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Abstract: Sage-grouse occupy less than 8% of their historic range. To address these declines, the western states and provinces have implemented sage-grouse management plans. These plans identified the need for local working groups (LWGs) to develop and implement conservation plans to address high priority issues. To facilitate LWGs in Utah, the Division of Wildlife Resources entered into a cooperative agreement with Utah State University Extension in 2001 to develop a Utah Community-Based Conservation (CBCP) program. Because sage-grouse occupy diverse landscapes each exhibiting different land ownership patterns, each of the sage-grouse management areas are somewhat unique. Thus, we believe the success of each working group rests on the ability of the LWGs to understand and incorporate this uniqueness of each environment in their plan. Each LWG is beginning to implement experimental management projects funded largely through the 2002 Farm Bill to learn more about what conservation practices will result in the greatest benefits for sage-grouse, other wildlife species, private landowners, and local Utah communities. Although the scientific literature contains good information on sage-grouse ecology, there is limited information on the effects of specific conservation practices that can be directly applied to management. In addition, because land uses are variable across the state, the site-specific management information required to address population declines and socio-economic needs is limited. To address these needs, we have implemented a "we know, we believe, and we feel" process to conservation planning. This process directly involves landowners and local communities in activities to learn more about the systems they are trying to manage while managing them. In this paper, we discuss and compare the success and limitations of this "we know, we believe, and we feel" approach to species conservation.

Key Words: adaptive management, *Centrocercus* spp., community-based conservation, extension, local working groups, planning, research, species conservation, sage-grouse, Utah

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Wildlife management has been defined as the art and science of applying scientific knowledge and ecological principles to manage wildlife populations for human objectives. Historically, wildlife managers have sought to maintain or increase desirable wildlife species (e.g., game fish, birds, and mammals) to meet human food and recreational needs by manipulating their habitats (indirect management) or the populations themselves (direct management). Indirect management approaches are implemented to improve habitat conditions that result in gradual increases in the size of desirable populations by raising birth rates or survival rates. Direct management approaches include those activities (e.g., regulation of harvest, predation management) that immediately affect population birth or death rates. Direct management approaches remain popular with traditional constituents because they perceive the benefits will be more immediate. The benefits of indirect management, particularly habitat manipulations often accrue over time and their magnitude can be diminished by other environmental factors.

Habitat management ultimately requires some type of vegetation manipulation. Leopold (1933) identified four major vegetation manipulation tools. Simply stated, there are: cow, plow, axe, and fire. Although there are published accounts of the ecological effects of these tools or on vegetation and habitat types, there is no "cookbook" or manual available for managers to use in planning both site specific and landscape-level manipulations to achieve desired population effects. Concomitantly, managers frequently combine what information they can from published and unpublished sources along with their personal knowledge and experiences of the species and habitats to be managed to design a management project. Ideally, once a project is implemented, managers will subsequently monitor their effort to determine if the actions taken resulted in the desired habitat and species outcomes. This information will then be used to guide future management decisions. This last step is in effect the "art" part of the definition of wildlife management.

Wildlife Management and Sage-Grouse in Utah

The greater sage-grouse (*Centrocercus urophasianus*) was historically one of the most abundant and widely distributed indigenous upland game birds in the western United States (Dalke et al. 1963). Although sage-grouse were once found in portions of at least 12 states and 3 Canadian provinces, populations have been diminishing in 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 habitat management and population monitoring efforts and techniques.

In 1999, the Western Association of Fish and Wildlife Agencies (WAFWA) signed a Memorandum of Understanding with federal partners calling for a coordinated rangewide sage-grouse management and monitoring effort. Connelly et al. (2000) indicated that monitoring was a key component of sage-grouse management. Unfortunately, although much is known about sage-grouse biology and seasonal habitat use (Connelly et al. 2000), little information currently exists to guide implementation of landscape projects to benefit the species (Connelly et al. 2004).

While it is believed that sage-grouse once occupied all 29 counties in Utah, they are currently found in 26 counties and inhabit 50% of their historical distribution (UDWR 2002, Beck et al. 2003). The UDWR estimates that as much as 50% of the state's remaining sage-grouse population inhabits private land.

In 2002, the Utah Wildlife Board approved Utah's Strategic Management Plan (UDWR 2002). The state plan reinforced the need to monitor sage-grouse populations and habitats.

The plan also recognizes the role of community-based working groups in helping to restore sage-grouse populations by identifying and implementing management solutions based on local information or compatible data and research to the extent practicable. The groups were further charged to develop management solutions that in addition to promoting a diverse and productive sagebrush habitat for sage-grouse and other obligate species also address local socio-economic needs.

Currently, there are 12 local sage-grouse working groups (LWGs) operating in Utah. Each LWG encompasses a unique physiographic region in Utah. The one thing they do have in common is that sage-grouse population trends in each area have been declining. As part of their planning efforts, each group has initiated a local assessment of the status of sage-grouse populations and habitats in their areas. The assessments will include: 1) estimation of current population size and trends as well as habitat status, 2) identification of research needs and knowledge gaps, 3) establishing desired future population goals and projecting habitat needs, and 4) identification of potential threats or risk to achieving desired conditions. Each of the groups has established a desired future condition that calls for no net loss, and where possible, increase sage-grouse populations and improvement of habitat conditions. The groups are proposing to accomplish this by incorporating management strategies from state and federal agency partners, local governments, and rangewide guidelines in implementing local actions (Connelly et al. 2000, Connelly et al. 2004), increased communication with all potential stakeholders, prioritizing threats to aid in prioritizing management solutions, and pursuing diverse funding sources, or support partners to help achieve specific strategies and actions. The local plans are designed to encompass multiple land ownerships and land uses in each geographic area. Local proponents anticipate that through implementation of this adaptive plan conservation issues will be addressed, implemented, and monitored across geographic and political boundaries to increase consistency of practices implemented and information collected. Because of the involvement of private lands in each area, the LWGs have been able to apply for funding under the 2002 Farm Bill to implement conservations practices.

The plans are designed to be dynamic, adaptive documents that can change with the needs of the local sage-grouse population, habitats, and local community as necessary. Each group will annually re-evaluate sage-grouse populations and habitats and their progress on strategies listed in their plans. The plans have been written to encompass a 10-year period.

A Need for Multiple Planning Approaches

Each of Utah's local working groups is quickly learning that they are operating, for the most part, in an information void. Little information exists regarding local sage-grouse population biology, let alone the effects of specific habitat management actions on habitat use patterns and productivity. To address these voids and stimulate group participation and ownership, we have introduced into the planning process a "learning by doing" philosophy. Under this philosophy, learning becomes a critical objective of the process. Group learning is facilitated through the development, implementation, and evaluation of experimental "flagship" projects that have been largely funded under the 2002 Farm Bill. Flagship projects are small-scale replicated experiments that are designed using Farm Bill conservation practices, to incorporate what is known about sage-grouse ecology and habitat requirements (e.g. the science) to address the perceived potential threats to sage-grouse populations in their area. The information gained from these experiments is then applied across the landscape and the effects monitored. In effect, through this process, "***we know***" what the threats are and outcome of management actions implemented to address them. We then take the information we have learned in one area to set up flagship projects in other areas that "***we believe***" exhibit similar site characteristics and potential threats. These projects are also evaluated and the results incorporated into future management. Where possible, we attempt to describe actual, known impacts to sage-grouse and their habitats. However, because in some areas we lack empirical information regarding many of the threats described and there is a high level of management uncertainty, we may be only able to make educated extrapolations about the threats and the effects of actions on local populations. In these cases, we have implemented a "***we feel***" approach to management that relieves heavily on local groups perceptions about management conditions.

Parker Mountain – "We know"

Parker Mountain is located in south-central Utah in Garfield, Piute, and Wayne counties. Parker Mountain is approximately 96,000 ha and is managed by private, state, and federal land management entities. The predominant land use in the area is grazing by domestic livestock. The Parker Mountain allotment is divided into a series of 10 pastures, grazed seasonally on an elevation gradient. Parker Mountain is also home to pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), elk, (*Cervus elaphus*), sage-grouse, pygmy rabbits (*Brachylagus idahoensis*), Utah prairie dogs (*Cynomys parvidens*), and many other wildlife species. The landscape is composed of multiple sagebrush (*Artemisia* spp.) species, including big sagebrush (*A. tridentata wyomingensis*), silver sagebrush (*A. cana*), and black sagebrush (*A. nova*), as well as a variety of grasses and forbs.

The sagebrush habitat on the Parker Mountain is one of the largest contiguous tracts in Utah, and has escaped development pressures. Annual precipitation on Parker Mountain varies with elevation, ranging from 30-60 cm per year. Precipitation comes mostly in the winter in the form of snow and late summer monsoonal rains. In addition to a few springs at higher elevations (>2000 m), many water developments are scattered throughout the area.

Although, Parker Mountain exhibits one of the largest contiguous tracts of sagebrush in Utah, sage-grouse populations in the area were experiencing declines similar to other areas in the West. Sage-grouse population estimates were 5,200 - 9,200 in 1935 - 1936, but by 1969 the population was estimated at less than 3,000 birds. In 1997, a group of people of diverse backgrounds and interests forged a partnership to achieve a common goal – "grow grouse." They called themselves the Parker Mountain Adaptive Resource Management working group, or PARM.

Although increasing trends in sage-grouse numbers are being reported rangewide, the Parker Mountain population has increased 8-fold over the last 8 years. In the past decade, PARM's efforts have increased sage-grouse populations from about 600 birds to over 4,500. Most of the habitat work conducted to "grow grouse" has been accomplished largely with funding provided through conservation provisions of the Farm Bill.

To address sage-grouse declines and assist in recovery, PARM initiated a study to determine the status of sage-grouse populations, their habitat use patterns, and factors that potentially limited sage-grouse production. This began with identifying all active and historic sage-grouse leks, and counting strutting males following standard protocols. This was followed up by research conducted to evaluate sage-grouse response to conservation practices implemented under the Farm Bill. The LWGs primary focus was "grow grouse" by improving sage-grouse habitat.

Research on Parker Mountain began when the Parker Grazing Association presented Utah State University with a check to purchase radio-collars to monitor sage-grouse hen habitat use and productivity. With the help of these collars, researchers determined nest initiation, nest success, predation rates, and clutch size. They also sampled vegetation canopy coverage of shrubs, forbs, and grasses. They determined that the traditional sage-grouse brood-rearing habitat was in poor condition. It was dominated by mountain big sagebrush canopy that had few or no grasses and forbs underneath – the same forbs that are critical for chick survival. In addition to low nest success, few of the broods monitored had chicks that survived to become adults.

Because vegetation sampling indicated that the increased sagebrush canopy cover was out-competing grasses and forbs for water, PARM set up an experiment to test this hypothesis. They set up several 40-ha experimental plots to be treated with the Dixie harrow, Lawson aerator, and a chemical treatment, Spike, to reduce sagebrush canopy coverage from 40% down to 20%. This work was done in 2000 and 2001. The cost of treating the plots was provided through a Natural Resource Conservation Service (NRCS) Wildlife Habitat Incentive Program (WHIP) grant. Following the treatments, researchers went back to the plots and measured the vegetation and use of the area by sage-grouse and sage-grouse broods.

They learned that the birds preferred the treated areas to non-treated areas, and the Spike-treated plots most of all. This may be because Spike treatments provide smaller open patches with nearby sagebrush skeletons for cover. Within treatment plots, they found more sage-grouse and grouse droppings within 100 feet of the edge. This suggested to PARM that any future treatment to reduce sagebrush canopy cover should be done to increase the amount of edge between open foraging areas and sagebrush cover. Thus, to benefit grouse, the strategy should be to open small linear plots in the middle of sagebrush seas, as opposed to treating large stands. Once small areas recovered from treatment, other plots can be treated.

Based on the findings of these experiments, more treatments were implemented. Given the increasing cost of using fossil fuels to conduct mechanical treatments, PARM is now looking at using biological methods like prescribed livestock grazing to maintain treated areas, treat new areas, and creating a landscape that offers a mosaic of vegetation types and structure. To date, about 3,000 acres have been treated in the form of small plots scattered throughout the mid-elevation pastures.

It is interesting to note that in interviews with retired ranchers, we learned that in the 1930s and 40s when sage-grouse populations on Parker Mountain were at an estimated all-time high, the livestock stocking density was considerably higher than it is currently and there were more sheep moving in small bands around the mountain. To enhance the forage potentials for their livestock, the herders and ranchers burned and treated small patches in big sagebrush. Thus, they created a landscape that exhibited different age classes of vegetation types. It is also interesting to note that sheep bedding areas were and are used as lek sites by sage-grouse.

Also during the 1930s and 40s, wide-scale predator control was conducted on Parker Mountain. Today, mammalian predator control is still in place for livestock protection. This control contributed to dramatic increases observed in Parker Mountain pronghorn populations. Frequently, these pronghorn are seen grazing and bedded down in the small plots that were treated. Because of concerns about the potential impacts of ravens on sage-grouse nests and chicks, U.S. Department of Agriculture Wildlife Services (WS) personnel began placing DRC 1339-treated eggs to kill ravens, prior to the nesting season in 2001. Research completed in 2005 demonstrated high nest success and chick survival. Nest success has steadily increased and become more consistent, and chick survival is estimated at 70%. The dramatic sage-grouse population

increases experienced on Parker Mountain are, no doubt, the result of a number of factors working in concert, with habitat management being one of the most important factors.

West Box Elder – "We believe"

The West Box Elder County Adaptive Resource Management Coalition (BARM) is a public and private partnership that was organized in 2002 to address stakeholder concerns about declining sage-grouse populations. The partnership is chaired by local landowners and administrated by the Utah State University Extension's Community-Based Conservation Program (CCES). The working group has completed a 10-year adaptive resource management plan that couples greater sage-grouse conservation and regional socio-economic sustainability with restoration of sagebrush communities.

Research conducted by Utah State University on Parker Mountain suggest that chemical and mechanical manipulations in degraded sage-grouse brood-rearing habitat can successfully restore sagebrush steppe environmental functions, resulting in increased forage production, plant diversity, and grouse use. The research demonstrated that plant diversity and production in sagebrush habitat types can be increased if sagebrush canopy cover is reduced to 19-20% (Braun and Wallestad 1977, Connelly and Braun 1997, Connelly et al. 2000). This work was conducted at elevations above 2,000 meters in brood-rearing areas. The size of the treatments were limited to 40-ha plots that exhibited 30-70% sagebrush canopy cover.

Research conducted by BARM in cooperation with Utah State University suggests that brood-rearing habitat may also be limiting the sage-grouse population in west Box Elder County. To address this, BARM believes that sagebrush treatments implemented on larger (80-ha) plots of private lands in the area will yield similar results. The need for conducting these types of management experiments at different elevations and scales has been highlighted in both the Utah and WAFWA sage-grouse management guidelines.

In 2005, BARM identified twenty-four 80-ha plots on private land that exhibited >40% sagebrush canopy. From these, 18 plots were randomly selected to conduct the experiment. Funding for the treatments was obtained through an NRCS WHIP grant. The plots were within 2 miles of active greater sage-grouse leks and within summer brood-rearing habitat. Baseline data on vegetation production, plant species composition, canopy coverage, and historical utilization by livestock and greater sage-grouse was collected in 2005 and will be repeated annually. The results of this research will be used to guide the management activities of the local working group.

Utah LWGS Conservation Action Planning – "We feel"

The "we feel" approach adopted by LWGs helps them compensate for a lack of empirical information regarding sage-grouse threats and an inherent high level of management uncertainty. Using this approach, the LWGS make educated extrapolations about the threats and the effects of actions on local populations. In these cases, we have implemented a "we feel" approach to management that relies heavily on local groups perceptions about management conditions.

To facilitate this process, we adapted The Nature Conservancy's (TNC) Conservation Action Planning (CAP) model to LWGs sage-grouse planning (www.nature.org). The CAP process allows the group to develop and prioritize strategies based on what they feel is happening in their area. Potential threats are identified and assigned a rank of "low", "medium", "high", or "very high" to each threat with regard to its contribution to reduction in population health or habitat condition, and its irreversibility. Again, given the stipulations regarding a lack of empirical locally-based information in many cases, the LWGs based these rankings on the best information available to them. The rankings help highlight potential priorities for subsequent strategies and actions. Many of these projects will be conducted on private land and funded under the Farm Bill.

Conclusion

Although the LWG process in Utah is still in its infancy, we attempted to compare each of the processes (Table 1). Based on the results to date, the "we know" approach has yielded the greatest benefits

Table 1. Cost and benefits of the "we know, we believe, and we feel" approaches to sage-grouse planning efforts being implemented by local working groups in Utah, 2006.

Attribute	Conservation Planning Strategy		
	"We know"	"We believe"	"We feel"
Cost	High	Moderate	Low
Time	High	Moderate	Moderate
Participation	High	Moderate/Low	High
Benefits	High	High	High
Sustainable	Moderate/Low	Moderate	Moderate
Adaptive	High	High	Moderate

in terms of LWG ownership and increase in grouse populations. However, it also has been the mostly costly in term of evaluation and monitoring. Costs include funding for graduate students and other research costs. The "we believe" approach comes in a close second. However, the level of LWGs involvement and participation is not as strong as the previous approach. Because of information gained from other experiments and local insights, this process has not required the same financial commitment to setup and evaluate the experiments.

One of the shortcomings of the first two approaches is the amount of time required to actually develop a plan. In both cases, LWG participants have been involved for 3 or more years before an actual flagship project was implemented. The "we feel" approach has helped expedite the planning process. Although it requires greater LWG participation up front, the planning period is shortened by the CAP process. The CAP process helps LWG participants focus their energy to identify and prioritize potential threats. In doing so, CAP has helped the LWGS to prioritize projects. These groups are currently using this information to identify and implement projects and actions to achieve their plan objectives.

The LWGs effort in Utah have completed Phase I (conservation planning) and are now moving into Phase II (project implementation and evaluation). We anticipate this effort will take five years to complete. At the end of this effort, we will be better able to assess the relative strengths and weaknesses of each approach. Regardless of which effort implemented, because of the involvement of private landowners, LWGs have been able to implement and evaluate the effects of Farm Bill conservation practices on sage-grouse.

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