 et seq.) and its implementing regulations (36 CFR 219, 2005)
5. Public rangelands Improvement Act of 1978 (P.L. 95-514, 92 Stat. 1806, 43 U.S.C. 1901-1908)
6. USDA Regulation 9500-4 and the Forest Service Manual (FSM) Chapter 2600

MUSY directs the USFS to administer the National Forest for multiple uses including fish and wildlife purposes, in cooperation with interested State and local governmental agencies, and others. 'Multiple use' refers to the congruent and coordinated management of the various surface renewable resources so that they are utilized in a manner that will best meet the needs of the American people. The Sikes Act provides authority for cooperative planning, habitat improvement, and providing adequate protection for species considered to be threatened, rare, or endangered by a State agency. RPA and NFMA provide for comprehensive, integrated planning that will provide for the diversity of plant and animal communities to meet overall multiple-use objectives. USDA Regulation 9500-4 directs the USFS to manage "habitats for all existing native and desired nonnative plants, fish and wildlife species in order to maintain at least viable populations of such species." USFS policy includes provisions for the development of conservation strategies for species that could be negatively affected by forest plans or proposed projects (FSM 2621.2).

Memorandum of Understanding

There are two Memoranda of Understanding (MOU) that address conservation of sage-grouse. The first was signed in 1999 by members of the Western Association of Fish and Wildlife Agencies (WAFWA) to promote conservation and management of sage-grouse and their habitats. Thirteen states, including Utah, and two Canadian provinces were signatories to that MOU. The second MOU, signed in 2000, is between WAFWA, USFS, BLM, and the USFWS. This MOU provides for cooperation among state, provincial, and federal agencies in the development of a rangewide strategy to direct conservation of sage-grouse and their sagebrush habitats.

A MOU between state and federal agencies within the state of Utah is currently being developed. The MOU promotes the conservation of sage-grouse and their sagebrush habitats, encourages cooperation between signatories, and supports Adaptive Resource Management Local Working Groups as the primary format for addressing sage-grouse and sagebrush steppe issues in the state.

G. Policy for Evaluation of Conservation (PECE) Standards

The PECE Standards set criteria for the USFWS to use in determining whether a formalized conservation effort contributes to making listing a species unnecessary or contributes to forming a basis for listing a species as threatened, rather than endangered. The draft PECE was published on June 13, 2000 (65 FR 37102), and was finalized on March 28, 2003 (68 FR 15100-115). The PECE contains nine criteria the USFWS will use to evaluate that the conservation effort will be implemented, and six criteria to determine if the action will be effective. Conservation efforts included under this policy include those identified in conservation agreements, conservation plans, management plans, or similar documents developed by federal agencies, state and local governments, tribal governments, businesses, organizations, individuals, and a combination of the above. The criteria are not considered comprehensive. The USFWS will consider all appropriate factors and unique, specific circumstances when evaluating formalized conservation actions.

PECE reviews will be conducted to individual conservation actions (rather than conservation

plans). Should Greater Sage-grouse be petitioned for listing or be listed under the ESA, this Plan will be reviewed and assessed as part of the preparation of a listing decision and will follow the most recent procedural guidance. Neither PECE review of this Plan nor signature of this Plan by the USFWS constitutes a PECE review of this Plan.

III. Conservation Assessment

A. General Sage-grouse Biology/Ecology

Numerous authors have described various aspects of sage-grouse biology, ecology, and life history; several more have, in recent years, published summaries. For the purposes of this document, we have included the summary from the Statewide Strategic Plan (UDWR 2002) and would also recommend the Conservation of Sage-grouse and Sagebrush Habitats by Connelly et al. (2004) for a thorough discussion.

Physical Description

The sage-grouse is the largest grouse species in North America. Adult males are larger than adult females. Adult males weigh 4–7 pounds (1.7–2.9 kg) and are 27–32 inches (65–75 cm) long. In comparison, adult females weigh 2–4 pounds (1.0–1.8 kg) and measure 20–25 inches (50–60 cm) long. Both sexes have narrow, pointed tails and a variegated pattern of grayish brown, buff, and black on the upper parts of the body and a diffuse black abdominal pattern. Males have blackish brown throats and a dark V-shaped pattern on the neck, and white breast feathers. When strutting, males inflate two gular sacs of olive green skin and erect hair-like black feathers (filoplumes) on the back of the neck. Females lack the V-shaped pattern, their throats are buff, and their lower throats and breasts are barred with blackish brown (Schroeder et al. 1999).

There are noticeable morphological differences between Greater Sage-grouse and Gunnison Sage-grouse. Gunnison Sage-grouse are two-thirds the size of Greater Sage-grouse. Gunnison Sage-grouse tail feathers have horizontal white barring along their length compared to a variegated pattern found in Greater Sage-grouse. The filoplumes, found only on male sage-grouse, are much thicker and denser in Gunnison Sage-grouse than in Greater Sage-grouse. There are also noticeable differences in the strutting behavior of the two sage-grouse species (Young et al. 2000).

Seasonal Movements and Home Range

Sage-grouse populations can be defined as one of two types: 1) non-migratory – grouse do not make long-distance movements between seasonal ranges, and 2) migratory – grouse make long-distance movements between distinct seasonal ranges. Movements between seasonal ranges can exceed 45 miles (75 km) (Connelly et al. 1993).

Home range size for migratory sage-grouse populations can exceed 540 mi^2 (1,500 km^2) (Hulet 1983). For non-migratory sage-grouse populations, home range size varies from 4–11 mi^2 (11 to 31 km^2). Sage-grouse exhibit high fidelity to seasonal ranges (Fischer et al. 1993). Females return to the same area to nest each year and may nest near their previous year's nesting site (Bunnell et al. 2000, Gates 1983).

Breeding

The center of breeding activity for sage-grouse is the 'lek' or strutting ground. Male sage-grouse

begin to congregate on leks in early March and perform a ritualized courtship display. Use of leks may continue as late as early June. Mating occurs on the lek. Fifty to ninety percent of the males utilize leks during the breeding season. As sage-grouse populations decline, the number of males attending leks may decline or the use of some leks may be discontinued. Likewise, as populations increase, male attendance on leks may increase and/or new leks may be established or old leks reoccupied (Connelly et al. 1981).

Nesting/Reproduction

Nesting generally takes place 1-2 weeks after mating and may continue as late as early June (Wallestad 1975). Sage-grouse generally have lower reproductive rates and higher survival rates than other species of upland game birds (Connelly and Braun 1997). Nesting rates vary from year to year and from area to area (Bergerud 1988, Connelly et al. 1993, Schroeder 1997, Coggins 1998). Connelly et al. (1993) reported that in Idaho up to 45% of yearling and 22% of adult female sage-grouse do not nest each year. Schroeder (1997) found that essentially all female sage-grouse in Washington nested. The variation is most likely a result of the quality of nutrition available and the health of pre-laying females (Barnett and Crawford 1994). Re-nesting by sage-grouse varies regionally from 20% (Hulet 1983, Connelly et al. 1993) to greater than 80% (Schroeder 1997). In summary, sage-grouse have the lowest reproduction rate of any North American game bird and as a result, populations are not able to recover from low numbers as quickly as those of most other game birds.

Sage-grouse nest success varies from 12–86% (Trueblood 1954, Gregg 1991, Schroeder et al. 1999). Adult females may experience higher nest success rates than yearling females (Wallestad and Pyrah 1974). However, differential nest success between age groups has not been observed in other studies (Connelly et al. 1993, Schroeder 1997). Nest success is dependent on vegetation cover type (Gregg 1991). Gregg (1991) reported that the highest nest success occurred in mountain big sagebrush (*A. t. vaseyana*) cover type. The greater cover of medium-height shrubs with grass 7 inches (>18 cm) in height, increases sage-grouse nest success (Gregg et al. 1994).

Clutch size of sage-grouse is extremely variable and relatively low compared to other species of game birds (Schroeder 1997). Average clutch size for first nests varies from 6.0–9.5 throughout the species range (Schroeder 1997, Sveum 1998). These differences may be related to habitat quality and overall health of pre-laying females (Coggins 1998).

Survival Rates

Annual survival rates for yearling and adult female sage-grouse vary from 35-85%; adult male survival rates vary from 38-54% (Wallestad 1975, Zablan 1993, Connelly et al. 1994). Lower survival rates for males may be related to physiological demands of sexual dimorphism and higher predation rates on males during the breeding season (Swenson et al.1987).

Sage-grouse predators include raptors, coyotes, ravens, squirrels, and skunks. The increase in urban development has resulted in the addition of non-native predators such as dogs, cats, and foxes (Connelly et al. 1991).

Little information has been published on mortality of juvenile sage-grouse, or the level of

production necessary to maintain a stable population. Among western states, long-term juvenile to hen ratios have varied from 1.40–2.96 juveniles per hen in the fall. In recent years, this ratio has declined to 1.21–2.19 juveniles per hen (Connelly and Braun 1997). It is thought that at least 2.25 juveniles per hen should be present in the fall population to allow for stable to increasing sage-grouse populations (Connelly and Braun 1997, Edelmann et al. 1998).

B. Habitat Requirements

Breeding/Nesting Habitat

Leks, or strutting grounds, tend to be traditional. In general, the same areas are used year after year. Leks typically occur in open areas surrounded by sagebrush (Patterson 1952, Gill 1965). Examples of lek sites include landing strips, old lakebeds or playas, low sagebrush flats, openings on ridges, roads, cropland, and burned areas (Connelly et al. 1981, Gates 1985). Sage-grouse males appear to form leks opportunistically at sites within or adjacent to potential nesting habitat. The lek is considered to be the center of year-round activity for non-migratory grouse populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1974), but this may not be the case for migratory populations (Connelly et al. 1988, Wakkinen et al. 1992). Average distances between nests and the nearest leks vary from 0.6–3.9 miles (1.1–6.2 km), however, some females may nest >12.5 miles (20 km) away from the lek (Autenrieth 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994).

Habitat used by pre-laying hens is also part of the general breeding habitat. These areas provide hens with forbs high in calcium, phosphorus, and protein, all of which are necessary for egg production. The condition and availability of these areas are thought to have a significant effect on reproductive success (Barnett and Crawford 1994, Coggins 1998).

Most sage-grouse nests are located under sagebrush plants (Patterson 1952, Gill 1965, Gray 1967, Wallestad and Pyrah 1974), however, nests have been found under other plant species (Griner 1939, Connelly et al. 1991, Gregg 1991). Sage-grouse that nest under sagebrush experience a higher nest success than those nesting under other plant species (Connelly et al. 1991). Research on sage-grouse nesting habitat has documented that sage-grouse tend to select sites under sagebrush plants that have large canopies. The canopies provide overhead cover and an herbaceous understory, thus providing lateral cover and allowing birds to be hidden from view (Patterson 1952, Gray 1967, Klebenow 1969, Wallestad and Pyrah 1974, Wakkinen 1990, Gregg 1991, Fischer 1994, DeLong et al. 1995, Bunnell et al. 2000). Herbaceous cover associated with nest sites may provide scent, visual, and physical barriers to potential predators (DeLong et al. 1995).

Brood-rearing Habitat

Early brood-rearing habitat generally occurs relatively close to nest sites, but movements of individual broods may be highly variable (Connelly 1982, Gates 1983). Early brood-rearing habitats may be relatively open (14% canopy cover) stands of sagebrush when compared to optimum nesting habitat (Martin 1970, Wallestad 1971), but need >15% canopy cover of forbs and grasses (Sveum et al. 1998, Bunnell et al. 2000). High plant species richness with abundant forbs and insects characterize brood areas (Dunn and Braun 1986, Klott and Lindzey 1989, Drut et al. 1994a, Apa 1998). Insects, especially ants and beetles, are an important food component of early brood-rearing habitat (Drut et al. 1994a, Fischer 1996). As herbaceous plants mature and dry, hens usually move their broods to more mesic sites during June and July where more succulent vegetation is available (Gill 1965, Klebenow 1969, Connelly et al.1981, Connelly et al. 1988, Fischer 1996, Bunnell et al. 2000). Sage-grouse broods occupy a variety of habitats during summer including sagebrush, relatively small, burned areas within sagebrush, wet meadows, farmland, and other irrigated areas adjacent to sagebrush habitats (Savage 1969, Martin 1970,

Connelly et al.1981, Gates 1983, Connelly et al. 1988, Pyle and Crawford 1996).

Late brood-rearing habitats are highly variable. Patterson (1952) reported that grouse move from summer to winter range in October but during mild weather in late fall, some birds may still use summer range. Movements from fall to winter ranges are slow and meandering, and occur from late August to December (Connelly et al. 1988). Wallestad (1975) documented a shift in feeding habits from September, when grouse were consuming a large amount of forbs, to December when birds were feeding only on sagebrush.

Winter Habitat

Sage-grouse winter habitats are relatively similar throughout most of their range. Because their winter diet consists almost exclusively of sagebrush, winter habitats must provide adequate sagebrush that is accessible through the winter. Eng and Schladweiler (1972) and Wallestad (1975) indicated that most observations of sage-grouse during winter in Montana occurred in sagebrush habitats with >20% canopy cover. However, Robertson (1991) indicated that sage-grouse used sagebrush habitats that had average canopy cover of 15%. Sage-grouse tend to select areas with both high canopy cover and taller big sagebrush (*Artemisia tridentata*).

During winter, sage-grouse feed almost exclusively on leaves of sagebrush (Patterson 1952, Wallestad 1975). Big sagebrush dominates the diet of sage-grouse in most portions of their range (Patterson 1952, Wallestad 1975, Remington and Braun 1985, Welch et al. 1988) but low sagebrush (*A. arbuscula*), black sagebrush (*A. nova*) (Dalke et al. 1963, Beck 1977), fringed sagebrush (*A. frigida*) (Wallestad 1975), and silver sagebrush (*A. cana*) (Aldridge 1998) are also consumed in many areas depending on the availability. Sage-grouse in some areas apparently prefer Wyoming big sagebrush (*A. t. wyomingensis*) (Remington and Braun 1985, Meyers 1992) and in other areas mountain big sagebrush (*A. t. vaseyana*) (Welch et al. 1988). Some of the differences in selection may be due to preferences for higher levels of protein (Remington and Braun 1985).

It is critical that sagebrush be exposed at least 10–12 inches (25 cm) above snow level (Hupp and Braun 1989). This provides both food and cover for wintering sage-grouse. In situations where snow covers the sagebrush, birds will move to areas where sagebrush is exposed.

During winter, sage-grouse will either partially or completely bury themselves in snow (snow roosting) for added thermal protection from winter temperatures.

C. Distribution and Abundance

Populations of Greater Sage-grouse have been declining for the past 25 years (Braun 1995, Connelly and Braun 1997, Beck et al. 2003, Connelly et al. 2004). Concerns about population status and distribution, have heightened awareness about the appropriateness of various monitoring efforts and techniques. Connelly et al. (2000) indicated that monitoring was a key component of sage-grouse management. Utah's Strategic Management Plan (UDWR 2002) also emphasizes the need to monitor sage-grouse populations and habitats. Further, the MOU signed by WAFWA representatives in 1999 with federal agencies (2000), calls for consistent monitoring and data collection.

Several techniques have historically been utilized in Utah and in the Resource Area to assess sage-grouse population trends, status, and distribution including lek counts, brood surveys, field bag checks, wing barrels, and hunter surveys. Currently, the primary technique employed by biologists in Utah and in the Resource Area is lek counts. This method is described in detail later in this section.

Historic Distribution of Sage-grouse

Determining historic distribution of sage-grouse is difficult and problematic for several reasons, but primarily because scientific studies are not available from historic time frames in question. For many areas, no written or zoological records exist. It is thought that sage-grouse once existed in all 29 Utah counties. Today sage-grouse are found in 26 counties in Utah and are thought to occupy 50% of the habitat they once did (UDWR 2002).

The Rangewide Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats (hereafter referred to as the Rangewide Plan) (Connelly et al. 2004) analyzed the historic distribution of sage-grouse based on historical sage-grouse distribution maps, habitat maps, sage-grouse museum specimens, known lek locations, and research on sage-grouse movement patterns and habitat use. The authors define historic distribution as a 'pre-settlement' distribution, occurring prior to 1800 when rapid settlement by people of European descent began.

The Rangewide Plan describes potential historic distribution of sage-grouse in the Uintah Basin as part of an evaluation of historic range in the Wyoming Basin (Connelly et. al. 2004). The authors state that there are no records of sage-grouse observations in the eastern portion of the Wyoming Basin in what is now the Uintah Basin, but are unable to account for this discrepancy with current observations of the species in this area. Further, they indicate that the distribution of forested habitats would have prevented sage-grouse from occupying portions of the Uinta Mountains in Utah.

Lek Counts

During the breeding season, sage-grouse congregate on a relatively small number of sites, called leks, to display and breed. Because sage-grouse demonstrate high fidelity to lek sites, they offer the best opportunity for monitoring populations (Jenni and Hartzler 1978, Beck and Braun 1980, Connelly et al. 2000, 2003, 2004). Lek count methodology was first described by Patterson (1952), who studied sage-grouse in Wyoming, and was based on a count of the maximum

number of males observed on a lek over a series of 3–4 visits. The method described by Patterson (1952) results in an index of the population. Population indices, commonly used by wildlife managers, involve a count, or measurement, of some aspect of the population that is both convenient to measure and thought to be related to abundance (e.g. bird calls, pellet counts, roadside observations, track surveys). Anderson (2001), whose primary criticism was that they fail to lead to defensible estimate of population size or status, described the shortcomings of this type of sampling. With regards specifically to lek counts, Beck and Braun (1980) noted that they only lead to conclusions about population size and status when the following information is known: total number of leks in an area, attendance patters of adult and yearling males, inter-lek movements patterns, and the ratio of males to females (i.e. the relationship between the maximum count and the size of the population).

Despite the problems associated with indices and lek counts specifically, they remain the best and primary available means for assessing population trends and estimating population size and status (Autenrieth et al. 1982, Connelly et al. 2000). Throughout Utah, lek counts are conducted between late February and May (depending on weather conditions and access to lek sites) on all known leks to the greatest extent possible. Leks are counted three to four times during this period and counts are made between 30 minutes before and 1 hour after sunrise. An estimate of population size is calculated based on the following assumptions: 1) 75% of all males were counted on strutting grounds, and 2) that the male:female ratio in the population is 1:2 (UDWR 2002).

The number of active leks in an area can also be used as an indicator of population size. Cannon and Knoph (1981) noted that lek numbers seem to increase roughly in proportion to population size. There is evidence that as population size increases, established, ‘traditional’ lek attendance increases and smaller ‘satellite’ leks appear and then disappear as population size decreases again. In Utah, a lek is defined as a site or area traditionally used for display. Leks are considered ‘active’ when at least two males have been observed for at least three years. Conversly, leks are considered ‘inactive’ when birds have been absent from a traditional site for more than years. The use of the number of ‘active’ or ‘traditional’ leks as an indicator of population size is also problematic. Satellite leks are typically smaller and are likely to be less noticeable, lek detection is likely to vary with both density of leks and population density, and search effort likely plays a large role in detection and consistency of measurement.

D. Assessment of Local Population

Plan Area

Morgan and Summit Counties are located in northern Utah. For planning purposes, MSARM has elected to combine Morgan and Summit Counties into the MSARM Resource Area, geographically defined by the existing county borders (Figure 1). The Resource Area (Resource Area) encompasses 2,513 square miles (1,608,659 acres) managed primarily by private landowners and the U.S. Forest Service (USFS), Bureau of Land Management (BLM), State of Utah, and private land owners. Elevation in the Resource Area ranges from approximately 5,000 feet in the Weber River drainage to over 10,000 feet in the mountains of Summit County.

Summit County is characterized by hot summers and cold winters. According to National Climate Data Center records collected in Coalville from 1961 to 1995, July is the hottest month with an average high temperature of 86.0ºF, and winter lows reach 10.8ºF in January. Morgan and Summit counties are wetter than much of Utah. Summit County receives an average of 15.4 inches of rain per year and the East Canyon weather station in Morgan County reports an average of 19.9 inches per year from 1952–1971.

Landownership

Most of the Resource Area is private land with small areas managed by the state of Utah, the USFS, and the BLM (Figure 1, Table 2).

Table 2. Landownership in the MSARM Resource Area.

Landowner*	**Area (acres)**	**Area (Miles^2)**	**% of Resource Area**
Private	12,884,653	20,132	97
BLM	99,885	156	0.75
State of Utah	2,163	3	0.02
USFS	352,262	550	3
* Water adds an additional 23,729 acres (30 mi^2) and represents 0.45% of the Resource Area			

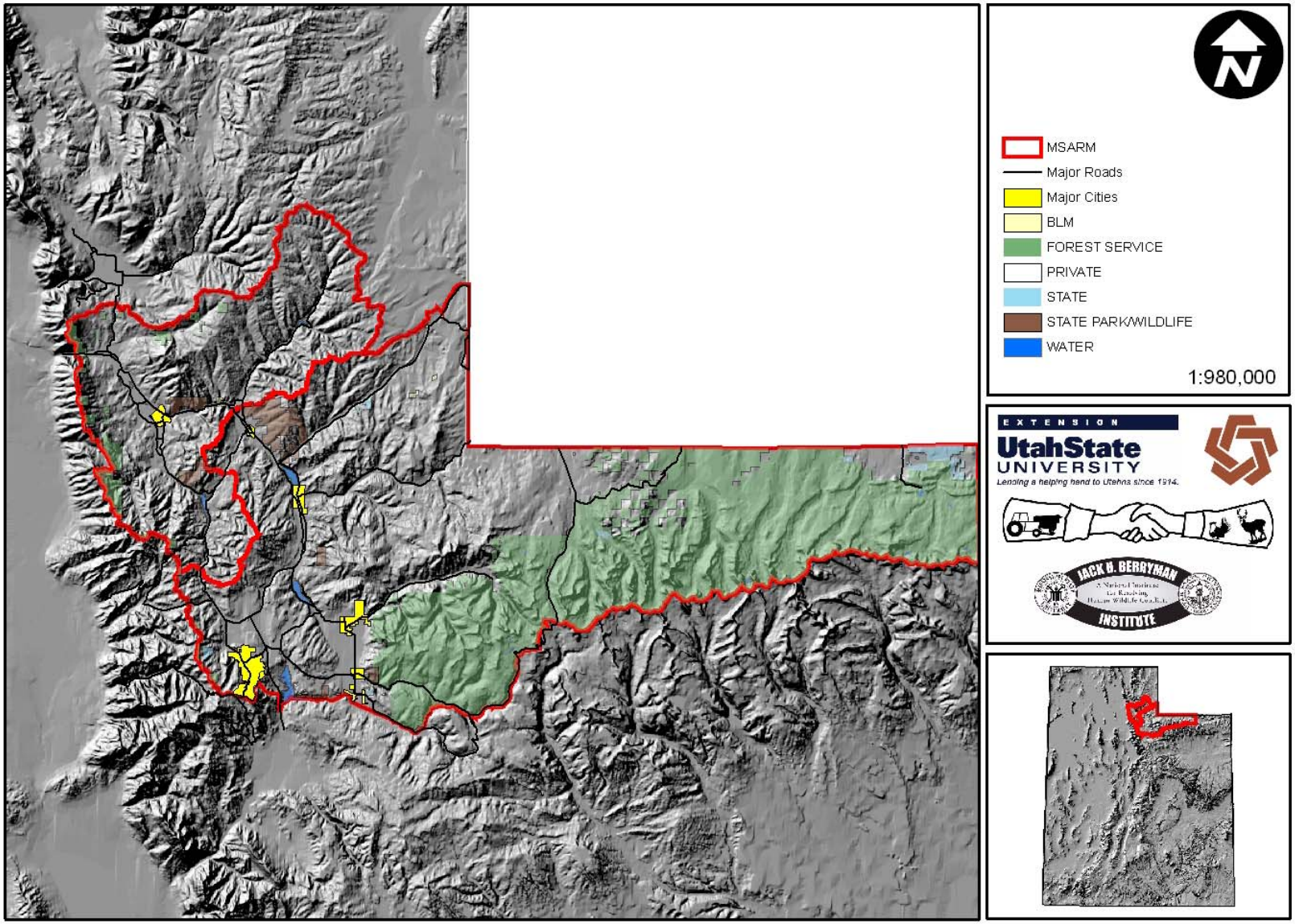

Figure 1. The MSARM Resource Area with land management and landownership designated.

Wildlife Populations

Several species of birds, small mammals, and reptiles are found only in sagebrush environments. Passerine birds obligated to use sagebrush environments include Brewer's sparrow, sage sparrow, and sage thrasher. Additionally, though not obligated to use only sagebrush environments, vesper sparrow and loggerhead shrike are commonly found in sagebrush communities in the Resource Area. Other obligate species include the sagebrush vole and the sagebrush lizard. In addition to these obligates, a large number of other birds, small mammals and reptiles commonly make use of sagebrush environments within the Resource Area.

While sage-grouse populations in the Resource Area have been counted and studied, little or nothing is known about the local status of these other wildlife species listed above. It is assumed that their numbers and geographic extent are tied to the condition and extent of big sagebrush communities. This plan operates with the intent that maintenance of substantial areas of high quality sagebrush steppe, measured by healthy populations of sage-grouse, will provide sufficient habitat for these other sagebrush obligate species to thrive in Resource Area.

Human Populations

The earliest known inhabitants of Morgan and Summit Counties are the Shoshone and Ute Indian Tribes. The Weber River and its tributaries, the Provo River, and the Wasatch Mountains in western Summit County, provided ample resources for early inhabitants of the area. Fur trappers frequented the area in the early 1800s and white settlers arrived in the mid-1800s. Well-known pioneer travel routes including the Hasting's Cutoff trail, traveled by the infamous Donner-Reed party, pass through Summit County's Echo Canyon. A year later, Mormon pioneers traveled part of the Hasting's Cutoff, but followed Emigration Canyon into the Salt Lake Valley. In the later half of the 1800s, the Union Pacific Railroad became a significant presence in both Morgan and Summit Counties. The city of Morgan was known as the only incorporated city on the Union Pacific line between Ogden and Omaha, Nebraska. Businesses and mining operations developed in the area due to the presence of the railroad.

Today, human populations are increasing in both counties as people flock there for scenic vistas and rural living opportunities. The 2000 census recorded 29,736 people and 10,332 households in Summit County, and 7, 129 people and 2, 046 households in Morgan County. Most people in Summit County live in and around Park City in the western half of the county. In Morgan County, the population is less concentrated. Morgan County does not provide sufficient employment opportunities and many leave the valley each day to work in the greater Ogden area. Similarly, many residents of Summit County work in the greater Salt Lake and Provo areas.

Livestock Grazing

Livestock grazing was introduced into the intermountain west in the mid to late 1800s. Early settlers to Morgan County established ranches in the fertile valley and these operations have largely continued into the present time. Today, agriculture is still the primary contribution to the Morgan County economy, with most ranches raising beef, dairy cattle, and some sheep. Although some early settlers to Summit County began ranching in the eastern portion of the county, mining and, later, skiing and other winter sports, have dominated the county's economy

since the late 1800s. Some ranches are still operating in Summit County, primarily raising beef with fewer numbers of dairy cows and sheep.

Farming

Agricultural production in the Resource Area began with early settlers. Agricultural farms were, and still are, present throughout Morgan County where primarily hay and other field crops are produced. Agriculture was restricted to the eastern part of Summit County where some farms still exist today. As in Morgan County, Summit County farms produced hay and other field crops.

Population Status and Distribution

Sage-grouse are believed to have existed as a species in North America for approximately 350,000 years. Sage-grouse likely were historically found in all 29 Utah counties and were likely abundant where suitable habitat existed throughout Utah until the early 1900s (Beck et al. 2003). Today, sage-grouse are found in 26 of Utah's counties and are thought to occupy only 50% of the geographic area they once did (Beck et al. 2003).

The UDWR began monitoring sage-grouse populations in the Resource Area by annually counting males on leks in 1962 and 1969, in Summit and Morgan Counties respectively (Figure 2). When monitoring began in Summit County, a total of 129 male sage-grouse were counted on four leks. Under the assumption that 75% of all males in the population were observed and counted, and assuming a sex ratio of 1.67 females to each male (Zablan et al. 1993), the estimated spring population size in Summit County was approximately 287 adult birds, in 1962. Population estimates based on lek counts should be treated cautiously due to variance in the methods used to collect lek count data, the assumptions built into the estimate, and other factors. However, as no other population estimation technique is currently available, MSARM will use this currently established method. Based on lek count information, sage-grouse populations in Summit County reached an all-time high in 1971 when 223 males were counted on five leks. This count represents a total estimated spring population of 496 adult birds. Since 1971, lek counts in Summit County have declined, as have the number of males per lek, a trend that better incorporates a measure of counting effort. Currently, based on a high count of 23 males on five leks, the population is estimated to be approximately 51 adult birds.

At the start of lek monitoring in Morgan County, a total of 85 males were counted on two leks (Figure 2). This count generates a population estimate of approximately 189 adult birds in the spring population. Based on lek count information, the Morgan County population reached an all-time high in 1980 when 131 males were counted on three leks. The 1980 spring population estimate, based on lek count information, was approximately 291 adult birds.

An observation of the number of males per lek is another index used to evaluate sage-grouse population trends. Because this index accounts for the number of leks counted, i.e. the amount of effort, this index may, in cases where effort is variable, be a more useful illustration of the population trend. In Summit County, the number of males per lek still reflects a decline in sage-grouse numbers since the early 1970s (Figure 3). In Morgan County, the number of males per lek is quite variable, likely reflecting varying degrees of counting effort (Figure 3).

It appears that population monitoring through the use of lek counts has been somewhat inconsistent in the past. As Figures 2 and 3 show, there are years when no counts were made. Lek sites can be difficult to access in some years due to inclement weather and road conditions. Additionally, with the predominance of private land in the Resource Area, leks are more likely to be located on private land and permission to access them may not be available.

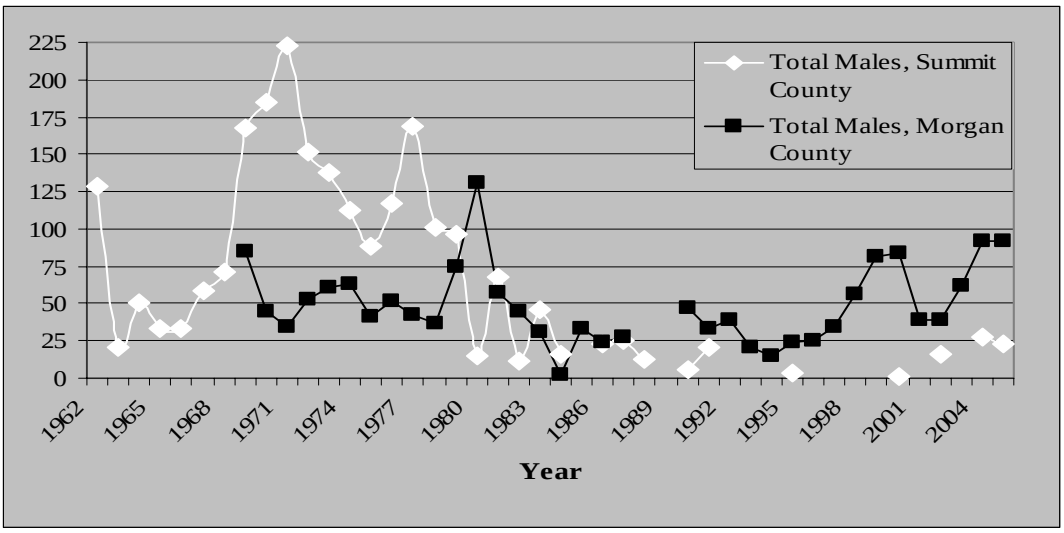

Figure 2. Maximum total number of males counted on all leks in the Resource Area, 1962-2005 in Summit County and 1969-2005 for Morgan County.

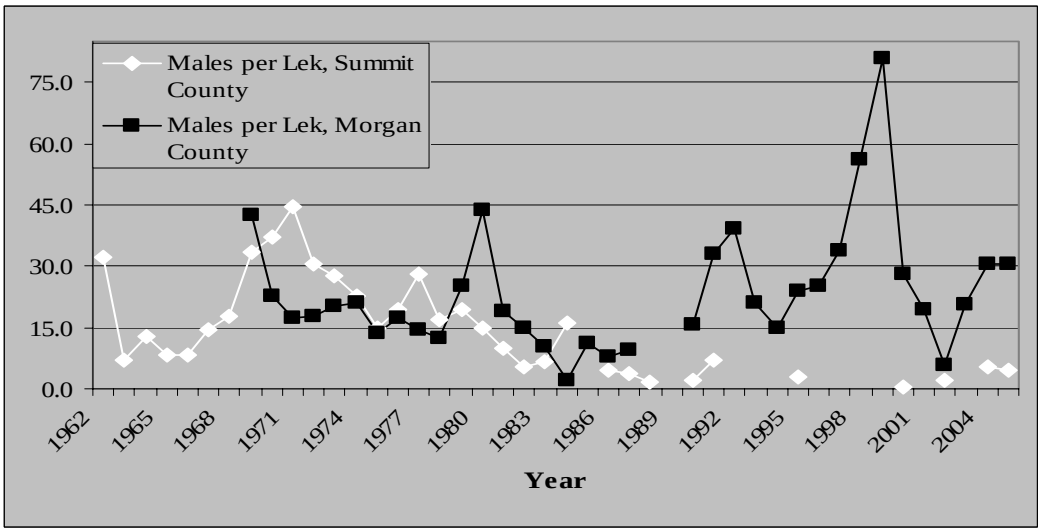

Figure 3. The number of males per lek observed in Summit County, 1962-2005, and Morgan County, 1969-2005.

Local Ecology & Life History

Little published information is available regarding the ecology and life history of sage-grouse populations in the Resource Area. Although monitoring (lek counts) has been conducted somewhat regularly since the late 1960s (Figure 2, Figure 3), few studies have documented information about aspects of habitat use, survival, sources of mortality, and reproductive success.

Local Habitat

In 1999, the UDWR mapped the extent of seasonal habitat types in the Resource Area. Figure 4 and 5 illustrate where nesting, brood-rearing, and winter habitats are located in the Resource Area.

The UDWR Big Game Range Trend project has been monitoring sites throughout the Resource Area to track changes in vegetation composition, structure, and diversity. Although these sites were placed in areas used by big game, where they overlap with sage-grouse seasonal habitat types (Figure 6), they can still provide some information about vegetation and habitat conditions in those areas in a general sense. Data collected at these sites are summarized and available at: http://www.wildlife.utah.gov/range/.

Habitat Improvements & Completed Conservation Actions

The UDWR has implemented several habitat improvement projects in the Resource Area targeted at restoring or enhancing sage-grouse habitat. Treatments were aimed at reducing sagebrush canopy and enhancing native grass/forb cover in the understory. Additional habitat improvement projects are planned for 2006. Several Big Game Range Trend sites were established in 2006 to monitor treatments. In Morgan County, the NRCS has provided or is providing technical assistance on 18,900 acres of rangeland. Most of these projects have been a combination of fence, water development, and brush management.

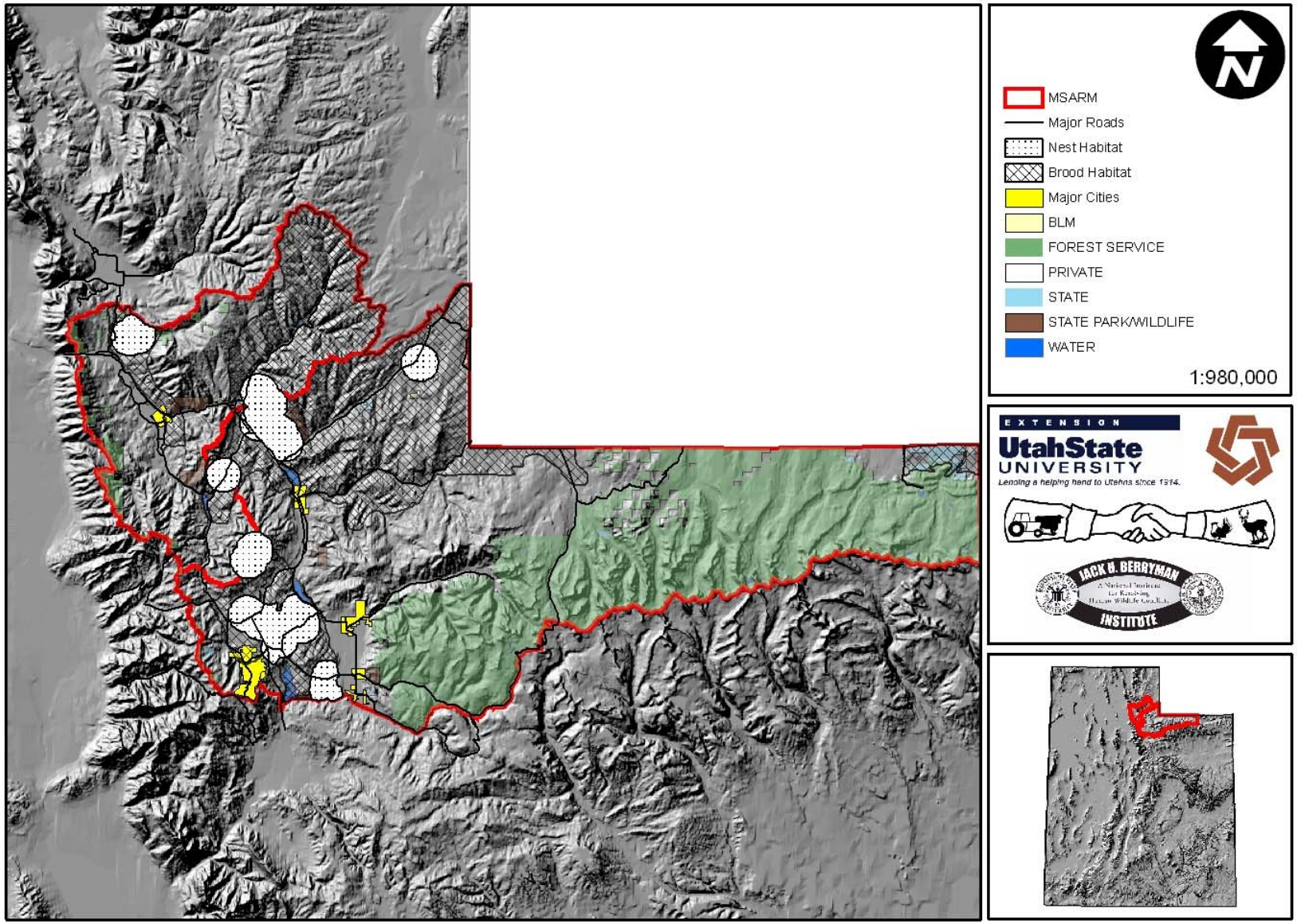

Figure 4. Location of sage-grouse nesting and brood-rearing habitat in the MSARM Resource Area, as identified by the UDWR, 1999.

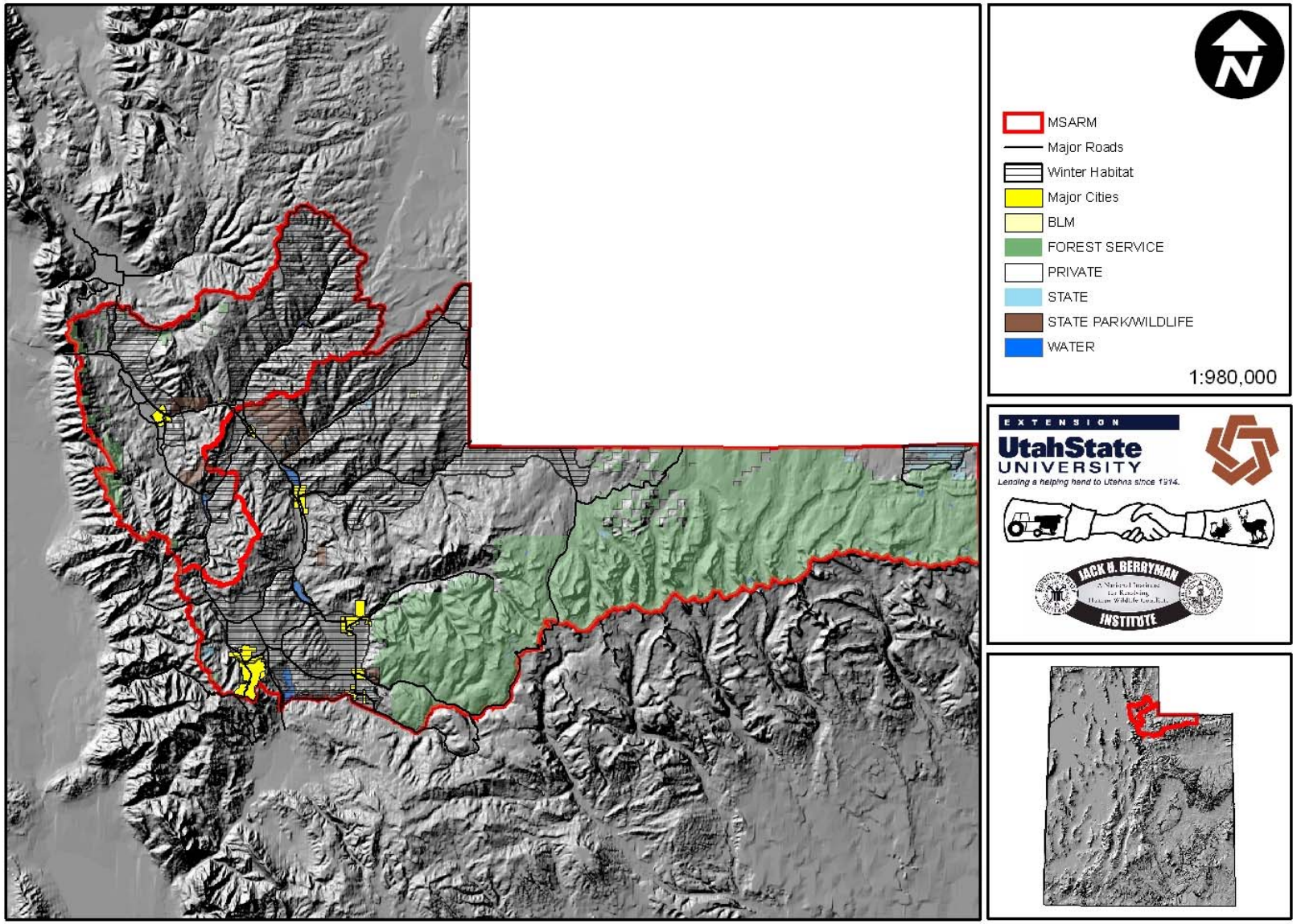

Figure 5. Location of sage-grouse winter habitat in the MSARM Resource Area, as identified by the UDWR, 1999.

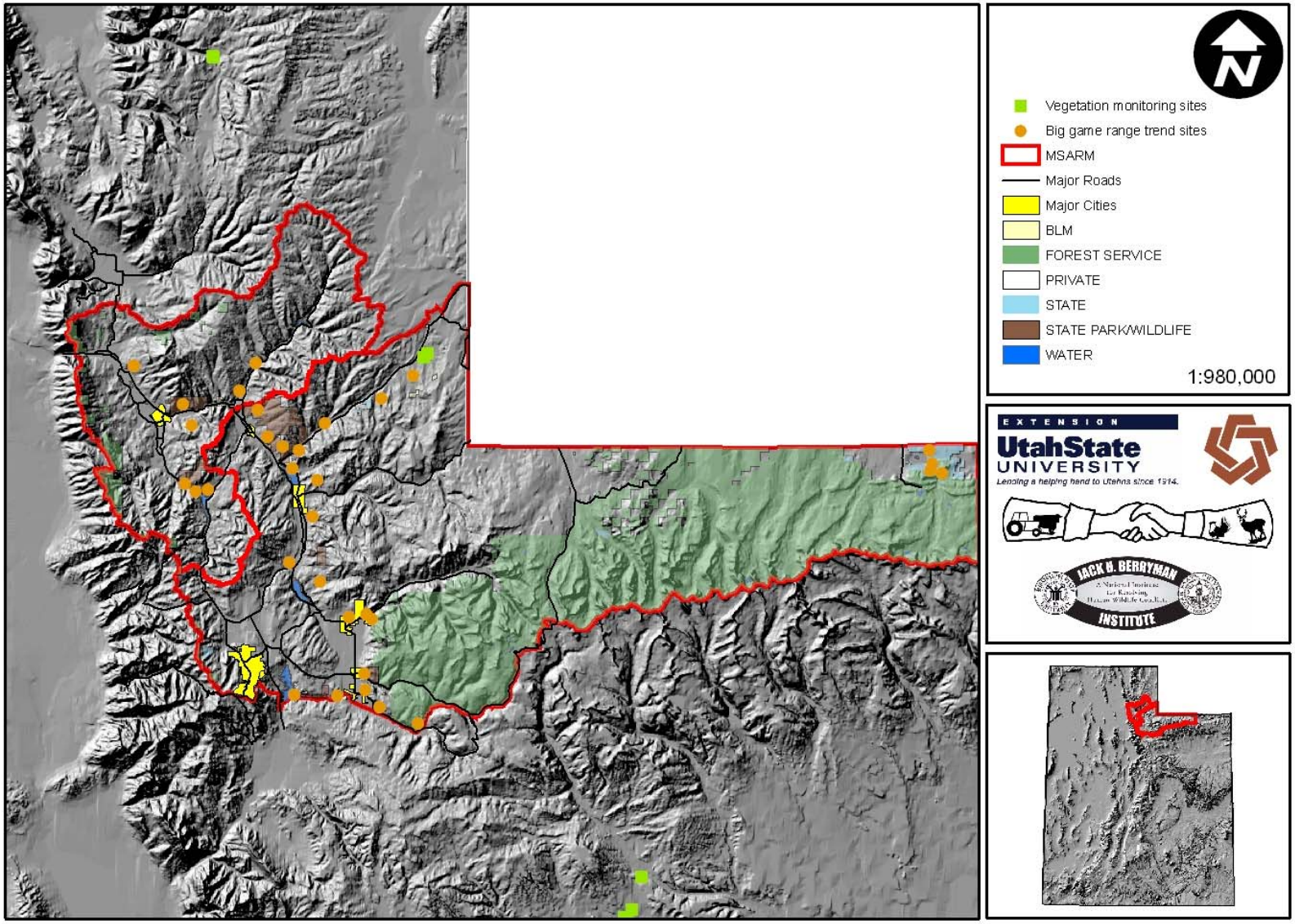

Figure 6. Location of Utah Big Game Range Trend Sites and vegetation monitoring sites that fall within sage-grouse seasonal habitat, as identified by the UDWR, 1999.

IV. Threat Analysis

In this section, we summarize and describe the potential threats to sage-grouse populations in the Resource Area. Where possible, we describe actual, known impacts to sage-grouse and their habitats, however, due to a lack of empirical information regarding many of the threats described, we are only able to present general information and make educated extrapolations about the local area. Potential threats are listed in alphabetical order below.

A. Altered Water Distribution

Water diverted into pipes from canals and ditches to improve flood control and irrigation efficiency has altered natural water sources. Lining ditches with concrete have made the less permeable. Some streams and rivers have been channelized to improve water distribution for irrigation and agricultural efficiency. These changes have also resulted in a loss of ground water, riparian habitat, and mesic/wet meadow sites. Channelization has resulted in increased bank erosion in some areas, and downcutting effects in both small creeks and larger streams and rivers.

Wet meadows and mesic sites provide succulent vegetation for sage-grouse and sage-grouse broods, especially in the drier late summer months. These areas are also an important source of insect food resources for both chicks and adult sage-grouse.

B. Development and Human Infrastructure

In this section, we summarize the potential effects of development and human infrastructure including 1) homes and cabins, 2) power lines, fences, and other tall structures, 3) renewable and non-renewable energy, and 4) roads, on sage-grouse populations in the Resource Area. These impacts were considered together because they are associated with similar stresses (loss of habitat quality and quantity, habitat fragmentation, direct disturbance, increased predator pressure). There is little empirical evidence available regarding the direct or indirect impacts of most of the threats reviewed in this section, especially that specific to the Resource Area.

Home & Cabin Development

Home and cabin development impacts sage-grouse populations through direct loss of habitat, habitat fragmentation, increased domestic predation (i.e. dogs and cats), and can lead to increases in other threats including power lines, fencing, roads, and incompatible OHV recreation.

Increases in the human population in and around the Resource Area have led to corresponding increases land development. Cities in the Resource Area are increasingly becoming bedroom communities for Salt Lake City and Ogden.

According to the Draft Morgan County Consolidated Plan (Morgan County 2006), approximately 122 new homes have been built in Morgan County in the last five years, and that the Wasatch Front Region Small Area Socioeconomic Projections, estimate household growth of approximately 58% (from 2,708 in 2005 to 4,683 in 2030) in the county. In addition, between 1990 and 1998, building permits for single-family housing units made up more than 90% of the total residential permits in Morgan County. In 2000, 82% of the 2,280 total housing units were single-family owner occupied (Census 2000, city/county data). Outside of Morgan City and Mountain Green, county residents still uses septic systems for sewage disposal. This necessitates large lots and developments of reduced density to accommodate drainage. Large lots and increasing property values will limit the ability of many people to purchase or build homes in the County (Morgan County 2006).

In Summit County, between 1990 and 2000, there was a 55.4% increase in the number of housing units built in the County. Growth is occurring both in municipalities including Park City, Oakley, Kamas, and Francis, and in rural areas outside of incorporated municipalities.

Power lines, Fences, & Other Tall Structures

Sage-grouse are potentially subject to increased mortality and disturbance resulting from man-made structures including fences, power lines, and other tall structures (wind turbines, communication towers), though this threat is poorly understood. Sage-grouse may fly into these structures which can result in death or may injure them to the point where they can not effectively avoid predators. Sage-grouse mortalities due to collision with power lines, fences, and other tall structures have been observed in Colorado, Utah, and other areas (Gunnison Sage-grouse Rangewide Steering Committee 2005). Construction of any structure can result in some habitat loss and fragmentation. Fragmentation may increase vulnerability to predation. Fences

have increased in number over the years, as allotments have been split and cross-fenced with the development of rural properties, and with construction of new county roads. Power lines have also increased in number and length (Figure 7), and transmission and service lines have been constructed to service mines and transfer electric power out of the area.

Roads

Collisions with motor vehicles, either while flying or while walking on or across roadways, are other potential causes of direct mortality or severe injury for sage-grouse. Road construction can cause an increase in dust on plants, spread of invasive/alien species, and provide access for predators and incompatible recreation activities (Gunnison Sage-grouse Rangewide Steering Committee 2005). New and expanded highways, roads, and rail sidings have been built to service energy development, ranches, and residential properties throughout the Resource Area.

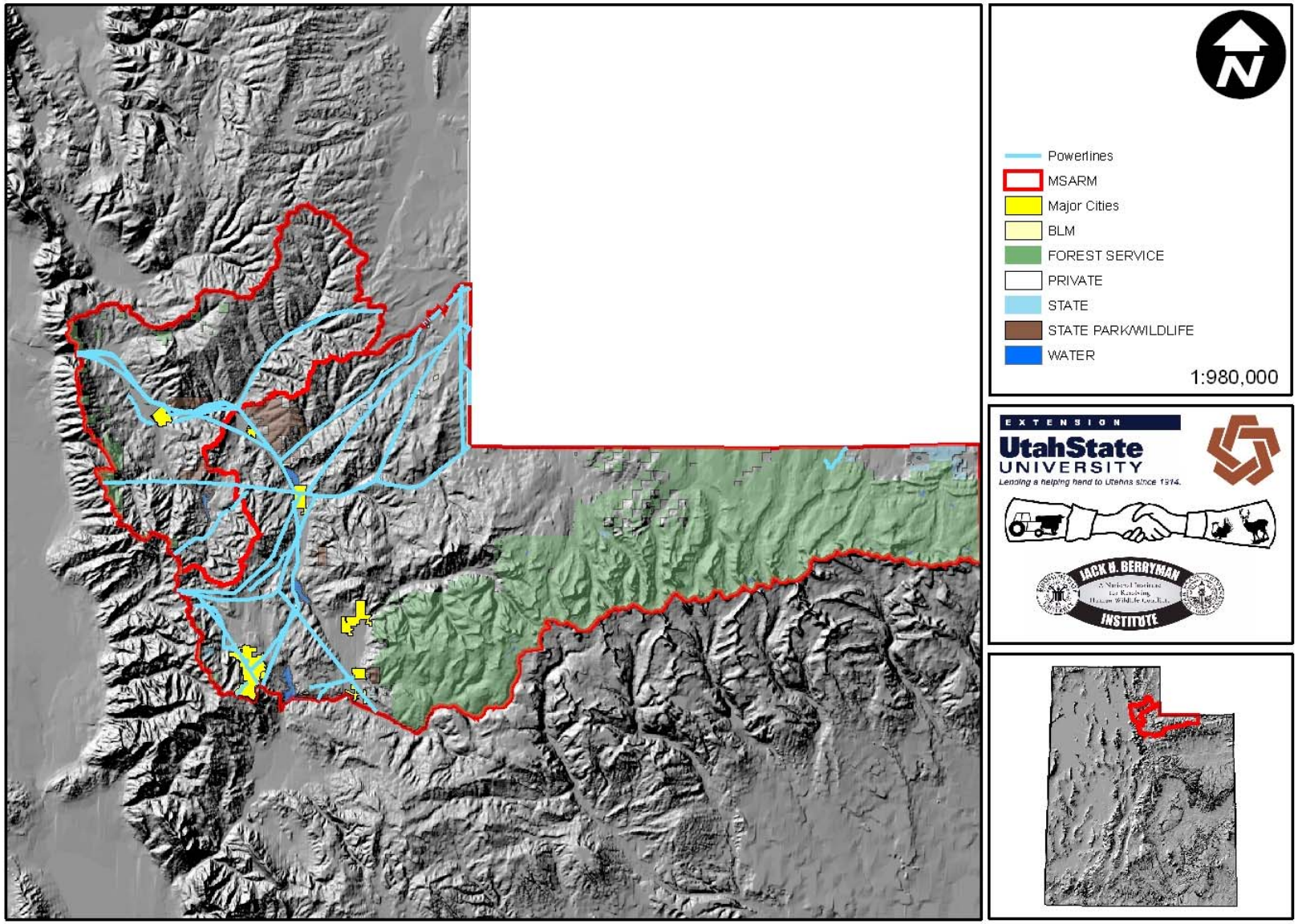

Figure 7. Location of power lines in the Resource Area. Data from Connelly et al. (2004), obtained from http://sagemap.wr.usgs.gov/index.asp.

C. Drought and Weather

Long periods of below average precipitation, above average summer temperatures, above average snowfall, or below average winter temperatures, can adversely affect sage-grouse reproductive success and survival. In fact, prolonged drought during the 1930s and in the later part of the 20th century coincided with declines in sage-grouse populations throughout their range (Patterson 1952, Fischer 1994, Hanf et al. 1994). Extreme climatic conditions that occur during important life-cycle sequences have the potential to negatively affect food quality and abundance, as well as hiding cover (Hanf et al. 1994, Fischer 1996).

Sage-grouse can be very sensitive to fluctuations in annual moisture (Patterson 1952, Fischer 1994, Hanf et al. 1994). Sage-grouse summer diet, especially for chicks, is heavily dependent on insects and succulent plant growth. Sage-grouse population declines in some areas have been linked to years of low precipitation, most likely due to low nest success and/or poor chick survival (Hanf et al. 1994; Fischer 1996).

The Resource Area is part of the Ogden/Weber River Basin. Precipitation reports from Basin monitoring stations indicate that the Resource Area experienced drought conditions from 2000-2004, during which time precipitation fell below the 30-year average (Figure 8).

Summer precipitation (April – September) appears to influence both sage-grouse habitat use and demographics on Deseret Ranch in nearby Rich County, Utah. Sage-grouse use of lowland meadows increased in drier summers, and was negatively correlated with summer precipitation on Deseret Ranch (Danvir 2002). Data suggests populations were negatively affected by dry summers, as lek counts tended to increase following wetter summers while remaining stable or declining after drier summers (Danvir 2002).

Severe winter conditions can be a prominent factor in reducing grouse survival but there is no conclusive evidence to support this claim (Wallestad 1975; Beck 1977; Robertson 1991). Winter snow accumulations force birds to move to areas blown free of snow, or areas with sagebrush which extends above the snow (Eng and Schladweiler 1972; Wallestad 1975; Beck 1977; Hupp and Braun 1989; Robertson 1991). Bird loss can be significant in especially harsh winters, especially if the aforementioned conditions exist. The winter of 1983-84 was particularly severe, bringing extreme cold and heavy snow in Utah (and many parts of the western United States) for an extended period. It is believed that grouse populations declined dramatically during this winter. A far less severe, but still harsh, winter occurred in 1992-93. However, the impact of this winter on grouse populations in the MSARM area is not well documented.

Poor weather conditions in the spring are also suspected of influencing sage-grouse production (Connelly et al. 2000). Mild winters followed by relatively wet springs can increase production (Wallestad 1975, Autenrieth 1981) by promoting good insect and forb production. In contrast, severe spring weather (cold temperature combined with rain and wind) that coincides with hatching can decrease production as chicks die of exposure (Wallestad 1975).

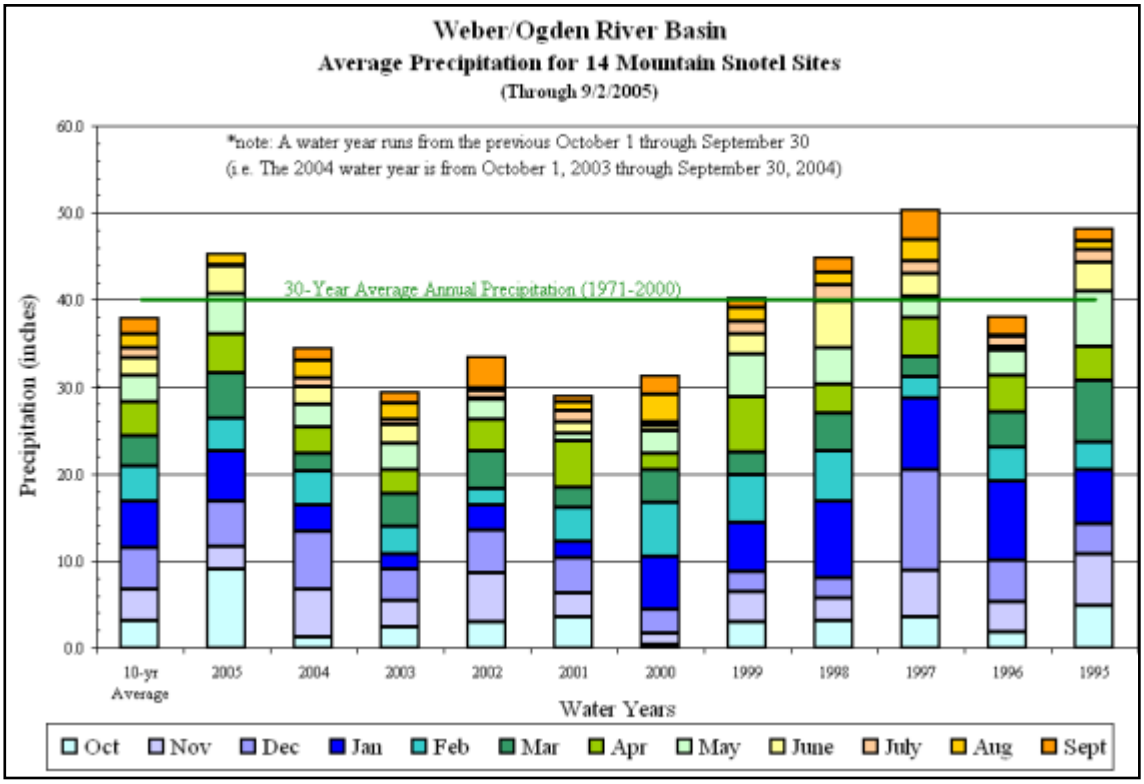

Figure 8. Average precipitation for the Weber/Ogden River Basin 1995-2005, 10-year average, and 30-year average (Utah Division of Water Resources 2006).

D. Hunting

Connelly et al (2000) maintain that most grouse populations can sustain controlled hunting seasons, but caution that grouse have the lowest reproductive potential of the upland game birds, that small populations (<100 male grouse counted during spring lek counts) are highly vulnerable, and that harvest rates should not exceed 10% of the fall population. Connelly et al (2003) found that populations that are not exposed to hunting, recovered faster than populations receiving light to moderate hunting pressure. They recommend that grouse hunting seasons be conservative and account for population trend and habitat quality (Connelly et al. 2003a).

Field bag check data has been collected on sage-grouse in Utah since the 1960s and analysis of collected sage-grouse wings has been conducted since 1973. Grouse hunting pressure and harvest is obtained by two principal methods. The first method is to collect data from hunter questionnaires or telephone surveys. Harvest is also measured by collections of wings harvested by hunters.

Wing data also provides important information on other population parameters, including an estimate of annual chick production, assuming harvest represents the population. In the late 1980s and early 1990s, a drop in juvenile grouse per 100 hens was likely the result of drought conditions throughout much of Utah. During these years chick production was well below the recommended level of 225 juvenile grouse per 100 hens in the fall population.

Sage-grouse have been hunted legally in Utah since 1951. In 1984, Morgan and Summit Counties were closed to sage-grouse hunting due to declining populations (based on annual lek counts). Despite the closure of the sage-grouse season, UDWR hunter surveys continued to report sage-grouse hunters in the area, and hunters continue to report some sage-grouse hunting success (Table 3-4). Hunter success information is obtained by the UDWR by mail-in surveys. Information for closed seasons, including Morgan and Summit Counties, may be an artifact from incorrect reporting by hunters, or is an indication of illegal activity. It appears likely that information collected in some years is incorrect and, therefore, should be interpreted cautiously, as the number of sage-grouse harvested exceeds the estimated population size, based on annual lek counts (D. Mitchell, UDWR, personal communication).

Table 3. Sage-grouse hunter harvest information for Summit County, Utah 1984-2003 (UDWR 1984-2000, UDWR 2003).

Year	Hunter-days Afield	Birds Bagged	Birds per Hunter-day
2001	-	-	-
2000	-	-	-
1999	345	51	0.15
1998	186	93	0.5
1997	1,039	124	0.12
1996	232	185	0.8
1995	155	19	0.13
1994	316	140	0.44
1993	684	380	0.56
1992	142	195	1.38
1991	417	278	2.25
1990	267	205	0.77
1989	145	103	0.71
1988	467	267	0.57
1987	269	147	0.55
1986	206	103	0.5
1985	214	42	0.2
1984	872	203	0.23

Table 4. Sage-grouse hunter harvest information for Morgan County, Utah 1984-2003 (UDWR 1984-2000, UDWR 2003).

Year	Hunter-days Afield	Birds Bagged	Birds per Hunter-day
2001	-	-	-
2000	-	-	-
1999	707	276	0.39
1998	279	116	0.42
1997	124	41	0.33
1996	557	1,068	1.92
1995	155	0	0
1994	281	52	0.19
1993	171	0	0
1992	302	213	0.71
1991	243	226	0.93
1990	370	123	0.33
1989	290	145	0.5
1988	550	200	0.36
1987	98	122	1.25
1986	618	288	0.47
1985	171	42	0.25
1984	893	284	0.32

E. Fire

Across the Intermountain west, fire suppression is believed to have caused sagebrush stands to increase in canopy cover and density with a resulting reduction or loss of herbaceous understory species in many areas. Sagebrush stands have become more even-aged and less productive across large areas of sage-grouse habitat. Fires that do start tend to burn greater acreage and at higher intensity due to the increased amount of fuel available to the fire.

The effects of any particular fire event depend on several characteristics of the local area including dominant sagebrush species, aridity, soils, topography, and disturbance (Bunting et al. 1987, Miller and Eddleman 2000). In general, sagebrush species are fire adapted and will re-colonize an area after a burn. Other threats such as invasive/alien species (e.g. cheatgrass, *Bromus tectorum*), livestock grazing, and agricultural cultivation, are now present in sagebrush biomes, and contribute to the frequency, intensity, and duration of fire disturbances.

Fire, in general, is not detrimental to sage-grouse. In fact, sage-grouse have been observed to use burned areas so long as suitable cover and food are present during the time of use (Slater 2003). However, two altered fire regimes have emerged as being potentially incompatible with habitat management for sage-grouse populations. In the first, invasion of cheatgrass has increased the frequency of fire disturbances, which has the potential of changing sagebrush-steppe plant communities into grasslands (Miller and Eddleman 2000, Connelly et al. 2000). In the second, the occurrence of fire suppression has prevented the regular setback of succession and promoted the advancement of pinyon-juniper stands (Burkhardt and Tisdale 1969, Young and Evans 1981, Miller and Rose 1995, Miller et al. 2000). In these areas, there is the potential for sagebrush seed sources to be lost, reducing the likelihood that sagebrush could become reestablished after an eventual fire disturbance.

In the Resource Area, fire planning and management fall under the purview of land management agencies like the BLM and USFS and local governments. The USFS Wasatch-Cache National Forest operates according to an adaptive fire plan. At the time of this writing, the USFS is using the 2006 fire plan (USFS 2006). According to that plan, the USFS fire management goals are to protect human life, both the public and firefighters; protect human communities, their infrastructure, and the natural resources on which they depend, and protect other property and improvements. The plan calls for the use of prescribed fire, wildfires, mechanical fuels reduction, and other available techniques to achieve these goals.

Cheatgrass and pinyon-juniper encroachment appear to be limited to small, isolated areas within the Resource Area. Fire management by the BLM and the USFS is done in close cooperation with the UDWR who often provides a seed mix for post-burn rehabilitation. Fire planning is done carefully and cautiously in the Resource Area.

F. Livestock Grazing

Livestock grazing is an important use of sage-grouse habitat in the Resource Area and throughout the range of sage-grouse in the West. The impacts of livestock grazing on sage-grouse are not clear, yet they are often contentious and controversial, perhaps more so than any other issue. Published literature and opinions run the gamut from completely compensatory or beneficial influence on one side, to incompatible, harmful practices that should be eliminated (Connelly et al. 2004). Due to the controversy, and following a thorough review on the subject by Rowland (2004), we have chosen to follow the lead of the Gunnison Sage-grouse Rangewide Steering Committee (2005), and simply provide several quotes from her (Rowland's) publication. In addition, the potential impacts of livestock grazing on sage-grouse are covered extensively in Connelly et al. (2004).

Impacts to Sage-grouse Habitat

Rowland (2004:17-19) summarized studies that suggest livestock grazing has a negative impact on sage-grouse habitat:

"Beck and Mitchell (2000) summarized potential effects of livestock grazing on sage-grouse habitats, and cited only four references that provide empirical evidence of direct negative effects of livestock grazing on sage-grouse, as follows. Of 161 nests examined in Utah, two were trampled by livestock (one sheep, one cattle) and five were deserted due to disturbance by livestock (Rasmussen and Griner 1938). In Nevada, sage-grouse habitat in wet meadows was degraded through overgrazing by domestic livestock and altered system hydrology (Oakleaf 1971, Klebenow 1985; as reported by Beck and Mitchell 2000). Klebenow (1982) examined sage-grouse habitat use in relation to grazing at the Sheldon NWR in Nevada, where sheep and cattle had grazed for >130 yr. Dominant sagebrush species at the refuge were low sagebrush, mountain big sagebrush, and Wyoming big sagebrush. Grasses included Sandberg and Cusick's bluegrass (*Poa secunda* and *P. cusickii*, respectively) in wet meadows, and Sandberg bluegrass and mat muhly (*Muhlenbergia richardsonis*) in dry meadows. A rest-rotation system was implemented for cattle grazing in 1980 over the majority of the refuge, where season-long grazing had occurred historically; a smaller portion had previously been managed under deferred rotation. Meadows heavily grazed by livestock (e.g., with few forbs and grasses and dense shrubs present) were avoided by sage-grouse, with the exception of use for free water when available (Klebenow 1982). (No explicit definitions were provided for light versus moderate or heavy grazing.)"

Rowland (2004:17-19) also noted cases where livestock grazing was reported to have had a positive effect:

"Some positive effects of livestock grazing were noted. When cattle were introduced into a meadow with residual grass, sage-grouse initially preferred the grazed openings, which had an effective cover height (sensu Robel et al. 1970) of 5 to 15 cm, compared to 30 to 50 cm in the lightly grazed surrounding areas. Grouse avoided dense, ungrazed basin wild rye meadows but were observed in adjacent wild rye that was grazed. One 40-ha meadow that was lightly grazed by cattle (41 yearling heifers, 60 days in June- August) was used throughout the summer by sage-grouse and had more sage-grouse (100) than any other meadow on the refuge. Effective

cover height in the meadow did not decrease below 5 cm during the summer."

Impacts on Sage-grouse Behavior and Demographics

Studies that focused on sage-grouse behavior and demographic parameter response to grazing reported mixed impacts (Rowland 2004:17-19): "Danvir (2002) reported two instances of nest abandonment related to livestock grazing in northern Utah during 7 yr of observations; one was caused by cattle, the other by sheep. Sage-grouse behavior on leks did not appear to be altered by the presence of cattle grazing (Danvir 2002). Sheep grazing in Idaho did not appear to disrupt use of leks by sage-grouse (Hulet 1983). Autenrieth (1981), however, cautioned against grazing sheep in sage-grouse winter habitat. He also suggested that livestock use of meadows occupied by sage-grouse, as well as livestock drives in sage-grouse habitat, could be detrimental to sage-grouse. In Wyoming, nesting densities of sage-grouse were considerably lower (10 nests/100 ha) in areas heavily grazed by domestic sheep compared to adjacent sites with moderate grazing (28 nests/100 ha) (Patterson 1952). Nest desertion caused by migrant bands of sheep also was documented (Patterson 1952). Heath et al. (1998) compared sage-grouse nesting and breeding success at three ranches with different grazing operations and levels of predator control in Wyoming. They found that, despite heavier livestock use (removal of >50% of annual herbaceous production, and grazing by both sheep and cattle) and long-term predator control on one ranch, nesting and breeding success of sage-grouse did not differ substantially among the three sites. Chick survival to 21 days was, however, greater on the ranch with lighter grazing, suggesting that predator control did not fully compensate for the greater reductions in herbaceous production (Heath et al. 1998). Further, hens were documented leaving the more heavily grazed ranch to nest elsewhere but returning to that ranch to rear broods (Heath et al. 1998). In a similar study, Holloran (1999) examined sage-grouse habitat use and productivity in relation to grazing management strategies at four ranches in southeastern Wyoming. He found no differences in nest success, brood survival, or numbers of chicks fledged among the ranches. Some differences in habitat use by sage-grouse were found among the ranches; however, these could not be ascribed to differences in grazing pressure, but were ascribed to differences in soil types and precipitation patterns (Holloran 1999). Above-average precipitation during the study, however, may have obscured any potential differences in habitat suitability for sage-grouse among sites. Neither of these studies employed control sites or replication."

Recommendations

In her extensive literature review, Rowland (2004:11) summarized recommendations found in the literature related to timing of grazing and reduction of impact to riparian areas used during brood-rearing. In addition, Rowland (2004: 24) made her own recommendations:

"Timing of grazing greatly influences the effects of livestock grazing in meadows and riparian areas. These sites are particularly vulnerable in late summer when excessive grazing and browsing may damage riparian shrubs, reduce the yield and availability of succulent herbs (Kovalchik and Elmore 1992), and cause deterioration of riparian function over time (Klebenow 1985). However, moderate utilization by livestock in spring, early summer, or winter is sustainable in non-degraded meadow and riparian areas within sagebrush habitat (Shaw 1992, Clary et al. 1996, Mosley et al. 1997). Moderate use equates to a 10-cm residual stubble height for most grasses and sedges and 5-cm for Kentucky bluegrass (Mosley et al. 1997, Clary and

Leininger 2000). Shrub utilization should not exceed 50-60% during the growing season, and at least 50% protective ground cover (i.e., plant basal area + mulch + rocks + gravel) should remain after grazing (Mosley et al. 1997). While hydrophytic shrubs may not directly serve as sage-grouse habitat, they do impact the stability of riparian and meadow habitats important to sage-grouse (Winward 2000). The length of time livestock have access to meadows may be more important than the level of utilization; it has been suggested that livestock access be limited to 3 weeks (Mosley et al. 1997). In riparian and meadow habitat degraded by heavy livestock utilization, rest from grazing may be necessary for recovery (Clary and Webster 1989)."

"Manage livestock grazing through stocking rates and season of use on all seasonal ranges of sage-grouse to avoid habitat degradation (Paige and Ritter 1999, Beck and Mitchell 2000, Wisdom et al. 2000), especially on recently disturbed sites, such as those sprayed or burned (Braun et al. 1977). In nesting and brood-rearing habitats, ensure that grazing does not reduce herbaceous understory cover below levels that serve as a deterrent to potential predators of eggs and chicks (Connelly et al. 2000b, Hockett 2002). Healthy native understories also support insects and forbs that are important in diets of pre-laying hens and chicks (Johnson and Boyce 1990, Barnett and Crawford 1994, Drut et al. 1994b). Riparian areas and wet meadows used for brood rearing are especially sensitive to grazing by livestock; in these habitats, removal of livestock before the nesting season may be prudent (Beck and Mitchell 2000, Hockett 2002)."

Conclusions

Livestock grazing is an important use of sagebrush rangelands in the Resource Area. Although some incompatible grazing likely occurs within the Resource Area, the majority of livestock operations appear to be coexisting with sage-grouse. However, no studies have been conducted in the Resource Area to address the issue of grazing impacts on sage-grouse and this is an area that may warrant future research.

G. OHV Recreation

The effects of off-highway-vehicle (OHV) recreation and other forms of recreation (snowmobiles, bird watching, etc.) on sage-grouse behavior and populations are poorly understood. Impacts of recreational activities are likely to be of two forms: disturbance of individuals and alteration of habitat.

Recreational activities, specifically OHV recreation, likely has the potential to impact individual birds or flocks of birds by flushing them from breeding grounds, nests, roost sites, or foraging areas, depending on the season in question. Noise associated with OHV recreation is likely the primary cause of disturbance to individual or flock behavior. Disturbance during nesting season may result in nest abandonment or failure. Disturbance during any time of year may increase the vulnerability of sage-grouse to predators. OHV recreation, and other forms of recreation, may also trample plants, disturb soils, and otherwise alter and degrade habitat. In many instances, specific areas are designated for use of OHVs. When confined to specific use areas, impacts are likely to be reduced.

OHV recreation is relatively common in the Resource Area. Although specific impacts to sage-grouse populations are unknown, they are thought to be minimal.

H. Invasive/Noxious Weeds

The Utah Department of Agriculture (Section 4-17-2) defines noxious weeds as "…any plant the commissioner determines to be especially injurious to public health, crops, livestock, land, or other property." Under the Utah Noxious Weed Act (4-17-10) county weed departments are charged to "…develop, implement, and pursue an effective program for the control and containment of noxious weeds on all lands under their control or jurisdiction, including highways, roadways, rights-of-way, easements, game management areas, and state parks and recreation areas."

Russian knapweed (*Centaurea repens*), dyers woad (*Isatis tinctoria* L), and several other species of thistle, grasses, and knapweed are listed on the Utah Noxious Weed List (Section 4-17-3, Utah Noxious Weed Act). Although cheatgrass is not listed there, nor is it included in individual county lists for Morgan and Summit Counties, this invasive plant species is known to be established in the Resource Area.

Invasive species affect the species composition, nutrient cycling, and physical structure of sagebrush systems. Invasive species also influence the natural function of sagebrush systems, especially their ability to recover from fire. These impacts often culminate in an alteration of wildlife species diversity and abundance in affected systems.

Cheatgrass is an annual grass native to Russia and parts of northern Europe. When it invades sagebrush communities, cheatgrass is known to increase fire frequency and has the potential to convert sagebrush communities to annual grass rangelands. Cheatgrass has also been reported to encourage establishment of other invasive species (Grahame and Sisk 2002).

Noxious weeds have been recognized within the Resource Area as a serious problem by County Weed Control departments, BLM, and USFS. County weed control departments maintain records of the location, extent, and severity of weed establishment and actively work to control the spread and establishment of weeds in their respective counties. In January 1996, the BLM published Partners Against Weeds, (PAW) an action plan for the Weed Management program in the Bureau. The PAW plan lists seven goals, the first being to develop a prevention and early detection program. The PAW recommends developing and enforcing a policy to "ensure seeds, seed mixtures, hays, grains and straws are free of weed seed" as a prevention and detection strategy. Utah's BLM Resource Advisory Council (RAC) developed a guideline requiring certified weed free forage to be used on BLM lands by anyone having the need to take forage with them when using BLM public lands. The guidelines were approved by both the Utah State Director and the Secretary of the Interior in 1997. Beginning in November 1998, users of BLM administered land in Utah are required to use only certified noxious weed-free hay, straw, or mulch. Approved products for livestock feed on public lands include pellets, hay cubes, processed grains and certified hay, straw or mulch, all of which are normally available at many feed stores and producers in Utah. The USFS is also committed to a campaign against the spread of invasive species. Working with agency and local government partners, the USFS aims to create Cooperative Weed Management Area (CWMA) Participative Agreements for all USFS lands.

I. Parasitism & Disease

Several bacterial and parasitic diseases may affect sage-grouse to varying degrees. Sage-grouse have long co-existed with a range of pathogens and many produce no, or few, ill effects in individuals and populations. Large-scale (i.e. rangewide or statewide) impacts to sage-grouse have not been reported. Below, we discuss a few of the pathogens that appear to be most likely to impact sage-grouse populations (Connelly et al. 2004).

West Nile Virus

West Nile virus (WNV) is an arbovirus, or arthropod-borne virus, of the flavivirus family, which also includes Dengue and Yellow Fever. WNV is one of many mosquito-borne viral infections. Mosquitoes of the Culex family primarily transmit West Nile Virus during normal blood feeding. Some species in this family feed primarily on birds, and birds act as reservoirs or amplifying hosts of the virus. Although many species of birds are known to contract WNV, species in the Corvid family (crows, ravens, and jays) are more susceptible to the disease and are therefore useful geographic detectors of WNV. Mammals, including humans and horses, are considered incidental hosts and are therefore viral 'dead ends'. Humans are most likely to acquire WNV from an infected mosquito. Other mammals, such as horses, do not maintain a sufficiently high level of the virus in the bloodstream to transmit the virus to humans.

WNV was first detected in the Western Hemisphere in 1999, and has since rapidly spread across the North American continent into all 48 continental states, seven Canadian provinces, and throughout Mexico. In addition, WNV activity has been detected in Puerto Rico, the Dominican Republic, Jamaica, Guadeloupe and El Salvador.

In 2003, several cases of WNV were confirmed in sage-grouse in Wyoming (nineteen birds), Montana (three birds), and Alberta, Canada (five birds). In that same year, WNV was detected in chickens in Price, Utah. In 2004, sage-grouse in Wyoming, Montana, Colorado, and California tested positive for the virus. In 2005, the virus was confirmed in a dead sage-grouse in the Uintah Basin, approximately 160 miles to the east of the Resource Area. WNV was also detected in a prairie falcon in Carbon County, to the southeast of the Resource Area. A limited percentage of sage-grouse appear to be capable of developing immunity to the virus (Cornish, unpublished data) and infection appears to be almost always fatal within 24–48 hours.

Macro-parasites

Coccidiosis—Coccidiosis is an intestinal disease caused by one or more species of the protozoan genus Emieria (Jolly 1982), which include *E. angusta, E. centrocerci, and E. pattersoni*. Infection results in diarrhea caused by damage to the mucosal lining of the digestive tract. The disease is transmitted through consumption of contaminated feces. Coccidiosis is the most well known of all diseases infecting sage-grouse (Connelly et al. 2004). In Wyoming, Colorado, and Idaho from 1932–1953 this disease resulted in significant losses of young sage-grouse (Honess and Post 1968), however no cases have been documented since the 1960s (Connelly et al. 2004). Cases were typically reported in areas where large numbers of birds are concentrated. The concentration led to contamination of and spread via water and food sources. Connelly et al. (2004) speculated that this disease lacks prevalence in recent years because sage-grouse density

has decreased. No cases of Coccidiosis are known from within the Resource Area, however this does not imply that the condition does not exist or have the potential to exist. Specifically, drought conditions that result in a decrease in water sources may potentially increase sage-grouse concentrations in localized areas, thereby increasing the potential for impacts from this infection.

Tapeworms—Sage-grouse are the only known host of the cestode tapeworm, *Raillietina centrocerci* (Honess 1982). There is little consensus on the impact *Raillietina centrocerci* may have on sage-grouse populations. The Canadian Sage Grouse Recovery Strategy indicates that this infection may be a largely overlooked cause of mortality. Honess (1982), suggested that there was a synergy between host and parasite with little negative impacts to sage-grouse. The parasite does not affect the quality of sage-grouse meat and here are no documented cases of *Raillietina centrocerci* in the Resource Area. This does not imply that this infection does not impact sage-grouse therein, however.

Filarid Worms—A filarial nematode, *Ornithofilaria tuvensis*, which utilizes the connective tissue between skin and breast muscle in sage-grouse, appears to prevent flight in infected birds (Hepworth 1962). This infection is rare but appears to have significant impacts. This infection is not known to occur in the Resource Area, although it may yet exist, undetected.

Avian Malaria—Avian malaria, caused by the protozoan *Plasmodium pediocetti*, is known to infect wild sage-grouse but is considered rare. Although this infection does not have a profound impact on sage-grouse populations, it does cause birds to reduce activity during morning hours and may affect courtship and breeding of strutting males (Boyce 1990, Johnson and Boyce 1991). Biting flies (Friend and Franson 1999) transmit this disease.

Conclusions

We currently consider WNV to be the disease/parasite with greatest potential to impact sage-grouse populations in the Resource Area. As previously mentioned, in 2005 a dead sage-grouse was found in the Uintah Basin, 160 miles to the east of the Resource Area, that was infected with WNV. Parts of Wyoming relatively near to the Resource Area have also detected infected birds. There is potential for disease persistence from transmission between these areas.

Other diseases discussed in this section may have an effect on sage-grouse but only one has been observed in the Resource Area and, therefore, is considered a limited potential threat.

J. Predation

Sage-grouse occupy an important place in the food web in sagebrush environments and are preyed upon by a wide variety of terrestrial and avian predators. Numerous predators have been documented preying upon differing ages of sage grouse and/or their nests. Documented nest predators include weasel, badger, elk, coyote, common raven, American crow, red fox, striped skunk, black-billed magpie, and various species of snakes (Batterson and Morse 1948, Patterson 1952, Nelson 1955, Autenrieth 1981, Hanf et al. 1994, Young 1994, DeLong et al. 1995, Sveum 1995). Numerous species have also been documented killing and/or consuming adult sage-grouse and include golden eagle, Cooper's, ferruginous, red-tailed, and Swainson's hawks, Northern goshawks, coyote, red fox, and bobcat (Girard 1937, Rasmussen and Griner 1938, Batterson and Morse 1948, Nelson 1955, Rogers 1964, Beck 1977, Dunkle 1977, Autenrieth 1981). Numerous predator species, many of which are listed above, have been documented to kill juvenile sage-grouse. Because of the small size of young sage-grouse, additional predators have been documented and include American kestrels, merlin, Northern harrier, common raven, and weasel (Girard 1937, Patterson 1952, Nelson 1955, Rogers 1964, Autenrieth 1981).

Predation is the end result for the vast majority of sage-grouse throughout their range, both historically and presently (Bergerud 1988). Schroeder and Baydack (2001:26) suggest that predation has the potential to affect the annual life cycle of sage-grouse in three primary ways:

1. Success of nests
2. Survival of juveniles during the first few weeks after hatch
3. Annual survival of breeding-age birds

Peterson and Silvy (1996) conclude that the relative importance of predation on the viability of sage-grouse populations is relatively unknown and warrants additional study.

Nest success varies by year, area, population density, and/or management strategy (Connelly et al. 1998, Schroeder et al. 1999). Connelly et al. (2000) suggested that several studies on nest success have illustrated success >40% and that nest predation does not appear to be a problem across the range of the grouse. In contrast, Gregg (1991) and Gregg et al. (1994) suggested that nest predation may be limiting grouse numbers in Oregon. Red foxes and common ravens have been implicated in affecting nest success and the annual survival of breeding age birds in the Strawberry Valley area of Utah (Bunnell et al. 2000). Researchers suggest that the advancing population of a nonnative predator, red fox, is responsible for preying upon a large portion of the population in that area (Flinders 1999). In artificial nest studies conducted in Strawberry Valley, ravens depredated 98% of artificial nests within 48 hours of their placement; remote cameras were used to verify the identity of artificial nest predators (Baxter and Flinders, unpublished).

History of Predator Management in Utah

Understanding the impact of predation on sage-grouse is difficult, as the primary effects (the number of sage-grouse killed by predators) is affected by habitat variables, variables associated with the predator population and variables within the sage-grouse population itself. Secondary effects of predation exist and are indicated when habitat choices are dictated by the risk of predation. What we currently know about habitat needs of sage-grouse is developed from

studies of core sage grouse range. However, if predation or the risk of predation is effecting habitat selection, then otherwise good habitat is made unavailable to grouse. To better understand the role predation management may have played historically, it is important to examine records of the past.

Predator management in Utah began in the late 1800s with territorial bounties followed by a federal appropriation in 1917. The original purpose for the federal program was the suppression of rabies. The program has gone through several changes involving both State and Federal agencies. The US Biological Survey managed predator control in early years and developed the structure that was later used by the USFWS which is to have supervised men in designated Wildlife Service districts (districts). From 1936 to 1986, the USFWS managed the program as Animal Damage Control. In 1986, it moved to the United States Department of Agriculture under the Animal and Plant Health Inspection Service, and in 1996 was renamed as Wildlife Services (again) (USDA-WS).

Correlations exist between livestock inventories and the intensity of predator management efforts. Domestic sheep numbers are on record (Utah Agricultural Statistics) at a high of 2.7 million in 1931. Breeding sheep inventories as of January 1, 2003 were reported at 290,000 head, or 10.7% of the maximum number. Sheep numbers varied quite a lot from year to year in some cases and from decade to decade since the early 1900s. Toxicants were used extensively in the early years when sheep numbers were high. Additionally, predator management in the early years involved many trappers, setting and tending steel traps statewide. As many as 132 men were hired (1936) to set traps and apply baits. Figure 9 shows the recorded take of coyotes from the predator control program between 1917 and 2004. These data do not include poisoned coyotes, which were not found but estimated at seven to ten coyotes for each dead one found.

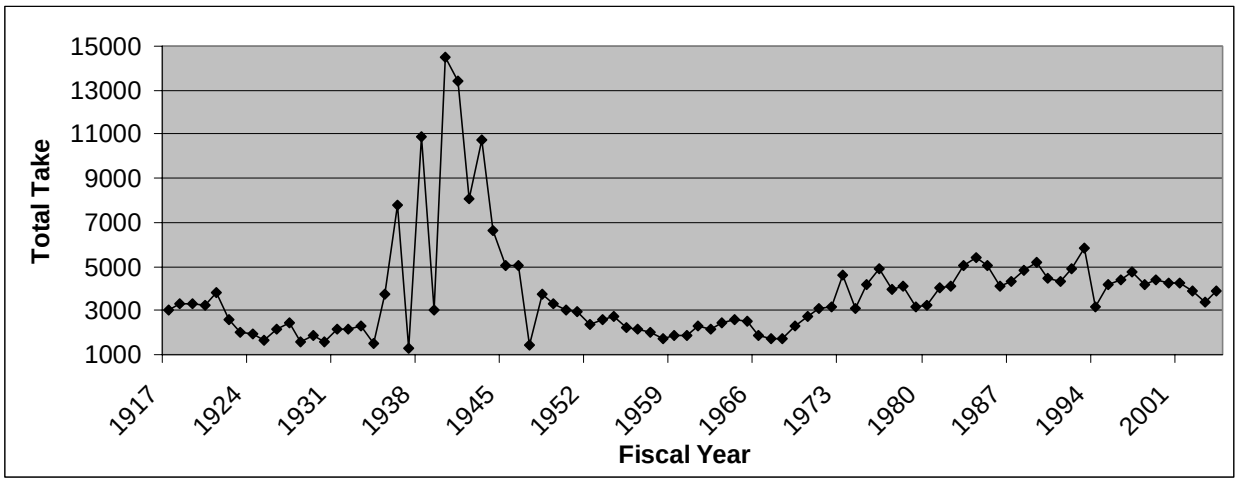

Figure 9. USDA-WS reported coyote take in Utah, 1917-2004. Data reported by USDA-WS.

Strychnine and thallium treated single-lethal-dose (SLD) baits were the main toxicants used between 1920 and 1950. Compound 1080 was developed around 1945, first as a rodenticide and later as a predicide used in large bait stations. USDA-WS records indicate that 1443 bait stations were applied in 1969, covering 54% of the townships in the State. Bait placement from 1950 to 1972 were large bait stations while SLD baits were used prior to that. From about 1950 to 1972, Compound 1080 became the main force in controlling coyotes in all districts of Utah by the government and by private individuals. The low government take of coyotes during this period indicates that coyote populations were suppressed by bait station use. Toxicants were banned in federal programs in 1972, and current policies allow only two very selective toxicants for limited use.

Early predation control also extended to ravens, crows, eagles and magpies. Records indicate that single baits were applied around 'draw stations' to target birds. Records also note that UDWR personnel targeted specific areas for bird suppression not treated by the federal program.

It is difficult to assess the poison years in terms of population suppression of species such as ravens, coyotes, and even red foxes. Individual species records are presented below:

Red Fox—While some early records of red foxes exist, red foxes are believed to have been virtually absent on the landscape before the 1970s. Red fox do not exist in government records before 1972, and have increased since then. Red foxes may have been successfully suppressed by rabies or by bait station use, or both. Figure 10 shows red fox take from 1972 to 2004.

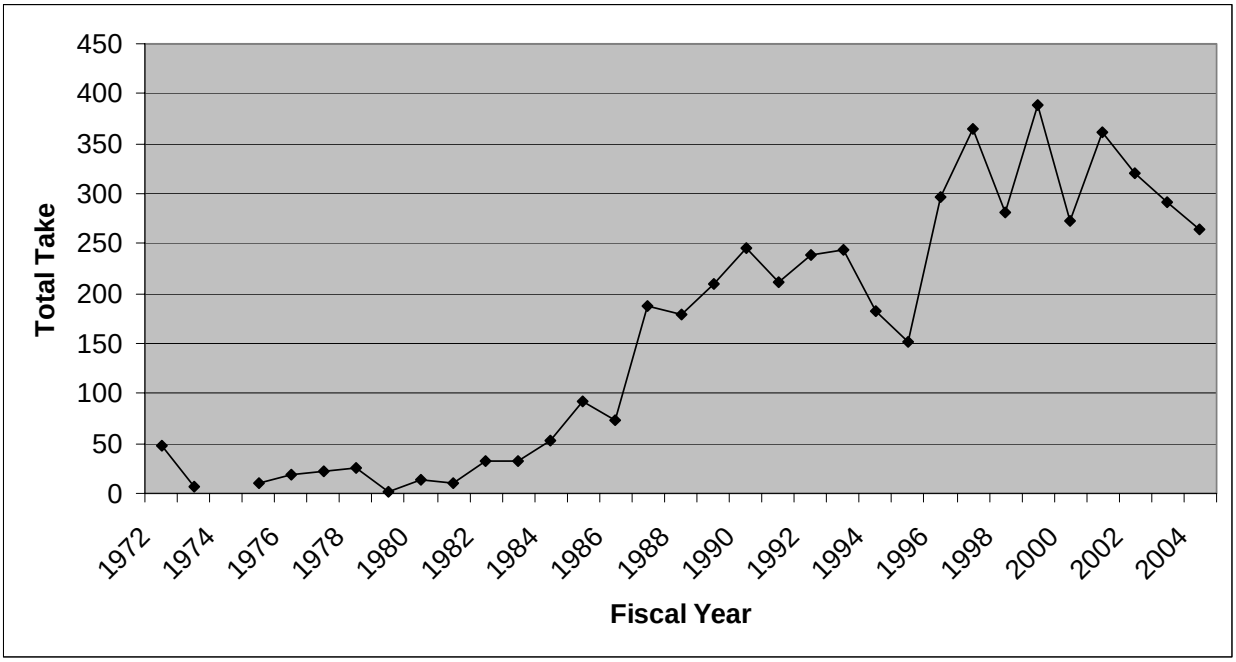

Figure 10. USDA-WS reported fox take in Utah, 1972-2004. Data reported by USDA-WS.

It is interesting to observe that the statewide increase in red fox abundance has occurred during the lowest period of coyote control. Sargeant et al. (1984, 1987) theorizes that protection for coyotes would allow coyote populations to increase, thus suppressing red fox populations. This has not happened on a landscape basis in Utah.

An argument may be made that red fox in Utah are an invasive species, based on historical data. Red foxes were historically divided into two species, *Vulpes vulpes* in the Old World and *V. fulva* in the New World, but today they are considered to be one species in the U.S. (*V. vulpes*). Churcher (1959) reviewed twelve subspecies of red foxes in North America with nine subspecies currently recognized in Canada. Churcher (1959) suggested that the red fox was introduced from Europe to the southern colonies around 1790.

Following the introductions, there was confusion as to which populations were expanding. Audubon and Bachman (cited in Churcher 1959) believed that Pennsylvania was the southern limit of the red fox's range in 1750, and documented a range extension southwards to Georgia by 1850. Leopold (1933) reported the expansion of red fox in Wisconsin, which was displacing the grey fox, while Godin (1977) reported *V. fulva* had established itself by 1850 and was displacing the gray fox to some degree along the southeastern seaboard. Godin also speculated that the introduced foxes might have interbred with a scarce population of indigenous red foxes, but historical accounts do not support this. Churcher (1959) concluded from the available evidence that the red fox was native to North America north of 40-45ºN but was scarce or absent in the hardwood forests where gray foxes were common. Churcher (1973) suggested that the 'original' habitat was the northern mixed hardwood and softwood forest zones. He also observed that the red fox might have been found in the hardwoods to the south, and the tundra to the north. Gilmore (1946) believed that red foxes were absent from Pennsylvania during aboriginal times and concluded that they did not range into the mideastern United States. Rhoads (1903 cited in Churcher 1959) stated, "in earlier colonial times the red fox was unknown in the austral zone (southern states).

Archaeological evidence from Ontario, Canada (Peterson et al. 1953) has shown that the red fox was present in the Midland area prior to introductions during the decade 1639–49 and that it was present earlier in the Oxford and Middlesex counties of southern Ontario, Canada. Sites farther south did not have red foxes (Gilmore 1946).

Once the red fox began to spread south and west from northeastern U.S. after its introduction from Europe, it expanded its range to include the prairies of the mid west and continued to expand west to Colorado and Utah. It has reached the Utah–Nevada line, and seems likely to invade Nevada as well.

Striped Skunk—Historically, what may be significant is the relatively few skunks found in Utah. Figure 11 shows skunk take by USDA-WS in Utah from 1917-2004. Periodic rabies eruptions suppressed skunk populations in the early years of the century. As an example, in 1918 with 51 full-time personnel setting traps, only ten skunks were removed statewide. In the 1920s, following years of SLD bait placements, skunk take in the program increased to above 100 annually, but then declined to none in 1933, 12 in 1934, 35 in 1935 and up to 98 in 1936. The cycle of skunk removal probably reflects the population level effect of rabies in skunks. The last skunk rabies incident in USDA-WS records, occurred in 1972 in Davis County, with a

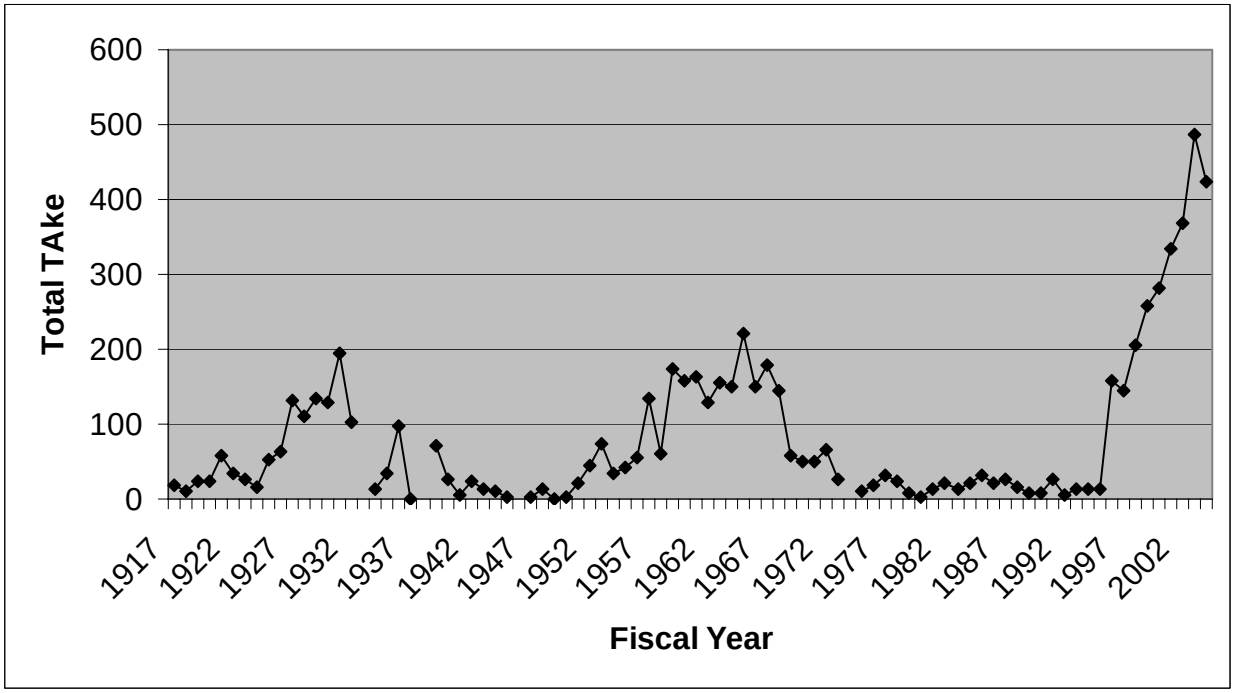

Figure 11. USDA-WS reported skunk take in Utah, 1917-2004. Data reported by USDA-WS.

countywide control program initiated as a result.

Raven and Magpie—Breeding bird survey results indicate a 300% increase in raven numbers from 1968 to the present. While most biologists believe the increase is due to more favorable conditions and anthropogenic food sources, the increase in populations also follows the reduction in use of poisons, likely keeping their numbers low.

Magpies were targeted along with ravens at draw stations with smaller baits placed especially for birds. USDA-WS records show that UDWR personnel placed baits to target birds in areas where federal poison programs were not active.

Coyote—Intensive coyote control prior to 1972 suppressed the coyote population. Since that time, the design of the predation management program has been to reduce coyote damage while not influencing populations. Analyses by Connolly and Longhurst (1975) and Pitt et al. (2002) indicate that the current level of exploitation does not affect coyote populations. It seems likely that coyote populations have never been higher than in modern times.

Impacts of Predation on Sage-grouse

Given that predators and nest predators are abundant and many are present in all time high numbers, impacts to sage-grouse may take one of two forms. Sage-grouse may be killed directly by predators (primary effects), and most mortality of sage-grouse is predation. Direct predation has negative population effects when it exceeds recruitment.

Secondary effects of predation include biological effects that are the result of behavioral changes

in sage-grouse. These behavioral changes result from the risk of predation and may take the form of lower fecundity, longer dispersals, use of sub optimal habitat, nest abandonment, and a number of other behaviors, which may affect populations.

Autenrieth (1981) suggested that nest predation was likely the most important population constraint on sage grouse in his study area. Here, predation on adult birds does occur and may be significant in some cases. Presnall and Wood (1953) reported tracking a coyote approximately 5 miles to its den in northern Colorado, and finding evidence along the way that the coyote had killed 3 adult sage-grouse and destroyed a sage-grouse nest. Examination of the stomach contents from an adult female coyote removed the next day showed parts of an adult sage-grouse, plus six newly-hatched sage-grouse chicks. The area around the den site was littered with sage-grouse bones and feathers. No other prey animal remains were found around the den, and it appeared that the pups had been raised largely upon sage-grouse. Till (1992) documented sage-grouse remains at 4 of the 30 coyote den sites examined during his study in south central Wyoming, but provided no indication of the relative abundance or distribution of sage-grouse in his study area. In northern Utah, researchers from Brigham Young University confirmed predation, primarily by red fox and coyote, as the cause of death for 13 of 21 radio-instrumented sage-grouse in the first year in their study area (Bunnell and Flinders 1999). Two additional instrumented birds could not be found, but were suspected to have been killed by predators, suggesting a 71% predation loss of instrumented birds. Additionally, eleven other sage-grouse were found dead in their study area, and all but one of these birds was killed by mammalian predators. USDA-WS is not aware of controlled studies conducted to determine if coyote and red fox control would actually result in significant benefits to grouse populations. However, the above studies indicate there may be some benefit to the removal of these predators in some situations.

In addition to primary predation effects secondary predation impacts likely exist in a number of populations. The risk of coyote predation may cause habitat abandonment or, through habitat choices, reduce fitness and make grouse more susceptible to other mortality. Coyote damage management may be indicated for populations not performing to habitat potential.

Meso-predator Release—As red fox have been implicated as primary predators of sage-grouse in many areas, the notion of some natural control of red fox by coyotes has been suggested. The idea that coyote removal may benefit red fox, and thus be a detriment to sage-grouse, has been offered by some as a need to limit coyote removal. The potential for an indirect effect on sage-grouse of coyote removal would take the form of a ‘meso-predator release’, which is the increase in smaller mammalian carnivore species after larger carnivores have been reduced or eliminated. The ‘meso-predator release’ theory allows that smaller predators are allowed to increase due to either a lack of predation, a release from competition, or both. Gehrt and Clark (2003) present an opposing view of meso-predator release and point out several weaknesses in the circumstantial evidence that has been used to suggest that meso-predator release occurs.

Sargeant, et al. (1984) reported on the effects of red fox predation on breeding ducks. Their data were collected when coyote populations were presumably suppressed by widespread use of predicide, and he notes that at the time (1968–73), "[c]oyote populations in most of the midcontinent area appear to be suppressed by man." The authors noted an inverse relationship between red fox and coyote populations and speculated, "...protection of coyotes will result in

expansion of local or regional populations that in turn will cause reductions in fox populations." They inferred that this would reduce predation on upland nesting ducks. Sargeant et al. (1987) reported on spatial relationships between coyotes and red foxes and showed that home ranges of fox families did not overlap the core centers of coyote home ranges on a North Dakota study site. Although none of their radio-collared foxes were killed by coyotes in their study, they hypothesized that red foxes tended to avoid coyote territories, presumably because of the fear of being killed by coyotes. Thus, they inferred that a red fox population would increase if the coyote population were reduced, because removal of territorial coyotes would create vacant coyote territories that could then become occupied by red foxes.

Still, the presence of coyotes does not completely displace red foxes. Voigt and Earle (1983) verified that red fox travel through coyote areas during dispersal, but did not establish there. They also reported, "...individual foxes and coyotes can occur in close proximity to each other along territory borders and when coyotes travel into fox areas." They also noted that "fox-coyote range overlap near borders was similar to fox-fox range overlap near borders," and that coyotes do not "completely displace foxes over areas." Gese et al. (1996) reported that coyotes tolerated red foxes when encountered about half of the time in Yellowstone National Park, although at times they were aggressive toward, and would sometimes kill foxes.

Other studies suggest that coyote territories would not remain vacant for very long after the coyotes are removed. Gese (1998) noted that adjacent coyote packs adjusted territorial boundaries following social disruption in a neighboring pack, thus allowing for complete occupancy of the area despite removal of breeding coyotes. Blejwas et al. (2002) noted that a replacement pair of coyotes occupied a territory in approximately 43 days following the removal of the territorial pair. Williams et al. (2003) noted that temporal genetic variation in coyote populations experiencing high turnover (due to control) indicated "...localized removal did not negatively impact population size..." In Utah, USDA-WS removes a small percentage (2-4%) of the estimated coyote population, not enough, even at a small scale, to create the vacant territories that would theoretically allow red fox populations to increase substantially. Therefore, we believe it would be unlikely for USDA-WS coyote removal actions to lead to indirect increases in predation effects on grouse populations. To the contrary, where populations are not performing to the full potential of the habitat, predation management may be necessary as part of an applied management plan for sage-grouse.

Predation Defense Mechanisms—Sage-grouse have adapted to live, and have evolved with, many of these predators. Sage-grouse, and other ground nesting birds, have developed effective strategies for hiding from predators when they occupy habitat of sufficient quality. Schroeder et al. (1999) briefly describe some of those adaptations. The actual timing of the strutting display and/or the formation of leks may have evolved due to predation selective pressures (Patterson 1952, Hartzler 1972, Bergerud 1988, Phillips 1990). Sage-grouse also respond to predation by either crouching in dense vegetation or flying away from an attacking predator (Hartzler 1972, Ellis 1984). Female Greater Sage-grouse have also been documented defending their nests from ground squirrels (Schroeder 1997). Girard (1937) observed females attacking predators in the defense of their brood. In an attempt to lead potential predators away from nests or young chicks, females have been documented performing distraction displays. The distraction display includes dragging wings on the ground while moving erratically (Peterson 1980). In addition, a female will occasionally re-nest if her first nest is destroyed by predators early in the incubation

period (Patterson 1952, Eng 1963, Connelly et al. 1993, Schroeder 1997), although re-nesting rates for sage-grouse are relatively low (Connelly et al. 1993).

Predator Control and Livestock Populations

Predator control activities began in Utah in 1888 with Territorial Bounty laws, which continued into Statehood and through the early 1900s. The inauguration of the government sponsored predator control program began in 1915 with small appropriations of funds used to hire a supervisor and eight men in designated areas where control was needed to protect livestock. Today this program is managed by USDA-WS.

Utah sheep numbers were at a record high of 2.7 million in 1931. Numbers varied from year to year in some cases and from decade to decade since the early 1900s. Today, approximately 265,000 sheep are grazed in Utah. Although sheep numbers are down, today more cattle ranching operations exist in the state compared to 1931.

Predator control for the protection of cattle replaced some of the reduction in control because of reduced sheep numbers. Improved methods of hunting with aircraft increased efficiency and effectiveness since the early 1970s, but poisons were used extensively in the early years when sheep numbers were high. Congress passed the Animal Damage Control Act of March 2, 1931. Records show that in 1936 up to 132 men were hired for predator control. Poison baits placed by men in the various field districts were more effective at controlling predator populations over a larger area than are currently worked today. Government trappers took a documented 16,719 predators in 1939, yet that figure doesn't reflect all of those which were poisoned. This amount was a record catch for any one fiscal year and shows more predators were taken in early years than records of today. The number of predators taken during this era not only exceeds the modern 'take', but likely represents a larger percentage of the population of the day. Modern records (since 1972) show that on average, USDA-WS in Utah averages about 5,000 coyotes per year by using 25 field men and several fixed-wing aircraft along with contracted helicopter work. Another 5,000 coyotes (on average) are taken by private hunters and trappers annually in Utah.

Utah's coyote population today is near 100,000 based on studies by USDA-WS research personnel (Connolly, 1996). Predator damage management today focuses on individuals causing damage, as opposed to population reductions (or eradication in the case of the wolf) of the past. Current control is practiced on less land mass, with more restrictions, and for the protection of fewer livestock than at any time in Utah history. Correspondingly, there are probably more coyotes alive today than at any time in Utah history.

Strychnine and thallium were the main poisons used in the early 1900s until the advent of compound 1080 in 1945. Compound 1080 was first effectively used on rodents and later on predators. From about 1950 to 1972, 1080 became the main method in controlling coyotes in all districts of Utah by the government and by private individuals. It is impossible to know precisely the effects it had on the coyote population, as population census were not conducted and the main objective of control was eradication.

It is reasonable to believe that Compound 1080 reduced coyote numbers considerably in large tracks of land that are no longer worked because current land-use practices prohibit coyote

control. Strychnine baits used for coyote control before 1972 (in conjunction with Compound 1080) likely controlled ravens and raptors, which fed on the baits. Compound 1080 is highly selective to canines but overused by most of the applicators because there were no dosage restrictions or regulations in place.

It is difficult to assess the extent of population suppression for ravens, coyotes, and even red foxes during the poison years. Some red foxes were found in Utah in low numbers and at high elevations early in the Territorial history. However, most biologists believe the red fox in Utah today is an invasive species, which arrived in the 1970s. Ravens have increased in numbers from the 1970s likely due to more favorable conditions, including human food sources (landfills, etc.). The increase in the raven population also follows the reduction in use of poisons that could have kept their numbers low. Early records show raven predation on lambs in the 1950s and concern to control them.

The effects of reduced coyote control on sage-grouse are not well understood. The decline of sage-grouse occurred at the same time as coyote populations expanded. It could be concluded that the poison ban allowed coyotes, raptors, and ravens all to expand in population numbers and range. Protections were placed at this time on ravens and magpies in the form of removing bounties and adding laws that prohibited shooting and nest destruction. The reduction in sheep numbers added to the favorable habitats for predators and raptors by the increases in prey base, and improved meadows and riparian areas. Red foxes arrived at this time and expanded in numbers because of the more favorable environments as previously discussed.

Incidentally, sage-grouse could have also benefited from the high numbers of sheep concentrated in winter areas. Properly managed sheep grazing in the winter, has the effect of rejuvenating sagebrush. As sheep numbers declined, sagebrush became decadent to some degree. Although natural cycles may have once occurred in sage-grouse populations, changes in the environment since the 1970s have caused a long term decline. Once a decline in sage-grouse numbers occurred, the increase in predator numbers, especially red fox and ravens, would be more detrimental to the grouse.

Conclusions

No empirical evidence is available specifically related to the effects of predation on sage-grouse in the Resource Area. Many sage-grouse predators are known to occur in the Resource Area and USDA-WS does conduct predator control in the area related to livestock operations which is likely to influence predator–prey dynamics involving sage-grouse. Predation by both native and nonnative predators is considered a relatively serious threat to sage-grouse populations in the area. Nonnative red fox populations have decimated relatively isolated populations of sage-grouse in nearby Strawberry Valley (Bunnell et al. 2000) and there is some concern that increasing populations of red foxes in the Resource Area could be having a negative impact on sage-grouse populations. Additional research and investigation into this issue seems warranted.

K. Renewable and Non-renewable Energy Development

Oil and gas development and exploration in the Resource Area has primarily occurred in Summit County; no drilling has commenced in Morgan County (Utah Division of Oil, Gas, and Mining 2005). In Summit County, oil and gas drilling increased somewhat in the late 1900s; however, few new sites have been established in recent years (Figure 12) (Utah Division of Oil, Gas, and Mining 2006).

Oil and gas facilities generally have a small footprint, usually a few acres or less. Each pad will often contain tanks and other equipment for a period of years. When the well is depleted, all facilities are removed and the pad is reclaimed. Some researchers believe the existence of these facilities suppresses sage-grouse use of the habitat for some distance beyond the actual footprint of the facility (Robel et al. 2004, Holloran et al. 2005). Compressor stations, active wells, and drilling rigs produce relatively loud and sustained noise that may interfere with sage-grouse, particularly during the breeding season (Crompton et al. 2006).

The location of drill sites is depicted in Figure 13. Although drill sights only represent places where oil or gas depositions were sought, many sites were fruitful and pads now exist in those areas. Figure 13 is provided to illustrate generally, where oil and gas impacts are located in the Resource Area.

Effective reclamation of oil and gas pads and other facilities, including the re-establishment of big sagebrush in some instances, is important for maintenance of sage-grouse habitat in these development areas. This can be challenging in drier portions of the Resource Area. Reclaimed pad sites have been used as leks sites in some areas (B. Maxfield, UDWR, personal communication).

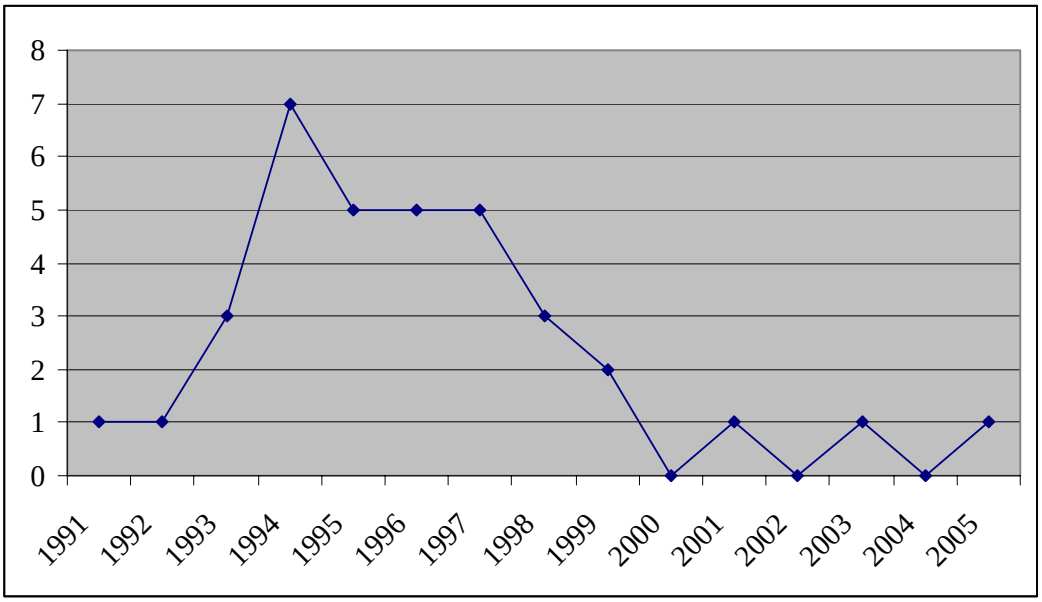

Figure 12. Number of oil and gas wells completed in Summit County, 1991-2005 (Utah Division of Oil, Gas, and Mining 2005).

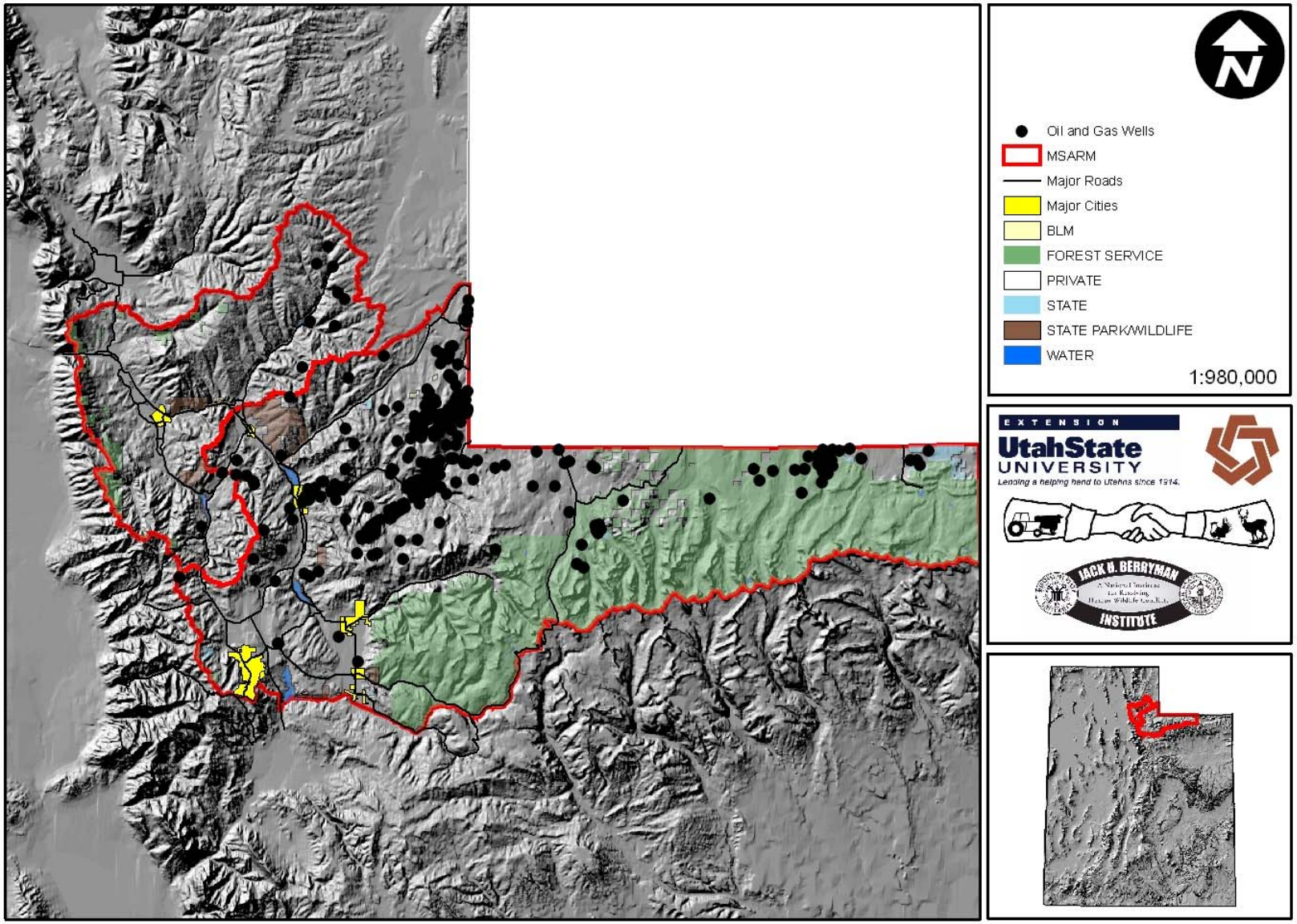

Figure 13. Location of drill sites in the MSARM Resource Area. Data obtained from http://www.ogm.utah.gov/oilgas/MAP_SEARCH/map_search.htm

L. Vegetation Management

Vegetation management conducted in the past was a reflection of the priorities of the time, and on the mandates and policies of the federal government, when vegetation management was done on federal land. Because much of the land in the Resource Area is under federal management, this is an important consideration when evaluating past and current conditions. In the past, many vegetation treatments were conducted to increase forage for livestock.

Recently, vegetation management has increasingly focused on restoring health to sagebrush rangelands. Management is increasingly done in a proactive manner. For example, seeing controlled burns to prevent the establishment of nonnative plants, setting back succession in sagebrush stands to create a mosaic of sagebrush cover classes across the landscape, and adjusting grazing practices to retain tall grasses for nesting cover. Habitat management also involves restorative treatments designed to remove cheatgrass and other invasive/noxious weeds, removal of pinyon-juniper stands, and restoration of native species.

Several treatment types are used to manipulate sagebrush communities. Connelly et al. (2005:7-46 to 7-50) describes the mechanical, chemical, and biological techniques available and discusses their successes and challenges.

Given the current climate of vegetation management (i.e. restore/maintain plant/wildlife community health), vegetation management is not likely to be an important negative impact to sage-grouse populations in the Resource Area. As discussed in an earlier section of this Plan, several habitat management projects have been implemented, or proposed, that are designed to improve sage-grouse habitat. Further, the Utah Partners for Conservation and Development (UPCD), a collection of resource management agencies, NGO, and private individuals, recently established a Regional Team in the Resource Area. The purpose of the UPCD Regional Team is to increase communication, coordination, and sharing of resources and information with regards to habitat and watershed improvements in the Resource Area. Increased focus and coordination is likely to improve project planning, implementation, and outcomes.

No empirical data exists regarding how sage-grouse have responded to vegetation treatments in the Resource Area. Several thousand acres have been treated in the Resource Area with the intent of improving sage-grouse habitat. We are not aware of post-treatment data that indicates the treatments resulted in conditions preferred by sage-grouse, however, that does not mean that those conditions do not exist or that the treatments were unsuccessful. Overall, we feel there is a great need to better monitor vegetation treatments in the Resource Area in an effort to expand our understanding of the influence of vegetation management on sage-grouse populations and habitats in the Resource Area.

V. Conservation Strategy

One of the main purposes of this Plan is to provide a framework of strategies and associated actions that can be implemented to abate threats, address information gaps, and guide monitoring efforts. Strategies and actions listed below (the order is irrelevant) were developed by MSARM partners. Several other documents and publications provide recommendations and guidelines for management of sage-grouse populations and their habitats, many of which were reviewed in the Introduction of this Plan. Strategies developed by MSARM are designed to be specific to the local area while taking into consideration the guidelines provided at a rangewide level.

Implementation of strategies and actions is strictly voluntary on the part of MSARM partners. Despite this, we have designated for each strategy the public and private partners who might be involved in implementation. Designation does not imply responsibility or commitment of resources of any sort to implementing, initiating, or completing any actions. However, it does provide a framework of resources and expertise.

To help prioritize implementation of the Plan, efficiently use resources, and develop and secure funding, we have also identified which threats each strategy addresses. In addition, we list the aspects of sage-grouse ecology likely to be impacted by each strategy.

A. Strategies and Actions

1. **Strategy:** Through 2016, prevent establishment of cheatgrass and other nonnative vegetation species in sage-grouse habitats.
   1.1. **Action:** Seed treated areas, where appropriate, with ecologically suitable seed mixes.
   1.2. **Action:** Avoid using fire in sage-grouse habitats that are prone to invasion by cheatgrass or other invasive weed species.
   1.3. **Action**: Evaluate all wildfires and prescribed burns, and reseed with ecologically suitable seed, where appropriate, to prevent establishment of cheatgrass and other invasive weed species.

   Partners: County weed boards, NRCS, UDWR, private partners
   Threats Addressed: Invasive/noxious weeds, vegetation management
   Aspects of Sage-grouse Ecology Addressed: Seasonal habitat quality, connectivity of seasonal habitat types

2. **Strategy**: By 2016, increase grass/forb understory in sagebrush stands.
   2.1. **Action**: Use sagebrush thinning techniques (Lawson aerator, spike, etc) in a mosaic pattern, where possible, to thin sagebrush stands.
   2.2. **Action**: Seed, when possible, treated areas with ecologically suitable seeds.
   2.3. **Action**: Reclaim and/or reseed areas disturbed by treatments when necessary, using seed mixtures with appropriate grasses and desirable forbs.
   2.4. **Action**: Restore understory vegetation in areas lacking desirable quality and quantity of herbaceous vegetation, where economically feasible.
   2.5. **Action**: Conduct vegetation treatments to improve forb diversity (e.g., harrowing, aerating, chaining) and reclaim or reseed disturbed area, if needed.
   2.6. **Action**: Develop management techniques to increase forb diversity and density in

sagebrush steppe, within limits of ecological sites and annual variations.

2.7. **Action**: Work with public and private partners to implement rest-rotation grazing systems, where possible.

Partners: UDWR, NRCS, private partners

Threats Addressed: Vegetation management, livestock grazing, invasive/noxious weeds, fire, pinyon/juniper encroachment

Aspects of Sage-grouse Ecology Addressed: Seasonal habitat quality, connectivity of seasonal habitat types

3. **Strategy:** By 2016, all new water projects will take into account MSARM recommendations to prevent conditions for extraordinary mosquito populations and potential persistence and spread of West Nile Virus in the Resource Area.

3.1. **Action:** Identify key elements of various water projects that are needed to prevent existence of standing water and minimize mosquito populations.

3.2. **Action:** Develop partnerships with key water management agencies to work cooperatively to both maintain necessary flow regime, and prevent conditions for extraordinary mosquito populations.

3.3. **Action:** Cooperate with Summit County Mosquito Abatement District.

3.4. **Action:** Assess any new water projects for contributions toward conditions that may enhance mosquito populations.

Partners: Summit County Mosquito Abatement District, UDWR, NRCS, private partners

Threats Addressed: Altered water distribution, parasites and disease

Aspects of Sage-grouse Ecology Addressed: Population size, population distribution, summer habitat quality

4. **Strategy:** By 2016, search additional areas (TBD) for new active lek sites.

4.1. **Action:** Coordinate with UDWR to conduct aerial surveys of areas suspected to contain undiscovered active leks.

4.2. **Action:** Coordinate with public and private partners to conduct terrestrial lek searches in areas suspected to contain undiscovered active leks.

4.3. **Action:** Coordinate with public and private partners to conduct count surveys of known active leks.

4.4. **Action**: Work with UDWR to enlist and coordinate private volunteers and/or other agency biologists to search for new leks, and conduct lek counts on active leks.

4.5. **Action**: Through 2016, test dead sage-grouse for West Nile Virus and any other parasites/pathogens of importance.

Partners: UDWR, USFS, USU Extension, private partners

Threats Addressed: Parasites and disease

Aspects of Sage-grouse Ecology Addressed: Population size, population distribution, connectivity of populations and subpopulations

5. **Strategy:** By 2016 decrease populations of sage-grouse predators, especially in areas used by sage-grouse for nesting and brood-rearing.

5.1. **Action:** Support efforts of USDA-WS to remove red foxes, coyotes, and ravens in areas used by sage-grouse for nesting and brood-rearing during spring and early summer.

5.2. **Action:** Develop and distribute educational materials to recreationists that provide information on the impact of littering on nonnative predator species.

Partners: USDA-WS, UDWR, Utah Department of Agriculture and Food, private partners, Summit County, Morgan County
Threats Addressed: Predation, OHV recreation, home/cabin development
Aspects of Sage-grouse Ecology Addressed: Population size, connectivity of populations and subpopulations

6. **Strategy**: Monitor impacts of lek viewing opportunities on lek behavior and lek attendance.
   6.1. **Action**: Provide educational material (brochures, presentations, etc.) to interested birding groups about the ecology of sage-grouse and threats they face in the Resource Area.
   6.2. **Action**: Increase law enforcement patrols in and around crucial lek sites.
   6.3. **Action**: Through 2016, include information about MSARM activities in County Extension newsletter.

   Partners: UDWR, USU Extension, UFBF, NRCS, SCD, private partners
   Threats Addressed: OHV recreation
   Aspects of Sage-grouse Ecology Addressed: Population size, population distribution, breeding habitat quality

7. **Strategy**: By 2016, increase funding opportunities for private partners interested in improving sage-grouse habitat on private land.
   7.1. **Action**: Participate in SCD and UPCD northern region team; share Plan Strategies with these groups and encourage funding of Plan Strategies.
   7.2. **Action**: Increase information dissemination about funding opportunities to private partners.
   7.3. **Action**: Develop educational material about habitat improvement techniques appropriate for sage-grouse habitat improvement and distribute to private partners.
   7.4. **Action**: Coordinate habitat projects on private land that meet the needs outlined in Plan and the needs of private partners.

   Partners: NRCS, SCD, FSA, UFBF, USU Extension, UDWR, USFWS
   Threats Addressed: Vegetation management
   Aspects of Sage-grouse Ecology Addressed: Seasonal habitat quality, connectivity of seasonal habitat types

8. **Strategy**: By 2016, increase the amount of breeding habitat in ‘good’ condition.
   8.1. **Action**: Work with public and private partners to implement rest-rotation/time controlled grazing management strategies, where appropriate.
   8.2. **Action**: Work with NRCS and private partners to implement Farm Bill programs beneficial to sage-grouse.
   8.3. **Action**: Work with NRCS and private partners to monitor effects of treatments on sage-grouse populations and habitat.

   Partners: NRCS, BLM, UDWR, CRM, USFS, private partners
   Threats Addressed: Invasive/noxious weeds, vegetation management, altered water distribution, livestock grazing
   Aspects of Sage-grouse Ecology Addressed: Seasonal habitat quality, connectivity of seasonal habitat types

9. **Strategy**: Coordinate fire management practices with public and private partners to prevent

loss of crucial sage-grouse habitat and enhance/improve sage-grouse habitat, where appropriate.

9.1. **Action**: Comment on BLM/USFS fire plans.

9.2. **Action**: Re-seed sites, post-burn, with ecologically suitable seed mixture to prevent the establishment of cheatgrass.

9.3. **Action**: Use fire management to reduce sagebrush canopy cover and create diverse sagebrush stands in brood-rearing and summer use areas.

Partners: BLM, USFS, UDWR, SITLA, private partners, NRCS

Threats Addressed: Invasive/noxious weeds, vegetation management, fire, pinyon/juniper encroachment

Aspects of Sage-grouse Ecology Addressed: Seasonal habitat quality, connectivity of seasonal habitat types

10. **Strategy**: Improve lek vegetation conditions to allow for predator recognition and visibility.

10.1. **Action**: Open lek areas that have been invaded by sagebrush and other shrubs.

10.2. **Action**: Map and inventory leks that have potential for restoration.

10.3. **Action**: Maintain and enhance desired habitat conditions for leks.

Partners: UDWR, USFS, private partners, USDA-WS, NRCS, university partners

Threats Addressed: Invasive/noxious weeds, vegetation management, pinyon/juniper encroachment

Aspects of Sage-grouse Ecology Addressed: Breeding habitat quality, population distribution

11. **Strategy**: Improve mesic and riparian areas for sage-grouse and watershed health.

11.1. **Action:** Identify opportunities or needs to create small wet areas; implement such projects where economically feasible.

11.2. **Action:** Design and implement livestock grazing management practices to benefit riparian areas.

11.3. **Action:** Modify or adapt pipelines or developed springs to create small wet areas.

11.4. **Action:** Locate projects to minimize potential loss of water table associated with wet meadows.

11.5. **Action:** Protect existing wet meadows and riparian areas where necessary.

11.6. **Action:** Manage vegetation and artificial structures to increase water-holding capability of areas.

Partners: UDWR, NRCS, USFS, private partners, UFBF

Threats Addressed: Invasive/noxious weeds, vegetation management, altered water distribution, livestock grazing

Aspects of Sage-grouse Ecology Addressed: Breeding habitat quality, summer habitat quality, connectivity of seasonal habitat types

12. **Strategy:** Minimize the amount of quality sage-grouse habitat eliminated by residential and commercial land development consistent with private property rights.

12.1. **Action:** Participate with County land-use decision makers in identifying key sage-grouse habitats.

12.2. **Action:** Maintain sagebrush environments of sufficient size and shape around developments in sage-grouse habitat.

12.3. **Action:** Encourage the voluntary use of conservation easements and other land protection vehicles with willing sellers in sage-grouse habitats.

12.4. **Action:** Educate rural residents about the importance of good grazing management in keeping small tracts weed free and capable of providing wildlife habitat.

Partners: Summit and Morgan County Commissions, Summit and Morgan County planning departments, private partners, USU Extension, NRCS, County Weed Boards, UDWR, USFS

Threats Addressed: Home/cabin development, roads, OHV recreation, renewable and nonrenewable energy, invasive/noxious weeds, predation, fences, power lines, and other tall structures, livestock grazing

Aspects of Sage-grouse Ecology Addressed: Seasonal habitat quality, connectivity of seasonal habitat types

13. **Strategy**: Encourage monitoring programs that are consistent with NRCS practices and Connelly et al. (2003b).

13.1. **Action**: Coordinate with MSARM partners to facilitate data collection.

13.2. **Action**: Schedule and/or advertise educational opportunities, disseminate printed materials.

13.3. **Action**: Coordinate with academic institutions to utilize students in monitoring efforts.

13.4. **Action**: Hold annual field tours of habitat improvement projects.

Partners: UDWR, NRCS, USU Extension, private partners, UFBF, SCDs

Threats Addressed: Vegetation management, altered water distribution, livestock grazing

Aspects of Sage-grouse Ecology Addressed: Seasonal habitat quality

14. **Strategy**: Improve efforts to increase size of sage-grouse population in the Resource Area.

14.1. **Action**: Explore the possibility of initiating translocations of hen sage-grouse from other areas within Utah that present stable or increasing populations.

14.2. **Action**: Continue existing predator management activities as called for by UDWR, USDA-WS, and other participating agencies and organizations.

Partners: UDWR, USDA-WS

Threats Addressed: Predation, home/cabin development, roads, power lines, fences, and other tall structures (i.e. fragmenting features)

Aspects of Sage-grouse Ecology Addressed: Population size, population distribution, connectivity of populations/subpopulations

15. **Strategy**: Define a level and system for domestic livestock grazing that maintains and improves both the long-term stability of sage-grouse populations and habitats, and the livestock industry in the Resource Area.

15.1. **Action**: Coordinate grazing management with livestock operators to reduce resource and timing conflicts on leks and prime nesting habitat when possible.

15.2. **Action**: Apply grazing management practices to achieve desired conditions including maintenance of residual herbaceous vegetation appropriate for the site.

15.3. **Action**: Encourage implementation of grazing systems that provide for areas and times of deferment while taking into consideration the resource capabilities and needs of the livestock operator.

Partners: UDWR, private partners, NRCS, USU Extension, USFS, UFBF

Threats Addressed: Invasive/noxious weeds, vegetation management, livestock grazing

Aspects of Sage-grouse Ecology Addressed: Seasonal habitat quality, connectivity of seasonal habitat types

B. Priority Evaluation

In order to help prioritize strategies, actions, and most effectively allocate resources, we have assigned a rank of 'low', 'medium', 'high', or 'very high' to each threat with regards to its contribution to reduction in population health or habitat condition (Table 5). Again, given the stipulations regarding a lack of empirical, locally-based information in many cases, these rankings are based on the best information available to us and our implicit, experiential knowledge of the Resource Area. Ranking definitions are based on The Nature Conservancy's Conservation Action Planning process (TNC 2005). Rankings are provided to help highlight potential priorities for subsequent strategies and actions.

MSARM partners and others can use the rankings in Table 6, combined with the strategies and actions listed above, to prioritize implementation and direct resources to efficiently and effectively abate threats, and maintain and improve sage-grouse populations and their habitats in the Resource Area.

Table 5. Relative importance/contribution of individual threats to reducing or degrading aspects of sage-grouse populations in the MSARM Resource Area. Threats are described in the "Threat Analysis" section of this Plan. Rankings are as follows: L = low; M = medium; H = high; and VH = very high. Ranks are defined according to TNC (2005).

	Aspects of Sage-grouse population in the MSARM Resource Area							
Threat	Reduced Population Size	Population Distribution	Reduced Nesting Habitat Quality	Reduced Brood-rearing Habitat Quality	Reduced Summer/Fall Habitat Quality	Reduced Winter Habitat Quality	Reduced Connectivity of Seasonal Habitat Types	Reduced Connectivity of Populations & Sub-populations
Drought and Weather	M	M	H	H	H	L	M	L
Existing and New Fences	L	L	L	L	L	L	L	L
Home and Cabin Development	H	H	M	M	M	M	H	VH
Power lines and Other Tall Structures	M	H	H	H	H	M	H	H
Renewable and Non-renewable Energy Development	M	M	M	M	M	M	M	M
Roads	M	H	H	H	H	M	H	H
Vegetation Management	M	H	M	M	M	H	M	L
Hunting	L	L	-	-	-	-	-	-
Fire	L	L	L	L	L	L	L	L
Livestock Grazing	L	L	L	L	L	L	L	L
OHV Recreation	M	M	H	H	H	VH	M	M
Invasive/Noxious Weeds	-	-	L	L	L	L	L	-
Parasites and Disease	M	M	-	-	-	-	-	-
Predation	VH	VH	H	H	M	M	M	M
Pinyon-Juniper Encroachment	M	M	M	L	L	M	M	M

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Appendix A

Morgan-Summit Adaptive Resource Management Local Working Group
Standard Operating Procedures