Western Watersheds Project

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Via the Federal eRulemaking Portal: http://www.regulations.gov.

Re: Proposed rules to list the Bi-State distinct population segment (DPS) of greater sage-grouse (*Centrocercus urophasianus*) as endangered under the Endangered Species Act and to designate critical habitat for that DPS

Dear Supervisor Swed:

Please accept these comments on the proposed rules by Western Watersheds Project and American Bird Conservancy regarding the listing determination of the Bi-State Distinct Population Segment of greater sage-grouse. We incorporate by reference the comments of WildEarth Guardians of December 27, 2013 and September 4, 2014. Per USFWS direction in its federal register notice, we will not attach scientific studies or reports attached to these previous comments, as these will already be part of the administrative record for this rulemaking proceeding.

The U.S. Fish and Wildlife Service (USFWS) is reopening the comment period on our October 28, 2013, proposed rules to list the Bi-State distinct population segment (DPS) of greater sage-grouse (*Centrocercus urophasianus*) as threatened under the Endangered Species Act and to designate critical habitat for that DPS.

On April 23, 2015, the Service published in the Federal Register (80 FR 22828) a withdrawal of the proposed rules to list the Bi-State DPS as a threatened species with a section 4(d) rule and to designate critical habitat for the DPS, a decision that was subsequently overturned by the courts. This decision was based on their conclusion that the threats to the DPS as identified in the proposed listing rule were no longer as significant as believed at the time of publication of the proposed listing rule, and that

conservation plans were ameliorating threats to the DPS. Thus, the Service concluded that the Bi-State DPS did not meet the definition of an endangered or a threatened species throughout all or a significant portion of its range.

The "not warranted" decision was also based on a suite of conservation measures and adaptive management strategies listed in the Bi-State Action Plan (2012). This plan, which represented a collaborative effort between State and Federal resource agencies and private stakeholders, identified threats to the persistence of the Bi-State DPS for the multiple Population Management Units (PMU) that comprise the DPS. The plan then outlined potential management actions designed to ameliorate those threats.

We disagree with these conclusions, as we observed threats to the habitat and to sage-grouse populations increasing since the 2015 withdrawal decision. In 2018, populations were continuing to decline and two populations were crashing despite conservation efforts by stakeholders. New and increasing threats include extreme drought, climate change, subsidized raven predator populations, livestock grazing impacts to important cover vegetation, cheatgrass invasions, changes in wet meadow management, and new threats such as proposed new utility corridors that could hold transmission infrastructure through Bi-State sage-grouse range.

The current conservation measures are not effective, as the vast majority of sage-grouse populations are continuing to decline, and two or more are crashing to the point that translocation of hens and broods are being used as an emergency triage to try to stop these populations from blinking out completely. The Parker Meadow population (South Mono PMU) is being augmented currently, agencies have recommended that the the Pine Nut Mountains (Pine Nut PMU) and Fales (Desert Creek-Fales PMU) populations may be in need of augmentation as well[1].

Based on our observations and the best available data, we recommend that the Service list the Bi-State DPS of greater sage-grouse in California and Nevada as an endangered species under the Act (16 U.S.C. 1531 *et seq.),* as well as designate critical habitat for the Bi-State DPS of greater sage-grouse. Recent genetic research (Row et al. 2018, Figure 4) confirms that this DPS is indeed genetically isolated from other greater sage-grouse populations. Oyler-McCance et al. (2015) has confirmed the genetic disctinctness of this DPS. Garton et al. (2015) performed a population viability analysis including the Bi-State DPS (Mono Lake and South Mono Lake populations in this study) and found both these subpopulations to have approximately an 8% chance of falling below a minimum viable population of 50 effective breeders within 30 years, and a 21% chance of falling below 50 effective breeders with 100 years.

We support the designation of more than 1.8 million acres of Critical Habitat as proposed in 2013, encompassing all occupied habitat plus unoccupied habitat needed for population expansion, adaptation to changing climate and vegetation patterns, and restoration of connectivity between subpopulations that have become isolated. It is important to note that sage-grouse have great site fidelity not only to leks but also to nest sites, including over multiple generations of hens (*see* Heinrichs et al. 2017). Protecting large core areas for sage-grouse conservation is critical; Spence et al. (2017) found that the probability of lek population collapse was twice as great outside protected core areas than within them (*and see* Gamo and Beck 2017). The fact that Bi-State subpopulations are largely isolated from each other, without

[1] Bi-State sage-grouse Local Area Working Group and Technical Advisory Committee meetings, July 18, 2018, Bridgeport, California and November 7, 2018, Bridgeport, California.

important connectivity (Crist et al. 2017), further underscores the necessity of an 'endangered species' finding. We encourage the Fish and Wildlife Service to consider expanding Critical Habitat in areas where it is comprised of long, narrow stringers of habitat, in recognition of the fact that disturbance due to industrial activities located 1.9 miles or more from the habitat in question – even if they occur in habitats unsuitable for sage-grouse – have the potential to displace sage-grouse from otherwise suitable habitat, rendering it unusable to the bird.

Information Requested

The Service is particularly interested in comments concerning (84 FR 14910):

(1) The Bi-State DPS's biology, distribution, population size and trend, including:
- (a) Habitat requirements for feeding, breeding, and sheltering;
- (b) Genetics and taxonomy;
- (c) Historical and current range, including distribution patterns; and
- (d) Historical and current population levels, and current and projected trends.

(2) The factors that are the basis for making a listing determination for a species under section 4(a) of the Act (16 U.S.C. 1533(a)(1)), which are:
- (a) The present or threatened destruction, modification, or curtailment of its habitat or range;
- (b) Overutilization for commercial, recreational, scientific, or educational purposes;
- (c) Disease or predation;
- (d) The inadequacy of existing regulatory mechanisms; or
- (e) Other natural or manmade factors affecting its continued existence.

(3) Biological, commercial trade, or other relevant data concerning any threats (or lack thereof) to this Bi-State DPS and existing regulations that may be addressing those threats.

(4) Information on current habitat conditions, including, but not limited to, quality of upland and meadow or riparian sites, presence and abundance of annual invasive grasses and weeds or other increasing plants (e.g., conifer trees), and recovery of previously burned sites. This information may include larger landscape-scale assessments or smaller site-specific investigations.

(5) Application of the Bi-State Action Plan of March 15, 2012, to our determination of status under section 4(a)(1) of the Act, particularly comments or information to help us assess the certainty that the plan will be effective in conserving the Bi-State DPS of greater sage-grouse and will be implemented.

(6) Information concerning whether it would be appropriate to include in the 4(d) rule a provision for take of the Bi-State DPS of greater sage-grouse in accordance with applicable State law for educational or scientific purposes, the enhancement of propagation or survival of the DPS, zoological exhibition, and other conservation purposes consistent with the Act.

(7) Whether the Service should include in the scope of the proposed 4(d) rule the incidental take of sage-grouse within the Bi-State DPS if the take results from other agricultural activities not

subject to the Sage Grouse Initiative or the Bi-state Action Plan, if those activities are compatible with the conservation of the Bi-State DPS.

(8) Past and ongoing conservation measures for the Bi-State DPS, its habitat, or both.

(9) Any new or updated information relative to our 2013 proposed designation of critical habitat for the Bi-State DPS.

To answer several of these questions, we present our field observations, photographs, research, and discussions with local experts from 2018, below. We have significant new information on plant community and sage-grouse habitat conditions from numerous 2018 field visits.

Population Levels and Trends

Based on 2018 and 2019 meetings which we attended, and viewing presentations from agencies and researchers at meetings (https://www.bistatesagegrouse.com/lawg) most populations in the Bi-State area continue to decline, and some are crashing. Only one PMU appears to be stable (Bodie).

Mark Ricca of the US Geological Survey (USGS) explained that Bi-State sage-grouse declines correlate closely with precipitation — droughts have led to population crashes, and then slow recovery in some areas but not others. Also, heavy snow years (such as the hard winter of 2017) can impact grouse. Raven predation associated with human-caused subsidies (e.g, open dumps) has been a contributing problem, especially in areas where livestock grazing has removed the grass cover essential for sage-grouse concealment from their natural predators. According to agency presentations at 2018 Local Area Working Group (LAWG) meetings, nest success range-wide was 44%, with a low at Long Valley (39%) and high at Bodie (56%). Brood success at Long Valley was 25% and at Bodie 33%.

Overall, all the Nevada lek counts in 2018 were down from 2017. Bodie Hills may be buffered somewhat from drought by high-elevation and north-facing mesic habitats ideal for brood-rearing.

The Long Valley population has declined 40% since 2012 according to Tim Taylor of California Department of Fish and Wildlife (CDFW, at 2018 LAWG meetings). Sage-grouse there have been impacted heavily by raven predation, ravens subsidized by the trash dump. The delay in addressing the raven predation problem could be causing irreversible declines in some subpopulations. The relatively more arid, lower-elevation area was not as well buffered from the extreme California drought of 2014-2016.

CDFW 2018 saturation lek counts (3-5 counts on core populations, including helicopter surveys), showed a decline of 37% from 2017 in the Fales subpopulation (Fales/Desert Creek Population Management Unit); a 4.4% decline in the Long Valley sub-population and 33.3% decline in the Granite Mountain subpopulation (both in the South Mono PMU), with Parker Meadows augmented to try to stave off extirpation (also in the South Mono PMU); and only the Bodie PMU experiencing an increase of 17.7%

since 2017.

The Parker Meadow sub-population crashed in the last two years, with low hatchability (eggs laid but not hatching). Parker Meadows has been augmented with translocated hens, which had a 9% success rate, so a decision was made to switch to translocating hens with their broods and a "soft" release with box door opened with a string from a blind. This had had better success: 75% survival after 35 days. One telemetered hen flew back to its former Bodie leks. Another hen flew to Tuolumne Meadows in Yosemite National Park and died.

USGS integrated population models (combining nest survival, brood survival, hen survival, and lek counts) in 2018 showed that sage-grouse populations track rainfall and droughts. If a population decouples from the measured rainfall pattern, something is wrong indicating that factors other than weather patterns are having a major effect on grouse population dynamics. Parker Meadows population decoupled in the last few years, and translocations are being done to stave off extirpation. Currently the Pine Nut Range population is decoupling. Leks in the Pine Nut PMU, Parker Meadows, Long Valley, and Sagehen populations are decoupling. Mark Rica of USGS said "soft triggers" for decoupling are happening in many leks in the Mt. Grant, Aurora, Virginia Complex, and Long Valley populations in 2017.

This alarming rate of populations recently decoupling from rainfall-drought patterns presses for greater protection of the Bi-State DPS under the Endangered Species Act. And not all populations are monitored each year.

The following graphs from Mathews et al. (2018 at 44 and 47) of male sage-grouse at leks—a raw count and estimated population, across the range of the Bi-State DPS, show declines at an increasing rate, despite recent rainy and snowy years. Bodie Hills is doing better, perhaps because of higher elevations and moist grasslands and sagebrush-steppe habitats buffered from drought more than the other lower-elevation populations.

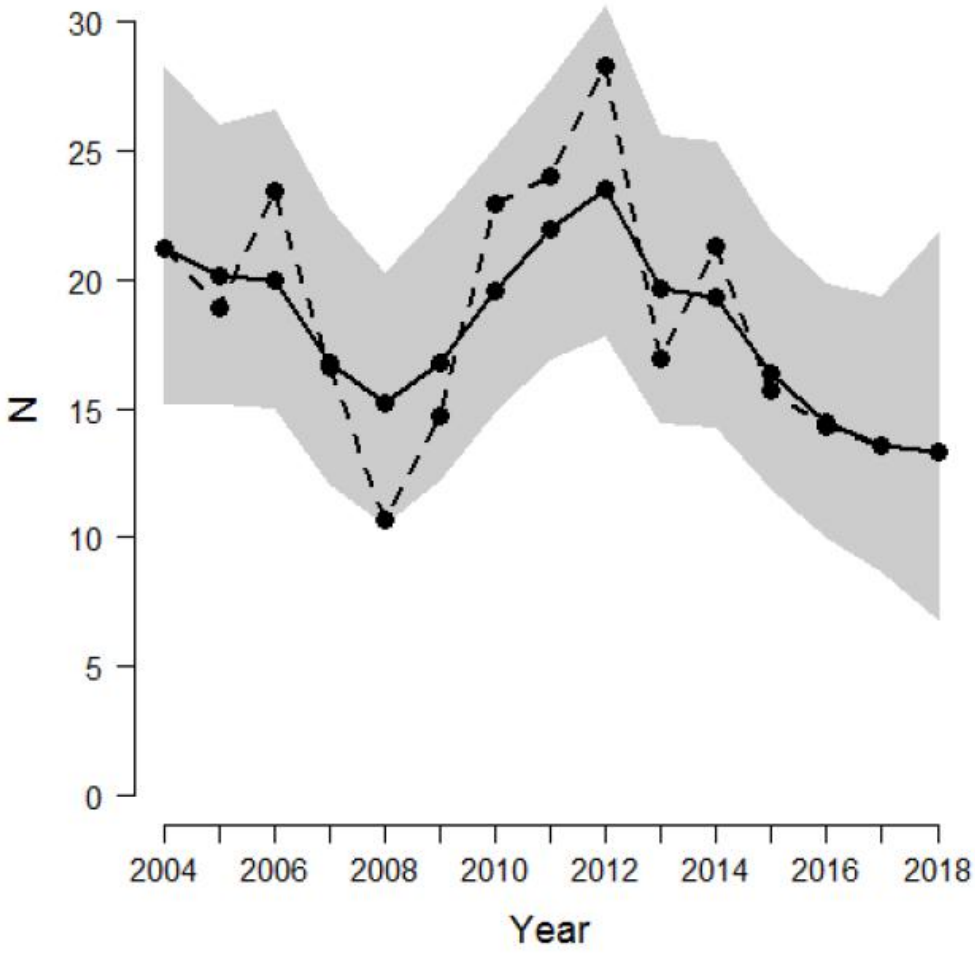

Figure 17. Graph showing annual counts (dashed line) of male greater sage-grouse (*Centrocercus urophasianus*) attending leks and estimates (solid line) across all Bi-State Distinct Population Segment study sites in California and Nevada, 2003–17. Gray shading represents the 95 percent credible interval. Estimated and observed values represent the average predicted and observed counts per lek within the Bi-State DPS on an annual basis.

At the June 5, 2019 Local Area Working Group meeting in Walker, California, Mike Ricca of USGS reported that the Mt. Grant PMU is undergoing "soft triggers" indicating decoupling from the rainfall-drought population trend pattern, and is in decline because of other factors than drought. Other lek complexes appear to be undergoing both hard and soft triggers, indicating decoupling, and USFWS should detail these. Drought is a normal cause of sage-grouse declines, but when populations decouple from Integrative Population Model trends, that means other threats are causing declines. We discuss these threats below.

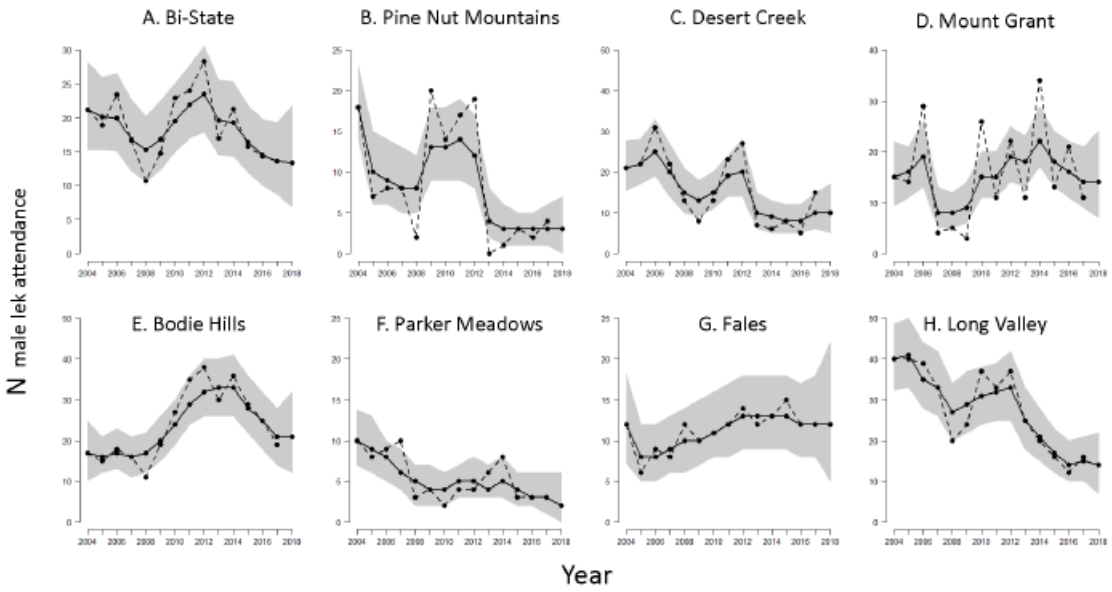

Figure 19. Graphs showing estimated number of male sage-grouse (*Centrocercus urophasianus*) per lek (solid line) and lek observations (dashed line) of the Bi-State Distinct Population Segment study area overall (A) and at subpopulations (B–H), California and Nevada, 2003–17. Gray shading represents the 95 percent credible intervals.

Thus, the picture of Bi-State sage-grouse population stability range-wide looks bleak. We did not hear of increasing populations anywhere from agencies and 2018 scientific reports. We question whether current and planned conservation actions are actually effective in stabilizing and increasing sage-grouse populations in the Bi-State region.

Present or Threatened Destruction, Modification, or Curtailment of Sage-grouse Habitat or Range

There are a number of factors that have been correctly identified by USFWS in their 2013 Proposed Rule that have resulted in sage-grouse population losses, habitat destruction, and/or range contractions over the past. There are also additional factors that threaten this DPS. These are addressed below.

Livestock Grazing

The Bi-State DPS needs to be protected under the Endangered Species Act because of excessive cattle grazing across its range, which is degrading nesting habitat, brood-rearing habitat, and reducing cover in general from predation in our field observations. Pinyon-juniper expansion is being used as the scapegoat for declines in sage-grouse populations. Meanwhile sage-grouse populations are continuing to decline, and in more cases are crashing. This is unacceptable.

Because of the ongoing threats of drought and potential climate change impacts, the habitats of sage-grouse must be maximized as to quality, extent, and health. A

recent analysis by Adler et al. (2018) indicates that sagebrush habitat capability in parts of the Bi-State DPS area is likely to decrease due to climate change, further stressing sage-grouse populations. The USFWS must fully consider and assess the threat posed by climate change to sage-grouse population and habitat persistence.

The degradation of native grasslands, sagebrush habitats, meadows, and riparian areas by livestock grazing is a major unexamined factor that could be a stressor and contribute of declines in sage-grouse populations. Specifically, livestock grazing appears to us to be reducing cover needed by sage-grouse to avoid predation, and may be lowering habitat quality in many places for food sources as well. High-quality sagebrush and wet meadow habitats for food sources might be declining. This needs more study.

The presence of cattle also subsidizes raven abundance (Coates et al. 2016a). Ravens are a significant nest predator to sage-grouse. In the Bodie Hills, most sage-grouse are predated by ravens. However, based on the published literature, ravens are primarily nest predators and not significant predators on adult grouse; while raptors and mammalian mesopredators are the main predators on adults (Conover and Roberts 2017). Most studies show that predator control is ineffective at improving sage-grouse population success (*see* Mezquida et al. 2006, Dinkins et al. 2016, Orning and Young 2017, Conover and Roberts 2017); and while raven control programs have been shown to increase nest success rates for individual hens, they do not necessarily have any effect on sage grouse population abundance (Conover and Roberts 2017).

The Service should give much more consideration as to how predators such as coyotes and ravens are impacting sage-grouse, and how livestock grazing reduces cover for hens and broods. We see few conservation actions that address range management on allotments impacting sage-grouse, such as barbed-wire fences (many in disrepair) that can cause collision hazards, water facilities that can attract ravens, and mowing of sagebrush to increase meadow forage for livestock. Plant communities are being degraded by stocking rates and season-long livestock grazing.

Predator populations may also be artificially high due to urbanization pressures (such as un-managed trash facilities), range management, and also extreme recreational activities such as high-speed motorcycle races as in the Pine Nut Range, NV.

Coates et al. 2016 states “While accounting for landscape characteristics, we found that the odds of raven occurrence increased 45.8% in areas where livestock were present. In addition, ravens selected areas near sage-grouse leks, with the odds of occurrence decreasing 8.9% for every 1-km distance increase away from the lek.”

The Service should analyze the US Geological Survey (USGS) field survey randomized plots of plant cover, plant class, and other vegetative measures that were being conducted in the Bodie Hills in the summer of 2018. Mirrors were used to measure obstacle blocking at ground-level, 45 degrees, and from above. These measures show how vegetative cover could hide a sage- grouse from coyotes and ravens. These kinds of cover surveys should also be conducted in livestock-grazed plant communities.

The Bodie Hills, having a higher-elevation and more mesic local climate, may have better cover of native grasses, forbs, and sagebrush species compared to lower and drier

regions, such as at Long Valley. Therefore, the Bodie Hills may be in better condition despite livestock grazing. But we would like the Service to consider how cover is being impacted in other regions within the Bi-State area, with grazing pressures.

We believe that sage-grouse populations in the Bodie PMU appear to be stable despite livestock grazing there—many allotments are failing rangeland health standards in the riparian areas. Bodie has high mesic sagebrush steppe with 10,000-foot elevation peaks, so is more buffered from droughts. Meanwhile, Long Valley is lower (6,400 ft) and more arid, and full of livestock which may be compounding drought problems.

At the June 5, 2019 Bi-State Sage-Grouse Local Area Working Group meeting in Walker, California, only wild horse grazing was mentioned as a threat to sage-grouse, and actions taken to survey wild horse herds in the Mt. Grant and Pine Nut PMUs, with a goal of maintaining Appropriate Management Levels and undertake gathers. Yet domestic sheep and cattle outnumber wild horses in the Bi-State area by a large amount, and there is no discussion of allotment use, stocking rates, season of use, and utilization of vegetation by livestock in sage-grouse habitats.

Subdivision and Exurban Development

Per Aldridge et al. (2008), human population density is the single greatest predictor of sage-grouse extirpation, and counties with population densities exceeding 4 persons/km^2 have an elevated likelihood of sage-grouse population extirpation. As of 2013, USFWS reported that Esmeralda and Mineral Counties (NV) and Mineral County (CA) possessed at the time human population densities below 4 persons/km^2 (although the Pine Nut and White Mountains PMUs, found in these counties, were and are declining in sage-grouse population). The population densities of Mono County (CA) and Douglas, Carson City, and Lyon Counties (NV) already exceeded 4 persons/km^2 in 2013, and almost assuredly still do today. USFWS must analyze human population density on a county-by-county basis to determine how it compares to the 4 persons/km^2 threshold established by Aldridge et al.

As of 2013, some 329,000 acres of private land in the Bi-State DPS area were enrolled in conservation easements that would prevent rural development and therefore represent an adequate regulatory mechanism to ameliorate that particular threat to sage-grouse and their habitats. Yet many of these conservation easements and private land purchases are ranches and ranchlands that may continue some of the same problems that we observe in the above section on livestock grazing.

USFSWS should present up-to-date acreage and percentage figures for private lands covered (and not covered) by conservation easements that prevent subdivision and construction of new buildings. Detailed projects on private-public lands that are funded by the National Resources Conservation Service should be listed and described, including vegetation treatments, stock water facilities, and fencing projects.

Roads and Off-Road Vehicle Use

To supplement the information already submitted to USFWS regarding the impacts of roads and off-road vehicles, we would like to point out that off-road vehicle (ORV) noise is substantially greater than levels tolerated by sage-grouse. Blickley et al. (2012b) found that noise levels mimicking truck traffic was sufficient to elevate stress-related metabolites in sage-grouse. According to BLM analysis, off-road vehicles are noisy, and typically exceed the background noise levels by more than 10 dBA. Northwest

Colorado Greater Sage-grouse RMP Amendment Draft EIS at 399. Off-road vehicle use also results in habitat degradation and destruction, disturbance of sage grouse, and proliferation of invasive weeds (NTT 2011; *see also* Manier et al. 2011). The fact that off-road vehicle use continues to be a significant issue for sage-grouse is highlighted by the fact that Sierra Trail Dogs and other ORV interests are currently suing for the ability to stage off-road vehicle rally through Bi-State sage-grouse habitats, during the breeding and nesting season.

In 2019 several off-road motorcycle clubs filed suit against Humboldt-Toiyabe National Forest over required lek buffers and seasonal closures in Bi-State sage-grouse habitat in the Pine Nut Range, Nevada. The groups are seeking to hold a 250-mile dirtbike rally through some of the best remaining sage-grouse habitat. They filed their lawsuit in December 2018 seeking to overturn protective measures that were added to the Humboldt-Toyaibe National Forest plan amendments in 2016.[2]

Noise

Advances in science make it increasingly clear that noise from roads or industrial facilities is having a major negative effect on sage-grouse and their ability to make use of otherwise suitable habitats. Noise can mask the breeding vocalizations of sage-grouse (Blickley and Patricelli 2012), displaces grouse from leks (Blickley et al. 2012a), and causes stress to the birds that remain (Blickley et al. 2012b). According to Blickley et al. (2010), "The cumulative impacts of noise on individuals can manifest at the population level in various ways that can potentially range from population declines up to regional extinction. If species already threatened or endangered due to habitat loss avoid noisy areas and abandon otherwise suitable habitat because of a particular sensitivity to noise, their status becomes even more critical." Noise must be limited to a maximum of 10 A-weighted decibels (dBA) above the ambient natural noise level after the recommendations of Patricelli et al. (2012); the ambient noise level in central Wyoming was found to be 22 dBA (Patricelli et al. 2012) and in western Wyoming it was found to be 15 dBA (Ambrose and Florian 2014, 2015; Ambrose et al. 2015). Piquette et al. (2014) examined the ambient noise level at Gunnison sage grouse leks and found an average noise level of 17.2 dBA.

The 2013 Proposed Rule did not include a comprehensive analysis on the threats posed by noise to Bi-State sage-grouse populations. Such threats may originate from exurban development, mines, geothermal plants, off-road vehicle use, and other types of industrial development. The USFWS must fully consider and explore the potential threats posed by noise to the Bi-State sage-grouse populations, and render determinations regarding the extent to which adequate regulatory mechanisms currently exist to prevent noise at decibel levels greater than 25 dBA that would impact breeding and/or nesting sage-grouse. At present, we are aware of no such regulatory mechanisms.

Sagebrush Burning and Removal

Earlier comments already outline much of the best available science demonstrating conclusively that sagebrush removal and burning is harmful to sage-grouse. The creation of "greenstrips" is actively called for under the Bi-State Action Plan (Bi-State TAC 2012); greenstrips constitute the elimination and degradation of sage grouse habitats. A new analysis by Shinneman et al. (2018) shows that there is little evidence that "greenstrips" have any positive effect whatsoever in reducing the severity, spread, or

[2] https://mcindependentnews.com/2019/03/environmentalists-oppose-off-roaders-lawsuit-over-bird-plan/

extent of fires in sage-grouse habitats, to offset their obvious and demonstrated habitat impacts. As of 2013, there were a large number of mining claims in Nevada alone that total hundreds of thousands of acres in counties containing Bi-State sage-grouse habitats (*see* Attachment 1). While small-scale sagebrush removal projects in northeast Utah were initially credited with sage-grouse population surges, these population gains were followed by crashes that reduced populations in treated habitats to levels similar to those in surrounding untreated habitats (Dahlgren et al. 2015). Smith and Beck (2017) reviewed multiple sagebrush treatments and found near-universal neutral or negative consequences for sage-grouse.

Current management strategies outlined at the June 5, 2019 Bi-State Sage-Grouse Local Area Working Group meeting in Walker, California, call for conifer removal, targeted fire suppression, and post-fire rehabilitation to combat weed invasions. This includes seeding with seed mixes. Yet there is no report at how effective conifer removal, seed planting, and fire suppression activities are for increasing sage-grouse habitat quality and numbers of birds. Evidence suggests wildfires continue to burn and spread because of a lack of funding and wildland restoration, however.[3]

Infrastructure and Disturbance

At the June 5, 2019 Bi-State Sage-Grouse Local Area Working Group meeting in Walker, California, agencies summarized how 13 miles of barbed wire fencing was removed and 63 miles of fencing was marked to try to lower sage-grouse collisions.

The Mono County Landfill and trash dump in Long Valley is an ongoing and unmitigated attractant to ravens, and will not be relocated until 2023. This is an ongoing threat.

New threats of development are recently coming in the form of pumped hydro storage projects, such as the 2019 Owens Valley Pumped Storage Project #1 proposal for a series of artificial reservoirs, water pipelines, and pumping facilities (along with associated transmission lines) from the Owens River to the White Mountains in California and Nevada. A permit application dated May 27, 2019 was filed with the Federal Energy Regulatory Commission (see attached letter OVPS Project 2019). This project would build industrial pumping, water transport, and water holding facilities in the White Mountains PMU and within proposed critical habitat. The purpose of the project is to store excess energy from utility-scale solar and wind projects in California, and therefore we foresee a push to construct more of these energy storage projects in order to help balance the grid when renewable energy is further built to fulfill increased renewable energy portfolio standards in California and Nevada.

Wind Farms and Transmission Lines

Wind project developments and transmission lines also pose a threat to sage-grouse in the Bi-State area. In addition to the scientific literature already presented to USFWS during earlier comments on the 2013 Proposed Rule, there are new studies reinforcing the significance of the threats posed by wind farm development in sage-grouse habitat. LeBeau et al. (2014) found that risk of nest failure and brood failure

[3] https://thenevadaindependent.com/article/with-more-extreme-wildfire-state-and-federal-agencies-look-to-improve-suppression-prevention-funding

decreased by 7.1% and 38.1%, respectively, with each 1 km distance away from wind turbines.

A wind project was proposed in the last several years on public lands Glass Mountain just south of Mono Lake, and the application was later withdrawn.[4] The Bi-State area has not been zoned as wind-free in any planning document by federal agencies.

New science regarding transmission line impacts to sage-grouse includes an important new study by Gibson et al. (2018), who found causal relationships between a large-scale transmission line and habitat selection (sage-grouse displacement) and demographic rates (decreased nest survival recruitment, and population growth), factors correlated with increased raven abundance near the powerline. This study found that the negative effects of powerlines extended to a distance of 2.5 to 12.5 km on either side of the powerline. These researchers recommended reducing tall structure within 10 km of important sage-grouse habitats.

Six miles of transmission lines were removed in the Bodie Hills, yet there has been recent pushback by utilities about undergrounding any new transmission lines through the area in the future (Southern California Edison, pers. communication May 2019 to L. Cunningham).

The West-Wide Energy Corridor[5] push is a new threat of future utility corridors and associated new transmission lines through the Bi-State area. The Bureau of Land Management (BLM), the U.S. Forest Service (USFS), and the U.S. Department of Energy (DOE) have released revised Regions 4, 5, and 6 corridor abstracts, available on the Regions 4, 5, and 6 Regional Review page of the West-wide Energy Corridor website. Energy Corridor 18-23 is being proposed that would pass through Bi-State sage-grouse habitat in the Mount Grant PMU on the east side of the Bodie Hills.

Mining

Mining continues to be a substantial threat to the Bi-State sage-grouse population, not only because active open-pit and mountaintop removal hard-rock mines are currently operating in this area, directly affecting habitat, but also because the levels of noise and truck traffic associated with large-scale hard-rock mining have impact s that radiate outward from mines and roadways for distances of two miles or more, stressing sage grouse and causing abandonment of otherwise undeveloped habitats adjacent to mines and access roads. USFWS has already been presented with the best available science regarding mining and mine impacts. USFWS will need to compile and present current mining claim data and assess its overlap with proposed Critical Habitats in order to properly assess the threat of future mining to Bi-State sage-grouse.

Fluid Minerals Development and Geothermal Energy

Increasing oil industry interest in leasing public lands in Nevada for fluid minerals development is indicative of an emerging threat of oil and gas development in the Bi-State area, a region that previously has seen little development pressure. Recent science (Holloran et al. 2015) shows that sage-grouse

[4] https://www.mammothtimes.com/content/proposed-wind-farm-project-comment-period-extended-field-trips-planned
[5] http://corridoreis.anl.gov

winter habitat use declines in proximity to oil and gas development, even when liquid gathering systems are employed to reduce vehicle traffic. Accordingly, USFWS must carefully consider the best available science on impacts to sage-grouse wintering habitats (*see* Attachment 2 for a literature review), and map Bi-State wintering habitat to assess threats to it. This is of critical importance because wintering habitats may be found outside habitats designated on the basis of breeding and nesting habitats (Smith et al. 2016, Heinrichs et al. 2017). Smith et al. (2014) also found negative impacts of energy infrastructure on wintering grouse, and stated, "displacement from these limited, high-quality winter habitats could have profound consequences to population persistence." Manier et al. (2014) published a review of available studies, finding that the "interpreted range" for appropriate lek buffers regarding roads and industrial facilities of many types is 3.1 to 5 miles.

Kirol et al. (2015) underscored earlier science by showing that 4% surface disturbance results in significant negative impacts on sage grouse, in multiple life history phases. Because geothermal developments are similar to oil and gas in their impacts to sage-grouse during both the drilling and energy production phases (while having superior climate change attributes), the science regarding oil and gas development also represents the best available science for geothermal energy development, a different type of fluid mineral development. In addition, geothermal development is ongoing in Nevada sage-grouse habitats, and due to the noise that emanates from these facilities, which exceeds noise tolerances for sage-grouse (see ***Noise*** section of these comments), the potential for additional future impacts from additional geothermal energy leasing and development must be considered in detail. According to Nevada Division of Wildlife analysis, geothermal development appears to be a causal factor in the decline of sage-grouse populations (*see* Attachment 3). The agency must present the extent to which current developments and proposals, as well as current geothermal leases, pose a threat to Bi-State sage-grouse and potential habitats identified as proposed Critical Habitat under the 2013 Proposed Rule.

Invasive and Noxious Species

Cheatgrass and other introduced plants threaten the quality of sage-grouse habitats and increase flashy fire fuels. More detailed field observations are described below in this comment letter.

At the June 5, 2019 Bi-State Sage-Grouse Local Area Working Group meeting in Walker, California, management strategies to combat this threat were listed as "protecting native perennial grasses and shrubs," and seeding native plants. Yet the stocking rate of cattle and domestic sheep on allotments was not discussed in order to reduce grazing pressure on these native perennial grasses and shrubs. Our photographs below of range conditions in the Bi-State area show that many areas are in a degraded condition because of cattle and sheep impacts, and management strategies are not addressing this threat.

Loss of Sagebrush and Meadows

Agency meetings in 2019 list the need to restore hydrology, write irrigation and watering plans, plant sagebrush, and "improve meadows." 1,500 acres of these management actions have been accomplished, according to agencies at the at the June 5, 2019 Bi-State Sage-Grouse Local Area Working Group meeting in Walker, California.

Yet in other areas we witnessed meadows that had sagebrush mowed to reduce it and increase forage for

cattle.

Other meadows have been dewatered, such as in Long Valley on lands owned and managed by Los Angeles Department of Water and Power (LADWP). Ranches in Long Valley with grazing lease-permits on LADWP land formerly received 22,000 acre-feet per year (afy) allowed to irrigate meadows in diversions off of creeks flowing from the Sierra Nevada. USGS recommended at least 2,000 afy into diversion ditches off Convict Creek in order to keep meadows moist for sage-grouse summer use, from a previous 5,000 afy. In 2018 after LADWP reductions in water use, only 500 afy was allowed for irrigating meadows, and reports came in of drying meadows and weed invasions; another 2,000 af was put in the diversion ditches but this was not enough to keep the meadow moist (Lynn Boulton, pers. communication June 2019).

LADWP never signed a Habitat Conservation Plan, even though one was drafted in 2015, and the utility has not been a part of the Local Area Working Group. This has caused great uncertainty about meadow management in lands under their control.

Meadows by the Cain Ranch have not been restored since irrigation was stopped 20 years ago, and this may be impacting the Parker Meadows population of sage-grouse. The area has become dry and weed-infested.

Figure 1. Sage-grouse hen with three chicks well concealed in the Bodie Hills near Potato Peak, summer 2018. Good cover of native bunchgrasses such as prairie junegrass (*Koeleria macrantha*).

Figure 2. Sage-grouse hen in diverse native bunchgrass and sagebrush area in the Bodie Hills, near Potato Peak. Indian ricegrass, prairie junegrass, and forbs.

Disease and Predation

Ravens are a significant contributing factor to sage-grouse population issues in this area, taking large numbers of chicks. Vegetative cover is essential for hens with broods to survive attacks, while hiding in dense and tall grasses and sedges/rushes, as well as sagebrush cover. As a result of excessive livestock grazing reducing or eliminating vegetation in the interstices between sagebrush, sage-grouse are unnaturally exposed to their natural predators.

Predation on sage grouse nests by ravens and other "subsidized" predators is of particular concern. Ravens predate on sage-grouse eggs and may take chicks. Nesting and brood rearing are performed entirely by the hens. Nesting may occur mid-April through mid-June, and occasionally into July if a hen loses her first clutch and re-nests. Incubation takes 25-27 days with peak hatching occurring mid-May through mid-June. The hen sits on her nest for most of the day but may leave for brief periods at dusk and dawn. Nest predators such as ravens may key on these movements by the hens to locate and predate on eggs in the nest (Coates and Delehanty 2008).

Livestock presence may subsidize the local raven population (Horney 2008). Ravens are visual foragers and use fence posts as perch sites to increase their visual fields. Livestock presence may be beneficial to ravens in other ways too, providing carcasses and disturbances that facilitate raven presence and foraging.

Dispersing livestock waters through sage grouse habitat subsidizes ravens and other predators. There is evidence that ravens show a preference for stock tanks rather than natural springs as a water source (Knight et al. 1998).

Ravens are visual foragers and poor screening might make nests especially vulnerable to them (Horney 2008). The best available science has established that at least 7 inches (18 cm) of residual stubble height needs to be provided in nesting and brood-rearing habitats throughout their season of use to provide adequate hiding cover. According to Gregg et al. (1994: 165), "Land management practices that decrease tall grass and medium height shrub cover at potential nest sites may be detrimental to sage grouse populations because of increased nest predation… Grazing of tall grasses to <18 cm would decrease their value for nest concealment… Management activities should allow for maintenance of tall, residual grasses or, where necessary, restoration of grass cover within these stands." Hagen et al. (2007) analyzed all scientific datasets up to that time and concluded that the 7-inch threshold was the threshold below which significant impacts to sage-grouse occurred (*see also* Herman-Brunson et al. 2009). Prather (2010) found for Gunnison sage-grouse that occupied habitats averaged more than 7 inches of grass stubble height in Utah, while unoccupied habitats averaged less than the 7-inch threshold. According to Taylor et al. (2010: 4),

The effects of grazing management on sage-grouse have been little studied, but correlation between grass height and nest success suggest that grazing may be one of the few tools available to managers to enhance sage-grouse populations. Our analyses predict that already healthy populations may benefit from moderate changes in grazing practices. For instance, a 2 in increase in grass height could result in a 10% increase in nest success, which translates to an 8% increase in population growth rate.

Heath et al (1997) found that near Farson, Wyoming, nests with taller grass heights were more

successful than those with shorter heights. Holloran et al. (2005) found that residual grass height and residual grass cover were the most important factors correlated with sage-grouse nest success in their central and southwestern Wyoming study area, with habitats with the tallest and densest grasses showing the greatest nest success. Doherty et al. (2014) found a similar relationship between grass height and nest success in northeast Wyoming and south-central Montana but did not prescribe a recommended grass height. While there are those who have attempted to cast doubt on the necessity of maintaining grass heights to provide sage-grouse hiding cover, based on timing differences in grass height measurements between failed nests and successful nests, these concerns have been scientifically refuted for Wyoming. Studies pointing to potential bias in date of grass measurement between successful and failed nests have largely failed to invalidate the scientifically significant results of published studies finding significant differences in nest success with greater grass height. The significance of the Doherty et al. (2014) study was explicitly tested by Smith et al. (2018), who confirmed that grass height continued to have a significant effect on nest success for this Wyoming study after correction factors were applied to the data. Importantly, the one study in the Bi-State area that finds no significant benefit to grass height in regard to nest success (Kolada et al. 2009) also notes an abundance of rabbitbrush providing concealment cover that is unusual for Bi-State sage-grouse habitats as a whole, and is likely limited in applicability to washes, valleys, and alluvial fans. Farther east in the Bi-State area, Wyoming big sagebrush habitats are comparable to those range-wide where grass height has been shown to play a key role in nest success.

The agencies heavily promote removal of juniper trees from sagebrush habitat. However, juniper reduction may paradoxically increase the visual field for ravens from fence posts. And, with the practice of leaving isolated junipers when it does a larger-scale clearance, the agencies maybe inadvertently opening new vantage points.

Coyotes also predate sage-grouse, so tall grass and native shrub cover is crucial for allowing broods to recruit and reach adulthood.

Figure 3. The trash dump in Long Valley, which is in the midst of leks and nesting/brooding habitat, should be immediately closed. It is open during the day and we counted around 50 ravens here during this visit in August 2018. Sage-grouse leks, nesting areas, brood-rearing meadows, and wintering habitats are all closely adjacent to this trash dump. This is an ongoing large threat to the local sage-grouse population.

Figure 4. Ravens flying around open trash dump heaps, Long Valley.

Habitat Fragmentation

Agencies blame conifer "encroachment" in sage-grouse habitat as fragmenting habitat. Yet the efficacy of such chainsawing projects are still not clear as far as increasing high quality habitat, fuels, and predator mortality on sage-grouse. Some treatments have resulted in cheatgrass invasions. We examine in more detail our observations and the scientific basis for these actions below.

As of June 2019, agencies tallied over 46,000 acres of pinyon-juniper treatments, 24% of those acres identified for treatment in the Bi-State Action Plan. Yet most sage-grouse PMUs continue to decline.

Many conservation actions still seem to be focused solely on pinyon-juniper treatments, ignoring human-caused habitat degradation factors that are likely having greater impacts on grouse populations.

Inadequacy of Existing Regulatory Mechanisms

The stakeholder group with voluntary mechanisms for conserving sage-grouse is not working. The court ruled on the **inconsistency of the Coates et al. 2015 study**. We believe this may center on how the Service should focus more attention on droughts, and extreme droughts—which may become more important in California with climate change impacts. Sage-grouse populations fluctuate with rainfall, and to mitigate the negative impacts of droughts, the Service needs to consider all other factors in sage-grouse conservation that are effective—such as habitat quality, predation reduction, vegetation cover, and ecophysical processes such as fire as a natural part of sage-grouse ecology and livestock grazing as an unnatural stressor.

Currently, the Sage-Grouse Initiative and local stakeholder conservation measures are not resulting in increased sage-grouse populations. The populations are declining, and existing regulatory mechanisms appear to us to be failing.

Even the number of PMUs and their mapped boundaries are inconsistent across media presented by the agencies and land managers. On the Bi-State sage-grouse website, only five PMUs are mapped, with the Bodie Hills and Mount Grant regions combined into a single PMU:
https://www.bistatesagegrouse.com/general/page/bird-status

Yet in recent hand-outs at LAWG meetings in 2018, six PMUs were mapped, with Bodie and Mount Grant named as separate PMUs along the California-Nevada border (see Figure X.).

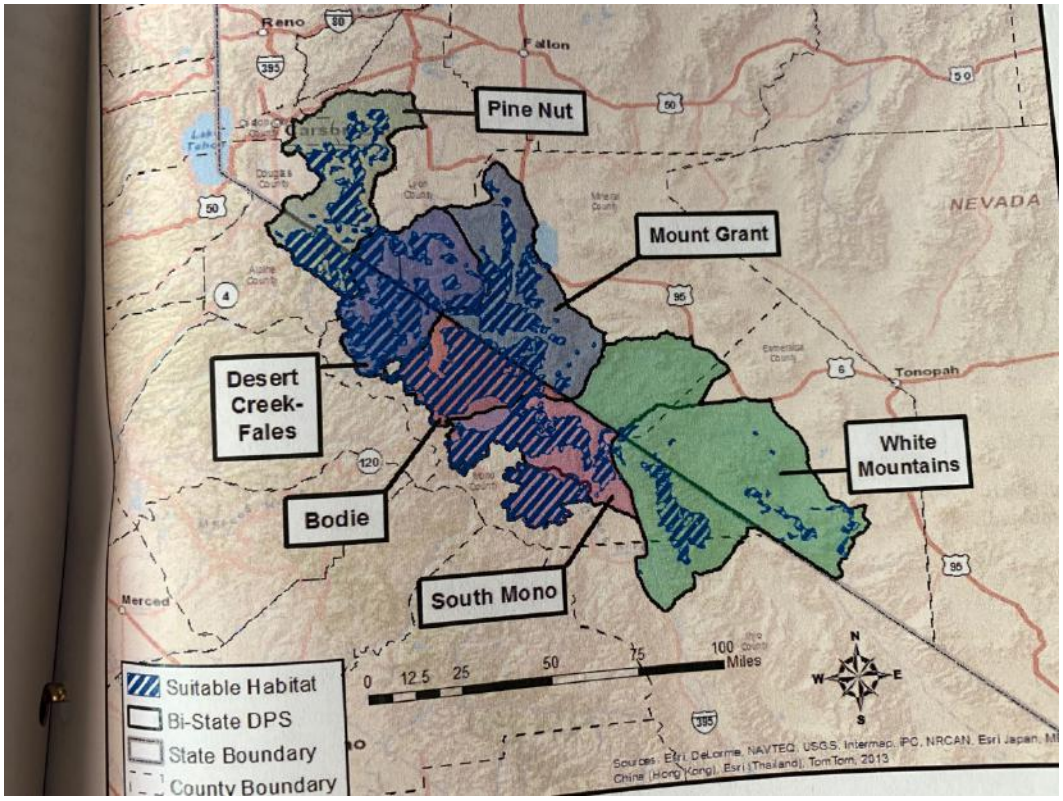

Figure X. Handout from agencies at November 7, 2018 Local Area Working Group meeting in Bridgeport, California, showing six PMUs.

Inconsistencies and disagreement in the basic mapping of sage-grouse populations point towards severe inadequacies in the existing regulatory mechanism for conserving this species.

In addition, the Inyo National Forest Plan is undergoing revision[6], with uncertain outcomes for sage-grouse management. The Carson City District of Bureau of Land Management in Nevada is also undergoing a land use planning revision, which raises uncertainty about existing management mechanisms for sage-grouse[7].

Other Natural or Manmade Factors Affecting the Sage-grouse's Continued Existence

Domestic cattle and sheep impacts to sage-grouse habitat in reducing cover to hide from predators is a factor that has not been addressed under section 4(a) of the Endangered Species Act (16 U.S.C. 1531 *et. seq*.): (e) other natural or manmade factors affecting its continued existence, as part of the basis for making a listing determination for a species. Because this crucial factor has not been mitigated with any conservation measures, we support listing the Bi-State DPS as Threatened. We have observed no conservation measures to reduce the impacts of grazing on crucial vegetative cover so that sage-grouse broods may hide from raven, coyote, and other predators. This is a significant impact that has not been addressed with current conservation measures.

[6] https://www.fs.usda.gov/main/inyo/landmanagement/planning
[7] https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=renderDefaultPlanOrProjectSite&projectId=22652

Whether the Service should include in the scope of the proposed 4(d) rule the incidental take of sage-grouse within the Bi-State DPS if the take results from other agricultural activities not subject to the Sage Grouse Initiative or the Bi-state Action Plan, if those activities are compatible with the conservation of the Bi-State DPS.

During our 2018 field visits to many areas of the Bi-State sage-grouse range in California and Nevada, we saw overgrazed ranges, broken and trampled willow riparian areas, meadows turned to cheatgrass or bare dirt, stream trenching and erosion, and loss of vegetative cover from livestock grazing. This is supported by the mapping of Botye and Wylie (2018), who mapped cheatgrass infestations in excess of 20% total cover (and some exceeding 60%) in the Bi-State DPS area. This is all a result of unfettered cattle and sheep grazing on sage-grouse habitats. Conservation measures that reduce livestock grazing and management impacts are lacking in current conservation measures and Sage-Grouse Initiative measures. Current livestock management measures on public lands managed by the Bureau of Land Management and US Forest Service are not compatible with sage-grouse management, and increasing populations.

The root causes of sage-grouse declines be eliminated and habitats restored to better condition so that sage-grouse populations would increase.

Past and Ongoing Conservation Measures for the Bi-State DPS, its Habitat, or Both: **Inadequacy of Existing Regulatory Mechanisms**

According to 2018 agency presentations given at stakeholder meetings, 50,000 acres of "sagebrush restoration" projects have taken place (or perhaps are planned) in the Bi-State DPS area. A lot of these are pinyon-juniper treatments. The National Resource Conservation Service (NRCS) is pouring $8 million of Farm Bill funds into "working lands for wildlife" projects--funding a lot of pinyon-juniper treatments. NRCS told ranchers it can help public lands permittees with projects such as fence marking, water pipeline projects, and other management projects on public lands grazing allotments, in addition to private lands.

These conservation measures are not proven effective, and in fact all but one PMU are in decline despite completed vegetation treatments. Habitat degradation may also result from these treatments. We have observed cheatgrass invasions in pinyon-juniper treatments during our field visits (see photos below).

The **"certainty of effectiveness"** definition is crucial in our opinion. Policies, conservation actions, and criteria are defined in order to measure the effectiveness of management actions. This is a large problem area since we observe that ongoing conservation actions appear to not be effective in halting sage-grouse declines, even in 2018. The Service must evaluate how effective pinyon-juniper treatments are, as there is little evidence that these treatments are effective conservation actions. The Service should evaluate livestock grazing impacts to sage-grouse much more seriously, as has been done in other sage-grouse regions.

In May of 2018, the U.S. District Court in the District of Northern California ruled that the "not warranted" finding for the Bi-State sage grouse is not founded in sound science. The conservation measures in existence at the time of the decision (mostly voluntary) met the "certainty of implementation" prong, but did not meet the "certainty of effectiveness" prong of the USFWS Policy for Evaluation of Conservation Efforts. In several examples, the judge pointed to the agency's own admission that it could not predict whether a given habitat treatment (examples given, pinyon-juniper cutting and cheatgrass removal) would actually result in more sage-grouse. The judge ruled that 3 of the 6 populations were indeed in a precarious state (Pine Nut, Mount Grant, and White Mountains). But at present, only the Bodie population seems to be stable and not in decline.

Most of the current funded conservation action updates for Bi-State sage-grouse habitat in California and Nevada reported at the stakeholder meetings in 2018 were pinyon-juniper treatments "to improve sage-grouse habitat".

How many studies show that pinyon-juniper treatments are correlated with sage-grouse increases? Are there any from the Bi-State DPS area? Many new pinyon-juniper treatments are planned, but with no evidence of correlation or effectiveness to sage-grouse population numbers or habitat usage. Based on field visits, we are not seeing correlation between pinyon-juniper treatments in the Bodie Hills, and sage-grouse use. We are seeing several Phase 2 and 3 pinyon-juniper chainsaw removal projects – targeting woodlands that are very mature with little sagebrush in the understory – on Bureau of Land Management (BLM) land and US Forest Service land that are full of new cheatgrass invasions. Karl and Chambers (2019: 145) present a state-and-transition model for sagebrush habitats applicable to the eastern half of the Bi-State population area, where populations are doing most poorly. Where is the evidence that pinyon-juniper treatments help sage-grouse? We do not want to see these conifer removal projects as a pointless "conservation action," meanwhile ignoring livestock grazing, fencing, trash-subsidized raven predation, climate-drought impacts, and other threats.

There is little, if any, evidence that the Bi-State Action Plan is actually successful, and appears instead to be a large commitment of misallocated conservation funding largely funneled into questionable pinyon-juniper treatments instead of root causes of sage-grouse declines.

The Service needs to truly take a hard look at all the past, present, and new science on the 2013 proposed Threatened finding in its forthcoming Final Rule.

We fully support the USGS launching a study of movement and demographic response of sage-grouse to pinyon-juniper treatments, to help inform the USFWS listing decision. This is long overdue, and much more data needs to be collected about how vegetation treatments impact sage-grouse populations. To date, this study remains uncompleted, and therefore the agency cannot rely on pinyon-juniper removal "treatments" as a mechanism to restore sage-grouse habitats and populations. The science on pinyon- juniper "encroachment", as we discuss below, has been spotty and inconsistent.

USGS will analyze 1) how sage-grouse use pinyon-juniper treatments, 2) changes in

space-time use of sage-grouse in conifer treatments, 3) effects of treatments on sage-grouse population size, and 4) changes in sage-grouse demographic rates. We will be interested to see the results of these studies.

USFWS admitted at stakeholder meeting[8]s that they need to take a look at the certainty of effectiveness of pinyon-juniper treatments as conservation actions in keeping the Bi-State DPS off the Endangered Species List. USFWS has hypothesized that there may be a 5-30-year delay after treatments, after which sage-grouse might (or might not) respond positively. This delay is unacceptable as populations continue to decline, and in some cases, crash. More effective conservation actions need to be immediately implemented to stave off extinction.

Many research papers purporting to show how pinyon-juniper treatments help sage-grouse, such as Severson et al. (2017), have serious flaws. For example, Severson et al. (2017) appears to be largely based on simulations and projected population growth rates. The paper is unclear but seems to indicate sage-grouse females and nests were found in both treated and untreated areas, but the model supposes increased survival in treated areas. No maps of habitat or telemetered individuals or nests are presented. We are not convinced. But agencies are using this paper to support pinyon-juniper treatments. This research had a very small sample size, short duration, and only considered one variable (treatment) in a multi-variable environment.

That said, this is the only scientific study we have seen thus far to show any direct short-term benefit from treatment. It fails to consider long term benefit or harm, weed invasion, fire, grazing, and their interactions. The abstract even admits that treatment outcomes have not been adequately studied—it is a preliminary finding and more research is needed. We believe that it is irresponsible to commit to landscape scale disturbance (treatments) based on a few small-sample, short-term studies.

We have heard multiple times from agency personnel that conifers present a threat to sage-grouse by providing perches for hawks. But all sources implicate ravens as the main predator in the Bi-State region, not hawks. Ravens also fly along pathways to search aerially for prey items, such as sage-grouse and desert tortoise. Ravens are influenced more by trash sources, livestock water facilities, livestock carcasses and stillborn calves, and urban edges effects, than by availability of pinyons and junipers for perching.

Transmission infrastructure is also a threat, with ravens using transmission towers for nesting. Breeding pairs of ravens at these nests scan for prey, more so than transient ravens that do not have territories. USGS explained during the June 5, 2019 LAWG meeting in Walker, California[9], that ravens have been tracked nesting on "wind mills, trees, and cliffs." The trees were not identified as to species, and could include native aspen and cottonwood trees, in addition to conifers. USFWS should analyze what trees

[9] Bi-State sage-grouse Local Area Working Group meetings: November 7, 2018 in Bridgeport, with including US Fish and Wildlife Service, California Department of Fish and Wildlife, Nevada Department of Wildlife, Bureau of Land Management (Bishop Field Office), Inyo National Forest, Humboldt-Toiyabe National Forest, National Resource Conservation Service, Mono County, Bridgeport Piute Tribe, local ranchers, and local environmental groups

are used by ravens, including native aspen groves and riparian woodlands. Windmills associated with livestock operations should also be considered in conservation actions.

Future research should examine whether the far-western edge sage-grouse Eastern Sierra populations may be more adapted to conifer groves than, say sage-grouse in the open Wyoming plains.

The **"significant portion of range"** definition needs clarification by the Service, according to the court.

Critique of The Nature Conservancy Model

The Nature Conservancy prepared a white paper (Provencher et al. 2009), titled Bodie Hills Conservation Action Planning Final Report, and developed a model using Fire Regime Condition Class (FRCC) methodology that claimed several natural vegetation communities had departed from their natural range of variability. Particularly pinyon-juniper woodlands are modeled to be outside of their natural range of variability. This is a controversial model, and not all researchers and observers agree with the claims that native plants can depart from modeled variability. It is incumbent on USFWS to show that natural vegetation communities have departed from historic levels, and that this negatively impacts sage-grouse. We do not see this evidence.

Natural range of variability, or historical range of variability, describes the conditions of a natural system or ecosystem prior to intensive human alteration of that system (for instance, see Wohl 2017). In North America this is commonly considered to be prior to Euro-American contact.

Estimates of historical or reference conditions need more review and evidence, as these can vary widely depending on interpretations of different historical ecologists. There is still much debate and controversy over what historical conditions were, as these are all educated guesses. Many habitats have no settled consensus about pre-Contact fire regimes, such as the California chaparral, where widely divergent theories may be both scientifically credible and all competing theories need further testing. So modeling does not always indicate that a particular modeled historical reference condition is the only possible historical reference condition. Other hypotheses or models may better reflect historical variations.

There is great potential for error and divergent interpretation of the data used to create historical reference conditions: reliance on qualitative descriptions by early explorers who were not botanically trained or who had biases, can be a poor source of information for reconstructing a natural community back in time. Such proxy data as packrat middens, archaeological sites, and pollen cores can only give general species lists with some relative indication of abundance or presence, but those data have inherent biases that must be taken into account, and do not represent a complete sample of a plant community.

The FRCC Guidebook[10] states: "…each stratum is delineated according to Succession Classes (or S-Classes), which represent discrete units of early-, mid-, or late-succession vegetation that can be quantified to assess possible ecological departure between the current and reference (or historical) periods." But this guidebook clause conflates simple ecological succession analysis with deeper questions about what habitat communities for sage-grouse were like hundreds of years ago, before European Contact. These are two different questions, that are not addressed by the LAWG in their conservation measure discussions.

But successional stages of a plant community do not necessarily indicate whether it has departed ecologically from a historical position. What exactly is the reference period chosen to restore this landscape to? Is it 1860? 1700? Two thousand years ago? The Holocene Epoch had major climatic and vegetation fluctuations, epic droughts, and the Little Ice Age more recently, so a specific reference period should be delineated. In addition, it cannot be assumed that ecosystems had well-defined bounds (ranges of natural variation), or that the bounds stayed stable through time.

In addition, it cannot be assumed that ecosystems had well-defined bounds (ranges of variation), or that the bounds stayed stable through time.[11]

On page 16 of the FRCC Guidebook "Departure classes" are discussed: "Common causes of departure include advanced succession, effective fire suppression, timber harvesting, livestock grazing, introduction and establishment of exotic plant species, and introduced insects and disease…."

For pinyon-juniper woodlands there is insufficient scientific knowledge about the historical ecology of pinyon-juniper woodlands to be able to understand whether these plant communities have departed from some theoretical reference state. The term "advanced succession" is not defined, nor is it supported to be outside the natural range of variation for the plant community. Livestock grazing is cited as a cause for departure from natural reference conditions, yet one of the objectives of federal agency management in the Bodie Hills appears to be increasing desirable forage grasses that would benefit livestock. Mowing sagebrush on land managed by the Bureau of Land Management on the Bodie Hills seems oriented towards improving livestock forage, while destroying or degrading sage grouse habitat, mule deer habitat, and "healthy, resilient, functional" native plant communities.

Examining areas proposed for pinyon-juniper treatment sites on the Bodie Hills, we found a high diversity of native perennial grasses and forbs, as well as abundant biological soil crusts. The occurrence of weedy annual cheatgrass (*Bromus tectorum*) was very low in our field investigations (<10%). Disturbing these fragile soils with chainsawing, pile burning, and trampling is likely to increase the potential for cheatgrass invasion on these undisturbed ecosystems. These projects are counter to maintaining ecological resilience and health in several ways.

On page 17 the FRCC Guidebook says, "FRCC metrics do not address the question of natural spatial patterns." Spatial patterns are an important metric to take into account with respect to natural disturbance regimes and wildlife habitat: the size and distribution of patches and mosaics created

[10] https://www.landfire.gov/frcc/frcc_guidebooks.php

[11] White, P. S. and J. L. Walker. 1997. Approximating nature's variation: Selecting and using reference information in restoration ecology. Restoration Ecology 5(4): 338-349.

by wildfires. During our field surveys of the proposed treatment areas, we observed many burn scars, most perhaps caused by lightning since they were on remote montane ridges. The fire scars were of various ages and shapes, but often repeated a pattern of starting lower on the mountain ridge or upper alluvial fan and burning upwards with convective winds, until burning out on the crests of the ridge, creating a fan shape. These complex patches of successional habitats need more study. Enough of these wildlife burn mosaics may exist in Great Basin sagebrush and pinyon-juniper woodland habitats that no artificial treatments are needed.

On page 23 the FRCC Guidebook admits: "Until sufficient data are available to describe sustainable landscapes under the modern climatic regime, FRCC reference conditions will be based on the historical range of vegetation and fire regimes that existed during the pre-EuroAmerican settlement era."

There are a lot of assumptions to unpack in this FRCC biophysical model promoted by The Nature Conservancy for the Bi-State area.

Methods are not scientifically rigorous. The field worker is asked to go into the forest and estimate roughly the number of times an area has burned by looking at a few tree ring-burn scar samples or eyeballing the forest wildfire patches. A much more refined research project that tests hypotheses in an historical ecological approach needs to be done to validate estimates of fire return intervals, including a systematic and well-designed research study that examines a broad spectrum of fire scars matched with tree rings, and charcoal deposits in ponds and lakes that reconstructs several centuries of fire history in a region.

Many scientific studies have been published, and often differ from the FRCC model. Arendt and Baker (2013) used General Land Office survey records as a historical dataset to compare to modern digital datasets for Dinosaur National Monument in Utah. They found declines of pinyon-juniper woodland of 3-7% over 90 years. Shorter natural and human-caused fire return intervals of 188-216 years appear to be driving this contraction. Cheatgrass invasion may also be moving parts of the woodland into earlier seral stages of sagebrush and grassland. The authors recommend direct control of cheatgrass, and not prescribed fire, to manage these areas. They also note that, "Spatially complex patterns of woodland stability, recovery, contraction, and expansion show that century-scale data are needed across large landscapes to discern net trends in landscape change needed for ecological restoration, management, and understanding impending future change."

They conclude that, "The net decrease of woodland and increase of shrubland does not support past findings that pinyon-juniper is generally invading sagebrush shrublands of the western United States…" They critique other studies that posited pinyon-juniper expansion by using too limited a scale of landscape, or looking at changes in tree density and not geographic location of woodland-shrubland ecotones. Studies that depended on forensic evidence such as dead trees may be biased because that evidence may disappear at unknown rates.

Some local expansions of pinyon-juniper woodland could be due to recovery from a fire,

where seeds are cached by rodents or birds, or present in the soil. Animal dispersal agents would naturally revegetate pinyons and junipers into sagebrush areas recovering from fire.

Climate change must also be considered in fire rotation studies, as well as expansions and contractions of woodland ecotones. Downward expansion of trees into sagebrush slopes is occurring in some sites studied in Utah, Nevada, and Idaho, but may be due to numerous factors such as overgrazing that reduced tree sapling competition with native perennial grasses and shrubs, or milder winters allowing trees to grow into toe slopes and basins. More study is needed about the soil characteristics, slope, aspect, and other abiotic habitat variables of these ecotones. Pinyons and junipers are highly adaptable to a wide range of habitat types, and this adds complexity to any claims of departure from an apparently very wide natural range of variation.

Considerations should be given to data quality and uncertainty, and the short time frames of historic observations of long-lived trees. More research about stand structure, spatial extent of woodlands, and hypotheses that test climate, grazing, fire, invasive grasses, and other variables should be undertaken. Better research into landscape-scale patterns of expansion and contraction, steady states, and multi-century scales of time need to be done before sweeping generalizations can be made about local historical reference conditions.

Arendt and Baker (2013) conclude:

> "Our results show that century-scale dynamics included much more than simply uniform woodland expansion, but rather, spatially heterogeneous expansion and contraction of several ecosystems, mediated by natural fire and human land uses. Pinyon-juniper expanded in some areas, often near ecotones, and contracted in others, where fires occurred. Pinyon-juniper-sagebrush ecotones were not historically maintained in fixed locations by fire, because fire was rare and spatially heterogeneous in sagebrush and pinyon-juniper. Areas of pinyon-juniper undergoing post-fire recovery appeared similar to expansion, which also occurred outward from ecotones, with contraction elsewhere. Overall, losses in historical pinyon-juniper, montane shrubland, and mature sagebrush have occurred, which will likely have a negative impact on this landscape's biodiversity, if continued indefinitely into the future. "

The FRCC Guidebook on page 52, after unscientifically estimating what an historic reference condition for a woodland would be with no historical ecological study, no discussion of assumptions and what data were used, then proceeds to instruct the field surveyor to estimate how much a class of vegetation departs from this assumed and ill-defined reference condition. It uses the very un-scientific label "Overrepresented" for estimates of relative abundance of vegetation stands. This seems like a completely subjective label and not scientifically supported.

The lengthy references contain a large number of fire studies, but the Guidebook has no critical review or discussion of the science used to base their model. The referenced studies have very different hypotheses, assumptions, datasets, and conclusions. There are an equal number of scientific studies, not referenced, that come to very different

conclusions regarding fire regimes in different ecosystems, estimates for historic reference conditions, and methodologies to be used. On page 100, the FRCC Guidebook admits that much uncertainty about reference conditions exists, and in its glossary definition of Historic Range of Variation it says: "Until this concept has been more fully developed and models built, however, relying on estimates from the historical period is appropriate." We believe this it is not appropriate to rely on such vague estimates.

The FRCC field data sheets are good at describing current-day seral stages and fire burn characteristics of various plant communities, but in no way can filling out these datasheets, using vague estimates, be supported as evidence for what past conditions and ecologies were like, say 500 years ago. More rigorous scientific research designs should be carried out in each geographic area and plant alliance type to address those questions. It would be interesting to fill out these same datasheets 20, 50 or more years in the future at the same sites with photo-references. This might start to show trends and changing conditions. But no such data sheets or datasets existed 100 years ago, so there is no frame of reference to compare this data collected by the FRCC Guidebook methods. Plugging current data from field surveys into models will give faulty results about what past conditions hundreds or thousands of years ago were like, without supporting historical ecological research.

On page 110 of the FRCC Guidebook, it is stated that the presence of a "very large-scale disturbance, such as a climate-driven stand-replacing fire" drastically skews the current succession class composition of a plant community in relation to the modeled reference condition. Very large-scale, stand replacing fires may be completely natural and within the range of historic variability, as witnessed by recent research, such as Hutto et al. (2016). Such "temporary anomalies" may indeed be well within the historic range of variation, and more study is needed.

Several complexities of understanding ecosystems through time are not addressed by the FRCC or The Nature Conservancy model. For instance, photographs and observations of pinyon-juniper woodland in the late 19th and early 20th Centuries were during a time coming off the Little Ice Age, a Northern Hemispheric time of generally cooler moister temperatures and montane glacial expansion. After the this, the climate in the western US trended towards warmer and drier. Whether natural or anthropogenic climate change is contributing to shifting plant communities needs more study. But a question arises about whether we should be manipulating vegetation if such plant shifts are a natural response to changing climates, and part of the resiliency of plant communities. If anthropogenic climate change is involved, we should allow these plant communities to shift naturally, and not be heavily manipulated until more scientific research is done. Climate responses by individual plant species in the past 100,000 years and longer, based on packrat midden, fossil, and pollen data, indicate that plant communities themselves are not homogeneous assemblages that remain constant through time, but transient assemblages—each species responds uniquely to climatic variations.

Repeat photography studies by Meagher and Houston (1998) done in Yellowstone National Park, show that many other conifer species also "encroached" into sagebrush and meadow habitats since 1871. Douglas fir (*Pseudotsuga menziesii*), lodgepole pine

(*Pinus contorta* var. *latifolia*), whitebark pine (*P. albicaulis*), and subalpine fir (*Abies lasiocarpa)* expanded into non-forested habitats through the century of photographic records. Are all these native conifer species also weedy and in need of clearing and "restoration" by cutting down? We believe these expansions and contractions of forests and woodlands are a natural response to complex changes in climate, historical use, fire, grazing, wildlife population fluctuations, and other factors.

Examining the extensive repeat photograph collection, Meagher and Houston (1998) determined that since 1871 one third of sagebrush-grassland stands remained the same (no change in area or density), one third showed decline, and one third showed a marked increase. Examining which factors are significant and which are minor has only been studied on a few sites. Much work needs to be done before we better understand the historical ecology of forests in the western US.

The influence of Native Americans on past landscapes should be documented by consultation, ethnological research, and archaeological data.

Instead of relying on the FRCC model, a research strategy should be worked out for the local Bi-State region, with statistically valid sampling, analysis, and uncertainties and interpretations made clear.

Site-specific information on current habitat conditions, including, but not limited to, quality of upland and meadow or riparian sites, presence and abundance of annual invasive grasses and weeds or other increasing plants (e.g., conifer trees), and recovery of previously burned sites.

In our field observations of the Bi-State area in 2018, we saw a diverse landscape of Eastern Sierra slopes, Long Valley and surrounding Glass Mountains, Mono Lake edges, Bodies Hills, and Walker River watershed areas with healthy stands of subalpine forests and pinyon-juniper woodlands, mixed with open sagebrush-steppe and meadows. Conifer are highly diverse here: lodgepole pine (*Pinus contorta* ssp. *murrayana*), whitebark pine (*Pinus albicaulis*), western white pine (*Pinus monticola*), Jeffrey pine (*Pinus jeffreyi*), singleleaf pinyon pine (*Pinus monophylla*), Sierra juniper (*Juniperus occidentalis*), and Utah juniper (*Juniperus osteosperma*). Whiteback pine is proposed for listing under the Endangered Species Act, and we found it regularly in the Sierran slopes above Mono Lake in occupied sage-grouse range. Groves of aspen (*Populus tremuloides*) occur throughout the region as well. Are the agencies proposing to cut down all these native trees to prevent supposed hawk perches? This would be unacceptable. This is a very different environment from typical Nevada greater sage-grouse habitat; these Eastern Sierra tree-rich habitats should be further studied as to how sage-grouse use is unique in the Bi-State region.

Figure 5. Whitebark pine and sagebrush communities with recovering perennial bunchgrass cover, Jordan Basin unit of the Dunderberg Allotment, Humboldt-Toiyabe National Forest, Sierra Nevada CA. This area is closed from sheep grazing but the Forest is proposing to open it to cattle grazing. April 2018.

The Severson et al. (2017) model can also be critiqued in that their conclusions do not actually implicate conifer presence in sage-grouse habitat selections. In their Warner Mountains, Oregon study, telemetry was used to locate female sage grouse nests in 2010 and 2011. Researchers located and surveyed 160 nests and 167 available nest sites. They found that when conifer trees were present within 800m of potential nest sites, sage-grouse chose a site where trees were clustered rather than dispersed, suggesting selection for more open habitat. But the study admits that tree groves were not avoided. This study adds to the complexity of how sage-grouse choose habitat, and we suggest that much more study is needed before conifer trees are targeted as the culprit in sage-grouse declines, while not fully taking into account other stressors.

During our July 2018 field visits with Bureau of Land Management (BLM) we saw several Phase 3 past treatments by BLM in the Bodie Hills now covered with cheatgrass. Adjacent untreated pinyon-juniper communities had natural sagebrush and open native bunchgrass cover. We asked BLM about this, and they told us the cheatgrass invasions were not expected, and were a mistake. We asked BLM if they use control plots of non-treated pinyon-juniper communities, to compare with pinyon-juniper removal treatments, and compare these with sage-grouse numbers and populations trends. They told us they have not done this. How do we know whether conifer removal is an effective

conservation action to increase sage-grouse numbers when no baseline surveys have been done, no control sites have been studied, and no comparison treatment sites have been surveyed? We essentially have no baseline or control sites in the Bi-State area to compare to ongoing and future planned conifer removal treatments to analyze whether these "conservation actions" (native conifer removal projects) are actually helping to stave off sage-grouse declines. We are concerned that these actions are not leading to sage-grouse increase in populations, but are a side-tracked ineffective action.

We have not seen any stakeholder projects that analyze livestock grazing impacts to core sage-grouse habitats to determine the levels of vegetation removal by grazers, that in our observations impact cover for sage-grouse, that appears to be crucial to avoiding raven and coyote predation—this habitat degradation is a top threat to present sage-grouse populations.

We need many more scientifically controlled studies of how chainsawing down native conifers will correlate with sage-grouse population increases and habitat use.

For pinyon-juniper woodlands we do not agree that enough is known about the historical ecology of pinyon-juniper woodlands to be able to understand whether these plant communities have departed from some theoretical reference state. The term "advanced succession" is not defined, nor is it supported to be outside the natural range of variation for the plant community. Livestock grazing can be a cause for departure from natural reference conditions.

We suspect that sage-grouse management in the Bi-State area may be attempting to change this landscape, and artificially disturb it for management objectives that are not in harmony with the possible natural reference conditions of these pinyon-juniper and sagebrush-steppe plant communities. The Sage Grouse Initiative, for example, appears to have as an underlying objective the conversion of healthy functioning ecosystems into disturbed and artificially-manipulated plant communities that favor forage vegetation to benefit cattle and sheep. We do not see how the disturbance of biological soil crusts, native bunchgrass-sagebrush communities, and vibrant pinyon-juniper woodlands with different age classes of trees, will benefit most native wildlife.

We have observed sage grouse hens in summer months using pinyon-juniper woodland with an open canopy and mature sagebrush in the Toiyabe Range and Monitor Valley of central Nevada, so to use references or models that claim all pinyon-juniper habitat is undesirable to sage grouse may be an over-simplification.

The elephant in room: there is still no discussion of removing livestock from pinyon-juniper treatments, or anywhere for that matter. This should be tested and analyzed as to the certainty of effectiveness of management actions.

USGS released a report that briefly summarized sage-grouse space use in relation to conifer removal treatments (Mathew et al. 2018 at 33 and 34), where the authors write:

> Descriptive statistics for sage-grouse use of conifer removal treatments across the Bi-State DPS during the study period are presented in table 2. Overall, preliminary analyses indicate that average proportions of GPS locations in post-treatment areas tended to increase over time and

> across spatial scales. For example, average proportions of pre-treatment locations appeared higher than those for post-treatments in 2015, but patterns appeared to reverse thereafter. As of 2017, 3, 10, and 18 percent of locations averaged across individual sage-grouse occurred within post-treatment areas at the 0, 439, and 1,451 scales, respectively.

But no map of transmittered sage-grouse overlaying pinyon-juniper treatment polygons is provided. We are unclear what the authors mean by "average proportions of sage-grouse GPS locations" in relation to the 16,712 hectares (41,296 acres) of pinyon-juniper communities that were cut down and debris-piled from 2014 to 2017. These "use estimates" should be compared with actual use in mapped sage-grouse movements in and around treatment polygons in further analysis. This preliminary analysis does little to convince us that removing native pinyon-juniper communities is an effective conservation measure for Bi-State sage-grouse.

Figure 6. Bodie Hills area of a past pinyon-juniper treatment where trees are chainsawed and left on the ground. This does not seem to us to reduce wildfire fuels.

Figure 7. Pinyon-juniper treatment slash left in place. Bodie Hills, July 2018.

Figure 8. Drought-killed single-leaf pinyon pines (*Pinus monophyla*), northern White Mountains, near Trail Canyon. 2018. We question whether pinyon-juniper communities are "encroaching" or in actuality undergoing natural boundary fluctuations with drought and rainy periods.

Why not allow lightning-caused wildfires to open up a patchwork of sagebrush mosaics over time, in a manner that may be more in tune with the historic reference conditions for this part of the Great Basin?

Figure 9. Bodie Hills CA, summer 2018. More study needs to be done about fire regimes in this wildfire-prone landscape. We found sage-grouse scat here among scattered open pinyon-juniper trees and sagebrush scrub. Lightning-ignition wildfires are common here and burn large areas of the peaks before wildland fire crews can put the fires out. Pinyon- juniper treatments have removed some woodlands in the valleys here, but scrub jays and pinyon jays quickly reseed the trees—young trees are growing in the foreground. But are sage-grouse here adapted to more trees than birds in other parts of sage-grouse range?

Wildfire is an important metric to take into account with respect to natural disturbance regimes and wildlife habitat: the size and distribution of patches and mosaics created by wildfires. Following large-scale fire, instead of emigrating to unburned habitats, sage-grouse show high site-fidelity and returned to unburned patches within burn perimeters, incurring serious survival and reproduction penalties in doing so (Foster 2016, Foster et al. 2018). During our field surveys of proposed treatment areas in the Bi-State region we observed many burn scars, most perhaps caused by lightning since they were on remote montane ridges. The fire scars were of various ages and shapes, but seemed to often repeat a pattern of starting lower on the mountain ridge or upper alluvial fan and burning upwards with convective winds, until burning out on the crests of the ridge, creating a fan shape. These complex patches of successional habitats need more study. It is our opinion that enough of these wildfire burn mosaics exist in Great Basin sagebrush and pinyon-juniper woodland habitats that no artificial treatments are needed.

Arendt and Baker (2013) estimated Wyoming/basin big sagebrush had an historic fire return interval ranging from 458-729 years, while mountain big sagebrush had a historic fire return interval that is around 100 years. Cheatgrass fire return interval was 61 years. Cheatgrass-mediated fires eliminate sagebrush, the key habitat feature for sage-grouse,

over the long term (Coates et al. 2015b). Importantly, the cheatgrass-fire cycle ultimately has negative effects on sage-grouse (Coates et al. 2016b), making the prevention of cheatgrass spread through reduction or elimination of livestock crucial.

Another problem with Bi-State area management and The Nature Conservancy model using FRCC methodology is that widely differing forest and woodland types seem to be lumped together without discernment, assuming all have the same fire characteristics, seral stages, and historic ecology. For example, Sierra Nevada ponderosa pine and mixed coniferous woodlands may have had a pattern of frequent ground fires that thinned out stands, with some stand-replacing canopy fires also occurring before European Contact. Aboriginal burning practices were apparently significant in these geographic regions. Fuel build-up therefore may be more of a condition shift since fire control measures were enacted in the late 19th and 20th Centuries. But other forest types, such as lodgepole pine forests and pinyon-juniper woodlands had a completely different fire regime, with infrequent stand-replacing fires ignited by lightning, that created a patch mosaic of different seral stands. Aboriginal fire management was apparently less significant in some of these forest communities.

Given these complexities, how a percentage of a stand's departure from a vague reference condition can be estimated is unclear.

Very large-scale, stand replacing fires may be completely natural and within the range of historic variability, as witnessed by recent research, such as Hutto et al. (2016). Such "temporary anomalies" may indeed be well within the historic range of variation, and more study is needed.

A model for consideration for possible management to increase sage-grouse habitat quality is Sheldon National Wildlife Refuge in Nevada, where livestock grazing has been absent for decades. Lightning fires have replaced livestock grazing as ecophysical processes that dominate habitats here. Prescribed fire is being used in experimental ways to reduce conifers, and keep meadows open:

> No livestock grazing occurs on the Refuge at this time. However, the Refuge is in an excellent position to experiment with prescribed fire for management of meadows for sage grouse. The Refuge should burn some meadows, and monitor grouse use and vegetation composition and height before and after the burn.[12]

Studies in Oregon may be of Western juniper savannas, which could have a very different historic fire regime that Utah juniper-Single-leaf pinyon woodlands in the Bi-State sage-grouse areas of California and Nevada. The fire regime in the Bi-State region was different, and included few, hot, stand-replacing fires that created a patch-mosaic of different seral stages. In our observations across the region, we see no evidence of a reduction or suppression of wildfires. This needs more study by independent researchers not funded by NRCS. Large open burn patches continue to be created by natural

[12] http://www.ndow.org/uploadedFiles/ndoworg/Content/Nevada_Wildlife/Sage_Grouse/Sheldon-PMU-Plan.pdf, page 15.

wildfires, as evidenced around Mono Lake. Because of this ongoing fire regime, we do not see a need to continue to remove native conifers by chainsawing across sage-grouse habitat. This is a diversion and dead- end road as far as sage-grouse conservation is concerned.

Agency resources are being diverted to conifer treatments as un-tested mitigation and conservation actions while root causes of sage-grouse declines are not being adequately addressed: raven subsidy by trash dumps, cattle grazing down native grass cover, fences and other range facilities creating raven attractants and hawk perches, as well as collision hazards, and other threats.

Figure 10. Burned meadow and sagebrush near Lida NV, grazed by cattle. Wildfire areas should be rested from livestock use to prevent cheatgrass infestations.

Cheatgrass

During our 2018 field visits we observed several past pinyon-juniper treatments in the Bodie Hills CA that were invaded by dense cheatgrass (*Bromus tectorum*) infestations. One area was a phase 3 pinyon-juniper woodland that was cut down in a block of several acres—it was a mass of cheatgrass. Next to it, the uncut block of phase 3 pinyon-juniper woodland that was uncut had native bunchgrasses and sagebrush in the understory, and no cheatgrass.

Figure 11. Past pinyon-juniper treatment of Phase 3 woodland on the right. BLM land in Bodie Hills CA. The area was invaded by dense cheatgrass, visible in the photo. We questioned BLM personnel about this cheatgrass, and were told sometimes south-facing slopes do not take disturbance well, and that this vegetation treatment was a mistake. But how common are cheatgrass expansions in treated areas?

Figure 12. Another view of the same past treatment, showing undisturbed pinyon-juniper woodland on the left, and chainsawed woodland removed on the right, with cheatgrass moving in. We question the efficacy of these treatments as conservation measures for sage-grouse.

We examined Treatment Units closely by walking through the sagebrush and pinyon-juniper woodlands proposed to be treated, and found a high diversity of native perennial grasses and forbs, as well as abundant biological soil crusts, in untreated pinyon-juniper woodlands. The occurrence of weedy annual cheatgrass was very low in our estimate (<10%). Disturbing these fragile soils with chainsawing, truck and vehicle traffic, tractors, and masticators, in our view would increase the potential for cheatgrass invasion on these undisturbed ecosystems.

At stakeholder meetings in 2018, Humboldt-Toiyabe National Forest interdisciplinary team members reported that they monitored past pinyon-juniper treatments that were to make "functional corridors" for sage-grouse, and found cheatgrass infestations. They are trying to stop the cheatgrass. But areas are disturbed by livestock. They will reseed with native species. We question how these USFS conservation actions are actually benefitting sage-grouse, and not creating more cheatgrass by disturbing native plant communities. This needs to be addressed. Are pinyon-juniper treatments actually increasing cheatgrass due to soil disturbance? Are pinyon-juniper treatments rested from livestock grazing to allow recovery?

In summer 2018 we found cheatgrass (*Bromus tectorum*), tumble mustard (*Sisymbrium altissimum*), and Russian thistle (*Salsola tragus*) in Long Valley CA. These are not recent

infestations, but due to chronic disturbance of natural communities from grazing, social trails, off-road driving, and urban development. We have observed populations of these weedy invasive plants to increase with ground disturbance, such as long-term livestock grazing. The USFWS will need to provide detailed information regarding the spatial extent and degree of habitat degradation caused by invasive weed infestations within the Bi-State population area.

Figure 13. Cheatgrass infestation in heavily cattle-grazed meadow along Trail Canyon Creek, where bare ground is increasing. Inyo National Forest, northern White Mountains NV. September 2018.

Livestock Grazing and Range Management

Cattle and domestic sheep grazing may be one of the larger unaddressed threats to sage-grouse and to habitat in the Bi-State region.

In the Sierra Nevada Ecosystem Project's *Final Report To Congress*, Kattelman (1996) stated that livestock grazing has "affected more area in the Sierra Nevada than any other management practice." Montane meadows, riparian zones of streams, and lakes in meadows may be more likely to encounter livestock grazing impacts than other upland habitats. High-elevation riparian habitats may be particularly vulnerable to disturbance, presumably because of their short growth season and consequently slow rates of recovery.

Historical evidence indicates that heavy livestock use in the Sierra led to sod destruction

in meadows, which reduced or eliminated protective vegetative, while hoof shear, trampling and chiseling contributed to gully erosion by exposing soils to erosive flows. Transient sheep grazing in the high-elevation meadows of the Sierra and Glass Mountains also may have caused heavy damage from overuse.

The impacts of livestock grazing on high elevation wetland and riparian ecosystems are well documented (Menke et al. 1996). Livestock tend to concentrate in riparian areas (Belsky et al. 1999) and can remove and trample riparian and wetland vegetation (Kauffman and Krueger 1984, O'Callaghan et al. 2014). Chronic trampling in wet and mesic meadows can reduce infiltration by increasing compaction, which can increase bare ground and decrease site productivity. This pattern can be reversed by natural freeze and thaw cycles if trampling ceases. Olson-Rutz et al. (1996a, 1996b) noted that decreased cover and increased bare soil were correlated with grazing intensity and duration in mountain meadows—this can have significant effects to sage-grouse. Vegetation removal and trampling by livestock in a montane riparian habitat also had the secondary effects of altering micro-channel characteristics resulting in increased velocity of runoff because of fewer micro-channels with deeper flows (Flenniken et al. 2001). The cumulative effects of overgrazing can result in insufficient residual vegetation and decreased vegetative cover that impacts such species as sage-grouse, meadow-nesting birds, mountain yellow-legged frogs, and small mammals.

Livestock also can alter the physical and hydrological characteristics of stream margins, springs, and other riparian areas. The typically high soil moisture along stream banks and other aquatic edge habitats makes these areas easier to trample. Trampling often increases bank erosion, filling in pools, and can make stream channels wider and shallower (Kauffman and Krueger 1984, Bohn and Buckhouse 1985). Livestock grazing also has the potential to increase erosion of connecting stream channels, lower the water table, and eliminate ephemeral and even permanent water bodies (Meehan and Platts 1978, Armour et al. 1991). Repeated over-utilization and trampling also may result in alterations to aquatic micro-topography (e.g., undercut banks) used by fish for cover.

Developing springs for stock water can affect native plant and terrestrial species habitat by altering or de-watering riparian areas.

Figure 14. Meadow near Lida NV grazed by cattle. Bare ground and weeds are increasing here. Summer 2018.

The livestock grazing guidelines for greater sage-grouse nationally are worth reviewing for the Bi-State area, as we believe these apply here too. The greater sage-grouse National Technical Team (NTT) report recommends: "Managing livestock grazing to maintain residual cover of herbaceous vegetation so as to reduce predation during nesting may be the most beneficial for sage-grouse populations (Beck and Mitchell 2000, Aldridge and Brigham 2003)…."

The NTT identified measures to benefit sage-grouse, including:

- "Within priority sage-grouse habitat, incorporate sage-grouse habitat objectives and management considerations into all BLM grazing allotments through AMPs or permit renewals";
- "Prioritize completion of land health assessments and processing grazing permits within priority sage-grouse habitat areas";
- "Manage riparian areas and wet meadows for proper functioning condition within priority sage-grouse habitats";
- "Only allow treatments that conserve, enhance or restore sage-grouse habitat (this includes treatments that benefit livestock as part of an AMP/Conservation Plan to improve sage-grouse habitat"; and
- "Maintain retirement of grazing privileges as an option in priority sage-grouse areas…."

NTT at 14-17.

The Conservation Objectives Team (U.S. Fish and Wildlife Service 2013) report also included grazing management recommendations, including:

- Ensure that [grazing] allotments meet ecological potential and wildlife habitat requirements; and, ensure that the health and diversity of the native perennial grass community is consistent with the ecological site. COT report at 45. [Range management structures] that are currently contributing to negative impacts to either sage-grouse or their habitats should be removed or modified to remove the threat. Id. at 46.

Residual grass height and cover are also emphasized under national greater sage-grouse guidlelines. Nest success is higher where there is more cover, and grass height is a measurable way of limiting livestock removal of concealing factors.

Figure 15. Bare ground, grazed and trampled meadow vegetation and sagebrush in Trail Canyon from cattle. Inyo National Forest in the northern White Mountains NV. September 2018.

Livestock are known to stress sage-grouse (Jankowski et al. 2014) and cause nest abandonment, and increase nest predation (including by the cattle themselves; 75 F.R. 13940-41). Therefore livestock grazing in sage-grouse habitat must be limited during nesting and brood-rearing seasons, and grass height is a useful indicator of the intensity of grazing use. Grazing use and livestock incursions into sage-grouse habitat would increase the frequency of nest flushing, a factor also linked to nest success in observer-interaction studies (Gibson, et al. *in press*). Grass height may also have significance for foraging distance from nests, not simply cover at the nest bowl. Brood- rearing use of cover exemplifies the importance of structurally diverse microhabitats that consist of mixed vegetation to conceal sage-grouse nests and their chicks.

Connelly et al. (2000) recommend grass height of greater than or equal to 18 cm in breeding habitat. This may be crucial to providing cover for sage-grouse hens and broods in both meadows and uplands, to escape predation by ravens and coyotes.

We note that protective measures of the national greater sage-grouse 2015 plans regarding the construction of new permanent livestock facilities, still in effect, mandated that livestock range structures such as windmills, water tanks, corrals not be placed within 1.2 miles of occupied leks, per Manier et al. (2013).

The NTT report recommends, "Maintain retirement of grazing privileges as an option in priority sage-grouse areas…." and this should be a conservation action to be considered.

There is no evidence that livestock grazing provides a distinct benefit for sagebrush ecosystems; at best, well-managed livestock grazing does less harm to the vegetation and habitats of sage-grouse than poorly-managed livestock grazing.

We maintain that grass height is very important to sage-grouse survival and cover that protect birds from raven and coyote predation.

Rest-rotation should be recommended on public lands leases. Less grazing is better than continued season-long annual grazing where the grasses and forbs have no chance to recover, no chance to set seed, and no chance to build up thatch and excess vegetative material that serves both as cover for sage-grouse and food for a diverse arthropod fauna.

Agencies at the very least should consider seasonal grazing restrictions during breeding and brood-rearing times along the lines of what the District of Idaho recommended: livestock grazing should be restricted in sage-grouse nesting and brood-rearing habitat to the "well established" timeframes necessary for adversely impacting sage-grouse – June 20 to August 1, and November 15 to March 1. *WWP v. Salazar*, 843 F. Supp. 2d 1105, 1123 (D. Idaho 2012). The best science (Knick et al., 2005) advocates for limiting livestock utilization to 30 percent.

Los Angeles Department of Water and Power (LADWP) allows mowing of sagebrush and rabbitbrush, and prescribed burns in order to increase livestock forage in Long valley. BLM also allows sagebrush mowing in the Bodie Hills, apparently to increase

grass forage for livestock. These range practices could harm leks and nesting areas, and reduces cover for sage-grouse in general.

Figure 15. Bodie Hills CA, meadow edge where BLM pointed out a sagebrush- rabbitbrush mowing project to decrease the shrubs in this meadow. Cattle were present in the meadow, and sage-grouse scat also observed here. These projects appear to be range improvements, and not sage-grouse conservation actions.

Meadows that will be dried out in Long Valley from LADWP water diversion changes will have weak vegetation that has been heavily grazed or weed-infested from chronic disturbance by livestock should be rested from all use for a period of 10 years after irrigation is shut off, to allow deep-rooted upland native grasses and shrubs the chance to recover. This will help hold groundwater in the region, and prevent increased bare ground, erosion, and water runoff. There are precedents in the region for resting ranges to allow recovery, before allowing grazing to continue. These should be studied.

We have observed infestations of non-native plants on Long Valley rangelands consistent with long-term chronic cattle grazing impacts. These should be separated out from any recent effects of shutting off flood irrigation, which does not necessarily cause invasive weed infestations outside of cattle grazing. Detailed assessments of changes over time should be made of how plant communities are impacted from halting artificial diversions, as well as background disturbance from cattle grazing over many years.

Figure 16. Long Valley CA grazing lease on LADWP land in meadows (right), and ungrazed roadside meadow (left) along a marked barbed wire fence.

Figure 17. Cattle grazing in Long Valley CA. The impacts of vegetation removal and disturbance to meadows and sagebrush communities needs more consideration for Bi- State sage-grouse conservation. Glass Mountains in the distance.

The U.S. Forest Service Bridgeport Southwest Rangeland Project would analyze whether cattle grazing should be allowed on allotments that were closed to previous sheep grazing, on Bi-State DPS habitat. The allotments include Cameron Canyon, Dunderberg, Summers Meadow, and Tamarack grazing allotments on lands within the Humboldt-Toiyabe National Forest, Bridgeport Ranger District in Mono County, California. These allotments are recovering very well from past livestock grazing, and should be studied to determine how sage-grouse may be returning to the area and using the meadows, sagebrush-steppe, and groves of whitebark pine and aspen.

Figure 18. Recovering meadow in the Dunderberg Allotment, Humboldt-Toiyabe National Forest on the eastern slope of the Sierra Nevada CA. Past sheep grazing has impacted these communities, but cattle grazing is proposed now here.

Although there are no known leks in the project area, this habitat could be utilized as the species recovers. Before allowing cattle to graze this area, the Forest should do detailed surveys for sage-grouse, any new lek, nesting areas, early brood rearing areas, and other habitat use. Any Allotment Management Plan must reduce or eliminate grazing during these and any other seasonal periods of critical importance to this species.

During our visit in May 2018 (see Western Watersheds Project, the Center for Biological Diversity, and Wilderness Watch 2018), we saw large areas of the Jordan Basin, Dunderberg, Cameron Canyon, and parts of the Summers Meadow Allotments that appeared to be excellent habitat for sage-grouse. Both winter and summer habitat was present, with dense sagebrush and bitterbrush. Brood-rearing habitat on shrub-meadow edges appeared to be of high quality and recovering from past sheep grazing. We found native bunchgrasses, rhizomatous meadow grasses, and forbs were growing well in this ungrazed condition.

Figure 19. Meadows and aspen groves recovering from sheep grazing in the Cameron Canyon Allotment, Humboldt-Toiyabe National Forest, eastern slope of the Sierra Nevada. These are proposed for cattle grazing after years of grazing rest. April 2018.

Figure 20. Recovering from sheep grazing, Cameron Canyon Allotment.

Figure 21. Summer Meadow Allotment recovering from sheep grazing with healthy willow riparian and meadow communities. Humboldt-Toiyabe National Forest, eastern Sierra Nevada. April 2018. This area is proposed to be opened for cattle grazing.

Thines et al. (2004) found that cattle grazing reduced the nutritional quality (e.g., increased fiber and decreased protein) of the remaining grass. This depletion of native bunchgrasses not only alters the nutritional composition of native bunchgrasses, it also reduces the protective screening cover of native bunchgrasses critical to conceal sage-grouse nests. Sage-grouse also use herbaceous understory plants as forage.

Utilization rates of 45% in herbaceous upland sagebrush and mountain shrub communities are recommended by Humboldt-Toiyabe National Forest in allotments for cattle, but we are concerned this is too high.

The herbaceous understory of sagebrush shrub communities may be severely altered with cattle grazing: 45% utilization of herbaceous species in functioning upland sagebrush and mountain brush sites may not provide requisite cover for sage-grouse. For example, 45% utilization of needlegrass (*Stipa* spp.) may only leave 2.5 inches of stubble height remaining, and 45% utilization of squrreltailgrass (*Elymus elymoides*) may only leave 1 inch of stubble height. This is not enough to provide cover for sage-grouse, especially nesting cover. Bitterbrush is often selected as a nest shrub in the Bodie PMU (NDOW 2004).

Nest site evaluations in the Bodie PMU find forbs such as milkvetch (*Astragalus* sp.,), hawksbeard (*Crepis* sp.), phlox (*Phlox* sp.), groundsmoke (*Gayophytum* sp., scattered to common) and yarrow (*Achillea millifolium*). We saw all these species with the exception of groundsmoke on the allotments—land managers must ensure these forbs remain plentiful enough to provide nesting and foraging habitat in future. Abundant forbs are an important source of nutrition for pre-laying hens and hens with broods (Connelly et al. 2000). June hatching dates have been documented in the Bodie PMU and some potential for nest disturbance and trampling does exist for late season nesters (NDOW 2004). Land managers must implement methods wherein these and other impacts to sage grouse habitat can be avoided or mitigated, but such methods are not currently required regulatory mechanisms.

Summer habitat for sage-grouse in the Bodie PMU is at higher elevations, and sage-grouse often cluster around meadows, springs, and streams. These areas should be protected from heavy grazing. Due to their limited extent and susceptibility to livestock grazing induced ecological changes, the availability of quality meadow and riparian habitats may be a significant limiting factor for sage-grouse in the PMU (NDOW 2004).

Winter habitat commonly includes lower elevation stands of dense sagebrush. Fragmentation of these stands by cattle and fencing will impact sage grouse habitat and recovery as well.

Water projects also expand livestock use into less impacted sagebrush habitats, and expand livestock depletion. Salting and feeding of nutrients and supplements on the allotments can further create disturbed areas where weeds invade, shrub structure is altered, and the ground is trampled. Water hauling may also in allotments, which can create disturbed ground where cheatgrass can expand to.

Consideration of how cattle may impact the lek in Lower Summers Meadow, one of the few in the PMU west of US Route 395, and how impacts may occur from cattle grazing in such close proximity including fencing infrastructure and increased human activity. This allotment was closed to sheep grazing but is proposed to be opened to cattle grazing by Humboldt-Toiyabe National Forest.

A good model for managing sage-grouse areas with no cattle grazing can be found at Sheldon National Wildlife Refuge Nevada. Managers describe how sage-grouse habitats are recovering without cattle grazing: "With no cattle grazing, Refuge habitats are recovering."[3] Refuge management for sage-grouse recommends "Conservation Measures: Rest from livestock grazing."[4] Long term overutilization and annual long-duration spring grazing have contributed to risks to sage-grouse. Cattle grazing was removed from the Refuge to allow uplands to recover. Higher elevation sites appear to be recovering well,

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[1] http://www.ndow.org/uploadedFiles/ndoworg/Content/Nevada_Wildlife/Sage_Grouse/Sheldon-PMU-Plan.pdf, page 17.

[2] *Ibid.,* page 18.

with vigorous grasses noticeable. Even in the absence of horse use, recovery in lower elevation sites will be slow. Refuge habitats still suffer the effects of historic over-grazing, particularly at lower elevations.

Lack of understory for nesting cover and spring forage is another risk to sage-grouse, from over utilization of the understory in these communities. In many areas grass plants are still lacking, even 8 years after cattle were removed. Conservation measures considered to aid in restoration of the sage-brush-steppe here include prescribed fire.

Low density or lack of appropriate insects for early brood rearing is a risk to sage-grouse. Insects are critical to sage grouse chick survival, but sage grouse rely on a small number of insect families for food (ants, grasshoppers, and beetles). Sage grouse brood areas are characterized by great plant species richness with abundance forbs and insects. Healthy sagebrush systems with strong native understories should provide appropriate insects for sage grouse chicks.

Little is known about habitat needs for insects, but sagebrush plant communities with degraded understories are assumed to have fewer insects sage grouse need. Long-duration spring grazing use, long term overutilization and noxious weed/cheatgrass encroachment all lead to degraded understories. Conservation measures should include rest from livestock grazing.[5]

Gregg et al. (2009) found that poor habitat quality may be an important causative factor in reduced annual recruitment in sage-grouse. They found that both food and cover variables were positively associated with chick survival, including Lepidopteran availability, slender phlox (*Phlox gracilis*) frequency, total forb cover, and total grass cover. The hazard of an individual chick's death decreased 8.6% for each percentage point increase in total grass cover when the proportion of short grass was greater than 70%. The high-quality nutrition of certain insects and forbs may be important for early growth in chicks. Habitat management that promotes Lepidoptera and phlox abundance during the May and June early brood-rearing season should have a positive effect on brood survival, the authors determined.

[3] *Ibid.,* page 20.

Figure 22. Abundant phlox blooming in spring 2018 on the Dunderberg Allotment, east slope of the Sierra Nevada, recovering from sheep grazing as Humboldt-Toiyabe National Forest closed the allotment several years ago. But this allotment is being proposed for cattle grazing. This area needs to recover more from grazing.

The extent of current sheep grazing across the Bi-State area should also be considered as a cumulative impact on meadows, sagebrush shrublands, and montane habitats. In 2018 we observed domestic sheep grazing in the Glass Mountains and near Granite Basin along Highway 120.

Figure 23. Domestic sheep herd in sagebrush-bitterbrush hills near Granite Basin and Big Sand Flat along Highway 120. Summer 2018.

Fences

If sensitive resources such as springs or wet meadows need protection, the analysis should weigh the impacts of constructing more fences to exclude cattle, as fences still cause mortality to sage-grouse, and instead consider removal of cattle and fences from these areas. Tagging or marking of barbed wire fences across the Bi-State region is haphazard. Long Valley has marked fences, yet BLM land in the Bodie Hills has many unmarked fences, old fences falling down, and in disrepair.

Yet tagging barbed wire fences does not eliminate sage-grouse mortality—mortality is only reduced. Christiansen (2009) observed a 61% reduction in fence collisions with reflectors on fences, yet this still equates to mortality. Van Lanen et al. (2017) say: "Our results suggest that all three types of fence markers employed in our research were effective at reducing collision probabilities and confirmed our hypothesis, with stretches of marked fence having a 57% (27% - 87%) lower probability of containing ≥1 collision." But this means, broadly, that fence markers fail to prevent 43% of the collision mortalities from an unmarked fence. The best conservation action would be to remove fences where appropriate.

Twenty-two new miles of new fencing are proposed by Humboldt-Toiyabe National Forest in a recent Environmental Assessment[6] for the Jordan Basin, Dunderberg, Cameron Canyon, and parts of the Summers Meadow Allotments allotments. The Scoping Notices says that where possible, the amount of new pasture boundary fences needed would be reduced by taking advantage of topographic features or other natural barriers. The Forest Service also says that the permittee may employ herding as a substitute for fencing in some cases.

Existing and proposed fencing should be mapped in detail. A comprehensive fencing inventory of existing fencing should be included. In a recent visit to these Forest Service allotments, we found many confusing fence-lines on the edges of and within allotment boundaries. A non-live hot-wire was strung apparently on the edge of the Dunderberg Allotment that separated it from lands managed by the Eastern Sierra Land Trust in Sinnamon Meadow. Other hotwires (not live) were found in meadows near Dunderberg Creek. We recommend all non-essential fences be taken down to protect sage-grouse and other species.

The understory of gooseberry, meadow grasses and forbs was recovering well under riparian aspen groves along Cameron Creek, and we saw a pair of sooty grouse fly up from the dense streamside understory in the summer of 2018. Fencing off these riparian areas from cattle grazing could greatly improve riparian health. But more fencing will also be a hazard for sage-grouse and other wildlife.

Fencing can have significant impacts to wildlife by, for example, fragmenting habitat and by providing perching opportunities for predators. Existing fencing should be reduced or eliminated in Bi-State sage grouse habitat including occupied and recovery habitat and no new fencing should be allowed in these areas.

Sheldon National Wildlife Refuge has an active fence removal program. Since cattle no longer graze on the Refuge, new fences and watering facilities for livestock will not be built. Thus, predator perches are being removed here to benefit sage-grouse. This should be examined as conservation actions in the Bi-State area.

[4] https://www.fs.usda.gov/project/?project=49993

Figure 24. Old barbed wire fence in disrepair. Bodie Hills CA.

Figure 25. Unmarked metal and barbed wire fences presenting sage-grouse collision hazards in the Bodie Hills CA.

Threats to Sage-Grouse Habitat

Habitat quality is extremely important in our view. The Sage Grouse Initiative proclaims that sage-grouse numbers are declining, "largely due to habitat loss."[7]

Insufficient stubble for successful nesting cover, low vigor and diversity herbaceous vegetation that presents poor nesting cover and spring food, conversion of meadows to bare ground, and loss of sagebrush acres all contribute to poor sage-grouse habitat.

Residual grass cover for nesting and cover could be a key factor of sage-grouse conservation that is not being correlated with preferred habitat. Instead of focusing on conifer removal, we recommend the agencies analyze how residual grass cover relates to sage-grouse habitat use and declines—does livestock grazing reduce residual grass cover in certain areas, thus reducing cover quality for nesting and brooding sage-grouse hens? Does less residual grass cover on grazed ranges allow more coyote and raven predation of

[5] https://www.sagegrouseinitiative.com/sagebrush-community/the-bird/

sage-grouse? These questions need much more study to help understand causative factors in sage-grouse population declines.

The Sage Grouse Initiative has also claimed that livestock grazing increases insect foods for sage-grouse in meadows. Yet other studies question this.

Goosey (2018) in Montana, studied arthropod foods of sage-grouse in relation to livestock grazing. Goosey's preliminary analysis suggests that rested pastures harbor significantly more food arthropods than grazed pastures, as well as taller vegetation, which shelters and feeds both the birds and their arthropod prey. That suggests that deferring grazing during the early brooding period may increase the number of chicks that survive to adulthood.

Rest-rotation livestock grazing has been implemented on sage-grouse core areas with the purpose of improving rangeland health. Goosey collected arthropods in central Montana from three habitat classes: 1) Grazed (actively grazed livestock pastures), 2) Deferred (Ungrazed pastures), and 3) Idle (Lands of the Lake Mason National Wildlife Refuge lower unit). Total arthropod catches in pitfall traps were greatest from livestock Idle pastures. Deferred pastures also had numbers of preferred sage-grouse arthropod foods. Differences in habitat class catches revolved primarily around the high levels of thatch found on the Lake Mason Wildlife Refuge which altered the community composition and predator:prey ratios. Land managers have done an inadequate effort of maintaining higher levels of thatch on allotments.

Pesticide residues in the manure may be playing a role in why more arthropods of certain types were found on the ungrazed study site (Goosey et al. 2017). This brings up a point of the need to study herbicide applications that are often used following pinyon-juniper treatments and cheatgrass removal projects: how are these chemical applications, and other herbicide and pesticide use, potentially impacting sage-grouse arthropod and forb food sources? The USFWS will need to determine the extent to which chemical poisons may be affecting Bi-State sage-grouse populations, both directly through poisoning and indirectly through removing important food supplies for developing chicks.

Goosey found that for the first 21 to 28 days, the chicks eat arthropods almost exclusively. Butterfly and moth larvae are particularly important. Taller grasses and sagebrush and less bare ground correlated with higher numbers of beetles, moth and butterfly larvae and other arthropods. Rest-rotation may help increase arthropods.

Threats to Upland Plant Communities

In July 2018, we observed in the uplands above Convict Creek in Long Valley: Needle-and-thread grass (*Stipa comata*), other needlegrass species (*Stipa* spp.), Indian ricegrass (*S. hymenoides*), squirreltail grass (*Elymus elymoides*), and Great Basin wildrye (*E. cinereus*). These native bunchgrasses may gradually move in to occupy drying meadows, forming important native habitats for sage-grouse and other species. Continuing livestock grazing could hinder this recovery of upland native plant communities.

At the Bridgeport Southwest Rangeland Project on the eastern Sierra slope in Humboldt-Toiyabe National Forest closed allotments, we found a diversity of upland, sagebrush, and meadow communities. We found cheatgrass (*Bromus tectorum*) in low quantities in a few places in the Dunderberg and Cameron Canyon Allotments. The native grass and sagebrush scrub plant communities appear to be recovering well since 2009 when sheep were last removed. We found vigorous and abundant native bunchgrasses and rhizomatous grasses in uplands and meadows, such as Stebbins' bluegrass (*Poa stebbensii*)—a California endemic—as well as prairie junegrass (*Koeleria macrantha),* squirreltail grass (*Elymus elymoides*), thickspike wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*), blue wildrye (*Elymus glaucus*), Great Basin wildrye (*Elymus cinerreus*), creeping wildrye (*Elymus tritcoides*), needlegrasses (*Stipa* spp.), California brome (*Bromus carinatus*), as well as several species of sedge (*Eleocharis* spp.) and rush (*Juncus* spp.). In this matrix, various native forbs were seen growing, such as phlox (*Phlox* sp.), larkspur (*Delphinium* sp.), lupine (*Lupinus* spp.), pussypaws (*Calyptridium* sp.), cinquefoil (*Potentilla* sp.), fleabane (*Erigeron* sp.), white yarrow (*Achillea millefolium*), wild onion (*Allium* sp.), penstemon (*Penstemon* spp.), everlasting (*Antennaria* sp.), mule ears (*Wyethia* sp.), and hawksbeard (*Crepis* sp.).

Aspen groves in several places had a recovering lush understory of native plants. In Cameron Creek within the allotment we found native plants such as corn lily (*Veratrum californicum*), starry false Solomon's seal (*Maianthemum stellatum*), sweet cicely (*Osmorhiza* sp.), gooseberry (*Ribes* sp.), and stinging nettle (*Urtica dioica*) growing densely under aspen, harboring a pair of sooty grouse (*Dendragapus fuliginosus*) (May 24, 2018 visit).

Figure 26. Sage-grouse hen and young bird in the Bodie Hills in healthy ungrazed area near Potato Peak, with sagebrush, green rabbitbrush, and native perennial bunchgrasses. There is ample cover for sage-grouse here.

Increased grazing, trampling, vegetation removal, soil erosion, and increased disturbance is likely to increase cheatgrass in these native plant communities.

The mortality of juvenile big sagebrush increases with grazing intensity, and even small shifts in the juvenile sagebrush survival rate generate large repercussions in the vegetation community's future composition (Owens and Norton 1990).

Figure 27. Cattle impacts to sagebrush communities in Aurora Creek Canyon, Bodie Hills CA.

In addition, we saw other introduced plants on our visit: dandelion (*Taraxacum* sp.) in meadows in the Dunderberg and Summer Meadow Allotment, some remnant crested wheatgrass (*Agropyron cristatum*) in slope meadows in Dunderberg Allotment, bulbous bluegrass (*Poa bulbosa*) in lower meadows of Cameron Canyon Allotment, and some common mullein (*Verbascum thapsus*) in low areas of Cameron Canyon Allotment. All these species could potentially spread with cattle disturbance and degrade recovering sage-grouse habitat here.

Threats to Willow Riparian Plant Communities

Healthy riparian areas benefits sage-grouse by maximizing instream flow and adjacent meadow vegetation productivity, as well as reducing erosion from trampling and grazing.

Much of the willow groves along streams and along the Owens River may have been eliminated by historic grazing and other uses, and much habitat lost. These areas can be restored, however. Many willow riparian areas remain unfenced to livestock grazing on streams, and only more recently have streams been fenced in Long Valley by LADWP.

All current willow riparian vegetation in the Bi-State area should be mapped, as well as historic or potential willow vegetation that may have been degraded or eliminated by livestock grazing.

Utilization of willow riparian habitats of 20% is allowed in parts of the Humboldt-Toiyabe National Forest—this is too high, as cattle tend to concentrate along creeks and over-utilize willows. The willow riparian areas that are recovering from sheep grazing, as along Dunderberg Creek and Cameron Creek, may or may not be fenced in exclosures to protect them from browse-lines and breakage if cattle are allowed to graze these closed allotments in the future. These types of cumulative impacts should be considered for Bi-State sage-grouse survival.

Figure 27. Bare ground grazed and trampled by cattle along Aurora Creek in the Bodie Hills.

Figure 28. Bare ground grazed and trampled by cattle along Aurora Creek in the Bodie Hills. Willows browsed and broken.

Figure 29. Bare ground riparian vegetation grazed and trampled by cattle along Aurora Creek in the Bodie Hills.

Figure 30. Stream bank eroded and trampled by cattle along Aurora Creek in the Bodie Hills.

Figure 31. Cattle browsed and trampled willows, riparian marsh vegetation and big sagebrush in Aurora Creek, Bodie Hills CA.

Threats to Meadows

Moist and wet meadows are important to sage-grouse chicks because they provide abundant forbs and arthropod food for rapid growth. Sagebrush and rabbitbrush shrubs species provide protective cover for sage grouse and their broods within the meadows. The surrounding upland shrub communities provide cover, nesting habitat, and additional forage for adult sage grouse.

The following native meadow species and communities have been reduced in extent and quality in 2018 in Long Valley CA due to livestock grazing management practices: bulrush (*Schoenoplectus* spp.) marsh, sedge (*Carex* spp.) meadow, tufted hairgrass (*Deschampsia cespitosa*) wet meadow, saltgrass (*Distichlis spicata*) meadow, rush (*Juncus* spp.) meadow, Nevada bluegrass (*Poa secunda* spp. *juncifolia*) meadow, meadow barley (*Hordeum jubatum*) meadow, riverine creeping wildrye (*Elymus triticoides*) meadow, rabbitbrush (*Ericameria nauseosa*) scrub, upland native bunchgrass communities, Great basin wildrye (*Elymus cinereus*) stands, spring and spring-brook vegetation, and playas. The reduction and degradation of these sage-grouse habitats has not been addressed by land managers.

In Long Valley in 2018 we documented and photographed numerous natural green wet meadows this past summer that are supplied with natural hot spring brooks and stream flow. We have seen plenty of green meadow vegetation this summer, despite ditch diversion dewatering. Natural springs, streams, Sierra Nevada snowmelt runoff, and hot springs, as well as the Owens River and Lake Crowley shoreline wetlands, should be inventoried and protected from disturbance, as these provide high-quality sage-grouse nesting and brood-rearing habitats that are less subject to the changes in irrigation practice.

Conversion of meadow plant communities into bare ground is a threat to sage-grouse. Livestock grazing has been a major factor in disturbing native perennial plant cover enough to cause widespread bare ground in this region, from our field visits.

In 2018 we visited meadows in the Inyo National Forest at Trail Canyon, White Mountains, along the California/Nevada border, that were in extremely degraded state. Bare ground dominated the meadows from cattle overgrazing. Stream banks were eroded and chiseled, muddy areas were trampled that formerly help native meadow grasses such as tufted hairgrass (*Deschampsia cespitosa*), and cow carcasses littered the area. This could be an attractant to ravens and coyotes, who might then prey on the local sage-grouse populations.

Figure 32. Heavily grazed and trampled meadow in Trail Canyon, Inyo National Forest NV. The grasses, sedges, and rushes have mostly been eliminated, and cheatgrass is invading this flat. Sagebrush is trampled, and stream banks are eroding. September 2018.

Figure 33. Broken sagebrush and bare ground from cattle grazing and trampling in a sedge meadow. Trail Canyon, Inyo National Forest NV.

Figure 34. Heavily cattle-grazed meadow with cheatgrass patches. Trail Canyon, Inyo National Forest NV. September 2018.

Figure 35. Livestock grazed and trampled tufted hairgrass (*Deschampsia cespitosa*) meadow and willow riparian in Trail Canyon, northern White Mountains in the Boundary Peak Wilderness Area, NV.

We found several meadows in the Dunderberg Allotment in Humboldt-Toiyabe National Forest on the eastern slope of the Sierra Nevada to be somewhat degraded, yet recovering from past sheep grazing. Native grass and graminoid species were present, but some cheatgrass and bare soil was also in evidence. In the Cameron Canyon Allotment, along Cameron and Summers Creeks, meadows had infestations of weedy *Poa bulbosa,* and may be at risk. Upper Summers Meadow in the Summers Meadow Allotment was full of weedy dandelion and barely above Non-Functioning in many places in our opinion. This meadow should be rested from all grazing to allow for further recovery.

Irrigation of Meadows for Livestock Pasture

There are questions concerning the supposed benefits of irrigated meadows and livestock pastures to sage-grouse, when balanced by the costs and stressors of livestock grazing on habitat quality and cover.

In the semiarid cold deserts of the sagebrush steppe of the Eastern Sierra, irrigated agriculture has exerted dramatic effects on ecological processes and native riparian vegetation. Riparian areas and wetlands have been utilized for agriculture at much higher rates than adjacent uplands due to abundant water and fertile soils. Intensively engineered manipulations, such as groundwater pumping, construction of irrigation ditches, and river damming, usually accompany conversions from natural vegetation types to agricultural land.

In the Walker River Basin, 6,492 m of channels were recorded as diverted along section lines in General Land Office surveys (Tilts et al. 2012). Long Valley should be measured similarly with respect to historic diversions.[13]

LADWP owns over 315,000 acres of land in Inyo and Mono Counties. Much of this land is open to the public for recreational use and portions of it are leased to commercial ranching operations for cattle grazing.

On August 16, 2018 the Los Angeles Department of Water and Power (LADWP) today released a Notice of Preparation (NOP) for an Environmental Impact Report (EIR) which began the environmental review process for the proposed Mono County Ranch Lease

[13] http://www.ladwpnews.com/update-on-the-status-of-ladwp-leases-with-commercial-ranch-operators-in-mono-county-ca/

Figure 36. Bridgeport Valley CA ditch and wet meadow flood-irrigated pastures for cattle, as photographed from US 395 highway edge. Summer 2018.

Renewal Project under the California Environmental Quality Act (CEQA). LADWP owns grazing leases and water rights on land it owns in Long Valley, and says it proposes to enter into new, 20-year leases, with 10 current lessees of approximately 28,000 acres of City of Los Angeles-owned lands in Long Valley. LADWP says that "past leases of these lands to the same operators have expired, and they are currently operating on holdover status," according to the NOP.

The NOP goes on to describe how "historically, 6,100 acres of these lands were flood irrigated on an ad hoc basis to answer an LADWP operational need to manage surplus water flowing to the Los Angeles Aqueduct." As we understand it, LADWP decided to shut off irrigation water this summer to its ranch leases. Local outcry from ranchers, Mono County, and environmental groups resulted in LADWP initiating this environmental review under CEQA, and naming itself as the lead agency as it carries out this project. The recent extreme drought in California, which peaked in 2015-2016, probably played a role in Los Angeles tightening control of water in its holdings.

LADWP is proposing to issue new leases with the provision that "water may only be diverted to the leased lands to address LADWP's operational and environmental-protection purposes," according to the NOP. These "operation needs" are defined as "LA Aqueduct operations and shutdowns, flow limitations (such as managing last years' extremely high runoff to avoid flooding in the Owens Valley and overtopping Lake Crowley), and meeting habitat and fishery flow requirements."[9]

Surface water diversions located on streams for pasture irrigation is increasingly stressing

aquatic populations and habitats (Northcote 1998).

We support returning water to natural stream channels and wetlands, and avoiding the use of artificial ditches and flood irrigation of livestock pastures. We also recommend a reduction of AUMs on these areas, in order to help pastures return to potential natural vegetation, free of disturbance. In our observations, long-term livestock grazing and ground disturbance is a major cause of weedy invasive plant increase, not recent shut-off of irrigation ditch water. Without grazing pressure, dry meadows could return to native upland bunchgrass and sagebrush-shrub communities if allowed enough time to regrow from adjacent areas.

Native wildlife such as Sierra Nevada bighorn sheep, mule deer, and sage-grouse may have been historically displaced by cattle or domestic sheep over large areas that are now livestock irrigated pastures.

The Endangered Species Act requires agencies to ensure that any action they authorize "...is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [designated critical] habitat" (16 U.S. Code § 1536 (a)(2)). How have historic and recently modified

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[1] ibid.

diversions from natural streams impacted threatened or endangered species, or candidate species such as the Bi-State sage-grouse?

Prior to stream diversions in Long Valley, there may have been natural wet meadows associated with Convict Creek, McGee Creek, Hilton Creek, and other streams flowing from the Sierra Nevada into Owens River, within Long Valley. Natural snow-melt flood events may have dispersed water above channels and floodplains onto adjacent valley floors during wet years and high snowpack years in the Sierra Nevada. These natural overbank flooding events may have created wet meadows that provided sage-grouse brood-rearing habitat.

We noted that large acreages of Long Valley ranch leases are allowed to mow native sagebrush (*Artemisia tridentata*) and rubber rabbitbrush (*Ericameria nauseosa*) to eliminate this shrub community in favor of artificially flood-irrigated wet meadow pasture, in order to increase livestock forage. How much sagebrush is mowed each year, and how much native valley plant communities have been converted to mowed livestock pastures?

Axness and Clarkin (2013) described that diversion structures change the nature of a stream by ponding and diverting some water. Ideally, they are designed to remove water from the channel while passing sediment, woody debris, and fish beyond the structure. Most structures are effective in removing water, but they occasionally block sediment movement, accumulate debris, block fish passage in the main channel, entrain fish in the diversion ditch, or dewater the stream entirely.

Diversions could have been in place for decades and are still using manual techniques for water control. Many are in remote locations where headgates—if they exist—may or may not be adjusted in response to changing runoff, and ditch failures may not be noticed for days or weeks. Some diversions could take water from streams with threatened and endangered or candidate species, and effects on the aquatic system are of high concern for that reason.

Diversions that are not well designed and operated can damage streams, aquatic and riparian habitats, and aquatic organisms in very important ways.

Diversion ditches are periodically improved, maintained, and dug out with heavy machinery? This could impact sage-grouse, leks, nests, and brood-rearing areas, as well as to fish and willow flycatchers.

Active removal of diversions or allowing passive return to natural conditions in stream channels should be analyzed as a potential benefit to sage-grouse. The hydrology of all natural streams, rivers, and artificial diversion ditches should be analyzed with respect to flow, climate change impacts, groundwater retention, and watershed function.

2018 survey data summarized at the Bridgeport meeting of the Bi-State Sage-grouse Local Area Working Group and Technical Advisory Committee (TAC) meeting on July

18, 2018, indicate this sage-grouse DPS as a whole is in sharp decline. There are data gaps in the White Mountains Population Management Unit (PMU), the Long Valley PMU was hit hard by the recent extreme California drought and experienced a population crash, as well as suffering from raven predation subsidized by the trash dump in Long Valley. The Granite Mountains population, South of Mono Lake, only had two males counted on Big Sand Flat lek in 2018. Sagehen Meadow also had only two males on the lek. Only Bodie Hills has had increases in lek counts, possibly because it is higher elevation and therefore more buffered from droughts.

The Long Valley PMU experienced a 40% decline from the 2012 average, as determined by lek counts this year. It is imperative that LADWP incorporate recent drought crashes into ranch lease management for sage-grouse, and modify other management actions accordingly to ease stressors on sage-grouse populations (such as livestock grazing, fencing, and raven predation). Lowered stubble heights and removal of native sagebrush and rabbitbrush can reduce cover for sage-grouse hens and broods on meadows, increasing raven predation.

The unnaturally large subsidized raven population feeding daily on garbage at the Benton Crossing Landfill owned by Mono County is a large ingoing problem for sage-grouse locally. Although the landfill is slated to be closed in a few years we hope, it nevertheless is a huge stressor to sage-grouse, as ravens are attracted to the dump and then likely predate on sage-grouse in the surrounding ranch leases and meadows. We counted around 50 ravens at the landfill in August 2018, a much higher number than normal compared to a typical wild, remote sagebrush-steppe basin.

Radio-collared broods in Long Valley experienced 50% predation mortality by June 2018 from ravens (personal communication with LADWP staff August 2018).

LADWP could greatly help the problem by reducing or retiring grazing leases in significant sage-grouse meadows and habitats, in order to allow grass height to grow taller, meadows to recover from grazing impacts, sagebrush to recover from breakage and removal, and fences to be taken down. Cover should be measured in randomized vegetation plots.

Sage-grouse strongly select for moist sites with riparian shrubs or montane sagebrush during late brood rearing. Late brood rearing habitat on which broods are successfully reared represent rare habitats with a restricted distribution. There is a potential that such habitat could limit sage-grouse populations in Long Valley and the Bi-State region.

Convict Creek diversions 26 and 27 feed into sage-grouse lek areas. Diversion 26 apparently goes straight into lek 2 which may be at the edge of uplands and meadows, and diversion 27 may contribute to wet meadows in the area. The Sierra Nevada stream runoff may be impacted by climate change, and this should be a consideration for sage-grouse management. The recent epic drought was a large stressor to sage-grouse in Long Valley, and livestock grazing impacts on wet meadow and sagebrush vegetation may have played a part in accentuating these drought stresses.

Sage-grouse use meadows from mid to late summer. Meadow habitats provide insects and succulent forbs which are important for young sage-grouse. Greatest use of wet meadows occurs when vegetation in the surrounding upland habitat has dried out in the summer heat. Long Valley has an abundance of natural wet meadows, streamside wetlands, springs (see Appendix, Figure 4), natural lakeshores (such as Alkali Lake), and reservoir edges (Crowley Lake). These should be mapped, and an analysis of how sage-grouse use the natural wetlands and meadows undertaken.

Livestock management during sage-grouse lekking seasons, nesting, and brood-rearing seasons may be crucial to survival of the Long Valley and other populations of sage-grouse. Are cattle removed from these areas seasonally, and during which dates? What modified grazing practices are undertaken to conserve sage-grouse?

LADWP has described that it will use an adaptive management approach to determine how much water to release for sage-grouse (personal communication with LADWP staff 2018). Currently there is apparently 900-1,000 acre-feet/year released from Convict Creek diversions 26 and 27 to lek 2 and 3a. If there is more snowmelt, the area will receive large amounts of water; but if there is a drought the area will receive less water. This will impact sage-grouse leks. Because Long Valley is lower in elevation than the Bodie Hills PMU, it is less buffered from droughts. Therefore, LADWP should take more actions to conserve sage-grouse here, such as reducing livestock grazing impacts.

Other conservation measures should be considered in order to stop the declines of sage-grouse in Long Valley. The recently-acquired Nine-Mile Ranch along the Walker River in Nevada was made into a state recreation area[10] and opened to the public in September with interpretive panels and a visitor center. Work to protect priority habitat for sage-grouse is underway here. Beaver dams were found throughout the system on Rough Creek and Bodie Creek, and the resulting wet meadows and wetlands that form behind the dams may provide excellent sage-grouse brood-rearing habitat. Conservation measures discussed at the TAC meeting include installing a certain number of beaver dam analogs—artificial beaver dams that would mimic the function of actual beavers to create wet meadows.

On the Walker River State Recreation Area, cattle numbers were brought down considerably, which is allowing recovery of stream banks, meadows, and riparian areas. New grazing management practices are being implemented including a rotation system to alleviate pressure on sage-grouse and meadows. Certain riparian stream areas will be placed into exclusion zones. The state is undertaking a **Proper Functioning Condition Assessment** of riparian areas in the entire watershed, and ranking areas that are not functioning. Working with Ken Nussear and Scott Bassett out of the University of Nevada, Reno, a drone survey is being done to obtain high-resolution photographs of streams, meadows, and any irrigation ditches to gather a finer level of baseline data. They have discovered some new springs using this approach, and these springs will be protected from grazing. Weak spots in ditches are also found, that can be repaired if

[10] http://parks.nv.gov/about/explore-your-nevada-initiative/q-a-walker

needed (Pers. communication, with Zach Ormsby, Walker River State Recreation Area, October 2018).

According to the Fluvial Habitats Center out of Utah State University:

> Beaver (*Castor canadensis*) dam-building activities lead to a cascade of hydrologic, geomorphic and ecological effects that increase stream complexity, which benefits a wide-variety of aquatic and terrestrial species. Depending on biophysical and vegetation conditions present, beaver dam-building activities variously trap sediment; raise incised streambeds, often reconnecting them with their floodplains; subirrigate the valley downstream of a dam; create wetlands; slow runoff; mitigate impacts by floods; extend seasonal streamflow; increase stream complexity; extend riparian woody and other vegetation; and create or increase habitat for diverse and sometimes rare species, including amphibians, fish, small mammals, and birds. As a result, beaver are increasingly being used as a critical component of passive stream and riparian restoration strategies.[11]

The State of Nevada is using the **Beaver Restoration Assessment Tool**[12] to give a recommended density of beaver dams per kilometer of reach. This is designed to increase wet meadows for sage-grouse habitat (ibid.). Beaver are becoming more broadly appreciated for their utility as an ecosystem engineer capable of restoring streams, rivers, and wetlands to the benefit of numerous flora and fauna, including salmonids. Recently, Utah State University collaborated with Integrated Status and Effectiveness Monitoring Progam to develop a spatially explicit network model called the Beaver Restoration Assessment Tool (BRAT) to help assess the potential for using beaver as a stream conservation and restoration agent at the watershed scale. BRAT models the capacity of the landscape to support dam-building activity by beavers.

This type of management strategy should be considered for Long Valley and other grazed, irrigated meadows, including analog beaver dams.

[11] http://etal.joewheaton.org/udwr-beaver-restoration-assessment-tool-brat.html
[12] http://brat.riverscapes.xyz

Figure 37. Cattle pastures as seen from Benton Crossing Road in Long Valley, Mono County CA. Grazing leases managed by Los Angeles Department of Water and Power. Wet meadow, saltgrass, and sagebrush-rabbitbrush communities. This appears to us to be insufficient sagebrush cover, and possible insufficient grass cover and height, to make good nesting habitat (when compared to photographs for sagebrush habitats in Gillan et a. 2010). August 2018. Photographs by Laura Cunningham.

Figure 38. Ungrazed meadows near the Owens River fenced to exclude livestock, consisting of creeping wildrye (*Elymus triticoides*). Long Valley CA. August 2018.

Figure 39. Cattle grazed saltgrass and sagebrush-rabbitbrush meadow along Benton Crossing Road, Long Valley CA. Native saltgrass here is grazed heavily and bare ground is common, in what should be a wet meadow edge. August 2018.

Figure 40. Ungrazed fenced road right-of-way and apparently ungrazed spring brook and natural wet meadows near Little Alkali Lake, Long Valley CA. We saw sage-grouse hens here. Grass height and cover is much more acceptable as sage-grouse habitat, compared with grazed meadows. August 2018.

Figure 41. Grazed LADWP lease next to Whittmore Hot Spring consisting of tufted hairgrass (*Deschampsia cespitosa*) and rush (*Juncus* sp.). Long Valley CA. Utilization is about 30%. August 2018.

Figure 42. Ungrazed reference site of tufted hairgrass (*Deschampsia cespitosa*) in the Monitor Range, Nevada, Humboldt-Toiyabe National Forest. About 9,000 ft. July 2017.

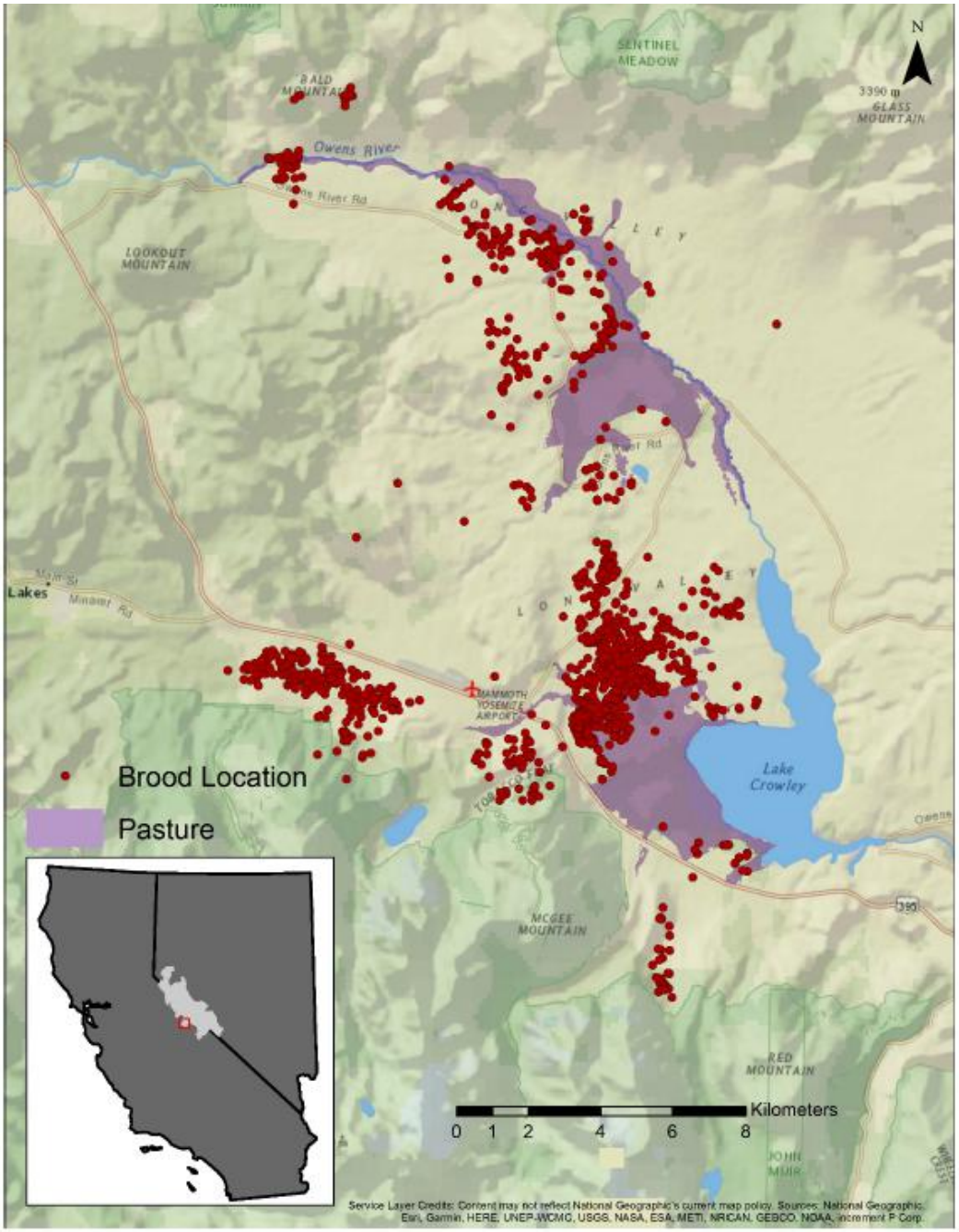

Figure 14. Locations of greater sage-grouse (*Centrocercus urophasianus*) females with broods (*n*=1,554) in relation of two irrigated pastures in Long Valley, California, 2007–17.

USGS map from Mathew et al. (2018 at 35) indicates little usage of irrigated pasture meadows in Long Valley by female sage-grouse with broods. Cover here is limited by livestock grazing. The researchers admit that, "At Long Valley, long-term data indicated uneven spatial patterns of irrigated pasture use, whereby use appears to be linked

to pasture edges more so than pasture interiors" (*ibid.* at 33).

Further analysis should include a detailed and thorough description of historical ecological baseline natural conditions in the Bi-State area, before European contact and before livestock grazing, such as existed before 1850. Looking at relict native vegetation communities, we believe conditions of natural meadows, grasslands, riparian groves, and sagebrush steppe have changed fairly drastically since this early time, and some areas appear to be trending to further disturbance and aridity. Comparing ungrazed reference sites to equivalent grazed and ditched pastures should be one method for determining healthy baseline conditions of these natural communities.

Other avenues of research are also available. Dilts et al. (2012) studied the ecological history of the Walker River Basin in Nevada, which lies just to the north of the Owens River Basin and Long Valley, using General Land Office Survey notes to quantify landscape conversions since the 1860s. Ditches were dug as early as this time period during Euro-American settlement. In the Walker River Basin 95 percent of historical meadow or wetland has transitioned to another land cover type, often agricultural use, according to this study. A similar study would be of interest for Long Valley.

In this study area, vegetation transitions that were classified as mesic to xeric were more frequent and far more geographically widespread than transitions from xeric to mesic. The authors go on to state:

> Thus, the pattern of land cover change at the watershed scale was consistent with the hypothesis of gradual desertification due to river incision, channelization, surface water withdrawals, groundwater pumping, and overgrazing. Transitions from meadow or wetland to upland shrub likely indicate changing groundwater conditions due to pumping or river straightening, and typically these transitions were located near the downstream portion of large valleys…. This general pattern has been noted elsewhere in Nevada where geomorphic constrictions, such as alluvial fans, have resulted in elevated water tables and meadow vegetation (Chambers and Miller 2004, 274). Wet meadow complexes were similarly noted by early travelers at the downstream portion of the Truckee Meadows valley in a watershed 75 km to the north of the Walker River study area (Bailey 1870). (ibid. p. 544)

Ditches dug through wetlands or springs can drain them and dry them out as well as redirect flow. Agricultural impacts may have gradually caused increased aridity in vegetation communities, and this needs investigation in Long Valley.

Irrigated meadows may not always attract sage-grouse, and this needs more study. We have investigated extensive diversion ditch and flood irrigated wet meadows that are grazed by livestock in Modoc County CA that have no sage-grouse, and leks have been reduced to very few in number in northeastern California despite extensive and widespread ditch irrigation. Other conservation measures and stressors should be investigated with respect to sage-grouse.

Traditional Ecological Knowledge

We support the inclusion of local Paiute oral traditions and Traditional Ecological Knowledge (TEK) into any status review, as equally important to Western scientific knowledge. This deep source of knowledge can be useful to all stakeholders, and can give perspective to historic conditions. With current baselines already much altered since the 1800s and early 1900s, TEK can inform possible future goals of restoration of habitats and recovery of sage-grouse populations.

In July 2018 we spent time in the Bodie Hills with members of the Bridgeport Paiute Tribe, learning about the TEK in this region. We encourage the Service to invite and interview native people to give testimony as to their deep knowledge, memories, and oral traditions about their historic and pre-historic observations of sage-grouse and habitats in this area. This knowledge should be integrated into any management planning for recovery of sage-grouse.

For example, we learned from Joseph Lent—Bridgeport Paiute—that along Aurora Creek in the Bodie Hills this area used to have sage-grouse leks. The old people, he said, used to burn the meadows to open up the sagebrush and create more grass. This also increased the edible grass and shrub seeds that people collected for food: Great Basin wildrye, ricegrass, buckberry, and gooseberry.

Suckers (*Catostomus* spp.) were common in creeks in the Bodie Hills in early days of his memory, he showed us, that are now devoid of surface water. He and his family used to net suckers in Clark Canyon Creek. Informants told us they used to see a lot of sage-grouse dancing in Aurora Meadows, but now there are none here. Cheatgrass has come in, they told us. But now due to cattle impacts there is no water here. The Clark Canyon tributary of Aurora Creek, for example, was heavily impacted by cattle during our July 2018 field visit to the Bodie Hills—there was only trampled mud and banks, no meadow vegetation, and browselines on the willows. No surface water remained—see our photos. This habitat in the past apparently held a viable sucker population, and could have been good sage-grouse habitat. Yet now it is highly degraded by cattle grazing on this allotment. We do not see how this management on BLM land is helping to stave off listing of the Bi-State DPS of greater sage-grouse.

There are oral histories of wagons crossing Bridgeport Valley in the early 1900s, and having large numbers of sage-grouse fly out of the meadows and sagebrush flats. Currently, sage-grouse seem to be absent from Bridgeport Valley.

Conclusion

We recommend that the Service lists the Bi-State DPS of greater sage-grouse as federally endangered, due to the lack of reversal of declines in almost all PMUs, including in 2018. The fact that one, and now possibly a second subpopulation will need augmentation indicates to us that conservation actions are not working. Before depleting more hens and broods from the Bodie PMU for translocation, the Service needs to take a hard look at recovery efforts that target root causes of population declines: raven predation, livestock grazing that reduces crucial native grass and shrub cover from predation, subsidy of raven and coyote numbers that may be artificially high due to urban and agricultural pressures, grazing infrastructure such as fences and water troughs, increases in cheatgrass, and degraded meadow habitat due to overgrazing of cattle and sheep. Using

large numbers of pinyon- juniper natural communities as a scapegoat for sage-grouse population declines is going in the wrong direction in our observation.

A better understanding of how pinyon-juniper treatments actually benefits sage-grouse in this tree-rich environment would go far in deciphering why vegetation treatments appear to not be effective in reversing sage-grouse declines.

We fully support new scientific studies which seek evidence of correlation of sage-grouse declines with habitat deterioration. We also seek scientific studies which give evidence of correlation of pinyon-juniper treatments with actual sage-grouse population increases. A lag time between conifer removal, and sage-grouse increase of several years, is not acceptable when populations are crashing in the Bi-State area. These studies should be ongoing as part of recovery while listing the DPS as threatened, and designating critical habitat. Only then will true effectiveness of conservation actions be tested and determined in the public eye, and redirecting agency and stakeholder resources to recovery actions that yield increasing populations.

Local Area Working Group agencies need to make all trend data and lek counts public and published. We are forced to take notes quickly and piece together the story, and the agencies are slow to publish their presentations on the Bi-State Sage-Grouse website or send their slide shows on request.

We support continuing a program of conservation easements on private ranchlands to aid the sage-grouse. But on public lands we will only support an effective and scientifically-based management strategy that truly increases sage-grouse populations with full public input, transparency, and independent verification with research and monitoring.

Thank you,

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References

Adler, P., K. Renwick, E. Kachergis, M. Manning, T. Remington, E. Thacker, C. Aldridge, B. Bradley, A. Kleinhesselink, C. Curtis, D. Schlaepfer, and B. Poulter. 2018. Managing big sagebrush in a changing climate. Logan, UT; Utah State Univ., 5 pp. Online at https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2900&context=extension_curall.

Ambrose, S., and C. Florian. 2014. Sound levels at greater sage-grouse leks, Pinedale Anticline Project Area, Wyoming, April 2013. Unpublished report prepared for the Wyoming Game and Fish Department, 133 pp. Available online at http://www.wy.blm.gov/jio-papo/papo/wildlife/reports/sage-grouse/2013GSGacoustic-rpt.pdf.

Ambrose, S., C. Florian, and J. MacDonald. 2014. Sound levels at greater sage-grouse leks in the Pinedale Anticline Project Area, WY, April 2013-2014. Unpublished report prepared for the Wyoming Game and Fish Department, 79 pp.

Ambrose, S., C. Florian, and J. MacDonald. 2015. Sound levels at greater sage-grouse leks in the Pinedale Anticline Project Area, WY, April 2013-2015. Unpublished report prepared for the Wyoming Game and Fish Department, 113 pp.

Arendt, P. A., and W. L. Baker. 2013. Northern Colorado Plateau pinyon - juniper woodland decline over the past century. Ecosphere 4(8):103. http://dx.doi.org/10.1890/ES13-00081.1

Armour, C. L., D. A. Duff, and W. Elmore. 1991. The effects of livestock grazing on riparian and stream ecosystems. Fisheries, 16:7-11.

Axness, D. S. and K. Clarkin. 2013. Planning and Layout of Small-stream Diversions. United States Department of Agriculture, Forest Service National Technology and Development Program 2500, Watershed, Soil and Air Management 1325: 1801.

Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation, 54: 419-431.

Bi-State Action Plan. 2012. Bi-state action plan—Past, present, and future actions for conservation of the Greater Sage-Grouse Bi-State distinct population segment: Prepared by the Bi-State Technical Advisory Committee (Nevada and California) for the Bi-State Executive Oversight Committee for Conservation of Greater Sage-Grouse, at http://sagebrusheco.nv.gov/uploadedFiles/sagebrusheconvgov/content/Archive/Bi-

StateActionPlan2012.pdf.

Bohn, C. C., and J. C. Buckhouse. 1985. Some response of riparian soils to grazing management in northeastern Oregon. Journal of Range Management, 38:378-381.

Boyte, S.P., and Wylie, B.K., 2018, Near-real-time herbaceous annual cover in the sagebrush ecosystem, USA, July 2018: U.S. Geological Survey data release, https://doi.org/10.5066/P9RIV03D.

Christiansen, T. 2009. Fence Marking to Reduce Greater Sage-grouse (*Centrocercus urophasianus*) Collisions and Mortality near Farson, Wyoming – Summary of Interim Results. Wyoming Game & Fish Dept. October 26, 2009.

Coates, P. S. and Delehanty, D. J. 2008. Effects of environmental factors on incubation patterns of Greater Sage Grouse. The Condor 110; 627-638.

Coates, P.S., K.M. Andrle, P.T. Ziegler, and M.L. Casazza. 2015a. Monitoring and research on the Bi-State Distinct Population Segment of greater sage-grouse (*Centrocercus urophasianus*) in the Pine Nut Mountains, California and Nevada – Study Progress Report, 2011-15. USGS Open File report 2015-1222, online at https://pubs.usgs.gov/of/2015/1222/ofr20151222.pdf.

Coates, P.S., M.A. Ricca, B.G. Prochazka, K.E. Doherty, M.L. Brooks, and M.L. Casazza, 2015b. Long-term effects of wildfire on greater sage-grouse—Integrating population and ecosystem concepts for management in the Great Basin: U.S. Geological Survey Open- File Report 2015–1165, https://doi.org/10.3133/ofr20151165.

Coates, P.S., Brussee, B.E., Howe, K.B., Gustafson, K.B., Casazza, M.L., and Delehanty, D.J., 2016a, Landscape characteristics and livestock presence influence common ravens— Relevance to greater sage-grouse conservation: Ecosphere 7: e01203, https://doi.org/10.1002/ecs2.1203.

Coates, P.S., Ricca, M.A., Prochazka, B.G., Brooks, M.L., Doherty, K.E., Kroger, T., Blomberg, E.J., Hagen, C.A., and Casazza, M.L. 2016b. Wildfire, climate, and invasive grass interactions negatively impact an indicator species by reshaping sagebrush ecosystems: Proc. Nat. Acad. Sci. 113: 12745–12750.

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(4): 90-96

Conover, M.R., and A.J. Roberts. 2017. Predators, predator removal, and sage-grouse: A review. J. Wildl. Manage. 81: 7-15

Crist, M.R., S.T. Knick, and S.E. Hanser. 2017, Range-wide connectivity of priority areas for greater sage-grouse—Implications for long-term conservation from graph theory. Condor 119: 44–57.

Dahlgren, D.K., R.T. Larsen, R. Danvir, G. Wilson, E.T. Thacker, T.A. Black, D.E. Naugle, J.W. Connelly, and T.A. Messmer. 2015. Greater sage-grouse and range management: Insights from a 25-year case study in Utah and Wyoming. Rangeland Ecol. Manage. 68: 375-382.

Dilts, T. E., P. J. Weisberg, J. Yang, T. J. Olson, P. Lee Turner, and L. A. Condon. 2012. Using Historical General Land Office Survey Notes to Quantify the Effects of Irrigated Agriculture on Land Cover Change in an Arid Lands Watershed. Annals of the Association of American Geographers 102 (3): 531-548.

Dinkins, J.B., M.R. Conover, C.P. Kirol, J.L. Beck, and S.N. Frey. 2016. Effects of common raven and coyote removal and temporal variation in climate on greater sage-grouse nesting success. Biol. Conserv. 202: 50-58.

Doherty, K.E., D.E. Naugle, J.D. Tack, B.L. Walker, J.M. Graham, and J.L Beck. 2014. Linking conservation actions to demography: Grass height explains variation in greater sage-grouse nest survival. Wildlife Biology 20:320-325.

Flenniken, M. R., R. McEldowney, W. C. Leininger, G. W. Frasier, and M. J. Trlica. 2001. Hydrologic responses of a montane riparian ecosystem following cattle use. Journal of Range Management, 54: 567–574.

Foster, L. 2016. Resource selection, and demographic rates of female greater sage-grouse following large-scale wildfire. M.S. Thesis, Oregon State Univ., 181 pp.

Foster, L.J., K.M. Dugger, C.A. Hagen, and D.A. Budeau. 2018. Greater sage-grouse vital rates after wildfire. J. Wildl. Manage. 83: 121-134.

Gamo, R.S., and J.L. Beck. 2017. Effectiveness of Wyoming's sage-grosue Core Areas: Influences on energy development and male lek attendance. Environ. Manage. 59: 189-203.

Garton, E.O., A.G. Wells, J.A. Baumgardt, and J.W. Connelly. 2015. Greater sage-grouse population dynamics and probability of persistence. Final Report to the Pew Chartitable Trusts, 90 pp.

Gregg, M. A., Crawford, J. A., Drut, M. S. and Delong, A. K. 1994. Vegetational cover and predation of sage grouse nests in Oregon. Journal of Wildlife Management 58: 162–166.

Gibson, D., E.J. Blomberg, M.T. Atamian, S.P. Espinosa, and J.S. Sedinger. 2018. Effects of powerlines on habitat use and demography of greater sage-grouse (*Centrocercus urophasianus*). Wildl. Monogr. 200: 1-41.

Gillan, J. K., G. M. Gray, J. Baungardt, and E. K. Strand. 2010. Sage-Grouse Habitat in Idaho: A Practical Guide for Land Owners and Managers. University of Idaho Rangeland Center.

Goosey, H. 2018. Arthropod Abundance Associated with the Natural Resources Conservation Service: Implications for Greater Sage-Grouse Management. Accessed on https://www.biorxiv.org/content/early/2018/07/02/356451, 1-2019. doi: https://doi.org/10.1101/356451

Gregg, M. A. and J. A. Crawford. 2009. Survival of Greater Sage-Grouse Chicks and Broods in the Northern Great Basin. Journal of Wildlife Management 73(6).

Hagen, C.A., J.W. Connelly, and M.A. Schroeder. 2007. A meta-analysis of greater sage-grouse *Centrocercus urophasianus* nesting and brood-rearing habitats. Wildlife Biology 13:42–50.

Heath, B.J., R. Straw, S.H. Anderson, and J. Lawson. 1997. Sage grouse productivity, survival, and seasonal habitat use near Farson, Wyoming. Unpublished completion report to the Wyoming Game and Fish Department.

Heinrichs, J.A., C.L. Aldridge, M.S. O'Donnell, and N.H. Schumaker. 2017. Using dynamic population simulations to extend resource selection analyses and prioritize habitats for conservation. Ecol. Modell. 359: 449-459.

Herman-Brunson, K.M., K.C. Jensen, N.W. Kaczor, C.C. Swanson, M.A. Rumble, and R.W. Klaver. 2009. Nesting ecology of greater sage-grouse *Centrocercus urophasianus* at the eastern edge of their historic distribution. Wildl. Biol. 15: 395-404.

Holloran, M.J., B.J. Heath, A.G. Lyon, S.J. Slater, J.R. Kuipers, and S.H. Anderson. 2005. Greater sage-grouse nesting habitat selection and success in Wyoming. J. Wildl. Manage. 69: 638-649.

Holloran, M.J., B.C. Fedy, and J. Dahlke. 2015. Winter habitat use of greater sage-grouse relative to activity levels at natural gas well pads. J. Wildl. Manage. 79:630-640.

Horney, M. 2008. Draft Conservation and recovery strategy for sage-grouse (*Centrocercus urophasianus*) and sagebrush ecosystems within the Devil's Garden/Clear Lake population management unit. 173 pp. including appendices.

Hutto, R. L., R. E. Keane, R. L. Sherriff, C. T. Rota, L. A. Eby, and V. A. Saab. 2016. Toward a more ecologically informed view of severe forest fires. Ecosphere7(2):e01255. 10.1002/ecs2.1255

Jankowski, M. D., Russell, R. E., Franson, J. C., Dusek, R. J., Hines, M. K., Gregg, M. and Hofmeister, E. K. 2014. Corticosterone Metabolite Concentrations in Greater sage-grouse are Positively Associated with the Presence of Cattle Grazing. Rangeland Ecology and Management. 67(3): 237-246. doi: http://dx.doi.org/10.2111/REM-D-13-00137.1

Karl, M.G., and J.C. Chambers. 2019. Livestock grazing management. Pp. 131-161 *in* Science framework for conservation and restoration of the sagebrush biome: Linking the Department of Interior's Integrated Rangeland Fire Management Strategy to long-term strategic conservation actiions, Part 2: Management Applications, M.R. Crist et al. eds. USDA Gen. Tech. Rep. RMRS-GTR-389.

Kattelman, R. 1996. Volume II. Chapter 30. Sierra Nevada Ecosystem Project - Status of the Sierra Nevada Final Report to Congress. Pp. 866-899 In: Sierra Nevada Ecosystem Project: Final report to Congress. Centers for Water and Wildland Resources, University of California, Davis.

Kauffman, J. B., and W. C. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management implications: A review. Journal of Range Management, 37:430-438.

Kirol, C.P., J.L. Beck, S.V. Huzurbazar, M.J. Holloran, and S.N. Miller. 2015. Identifying greater sage-grouse source and sink habitats for conservation planning in an energy development landscape. Ecol. Appl. 25: 968–990.

Knick, S. T., A. L. Holmes, R. F. Miller. 2005. The role of fire in structuring sagebrush habitats and bird communities. FIRE AND AVIAN ECOLOGY IN NORTH AMERICA. Studies in Avian Biology, no. 30. Page 6. Cooper Ornithological Society. Boise, ID.

Knight, R. L, Camp, R. J. and Knight, H. A. L. 1998. Ravens, Cowbirds, and Starlings at Springs and Stock Tanks, Mojave National Preserve, California. Great Basin Naturalist. 58(4): 393-395.

Kolada, E.J., M.L. Casazza, and J.S. Sedinger. 2009. Ecological factors influencing nest survival of greater sage-grouse in Mono County, California. J. Wildl. Manage. 73: 1341-1347.

LeBeau, C.W., J.L. Beck, G.D. Johnson, and M.J. Holloran. 2014. Short-term impacts of wind energy development on greater sage-grouse. J. Wildl. Manage. 78: 522-530.

Manier, D.J., C.L**. Aldridge**, P.J. Anderson, G. Chong, C.G. Homer, M. O'Donnell, and S.J. Schell. 2011. Land use and habitat conditions across the southwestern Wyoming sagebrush steppe: development impacts, management effectiveness and the distribution of invasive plants. *Natural Resources and Environmental Issues* Vol. 17, Article 4. Available at: http://digitalcommons.usu.edu/nrei/vol17/iss1/4.

Manier, D.J., Wood, D.J.A., Bowen, Z.H., Donovan, R.M., Holloran, M.J., Juliusson, L.M., Mayne, K.S., Oyler-McCance, S.J., Quamen, F.R., Saher, D.J., and Titolo, A.J. 2013. Summary of science, activities, programs, and policies that influence the rangewide conservation of Greater Sage-Grouse (Centrocercus urophasianus): U.S. Geological Survey Open-File Report 2013–1098, 170 p., http://pubs.usgs.gov/of/2013/1098/.

Manier, D.J., Z.H. Bowen, M.L. Brooks, M.L. Casazza, P.S. Coates, P.A. Deibert, S.E. Hanser, and D.H. Johnson. 2014. Conservation buffer distance estimates for greater sage-grouse: A review. USGS Open File Report 2014-1239, 14 pp.

Mathews, S.R., Coates, P.S., Prochazka, B.G., Ricca, M.A., Meyerpeter, M.B., Espinosa, S.P., Lisius, S., Gardner, S.C., and Delehanty, D.J., 2018, An integrated population model for greater sage-grouse (*Centrocercus urophasianus)* in the Bi-State Distinct Population Segment, California and Nevada, 2003-17: U.S. Geological Survey Open-File Report 2018-1177, 89 p., https://doi.org/10.3133/ofr20181177.

Meagher, Mary and Douglas Houston. 1998. Yellowstone and the Biology of Time: Photographs Across a Century. University of Oklahoma Press: Norman.

Meehan, W. R., and W. S. Platts. 1978. Livestock grazing and the aquatic environment. Journal of Soil and Water Conservation, 33:274-278.

Menke, J. W., C. Davis, and P. Beesley. 1996. Volume III, Chapter 22. Rangeland Assessment. Pp. 901-972. In: Sierra Nevada Ecosystem Project: Final report to Congress.

Centers for Water and Wildland Resources, University of California, Davis.

Mezquida, E.T., S.J. Slater, and C.W. Benkman. 2006. Sage-grouse and indirect interactions: Potential implications of coyote control on sage-grouse populations. Condor 108: 747-759.

Nevada Division of Wildlife (NDOW). 2004. Greater Sage-Grouse Conservation Plan for the Bi-State Plan Area of Nevada and Eastern California. First Edition. Prepared by the Bi-state Local Planning Group in conjunction with the Nevada Governor's Conservation Team.

Northcote, T.G. 1998. Migratory behavior of fish and its significance to movement through riverine fish passage facilities. *In*, Fish Migration and Fish Bypasses. 1998. Jungwirth, M., Schmutz, S., Weiss, S., eds. Oxford, England: Fishing News Books, Oxford, England.

(NTT) Sage-grouse National Technical Team. 2011. A Report on National Greater Sage-grouse Conservation Measures. Available at www.blm.gov/pgdata/etc/medialib/blm/co/programs/wildlife.Par.73607.File.dat/GrSG%20Tech%20Team%20Report.pdf.

O'Callaghan, P., M. Kelly-Quinn, E. Jennings, P. Antunes, M. O'Sullivan, O. Fenton, and D. Ó hUallacháin. 2014. Impact of Cattle Access to Watercourses: Literature Review on Behalf of the COSAINT Project (2014-W-LS-6). EPA Research Report. Prepared for the Environmental Protection Agency by Teagasc, Dundalk Institute of Technology and University College Dublin.

Olson-Rutz, K. M., C. B. Marlow, K. Hansen, L. C. Gagnon, and R. J. Rossi. 1996a. Packhorse grazing behavior and immediate impact on a timberline meadow. J. Range Management, 49:546-550.

Olson-Rutz, K. M., C. B. Marlow, K. Hansen, L. C. Gagnon, and R. J. Rossi. 1996b. Recovery of a high elevation plant community after packhorse grazing. J. Range Management, 49:541-545.

Orning, E.K., and J.K. Young. 2017. Coyote removal—Can the short-term application of a controversial management tool improve female greater sage-grouse survival or nest success? Wildlife Biology 2017: wlb.00345.

Owens, M. K. and Norton, B. E. 1990. Survival of juvenile basin big sagebrush under different grazing regimes. J. Range Manage. 43: 132-135.

Oyler-McCance, S.J., R.S. Cornman, K.L. Jones, and J.A. Fike. 2015. Genomic single-nucleotide polymorphisms confirm that Gunnison and greater sage-grouse are genetically well differentiated and that the Bi-State population is distinct. Condor 117: 217-227.

Piquette, D., A. Keck, N. Seward, B.P. Magee, P.A. Magee, and G. Patricelli. 2014. Acoustic soundscapes in the Gunnison Basin and effects of anthropogenic noise on Gunnison sage-grouse (*Centrocercus minimus*) in the Gunnison Basin, Colorado. Final Report submitted to Colorado Parks and

Wildlife, 27 pp.

Prather, P.R. 2010. Factors affecting Gunnison sage-grouse (*Centrocercus minimus*) conservation in San Juan County, Utah. PhD Dissertation, Utah State Univ., 134 pp.

Provencher, Louis, Greg Low, and Susan Abele. 2009. Bodie Hills Conservation Action Planning Final Report to the Bureau of Land Management Bishop Field Office, October 2009. The Nature Conservancy, One East First Street, Suite 1007, Reno, NV 89501.

Romme, W. H., C. D. Allen, J. D. Bailey, W. L. Baker, B. T. Bestelmeyer, P. M. Brown, K. S. Eisenhart, M. L.Floyd, D. W. Huffman, B. F. Jacobs, R. F. Miller, E. H. Muldavin, T. W. Swetnam, R. J. Tausch, and P. J. Weisberg. 2009. Historical and Modern Disturbance Regimes, Stand Structures, and Landscape Dynamics in Piñon–Juniper Vegetation of the Western United States**.** Rangeland Ecology & Management, 62(3): 203-222.

Row, J.R., K.E. Doherty, T.B. Cross, M.K. Schwartz, S.J. Oyler-McCance, D.E. Naugle, S.T. Knick, and B.C. Fedy. 2018. Quantifying functional connectivity: The role of breeding habitat, abundance, and landscape features on range-wide gene flow in sage-grouse. Evol. Appl. 11: 1305-1321.

Severson JP, Hagen CA, Tack JD, Maestas JD, Naugle DE, Forbes JT. 2017. Better living through conifer removal: A demographic analysis of sage-grouse vital rates. PLoS ONE 12(3): e0174347. https://doi.org/ 10.1371/journal.pone.0174347

Smith, K.T., C.P. Kirol, J.L. Beck, and F.C. Blomquist. 2014. Prioritizing winter habitat quality for Greater Sage-Grouse in a landscape influenced by energy development. Ecosphere 5(2):15. http://dx.doi.org/10.1890/ES13-00238.

Smith, K.T., J.L. Beck, and A.C. Pratt. 2016. Does Wyoming's Core Area policy protect winter habitats for greater sage-grouse? Environ. Manage. 58: 585-596.

Spence, E.S., J.L. Beck, and A.J. Gregory. 2017. Probability of lek collapse is lower inside sage-grouse Core Areas: Effectiveness of conservation policy for a landscape species. PLoS ONE 12(11): e0185885. https://doi.org/10.1371/ journal.pone.0185885.

Taylor, R. L., D. E. Naugle, L. S. Mills. 2010. Viability analysis for conservation of sage-grouse populations: Miles City Field Office, Montana. BLM Contract 09-3225-0012; Number G09AC00013. Final Report. Prepared for Bureau of Land Management, Miles City Field Office. Miles City, MT.

U.S. Fish and Wildlife Service. 2013. Greater Sage-grouse (*Centrocercus urophasianus*) Conservation Objectives: Final Report. U.S. Fish and Wildlife Service, Denver, CO. February 2013.

Van Lanen, N. J., A. W. Green, T. R. Gorman, L. A. Quattrini, D. C. Pavlacky Jr. 2017. Evaluating efficacy of fence markers in reducing greater sage-grouse collisions with fencing. Biological Conservation 213: 70-83.

Western Watersheds Project, the Center for Biological Diversity, and Wilderness Watch. 2018. Comments are submitted regarding the Public Scoping Notice for the Bridgeport Southwest Rangeland Project which anticipates preparation of an environmental assessment (EA) addressing livestock grazing on the Cameron Canyon, Dunderberg, Summers Meadow, and Tamarack grazing allotments on lands within the Humboldt-Toiyabe National Forest, Bridgeport Ranger District in Mono County, California.

White, P. S. and J. L. Walker. 1997. Approximating nature's variation: Selecting and using reference information in restoration n ecology. Restoration Ecology 5(4): 338-349.

Wohl, Ellen. 2017. Historic Range of Variability. Oxford Bibliographies. Accessed at https://www.oxfordbibliographies.com/view/document/obo-9780199363445/obo-9780199363445-0001.xml, May 2019.