January 5, 2016

Tim Murphy
Idaho State Director
Bureau of Land Management

Dear Mr. Murphy,

As ecologists who collectively have spent well over 150 years studying the shrub-steppe, we have read the Soda Fire Rehabilitation Plan with great interest. Thank you for making the restoration plan available to the public for comment. We also appreciate the opportunity to participate in the Soda Fire Rehabilitation tour on November 24. One of us (Eric Yensen) was able to attend and found it very helpful in better understanding the ongoing Soda Fire rehabilitation efforts. We appreciate the transparency and the requests for public input.

During the tour, BLM personnel stated that the rehabilitation team was open to suggestions on how to improve the effort. Based on our experience with shrub-steppe ecology, we have some observations, comments, and suggestions that we hope will be useful to BLM in improving the rehabilitation effort in 2016 and beyond.

The area being rehabilitated is topographically complex, and includes parts of two states; two BLM Districts; a mix of private, state and federal land; diverse pre-fire plant communities; and a range of burn patterns. Given this complexity and the need for emergency stabilization, the rehabilitation plan was assembled rapidly. Our kudos to BLM for their rapid response, trying to go beyond standard rehabilitation practice, and using the Soda Fire Emergency Stabilization and Rehabilitation (ESR) as an opportunity to improve methods of sagebrush steppe rehabilitation.

Over the years, BLM has become very proficient at reestablishing large seeded grasses to maintain productive rangelands. While commodity production is important, we recognize that sage grouse and other issues are driving the agency to explore new ways to rehabilitate rangeland for other things than beef production.

The public wants viable populations of sage-grouse, but they depend on forbs and sagebrush. We want golden eagles, but that implies good jackrabbit populations. Having prairie falcons implies good ground squirrel populations, and they are best sustained with forbs and Sandberg's bluegrass. Pronghorns require forbs and shrubs. We need biological soil crusts for nitrogen fixation. Conservation of native pollinators requires preserving the right species of forbs and shrubs. And so on. In this context, we offer the following suggestions and comments on the Soda Fire Rehabilitation Plan:

1) Ecosystem Focus. From an ecological point of view, the Soda Fire Emergency Stabilization and Burned Area Rehabilitation Plan seems focused on restoring tall grasses with some sagebrush and a few forbs added near areas with sage-grouse leks. Other wildlife mentioned included high profile species such as golden eagles. There does not seem to be explicit

recognition that a healthy shrub-steppe ecosystem depends on a diversity of plant, vertebrate, insect, and soil communities that may be impacted by fire.

Degraded shrub steppe is causing declines in populations of many formerly common species. Examples include the well-known pygmy rabbits and shrub-steppe dependent bird species, as well as a host of lesser known creatures such as horned lizards, reptiles in general, several species of small mammals, many plants (e.g., Idaho milkvetch, *Astragalus conjunctus*), etc. The list is long.

2) Rehabilitation Team. There are numerous range ecologists, wildlife biologists, and natural resource professionals that have substantial experience with sagebrush steppe ecosystems and who could be involved in this effort. We recommend establishing a science panel to guide future rehabilitation efforts. This panel should be composed of ecologists and resource specialists that could bring varied pertinent experience to rehabilitation efforts, instead of a team dominated by fire and operational personnel who lack scientific training and an ecosystem perspective. We suggest this group include federal, state, and university scientists and managers but that, for the sake of efficiency, the panel be confined to 6-10 qualified individuals.

3) Forbs. It is not clear from the plan just how much of the burned area will be seeded with forbs. The total area appears to be small and focused on places with high sage-grouse use. The sagebrush steppe had a diverse flora of forbs; many native species depend on them. The myth that the Intermountain West was largely grassland dies hard.

If benefitting sage-grouse is a primary driver for the rehabilitation effort, then seeding mixes need to place far more emphasis on native, perennial forbs preferred by sage-grouse and other native wildlife. Sage-grouse do not eat grasses, whereas forbs are crucial (Connelly et al. 2000).

Forbs are not as competitive as grasses. Their seedlings will be swamped out in seeding mixes containing high percentages of large-seeded grasses (Richards et al. 1998). The strategy of waiting to plant forbs until after large-seeded grasses are established is not convincing.

Forbs are critical components of sagebrush steppe ecosystems. The majority of our native herbivores eat little to no grass because of the difficulties of digesting cellulose. Forbs are far more digestible and are preferred by most native sagebrush steppe herbivores[1]. These sagebrush steppe forb-eating species perform important ecosystem services. Without more forbs, the ecosystem will degrade.

4) Cheatgrass Control and Forbs. We applaud the enthusiasm of the group that drafted the ESR plan, particularly for going after cheatgrass aggressively. This is very important. However, we have two concerns. First, spraying a pre-emergent herbicide (imazapic/Plateau) may not have much effect on cheatgrass in 2015 because it germinated prior to application. Second, and much more importantly, imazapic will kill any seedling forbs that emerge from the seed bank. This will decrease abundance and diversity of forbs which are necessary for sage grouse, pronghorns,

[1] Important exceptions were bison, elk, and jackrabbits. Bison and elk have a 4-chambered stomach and probably utilized shrub-steppe during the colder months. Jackrabbits have to pass grass through their digestive system twice to utilize it as food.

ground squirrels (keystone species), pollinators, other insects, and many others. Moreover, because of relatively high levels of crude protein, calcium, and phosphorus, early spring forbs are critical for female sage-grouse prior to incubation (Gregg et al. 2008).

On the other hand, the bio-herbicide trial using *Pseudomonas fluorescens* seems like an excellent idea and well worth the resources. We are anxious to see how effective it will be.

5) Drill Seeding. A rapidly growing body of peer-reviewed scientific literature shows that soil disturbing approaches to rehabilitation can be counterproductive (e.g., Pierson et al. 2009, Miller et al. 2012, Pyke et al. 2013, Knutson et al. 2014, Duniway et al. 2015). We have seen repeatedly that plowing stabilized Sandberg bluegrass sod opens it to cheatgrass invasion. Further, these are some of the most difficult areas to establish seeded species (Link et al. 1990). The tour even "showed off" an area with Sandberg bluegrass that had been drill seeded, albeit lightly. This is ironic, given that Sandberg bluegrass is a good competitor with cheatgrass. Areas dominated by Sandberg bluegrass, a small native bunchgrass with the same phenology as cheatgrass, should be maintained, not destroyed. The rationale for disturbing a stable community is hard to fathom.

Almost every study by BLM and USGS suggests that standard post-fire rehabilitation is too "heavy handed" (e.g., Downs et al. 2010, Miller et al. 2012). Minimum till drills and seeding shrubs are more effective than massive soil disturbance by rangeland drills plowing up the soil and creating an ideal seed bed for cheatgrass and other exotic annuals. The same picture emerges from rehabs done at the Hanford Site, which has the best long term monitoring. After ten years they had to report "no improvement in the rehab versus control areas" that were not treated but were rested from grazing (Hanford Site Revegetation Manual 2013).

6) Soils Crusts and Mycorrhizal Fungi.
Little things like biological soil crusts, mycorrhizae, blue-green algae (Cyanobacteria), and insects make or break ecosystems. Ironically, the human tendency is to focus on big things like livestock, sage-grouse, and mule deer. Rangeland drills do not appear to benefit biological soil crusts, mycorrhizae, soil organisms, or soil chemistry.

Drill seeding breaks up biological soil crusts (Miller et al. 2012). Biological soil crusts (a.k.a. cryptogamic crusts, microbiotic crusts) and other aggregated soil surface conditions have several important ecological functions.

- First, they inhibit erosion (Ravi et al. 2011).
- Second, biological soil crusts are the most important source of nitrogen fixation in sagebrush steppe ecosystems. After we lose the crusts, cheatgrass depletes the nitrogen, and the system spirals down into barren wasteland, as we see in many places today.
- Third, biological soil crusts are natural fire breaks in the sagebrush steppe. At low elevations in Wyoming sagebrush steppe habitat, biological soil crusts can cover over 40% of the soil surface (Rosentreter 1986).
- Fourth, biological soil crusts inhibit cheatgrass germination. Drill seeding can severely damage the same biological soil crusts that hinder cheatgrass germination and therefore their use be counterproductive (Serpe et al. 2006).

Soil crusts are a critical vegetative component of arid ecosystems around the world (Belnap and Lange 2001). BLM's own Technical Reference 1730-2 (Belnap et al. 2001) has a chapter dedicated to management techniques to maintain and improve existing biological soil crusts. There are examples of fire rehabilitation that promoted soil crust. A good example is in the Kuna Butte area. That rehab appears successful. After rehab, this arid area was rested from grazing for 9 years. When portions of the area burned a second time some 15 years later, no active rehab was necessary in order for the area to recover (Hilty et al. 2004).

Mycorrhizal fungi are also damaged or killed by rangeland drills. When rangeland drills cut into the soil profile, they break the net of fungal hyphae created by mycorrhizal fungi. Subsequently, mycorrhizal fungi decrease and may slowly die off. If the mycorrhizal fungi die and their co-evolved shrubs are not present within 2-4 years, no viable spores remain in the soil. The site will need to be re-inoculated with fungi. It then becomes very difficult for shrubs to reestablish on the site due to the lack of fungi. The less the soil is disturbed the longer the fungi can survive (Wicklow-Howard 1998).

Most native forbs form obligate mycorrhizal associations. In fact, the main plants that can thrive without mycorrhizae are weedy species adapted for disturbance, such as Russian thistle, annual kochia, forage kochia, halogeton, bur buttercup, and cheatgrass. Moreover, one of the main lessons learned from the "Dust Bowl" was to not drill or plow native habitat. We seem to have short memories. As a nation have we forgotten the lessons of the Dust Bowl?

At a bare minimum, the rehabilitation plan should include monitoring for biological soil crusts instead of ignoring them.

7) Native vs. Introduced Species. There are several ecological, evolutionary, and procedural problems with using non-native species in rehabilitation.

- There is no current way of predicting an introduced species' evolutionary potential. One of the hot topics in evolutionary biology right now is the evolution of invasive species. Most of the successful invaders seem to evolve after arriving in North America.

- Invasive species are usually introduced multiple times from various parts of their native ranges. This allows them opportunities to recombine with genes from distant relatives to form novel genotypes here in North America where they encounter novel environments and new selection pressures. They are either unsuccessful or they adapt to the novel environment. We can actually observe it happen in real time in some cases. Dr. Steve Novak at Boise State University is an expert on this topic. His work, and the work of others, has shown that cheatgrass in North America has evolved significantly since its arrival from Eurasia (Merrill et al. 2012; Novak 2004; Novak and Mack 1993, 2001; Novak et al. 1991a). So have many other Eurasian weeds (e.g., Novak et al. 1991b).

- After exotic species are introduced, either accidentally or deliberately, there is often a latent period before the species becomes invasive. During this latent or lag period, the plants adapt to the new environment. If they acquire the right adaptations, they can explode across the new landscape. The latent period can last from a few years to over a century.

- Non-native plant species used in rehabilitation are usually a single cultivar, less diverse genetically, and less prone to rapid evolution after establishment. This is good. However, the realized niches of these species are poorly understood. Even if a species used in rehabilitation is not spreading now, that does not mean that it will not become invasive at some time in the future.

8) Firebreaks and Forage Kochia. The rehabilitation plan calls for 69 miles of firebreaks (3,327 acres) at lower elevations to be planted with forage kochia. We think this is problematic for several reasons.

- There is peer-reviewed literature as well as unpublished reviews suggesting that forage kochia does not necessarily stay where it was seeded, but instead can spread away from the seeding area (Gray and Muir 2013). If BLM has contrary evidence, it should be published as quickly as possible. We do not need another invasive plant on our lands.

- Forage kochia has a deep tap root. It can remove ground water and change the hydrology of an area.

- Forage kochia simplifies plant communities. In the Birds of Prey National Conservation Area where forage kochia has been planted, the resulting plant communities have exactly two plant species: forage kochia and bur buttercup. While the community may be essentially fireproof, its diversity is too low to support many native species.

- Forage kochia's evolutionary potential is unknown. Even if it is not invasive now, it could become so in the future (#7 above).

- Native alternatives to forage kochia exist and can be used. Why not plant Sandberg's bluegrass and squirreltail grass, both of which do well in competition with cheatgrass?

- Bottomlands probably had basin wildrye which is included in some of the seeding mixes. This is fitting because it is native and was originally abundant in our region. It is also quite palatable to cattle in winter. Its consumption by livestock fueled the California gold rush and was critical in the settlement of the west (Lesperance et al. 1978). We encourage its re-establishment in appropriate sites.

- Several firebreaks in Owyhee and Elmore Counties created in the 1980's as part of the "Greenstrip" program. Now neglected, these long, plowed up strips in the landscape are merely weed corridors that OHV's drive on and spread cheatgrass. These firebreaks are not maintained for some reason. Will these new firebreaks look the same once the current concern dies down?

9) Rhizome-forming grasses. Streambank wheatgrass and thickspike wheatgrass are being used in the rehab effort. These are rhizome-forming (rhizomatous) grasses. While strong rhizomes can provide good erosion control, they crowd out everything else. Low biological diversity (= one species) is the result. Most native grasses are bunchgrasses rather than sod-forming or rhizomatous grasses. The native ecosystem had a relatively high percentage of bare ground (or biological soil crusts) where lizards, mice, and beetles could move freely. Many of these small, seemingly unimportant species perform essential ecosystem services. Rhizome-forming grasses such as intermediate wheatgrass, thickspike wheatgrass, and common brome crowd them out. These grasses are neither wildlife nor ecosystem friendly.

10) Insects. Insects have a number of important roles in rangeland ecosystems including pollination, decomposing litter, and providing food for higher trophic levels. Insects are also necessary for sage-grouse brood rearing. Therefore we need to produce habitats with plant species that can support a diverse insect fauna. A few species of large, exotic grasses will not accomplish this.

Insects are often critical for initiating plant litter decomposition (Belovsky and Slade 2000). However, native insects did not co-evolve with exotic plants and many are not adapted to eat them (Tallamy 2014). For this reason, exotic plants do not decompose as quickly as native species. Accumulations of up to 10 feet of undecomposed Russian thistle in some drainages in Owyhee and Malheur Counties are examples of this undesirable consequence of exotic weed invasions.

Because non-native plants do not decompose as readily as native plants, planting exotics can actually increase the fuel load since exotic grasses maintain a lot of standing dead material from year to year. This seems counterproductive to current management direction.

On the field trip, the argument was used that we need to get something (= large grasses) out there to stabilize things as soon as possible, and then we can go back and fill in with forbs. While there is certainly the necessity for rapid stabilization, those grasses are going to be there for a very long time. Disking up native Sandberg bluegrass to plant larger exotic grasses is counter-productive. Permanent changes are being made in an ecosystem. Seedlings of shrubs and forbs have a difficult time establishing in stands of competitive exotic grasses, so succession stagnates

at the site. When non-native species are included in rehabilitation efforts, they will likely persist for many decades.

11) Rest from Grazing. The Boise District may wish to re-visit the existing regulations about how soon grazing can begin after a fire. In the Boise District, this is an arbitrary time whereas in the Vale District, range condition is the determinant. The latter approach is more ecologically defensible.

12) Targeted Grazing. There are three issues with targeted grazing.

- Targeted grazing needs the right class of livestock managed in a narrow, targeted area. The literature on targeted grazing recommends goats and sheep, not cattle, as the livestock class to use (Launchbaugh and Walker 2006).

- Animals must be confined to targeted areas, but this requires either expensive fencing or herders.

- Most of the literature on the success or failure of targeted grazing merely measures grass cover and not soil compaction, diversity of forbs, soil aggregates, or other ecosystem functions (Seefeldt and McCoy 2003). Soil surface trampling could be more of problem in the sagebrush steppe than herbivory.

13) Local Sagebrush Seed Sources. The plan does not specify sagebrush seed sources. However, the news media are reporting that seeds of all three big sagebrush subspecies are being collected from the area of the fire. This is important because sagebrush adapts to local conditions and local genetic variants should be used. Our hats off to BLM for this! This is extremely positive.

On the other hand, low sagebrush and early sagebrush were common prior to the Soda Fire, and they are more preferred by sage-grouse than any of the big sagebrush subspecies (Rosentreter 2005, Frye et al. 2013). We found no discussion of those sagebrush types in the rehab plan.

14) Rehabilitation Practices

"For policy guidance on EMR decision memos, BLM area managers rely on FLMPA and an Executive Order from President Jimmy Carter in 1977 that mandates the Secretary of the Interior, in consultation with the Secretary of Agriculture, to restrict introduced species and encourage the use of native species. Because of FLMPA, the BLM is directed to reseed burned areas with species that will produce wildlife habitat as well as control soil erosion. These species should include native plants, particularly shrubs. The Presidential order primarily guides the BLM national rules set forth in Manual 1745 (1992) that require the site-specific evaluation of the use of nonnative plants in all activity plans, including *both normal and emergency fire rehabilitation projects*, and site-specific environmental assessments unless waived by the state BLM director. This evaluation is also guided by BLM Manual 1742 (1985) that describes fire rehabilitation procedures. … Similarly, state BLM policy in Idaho has encouraged the use of native plants in fire rehabilitation projects since 1995" (Richards et al. 1998: 628, emphasis added).

BLM Manual 1745 ("Introduction, Transplant, Augmentation, and Reestablishment of Fish, Wildlife, and Plants") discourages the use of exotic species if there is potential to adversely impact natural ecosystems and their biological diversity. The Manual states that: "Native species shall be used, unless through the NEPA process it is determined that: (1) Suitable native species are not available; (2) The natural biotic diversity of the proposed management area will not be diminished; (3) Exotic and naturalized species can be confined within the proposed management area; (4) Analysis of ecological site inventory information indicates that a site will not support reestablishment of a species that historically was part of the natural environment; (5) Resource management objectives cannot be met with native species."

With respect to the above, the Soda Fire rehabilitation currently includes the following exotic species: Crested wheatgrass "Hycrest II," Siberian wheatgrass "Vavilov II," thickspike wheatgrass "Schwendimar," triticale, alfalfa "Ladak," small burnet "Delar," and forage kochia 'Immigrant." This generates several questions:

- Was there a NEPA process to determine that suitable native species were not available? We understand ample Sandberg bluegrass seed is available.
- Did the NEPA process determine the exotic grasses and forage kochia will not diminish native diversity?
- Is there any assurance that exotic grasses and forage kochia can be safely confined?
- Did ecological site inventory indicate that areas within the Soda Fire will not support reestablishment of native species historically in the area?
- Do we know that resource management objectives cannot be met with native species?

Further, the Sage-Grouse National Technical Team (2011) recommended that the re-establishment of sagebrush cover and desirable understory plants should be given highest priority in restoration efforts and managed to ensure long-term persistence. Accomplishing this could include changes in livestock grazing management in order to achieve and maintain conditions beneficial to sage-grouse. Use of native seeds should be prioritized.

The argument is frequently made that native forb seeds are not available commercially in sufficient supply, so we don't use them. As we all know, demand drives supply. By avoiding using forbs, it keeps forbs in low supply and the price high. If rehabilitation efforts use more of them, the supply will increase and the cost will decrease.

Summary

In spite of the comments above, the Soda Fire ESR appears to be a substantial improvement over traditional rehabilitation plans of the past. It is moving in the right direction. We are encouraged to see more holistic thinking, and we want to give credit to the folks involved in the rehabilitation effort for the many good things they are doing.

However, we think the rehabilitation will be more successful if BLM were to:

- Employ an ecological science advisory team for guidance.

- Plant forbs over the entire area and use more species of forbs. Because sage-grouse are particularly vulnerable, plantings within breeding habitats can take priority, but the entire rehab area needs a high diversity of forbs for native wildlife. Planting forbs in grass-heavy seeding mixes may not be very successful.

- Rely less on drill seeding and use minimum till or no till when possible.

- Avoid using rhizome-forming grasses in seed mixes.

- Avoid using forage kochia until its ecology and evolutionary potential are better understood. The scant literature on the species is full of cautions.

- Refrain from disturbing the surface in areas dominated by stands of Sandberg's bluegrass. There is no need to plant shrubs, forbs, or tall grasses into these functioning systems.

- Manage to maintain diversity of forbs, soil crusts, insects, and fungi, and to maintain the sagebrush-steppe.

We wish BLM utmost success in the Soda Fire rehabilitation effort. Thank you for this opportunity to comment.

Sincerely (in alphabetical order),

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