WERA507 Draft Proposal

PROJECT NUMBER:

PROJECT TITLE: Sustainable management of free-roaming equid populations on designated western U.S. landscapes

REQUESTED PROJECT DURATION: October 1, 2022- September 30, 2027

STATEMENT OF ISSUES AND JUSTIFICATION:

As of March 1, 2020, the Bureau of Land Management (BLM) estimated that there were 95,114 free-roaming equids (i.e., wild horse and burros [WHB]; *Equus ferus* and *E. asinus*, respectively) occupying BLM-administered herd management areas (HMAs). This is more than three times the designated appropriate management level (AML). As of March 1, 2018, AML for BLM-administered WHB herds was set at 26,690. Not every HMA is affected adversely, but where there is an overabundance of WHBs, they impact the overall health of U.S. western public rangelands by degrading ecosystem functions and reducing the forage and water available for domestic livestock, habitat of native wildlife species, compromising multiple-use principles that guide the management of public lands.

The Wild Free-Roaming Horses and Burros Act of 1971 (WFRHBA) gave the BLM and the U. S. Forest Service (USFS) the statutory obligation to manage and protect feral equids in HMAs and Wild Horse and Burro Territories, respectively. The intent of the WFRHBA was to ensure healthy populations of free-roaming equids, defined as WHBs, on certain federal lands, in ecological balance with other multiple-uses. While all free-roaming equids in the U.S. may be considered feral, only the subset designated by the WFRHBA have the legal protections for WHBs (The Wildlife Society 2016, Schoenecker et al. 2021). These include descendants of unclaimed, unbranded, free-roaming horses and burros present on BLM and USFS lands when the Act was signed into law. The WFRHBA definition of WHBs, does not apply to free-roaming equids that may inhabit tribal, state, and private lands. Section 3 of WFHBA requires the Secretary of the Interior and Agriculture to 'consult with the wildlife agency of the State wherein HMAs are located to protect the natural ecological balance of all wildlife species that in habitat such lands, particularly endangered wildlife species.

The WFRHBA as amended by the Public Rangelands Improvement Act (PRIA) of 1978 (Public Law 95-514), required the BLM to issue AMLs for WHBs on [designated] public lands." The WFRHBA identified tools that the BLM and USFS could use to manage WHBs. However, the U.S. Congress has limited the use of two of the tools (i.e., the sale of WHBs without limitation and euthanasia) which had been historically used to manage populations. Without active management to reduce growth rates the on-range WHB population within 4 years could exceed 160,000. At these herd sizes, and within the context of the further drying of western rangelands due to climate change, it is anticipated that more WHBs will die from dehydration, starvation, and vehicle collisions, and that their impacts on native wildlife and rangelands will become irreversible (Garrott 2018).

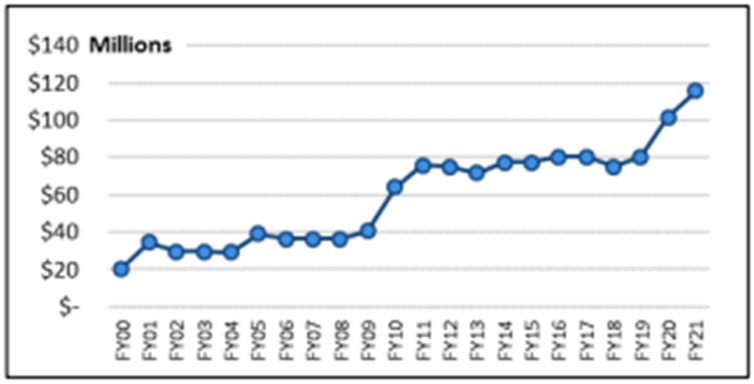
The BLM and USFS have retained the ability to gather WHBs in areas where populations are impacting rangelands and the health of the animals is compromised. However, if gathered animals are not adopted or sold under applicable legal limitations, the agencies must care for them for the remainder of their lives. A recent editorial in the New York Times written to recognize the 50th Anniversary of the WFRHBA was highly critical of the current adoption programs (https://www.nytimes.com/2021/05/15/us/wild-horses-adoptions-slaughter.html). In Fiscal Year 2018, the BLM spent $49.8 million, 61% of its $81.2 million budget to care for animals in holding facilities (BLM 2018, Figure 1).

Figure 1. The growing cost of Bureau of Land Management wild horse and burro management program

https://crsreports.congress.gov/product/pdf/IF/IF11060.

Figure 1. BLM Appropriations for Wild Horse and Burro Management, FY2000-FY2021

(in millions of current dollars)



Source: CRS; data from BLM and appropriations documents.

The BLM program fiscal year 2021 appropriations was $115.7 million dollars. Given that WHB populations double every 5 years or less (National Research Council [NRC] 2013, https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3796106.pdf), failure to effectively control populations is likely to require increasing future appropriations. Particularly when a primary population management tool is to place WHBs in long-term off-range pastures. Public and policy development interest in economic studies is growing to evaluate the direct economic costs of managing the wild horse and burro program under alternative management scenarios. Interest is also growing in evaluating the opportunity costs imposed by WHB management on ecological damages caused by excess wild horse and burro populations and displaced commercial livestock production both in the HMAs and from placing horses in off-range pastures.

The BLM acknowledges that public support will be required to achieve AML (BLM 2018). Despite the documented negative ecological impacts of free-roaming equids where numbers exceed ecological balance, public stakeholders have a high regard for WHBs. However, respondents to informal non-rigorous public surveys have expressed dissatisfaction with the current WHB program status quo. As Congress, the BLM, USFS, Native tribes, and the states begin to pursue implementing the WHB and free-roaming equid management options, all must also develop, implement, and evaluate proactive public outreach programs that inform the public about the "tradeoffs" or consequences that could result from a failure to deploy a more comprehensive and collaborative management approach.

The only tool used broadly enough to make systemic reductions in WHB populations has been the capture and removal of animals from western rangelands (BLM 2017, Hendrickson 2018). The BLM management options identified in the Report to Congress will require the increased and widespread gathering and handling of WHBs to implement the proposed population reduction strategies. Implementing any of the options will require different levels of funding, time, agency persistence, and Congressional and stakeholder support.The options outlined by the BLM in the 2018 Report to Congress did not address some important underlying sociological questions regarding how to gain the public support required to achieve AML

The human-dimension aspect of WHB management are less understood than the ecological or biological problems (Beever et al. 2018, Scasta et al. 2018) Contemporary WHB management policies, which include a legacy of administrative and political constraints on euthanizing healthy horses (Norris 2018), suggest that WHBs are valued above all other animals in contemporary U.S. society. The strength of the emotional human-horse connection that developed through human-horse co-evolution surfaced in the late 1950s, when public concerns over the humaneness of “mustanging” led to the passage of the Wild Horse Protection Act of 1959 (i.e., the Wild Horse Annie Act; Smith et al. 2016). However, until Congress passed the WFRHBA, most WHBs had no legal status and still could be captured, killed, and utilized for any purpose. The WFRHBA established public ownership of WHBs on western public rangelands they inhabited at the time the legislation was passed. It also prohibited the exploitation or destruction of these animals by private citizens, and gave the BLM and the USFS the authority and responsibility for their management (Norris 2018).

A 2013 non-rigorous survey of 1,247 registered voters by Public Policy Polling, Raleigh, NC (information@publicpolling.com) reported that 71% of the respondents were aware that WHBs roamed free western public rangelands, and 72% felt they should be protected. When the respondents were informed, that the federal government spends $50 million (70% of the current program budget), to capture and hold WHBs, and less than 4% of the budget on fertility control or other measures to keep them on the range, and that the "stockpiling of horse's costs taxpayers more than $100,000 a day, 62% agreed it was not an efficient use of taxpayer dollars. When respondents were asked if they thought the program was being managed efficiently; 62% agreed that t was not. However, respondents to the survey were not informed that at the time the survey was conducted, that WHBs populations threatened the ecological balance of western rangelands (NRC 2013), were impacting other legal multiple-uses of public lands (Danvir 2018), and that fertility control methods alone are not a viable option given the current herd sizes (Kane 2018).

Over abundant free-roaming equid populations are an ongoing management challenge on western public lands. In western states almost 90% of free-roaming equid populations currently exceed the established AML (BLM 2017). Gathers, removals, contraception, and adoptions have been inadequate to keep pace with intrinsic growth rates, making this goal difficult to achieve.

The BLM and USFS are directed to provide for multiple-uses on public lands, in which other land uses must be considered alongside the needs of free-roaming equids. The WFRHBA states: "All management activities shall be … carried out in consultation with the wildlife agency of the State wherein such lands are located in order to protect the natural ecological balance of all wildlife species which inhabit such lands…." Western states rely on public lands for economic benefits derived from livestock grazing, recreation, and hunting. Many economically important wildlife species exhibit extensive habitat overlap with free-roaming equids (e.g., greater sage-grouse [*Centrocercus urophasianus*], Beever and Aldridge 2011, Coates et al. 2021). Excess equids on fragile, arid rangelands have been associated with wetland degradation, soil compaction, spread of noxious weeds, increased bare ground, and reduction in grass height (Davies et al. 2014, Boyd et al. 2017, King et al. 2019, Hennig et al. 2021). Consequently, concerns over animal malnutrition and starvation, loss of livestock grazing capacity, and habitat degradation for native wildlife have reached critical levels.

The NRC recommended that science is needed to improve management of the BLM WHB program (NRC 2013). A better understanding of animal health and abundance relative to environmental constraints is needed to provide more evidence-based and proactive population management. A recent assessment of WHB demography and rangeland health suggests that widespread starvation is a likely outcome when equid populations exceed carrying capacity (Garrott 2018). Moreover, given documented impacts of these animals on sagebrush and riparian communities (Davies et al. 2014, Boyd et al. 2017, Hennig et al. 2021), impacts to vegetation have the potential to affect other species and land uses. Thus, efforts to match free-roaming equid management efforts to rangeland conditions will enhance ecosystem health, animal condition, and private-public relations.

The BLM acknowledged that public support will be required to implement any of the management options identified (BLM 2018). Several NRC reports (NRC 1980, 1982, and 2013) also highlighted the need for research into the social context of the WHB management, particularly studies that evaluate what aspects of horse management are understood and supported by the public. If decision makers (i.e., public land management agencies, state and local government representatives) better understand the different levels of knowledge regarding WHB management on public lands, they may begin to strategically engage a diversity of backgrounds and viewpoints toward creating a management plan that would be supported by most of the public (NRC 2013).

Most Americans also have positive perceptions about science and individuals with greater science literacy are more likely to report positive attitudes toward science (Allum et al. 2008). This argument has been used to support the science deficit model of communication; those who do not accept the science, simply do not understand it; therefore, all they need are more facts (Bauer 2003). Drummond and Fischhoff (2017) reported that education, whether measured in terms of general educational attainment, science educational attainment, or science literacy, may increase rather than decrease polarization on issues linked to beliefs. These patterns suggest that in the case for the biological management of WHBs, more scientific knowledge may facilitate increased advocacy in individuals defending positions motivated by non-scientific concerns – their beliefs – and as such a greater resolve when defending their existing beliefs. Human dimensions research suggests that most of the American public acquire the information used to make decisions about public policy and personal matters from family and friends (http://www.pewinternet.org/2017/09/11/how-people-approach-facts-and-information).

The rise of contemporary social media has also replaced more traditional print and oral communications. Research further suggests, over 67% of the public may now get their news and information via social media (Pew Research Center 2017). These results become particularly concerning when value-laden issues such as the management of free-roaming equids are discussed via social media outlets without access to competing information. Typically, when a controversial resource management decision is being considered or proposed, stakeholder groups are presenting information that emphasizes particular aspects of the issue favorable to their position. Thus, the nature of the public's response depends in part on the relative ability of different stakeholders to convince others that their version of the "truth" is the right one (Gentile 1987, Kirkpatrick and Turner 1997). Although information marketing campaigns can certainly influence the strength of support or opposition for predator or WHB management options, such advocacy campaigns are not likely to cause substantial shifts from support to opposition among neutral stakeholders (Messmer et al. 1999). Despite small, potentially biased surveys conducted by interest groups, at this time there has not been a well-designed, national survey with a large sample size of citizens to assess the public opinion about WHB management. State governments or private parties may be in a better position to conduct such a survey because Privacy Act restrictions complicate any federal government actions that collect information from more than nine individuals.

Messmer et al. (1999) provided some insights into how information can affect public opinions about a controversial management issues such as predator control (Decker and Brown 1987, Messmer et al. 2001). Predator control to benefit wildlife has historically been a common practice that has enjoyed wide-scale support among traditional constituents of wildlife management agencies (Minnis 1997, Messmer et al. 2001). The predator control controversy surfaced in the political arena as stakeholders have sought to define the acceptable range of predation management options through voter ballot initiatives, legislative lobbying, and judicial actions (Messmer et al. 2001). Similar to the feral equid issue, social targeting of this political action has been aimed at a portion of the public who for the most part had been considered to be "neutral" or uninformed on these issues (Gentile 1987, Kirkpatrick and Turner 1997). Messmer et al. (1999) employed a scenario-based information approach to present wildlife management decisions regarding predation management in a contemporary context. Their scenarios presented information about specific predation management problems and consequences so that respondents could more fully evaluate their support or opposition to predator control.

Messmer et al. (1999) reported a moderately knowledgeable, interested public who were able to see shades of gray in the relationship between people, predators, and their management. As a result, they may be less susceptible to public information campaigns than less knowledgeable individuals. Messmer et al. (1999) respondents also believed that lethal predator control should be considered when examining options for population management that are based on sound scientific evidence. Social scientists have long argued that general attitudes of an uninformed or misinformed public are not good predictors of specific behaviors (Dollard 1949, Wicker 1969, Heberlein and Black 1975). Surveys conducted to assess general public attitudes toward direct management approaches such as predator control or the management of feral equids that do not provide competing information are weak predictors of political action in support or opposition to a particular agency response to a management problem (Messmer et al. 1999). Thus, managers and policy-makers should be cautious when extrapolating public attitudes to specific free-roaming equid management options based on well-organized social media or signature petition campaigns.

To achieve the sustainable management of WHBs in balance with other public land multiple-uses (Danvir 2018), it will be imperative for Congress to better understand the needs, desires, and attitudes of all the stakeholders of western public lands. To actively engage these stakeholders in the decision-making process, Congress must first understand their information needs. This can only be done by completing a rigorous national human-dimension survey to assess public perceptions, values, and beliefs not just about WHBs and other free-roaming equids, but what constitutes sustainable management of western public lands. With the completion of such a survey, Congress will have new information regarding how to more fully inform and engage public land stakeholders with factual information about the consequences of policy decisions that limit or restrict public land management approaches (Hewitt and Messmer 1997). Until this is done, managers should not expect to see increased Congressional support for any of the WHB management options outlined in the Report to Congress (BLM 2018).

Completion of this project will:

1. Enhance interstate and interagency coordination of the plight of WHBs in the face of a changing climate. The related environmental education efforts will expand public understanding of the BLM and USFS roles in maintaining and enhancing viable populations of WHBs and their habitat and encouraging private care placement of animals through adoptions and sales.

2. Provide information and identify positive actions that support, coordinate, integrate, and focus financial and in-kind investments in the management of WHB populations and natural resources impacted by these populations in an effort to achieve or maintain a thriving natural ecological balance.
3. Provide new information and promote multiple use on public lands which lead to increased collaborative efforts to manage WHBs populations on public lands
4. Provide information and garner support implementing authorized gathers and projects in WHBs HMAs above AML.
5. Provide information in support for working with local partners in an effort to meet the WHBs goals identified in resource management plans and other planning and conservation documents.
6. Reinforce the role of collaborative efforts and case studies with state and local partners and organizations critical to addressing challenges to habitat conservation on sage-grouse and other critical habitats.
7. Promote habitat resiliency and connectivity, which is often conducted in cooperation with industry stakeholders, states, and other partners, will also be directed to highest priority areas where partners are available to leverage and increase capacity.
8. Highlight the need for the public to collaborate with state, federal, and non-government organization partners to leverage technical expertise and financial resources (cost share) to effectively obtain a thriving natural ecological balance in WHB HMAs.
9. Result in new peer-reviewed science and extension outreach products, both ecological and human dimensions research, and the implications for the sustainable management of WHBs.

RELATED, CURRENT, AND PREVIOUS WORK

In 2017, USU Extension hosted a Summit in Salt Lake City, Utah to discuss the "full implementation of the WFRHBA." Participants included over 250 representatives from 109 state, local and tribal governments, academia, public land users, conservation groups, wildlife interest and advocate groups, and federal agencies. The participants shared their concerns regarding the sustainable WHB management.

In 2018, the USU Berryman Institute published a special topics issue on WHB management in *Human-Wildlife Interactions* https://digitalcommons.usu.edu/hwi/vol12/iss1/. Authors explored in depth the policy and management of WHBs in the United States and concluded that if current management policies continue, the impacts to fragile western rangelands, WHBs, wildlife and their habitats, and humans will intensify, resulting in irreversible consequences (Messmer 2018).

Subsequently, Summit stakeholders organized the **Free-roaming Equid and Ecosystem Sustainability Network (FREES)** in 2018. FREES established a new public forum committed to facilitating open dialogue and building positive relationships to reengage all Americans in collective actions to ensure the health of free-roaming equids (WHBs), western rangeland ecosystem health and sustainability, and the principles of multiple-use. The FREES network is administered through USU Extension (https://extension.usu.edu/freesnetwork/).

In May 29-31, 2019 FREES hosted a second Summit in Reno, Nevada "to develop a stakeholder-based comprehensive communication strategy and processes to manage free-roaming equids in concert with other public lands multiples-use to achieve western rangeland ecosystem sustainability." The most notable change was contracting with The Langdon Group in 2019 to facilitate Summits that ensured for the widest diversity of opinions and participant views.

Delegates from 90 plus organizations called for increased collaboration to resolve the issues impeding the management of WHBs. The delegates recognized that there was not one single solution, but that all solutions must be economically, biologically, ecologically, and ethically practical. They also recognized that the solutions must fully engage state legislatures, the U.S. Congress, interested non-governmental organizations, and private individuals in funding innovative ideas to be tested, and practical alternatives to be implemented that represent the values and desires of diverse public stakeholders, and are within the purview and management authority of the BLM, USFS, Native American Tribes, and the states. Working with stakeholders to promote increased dialogue regarding the management of WHBs and other free-roaming equids in open forums to discover and share needed science, emerging stakeholders needs and develop collaborative actionable solutions was identified as the highest priority (https://extension.usu.edu/freesnetwork/ou-files/SummitHandout28Oct.pdf).

FREES hosted a 3rd Summit on October 6-8, 2020 in Cody, Wyoming. Delegates from over 79 different organizations convened to achieve the FREES mission of "Healthy Herds on Healthy Rangelands." The theme of the 2020 Summit was "Connecting the Dots." On-site participation in this Summit was impacted by the COVID-19 pandemic. Summit planners implemented a hybrid format - consisting of both on on-site and virtual presence -

to ensure participant diversity. Over 170 participants both on-site and virtually shared their stories, new research, program updates, needs, and hopes. Recorded presentations and reports from the all of Summits are available on the FREES website (https://extension.usu.edu/freesnetwork/summit-2020).

FREES approach to increasing public awareness of the issues through education and outreach, has increased public knowledge and appreciation of the complexity of issues surrounding WHB sustainable management. Through the Summits and the network, FREES has demonstrated the ability to form new and effective partnerships to share resources and expertise, and improve WHB public education

W507 Wild Horse and Burro Management

At the 2018 spring meeting of the Western Association of Agricultural Experiment Station and Western Extension Directors Association, the directors highlighted the need for involvement in WHB management. The directors approved the multistate project rapid response task force - W507 and recruited interested biologists, ecologists, sociologists, and economists to collaborate on this effort. The objectives of W507 included:

1. Integrate existing biological, ecological and economic data to make comprehensive science-based recommendations for the BLM Wild Horse and Burro Advisory Board for sustainable management of WHBs and the rangelands they inhabit.
2. Identify areas for future collaboration between land-grant universities and the BLM and others for sustainable management of WHBs and the rangelands they inhabit.

The first W 507 meeting was hosted at Utah State University (USU) on January 23-24, 2019 by the Administrative Advisors (AA) Brian Higginbotham (USU) and Chris Pritsos (University of Nevada-Reno [UNR]). Representatives from each state described current WHB activities and identified topic areas they felt were important to address regarding WHB management. Participants prioritized the topics they felt were most important and feasible to address. The subgroups established were; National Survey, Fertility Management, Youth and Community Engagement, Decision Support Tools, and Economics.

National Survey

The National Survey subgroup was created to complete national surveys to determine the knowledge and opinions of the public toward WHBs and their management in the US. Subgroup members included: Nicki Frey (Chairperson), Jessie Hadfield, Mark Nelsen, Terry Messmer, and Jeff Beck. Derek Scasta, Laura Snell, and Loretta Singletary. In 2020 the subgroup implemented the national online survey. Funding for the survey secured through UNR Agricultural Experiment Station and USU Extension was matched with funding provided by USU Agricultural Experiment Station's Public Lands Initiative. The survey was created and edited by the subcommittee and then reviewed by the full W507 committee. Dr. Frey worked with Qualtrics to build the online survey instrument. In July 2020, the survey was launched and administered by Qualtrics. The survey was designed to acquire 400 responses in each of 5 regions. Our additional funding allowed for an additional 1000 responses from Nevada and 1000 responses from Utah. In the process of reaching the quotas for our demographics, additional responses were acquired above the base 400 in each region, resulting in 5000 responses. The data were broken into several parts: Knowledge Questions, Opinion Questions, National Dataset (using a subset of the Nevada and Utah data to ensure an even distribution of responses), and Western Dataset (using a subset of Nevada and Utah data to ensure an even distribution of responses).

Dr. Frey presented the results of the national dataset of knowledge questions to the 2020 Free-roaming Equid Summit in Cody, Wyoming, USU Stock and Flock Talks, and the BLM Wild Horse and Burro Program staff. She has also presented the results of the national dataset of opinion questions to the Western Section of the Wildlife Society's annual conference and at the national Wildlife Society's annual conference in October 2021. Dr. Frey also created a website to present basic findings of the survey, as they are examined and prepared for manuscripts. The website is designed to be informative, but very approachable to people new to the WHB issue https://www.usuhumanwildlifeinteractions.com/freeroamhorsesurvey.html.

Papers to be published include; 1) U. S. Knowledge of Wild Horses and their Management. Journal of Extension, 2) Western Knowledge of Wild Horses and their Management. Rangeland Ecology and Management, 3) U. S. Knowledge of Wild Horses and their Management Extension Publication, 4) U.S. Public Opinion of Reproductive Control Options for Free-roaming Horses on Western Public Lands – accepted into Human Wildlife Interactions to be published Summer 2022.This study was the first rigorous attempt at gaining insight into public perceptions

of WHB management in the Western United States.

Fertility Management

This subgroup is led by Chris Davies (USU). Two iUPOD breeding trials were completed in 2019, one at the University of Massachusetts (UMass) by Carlos Gradil and the one at USU by Karl Hoopes and Dirk Vanderwall. Both studies involved natural breeding in a pasture (MA) or paddock (UT) setting of mares fitted with 40x16 mm or 38x16 mm iUPODs. These studies evaluated; 1) contraceptive efficacy in mares carrying the device for up to a 4-month period under active breeding, 2) device retention, 3i) the effect of the device in suppressing estrous cycle periodicity, and 4) fertility following device removal. The iUPODs were inserted transcervically in mares under sedation, regardless of the stage of the estrous cycle. Mares were examined by transrectal ultrasonography immediately before and within 5-minutes post-insertion. Mares were exposed to a stallion of known fertility beginning on the following day to allow for full recovery from sedation. Mares were pastured together with the stallion for 120 days. Mares were examined by transrectal ultrasonography on day 14, day 30, and every third week thereafter. The number and size of follicles, corpora lutea, and the presence of intrauterine fluid were assessed with ultrasonography and recorded. Transabdominal detection of the iUPOD, using a handheld magnetic detector wand, was performed weekly. Mares and stallion were observed daily for mating behavior for 15 minutes AM/PM. Progesterone was assayed at the time of iUPOD insertion to confirm stage of the estrous cycle and then assayed every week up until 3 weeks post-stallion removal - for a total of 20 weeks - to monitor corpus luteum function. The presence of biofilm on iUPODs was measured by a crystal violet assay. In both studies, there was 100% iUPOD retention and 100% contraceptive efficacy. Many of the mares were shown to be fertile after iUPOD removal. Diestrus was only prolonged in a few of the mares. It is likely that presence of a stallion stimulated the mares to return to estrus. Articles on both studies were recently published (Gradil et al. 2021,Hoopes et al. 2021).

Karl Hoops and Dirk Vanderwall at USU in 2020 examined the effects of adding copper to the iUPODs. The incorporation of copper seemed to increase inflammation, which isn't desirable. Consequently, plain iUPODs without copper will be used in the proposed range study..

Youth/Community Engagement

This subgroup is led by Jessie Hatfield (USU). Several western U.S. states have collaborative programs with the USFS and BLM that support youth and community WHB engagement. These programs follow a youth mustang challenge and adoption format. These programs aid in the successful adoption of a small percentage of animals each year. Additionally, USU has created a Mustang Camp program that provides youth an immersive experience exploring the history of WHBs, range management, current population control methods, and related careers. These camps have exposed suburban youth to these unique sectors and provided education.

The subgroup broke their responsibilities into two phases: Phase I: "what youth outreach is happening?" and Phase II: Increase youth and community engagement. Phase I was accomplished by doing initial research and investigating existing programs involving mustangs and looking at opportunities for additional programming. The group concluded that our programs are inward facing and do not do a great job of educating the public. The group also concluded discovered that the programs are shrinking or disappearing with the exception of the California Devil's Garden Colt Challenge. The cause of this is partly due to a saturated market (new audience needs to be targeted) and partly to increased pressure from advocate groups.

In 2019 USU Extension and Youth Programs held their annual Youth Mustang Challenge and increased their scope by creating a Military Mustang Challenge. The goal moving forward was to continue with our existing programming and share these with surrounding states. In 2020 they sought to build partnerships and increase collaboration with the BLM and National Parks. This partnership will include the creation of "Mustang Camps", curriculum, and other resources that can be shared to surrounding states.

The subgroup continued to explore partnership possibilities and try to grow our committee to expand our reach. The group sought funding and support from RFDTV, Protect the Harvest, and NSF. They contacted the Desert Research Institute to collaborate and work together for "green box" kits surrounding ecology and healthy herds. We also completed ag in the classroom, discover 4-H, and project curriculums. The group currently has Discover 4-H Guides, Camp Guides, and additional resources under review for publication.

Decision Support Tools

This subgroup is led by Eric Thacker (USU) and represents a joint effort initiated in July 2019 between USY (Karl Hoopes, David Stoner), UNR (Wade Laurence, Tamzen Stringham, and Amanda Gearhart), and University of Wyoming (Jeff Beck, Derek Scasta) to evaluate ecological conditions of BLM HMAs across the three neighboring states. The subgroup has convened two in-person conferences and 3 teleconferences, compiled relevant data, and outlined two manuscripts. These cover the effects of varying habitat conditions - as measured through satellite imagery and DRGs – on horse density and body condition.

The subgroup focused on wild horses because of their distribution, density, and environmental impacts. The physical condition of an animal reflects the combined effects of population density and forage availability. Body Condition Scores (BCS) offer a noninvasive and systematic means of assessing the health of an individual animal, while on the hoof (Carroll and Huntington 1988). Furthermore, body condition can provide a post-hoc evaluation of the habitat conditions under which the animal is living. Declining body condition is symptomatic of inadequate nutrition or forage quantity, and can be indicative of habitat degradation. By including horse health in gather priorities, managers can respond to the actual physical conditions of the animals, independent of population counts or AML.

The complex and dynamic nature of rangeland environments has long been recognized by ecologists and land managers. This has led to various methodologies for delineating management units based on geology, soils, and climate to reduce complexity and enhance understanding (Winthers et al. 2005, USDA-NRCS 2017). Recently, efforts to upscale Ecological Sites (ES) into larger landscape units based on disturbance ecology has been undertaken by Stringham et al. (2016). Utilizing pre-existing ecological sites, a team of natural resource specialists has developed a process that examines local knowledge, soil mapping data, and published literature on plant response to various natural or human-induced disturbances to sort ES or terrestrial ecological units (TEU) into Disturbance Response Groups (DRG; Stringham et. al 2003, 2016, Briske et al. 2008), defined here as a collection of ecological sites that respond similarly to disturbance. DRGs provide landscape-scale information spatially that can be correlated to horse management areas to determine whether certain DRG types or attributes are related to herd health. Initial DRGs would be developed from existing NRCS soil mapping products and ecological site information.

Funding for this project was obtained from a USU Public Lands Grant with matching funds from the Nevada and Wyoming Agricultural Experiment Stations. As of January 2020, the subgroup hired a part-time staff research assistant to develop GIS/Remote Sensing based models for evaluating and monitoring range conditions on HMAs. USU personnel obtained population data from the BLM WHB Program and have merged these data with several remotely sensed measures of ecological condition (e.g., precipitation and soil moisture). The subgroup received a commitment from Brigham Young University to provide camera trap data from the Cedar Mountain herd management area in Utah. Lastly, the subgroup developed a sampling criteria for analyzing photo data of horses to evaluate body condition.

To date, the subgroup has acquired 1,984,972 photos from Nevada, 17,496 photos from Utah, 51,994 photos from Wyoming, and 19,028 photos from California. Animals were identified and photo data and metadata were processed and stored into a custom database. Serial visit numbers (sequences) were calculated and assigned based on breaks longer than a one-hour time period where no horses were detected. This set up a framework for future photo sampling during the body condition scoring process. Summary statistics were generated on horse count and visit number by day and week. Elevation, precipitation, reference vegetation production, and vegetation cover summary statistics were generated for each HMA as possible model inputs. Possible HMA candidates outside of Nevada were identified based on available NRCS soils data, which would be used along with draft Disturbance Response Groups (an ecological site grouping) as model input. Dr. Kate Schoenecker, USGS Ft Collins and Dr. Sarah King, have joined the group.

Wade Lieurance, from Dr. Stringham's lab, applied machine learning tools to identify animals in photos and manually identified/counted animals in those photos for California, Nevada, and Utah. The total number of photos with wild horses is 71,394. Dr. Hoopes trained vet students at USU to assign BCSs from randomly generated photo sequences; to date, we have scored horses in 8,420 photos in 2,655 sequences from across the study area having a total of 22,659 individual photo scores. In March of 2021, the subgroup received additional funding to increase their sample size to continue body condition scoring horse photos. Photo scoring has continued through 2021. These efforts have resulted in graphs illustrating BCS change over time and preliminary assessments of

vegetation compositional differences among sampled HMAs.

Dave Stoner (USU) presented the preliminary results at the 2020 FREES Summit in Cody, Wyoming. Dr. Scasta and Dr. Thacker have a manuscript accepted publication in Human-Wildlife Interactions that searched through media reports of WHB mortalities and emergency interventions, including gathers, feeding, and watering events.

Economics

The W 507 Economics subgroup completed its initial zoom meeting on March 2, 2020 to discuss developing a direct and indirect economic cost study of the BLM WHB program. Eight people attended the meeting representing Utah, Nevada, Arizona, Texas, Kansas, and Washington. The subgroup drafted a scope of work to define the specific study area as a state, a multi-herd management area (HMA) region, or a specific HMA; the scope of effort and data needed to evaluate both on-range and off-range economic costs; wild horse adoption and tourism benefits; and to estimate ecological costs of wild horse impacts from overgrazing and competing for range resources with wildlife and endangered species such as the greater sage-grouse. The subgroup is integrating economic cost models with the PopEquus Wild Horse population model to estimate costs under alternative WHB population growth and contraception technology/policy scenarios.

OBJECTIVES BY SUBGROUP

National Survey: 1) Survey native tribes in a format that both respects their cultures and measures their values and opinions of WHBs on tribal lands, 2) Survey of U.S. stakeholders to document opinions and trade-offs regarding reproduction and euthanasia, and 3) Survey U.S. stakeholders to determine the public's support of current and potential management actions, based on willingness to pay and budgetary constraints.

Fertility Management: 1) Test the self-assembling iUPOD intrauterine device (IUD) for long-term fertility control in free-roaming equids and 2) Evaluate the behavior and other social attributes of wild mares fitted with iUPODs.

Youth Community/Development: 1) Create research-based resources for education of the public on WHB populations and their management that can be shared across the Nation. These resources include videos, fact sheets, and journal articles that target the non-academic or scientific community, 2) Develop a model for Mustang Camps; these one to three day immersive experiences will give youth and adults hands-on and applicable experiences to aid in education. Utah State University piloted the first camp July 2021 and was met with tremendous success and support. Majority of participants demonstrated increased knowledge about WHB and range evaluation and management. Participants also indicated an increased desire to learn more about career choices related to wild life and natural resource management, and 3) Support and further cultivate existing programs that promote current adoption initiatives through the BLM such as Youth Mustang Challenges, Adoption Events, and further educational resources for successful adoption and placement of WHB. To increase public awareness and support for science-based solutions to WHB management

Decision Support Tools: 1) Quantify horse body condition, abundance, and growth rates relative to interannual variation in weather, HMA management regime, and rangeland condition, 2) Provide guidance on resilience of HMAs for producing forage during droughts or for recovery from fire or other disturbances using DRG (ecological site group) methodology, and 3) Identify a set of readily measurable ecological criteria to indicate when horse condition may decline.

Economics: 1) Using the PopEquus model to account for horse population dynamics develop an economic cost model to research and evaluate population growth, fertility control treatments, adoption rates, gathers and other management policies, 2) Evaluate the extent, potential, and economic impact of wild horse tourism in providing a positive economic return to managing WHBs, and 3) Evaluate the net economic impact of placing WHBs in off-range pastures taking into account government expenditures on off-range pastures and displacement of grazing livestock.

METHODS BY SUBGROUP

National Survey: We will use online surveys to conduct large-scale assessments of the national public. However, our methods to survey tribal nations will differ from this process. We are working with tribal representatives to

determine the best approach to surveying members of tribes effectively. Methods may include in-person discussions with tribal elders and printed surveys distributed via tribal representatives or tribal meeting centers. National and online surveys will be constructed via collaboration within the subcommittee and with experts and researchers in the topics of the survey (economics, reproductive control, veterinarians, etc.). Online surveys will be conducted via Qualtrics online survey platforms that use multiple marketing panels to obtain large sample sizes of respondents.

Fertility Management: Our goal is to conduct a minimum of two multi-year field trials to test the efficacy and safety of the self-assembling iUPOD intrauterine device (IUD) for long-term fertility control in free-roaming mares. An IUD design that withstands the dynamics of equine breeding is key for long-term retention. One major element that is unique to equids and affects the stability of an IUD during a breeding event, is the active dilation of a relaxed cervix of a receptive female by a male's flared glans penis. We will test different iUPOD sizes for retention/contraceptive efficacy, breeding opportunities/inter-estrus interval, vaginal discharges, and fertility post-device removal (if possible) in feral horses with age estimated based on tooth wear.

The first trial will be conducted in western Nevada with the mares housed in paddocks at the Carson City penitentiary for the first year and on pasture at a University of Nevada Experiment Station farm during the second year. This study will span three years with 30 mares starting in year one and a second group of 30 mares starting in year two. Each cohort of mares will be followed for two years. Cohorts will be comprised of three groups of mares: a group with 38x16 mm iUPODS, a group with 36x16 mm iUPODS, and a control group. Half of the mares fitted with 36x16 mm iUPODs will have devices with one unit that incorporates copper, which has both antibacterial and spermicidal characteristics. To mimic a catch and release scenario on the range, iUPODs will be inserted regardless of the stage of estrous cycle, even in mares with a non-dilated cervix (e.g., early estrous period, diestrus, and nulliparous mares). Mares and stallions will be observed twice daily for at least 15 min in the morning and afternoon by one/two individuals for behavioral estrus and mating behavior. During the first year, mares will be monitored every two months by transrectal ultrasonography for IUD retention, uterine health, and pregnancy. At the end of the two-year trial the iUPODs will be removed and evaluated for integrity. After completion of the trial, the IUDs may be replaced with new devices, and mares released to the range after being microchipped and freeze branded for permanent identification.

The second study will be a range study conducted in collaboration with USGS and the BLM. This study will be conducted with a herd of free-roaming horses managed by the BLM. We hope to have three groups of 20-40 mares in this study: a group with 38x16 mm iUPODS, a group with 36x16 mm iUPODS, and a control group without IUDs. After the herd is gathered, the mares will be evaluated to determine which ones are pregnant. IUDs can be inserted in non-pregnant mares immediately after they are gathered. However, pregnant mares would need to foal before an IUD can be inserted. Ideally, the BLM will hold some of the pregnant mares until after they foal for insertion of IUDs but this will depend on the availability of an appropriate facility for holding the mares. Mares will be freeze branded, so they can be identified from a distance, and microchipped, for permanent identification, prior to being returned to the range. Mares will be observed to see how the IUDs affect their behavior for 3-5 years by staff from Colorado State University and USGS. When the mares are gathered again after 3-5 years, the iUPODs will be removed for evaluation and potentially replaced with new devices.

Youth/Community Engagement: Our efforts will be two-fold. Some of our time and resources will focus on continuing support of existing programs. Most of our time and resources will be spent developing an interconnected resource of 4-H kits for checkout, camp activity guides, and other educational resources pertaining to free-roaming horses by utilizing the diversity of expertise involved in this project. Content creators and a graphic designer will be used for production. Second, we will develop multi-day immersive “Mustang Camps”, involving both classroom and field trip activities, to increase understanding of the history of feral horses and burros as well as their management and rangeland impacts.

Decision Support Tools: This effort will be focused on HMAs in three of the four states with the largest horse populations; Nevada, Wyoming, and Utah. We are also interested in northern California specifically and any other states that may have game camera images of free-roaming horses available. Annual ground-based vegetation monitoring is not feasible across HMAs. Therefore, we propose to develop models of forage and water availability from satellite imagery for HMAs in the study region (n = 127). Remotely-sensed data provides a synoptic picture of rangeland production on the scale of days to decades, and has been used to model ungulate demography in arid western systems (Stoner et al. 2016, 2018;). To characterize HMAs, we will estimate annual variation in primary

production and plant phenology using the Normalized Difference Vegetation Index (NDVI). In conjunction, we will map ephemeral water to predict animal movement over a variety of water years, and snow depth to delineate winter ranges.

Other independent data that will be used to conduct this assessment include: digital elevation models, and vegetation data (USDA SSURGO soil dataset). All variables of interest with the exception of vegetation data are continuous and sampled across a climatic gradient spanning the western United States. Therefore, to evaluate the relationship between horse body condition and abundance, with respect to underlying environmental conditions, we will first conduct regression analyses to better understand the effect of independent variables on dependent variables. This will include multiple regression models or related non-parametric tests such as Generalized Additive Models (GAM). Sample sizes for each response variable differ, with HMA population estimates numbering ~155 HMAs over 8 years (2013-2021). We currently possess 37 photo datasets from 51 cameras in California, Nevada, Utah, and Wyoming with which to estimate body condition scores. Those in hand represent 10 HMAs and seven sites not within HMAs. Given that this project represents a descriptive pilot study to determine the feasibility of this approach, our objective is not to statistically evaluate a treatment effect, but to describe animal-environment relationships across a gradient in conditions. As such, the sample sizes described here are suitable for that purpose.

Economics: We will use the Pop Equus model to account for horse population dynamics develop an economic cost model to research and evaluate population, management policies, and fertility control effects on population and cost. The Pop Equus model is currently being reprogrammed in R coding. This task will develop an economic cost model to add onto the Pop Equus model using R. We will match the economic cost model to the Pop Equus model population scale. If Pop Equus provides population modeling on the HMA scale we can develop a matched HMA cost budget with BLM help on allocating HMA cost data. Each policy option costs such as adoption and off-range holdings will be accounted and integrated into the model. Ideally, data will be available to model each HMA and collectively sum the HMA's to evaluate the total WHB program costs, however the extent of the Pop Equus model and available data will dictate the modeling scale. In this task, only the direct budget costs will be modeled and projected into the future to match the Pop Equus model time step.

We will evaluate the extent, potential, and economic impact of wild horse tourism in providing a positive economic return to managing WHBs. An economic contribution study will be developed to capture the direct, indirect and induced effects. This objective is similar to evaluating the economic contribution of agrotourism. This modeling methodology requires a defined geographic region at a state level, or the counties where WHB tourism occurs. One of the first steps in this modeling objective is to identify the modeling region and then collect tourism expenditure data. We will have to identify tourism operators willing to provide visitor and operating cost data, as well as identify day visitor use and costs not directly tied to WHB tourism enterprises. The IMPLAN program will be applied to develop the economic contribution model. IMPLAN is recognized as an industry standard for this type of economic modeling.

We will evaluate the net economic impact of placing WHBs in off-range pastures accounting for government expenditures on off-range pastures and displacement of grazing livestock. Increasingly, WHBs gathered from HMAs are moved to privately held off-range pastures. As the population of WHBs increase due to limited fertility control, this policy option is likely to see increased use. This task will evaluate the net economic cost of maintaining off-range pasture allotments, plus the opportunity cost loss from displaced grazing livestock. This will be a budget model developed using Excel.

MEASUREMENT OF PROGRESS AND RESULTS

OUTPUTS

National Survey: Completion of this project will yield a database of survey results exploring national and tribal opinions of free-roaming horse and burro management, publications detailing the results of each survey, additional online resources for public education. Increased understanding of public perception of management strategies, support for management strategies, and willingness to pay for future management programs. Knowledge of public support that can be used by national managers to make difficult decisions. Increased public education of free-roaming horses and burros.

Fertility Management: 1) Data on the efficacy of IUDs for long-term fertility control in free-roaming equids, 2) Scientific and popular press publications, and 3) Presentations at scientific and stake-holder meetings.

Youth/Community Engagement: We will use a pre-post reflective survey evaluation. We will ask baseline information of our students prior to the camp. At the end of the program, we will ask them to reflect on how much they have learned, and measure their knowledge gained. Evaluation data will be used to assess the outcomes and impacts of engagement and experience on youth over the course of the grant. Only short and medium-term outcomes will be measured during this grant period. Primary outcome indicators include; 1) knowledge change related to youth understanding of healthy lands and healthy horses, 2) motivation to learn more about healthy lands and horses, 3) interest in pursuing related projects, and 4) aspirations to pursue future careers related to agriculture, natural resources, and STEM. The evaluation plan will be adjusted based on programming factors to account for additional medium and long-term outcomes as the project progress into future years. Cross-sectional evaluation data will be analyzed using descriptive analysis.

Decision Support Tools: We will publish a model which that relates free-roaming equid variables such as body condition, foaling rates, and/or population growth rates to independent environmental variables such as ecological site, DRG, ecological state, precipitation, elevation, ephemeral water sources, and remote sensing derived values such as NDVI.

Economics: The economic analysis done within this project will evaluate social investment costs in the BLM WHB program to aid policy development towards sustainability. Modeling results will increase understanding of the high economic costs associated with the BLM WHB program and the level of economic risk of projected population rates of growth.

OUTCOMES or PROJECTED IMPACTS

National Survey: Increased understanding of public perception of management strategies, support for management strategies, and willingness to pay for future management programs. Knowledge of public support that can be used by national managers to make difficult decisions. Increased public education of free-roaming horses and burros.

Fertility Management: 1) Proof of concept for using the self-assembling iUPODs for long-term fertility control in free-roaming equids. 2) Improved fertility and population control for free-roaming equids, and 3) Improved health of Western rangelands.

Youth/Community Engagement: Increased public awareness and support for science-based solutions to the management of WHB, as well as increase education opportunities and awareness' of WHBs in youth and adult populations. This will be achieved by the development and distribution of new educational materials which will contribute to increased youth and adult engagement in WHB adoption programs.

Decision Support Tools: Completion of this project will enhance land management by identifying areas of priority management which overlap priority habitat for multiple species. Currently, land managers have few resources available that can assess these priority habitats with respect to free-roaming equid resource concerns and impacts at an ecologically specific scale, and as such we anticipate this information can be readily integrated into decision making processes with respect to native wildlife and livestock. Thus, the impact of this work should be seen immediately. The tools produced can be readily incorporated to identify areas of habitat restoration, cattle-horse conflicts, Bromus invasions, and resource competition between horses and state-managed wildlife, such as mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and the greater sage-grouse.

Economics: Completion of our objectives will contribute to an improved understanding of the projected economic cost of current program policy and the net economic gain that could be achieved under program policies with sustainable population growth rates. We will also identify economic contributions from WHB to local tourism.

MILESTONES

National Survey: 1) Funding acquired to support additional surveys acquired in 2022, 2) Additional national surveys administered by Fall 2022, 3) A survey of tribal members conducted by 2023, 4) Results disseminated beginning in 2023, and 5) All papers submitted and website finalized by 2025.

Fertility Management: 1) Submission of a grant proposal in response to the BLM RFP for Wild Horse and Burro Research Projects to support the range study with BLM horses (January 2022), 2) Submission of a USU Public Lands Initiative grant proposal to cover some of the costs associated with the Nevada study (March 2022), 3) Completion of paperwork required for the Nevada study including the contract with the Nevada Department of Corrections and IACUC approval (May 2022), 4) Gather Nevada Department of Agriculture horses and select the first cohort of 30 mares and 2 stallions for Nevada Study (Summer 2022), 5) Gather BLM horses for range study (Fall 2022), 6) Gather Nevada Department of Agriculture horses and select the second cohort of 30 mares and 2 stallions for Nevada Study (Summer 2023), 7) Complete Nevada Study (Summer 2025), 8) Submit manuscript on the Nevada study (fall 2025), 9) Complete range study – timing will depend on when BLM decides to gather the herd a second time (Fall 2027), and 10) Submit manuscript on the range study (Fall 2027.

Youth/Community Engagement:

Decision Support Tools: 1) Completion of the free-roaming equid Body Condition Scoring of random samples for all sites/years in order to characterize spatiotemporal differences of BCS by 2023, 2) identification of the most relevant independent variables and assess their ability to model dependent equid metrics and develop predictive model completed by 2023, 3) testing the predictive power of the model with data held back for that purpose and refining the model as necessary to be finalized in 2024 and, 4) developing a spatially explicit product that incorporates model predictions by 2025.

Economics: 1) Economic cost model integration with the Pop Equus population model to link economic costs with population dynamics, 2) Identify WHB tourism enterprises to evaluate tourism economic benefits, and 3) Determine carrying capacity numbers of displaced grazing livestock in WHB off-range pastures.

PROJECTED PARTICIPATION:

OUTREACH PLAN

National Survey: We will disseminate our information to the umbrella group. We will also share our results via presentations to the BLM WHB program affiliates and through the FREES network. We will present our findings at professional conferences such as the Society for Range Management and The Wildlife Society annual conferences. We will publish at least 3 articles in professional journals. We will continue to develop a website that explains our results to the general public.

Fertility Management: We will engage the BLM, Forester Service, State Departments of Natural Resources, Tribal Nations, and the FREES Network to inform them about our projects and identify additional herds to work with. We will respond to requests from the media for updates on the IUD studies, present findings from our studies to the FREES network, at scientific meetings, and relevant public forums, and publish the results of our studies in both scientific journals and, when appropriate, in lay journals or magazines.

Youth/Community Engagement:

Decision Support Tools: Subgroup outreach will comprise traditional scientific outlets, media, and extension. This outreach will include scientific publications, conferences, and presentations to federal and state natural resource agencies. Extension products include fact sheets and integration of results with stakeholder workshops. We will participate and present in the FREES network and Summits.

Economics: We will disseminate the economic research findings in meetings with the W 507 group and in-turn to public meetings addressing WHB management and professional conferences, and FREES Summits and network. Research findings will be published in agricultural economics and resource economics journals.

ORGANIZATION and GOVERNANCE

The multi-state grant process and committee will initially be co-chaired by Dr. Terry A. Messmer (USU) and Dr. Tamzen Stringham (UNR). The co-chairs will serve an initial one-year term. In the advent, a co-chair can no longer serve, the remaining chair will serve. The co-chairs will provide administrative support to the sub-groups to include soliciting funds to coordinate annual meetings, reporting, and communications within the group and institution administration. Prior to the first annual meeting, the co-chairs will call for nominations from participants for the positions of Chair and Vice-Chair. The elected Chair and Vice Chair will serve two-year term.

The co-chairs will be advised by an Executive Committee (EC) to constitute of subgroup committee chairs. The EC members are Dr. Nicki Frey (National Survey), Dr. Chris Davies (Fertility Management), Dr. Eric Thacker (Decision Support Tool), Ms. Jessie Hatfield (Youth Community Engagement), and Dr. Shannon Neibergs (Economics). The EC will coordinate administration of the subgroups, to include scheduling meetings, extramural funding, preparing and submitting reports to the Chair. The subgroup committee chairs will be appointed by acclamation.

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Land Grant Participating States/Institutions: The following land-grant states and institutions participating include; 1) Utah State University, 2) University of Wyoming, 3) University of Nevada – Reno, 4) University of California-Davis, 5) Washington State University, Colorado State University, and University of Massachusetts.

Non-Land Grant Participating States/Institutions Participation: The following non-land grant states and

institutions participating include; 1) University of Massachusetts, 2) U.S. Geological Services, 3) U.S. Forest Service, 4) Utah Public Lands Policy Coordination Office, 5) Utah Department of Natural Resources, 6) Brigham Young University, 7) Nevada Department of Agriculture, 8) Navajo Nation, and 9) Bureau of Land Management.