United States Department of Agriculture

Natural Resources Conservation Service

May 2009

Greater Sage-Grouse Habitat Conservation Strategy

Photo courtesy of Bruce Waage, USDA-NRCS

Helping People Help the Land

Montana Natural Resources Conservation Service (NRCS): An Approach to Greater Sage-Grouse Habitat Conservation

The details of the NRCS *Greater Sage-Grouse Habitat Conservation Strategy* are based largely on the management recommendations outlined in *Guidelines to Manage Sage Grouse Populations and Their Habitats* (Connelly et al. 2000) and *Management Plan and Conservation Strategies for Sage Grouse in Montana* (Montana Sage Grouse Work Group 2004).

To develop this strategy, NRCS consulted with many stakeholders and management agencies, including the U.S. Fish and Wildlife Service; Montana Fish, Wildlife and Parks; Bureau of Land Management; University of Montana; Montana State University; Montana Stockgrowers Association; Montana Department of Natural Resources and Conservation; Intertribal Agricultural Council; The Nature Conservancy; Sutton Research Center; Rio Tinto Mine; private landowners; and others. I would like to personally thank all contributors, landowners, and partners for their continued efforts and contributions and look forward to implementing cooperative conservation that will benefit the greater sage-grouse and sage-steppe communities throughout Montana.

For updated information on sage-grouse and associated obligate sage/steppe species conservation, please see the NRCS Web site at (http://www.mt.nrcs.usda.gov/technical/ecs/biology/sagegrouse/index.html).

Joyce Swartzendruber
State Conservationist
Natural Resources Conservation Service

Nondiscrimination Statement

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Montana NRCS' Focus for Greater Sage-Grouse Habitat Conservation, Application of the 2008 Conservation Title of the Farm Bill

The decline of greater sage-grouse (*Centrocercus urophansianus*; hereafter sage-grouse) populations has concerned naturalists and biologists for at least 90 years (Hornaday 1916, Patterson 1952, Autenreith 1981, Connelly and Braun 1997). Documented sage-grouse population declines and rising threats to their survival have caused the U.S. Fish and Wildlife Service (USFWS) to reevaluate sage-grouse for protective listing under the Endangered Species Act (ESA). The review is in progress. Sage-grouse, as their name implies, are dependant year-round on sagebrush-grassland for survival. Currently, about 27 million acres of sagebrush steppe capable of providing habitat for sage-grouse exist in Montana. The U.S. Department of Agriculture—NRCS' primary function is assisting agricultural producers with treating resource concerns on their lands. Because a substantial amount of sagebrush habitat in Montana is privately owned, NRCS is a key partner for sage-grouse conservation. Montana NRCS has developed a *Greater Sage-Grouse Habitat Conservation Strategy* that is specifically designed to maintain and enhance sage-grouse habitat and sage-grouse populations. This document outlines the specific measures that Montana NRCS will pursue for private land sage-grouse conservation.

A publication entitled *Guidelines to Manage Sage Grouse Populations and Their Habitats* (Connelly et al. 2000) was developed to compile the extensive body of sage-grouse research and to develop sound management guidelines for this iconic sagebrush steppe species. This publication is regarded as a primary source of technical guidance for sage-grouse management. In 2004, a diverse group of stakeholders developed a comprehensive document entitled *Management Plan and Conservation Strategies for Sage Grouse in Montana* (Montana Sage Grouse Work Group 2004). The details of the NRCS *Greater Sage-Grouse Habitat Conservation Strategy* are based largely on the management recommendations listed in both of the above publications. To develop this strategy, NRCS consulted with many stakeholders and management agencies, including the U.S. Fish and Wildlife Service (USFWS); Montana Fish, Wildlife and Parks (MFWP); Bureau of Land Management (BLM); University of Montana; Montana State University; Montana Stockgrowers Association; Montana Department of Natural Resources and Conservation; Intertribal Agricultural Council; The Nature Conservancy; and private landowners.

Several other sagebrush obligate wildlife species are experiencing population declines. These species include the Brewer's sparrow, sage sparrow, sage thrasher, pygmy rabbit, and sagebrush vole. Many of these species share the same threats as sage-grouse, and implementation of the *Greater Sage-Grouse Habitat Conservation Strategy* will directly benefit them as well.

There are twelve primary issues identified by the Montana Sage Grouse Work Group that have potential to affect sage-grouse populations adversely in Montana (Table 1). Although NRCS cannot address all of these issues, implementation of this strategy will address many of them, including grazing management, noxious weed management, outreach and education, power lines, predation, and vegetation.

Table 1. Issues Requiring Conservation Actions—*Management Plan and Conservation Strategies for Sage Grouse in Montana* (Montana Sage Grouse Work Group 2004)
1) Fire management
2) Grazing management*
3) Harvest management
4) Noxious weed management*
5) Mining and energy development
6) Outreach and education*
7) Power lines and generation facilities *Ranch facilities only
8) Predation*
9) Recreational disturbance
10) Roads and motorized vehicles
11) Vegetation*
12) Managing other wildlife in sagebrush habitat

* Issues that NRCS will address or partially address with this strategy

Montana NRCS is fully committed to large-scale implementation of the *Greater Sage-Grouse Habitat Conservation Strategy*. Applicable Farm Bill conservation programs to accomplish the tasks listed below include the Grassland Reserve Program (GRP), Environmental Quality Incentives Program (EQIP), Farm and Ranch Lands Protection Program (FRPP), Wildlife Habitat Incentives Program (WHIP), Conservation Stewardship Program (CSP), Conservation Cooperative Partnership Initiative (CCPI), and Conservation Technical Assistance Program (CTA).

The strategy involves five steps:

- Identifying and delineating "core areas" where the largest benefit for sage-grouse conservation can be attained,
- Expanding NRCS' role to provide sage-grouse conservation outreach and education to stakeholders, including private landowners, Conservation Districts, local sage-grouse working groups, and NRCS employees,
- Providing long-term protection, through conservation easements, of the best remaining sagebrush habitat to prevent conversion to other uses,
- Improving the health and overall habitat values associated with sagebrush communities through management and structural improvements and/or modifications, and
- Developing and executing a comprehensive monitoring plan to assess the effectiveness of the strategy on sage-grouse populations.

Identification and delineation of the core area. There are currently about 27 million acres of suitable sagebrush steppe available to sage-grouse in Montana. However, sage-grouse are not uniformly distributed throughout this habitat. To focus conservation efforts, NRCS tapped the principles outlined by Kevin Doherty, PhD, in his dissertation, *Sage-Grouse and Energy Development: Integrating Science with Conservation Planning to Reduce Impacts* (Doherty 2008), in which he suggested a "core area" approach. The 27 million acres were refined by MFWP to 13 separate "core" sites (Appendix 1), totaling 8.9 million acres (Map 1). These core areas provide habitat for 75% of all known breeding sage-grouse in Montana. To refine the process, each core area was analyzed for energy development potential (wind, gas, or oil) as energy development has well-documented negative effects on the survival of sage-grouse

populations. NRCS conservation actions for sage-grouse will be targeted to these refined core areas where high quality habitat and low energy development potential coincide.

Outreach and Education. Currently, there is widespread concern about sage-grouse habitat management. Educating stakeholders (i.e., private landowners and land managers, Conservation Districts, sage-grouse working groups, and NRCS employees) about habitat management needs is essential to the success of the *Greater Sage-Grouse Habitat Conservation Strategy*. To address this subject, NRCS will:

- Continue funding and support for our interagency sage-grouse coordinator position. Currently, NRCS and BLM jointly fund this position, located in Billings. The primary function of this position is to provide interagency coordination and sage-grouse working group support to implement sage-grouse conservation in Montana on both private and public lands.
- Maintain the Montana NRCS Web site dedicated to sage-grouse and associated obligate sage/steppe species conservation. This site will be updated with information relating to sage-grouse conservation efforts. (http://www.mt.nrcs.usda.gov/technical/ecs/biology/sagegrouse/index.html)
- Produce videos that highlight sage-grouse conservation needs, actions, and progress.
- Publish and distribute a brochure that describes NRCS conservation practices used to benefit sage-grouse.
- Develop a comprehensive sage-grouse (and associated obligate sage/steppe species) life history and habitat conservation training course that targets NRCS field staff, Conservation District employees, and partner organizations (Appendix 2). This course can be given at one or more locations throughout the state, as needed.
- Increase participation in all sage-grouse local working groups with an emphasis on improving both NRCS and private landowner involvement.

Currently, there are three sage-grouse local working groups in Montana; additional ones may be needed. The *Greater Sage-Grouse Habitat Conservation Strategy* aims to empower these working groups with a set of technical and financial tools that will allow them to identify and implement sage-grouse conservation.

Habitat Protection. Unlike many states and Canadian provinces, Montana still has large blocks of intact habitat that support sustainable sage-grouse populations. Long-term protection of these sites from conversion to cropland and urbanization is the highest priority for NRCS sage-grouse conservation action.

Conversion of sagebrush-grassland is an ongoing threat to Montana's sage-grouse populations. Photo courtesy of Brendan Moynahan

NRCS administers several conservation easement programs that have the flexibility to focus on long-term protection of sagebrush habitat. Targeted outreach and increased funding for protecting high-value sagebrush-grassland through conservation easements and other long-term agreements is NRCS' highest priority.

- NRCS will seek to secure additional GRP and FRPP funding and target these programs to protect important sagebrush-grassland habitat. Funding easements located in sage-grouse "core areas" will be a priority.

Habitat Management, Restoration, and Enhancement. The amount, distribution, and quality of sagebrush habitat are vital for sage-grouse survival. Within blocks of sagebrush-grassland, sage-grouse select different habitat attributes depending on the time of year and the associated life-cycle requirements. Sage-grouse habitat is generally classified as A) breeding/nesting, B) brood, and C) winter. Because sage-grouse use a large home range, habitat management should be conducted on a landscape scale, ensuring that healthy, diverse, well-connected sagebrush-grasslands persist. To maintain and improve habitat for sage-grouse and other associated sage/steppe obligates, all management practices will be aimed at improving rangeland health, diversity, and sustainability.

- **Grazing Management.** Ranching has prevented the conversion of expansive tracts of sagebrush-dominated range from conversion to cropland. Livestock grazing also has the potential to affect significantly, both positively and negatively, the quality of sagebrush habitat. Therefore, the primary tool NRCS will use for sage-grouse habitat management is prescribed grazing. The Prescribed Grazing (528) Standard and Specification, along with a detailed inventory of known sage-grouse lek sites, roads, and associated infrastructure (i.e., fences, watering tanks, etc.) will be used to develop site-specific grazing systems. All prescribed grazing plans will be designed to A) improve overall rangeland health, B) be sustainable on the landscape, C) have no more than 50% forage utilization during winter grazing, and D) be monitored so informed adjustments can be made, when necessary. Site-specific management plans will be developed with each landowner; these plans will detail the stocking rates, rotations, timing, and duration of use in each field. All grazing plans will contain a drought contingency that adjusts grazing use commensurate with lower precipitation and plant growth. All required facilitative practices (i.e., fence, well, spring development, pipeline, etc.) will be planned and designed to minimize disturbance and, where possible, enhance sage-grouse habitat. Additional payments will be

considered for implementing planned grazing systems under Prescribed Grazing (528) and Upland Wildlife Habitat Management (645) Standards and Specifications. Payment rates will be set to encourage implementation of the prescribed grazing system. Financial assistance for the facilitative practices will also be included.

Livestock grazing is an important tool for managing sage-grouse habitat.
Photo courtesy of Tim Griffiths, USDA-NRCS

- **Rangeland Restoration/Enhancement Practices.** Some of Montana's rangeland has been significantly degraded to a point where it no longer supports diverse stands of native vegetation. These degraded areas often have significant clubmoss and blue grama cover that competes with more desirable and productive native vegetation. The effect is a reduction in the quality of habitat for livestock, sage-grouse, and other wildlife that may not be corrected on a large scale with livestock management alone.

Mechanical treatment of clubmoss cover
Photo courtesy of Phil Gonzales, USDA-NRCS

After identification of sites having significant clubmoss and blue grama cover, NRCS may prescribe Grazing Lands Mechanical Treatment (548) Standard and Specification to improve desirable plant composition. Practice specifications will be designed to stimulate new sagebrush growth and minimize removal of established sagebrush plants. Treatments may include use of the Lawson Aerator (with or without seeding of legumes, forbs, and sagebrush) and chiseling (with or without seeding). These mechanical treatments have often improved range and habitat conditions in Montana and Wyoming by stimulating growth of grasses, forbs, and sagebrush. Treatments will be implemented in a mosaic pattern, not applied to large blocks of habitat. **Prescribed grazing and a minimum grazing deferment of two growing seasons will be mandatory where mechanical treatments are implemented.**

- **Brood Habitat.** Several researchers have suggested that the quality and availability of brood habitat may be limiting sage-grouse populations through reductions in the recruitment of young (Drut et al. 1994*a, b;* Connelly and Braun 1997; Sveum et al. 1998). Previous studies, by showing correlations between forb abundance in brood habitat, have indicated that forbs are an important resource for chicks as well as for brood success and productivity. Studies have also suggested that forbs play a key role in brood habitat selection, brood movements, distribution, and home range size. Sage-grouse chick diets are dominated by invertebrates and forbs for the first 12 weeks of life. In laboratory studies, Johnson and Boyce (1990) have shown that chick growth and survival rates increase with the quantity of invertebrates in the diet and that sufficient invertebrate forage is required for survival until the chicks are at least 21 days old. Forbs contribute directly to the protein intake of chicks as food items and, more importantly, indirectly by attracting the invertebrates required for survival and growth (Blenden et al. 1986, Brush and Stiles 1986).

  West Nile Virus may be a significant mortality factor in moist brood habitat. For this reason, NRCS will not promote enhancement practices that would result in artificial saturation of soils or enhancing or creating ponded water features even though doing so would likely have positive effects on the amount and quality of brood habitat. Instead, NRCS will focus on restoration of degraded swales and coulees, restoring natural wetland seeps near spring developments, and establishing upland brood strips.

- **Establishing Upland Brood Strips.** Upland brood strips are areas established to maximize insect and forb production for young gallinaceous birds. These areas are planted to preferred

legumes and other forbs (introduced and native) in linear or sinuous strips. Appropriate sites for brood strips include the edges of existing cropland, hayland, and pastureland. Brood strips will not be considered on native rangeland. The Field Border (386) Standard and Specification will be used. The Deseret Land and Livestock Ranch (DLL), located in northern Utah, has used brood strips successfully to improve the quality of brood habitat as well as habitat for other wildlife species, including mule deer and pronghorn (Danvir 2002).

- **Swale and Coulee Restorations.** Many swales or coulees throughout sage-grouse habitat have been degraded by stream downcutting. Incised swales and coulees have a lowered water table with resulting loss of wet meadow habitat. Since wet meadows are extremely important for forb and invertebrate production, restoration of these sites should be a priority. Because of West Nile Virus, swale and coulee restoration will be limited to restoration of natural grades and will not be used to enhance functioning swales and coulees to artificial conditions. The Channel Stabilization (584) Standard and Specification will be used. Proposed treatments include construction of rock gabions, earthen check dams, vortex weirs, etc. to slow run-off events, capture sediment, and allow wet meadows to reestablish.

- **Spring Development Modifications.** Spring developments are a common practice throughout Montana and may threaten sage-grouse by drying the seep area and reducing forb and insect abundance. When springs are developed, the degree of impact is highly variable and depends on the amount of water produced in the spring, the success of capturing water in a spring box, and the overall design of the development. Although Montana NRCS policy currently requires that the seep be recreated below all new spring developments, many existing spring developments do not meet this specification. Applying design modifications to existing spring developments will recreate the seep near the source. NRCS will ensure that all new and existing troughs are equipped with wildlife escape ramps. Fences around springs or tanks will be modified to prevent avian predators from using the posts as hunting perches. The appropriate standards and specifications to address these concerns include Spring Development (574), Pipeline (516), and Fence (382).

Golden eagles and other raptors often use wooden fence posts as hunting perches. Photo courtesy of Wendy Williams, USDA-NRCS

- **Predation and Accidental Mortality**. Predation of sage-grouse and their nests affects sage-grouse populations to some degree. “The composition and abundance of various avian and

mammalian predator species has changed, and continues to change, since the termination of widespread predator control activities in the early 1970's. Changes in predator population composition and numbers may hold grouse numbers below their biological potential in some locations, even in areas characterized by largely un-fragmented habitats" (Montana Sage Grouse Work Group 2004). Common predators of sage-grouse and their nests in Montana include mammalian (i.e., coyote, red fox, raccoon, and skunks), avian (i.e., golden eagles, other raptors, ravens, and magpies), and reptiles (i.e., bull snakes). Most researchers agree, however, that predation is rarely population-limiting as common nest-success rates are reported at >40%, and high survival rates are reported for chicks >10 weeks old.

The impact of predation is, however, site-specific and a topic of much debate. Predation of adult and juvenile birds is highest in areas where they are most vulnerable: males displaying on leks, juveniles foraging actively in brood habitat, hens incubating nests, and all ages and sexes on winter range sites where snow often limits sagebrush cover.

Accidental mortality from collisions with fence wires and drowning in livestock water tanks are preventable mortality factors. The DLL (Danvir 2002) reported that 18% of all sage-grouse mortality resulted from collisions with fences, and the Sutton Research Center (Wolfe 2007) reported that 40% of all prairie chicken losses resulted from fence collisions. Both of these preventable mortality factors are easily reduced through implementation of specific conservation actions.

Sage-grouse mortality resulting from a fence collision. Photo courtesy of Stan Harter, WGF

Guidelines to Manage Sage Grouse Populations and Their Habitats (Connelly et al. 2000) and *Management Plan and Conservation Strategies for Sage Grouse in Montana* (Montana Sage Grouse Work Group 2004) include management recommendations for decreasing both predation and accidental mortality of sage-grouse. The factors listed below will be addressed or partially addressed by the NRCS' *Greater Sage-Grouse Habitat Conservation Strategy*.

- **Encroached Conifers**. Over the past 30 to 40 years, Montana has experienced significant conifer expansion from forested habitats into native meadows and sagebrush grasslands. Spread of conifers into rangeland is a result of wildland fire suppression and livestock grazing management (annually removing the fine fuels required to carry wildfire). Conifer encroachment into sagebrush-steppe communities adversely affects many native wildlife species, including sage-grouse. Negative effects from increased competition by encroached conifers with the shrub/grass/forb understory as well as increasing availability of perch sites for avian predators often reduces sage-grouse use. Removing encroached conifers from rangeland units will limit avian predation on sage-grouse. Conifer removal will be performed using the least destructive and most reasonable mechanical treatments available. All standing encroached conifers >3 feet in height will be mechanically removed, chipped, or piled/burned. Prescribed fire will not be used as a control method because it will also destroy sagebrush. Herbicidal treatment will be considered as a treatment option on conifers <3 feet tall. In areas where understory herbaceous vegetation is limited, reclamation of the site will be required (i.e., seeding of native and/or introduced grasses, legumes, and forbs) if grazing management alone is not effective. Brush Management (314) and Range Planting (550) Standards and Specifications will be used to address this issue.

- **Transmission Lines.** Transmission lines have well-documented negative effects on sage-grouse populations because they provide raptor perch sites. Opportunities exist to remove many of the smaller lines that supply power to livestock watering facilities. This issue will be addressed by one or more of the following:
  - The pump will be replaced with a solar-powered, variable speed pump.
  - The transmission line will be buried and poles removed.
  - Standing poles will be retrofitted with raptor-deterrent tops.

  Pumping Plant (533) Standard and Specification will be used to address this issue.

Avian predators often use transmission lines as hunting perches.

- **Fence Modifications and/or Relocations.** Fence location and design (wood or steel post) can enhance the ability of predators to take sage-grouse. Avian predators often use flat-topped wooden fence posts as hunting perches. Fences near leks and winter habitat may aid predators in

taking sage-grouse when they are most vulnerable. Mammalian predators often hunt along fence lines, especially woven wire fences, where sage-grouse are forced to travel as they look for a crossing. Additionally, as noted above, accidental mortality occurs when sage-grouse collide with fences. NRCS will remove, relocate, or modify fences that are within ¼ mile of known or suspected sage-grouse leks, winter habitat, or other problem areas to ensure the following.

- The fences are visible to sage-grouse in low-light conditions and placed to minimize accidental collision (i.e., mark wires to make them visible to sage-grouse, locate fences out of flight lines, etc.).
- The fences do not provide perches for raptors (i.e., install spikes or cone tops to wood posts, replace with metal t-posts, or use wire top deterrents).
- Woven wire fences do not impede wildlife movement (i.e., remove or provide passages).

Fence (382) and Obstruction Removal (500) Standards and Specifications will be used to address this issue.

Fence markers can dramatically reduce accidental sage-grouse mortality.
Photos courtesy of Bruce Waage, USDA-NRCS

Spikes in the top of wood posts are effective means to prevent raptor perches.

- **Livestock Watering Tanks.** Livestock watering tanks may cause wildlife mortality, including sage-grouse, when properly designed wildlife escape ramps are not installed. NRCS will address this issue by installing wildlife escape ramps in all planned and existing livestock watering tanks. Watering Facility (614) Standard and Specification will be used to address this issue.

Typical stockwater tank with wildlife escape ramp installed. Photo courtesy of Phil Gonzales, USDA-NRCS

- **Invasive and Noxious Weeds.** Invasive and noxious weeds pose a serious threat to sage-grouse survival because they compete with native rangeland vegetation. These weeds and annual grasses displace desirable native plant species and cause significant adverse biological and economic consequences by reducing productivity on healthy rangeland. NRCS will address this issue by identification and mapping of invasive and noxious weed infestations and through development of a cost-shared Integrated Pest Management (IPM) plan to control weeds. When developing the IPM plan, damage to native forbs will be minimized. Herbaceous Weed Control (797) Standard and Specification will be used to address this issue.

- **Expiring CRP and Go-Back Lands.** Recent upswings in commodity crop prices may cause Montana to lose a significant acreage of CRP lands. Although most CRP lands do not contain sagebrush habitat, conversion to cropland is undesirable for sage-grouse and associated obligate sage/steppe wildlife species. Expiring CRP acres can be effectively used to meet a rancher's feed and forage requirements and grazed in the spring to allow deferment of native range grazing until later in the year. Additional incentives can be established to promote the restoration of these sites to sagebrush-grassland. Key areas will first be identified where sagebrush-grassland is limited and those areas will be strategically targeted for restoration. Pasture and Hayland Planting (512), Range Planting (550), Fence (382), Pipeline (516), Well (642), Watering Facility (612), and Prescribed Grazing (528) Standards and Specifications will be used to address this issue.

Photo courtesy of Bruce Waage, USDA-NRCS

- **Research and Monitoring.** The primary goal of the *Greater Sage-Grouse Habitat Conservation Strategy* is to maintain large blocks of diverse, intact sagebrush-grassland where sage-grouse and other sagebrush obligates can persist. To evaluate this objective, scientific monitoring of project results is critical. Annual monitoring and recordkeeping will be required of individual producers and will be used to adjust management practices. The evaluation of "core area" habitat and sage-grouse population responses will be conducted through partnership efforts with the NRCS, leading universities, and other interested parties.

Literature Cited

Autenrieth, R.E. 1981. Sage grouse management in Idaho. Idaho Department of Fish and Game, Wildlife Bulletin 9, Boise, Idaho, USA.

Blenden, M.D., J.J. Armbruster, T.S. Baskett, and A.H. Farmer. 1986. Evaluation of model assumptions: the relationship between plant biomass and arthropod abundance. Pages 11-18 *in* J. Verner, M.L. Morrison, D.J. Ralph, editors. Wildlife 2000: Modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison, USA.

Brush, T. and E.W. Stiles. 1986. Using food abundance to predict habitat use by birds. Pages 57-63 *in* J. Verner, M.L. Morrison, C.J. Ralph, editors. Wildlife 2000: Modeling habitat relationships of terrestrial vertebrates. University of Wisconsin Press, Madison, USA.

Connelly, J.W., and C.E. Braun. 1997. Long-term changes in sage grouse *Centrocercus urophasianus* populations in western North America. Wildlife Biology 3/4: 123-128.

Connelly, J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Danvir, R.E. 2002. Sage grouse ecology and management in northern Utah sagebrush-steppe. Deseret Land and Livestock Ranch and the Foundation for Quality Resource Management, Woodruff, Utah, USA.

Doherty, K.E. 2008. Sage-grouse and energy development: integrating science with conservation planning to reduce impacts. Dissertation, University of Montana, Missoula, Montana, USA.

Drut, M.S., J.A. Crawford, and M.A. Gregg. 1994a. Brood habitat use by sage grouse in Oregon. Great Basin Naturalist 54:170-176.

Drut, M.S., W.H. Pyle, and J.A. Crawford. 1994b. Technical note: diets and food selection of sage grouse chicks in Oregon. Journal of Range Management 47:90-93.

Hornaday, W.T. 1916. Save the sage grouse from extinction, a demand from civilization to the western states. New York Zoological Park Bulletin 5:179-219.

Johnson, G.D., and M.S. Boyce. 1990. Feeding trials with invertebrates in the diet of sage grouse chicks. Journal of Wildlife Management 54:89-91.

Montana Sage Grouse Work Group. 2004. Management plan and conservation strategy for sage grouse in Montana – final.

Patterson, R.L. 1952. The sage grouse in Wyoming. Sage Books, Denver, Colorado, USA.

Sveum, C.M., J.A. Crawford, and W.D. Edge. 1998. Use and selection of brood-rearing habitat by greater sage grouse in south central Washington. Great Basin Naturalist 58:344-351.

Wolfe, D. H., M. A. Patten, E. Shochat, C. L. Pruett, and S. K. Sherrod. 2007. Causes and patterns of mortality in Lesser Prairie-Chickens and implications for management. Wildlife Biology. 13 (Suppl. 1):95-104.

APPENDIX 1

Greater Sage-grouse Core Areas Designation for Montana Version 1.0

Definition, Methods, and Numerical Results
Montana Fish, Wildlife and Parks
January 13, 2009

Objective: Designate sage-grouse core areas in Montana that support the greatest sage-grouse abundance or are important for maintaining sage-grouse distribution.

Definition: Sage-grouse core areas are habitats associated with 1) Montana's highest densities of sage-grouse (25% quartile), based on male counts and/or 2) sage-grouse lek complexes and associated habitat important to sage-grouse distribution.

Methods and criteria for #1 in the Definition:

1) Identifying Highest Density: Two different point density estimation methods (noted below) were used to identify the highest densities of displaying male sage-grouse based upon lek locations. Both techniques identified the same lek complexes as having the highest densities at the 25% quartile.

    a. Audubon (K. Doherty) used a 6440m circular neighborhood analysis (Spatial Analyst Tools ArcGIS 9.2) at 1km grid cell size. The maximum male count available between 2005-2007 was used to evaluate male density. The resulting surface was randomly sampled using 50,000 points to determine the quartile breakpoints.
    b. MT Fish, Wildlife and Parks used a Fixed Kernel Density Estimator (Hawths Tools –ArcGIS 9.2) with a bivariate normal kernel and a smoothing factor of 10, 000 at a 500m cell size. The kernel was weighted based upon the average of the highest male count for each year from 1998-2008. The quartile boundaries are provided by the program.

2) Focus Area: Lek complexes and associated habitats, typically within a 10 km search radius of leks in the complex, defined the outside boundaries of this analysis. In some instances, habitat associated with a core lek complex may have extended beyond 10 km. Overlaying documented seasonal habitats connected to and extending beyond these areas and manual editing were necessary to incorporate these exceptions.

3) Habitat Suitability Analysis: For the purposes of this analysis, unsuitable habitats and suitable habitats within or adjacent to core areas were generally defined as follows:

    a. Unsuitable Habitat
        - Cultivated row-crop parcels > 600 acres
        - Areas where 75% or more of the surrounding 1000 acres are cultivated land*
        - Areas where 20% or more of the surrounding 1000 acres are forested habitat*
        - Areas where 75% or more of the surrounding 1000 acres exceeded a terrain ruggedness threshold of 13.**

1. Note: This criteria was not included for intermountain valleys of southwestern Montana because of the unique topographic features and demonstrated habitat use by sage-grouse

* Landcover values were obtained from the National Land Cover Dataset (NLCD). Analyses were based upon a 30m grid cell. Percentages are based on a 2 km X 2 km search window (1,000 acres).

** Terrain ruggedness is the standard deviation of elevation surrounding an area based upon a 30m grid cell. The threshold was chosen based on 95% of leks having a value of 13 or lower.

b. Suitable Habitat

- Areas where 75% or more of the surrounding 1000 acres had a 10% or greater probability of supporting a sage-grouse lek.
  1. The majority of core area boundaries were based upon this delineation.
  2. The probability used is based upon a habitat suitability model that used lek locations to identify suitable habitat. This model was produced by the MT Natural Heritage Program and is documented at (http://mtnhp.org/reports/MaltaFO_2007.pdf).

Methods and criteria for #2 in the Definition:

1) Key areas for maintaining sage-grouse distribution in Montana are among the highest 50% density (50% quartile, using methods described above) occurring in the outer boundaries of the sage-grouse's range in Montana.
2) Key habitat corridors important for conductivity and sage-grouse distribution beyond Montana are also included under this definition (e.g., portions of northern Valley County).
3) Non-habitats and habitat boundaries within or adjacent to core areas follow the same criteria as under #3 above.

Refinement Process:

1) Field biologists from FWP and BLM reviewed printed maps showing the habitat parameters described above to identify outer boundaries of core areas and determined general accuracy of designated non-habitats. Printed maps were at a scale of 1:200,000.
2) Based upon those biologists expert opinion, refinements were made to the core area boundaries. This allowed for inclusion of nesting and brood rearing areas not captured by the lek driven model.
3) Telemetry data was utilized to refine core area boundaries in southwestern Powder River and southeastern Bighorn counties and Beaverhead and Madison Counties to help refine mapping of Core habitats in these areas. Data from Powder River and Bighorn counties was obtained from research done by Dr. Dave Naugle, University of Montana. Data from Beaverhead and Madison counties was obtained from research done by the BLM.
4) The mapped habitat, refinements based upon biological expert opinion and integration of existing research data were incorporated to develop Version 1.0.
5) As additional information becomes available, Core Area designations will be refined.

Numerical Results:

Core Areas mapped as Version 1.0 include 56% of the state's sage-grouse leks (953 of 1693 leks) and 71% of displaying males based on average male counts over the last 10 years (13439 of 18910 sum of average males).

APPENDIX 2

The following is a 2-day draft "Training Template" designed to increase the knowledge and understanding of the targeted audience regarding Sage-grouse and associated sage-brush obligates conservation.

Targeted audience: NRCS- All technical NRCS field and area employees located in counties that have sage-grouse present. Conservation districts- All CD staff located in counties that have sage-grouse present. Private landowners- All interested landowners that own or manage property where sage-grouse occur. Partner agencies and organizations- Any partner that would like to increase their knowledge regarding sage-grouse habitat and applicable management.

Montana sage-grouse and sage-brush obligates habitat conservation course

Date(s)
Location(s)

Day 1

Welcome and introductions
Presenter

Sage-grouse ecology, history, and current status
Presenter

Sage-brush obligates ecology, history, and current status
Presenter

Large-scale threats to sage-grouse and sage-brush obligates in Montana

Conversion of sagebrush to cropland and subdivision
Presenter

Energy development
Presenter

Grazing
Presenter

West Nile
Presenter

Core Area development and strategic focus philosophy
Presenter

Technology- (explaining what the typical rancher can do)
Various presenters
- **Fences and roads**
- **Water, spring developments, and wetlands**
- **Upland Brood Strips**
- **Accelerating practices (chiseling)**
- **Grazing**

Montana Sage-grouse Habitat Conservation Strategy (overview)
Presenter

Programs and sage-grouse- (putting it all together)
Presenter

Monitoring progress
Various Presenters
- **Habitat based**
- **Population based**

Day 2

Active sage-grouse lek viewing (Early morning group activity)

Inventory process for sage-grouse conservation
Presenter

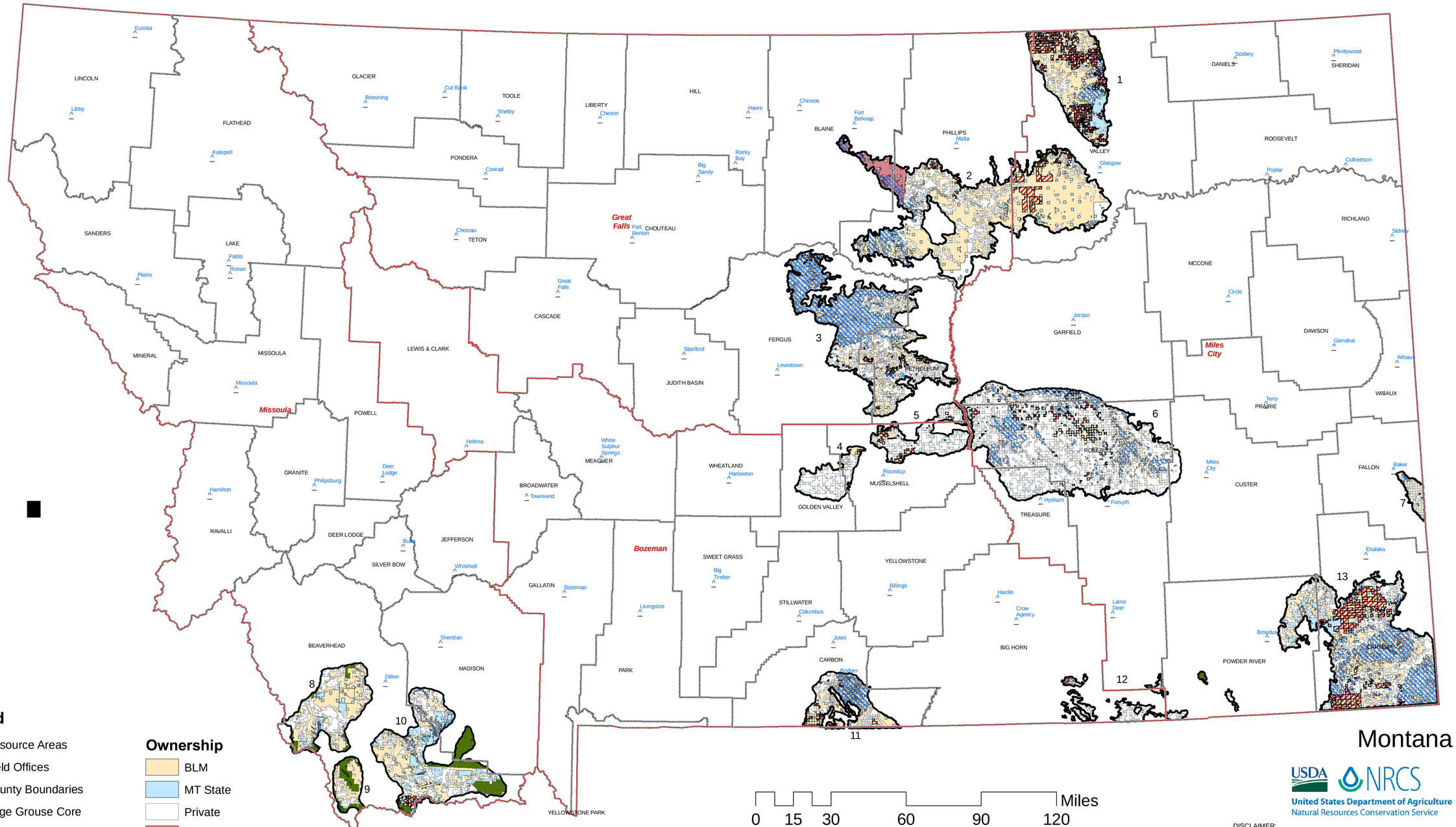
Inventory ranch areas near lek site (group activity)

Development of ranch alternatives to address sage-grouse concerns (group activity)

Group discussion

Conclusion
Presenter

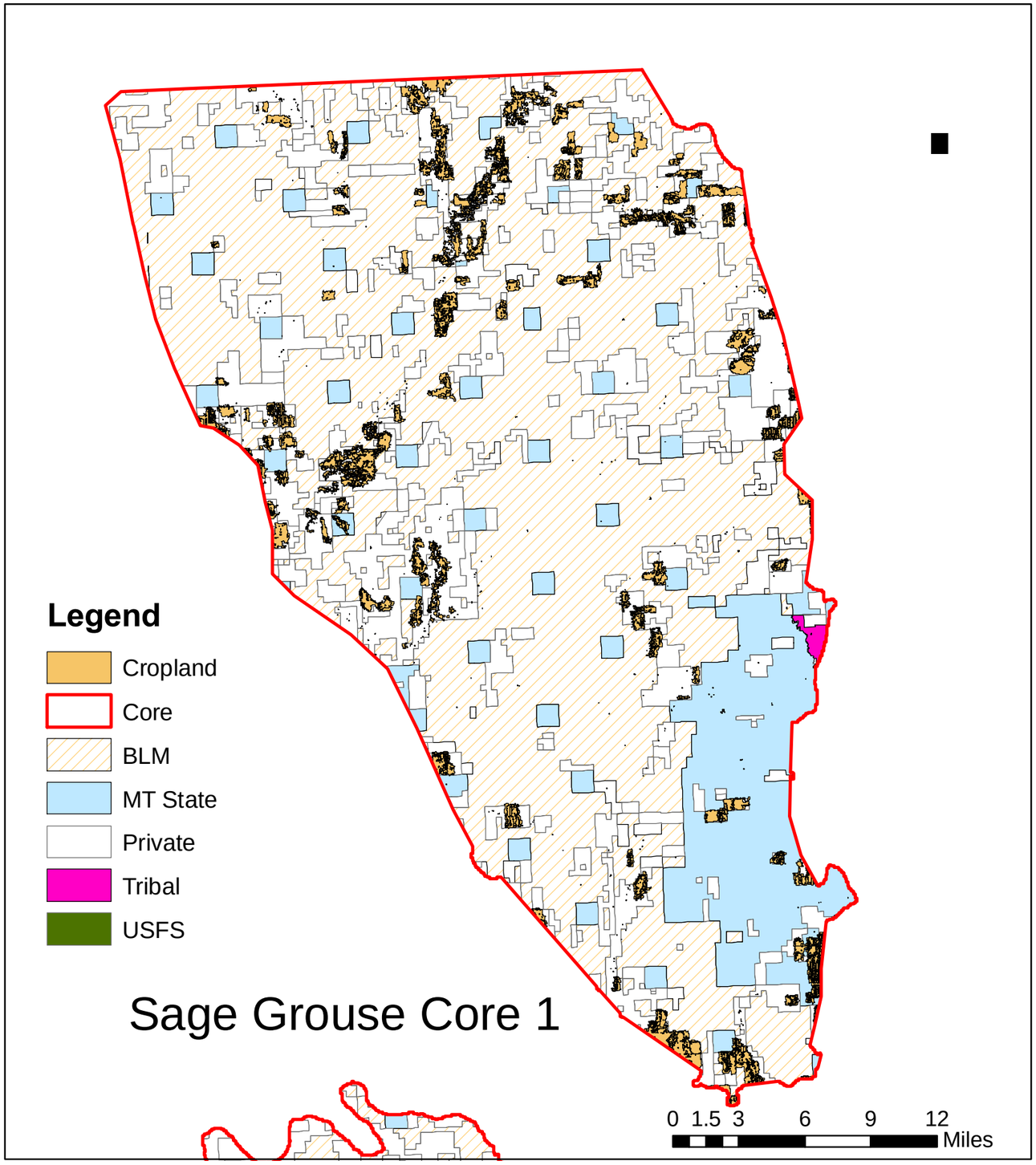
Sage Grouse

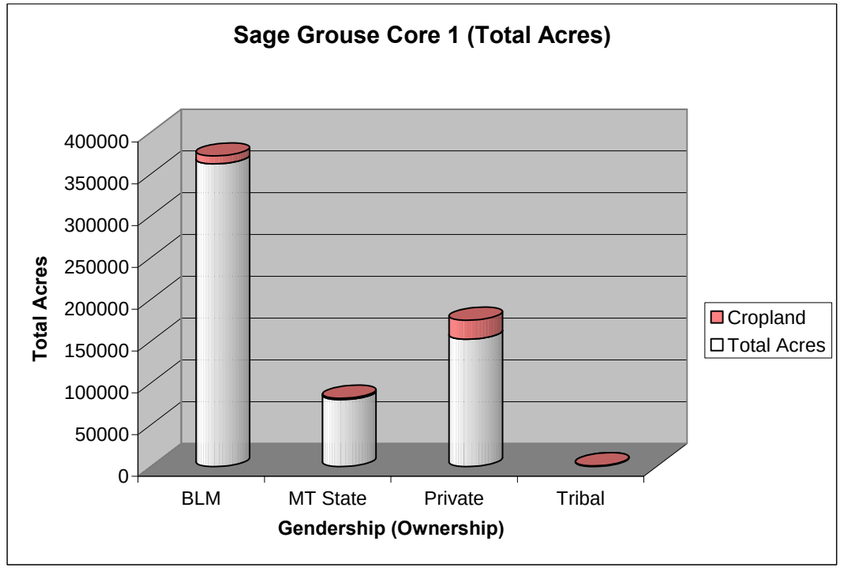


Montana

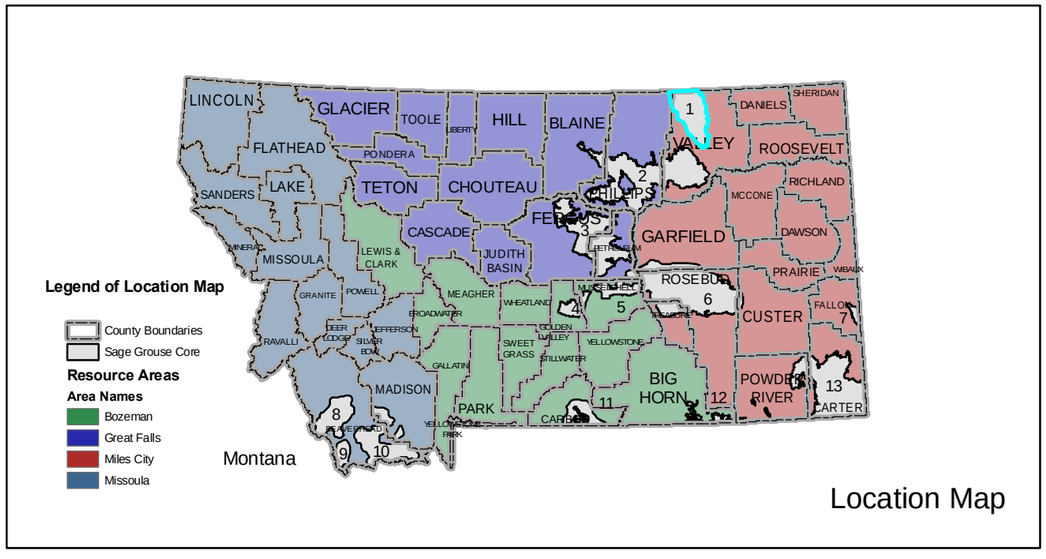
USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.





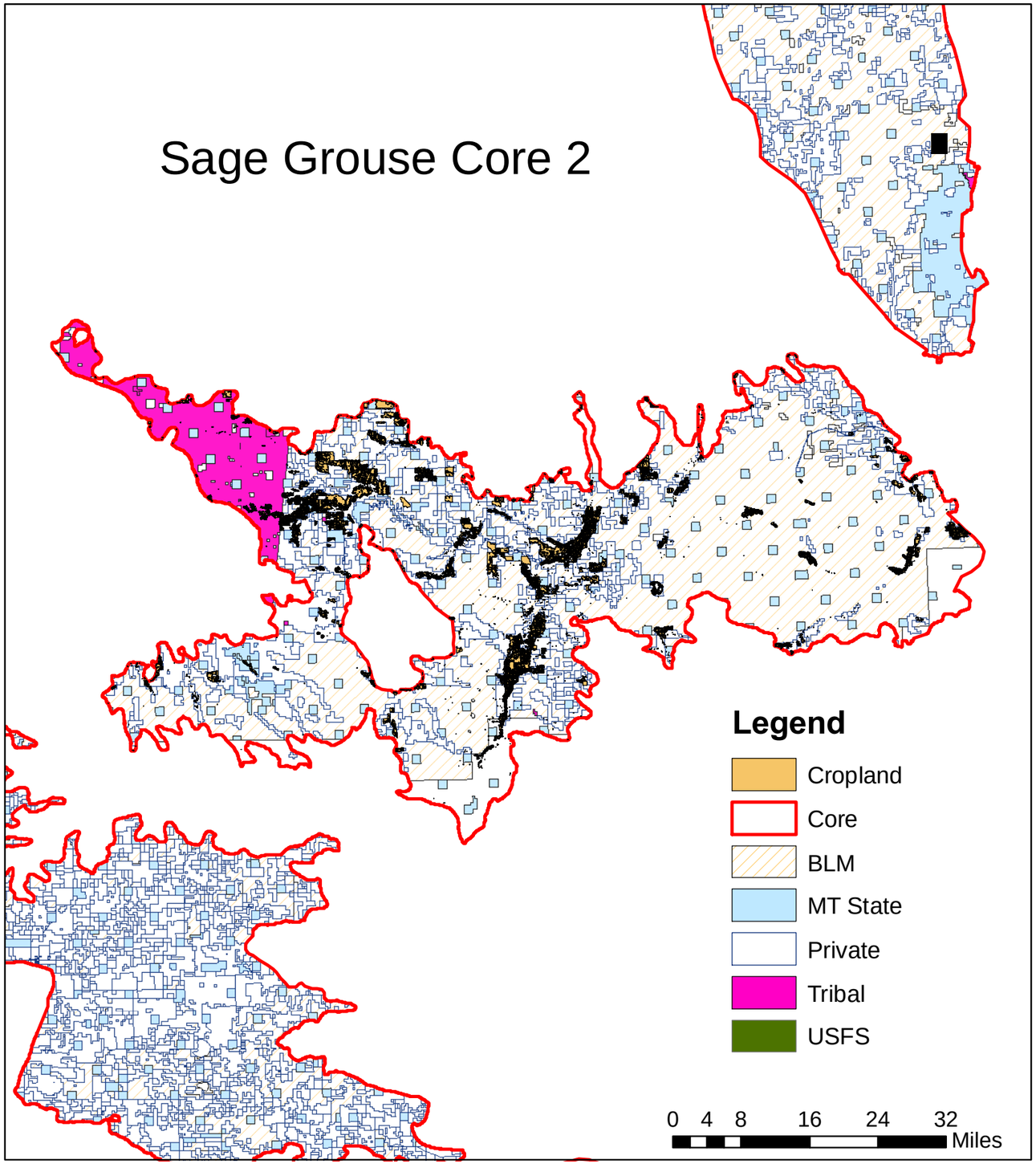
Gendership	Parcels	Total Acres	Cropland
BLM	3	362,138	9,346
MT State	1	79,937	1,760
Private	131	152,263	22,767
Tribal	1	912	1
Totals		**595,250**	**33,875**

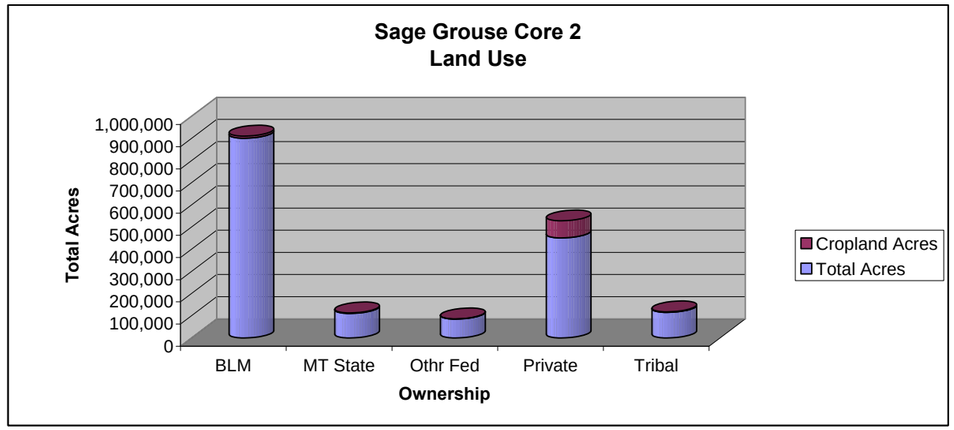


USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

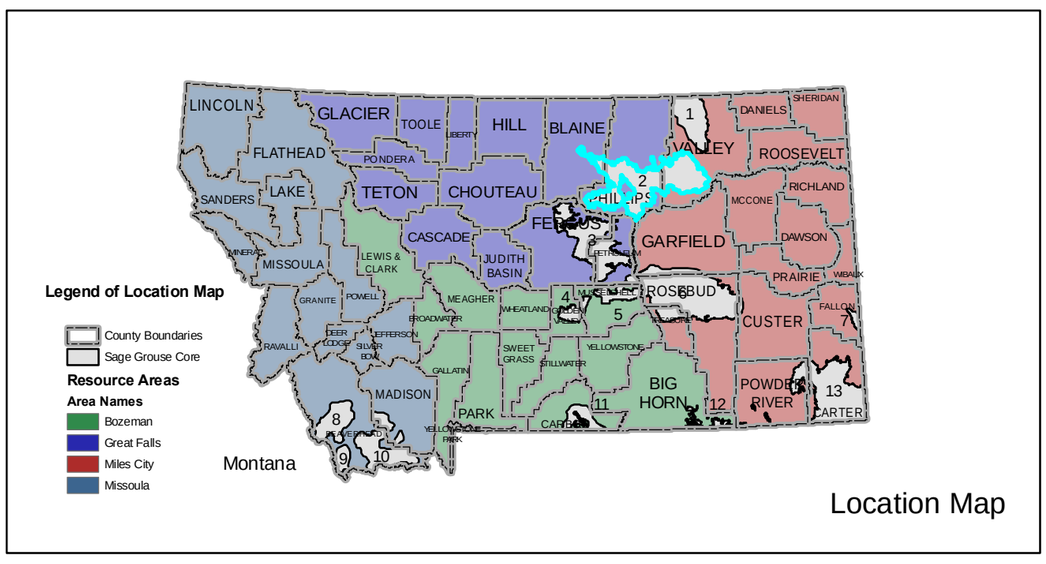
DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core1.mxd

Sage Grouse Core 2



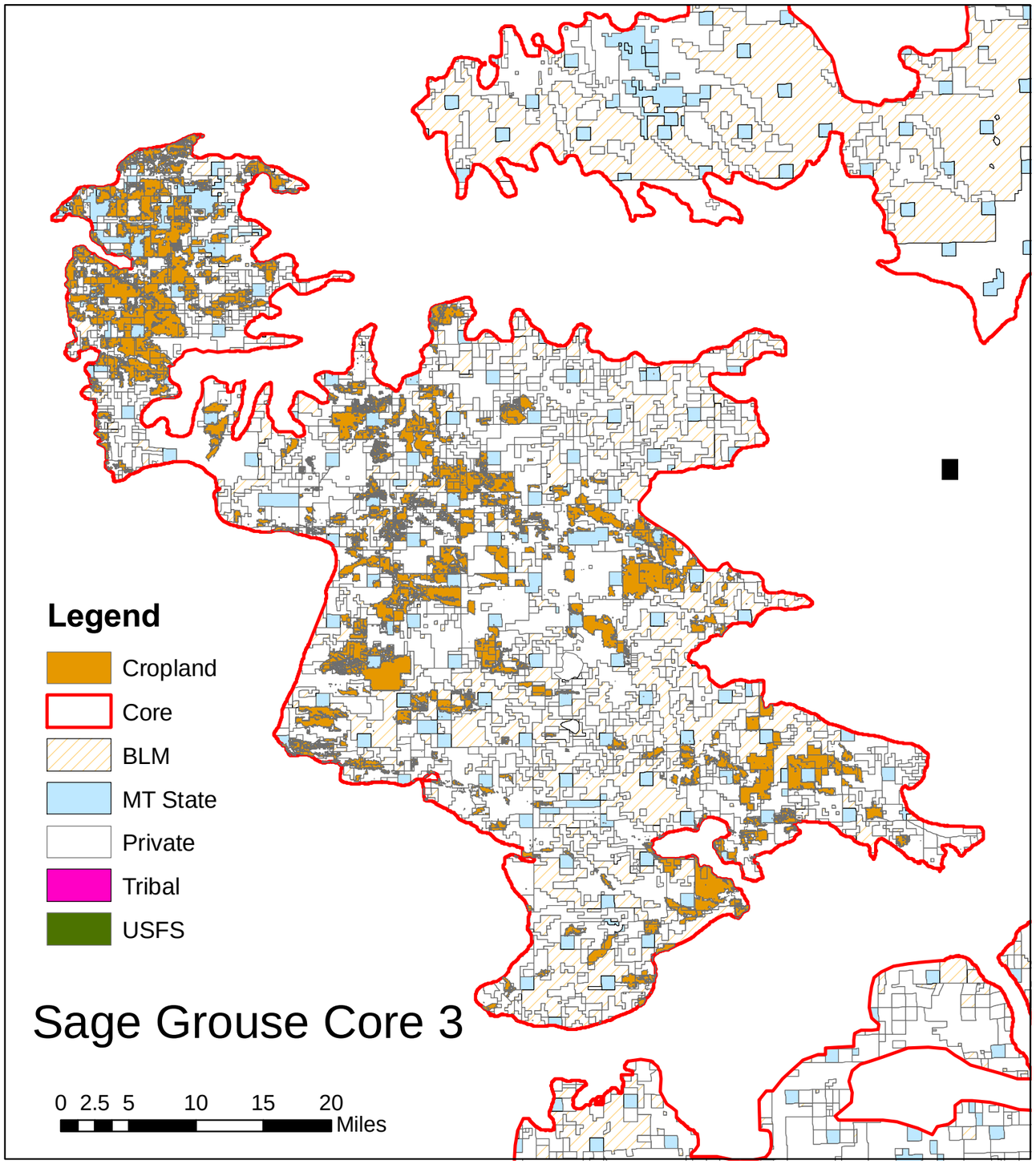


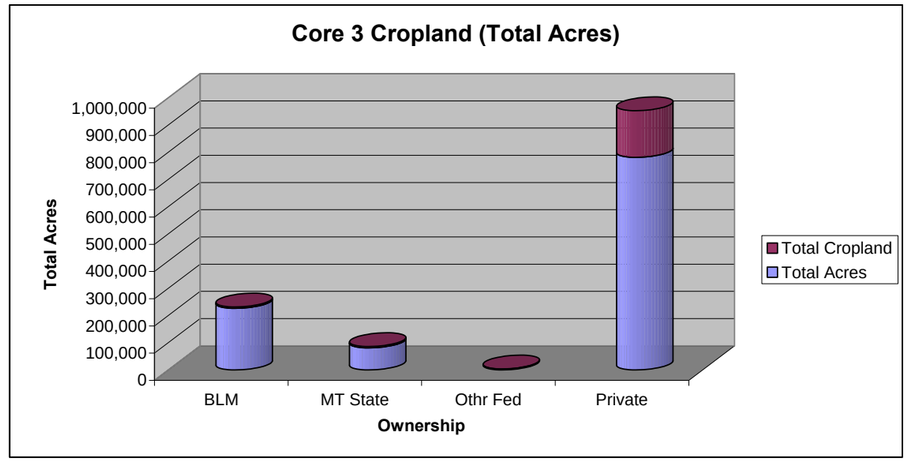
Ownership	Parcels	Total Acres	Cropland Acres
BLM	1	901,336	9,095
MT State	2	110,982	2,214
Othr Fed	4	84,974	923
Private	255	451,430	76,844
Tribal	6	115,103	2,775
Totals		**1,663,824**	**91,850**



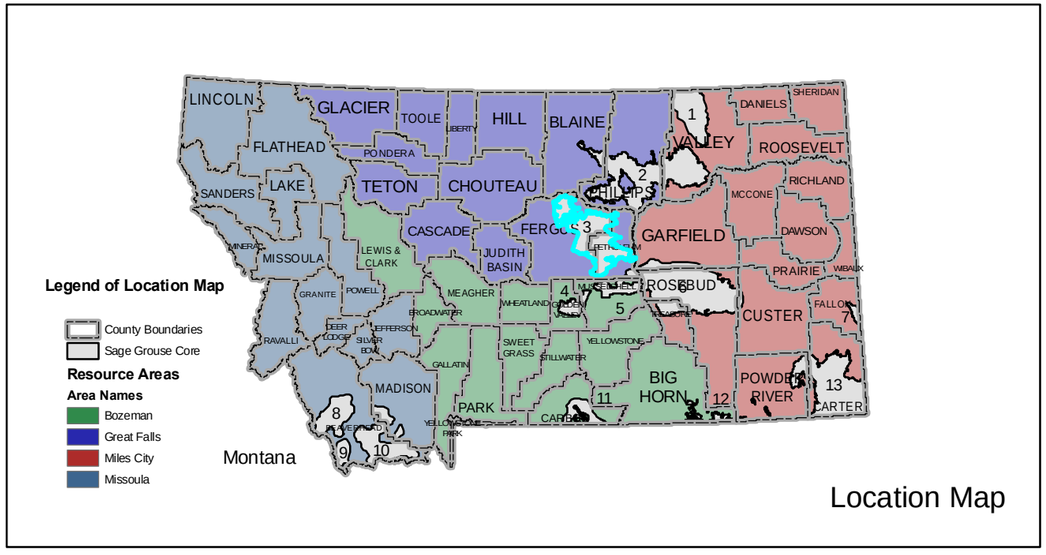
USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jw;02/18/09 core2.mxd





Ownerhip	Parcels	Total Acres	Total Cropland
BLM	7	226,601	4,976
MT State	3	81,443	4,984
Othr Fed	2	3,547	331
Private	482	781,436	171,200
Total Acres		**1,093,027**	**181,491**



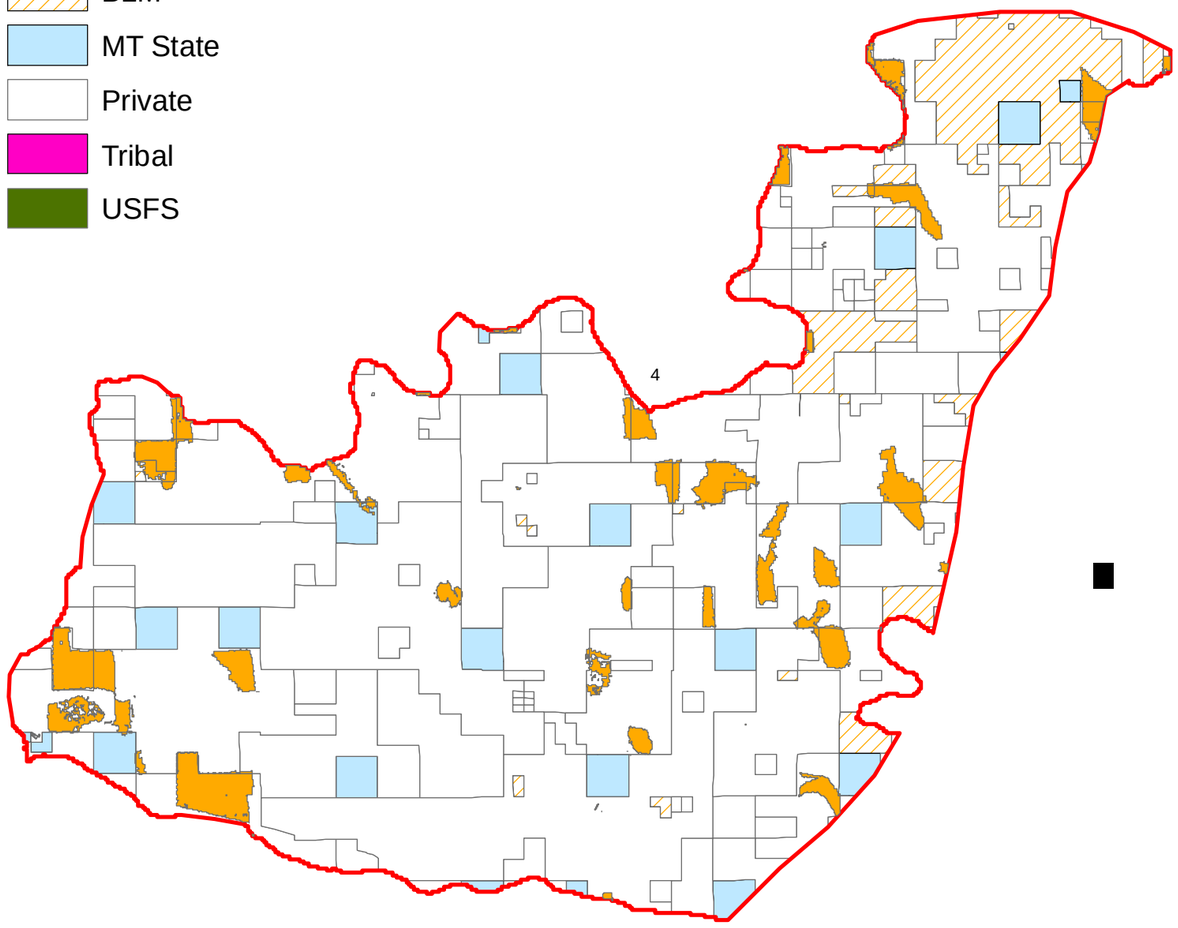
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core3.mxd

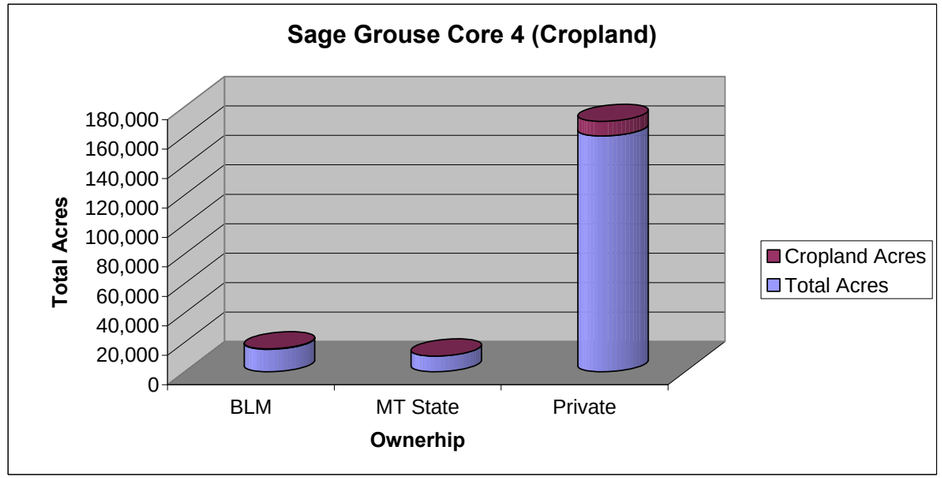
Legend

- Cropland
- Core
- BLM
- MT State
- Private
- Tribal
- USFS

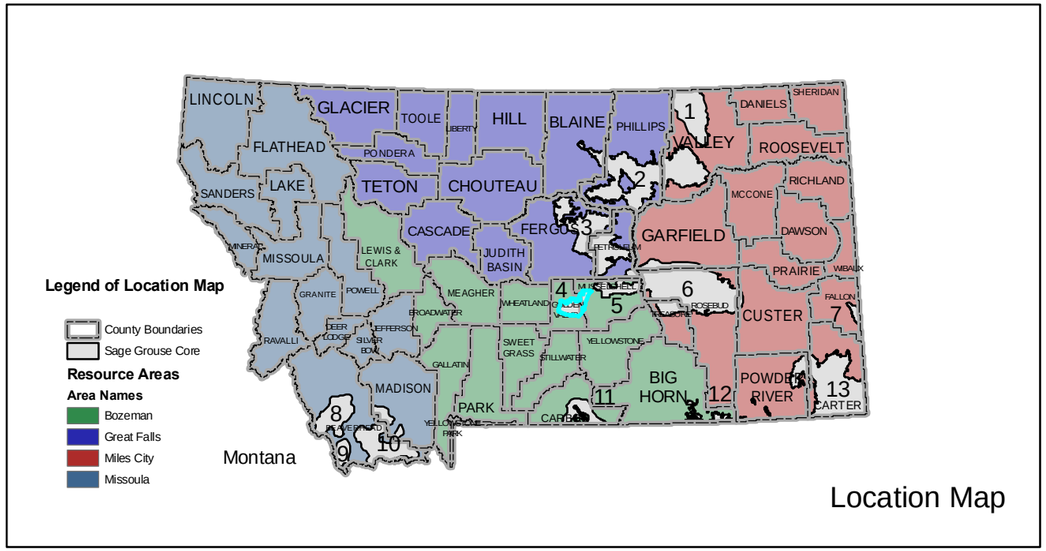
Sage Grouse Core 4



0 1 2 4 6 8 Miles



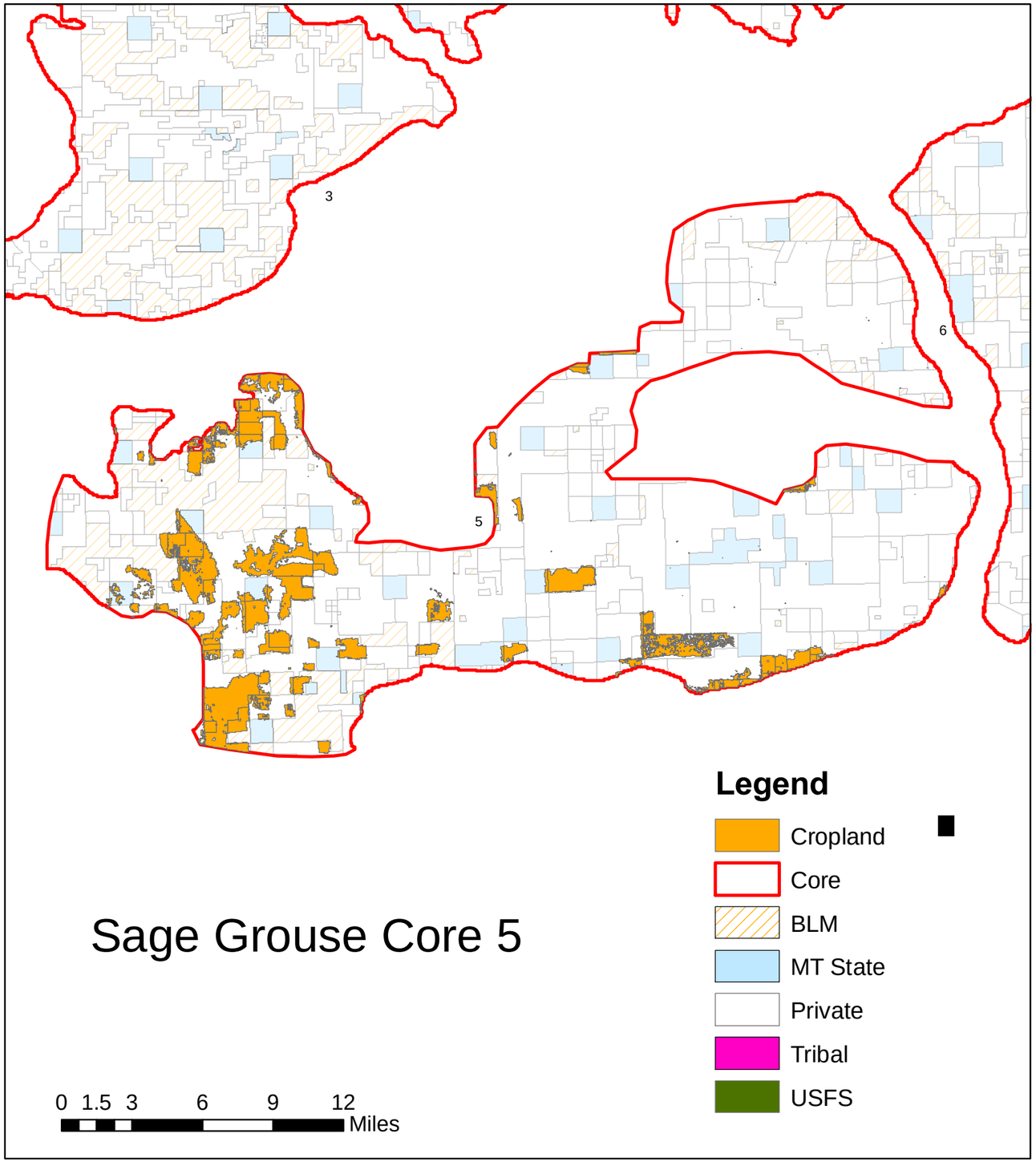
Ownership	Total Acres	Cropland Acres	Parcels
BLM	15,263	284	2
MT State	10,624	53	1
Private	160,095	9,924	90
Totals	**185,981**	**10,262**	

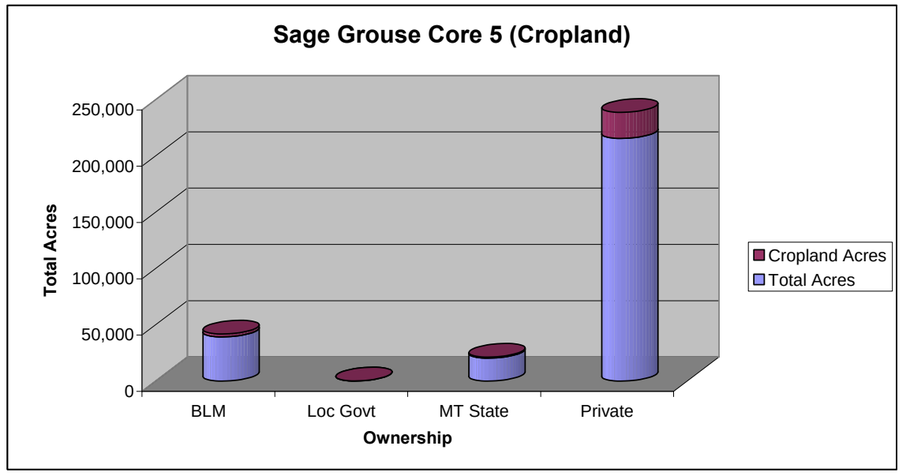


Location Map

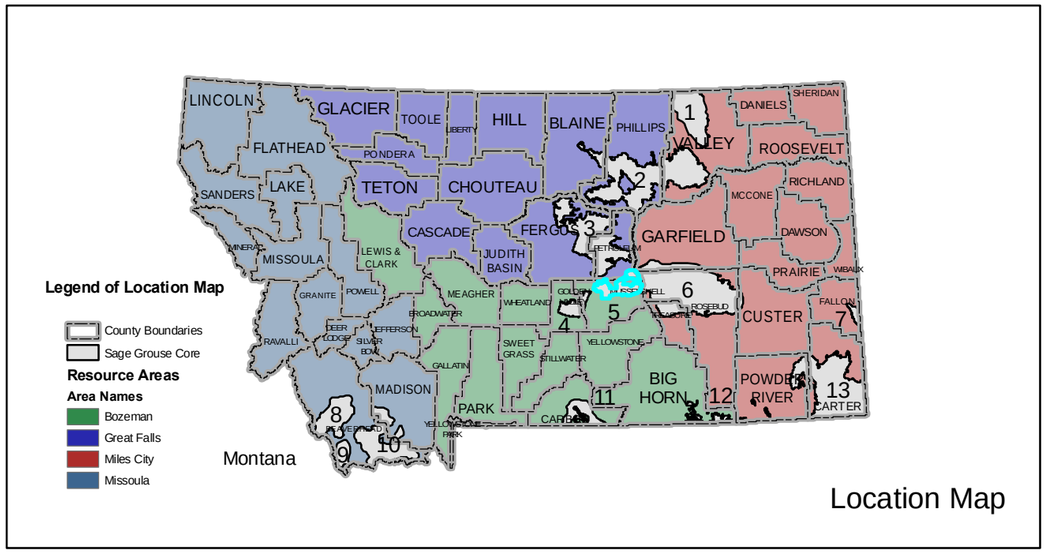
USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core4.mxd



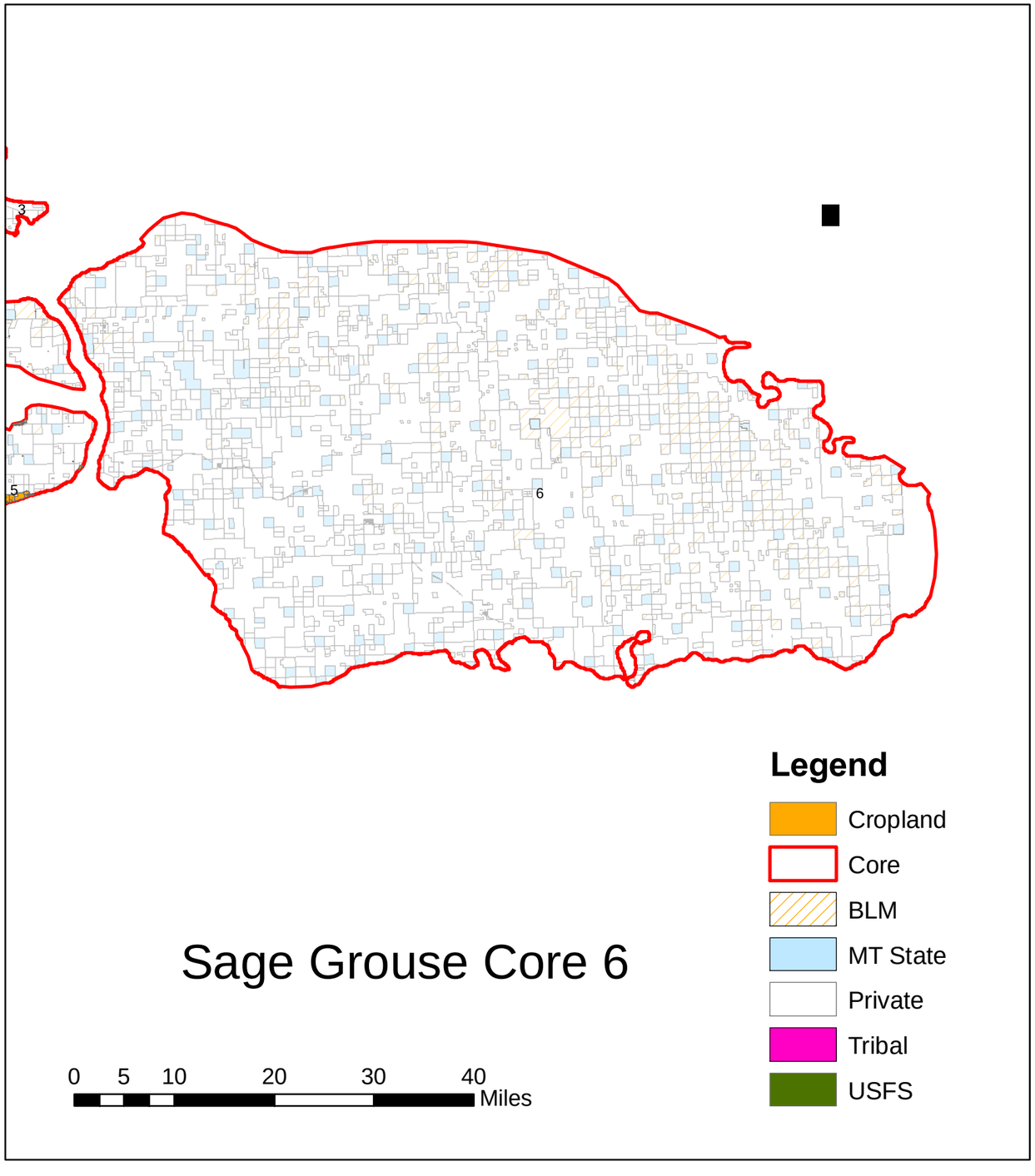


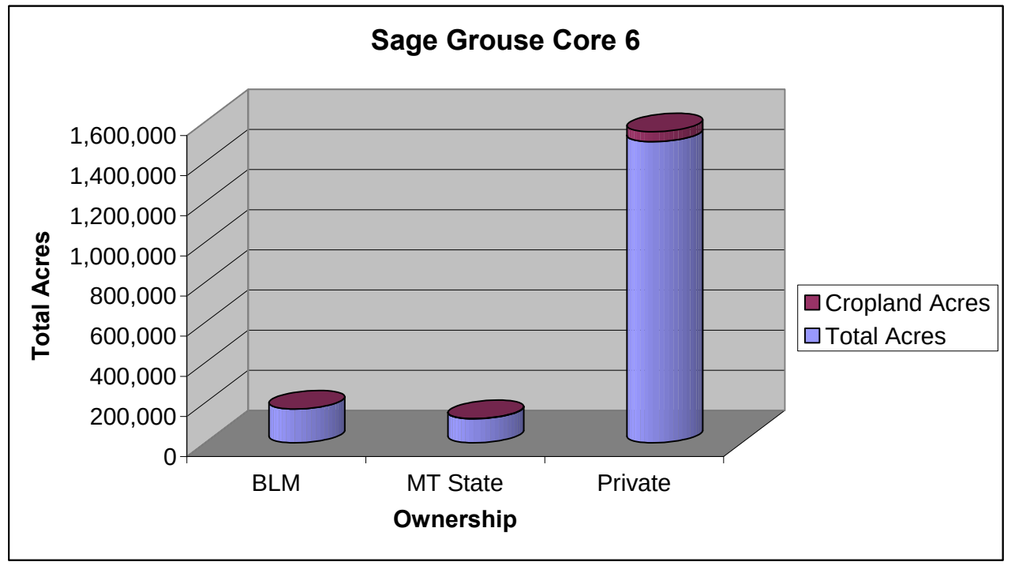
Ownership	Total Acres	Cropland Acres	Parcels
BLM	39,155	2,586	6
Loc Govt	51	0	9
MT State	20,392	848	1
Private	215,557	23,129	248
Totals	**275,155**	**26,563**	



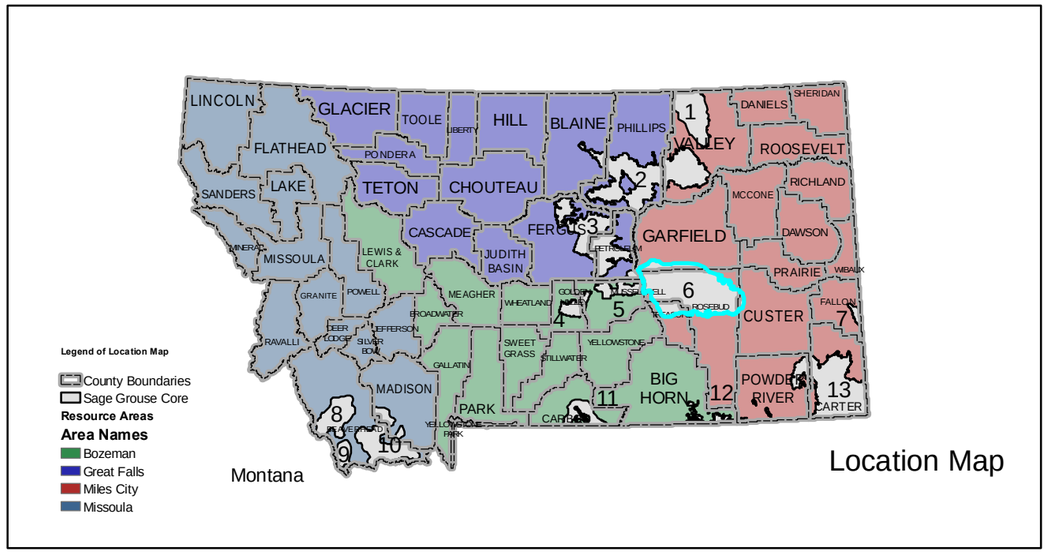
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core5.mxd



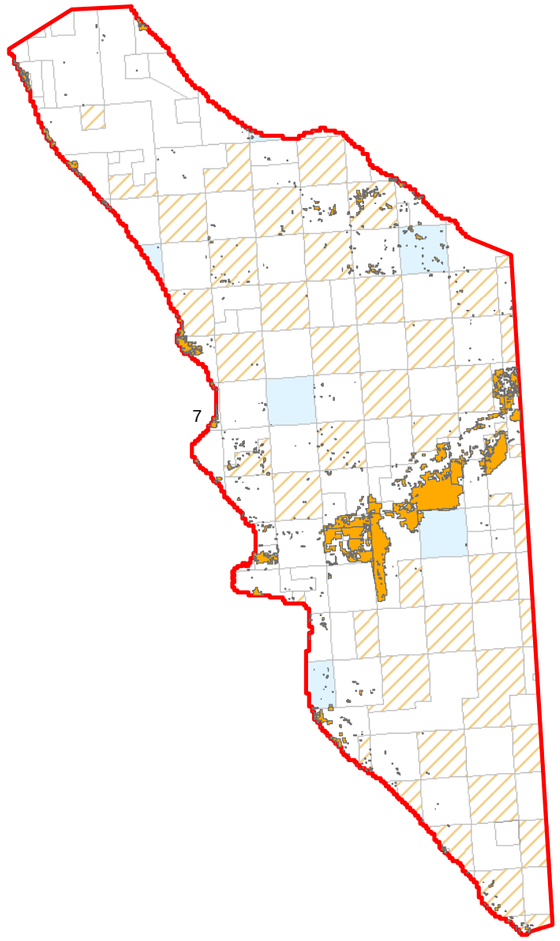


Ownership	Total Acres	Cropland Acres	Parcels
BLM	168,192	132	18
MT State	119,049	1,142	13
Private	1,500,288	49,300	1827
Totals	**1,787,530**	**50,574**	



USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core6.mxd

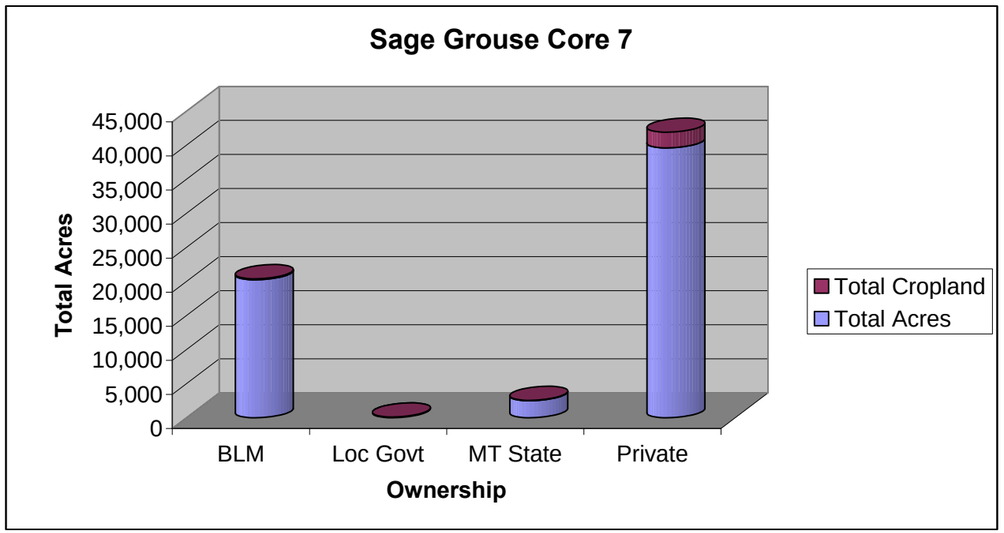


Sage Grouse Core 7

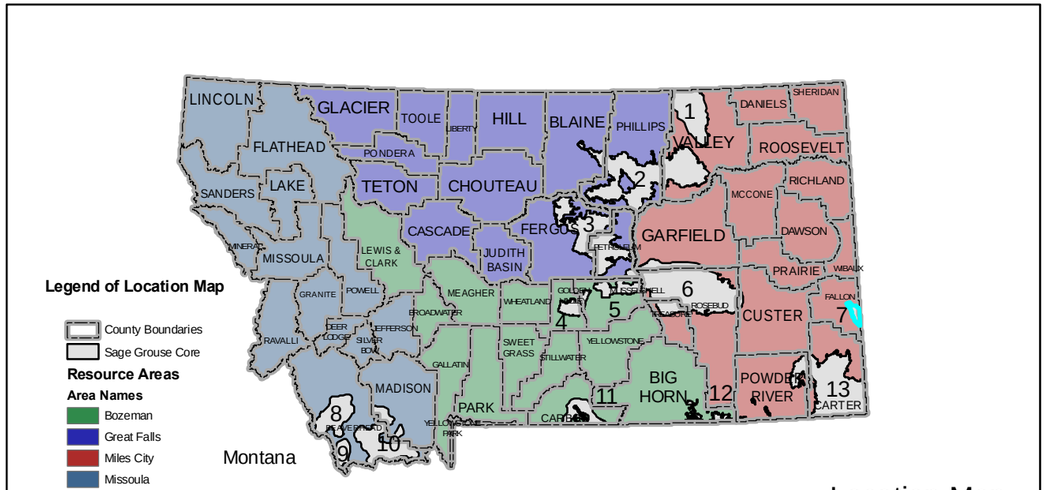
0 1 2 4 6 8
Miles

Legend

- Cropland
- Core
- BLM
- MT State
- Private
- Tribal
- USFS

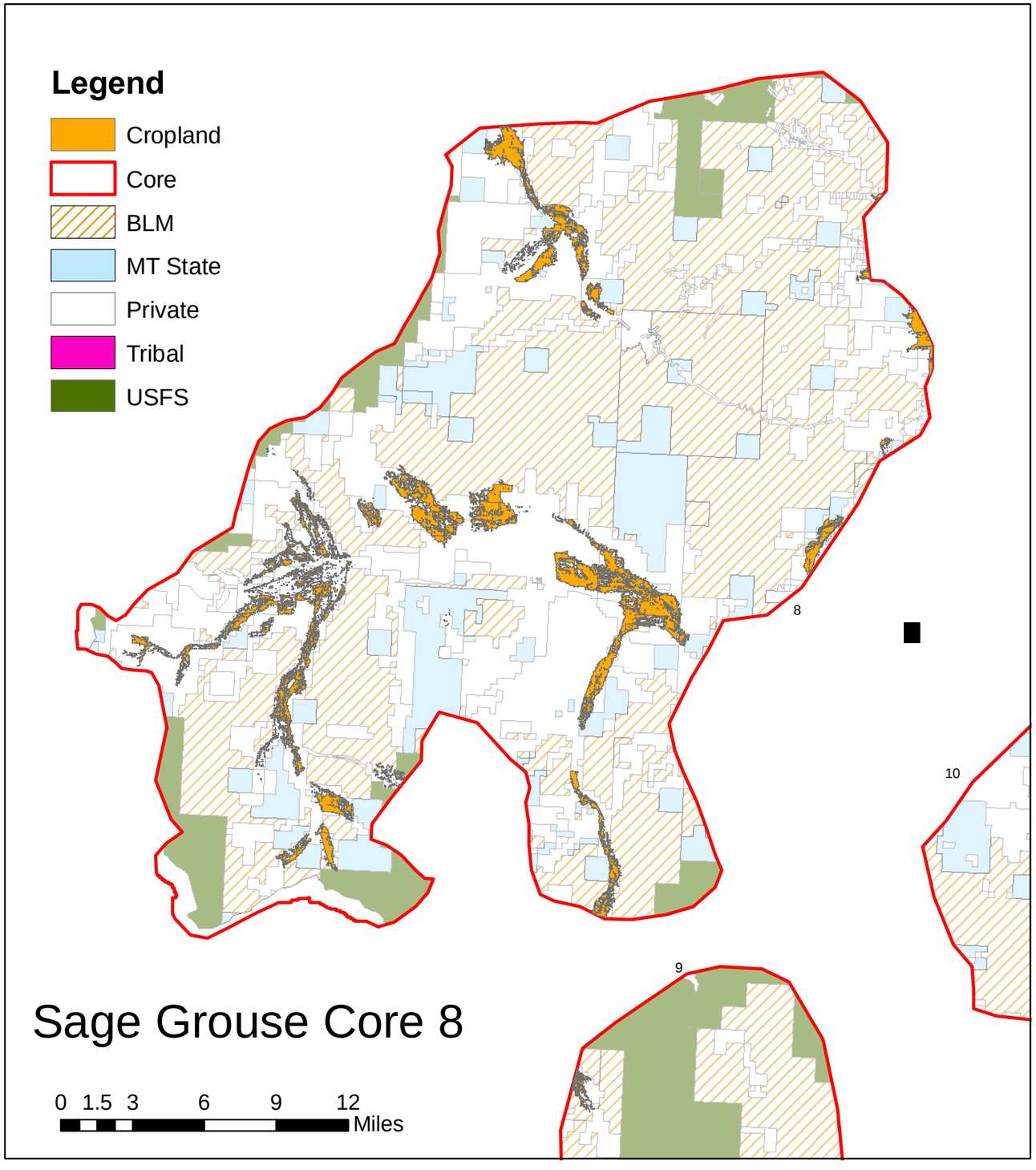


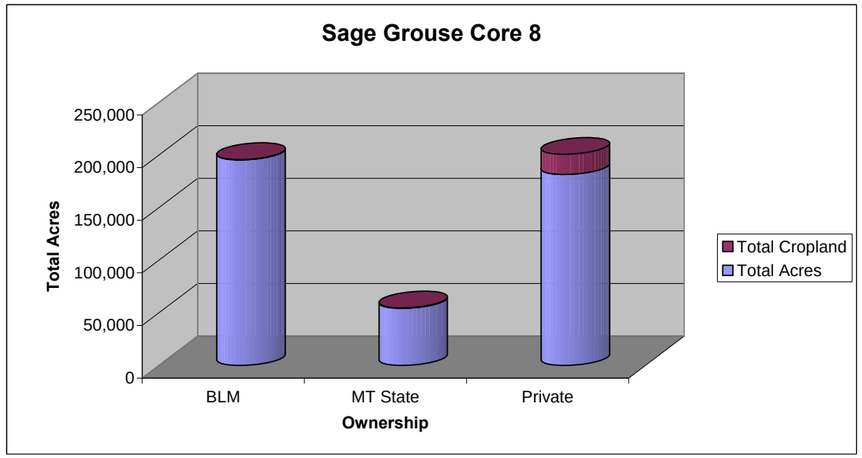
Ownerhsip	Total Acres	Total Cropland	Parcels
BLM	20,250	158	2
Loc Govt	117	1	1
MT State	2,502	52	1
Private	39,617	2,289	52
Total Acres	**62,486**	**2,498**	



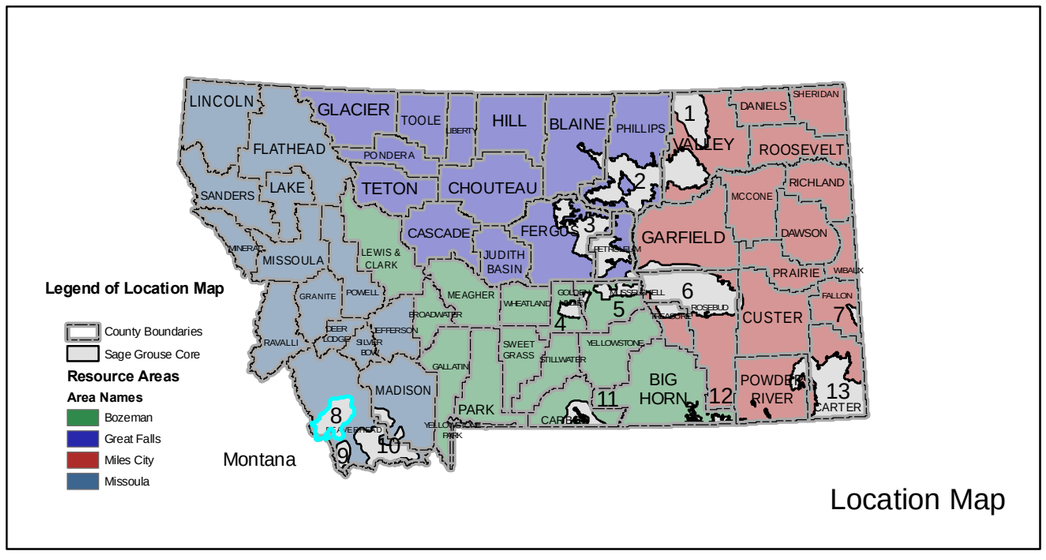
USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core7.mxd



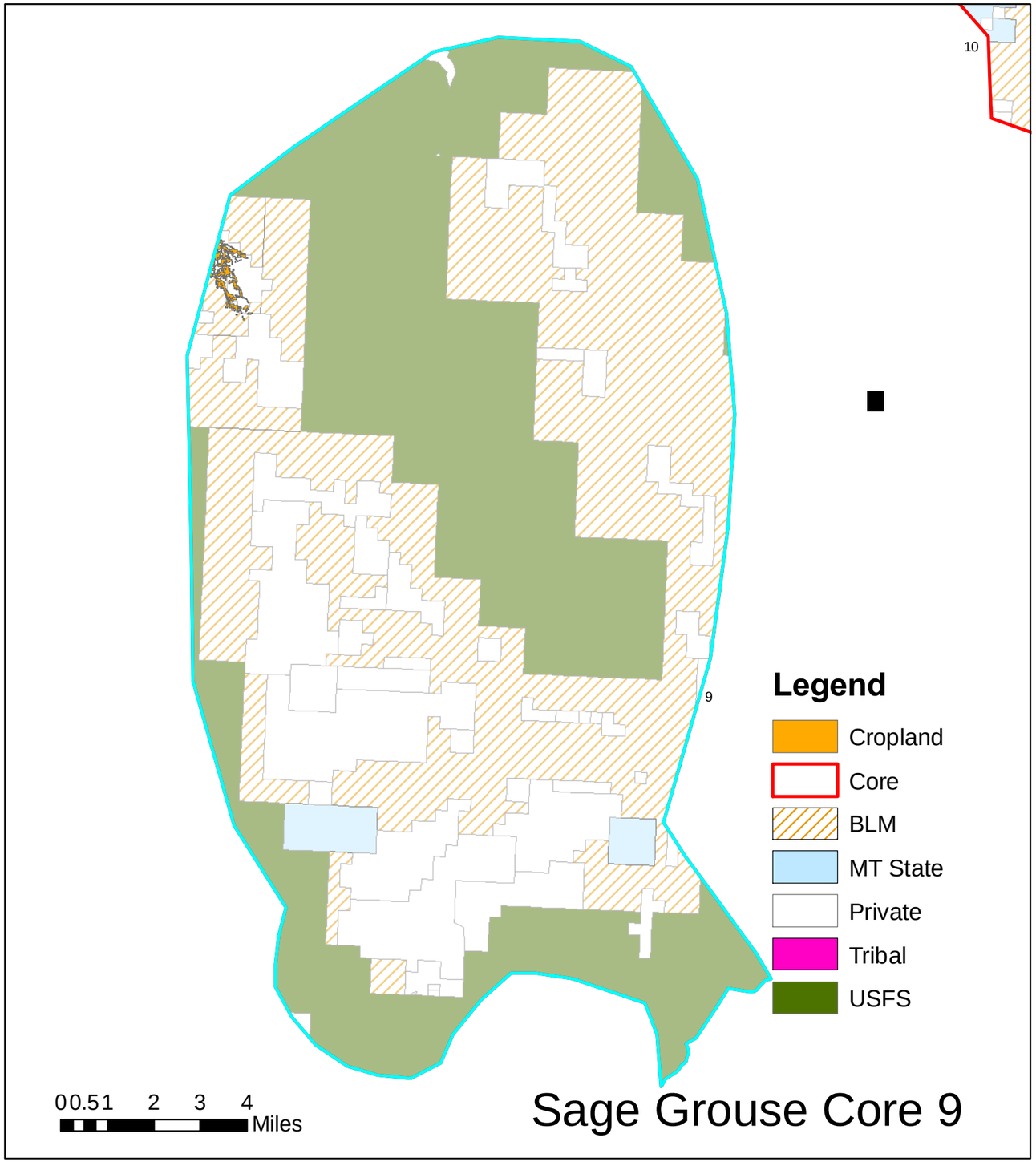


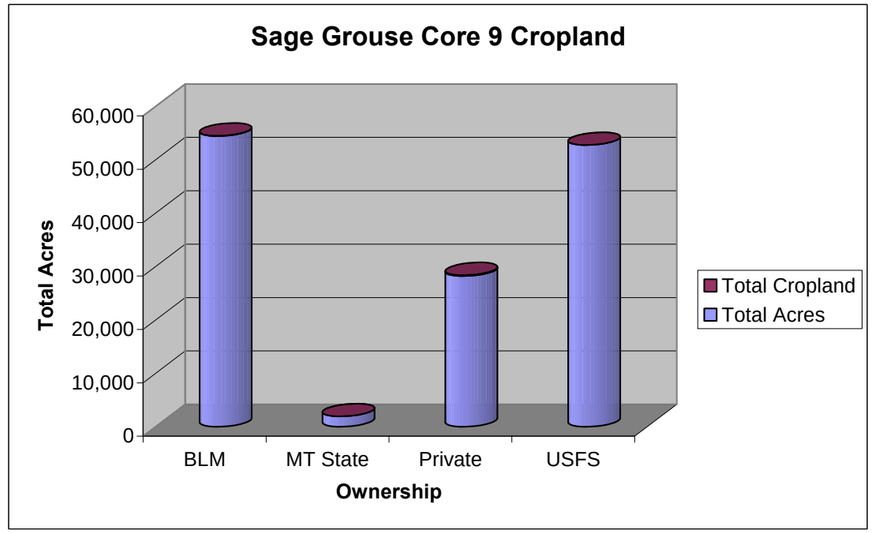
Ownership	Total Acres	Total Cropland	Parcels
BLM	195,345	351	6
MT State	54,215	465	7
Private	181,577	19,148	283
Totals	**431,137**	**19,964**	



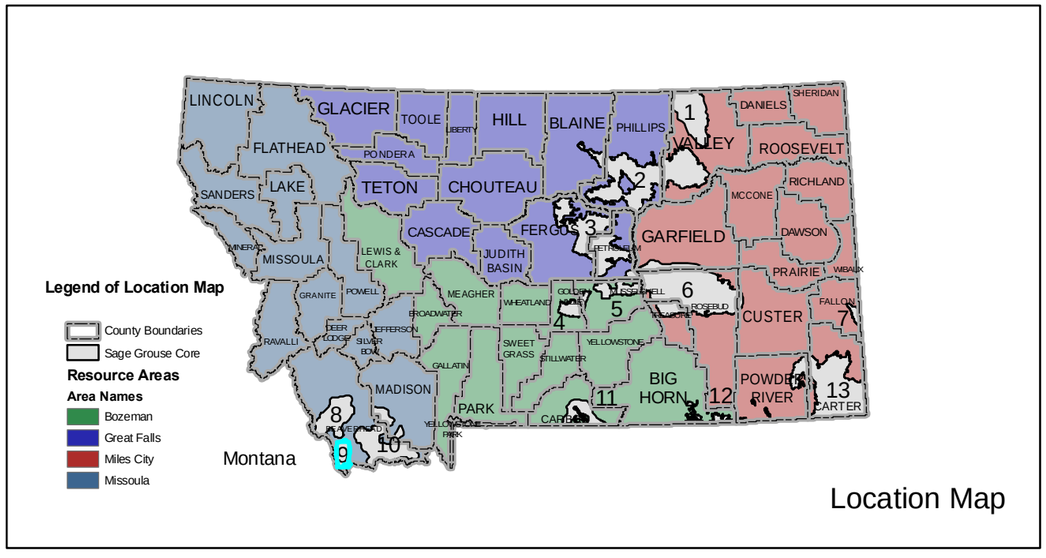
USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core8.mxd



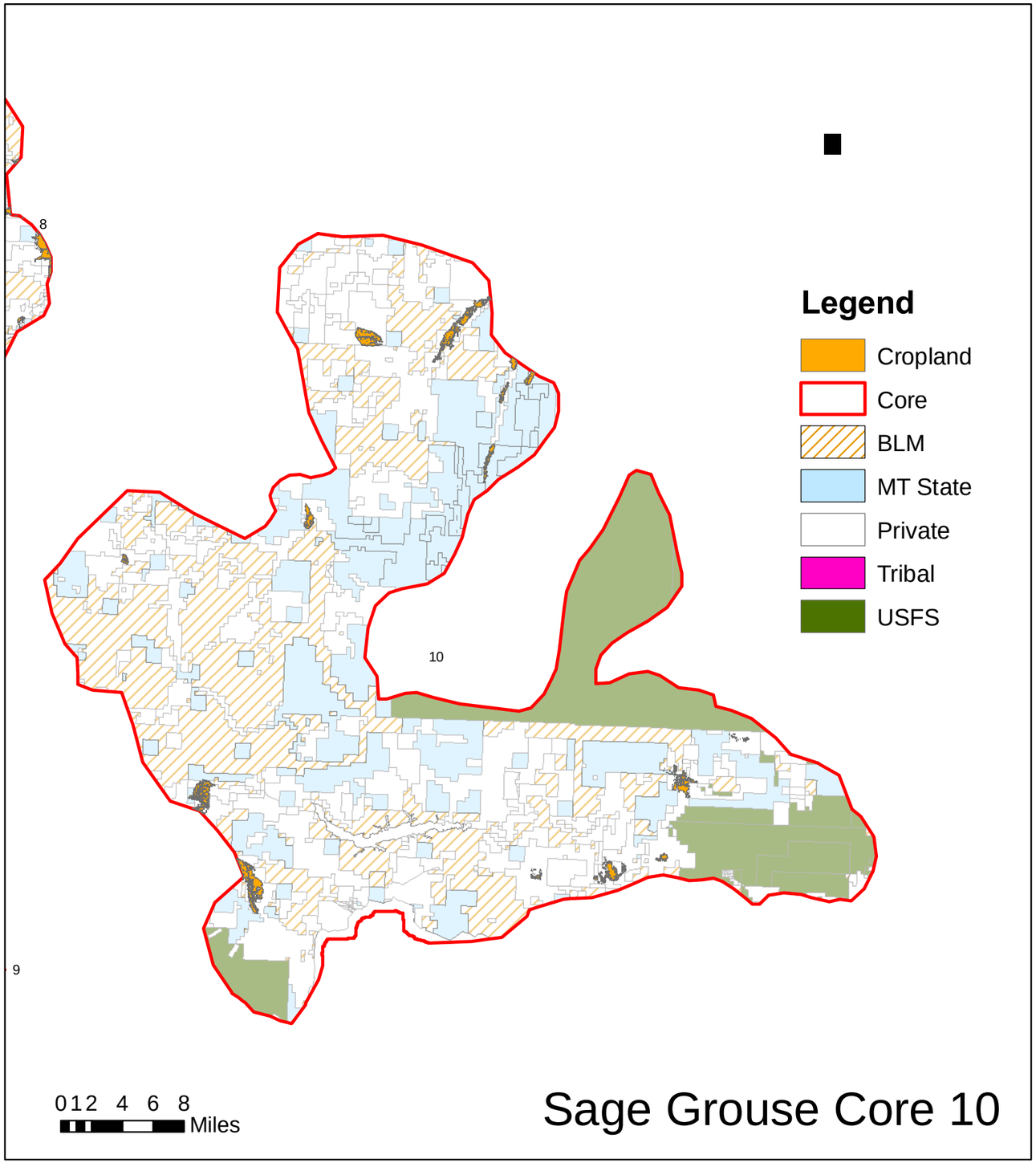


Ownership	Total Acres	Total Cropland	Parcels
BLM	54,419	45	2
MT State	1,920	0	1
Private	28,199	177	29
USFS	52,736	0	1
Total Acres	**137,274**	**222**	

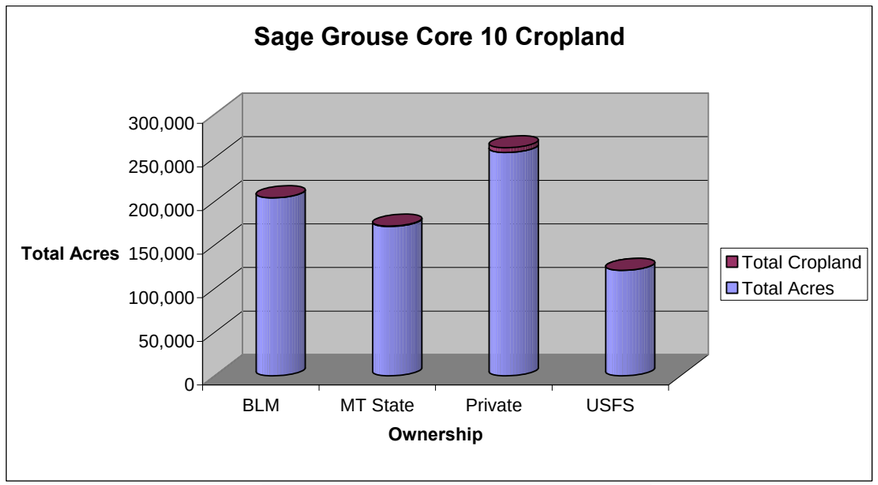


USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

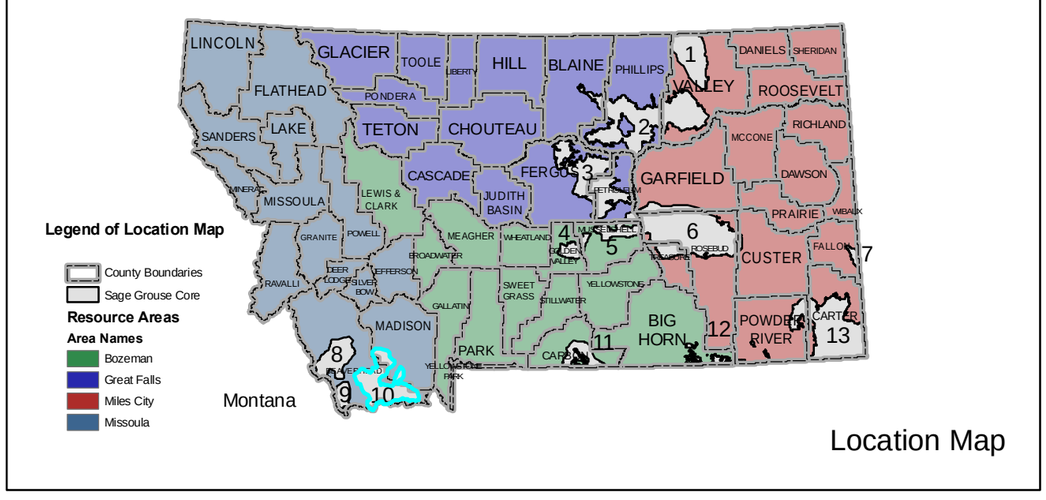
DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core9.mxd



Sage Grouse Core 10

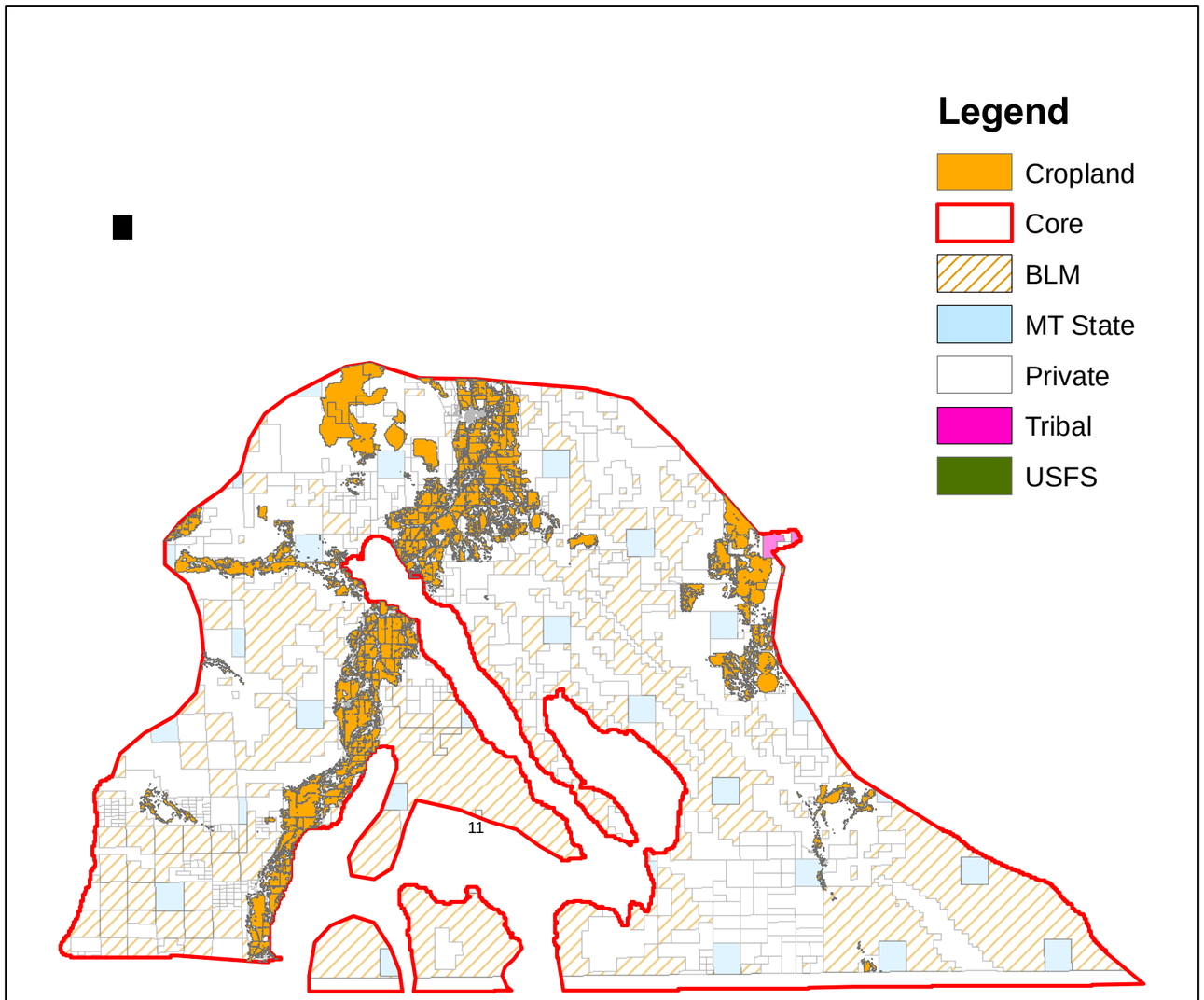


Ownership	Total Acres	Total Cropland	Parcels
BLM	204,098	141	3
MT State	171,253	493	7
Private	256,079	5,456	141
USFS	120,976	0	7
Total Acres	**752,406**	**6,090**	

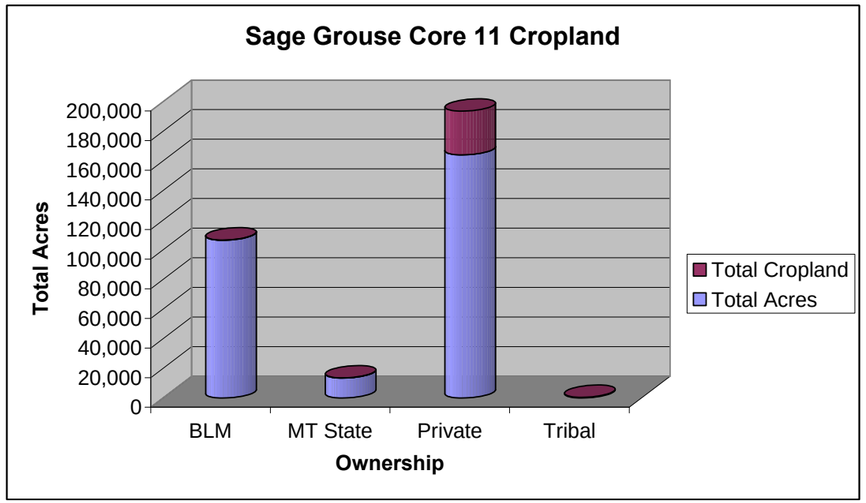


USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

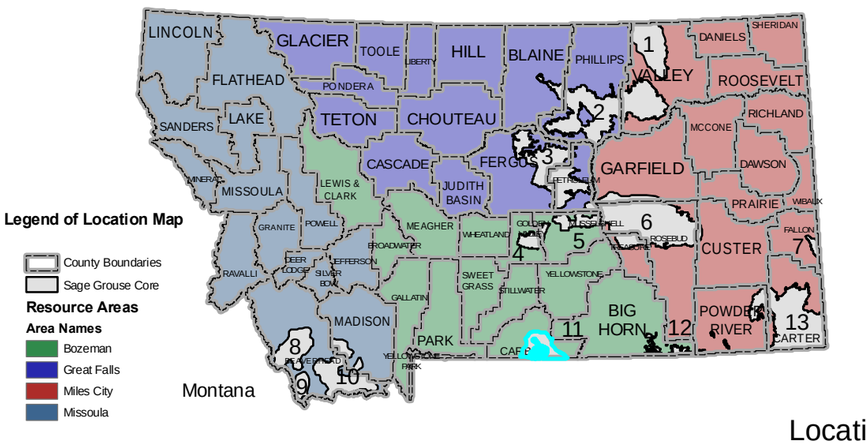
DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core10.mxd



Sage Grouse Core 11



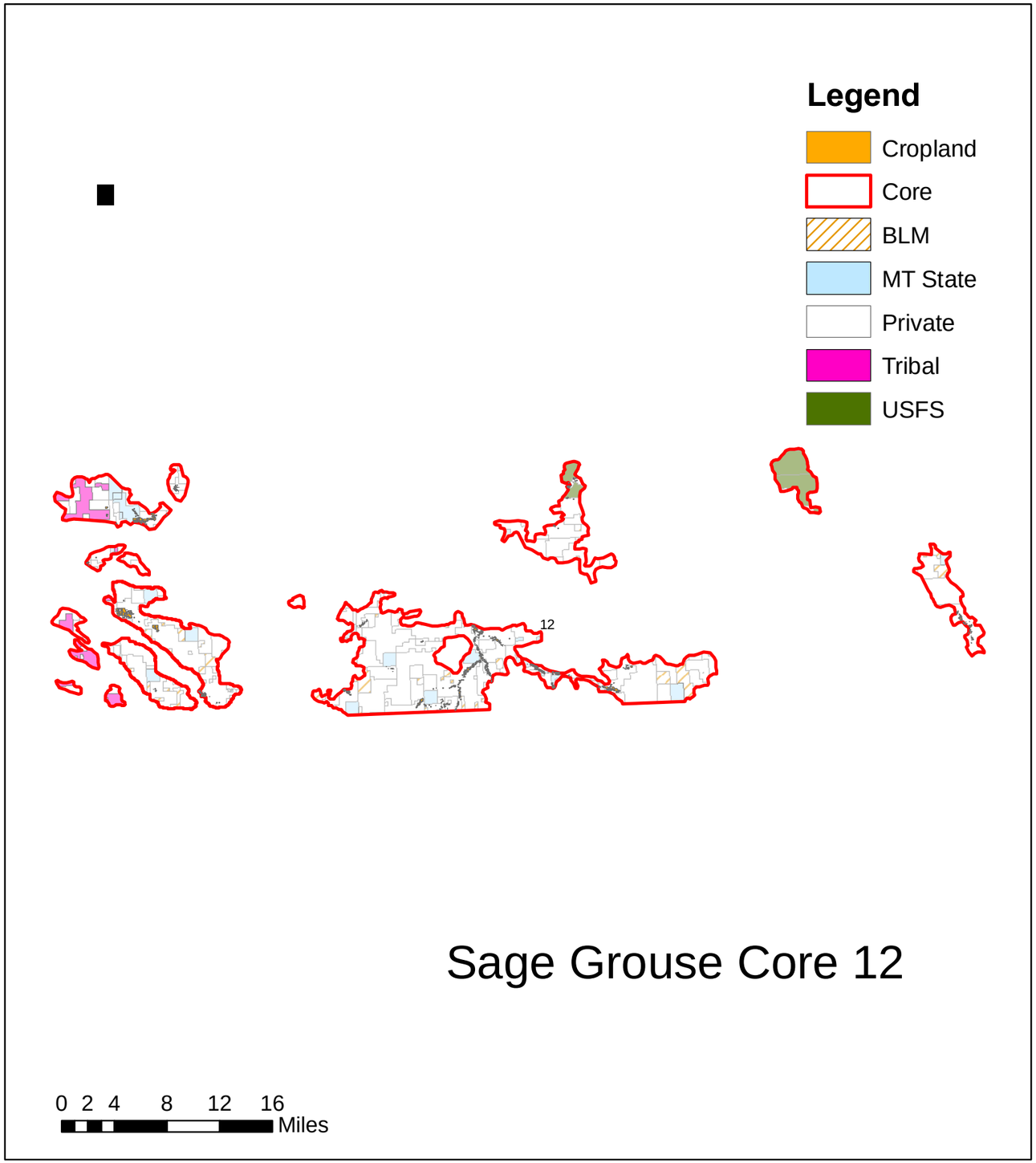
Ownership	Total Acres	Total Cropland	Parcels
BLM	106,503	108	3
MT State	13,399	120	5
Private	164,092	29,497	959
Tribal	436	1	1
Total Acres	**284,431**	**29,726**	

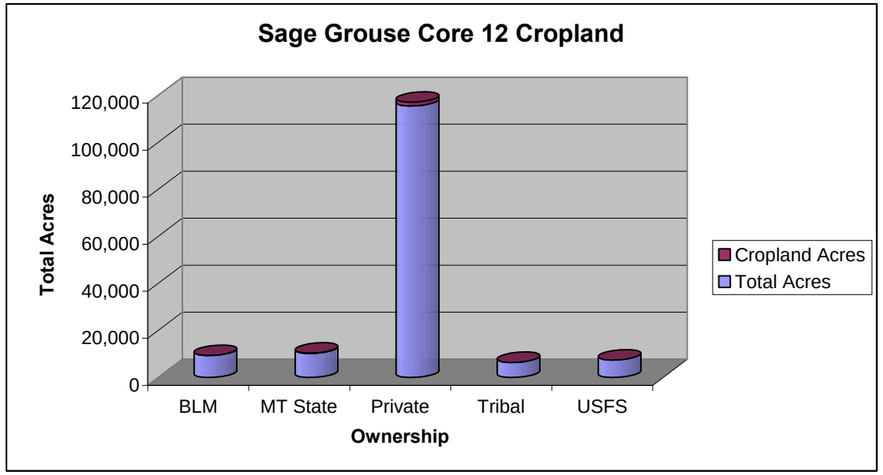


Location Map

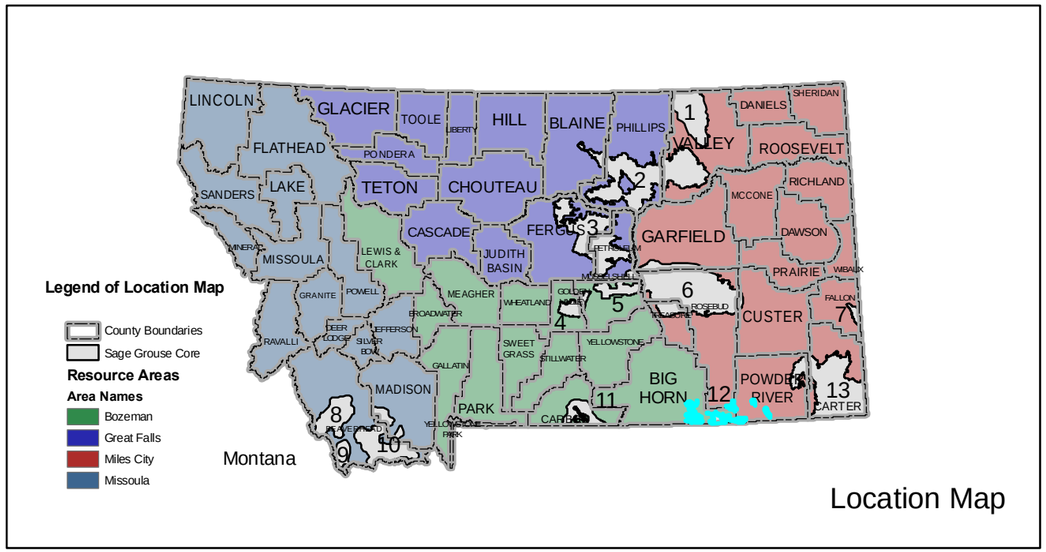
USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core11.mxd





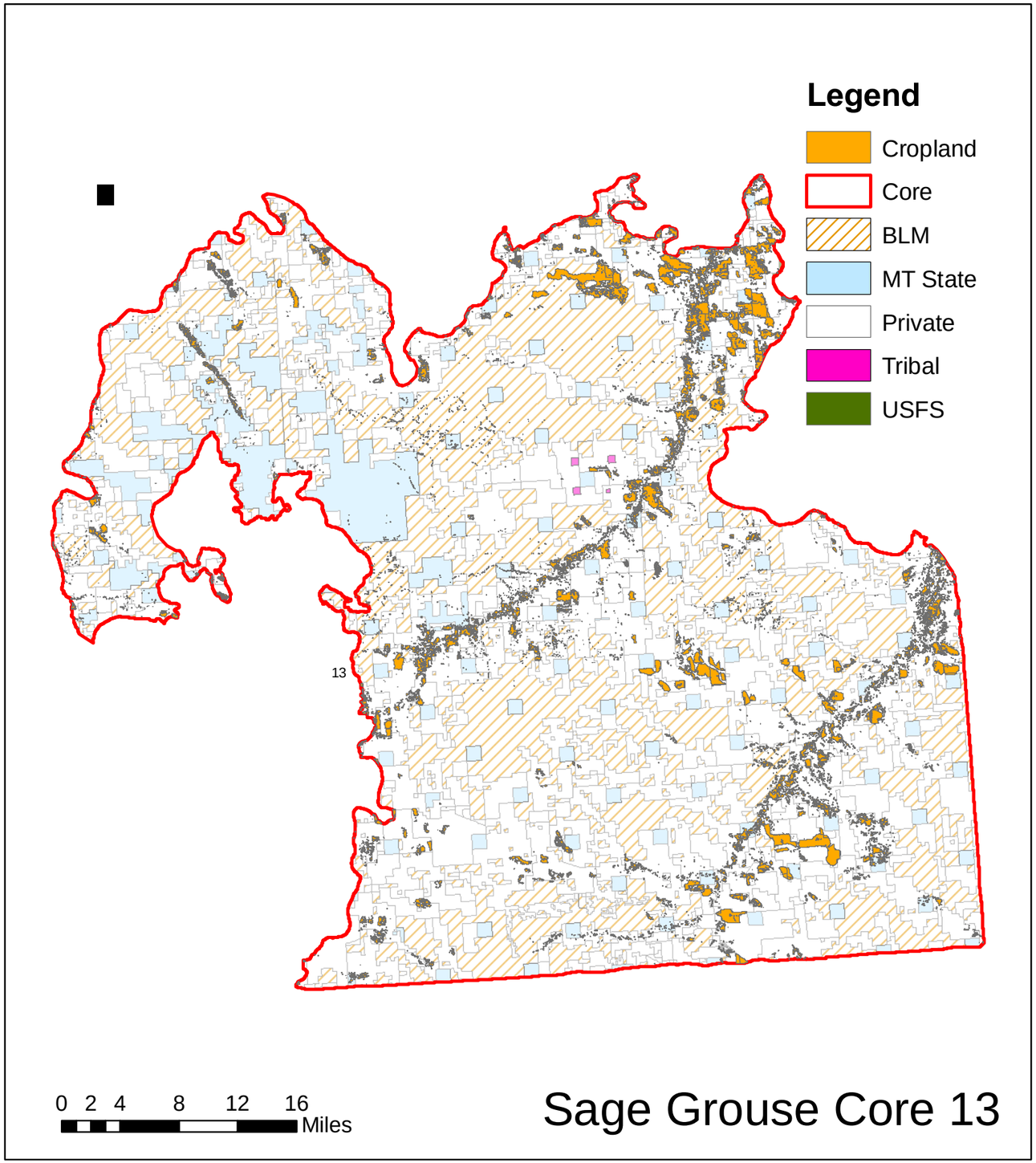
Ownership	Total Acres	Cropland Acres	Parcels
BLM	9,341	1	4
MT State	10,239	122	4
Private	115,532	1,554	83
Tribal	6,397	8	3
USFS	7,437	3	5
Total Acres	**148,947**	**1,689**	



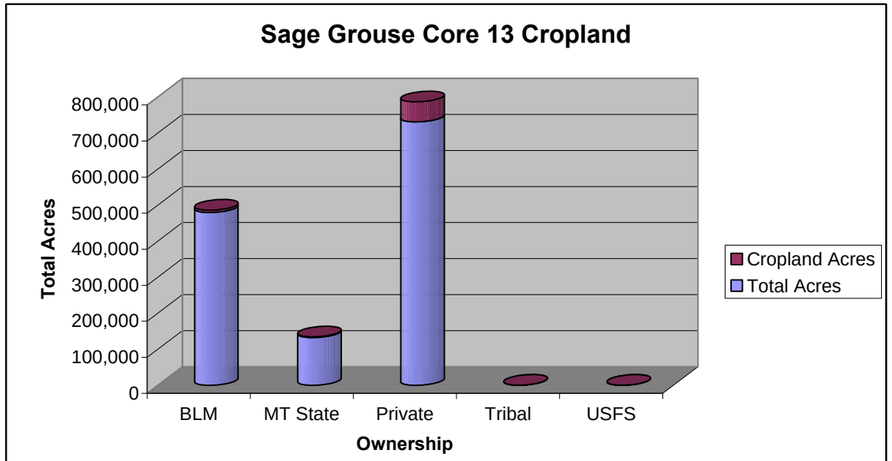
Location Map

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

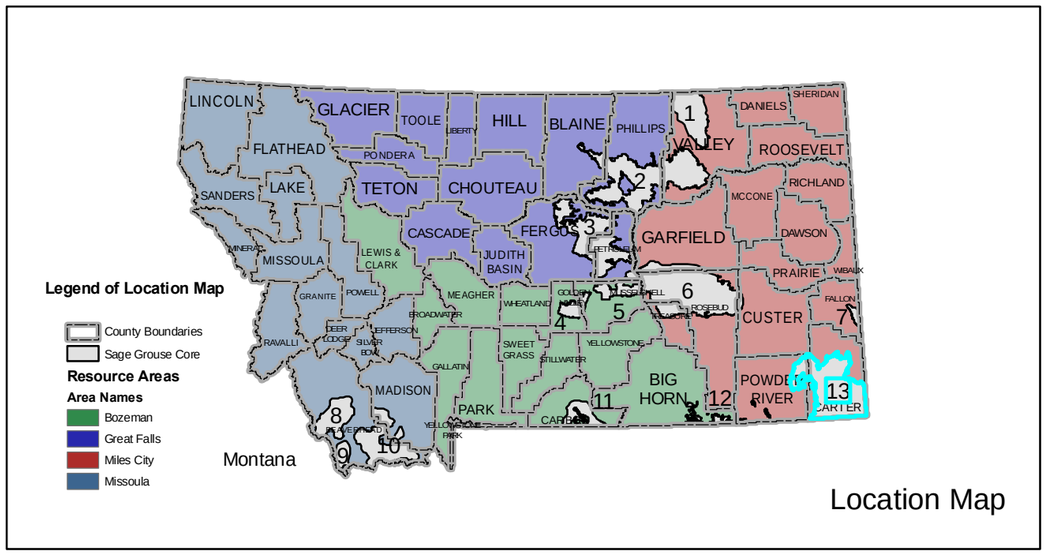
DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core12.mxd



Sage Grouse Core 13



Ownership	Total Acres	Cropland Acres	Parcels
BLM	479,554	6,540	6
MT State	132,606	1,822	2
Private	731,199	55,446	305
Tribal	521	0	1
USFS	362	2	1
Total Acres	**1,344,241**	**63,811**	



USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

DISCLAIMER:
This map is to be used as a primary reference source and is not intended for use in site-specific planning. This is public information and may be interpreted by organizations, agencies, units of government, or others, based on needs; however, they are responsible for the appropriate application. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions they make.
NOTE:!! Core numbering system 1-13 does not indicate ranking of areas only to label boundary areas.
jwl;02/18/09 core13.mxd