

**From:** [Martini, Jay](#)  
**To:** [Laura Romin](#); [Betsy Herrmann](#); [Larry Crist](#)  
**Subject:** Fwd: GRSG 2015: Urgent - Review of FIAT Step-down Assessment Comment Letter Needed by 12:00PM PST, Friday 1/30/15  
**Date:** Thursday, January 29, 2015 8:06:52 AM  
**Attachments:** [Draft FIAT Comments 012615 Meeting.docx](#)  
[BLM0003153 - 2 Attachment 2 Final Fire and Invasive Assessment 6-10-14 w Appendices.pdf](#)

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If any of you are interested in seeing the Southern/Northern Great basin or any of the assessments (500 pages each!) I have them on a thumb drive. They also are on the Z drive Z:\Martini\FIAT assessments

----- Forwarded message -----

**From:** **Davis, Dawn** <[dawn\\_davis@fws.gov](mailto:dawn_davis@fws.gov)>  
**Date:** Wed, Jan 28, 2015 at 4:23 PM  
**Subject:** GRSG 2015: Urgent - Review of FIAT Step-down Assessment Comment Letter Needed by 12:00PM PST, Friday 1/30/15  
**To:** Larry Crist <[larry\\_crist@fws.gov](mailto:larry_crist@fws.gov)>, Michael Carrier <[michael\\_carrier@fws.gov](mailto:michael_carrier@fws.gov)>, Dennis Mackey <[dennis\\_mackey@fws.gov](mailto:dennis_mackey@fws.gov)>, Paul Henson <[paul\\_henson@fws.gov](mailto:paul_henson@fws.gov)>, Ted Koch <[ted\\_koch@fws.gov](mailto:ted_koch@fws.gov)>, Mary Grim <[mary\\_grim@fws.gov](mailto:mary_grim@fws.gov)>, Jesse Delia <[jesse\\_delia@fws.gov](mailto:jesse_delia@fws.gov)>, Pat Deibert <[pat\\_deibert@fws.gov](mailto:pat_deibert@fws.gov)>, Lief Wiechman <[lief\\_wiechman@fws.gov](mailto:lief_wiechman@fws.gov)>  
**Cc:** Angela Sitz <[angela\\_sitz@fws.gov](mailto:angela_sitz@fws.gov)>, Sarah Kulpa <[sarah\\_kulpa@fws.gov](mailto:sarah_kulpa@fws.gov)>, Jason Pyron <[jason\\_pyron@fws.gov](mailto:jason_pyron@fws.gov)>, Jay Martini <[jay\\_martini@fws.gov](mailto:jay_martini@fws.gov)>, Katie Powell <[katie\\_powell@fws.gov](mailto:katie_powell@fws.gov)>, Brandon Miller <[brandon\\_miller@fws.gov](mailto:brandon_miller@fws.gov)>

All,

As you are aware, the BLM pushed back their deadline to complete FIAT step-down assessments to the end of February. The revised timeline includes a review period of the draft assessments by FWS (1/20 – 2/3/15) and then a subsequent period for revisions and improvements in assessments, with a final delivery of the FIAT assessments to the BLM State Directors 2/27/15.

The FWS FIAT technical team has completed their initial review of the FIAT assessments; however, due to the length and complexity of the step-down assessments and the short review period, we were not able to provide the BLM the line-by-line comments they initially requested. Despite these limitations, I want to commend our FO staff (Angela Sitz, Sarah Kulpa, Jay Martini, Jason Pyron, Katie Powell, and Brandon Miller) for their timely review and compilation of comments.

Attached, please find the FWS FIAT technical team review and draft comment letter. The team was not in complete agreement on the content and extent of comments for

this product and we are seeking additional input on the inclusion of ecologically-based statements. For example, to what extent (if any) should ecologically-based statements (specifically items. 5 and 9) be included in our initial comments to the BLM? Are inclusion of these statements beyond the scope of the FIAT assessments? In addition, is there a need to demonstrate certainty of implementation and effectiveness at this stage of the process (item no. 11)? The FIAT report (this was attachment 2 in the August IM which announced FIAT) articulates what the BLM is attempting to accomplish in the Step 2 assessments (attached for additional guidance).

Please provide your written edits/comments/and requested changes to me by **12:00PM PST, Friday 1/30/15**. We recognize that this is a tight time frame to work within but this allows me to compile comments and deliver a draft to ARDs for review by COB Friday, and ultimately our final comments to the BLM by **2/3/15**.

The FIAT assessments can be accessed electronically at the BLM FIAT SharePoint site. For FWS folks who have not accessed the SharePoint site, you will need to get permissions through the BLM's SharePoint steward. If you would like access to the SharePoint site please let me know and I will request permissions; otherwise, I encourage you to work directly with the FWS technical team lead for your priority area.

Thank you,

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**Dawn Davis, Ph.D.**

**Certified Wildlife Biologist ®**

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January 26, 2015

DRAFT: USFWS Comments on BLM Draft FIAT Assessments

On January 20, 2015, the U.S. Fish and Wildlife Service (Service) received the Bureau of Land Management's (BLM) Greater Sage-grouse Wildfire, Invasive Annual Grasses and Conifer Expansion Assessments (FIAT assessments) for five priority landscapes within the Great Basin, including:

- Northern Great Basin (NGB)
- Snake Salmon Beaverhead (SSB)
- Southern Great Basin (SGB)
- Western Great Basin (WGB)
- Central Oregon (CO)

The Service commends the BLM for completing the drafts of these step-down assessments within the short timeframes provided, and we appreciate the opportunity to comment. Due to the complexity of the topics involved, length of the step-down assessments, and compressed timeframes, we were not able to complete a "line by line" review of these documents. The review provided below was completed by Service staff from Regions 1, 6, and 8. We anticipate that this will be an iterative process and that the Service will continue to work closely with the BLM to ensure a consistent approach and the delivery of effective products across the five planning areas. We would like to emphasize that our comments are intended to continue the collaborative process in which we are engaged and provide you with ongoing feedback as you refine and implement the FIAT assessments.

On January 6, 2015, the Service issued a memorandum ("USFWS FIAT memo") to clarify our perspective on the FIAT assessment implementation. This document provided eight guiding principles to the BLM FIAT Planning Area Leads, as well as to the FIAT Technical Team, to help ensure the step-down assessments were completed in a consistent manner that will benefit sage-grouse. The Service used this memo as guidance for our review process and we reference specific principles below.

The following are comments that the Service has compiled regarding the five FIAT assessments:

1. Within each of the five FIAT assessments, there is repetitive proposed management action language that unnecessarily lengthens the step-down assessments. In each FIAT assessment, we recommend creating a section (e.g., 4.1.3) that captures this consistent language that can be applied across all Project Planning Areas (PPAs).
2. As the BLM completes the FIAT assessments, we strongly encourage coordination with other State and Federal partners (Principle 2) to maximize treatment effectiveness through implementation of management actions across jurisdictional boundaries and to ensure that the FIAT assessments are consistent with Resource Management Plan (RMP) goals, objectives, and management actions to conserve sage-grouse. Where coordination has occurred, please document appropriately.
3. The current FIAT assessments inconsistently apply management actions across the Resistance and Resilience (R&R) matrix (Chambers et al. 2014); therefore, effectiveness of these actions may be compromised. The Service encourages BLM to ensure that proposed management actions are appropriately proposed and prioritized per Table 4 (Chambers et al. 2014) (Principle 4). The Service recognizes the limitations of the R&R data and supports deviations in

management actions where it can be adequately supported by local biological and ecological data.

Specific examples of inconsistent application include:

- Fuels Management:
    - There are currently extensive fuel breaks proposed outside of 1<sup>st</sup> order priority areas (2B, 2C, and 3C). Sufficient rationale is necessary for prioritizing fuel breaks outside of these 1<sup>st</sup> order priority areas.
  - Habitat Restoration and Recovery:
    - Conifer treatments should be prioritized in Phase I and early Phase II conifer areas within focal habitats. We also recommend using Table 4 (Chambers et al. 2014) in addition to proximity to leks to guide the prioritization process. We recommend reviewing CO, WGB, and SGB step-down assessments for sufficient examples of prioritization.
  - Fire Operations:
    - Suppression was not prioritized according to Table 4 (Chambers et al. 2014) in the NGB and SSB step-down assessments. We recommend reviewing CO, WGB, and SGB step-down assessments for examples of prioritization per Table 4. Attributes, as currently mapped, do not clearly depict priority order.
  - Post-fire Rehabilitation:
    - Post-fire rehabilitation was not prioritized according to Table 4 (Chambers et al. 2014) in the NGB and SSB step-down assessments. We recommend reviewing CO, WGB, and SGB step-down assessments for examples of prioritization per Table 4. Mapped attributes do not clearly depict priority order.
4. The current FIAT assessments inconsistently apply proposed management actions across jurisdictional boundaries (e.g., state and BLM Districts). We recommend that the BLM use a cross-boundary approach that involves all major land owners to ensure effectiveness of proposed management actions. Specific examples of inconsistent application include:
- Fuels Management:
    - Proposed management actions were not always continuous across state borders and BLM District boundaries.
  - Fire Operations:
    - There was a lack of consistent management actions to improve or enhance suppression capabilities (e.g., response time, water availability, and prepositioning resources analyses). All of these analyses are needed in the NGB and SSB FIAT assessments and we recommend that BLM use CO as an example. In addition, consistency in displaying this information in the data layers is needed across all step-down assessments.
5. The FIAT assessments should facilitate a greater emphasis on proactive management actions and not just increase the application of reactive management actions (Principle 5). The Service recommends a greater emphasis on the following proactive management actions:
- Include standard language in all FIAT assessments to address passive restoration needs. For example, “Manage livestock grazing and wild horse and burro populations to prevent loss of perennial native grasses, forbs, and biological soil crusts and to allow for natural regeneration.”

- Across all FIAT assessments, a more consistent and thorough approach is needed to assess and address invasive annual grasses. We recommend management actions that include inventory, treatment (biologically, culturally, chemically, or mechanically), and long-term monitoring. In addition, consistency in displaying this information in the data layers is needed across all step-down assessments.
  - Include language that stresses the use and importance of native, genetically appropriate and locally-adapted seeds and plant stock in restoration treatments (Principle 6). Shortfalls in seed availability, seeding knowledge, and seed handling practices often hamper rehabilitation and restoration outcomes. Botanists and plant ecologists need to be involved in seeding/planting decisions to ensure that genetic and climatic factors are considered to select the best seed, seed mix, and restoration technique(s) to maximize plant establishment. Funding must be carefully directed to support seed collection, seed increase, seed storage, seed and plug planting, and vegetation monitoring.
  - Stand-alone fuel breaks and conifer treatments implemented solely to reduce fuel loads and/or reduce the risk of large, high severity fires may not equate to sagebrush ecosystem restoration and may require integration of other strategies to be considered restoration (e.g., treatment of invasive annual grasses, seedings, plantings, etc.). In addition, the purposeful introduction of nonnative species, such as crested wheatgrass and forage kochia, for fuel breaks or habitat restoration may undermine the long-term resistance and resilience of native plant communities (Principle 6). The use of nonnative species should be considered a type conversion and these species should not be used to meet restoration targets. At the Next Steppe Conference in Boise, Idaho (November 5-7, 2014), the Winnemucca BLM District identified the advantages of using native species (e.g., Sandberg bluegrass) for fuel breaks. This is an example of innovative management actions encouraged by the Service.
6. For proposed management actions outside of focal habitat, ensure there is a sufficient biological rationale for why they are included (i.e., incorporates winter or other seasonal habitat(s), addresses an invasive monoculture issue that is threatening habitat , etc.).
7. Conifer and invasive annual grass management actions are discussed in different sections in the various FIAT assessments (i.e., fuels management versus habitat restoration). Objectives for reducing fuels versus habitat restoration are different and FIAT assessments need to ensure that proposed conifer and annual grass management actions meet the appropriate management objectives. For example, removing conifers and/or annual grasses along a roadside as a fuel break may have different objectives than treating conifers and/or annual grasses to restore habitat to meet sage-grouse habitat requirements (e.g., restoration efforts may necessitate more treatments than simply removing invasive species).
8. Management actions that are baseline approaches (e.g., use of native plant seed, assessing areas for invasive species, strategies for fire rehabilitation, etc.) should be shared and incorporated across all FIAT assessments. Examples of this are WGB and CO fire operations language and SGB fire rehabilitation language.
9. Under the habitat restoration and recovery section, we recommend that all step-down assessments include incorporation of passive restoration language developed by the WGB: “Areas treated would be rested from livestock grazing for a minimum of two growing seasons to allow the cool season bunchgrasses- which are especially vulnerable to grazing after treatment-

to capitalize on resource availability created by the disturbance. However, reintroduction of livestock to a disturbed area prior to the native or reseeded plant community becoming established, regardless of the number of years of rest afforded the site, can result in failed rehabilitation efforts and increased levels of non-native invasive annual grasses, therefore grazing should be deferred until resource objectives are met as determined by a BLM interdisciplinary team.”

10. Currently there is an abundance of information articulated in the step-down assessments that have not been spatially depicted in a consistent format. Consistent geospatial depictions and associated attribute tables should be included where possible.
11. It is imperative that the results of these FIAT assessments demonstrate reasonable certainty of implementation and effectiveness (Principle 8). In addition to the general project or treatment type information, the Service is seeking a narrative explanation of how the effort intends to address one or more threat(s) identified in the Conservation Objectives Team (COT) Report (USFWS 2013). The Service is also seeking information on whether the efforts were successful in fulfilling the stated objectives, and effective in ameliorating or reducing one or more threats to sage-grouse.

Randomly applying management actions without considering the long-term duration of treatments will compromise the success of achieving ecologically relevant improvements. To the extent practicable, we recommend that the BLM provide clear direction on project prioritization and provide a summary table (see below for example) and associated schedule for implementation. This should include projects where NEPA has been completed and those where NEPA will be immediately initiated.

| Project | Treatment Type | Project Metrics <sup>1</sup> | Project Details | Threats Addressed | NEPA Needed | NEPA Complete | Treatment Timeframe <sup>2</sup> | Certainty of Effectiveness <sup>3</sup> | Maintenance Timeframe <sup>4</sup> |
|---------|----------------|------------------------------|-----------------|-------------------|-------------|---------------|----------------------------------|---|------------------------------------|
|         |                |                              |                 |                   |             |               |                                  |   |                                    |
|         |                |                              |                 |                   |             |               |                                  |   |                                    |
|         |                |                              |                 |                   |             |               |                                  |   |                                    |
|         |                |                              |                 |                   |             |               |                                  |   |                                    |

<sup>1</sup>E.g., total acres, total miles.

<sup>2</sup>Provide incremental objectives and dates for achieving them.

<sup>3</sup>Describe how the project reduces the threat(s).

<sup>4</sup>Provide quantifiable performance measures to monitor both implementation and effectiveness. If specific, measurable, time-bound, incremental objectives are not available, provide additional information that explains why the project or treatment type is on the correct trajectory to provide functional habitat given adequate time.

12. Once the FIAT assessments are completed, monitoring based on adaptive management triggers (including both spatial and temporal scales) and a robust data management plan is imperative to ensure management actions will be successful (Principle 7).

# **Greater Sage-Grouse Wildfire, Invasive Annual Grasses & Conifer Expansion Assessment**

**June 2014**



## Introduction and Background

The purpose of this assessment is to identify priority habitat areas and management strategies to reduce the threats to Greater Sage-Grouse resulting from impacts of invasive annual grasses, wildfires, and conifer expansion. The Conservation Objectives Team (COT) report (USFWS 2013) and other scientific publications identify wildfire and conversion of sagebrush habitat to invasive annual grass dominated vegetative communities as two of the primary threats to the sustainability of Greater Sage-Grouse (*Centrocercus urophasianus*, hereafter sage-grouse) in the western portion of the species range. For the purposes of this assessment protocol, invasive species are limited to, and hereafter referred to, as **invasive annual grasses** (e.g., primarily cheatgrass [*Bromus tectorum*]). Conifer expansion (also called encroachment) is also addressed in this assessment.

The United States Fish and Wildlife Service (USFWS) will consider the amelioration of impacts, location and extent of treatments, degree of fire risk reduction, locations for suppression priorities, and other proactive measures to conserve sage-grouse in their 2015 listing decision. This determination will be made based in part upon information contained in the United States (US) Department of the Interior, Bureau of Land Management (BLM) resource management plan (RMP) amendments and Forest Service land resource management plan (LRMP) amendments, including this assessment.

This assessment is based in part on National Resources Conservation Service (NRCS) soil surveys that include geospatial information on soil temperature and moisture regimes associated with resistance and resiliency properties (see following section on *Soil Temperature and Moisture Regimes*). While this assessment is applicable across the range of sage-grouse, the analysis is limited to Western Association of Fish and Wildlife Management Agencies' (WAFWA) Management Zones III, IV, and V (roughly the Great Basin region) because of the significant issues associated with invasive annual grasses and the high level of wildfires in this region. The utility of this assessment process is dependent on incorporating improved information and geospatial data as it becomes available. Although the resistance and resilience concepts have broad applications (e.g., infrastructure development), this assessment is limited to developing strategies to reduce threats to sage-grouse habitat (e.g., invasive annual grasses and wildfires).

Draft Greater Sage-Grouse Environmental Impact Statements (EISs) contain a suggested framework in the appendices ("Draft Greater Sage-Grouse Wildland Fire and Invasive Species Assessment") that provided a consistent approach to conduct these assessments. The current protocol was developed by the Fire and Invasive Species Team (FIAT), a team of wildland fire specialists and other resource specialists and managers, to specifically incorporate resistance to invasive annual grasses and resilience after disturbance principles into the assessment protocol. In October 2013, the BLM, Forest Service, and USFWS agreed to incorporate this approach into the final EISs.

The cornerstone of the FIAT protocol is recent scientific research on resistance and resilience of Great Basin ecosystems (Chambers et al. *In press*) and the USFWS-sponsored project with the Western Association of Fish and Wildlife Agencies (WAFWA) to assemble an interdisciplinary team to provide additional information on wildland fire and invasive plants and to develop strategies for addressing

these issues. This interagency collaboration between rangeland scientists, fire specialists, and sage-grouse biologists resulted in the development of a strategic, multi-scale approach for employing ecosystem resilience and resistance concepts to manage threats to sage-grouse habitats from wildfire and invasive annual grasses (Chambers et al. *In prep.* ). This paper is being published as a Forest Service Rocky Mountain Research Station General Technical Report and is available at [www.\\_\\_\\_\\_\\_](http://www.fs.fed.us/rmrs/pubs_gtr/gtr2015_001.pdf). It serves as the reference and basis for the protocol described in this assessment.

The assessment process sets the stage for:

- Identifying important sage-grouse occupied habitats and baseline data layers important in defining and prioritizing sage-grouse habitats
- Assessing the resistance to invasive annual grasses and resilience after disturbance and prioritizing focal habitats for conservation and restoration
- Identifying geospatially explicit management strategies to conserve sage-grouse habitats

Management strategies are types of actions or treatments that managers typically implement to resolve resource issues. They can be divided into proactive approaches (e.g., fuels management and habitat recovery/restoration) and reactive approaches (e.g., fire operations and post-fire rehabilitation). Proactive management strategies can favorably modify wildfire behavior and restore or improve desirable habitat with greater resistance to invasive annual grasses and/or resilience after disturbances such as wildfires. Reactive management strategies are employed to reduce the loss of sage-grouse habitat from wildfires or stabilize soils and reduce impacts of invasive annual grasses in sage-grouse habitat after wildfires. Proactive management strategies will result in long-term sage-grouse habitat improvement and stability, while reactive management strategies are essential to reducing current impacts of wildfires on sage-grouse habitat, thus maintaining long-term habitat stability. Management strategies include:

#### **Proactive Strategies-**

- 1. Fuels Management** includes projects that are designed to change vegetation composition and/or structure to modify fire behavior characteristics for the purpose of aiding in fire suppression and reducing fire extent.
- 2. Habitat Restoration/Recovery**
  - a. Recovery, referred to as passive restoration (Pyke 2011), is focused on changes in land use (e.g., improved livestock grazing practices) to achieve a desired outcome where the plant community has not crossed a biotic or physical threshold.
  - b. Restoration is equivalent to active restoration (Pyke 2011) and is needed when desired species or structural groups are poorly represented in the community and reseeding, often preceded by removal of undesirable species, is required. Note: The Fuels Management program supports recovery/restoration projects through its objective to restore and maintain resilient landscapes.

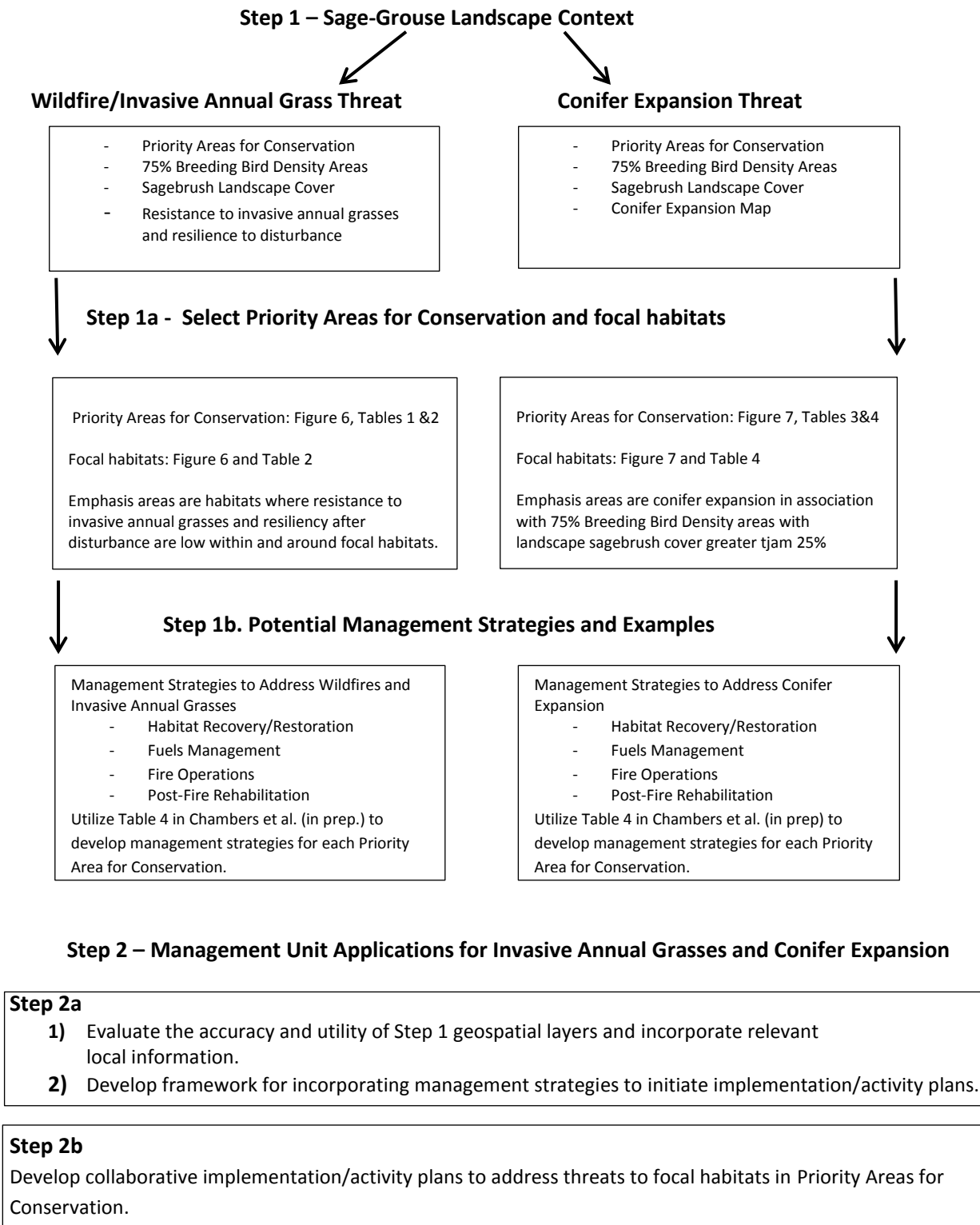
#### **Reactive Strategies-**

3. **Fire Operations** includes preparedness, prevention, and suppression activities. When discussing specific components of fire operations, the terms fire preparedness, fire prevention and fire suppression are used.
4. **Post-Fire Rehabilitation** includes the BLM's Emergency Stabilization and Rehabilitation (ES&R) Program and the Forest Service's Burned Area Emergency Response (BAER) Program. Policy limits application of funds from 1 to 3 years, thus treatments to restore or enhance habitat after this period of time are considered habitat recovery/restoration.

The assessment process included two steps with sub-elements. First, important Priority Areas for Conservation (PACs) and focal habitats are identified (**Step 1a**). Second, potential management **strategies** (described above) are identified to conserve or restore focal habitats threatened by wildfires, invasive annual grasses, and conifer expansion (primarily pinyon pine and/or juniper species; **Step 1b**). Focal habitats are the portions of a PAC with important habitat characteristics, bird populations, and threats (e.g., wildfires, invasive annual grasses, and conifer expansion) where this assessment will be applied. Areas adjacent to or near the focal habitats can be considered for management treatments such as fire control and fuels management if these locations can reduce wildfire impacts to focal habitats. Soil temperature and moisture regimes are used to characterize capacity for resistance to invasive annual grasses and resilience after disturbance (primarily wildfires) within focal habitats to assist in identifying appropriate management strategies, especially in areas with good habitat characteristics that have low recovery potential following disturbance. Soil moisture and temperature regime relationships have not been quantified to the same degree as for conifer expansion; however, Chambers et al. (*In prep.*) discuss preliminary correlations between these two variables.

The results of Steps 1a and 1b, along with associated geospatial data files, are available to local management units to complete Step 2 of the assessment process. Step 2 is conducted by local management units to address wildfire, invasive annual grasses, and conifer expansion in or near focal habitat areas. First, local information and geospatial data are collected and evaluated to apply and improve on Step 1 focal habitat area geospatial data (**Step 2a**). Second, focal habitat activity and implementation plans are developed and include prioritized management **tactics and treatments** to implement effective, fuels management, habitat recovery/restoration, fire operations, and post-fire rehabilitation strategies (**Step 2b**). This assessment will work best if Step 2b is done across management units (internal and externally across BLM and Forest Service administrative units and with other entities). **Figure 1**, Assessment Flow Chart, contains an illustration of the steps in the assessment process.

This analysis does not necessarily address the full suite of actions needed to maintain the current distribution and connectivity of sage-grouse habitats across the Great Basin because resources available to the federal agencies are limited at this time. Future efforts designed to maintain and connect habitats across the range will be needed as current focal areas are addressed and additional resources become available.



**Figure 1, Assessment Flow Chart**

# Step 1

The first component of the Wildfire and Invasive Annual Grasses Assessment describes the factors that collectively provide the sage-grouse landscape context. Step 1a provides this context by discussing PACs, breeding bird density (BBD), soil temperature and moisture regimes (indicators of resistance to annual grasses and resilience after disturbance), landscape sagebrush cover, and conifer expansion. See Chambers et al. (2014 in prep.) for a detailed description of Invasive Annual Grass and Wildfire threats to sage-grouse habitat. Priority PACs and focal habitats are derived from the information provided in this sage-grouse landscape context section.

## Step 1a- Sage-grouse landscape context

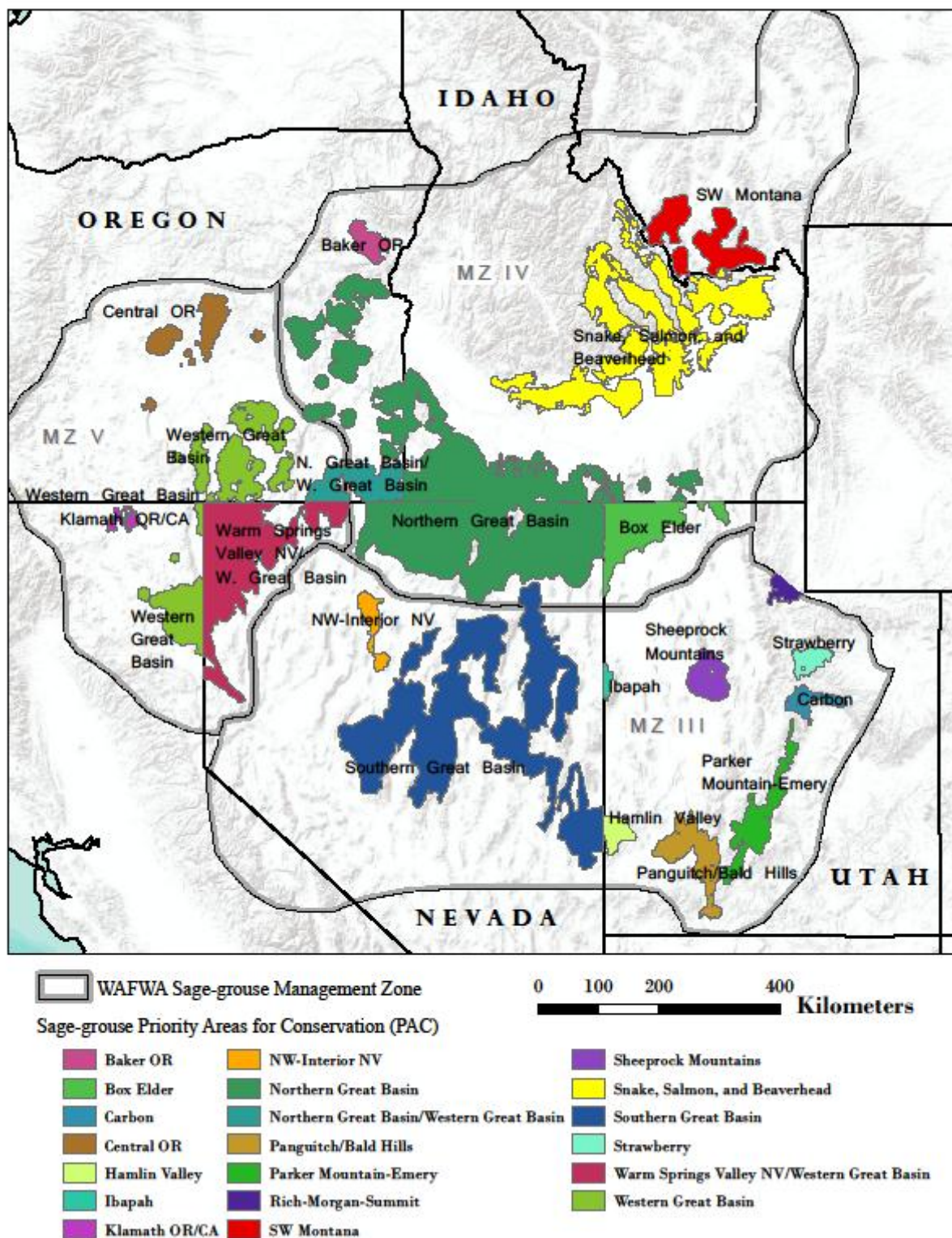
This component of the assessment identifies important PACs and associated focal habitats where wildfire, invasive annual grasses, and conifer expansion pose the most significant threats to sage-grouse.

The primary focus of this assessment is on sage-grouse populations across the WAFWA Management Zones III, IV, and V (**Figure 2**, Current PACs for WAFWA Management Zones III, IV, and V). Sage-grouse are considered a landscape species that require very large areas to meet their annual life history needs. Sage-grouse are highly clumped in their distribution (Doherty et al. 2010), and the amount of landscape cover in sagebrush is an important predictor of sage-grouse persistence in these population centers (Knick et al. 2013). States have used this information combined with local knowledge to identify PACs to help guide long-term conservation efforts. FIAT used data sets that were available across the three management zones as an initial step for prioritizing selected PACs and identifying focal habitats for fire and invasive annual grasses and conifer expansion assessments. These data sets (also described in Chambers et al. *In prep.* ) include:

### Priority Areas for Conservation (PACs)

PACs have been identified by states as key areas that are necessary to maintain redundant, representative, and resilient sage-grouse populations (USFWS 2013; see Figure 2). A primary objective is to minimize threats within PACs (e.g., wildfire and invasive annual grasses impacts) to ensure the long-term viability of sage-grouse and its habitats. A secondary priority is to conserve sage-grouse habitats outside of PACs since they may also be important for habitat connectivity between PACs (genetic and habitat linkages), habitat restoration and population expansion opportunities, and flexibility for managing habitat changes that may result from climate change. PACs have also been identified by the USFWS as one of the reporting geographic areas that will be considered during listing determinations for sage-grouse.

The combination of PACs with BBD data (described below) assists us in identifying connectivity between populations. PAC boundaries may be modified in the future requiring adjustments in focal habitat areas and management strategy priorities.



**Figure 2, Current PACs for WAFWA Management Zones III, IV, and V.** Bi-State sage-grouse populations were not included for this analysis and are being addressed in separate planning efforts.

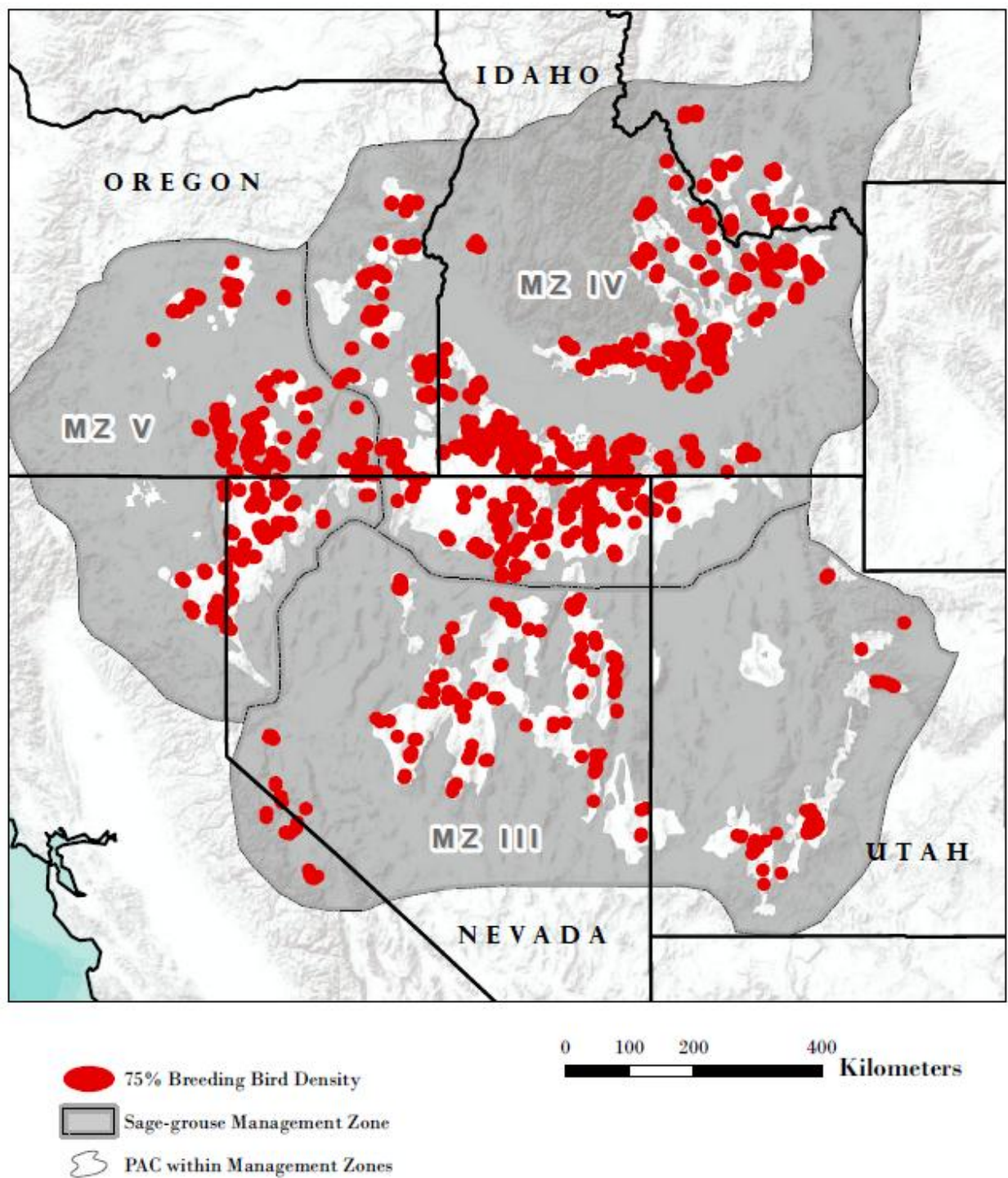
### Breeding Bird Density

Doherty et al. (2010) provided a useful framework for identifying population concentration centers in their range-wide BBD mapping. FIAT used maximum counts of males on leks (4,885 males) to delineate breeding bird density areas that contain 25, 50, 75, and 100 percent of the known breeding population. Leks were then mapped according to abundance values and buffered by 4 to 5.2 miles (6.4 to 8.5 kilometers) to delineate nesting areas. Findings showed that while sage-grouse occupy extremely large landscapes, their breeding distribution is highly aggregated in comparably smaller identifiable population centers; 25 percent of the known population occurs within 3.9 percent (7.2 million acres [2.92 million hectares]) of the species range, and 75 percent of birds are within 27 percent of the species range (50.5 million acres [20.4 million hectares]; Doherty et al. 2010). See **Figures 3**, Sage-Grouse Breeding Bird Density Thresholds.

This analysis places emphasis on breeding habitats because little broad/mid-scale data exists for associated brood-rearing (summer) and winter habitat use areas. Finer scale seasonal habitat use data should be incorporated (or, if not available studies, should be conducted) at local levels to ensure management actions encompass all seasonal habitat requirements. Federal administrative units should consult with state wildlife agencies for additional seasonal habitat information.

For this assessment, FIAT chose to use the 75 percent BBD as an indicator of high bird density areas that informed the approach used by state wildlife agencies to initially identify PACs. Range-wide BBD areas provide a means to further prioritize actions within relatively large PACs to maintain bird distribution and abundance. FIAT used state level BBD data from Doherty et al. (2010) instead of range-wide model results to ensure important breeding areas in Management Zones III, IV, and V were not underweighted due to relatively higher bird densities in the eastern portion of the range. BBD areas of 75 to 100 percent are included in Appendix 1 to provide context for local management units when making decisions concerning connectivity between populations and PACs.

Note that breeding density areas were identified using best available information in 2009, so this range-wide data does not reflect the most current lek count information and changes in conditions since the original analysis. Subsequent analysis should use the most current information available. Also, BBD areas should not be viewed as rigid boundaries but rather as a means to regionally prioritize landscapes where step down assessments and actions should be implemented quickly to conserve the most birds.



**Figure 3, Sage-Grouse Breeding Bird Density Thresholds** for 75% of the breeding birds, Management Zones, and PACs. Breeding bird density of 75 to 100% is shown in Appendix 1 to provide context for local management units when making decisions concerning connectivity between populations and PACs.

### Soil Temperature and Moisture Regimes

Invasive annual grasses and wildfires can be tied to management strategies through an understanding of resistance and resilience concepts. Invasive annual grasses has significantly reduced sage-grouse habitat throughout large portions of its range (Miller et al. 2011). While abandoned leks were linked to increased nonnative annual grass presence, active leks were associated with less annual grassland cover than in the surrounding landscape (Knick et al. 2013). Invasive annual grasses also increases fire frequency, which directly threatens sage-grouse habitat and further promotes the establishment of invasive annual grasses (Balch et al. 2013). This nonnative annual grass and fire feedback loop can result in conversion from sagebrush shrublands to annual grasslands (Davies 2011).

In cold desert shrublands, vegetation community resistance to invasive annual grasses, especially cheatgrass, and resilience following disturbance is strongly influenced by soil temperature and moisture regimes (Chambers et al. 2007; Meyer et al. 2001). Generally, cooler and moister soil temperature/moisture regimes are associated with more resilient vegetation communities as indicated by increases in vegetation productivity and ability to compete and recover from disturbance along elevation gradients (Chambers et al. 2007; Chambers et al. *in press*). Also, colder soil temperatures are associated with more resistant communities due to limitations on invasive annual grass growth and reproduction. Thus, communities with warm and dry soil temperature and moisture regimes tend to have relatively low resilience and resistance. Communities with cool and dry soil temperature and moisture regimes also can have relatively low resilience and resistance with the degree of resistance to cheatgrass depending on soil temperature (see Figure 9 in Chambers et al. *In prep.*). A continuum in resistance and resilience exists across soil temperature and moisture regimes that will need to be considered when developing implementation or activity plans in Step 2. These relationships can be used to help prioritize management actions within sage-grouse habitat using broadly available data.

To capture relative resistance and resilience to disturbance and invasive annual grasses across the landscape, soil temperature and moisture regime information (described in greater detail in Chambers et al. *In prep.*) were obtained from the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) data. Where gaps in this coverage existed, the NRCS US General Soil Map (STATSGO2) data was used (Soil Survey Staff 2014; see Appendix 1). The STATSGO2 database includes soils mapped at a 1:250,000-scale; the SSURGO database includes soils mapped at the 1:20,000 scale. Interpretations made from soil temperature and moisture regimes from the STATSGO2 database will not have the same level of accuracy as those made from the SSURGO database.

Areas characterized by warm and dry soil temperature and moisture regimes (low relative resistance and resilience) were intersected with sage-grouse breeding habitat and sagebrush landscape cover to identify candidate areas (emphasis areas) for potential management actions that mitigate threats from invasive annual grasses and wildfire (**Figure 4**, Soil Moisture and Temperature Regimes for Management Zones III, IV, and V, and **Figure 5**, Intersection of High Density (75% BBD) Populations). These data layers provide the baseline information considered important in prioritizing areas where conservation and management actions could be developed to address invasive annual grasses in a scientifically defensible manner (see Table 4 in Chambers et al. *In prep.*).

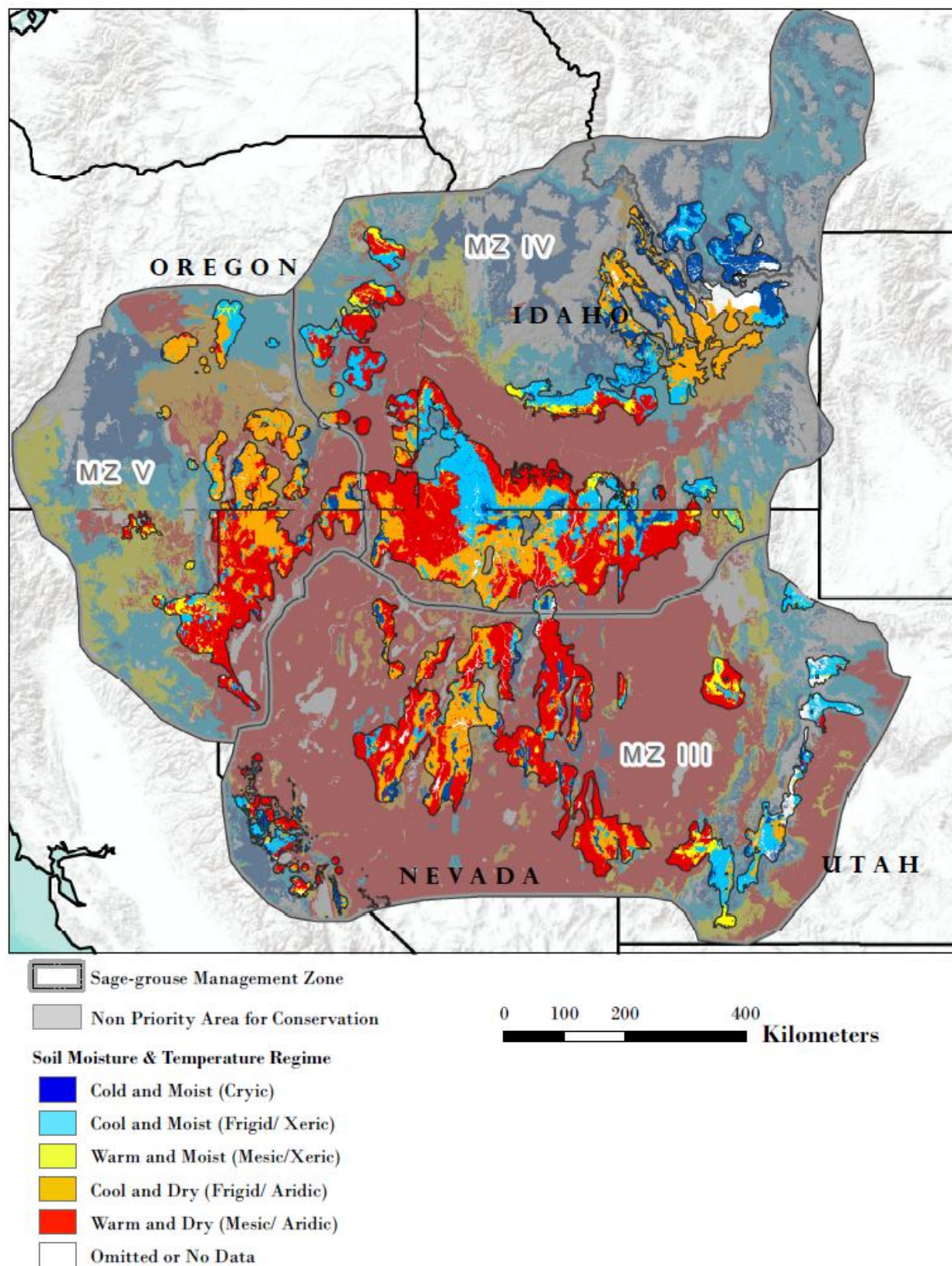
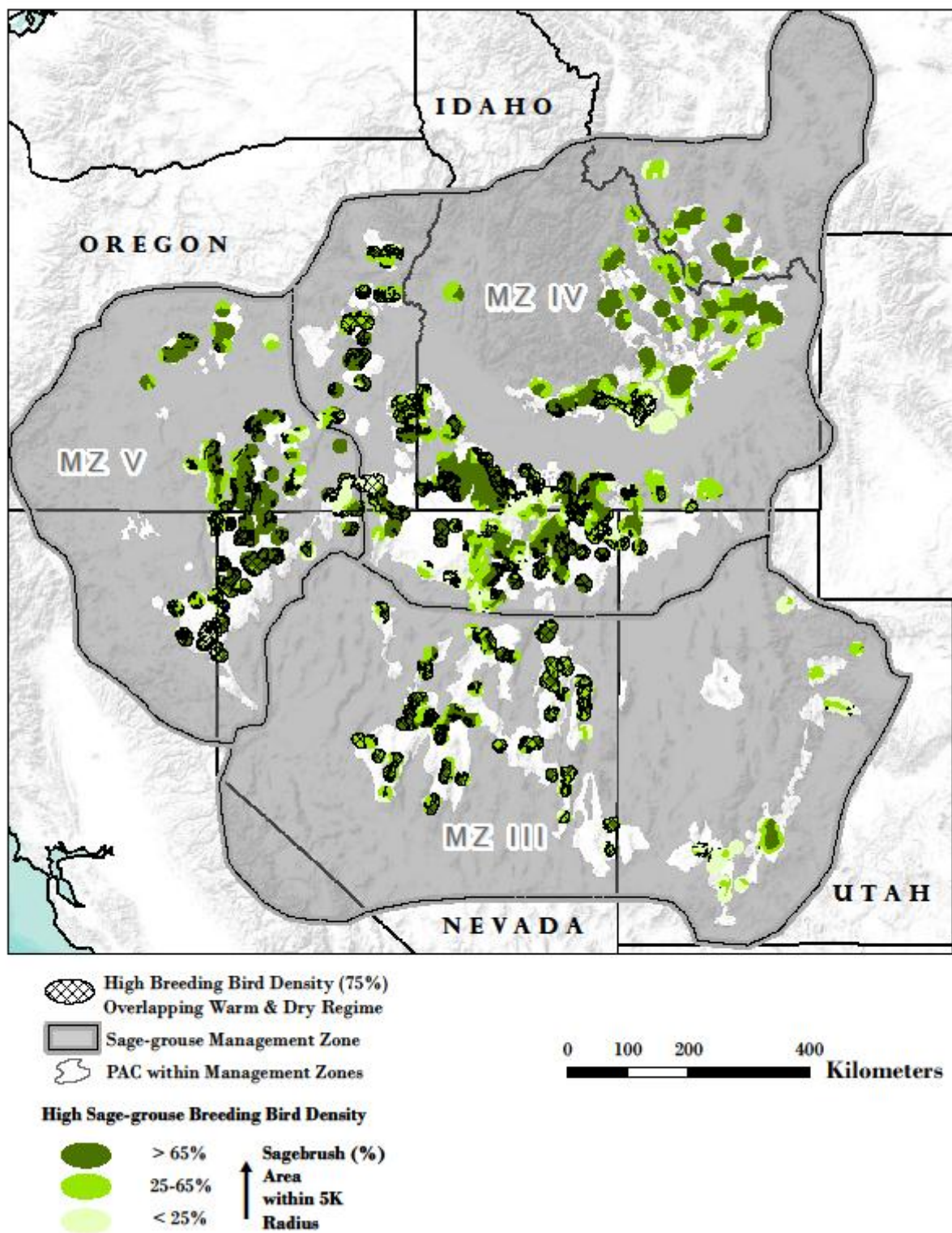


Figure 4, Soil Moisture and Temperature Regimes for Management Zones III, IV, and V



**Figure 5, Intersection of High Density (75% BBD) Populations.** The warm and dry sites and the proportion of these habitats in the three sagebrush landscape cover classes by management zone, and PACs within the Great Basin.

### Sagebrush Landscape Cover

The amount of the landscape in sagebrush cover is closely related to the probability of maintaining active sage-grouse leks, and is used as one of the primary indicators of sage-grouse habitat potential at landscape scales (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). For purposes of prioritizing landscapes for sage-grouse habitat management, FIAT used less than or equal to 25 percent sagebrush landscape cover as a level below which there is a low probability of maintaining sage-grouse leks, and greater than or equal to 65 percent as the level above which there is a high probability of sustaining sage-grouse populations with further increases of landscape cover of sagebrush (Aldridge et al. 2008; Wisdom et al. 2011; Knick et al. 2013). Increases in landscape cover of sagebrush have a constant positive relationship with sage-grouse lek probability at between about 25 percent and 65 percent landscape sagebrush cover (Knick et al. 2013). It is important to note that these data and interpretations relate only to persistence (i.e., whether or not a lek remains active), and it is likely that higher proportions of sagebrush cover may be required for population growth.

For the purposes of delineating sagebrush habitat relative to sage-grouse requirements for landscape cover of sagebrush, FIAT calculated the percentage of landscape sagebrush cover (Landfire 2013) within a 3-mile (5-kilometer) radius of each 98-foot by 98-foot (30 meter by 30 meter) pixel in Management Zones III, IV, and V (see Appendix 2 in Chambers et al. (*In prep.*) for how landscape sagebrush cover was calculated). FIAT then grouped the percentage of landscape sagebrush cover into each of the selected categories (0 to 25 percent, 25 to 65 percent, 65 to 100 percent; **Figure 6**, Sagebrush Landscape Cover and Fire Perimeters for the Analysis Area). Landfire data was based on 2000 satellite imagery so wildfire perimeters after that date were incorporated into this layer to better reflect landscape sagebrush cover. Burned areas were assumed to fall into the 0 to 25 percent landscape cover class.

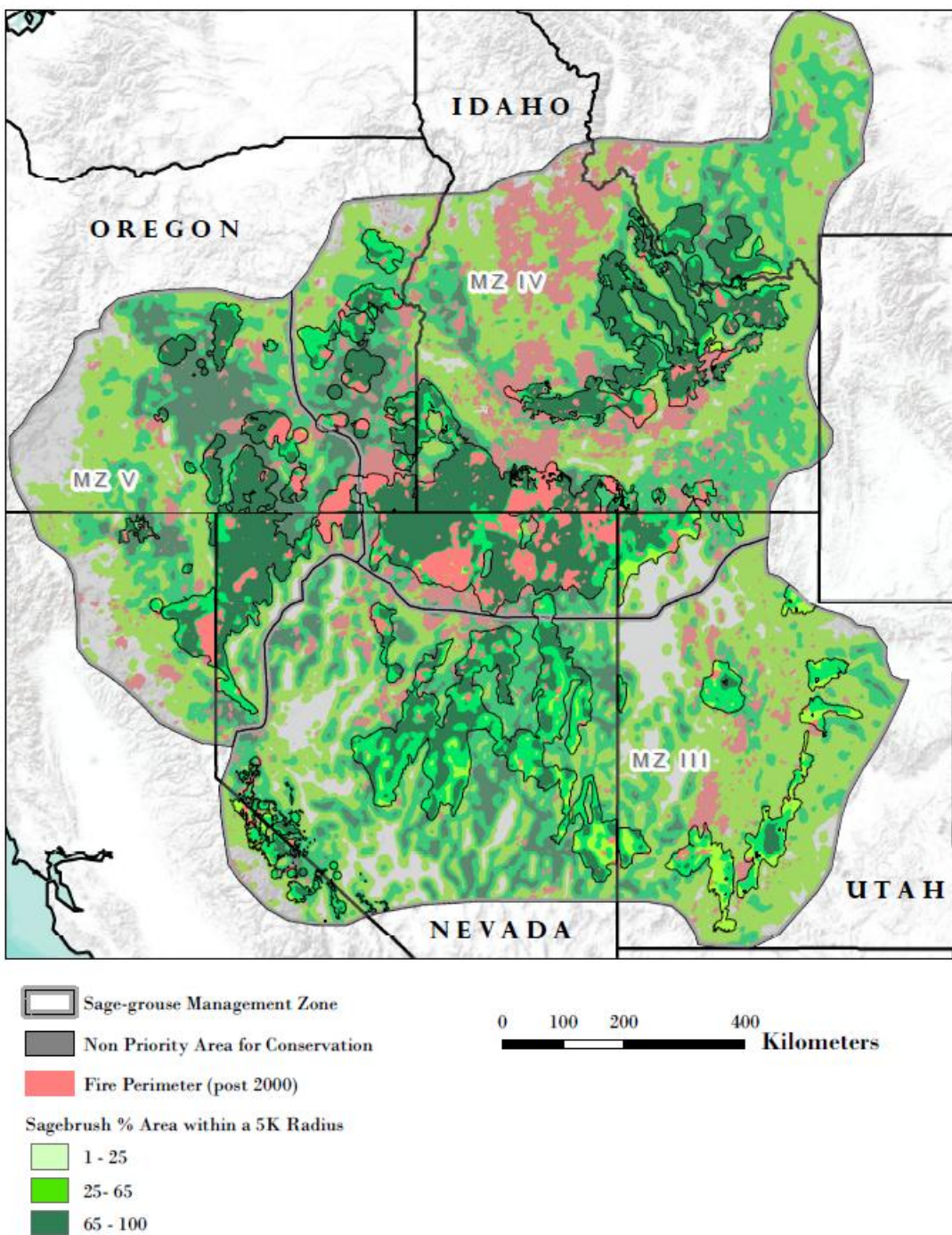
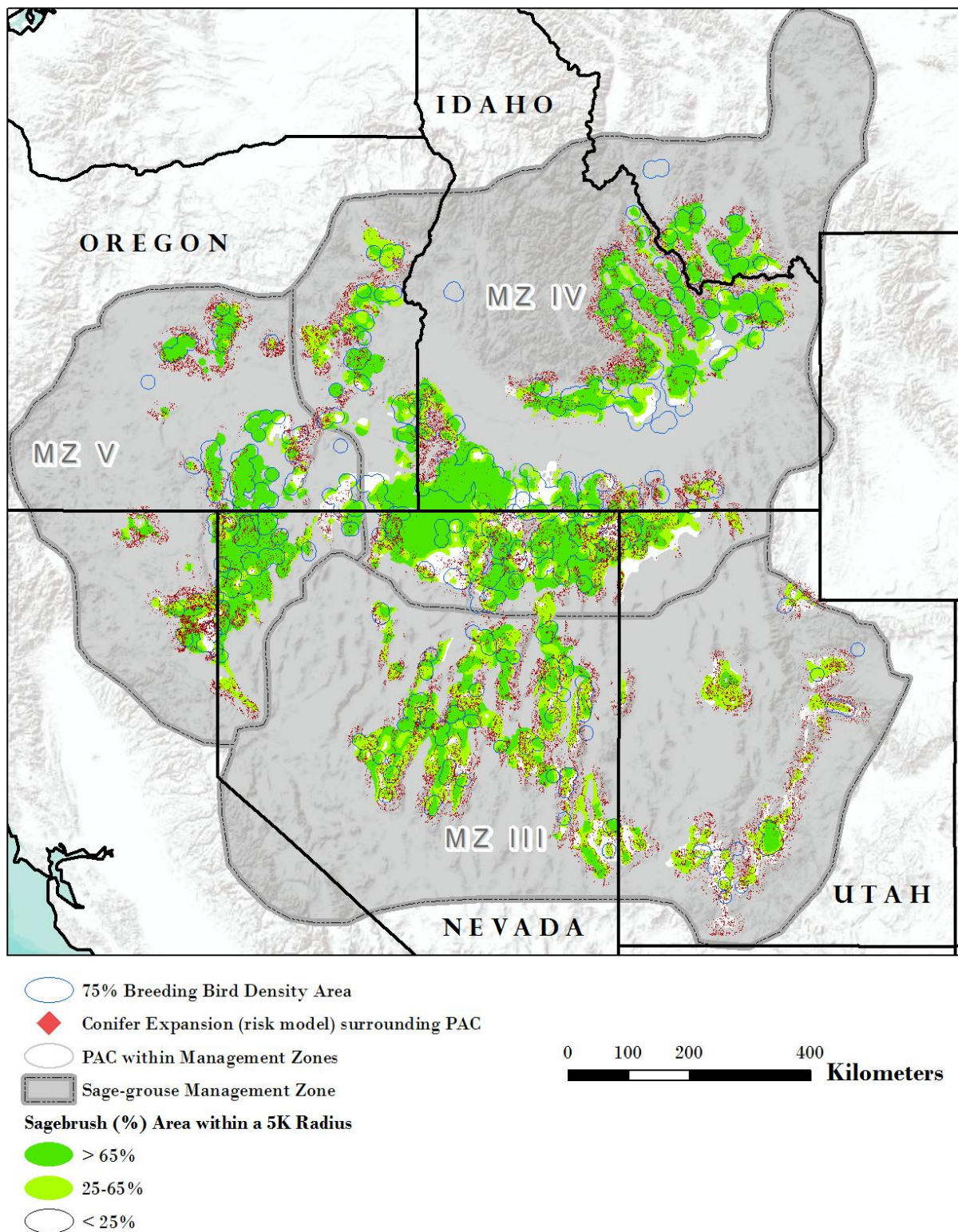


Figure 6, Sagebrush Landscape Cover and Fire Perimeters (post-2000) for the Analysis Area

### Conifer Expansion

Conifer expansion into sagebrush landscapes also directly reduces sage-grouse habitat by displacing shrubs and herbaceous understory as well as by providing perches for avian predators. Conifer expansion also leads to larger, more severe fires in sagebrush systems by increasing woody fuel loads (Miller 2013). Sage-grouse populations have been shown to be impacted by even low levels of conifer expansion (Baruch-Mordo et al. 2013). Active sage-grouse leks persist in regions of relatively low conifer woodland and are threatened by conifer expansion (Baruch-Mordo et al. 2013; Knick et al. 2013).

To estimate where sage-grouse breeding habitat faces the largest threat of conifer expansion, FIAT used a risk model developed by Manier et al. (2013) that locates regions where sagebrush landscapes occur within 250 meters of conifer woodland (**Figure 7**, Modeled Conifer Expansion for PACs with Greater Than 25% Sagebrush Landscape Cover In and Around 75% BBD). Although the model is coarse, it is available for the entirety of the three sage-grouse management zones analyzed. FIAT encourages using more accurate conifer expansion data in Step 2.



**Figure 7, Modeled Conifer Expansion for PACs with Greater Than 25% Sagebrush Landscape Cover In and Around 75% BBD**

## Step 1a. Identifying PACs and focal habitats

A primary goal for the conservation of sage-grouse populations is the identification of important habitats needed to ensure the persistence and recovery of the species. Loss of habitat, and by inference populations, in these habitats would likely imperil the species in the Great Basin. The first objective is to protect and restore those habitats that provide assurances for retaining large well connected populations.

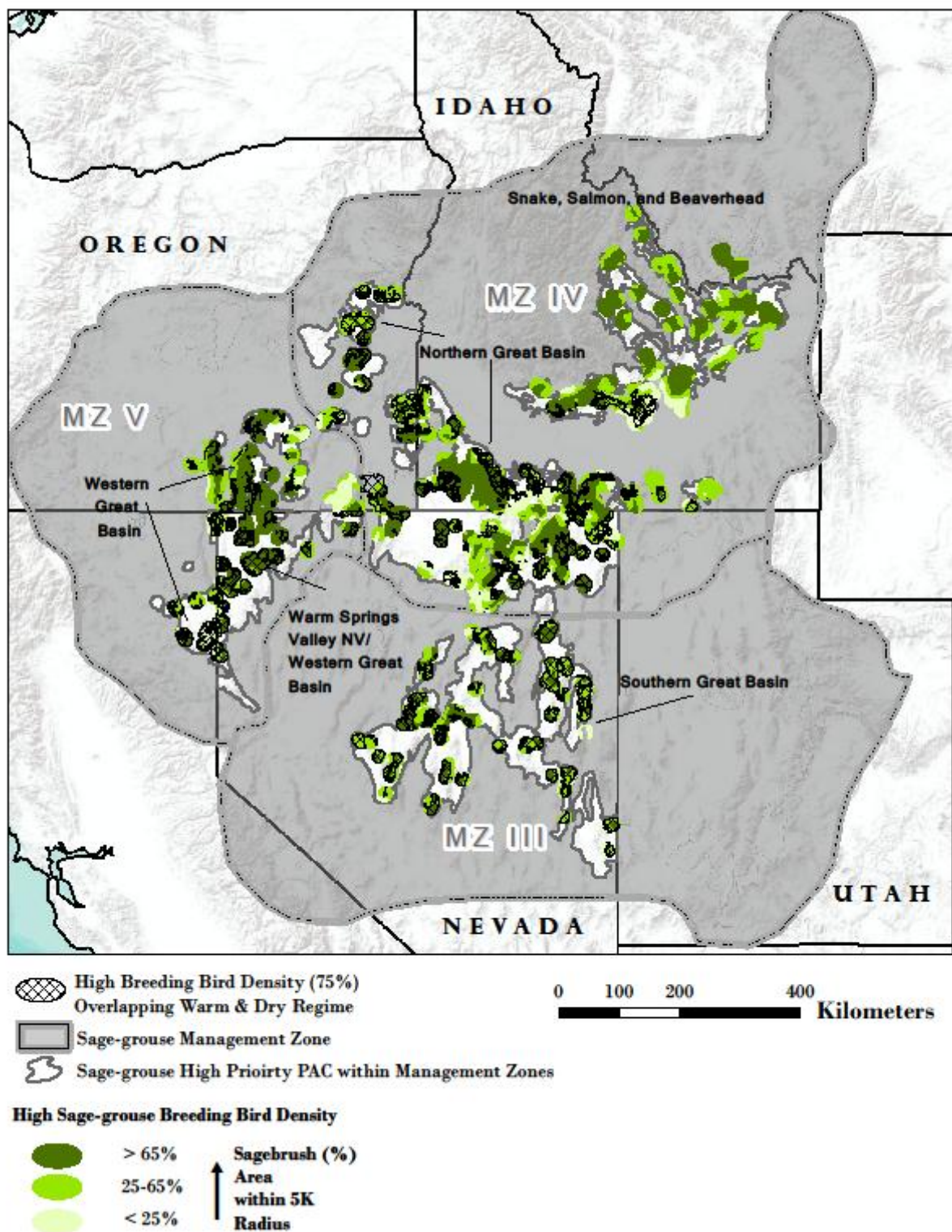
PACs and the 75 percent BBD maps were used to provide a first-tier stratification (e.g., focal habitats) for prioritizing areas where conservation actions could be especially important for sage-grouse populations. Although these areas are a subset of the larger sage-grouse habitats, they are readily identifiable and include habitats (e.g., breeding and nesting habitats that are considered critical for survival; Connelly et al. 2000; Holloran et al. 2005; Connelly et al. 2011) and necessary for the recovery of the species across its range.

The prioritization of habitats for conservation purposes was based on the several primary threats to remaining sage-grouse populations in the Great Basin including the loss of sagebrush habitats to wildfire and invasive annual grasses, and conifer expansion. The first, and probably the most urgent threat for sage-grouse, is the loss of sagebrush habitat due to wildfire and invasive annual species (e.g., cheatgrass; See Figure 11 in Chambers et al. [*In prep.*]). Areas of highest concern are those with low resistance to cheatgrass and low resilience after disturbance (warm/dry and some cool/dry temperature and moisture regimes sites) that are either **within or in close proximity** to remaining high density populations of sage-grouse (Figure 5). Sagebrush habitats (greater than 25 percent sagebrush landscape cover) prone to conifer expansion, particularly pinyon pine and/or juniper, are also a management concern when within or adjacent to high density sage-grouse populations (Figure 7).

Because these two threats occur primarily at different points along an elevational gradient and are associated with different soil temperature and moisture regimes, separate approaches are used to select PACs and focal habitats for each.

### **High Density Populations at Highest Risk from Wildfire and Invasive Annual Grasses**

PACs in Management Zones III, IV, and V. were evaluated on the basis of high density (75 percent) BBDs, sagebrush landscape cover, and soil temperature and moisture regimes to identify initial PACs that are a priority for assessments and associated focal habitats. **Figure 8**, High Priority PACs with High Density Sage-Grouse Populations (75% BBD), displays the results of the analysis focusing on the intersection of high density (75 percent BBD) populations, the warm and dry sites, and the proportion of these habitats in the three sagebrush landscape cover classes by management zone, and PACs within the Great Basin. **Table 1**, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Warm/ Dry Sites, and Percentage of Habitat in Sagebrush Landscape Cover Classes, displays quantitative outputs of this analysis. The table allows a comparison of these data, and assists in selecting five PACs that provide the greatest contribution to high density sage-grouse populations, and the amounts (acres and proportion) within those PACs of sagebrush cover classes associated with warm and dry soil temperature and moisture regimes.



**Figure 8, High Priority PACs with High Density Sage-Grouse Populations (75% BBD) sagebrush landscape cover classes, and areas with low resistance and resilience relative to wildfires and invasive annual species.**

**Table 1, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Warm/ Dry Sites, and Percentage of Habitat in Sagebrush Landscape Cover Classes**

| Sage-grouse Management Zone | Sage-grouse Priority Area for Conservation (PAC) Name | Total PAC Acres | Breeding Bird Density (75%) Acres | Percent of Breeding Bird Density (75%) Area within PAC | Warm and Dry Soil Moisture & Temperature Regime within Breeding Bird Density (75%) Acres* |                                   |                                |
|-----------------------------|---|-----------------|-----------------------------------|--|---|-----------------------------------|--------------------------------|
|                             |   |                 |                                   |  | 0-25% Sagebrush Landscape Cover   | 25%-65% Sagebrush Landscape Cover | 65%+ Sagebrush Landscape Cover |
| 4                           | Northern Great Basin                                  | 13045515        | 7383442                           | 57%  | 179551 (2%)   | 674554 (9%)                       | 1745163 (24%)                  |
| 3                           | Southern Great Basin                                  | 9461355         | 3146056                           | 33%  | 42596 (1%)  | 792780 (25%)                      | 1062091 (34%)                  |
| 4                           | Snake, Salmon, and Beaverhead                         | 5477014         | 2823205                           | 52%  | 68107 (2%)  | 89146 (3%)                        | 95970 (3%)                     |
| 5                           | Western Great Basin                                   | 3177253         | 2084626                           | 66%  | 149399 (7%)   | 140141 (7%)                       | 202767 (10%)                   |
| 5                           | Warm Springs Valley NV/Western Great Basin            | 3520937         | 1558166                           | 44%  | 31458 (2%)  | 207365 (13%)                      | 741353 (48%)                   |
| 4                           | SW Montana  | 1369076         | 659475                            | 48%  | 0 (0%)  | 0 (0%)                            | 0 (0%)                         |
| 4                           | Northern Great Basin/Western Great Basin              | 1065124         | 624581                            | 59%  | 114222 (18%)  | 85258 (14%)                       | 116513 (19%)                   |
| 5                           | Central OR  | 813699          | 451755                            | 56%  | 0 (0%)  | 6211 (1%)                         | 16463 (4%)                     |
| 3                           | Panguitch/Bald Hills                                  | 1135785         | 352258                            | 31%  | 6883 (2%)   | 5821 (2%)                         | 0 (0%)                         |
| 3                           | Parker Mountain-Emery                                 | 1122491         | 308845                            | 28%  | 0 (0%)  | 127 (0%)                          | 0 (0%)                         |
| 4                           | Box Elder   | 1519454         | 292658                            | 19%  | 22 (0%)   | 43325 (15%)                       | 23913 (8%)                     |
| 4                           | Baker OR  | 336540          | 184813                            | 55%  | 0 (0%)  | 46459 (25%)                       | 36214 (20%)                    |
| 3                           | NW-Interior NV  | 371557          | 108256                            | 29%  | 576 (1%)  | 17117 (16%)                       | 25173 (23%)                    |
| 3                           | Carbon  | 355723          | 97734                             | 27%  | 255 (0%)  | 180 (0%)                          | 0 (0%)                         |
| 3                           | Strawberry  | 323219          | 52635                             | 16%  | 0 (0%)  | 0 (0%)                            | 0 (0%)                         |
| 3                           | Rich-Morgan-Summit                                    | 217033          | 37005                             | 17%  | 0 (0%)  | 0 (0%)                            | 0 (0%)                         |
| 3                           | Hamlin Valley   | 341270          | 3244                              | 1%   | 0 (0%)  | 139 (4%)                          | 3105 (96%)                     |
| 3                           | Ibapah  | 98574           | 0                                 | 0%   | 0 (NA)  | 0 (NA)                            | 0 (NA)                         |
| 3                           | Sheeprock Mountains                                   | 611374          | 0                                 | 0%   | 0 (NA)  | 0 (NA)                            | 0 (NA)                         |
| 5                           | Klamath OR/CA   | 162667          | 0                                 | 0%   | 0 (NA)  | 0 (NA)                            | 0 (NA)                         |

\* Numbers in parenthesis indicate the percent of acres relative to total acres of breeding bird density (75%)

These five PACs comprise 90 percent and 95 percent of remaining PAC sagebrush landscape cover in the 25 to 65 percent and greater than or equal to 65 percent sagebrush landscape cover classes, respectively, of the 75 percent BBD associated with low resistance/resilience habitats. The 75 percent BBD habitats in the Northern, Southern Great Basin, and Warm Spring PACs appear particularly important for two reasons. They represent a significant part of the remaining habitats for the Great Basin metapopulation, and they have the greatest amount of low resiliency habitat remaining that still functions as sage-grouse habitat.

An examination of the 5 selected PACs shows that the sum of the 75 percent BBD within these PACs is 16,995,496 acres (**Table 2**, PACs with the Highest Acres and Proportions of 75% BBD acres, and Acres and Proportions of 75% BBD Acres within the Warm/Dry Soil Temperature and Moisture Class). These are the **focal habitats**. These five PACs constitute 84 percent of the 75 percent BBD low resiliency habitats for all Management Zones III, IV, and V PACs. Within and immediately around these focal habitats, 5,751,293 acres are in high BBD areas with landscape sagebrush cover in the 25-65 percent and  $\geq 65$  percent classes and in the warm and dry soil temperature and moisture regimes. These are the habitats in the most danger to loss due to their low resistance to invasive annual grasses and low resilience following wildfire. Within the focal habitats in the high priority PACs, low resistance and resilience areas (cross-hatched areas in Figure 8) are a high priority (emphasis area) for implementing management strategies. Applying management strategies outside the emphasis areas are appropriate if the application of fire operations and fuels management activities will be more effective in addressing wildfire threats.

**Table 2, PACs with the Highest Acres and Proportions of 75% BBD acres, and Acres and Proportions of 75% BBD Acres within the Warm/Dry Soil Temperature and Moisture Class (see Figure 8)**

| PAC  | PAC Acres         | Acres of 75% BBD in PAC (focal habitat) | Proportion of 75% BBD within PACs | Warm & Dry Soils within 75% BBD by Sagebrush Landscape Cover Classes Greater Than 25%* |                  |
|--|-------------------|---|-----------------------------------|--|------------------|
|  |                   |   |                                   | 25-65%   | >65%             |
| Northern Great Basin                       | 13,045,515        | 7,383,442                               | 0.57                              | 674,517(9%)  | 1,745,163(24%)   |
| Southern Great Basin                       | 9,461,355         | 3,146,056                               | 0.33                              | 792,780(25%)   | 1,062,091(34%)   |
| Snake, Salmon, and Beaverhead              | 5,477,014         | 2,823,205                               | 0.52                              | 89,146(3%)   | 95,970(3%)       |
| Warm Springs Valley NV/Western Great Basin | 3,520,937         | 1,558,166                               | 0.44                              | 207,365(13%)   | 741,353(48%)     |
| Western Great Basin                        | 3,177,253         | 2,084,626                               | 0.66                              | 140,141(7%)  | 202,767(10%)     |
| <b>Total for 5 PACs</b>                    | <b>34,682,074</b> | <b>16,995,496</b>                       | <b>0.49</b>                       | <b>1,903,949</b>   | <b>3,847,344</b> |

\* This category represents the emphasis areas for applying appropriate management strategies in or near the focal habitats due to the lower probability of recovery after disturbance and higher probability of invasive annual grasses and existing wildfire threats.

## High Density Sage-Grouse Habitats at Risk from Conifer Expansion

PACs, sagebrush landscape cover, and the 75 percent BBD data were also used in conjunction with the conifer expansion data (Mainer et al. 2013) to provide an initial stratification to determine PACs where conifer removal would benefit important sagebrush habitats. Conifer expansion threats are primarily western juniper in the northern Great Basin and pinyon pine/Utah juniper in the southern Great Basin.

Figure 7 displays results of the analysis focusing on the intersection of the 75 percent BBD, and modeled conifer expansion areas within two sagebrush landscape cover classes by management zone and PACs within the Great Basin. To identify high density sage-grouse areas affected by conifer expansion, the amount and proportion of acres estimated to be affected were calculated by sagebrush cover class to assist in the identification of the focal habitats (**Table 3**). **Table 4**, displays quantitative outputs of this analysis using the 25 to 65 percent and greater than 65 percent landscape sagebrush cover classes for the PACs. Thus, **focal habitats** for addressing conifer expansion are the areas within and near conifer expansion in sagebrush landscape cover classes of 25 to 65 percent and greater than 65 percent. Conifer expansion in these two sagebrush landscape cover classes in the 75 percent BBD areas constitutes an emphasis area for treatments to address conifer expansion. Landscapes with less than 25 percent sagebrush cover may require significant additional management actions to restore sagebrush on those landscapes and therefore were considered a lower priority for this analysis. Focal habitats are identified in Table 4 and displayed in **Figure 9**.

Table 3 assists in identifying those PACs that provide the greatest contribution to high density sage-grouse populations, and the amounts (acres and proportion) within those PACs of sagebrush cover classes associated with modelled conifer expansion areas. Although there are uncertainties associated with the model, the results help managers identify specific geographic areas where treatments in conifer (pinyon and/or juniper) could benefit existing important sage-grouse populations.

The results of the screening revealed 5 PACs that contribute substantially to the 75 percent BBD habitats and are currently impacted most by conifer expansion (primarily pinyon pine and/or juniper; Table 4 and Figure 9). Four of the five PACs identified as high priority for conifer expansion treatments were also high priorities for wildfires and invasive annual grass threats. This is likely due to the size of the PACs and the relative importance of these PACs for maintaining the Great Basin sage-grouse meta-populations. As expected, the locations of high density sage-grouse habitats affected by conifer expansion differ spatially from those associated with low resilience habitats within and among the PACs, primarily due to differences in the biophysical settings (e.g., elevation and rainfall) that contribute to threats from invasive annual grasses and wildfires.

Three PACs (Snake/Salmon/Beaverhead, Southwest Montana, and Northern Great Basin/Western Great Basin) ranked high due to their relatively large proportion of high density breeding habitats (Table 3), but were not selected since the threat of conifer expansion was relatively low. One PAC, (Snake/Salmon/Beaverhead, was identified as a potential high priority area but was dismissed because results of the conifer expansion model likely overestimated impacts due to the adjacent conifer forests in this region. The COT Report also identified conifers as a “threat present but localized” in these areas, whereas, the top five PACs prioritized all have conifers identified as a widespread priority threat to address (USFWS 2013).

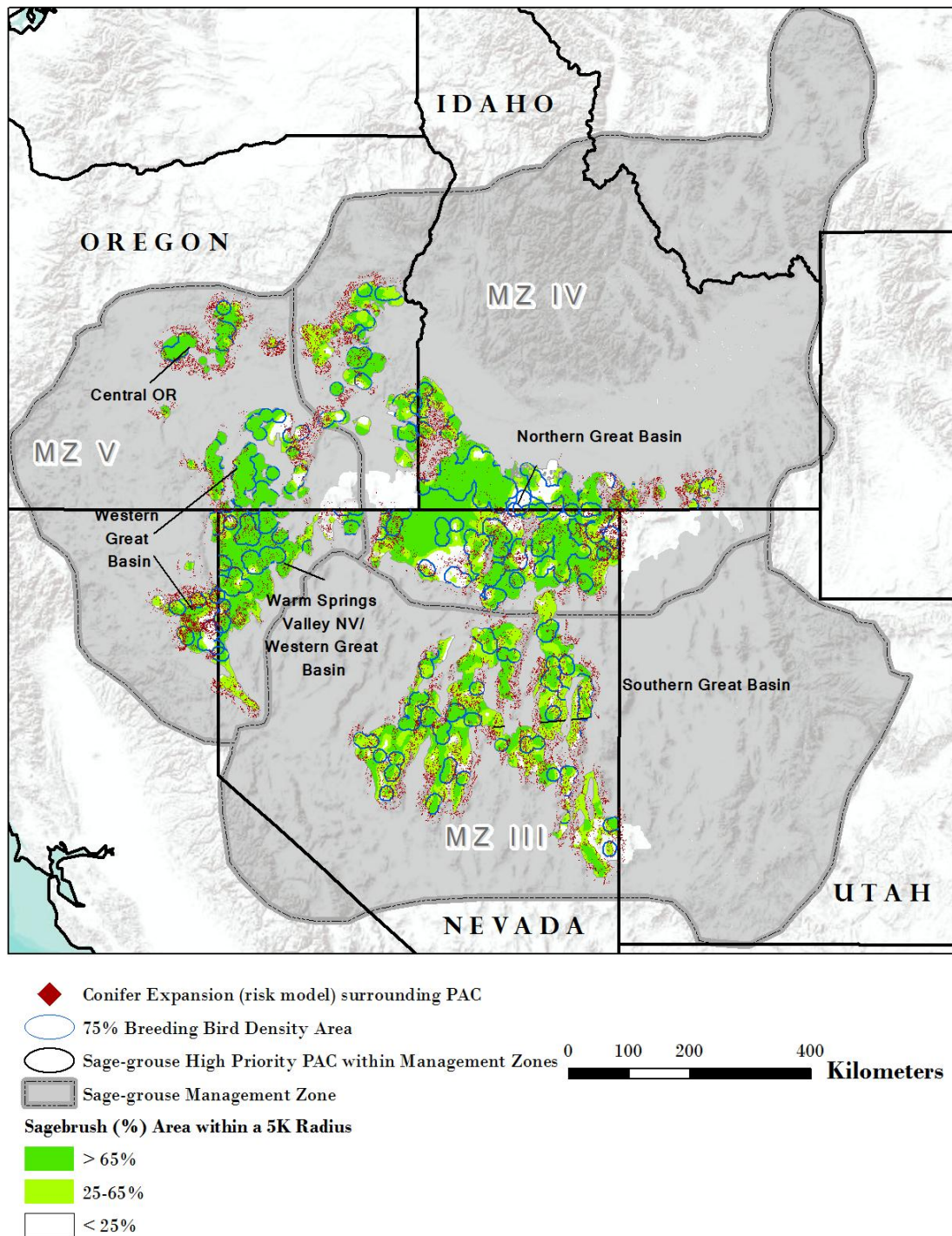
**Table 3, Relative Ranking of PACs Based on High Density (75% BBD) Populations, Modeled Conifer Expansion, and Percentage of Habitats in Sagebrush Landscape Cover Classes**

| Sage-grouse<br>Management<br>Zone | Sage-grouse Priority Area for<br>Conservation (PAC) Name | PAC acres | Breeding<br>Bird Density<br>(75%) Acres | Relative<br>Proportion of<br>Breeding Bird<br>Density Area<br>within PAC | Conifer Expansion (Modeled) Acres* |  |                                   |
|-----------------------------------|--|-----------|---|--|------------------------------------|--|-----------------------------------|
|                                   |  |           |   |  | 0-25% Sagebrush<br>Landscape Cover | 25%-65%<br>Sagebrush<br>Landscape<br>Cover | 65%+ Sagebrush<br>Landscape Cover |
| 4                                 | Northern Great Basin                                     | 13045515  | 7383442                                 | 0.57   | 188502 (1%)                        | 512949 (4%)                                | 442480 (3%)                       |
| 3                                 | Southern Great Basin                                     | 9461355   | 3146056                                 | 0.33   | 108657 (1%)                        | 738624 (8%)                                | 237828 (3%)                       |
| 4                                 | Snake, Salmon, and Beaverhead                            | 5477014   | 2823205                                 | 0.52   | 4209 (0%)                          | 92173 (2%)                                 | 216803 (4%)                       |
| 5                                 | Western Great Basin                                      | 3177253   | 2084626                                 | 0.66   | 87963 (3%)                         | 184618 (6%)                                | 126177 (4%)                       |
| 5                                 | Warm Springs Valley NV/Western Great I                   | 3520937   | 1558166                                 | 0.44   | 37148 (1%)                         | 107025 (3%)                                | 217101 (6%)                       |
| 4                                 | SW Montana   | 1369076   | 659475                                  | 0.48   | 1428 (0%)                          | 34765 (3%)                                 | 39215 (3%)                        |
| 4                                 | Northern Great Basin/Western Great Bas                   | 1065124   | 624581                                  | 0.59   | 12101 (1%)                         | 2247 (0%)                                  | 6161 (1%)                         |
| 5                                 | Central OR   | 813699    | 451755                                  | 0.56   | 3191 (0%)                          | 44937 (6%)                                 | 59624 (7%)                        |
| 3                                 | Panguitch/Bald Hills                                     | 1135785   | 352258                                  | 0.31   | 89141 (8%)                         | 75157 (7%)                                 | 2563 (0%)                         |
| 3                                 | Parker Mountain-Emery                                    | 1122491   | 308845                                  | 0.28   | 84719 (8%)                         | 83441 (7%)                                 | 7469 (1%)                         |
| 4                                 | Box Elder  | 1519454   | 292658                                  | 0.19   | 8531 (1%)                          | 114376 (8%)                                | 57645 (4%)                        |
| 4                                 | Baker OR   | 336540    | 184813                                  | 0.55   | 945 (0%)                           | 15263 (5%)                                 | 195 (0%)                          |
| 3                                 | NW-Interior NV   | 371557    | 108256                                  | 0.29   | 7929 (2%)                          | 29440 (8%)                                 | 11813 (3%)                        |
| 3                                 | Carbon   | 355723    | 97734                                   | 0.27   | 15968 (4%)                         | 34446 (10%)                                | 283 (0%)                          |
| 3                                 | Strawberry   | 323219    | 52635                                   | 0.16   | 7916 (2%)                          | 27340 (8%)                                 | 1075 (0%)                         |
| 3                                 | Rich-Morgan-Summit                                       | 217033    | 37005                                   | 0.17   | 11685 (5%)                         | 14280 (7%)                                 | 238 (0%)                          |
| 3                                 | Hamlin Valley  | 341270    | 3244                                    | 0.01   | 11321 (3%)                         | 29960 (9%)                                 | 6243 (2%)                         |
| 3                                 | Ibapah   | 98574     | 0                                       | 0.00   | 195 (0%)                           | 6770 (7%)                                  | 1039 (1%)                         |
| 5                                 | Klamath OR/CA  | 162667    | 0                                       | 0.00   | 1 (0%)                             | 1533 (1%)                                  | 15302 (9%)                        |
| 3                                 | Sheeprock Mountains                                      | 611374    | 0                                       | 0.00   | 16744 (3%)                         | 78580 (13%)                                | 11878 (2%)                        |

\* Numbers in parenthesis indicate the proportion of acres relative to total PAC acres

**Table 4, PACS with the Highest Acres and Proportions of 75% BBD acres and Estimated Conifer Expansion within Sagebrush Landscape Cover Classes (25-65 percent and ≥65 percent; see Figure 9)**

| PAC  | PAC Acres         | Acres 75% BBD in PAC | Prop. 75% BBD within PACs | Conifer Expansion by Landscape Sagebrush Cover Classes 25-65% and ≥65%* Focal Habitat |                       |
|--|-------------------|----------------------|---------------------------|---|-----------------------|
|  |                   |                      |                           | 25-65%  | ≥65%                  |
| Northern Great Basin   | 13,045,515        | 7,383,442            | 0.57                      | 512,949 (4%)  | 442,480 (3%)          |
| Southern Great Basin   | 9,461,355         | 3,146,056            | 0.33                      | 738,624 (8%)  | 237,828 (3%)          |
| Warm Springs Valley NV/Western Great Basin                                       | 3,520,937         | 1,558,166            | 0.44                      | 107,025 (3%)  | 217,101 (6%)          |
| Western Great Basin  | 3,177,253         | 2,084,626            | 0.66                      | 184,618 (6%)  | 126,177 (4%)          |
| Central Oregon   | 813,699           | 451,755              | 0.56                      | 44,937 (6%)   | 59,624 (7%)           |
| <b>Total for 5 PACS</b>  | <b>30,018,759</b> | <b>14,624,045</b>    | <b>0.49</b>               | <b>1,588,153 (5%)</b>   | <b>1,083,210 (4%)</b> |
| *Numbers in parenthesis represent the percent of total PAC acres for each class. |                   |                      |                           |   |                       |



**Figure 9, Five PACs Significantly Impacted by Conifer Expansion** that contribute substantially to the 75% BBD and that have sagebrush landscape cover greater than 25%.

While the coarse-scale conifer expansion data used in this analysis likely over estimates the extent of the pinyon pine and/or juniper threat, results suggest that far fewer acres are currently affected by conifers than might be at risk from fire and invasive annual grasses impacts. Conifer expansion into sage-grouse habitats occurs at a slower rate, allowing more time for treatment, but early action may be needed to prevent population level impacts on sage-grouse (Baruch-Mordo et al. 2013). Furthermore, conifer expansion is primarily occurring on cooler and moister sites that are more resilient and where restoration is more likely to be effective (Miller et al. 2011), providing managers the opportunity to potentially offset at least some habitat loss expected to continue in less resilient ecosystems. While the available data set used to estimate conifer expansion provides only a coarse assessment of the problem, considerable efforts are currently underway to map conifers across sage-grouse range. These maps are expected to be available in the near future and should be used by land managers to better target project level conifer removal.

FIAT cautions against using the plotted locations of estimated conifer expansion for local management decisions due to the coarse-scale nature of this range-wide data set. Conifer expansion estimates are primarily provided here to aid in judging the relative scope of the threat in each PAC.

## Step 1b. Potential Management Strategies

Potential management **strategies** (e.g., fuels management, habitat recovery/restoration, fire operations, post-fire rehabilitation) to conserve or restore Step 1 focal habitats are described below to assist local management units to initiate Step 2. These examples are illustrative and do not contain the full range of management strategies that may be required to address wildfires, invasive annual grasses, and conifer expansion within PACs and associated focal habitats. In general, the priority for applying management strategies is to first maintain or conserve intact habitat and second to strategically restore habitat (after a wildfire or proactively to reconnect habitat). Management strategies will differ when applying the protocol to:

**Wildfire and Invasive Annual Grass.** (See PACs identified in Table 2 and focal habitats shown in Figure 8). Focal habitats, as they relate to wildfires and invasive annual grasses, are defined as sage-grouse habitat in priority PACs within 75 percent BBD. Within these focal habitats, sagebrush communities with low resilience to disturbance and resistance to invasive annual grasses (warm and dry soil temperature and moisture regimes) are an emphasis area for management actions. Appendix 5 (A) in Chambers et al. (*In prep.*) includes a generalized state and transition model with an invasive annual grass component and warm and dry soil temperature and moisture regime associated with 8 to 12 inches of annual precipitation. This state and transition models is useful in developing management strategies to deal with annual grass issues as it contains useful restoration pathways.

Burn Probability is another tool that can be used to assist managers to identify the relative likelihood of large fire occurrence across the landscape within PACs and focal habitats. Burn probability raster data were generated by the Missoula Fire Lab using the large fire simulator - FSim - developed for use in the national Interagency [Fire Program Analysis \(FPA\)](#) project. FSim uses historical weather data and LANDFIRE fuel model data to simulate fires burning. Using these simulated fires, an overall burn probability is returned by FSim for each 270m pixel. The burn probability data was overlaid spatially with PACs, soil data, and shrub cover data. The majority of the high and very high burn probability acres lie within the top 5 PACs and are within areas with >25% sagebrush cover. Several of the other PACs have a greater overall percentage of the warm/dry soil regime with high/very high burn probability (northern great basin, baker, and NW interior NV) but the total acres are relatively few. Areas identified with high and very high burn probability are most likely to experience large fires given fire history, fuels, weather and topography. Results are displayed in the table 5 and Figure 10.

**Table 5, Percentages of sage-grouse PAC areas with high and very high burn probability, 75% BBD within PAC, 75% BBD and warm dry/temperature regime, and 75% BBD and warm dry/temperature and warm dry/temperature with high and very high burn probability.**

| <b>Sage Grouse<br/>Management<br/>Zone</b> | <b>Sage-grouse Priority Area<br/>for Conservation (PAC)<br/>Name</b> | <b>Total PAC<br/>Acres</b> | <b>High, very<br/>high burn<br/>probability<br/>(percent of<br/>PAC acres)</b> | <b>75% BBD<br/>within PAC<br/>(percent PAC<br/>acres)</b> | <b>75% BBD and warm<br/>and dry<br/>soil/temperature<br/>regime acres (percent<br/>PAC acres)</b> | <b>75% BBD and warm<br/>and dry<br/>soil/temperature<br/>regime with high, very<br/>high burn probability<br/>(percent PAC acres)</b> |
|--|--|----------------------------|--|---|---|---|
| 4  | Northern Great basin   | 13,045,415                 | 86%  | 57%   | 19%   | 17%   |
| 3  | Southern Great Basin   | 9,461,355                  | 48%  | 33%   | 20%   | 9%  |
| 4  | Snake, Salmon, and<br>Beaverhead                                     | 5,477,014                  | 68%  | 52%   | 5%  | 4%  |
| 5  | Western Great Basin  | 3,177,253                  | 61%  | 66%   | 15%   | 12%   |
| 5  | Warm Springs Valley<br>/Western Great Basin                          | 3,520,937                  | 30%  | 44%   | 28%   | 9%  |
| 4  | SW Montana   | 1,369,076                  | 1%   | 48%   | 0%  | 0%  |
| 4  | Northern Great<br>Basin/Western Great<br>Basin                       | 1,065,124                  | 82%  | 59%   | 30%   | 22%   |
| 5  | Central Oregon   | 813,699                    | 71%  | 56%   | 3%  | 2%  |
| 3  | Panguitch/Bald Hills   | 1,135,785                  | 70%  | 31%   | 1%  | 1%  |
| 3  | Parker Mountain-Emery  | 1,122,491                  | 28%  | 28%   | 0%  | 0%  |
| 4  | Box Elder  | 1,519,454                  | 61%  | 19%   | 4%  | 2%  |
| 4  | Baker Oregon   | 336,540                    | 74%  | 55%   | 25%   | 21%   |
| 3  | NW-Interior NV   | 371,557                    | 99%  | 29%   | 12%   | 11%   |
| 3  | Carbon   | 355,723                    | 22%  | 27%   | 0%  | 0%  |
| 3  | Strawberry   | 323,219                    | 26%  | 16%   | 0%  | 0%  |
| 3  | Rich-Morgan-Summit   | 217,033                    | 79%  | 17%   | 0%  | 0%  |
| 3  | Hamlin Valley  | 341,270                    | 60%  | 1%  | 1%  | 0%  |
| 3  | Ibapah   | 98,574                     | 0%   | 0%  | 0%  | 0%  |
| 3  | Sheeprock Mountains  | 611,374                    | 98%  | 0%  | 0%  | 0%  |
| 5  | Klamath OR/CA  | 162,667                    | 98%  | 0%  | 0%  | 0%  |

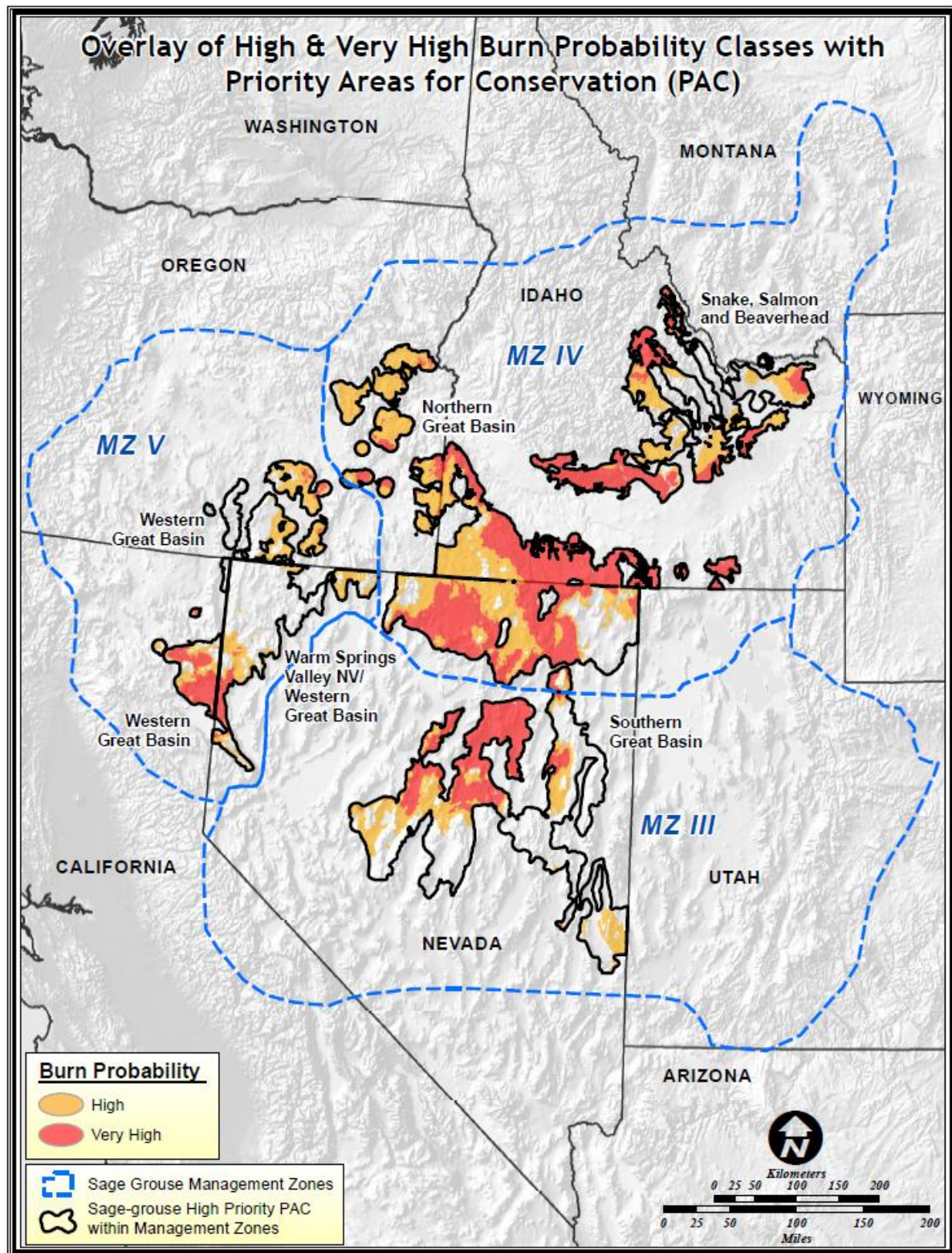


Figure 10, Burn Probability (high and very high) in priority invasive annual grass and wildfire PACs. .

**Conifer Expansion.** (See priority PACs for assessment identified in Table 4 and focal habitats shown in Figure 9). Focal habitats, as they relate to conifer expansion, are defined as sage-grouse habitat in a priority PAC with sagebrush landscape cover between 25 and 100 percent that is either near or in a conifer expansion area. The relationship between conifer expansion and resilience to disturbance and resistance to expansion is not documented to the same degree as with invasive annual grasses. However, Appendix 5 (D. and E.) in Chambers et al. (*In prep.*) includes two generalized state and transition models for conifer expansion with warm to cool and soil temperature regimes associated with precipitation ranges from 12 to 14 or more inches of annual precipitation. These state and transition models are useful in developing management strategies to deal with conifer expansion as they contain useful restoration pathways.

Chambers et al. (*In prep.*) is recommended for review at this point for information on applying resistance and resilience concepts along with sage-grouse habitat characteristics to develop management strategies to address wildfires, invasive annual grasses, and conifer expansion. The following tables are recommended for use in developing management strategies in or near focal habitats:

Table 1. Soil temperature and moisture regimes relationship to vegetation types and resistance and resilience.

Table 2. Sage-grouse habitat matrix showing the relationship between landscape sagebrush cover and resistance and resilience.

Table 3. Potential management strategies based on sage-grouse habitat requirements and resistance and resilience.

Table 4. Management strategies (fire suppression, fuels management, post-fire rehabilitation, and habitat restoration) associated with each cell in the sage-grouse habitat matrix (Table 2).

The “Putting it all together” section of the Chambers et al. (*In prep.*) also contains a case study from Northeast Nevada illustrating applications of management strategies to address the conservation, protection, and restoration of sage-grouse habitat.

To further assist in understanding Step 1b, examples of general priorities for management strategies are provided below and illustrated in Appendix 3 and 4:

1. Fuels Management: Projects that are designed to change vegetation composition and/or structure to modify potential fire behavior for the purpose of improving fire suppression effectiveness and limiting fire spread and intensity.
  - a. Identify priorities and potential measures to reduce the threats to sage-grouse habitat resulting from changes in invasive annual grasses (primary focus on exotic annual grasses and conifer encroachment) and wildland fires. Place high priority on areas dominated by invasive annual grasses that are near or adjacent to low resistance and resilience habitats that are still intact.

- b. Areas on or near perimeter of successful post-fire rehabilitation and habitat restoration projects where threats of subsequent fire are present are important for consideration.
  - c. Fuels management can be a high priority in large tracts of intact sagebrush if impacts on sage-grouse populations are minimal and outweighed by the potential benefits of reduced wildfire impacts in area being protected.
- 2. Habitat Recovery/Restoration Recovery (passive restoration) is a high priority in intact sagebrush stands to improve resistance and resilience before a disturbance. For example, where understory perennial herbaceous species are limited, improved livestock grazing practices can increase the abundance of these species and promote increased resistance to annual grasses.
  - a. Habitat restoration is important where habitat connectivity issues are present within focal habitats.
  - b. Pinyon pine and/or juniper removal in Phase I and II stands adjacent to large, contiguous areas of sagebrush (greater than 25 percent sagebrush landscape cover) is a priority.
- 3. Fire Operations (includes preparedness, prevention and suppression activities).
  - a. Higher priority should be placed on areas with greater than 65 percent cover than on areas with 25 to 65 percent cover, followed by 0 to 25 percent cover (these categories are continuums not discrete thresholds).
  - b. Higher priority should be placed on lower resistance/resilience habitats compared with higher resistance/resilience habitats.
  - c. Fire operations in areas restored or post-fire rehabilitation treatment where subsequent wildfires can have detrimental effect on investment and recovery of habitat are important for consideration.
  - d. Fire operations (suppression) are especially important in low elevation winter sagebrush habitat with low resistance and resiliency.
- 4. Post-Fire Rehabilitation
  - a. High priority should be placed on supporting short-term natural recovery and long-term persistence in higher resistance and resiliency habitats (with appropriate management applied).
  - b. High priority should be placed on reseeding in moderate to low resistance and resiliency habitats, but only if competition from invasive annual grasses, if present, can be controlled prior to seeding.

## **Step 2**

Step 2 is carried out by local management units using the Step 1 geospatial data, focal habitats, and the associated management strategies. Step 2 includes evaluating the availability and accuracy of local information and geospatial data used to develop local management strategies in or near focal habitats (Step 2a).

It also involves developing focal habitat activity/implementation plans that include prioritized management tactics and treatments to implement effective fuels management, habitat recovery/restoration, fire operations, and post-fire rehabilitation (Step 2b). These activity/implementation plans will serve as the basis for NEPA analysis of site-specific projects.

## **Step 2a- Review of Step 1 Data and Incorporation of Local Information**

Evaluate the accuracy and utility of Step 1 geospatial layers for focal habitats by incorporating more accurate or locally relevant:

- Vegetation maps (especially sagebrush cover)
- Updated or higher resolution conifer expansion layers (if applicable)
- Soil survey and ecological site descriptions
- Weather station, including Remote Automatic Weather Stations, data
- PACs, focal habitats, winter habitats, sage-grouse population distributions (i.e., more recent BBD surveys)
- Maps of cheatgrass and other invasive annual grasses that degrade sage-grouse habitat
- Wildfire polygons including perimeters and unburned islands within burn polygons
- Treatment locations and success (consult US Geological Survey Land Treatment Digital Library at <http://ltdl.wr.usgs.gov/>). The Land Treatment Digital Library allows the user to search on treatment results on an ecological site basis.
- Models and tools to help inform management strategies. For example, data which characterizes wildfire potential can help identify risk to focal habitats and help plan fire suppression and fuels management strategies to address these risks.
- Rapid Ecoregional Assessments
- Land Use Plans
- Appropriate monitoring or inventory information
- Any other geospatial data or models that could improve the accuracy of the assessment process

It is essential that subregional or local information and geospatial data be subjected to a quality control assessment to ensure that it is appropriate to use in developing Step 2b activity and implementation plans. Since PACs and focal habitats usually transcend multiple administrative boundaries, a collaborative approach is highly recommended for Step 2a.

A series of questions tied to the management strategies described in the Introduction section follows to assist managers in developing the framework to complete Step 2b (development of activity/implementation plans). The questions that follow apply to the focal habitats (and buffer areas around focal areas where management strategies may be more effectively applied) and will help in developing coordinated implementation/activity plans. These questions should not limit the scope of the assessment and additional questions relative to local situations are encouraged. These questions portray the minimum degree of specificity for focal habitats in order for offices to complete Step 2a.

## **Fuels Management**

1. Where are the priority fuels management areas (spatially defined treatment opportunity areas that consider fire risk, fuels conditions, and focal habitats [including areas adjacent to focal habitats])?
2. Based on fire risk to focal habitats, what types of fuels treatments should be implemented to reduce this threat (for example, linear features that can be used as anchors during suppression operations)?
3. Considering resistance/resilience concepts and the landscape context from Step 1, where should treatments be applied in and around focal habitats to:
  - a. Constrain fire spread?
  - b. Reduce the extent of conifer expansion?
  - c. Augment future suppression efforts by creating fuel breaks or anchors for suppression?
4. Based on opportunities for fire to improve/restore focal habitats, what types of fuels treatments should be implemented to compliment managed wildfire by modifying fire behavior and effects?
5. Are there opportunities to utilize a coordinated fuels management approach across jurisdictional boundaries?
6. What fuel reduction techniques will be most effective that are within acceptable impact ranges of local sage-grouse populations, including but not limited to grazing, prescribed fire, chemical, and biological and mechanical treatments? Will combinations of these techniques improve effectiveness (e.g., using livestock to graze fine fuels in a mowed fuel break in sagebrush)?

## **Habitat Recovery/Restoration**

1. Are there opportunities for habitat restoration treatments to protect, enhance or maintain sage-grouse focal habitat especially to restore connectivity of focal area habitat?
2. Considering the resistance and resilience GIS data layer (Figure 4) and the Sage-Grouse Habitat Matrix (Chambers et al. *In prep.*; Table 2), where and why would passive or active restoration treatments be used?
3. What are the risks and opportunities of restoring habitat with low resistance and resilience including the warm/dry and cool/dry soil moisture/temperature regime areas?
4. Are there opportunities to utilize a coordinated approach across jurisdictional boundaries to effectively complete habitat restoration in focal habitats?

## **Fire Operations**

1. Where are priority fire management areas (spatially defined polygons having the highest need for preparedness and suppression action)?

2. Where are the greatest wildfire risks to focal habitats considering trends in fire occurrence and fuel conditions (see Figure 10)?
3. Where do opportunities exist that could enhance or improve suppression capability in and around focal habitats?
  - a) For example, increased water availability through installation of helicopter refill wells or water storage tanks.
  - b) Decreased response time through pre-positioned resources or staffing remote stations.
4. Should wildfire be managed (per land use plan objectives) for improving focal habitat (e.g., reducing conifer expansion), and if so where, and under what conditions?
5. How can fire management be coordinated across jurisdictional boundaries to reduce risk or to improve focal habitats?

### **Post-fire Rehabilitation**

1. Where are areas that are a high priority for post-fire rehabilitation to improve habitat connectivity if a wildfire occurs?
2. Which areas are more conducive (higher resistance and/or resilience) to recovery and may not need reseeding after a wildfire?
3. What opportunities to build in fire resistant fuel breaks to reduce the likelihood of future wildfires impacts on seeded or recovering areas?
4. Are there opportunities to utilize a coordinated approach across jurisdictional boundaries to implement rehabilitation practices?

The outcome of Step 2a is the assembly of the pertinent information and GIS layers to assist managers in developing implementation or activity plans to address wildfires, invasive annual grasses, and conifer expansion in focal habitats. Activity plans generally refer to plans where management of a resource is changed (livestock grazing plans) whereas implementation plans are generally associated with treatments.

### **Step 2b- Preparation of Activity/Implementation Plans**

Activity/implementation plans are prepared to implement the appropriate management strategies within and adjacent to focal habitats. Since focal habitats cross jurisdictional boundaries, it is especially important that a collaborative approach be used to develop implementation/activity plans. The process of identifying partners and creating collaborative teams to develop these plans is a function of state, regional, and local managers and is not addressed as part of this step.

Implementation/activity plans are required to:

1. Address issues in and around focal habitats related to wildfires, invasive annual grasses, and conifer expansion

2. Use resistance to invasive annual grasses and resilience after disturbance (where appropriate) as part of the selection process for implementing management strategies
3. Emphasize application of management strategies within or near focal habitats with low resistance and resilience (warm/dry and cool/dry soil moisture/temperature regimes) invasive annual grasses and wildfires
4. Use the best available local information to inform the assessment process
5. Encourage collaboration and coordination with focal habitats across jurisdictional boundaries
6. Be adaptive to changing conditions, disturbances, and modifications of PAC boundaries

FIAT recommends considering other factors, such as adaptive management for climate change, local sagebrush mortality due to aroga moth or other pests, and cheatgrass die-off areas in developing activity/implementation plans. The latter two factors could influence where and what kind of management strategies may be needed to address the loss of habitat or changes in fuel characteristics (e.g., load and flammability) associated with these mortality events.

The following recommendations are provided to assist in the preparation of activity/implementation plans:

### **Fuels Management**

1. Spatially delineate priority areas for fuel management treatments per Step 2a information considering:
  - a. Linear fuel breaks along roads
  - b. Other linear fuel breaks to create anchor points
  - c. Prescribed burning which would meet objectives identified in the Fish and Wildlife Service's Conservation Objectives Team (COT) report
  - d. Mechanical (e.g., treatment of conifer expansion into sagebrush communities)
  - e. Other mechanical, biological, or chemical treatments
  - f. If they exist, spatially delineated areas where fuel treatments would increase the ability to use fire to improve/enhance focal habitats.
2. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of fuels treatments.
3. Quantify a projected level of treatment within or near focal habitats.
  - a. Identify treatments (projects) to be planned within or near focal habitats.
  - b. Include a priority and proposed work plan for proposed treatments.

### **Habitat Recovery/Restoration**

1. Spatially delineate priority areas for restoration, using criteria established in Step 2a. Priority areas for restoration should be delineated by treatment methods:
  - a. Seeding priority areas
  - b. Invasive annual grasses priority treatment areas (herbicide, mechanical, biological, combination)

- c. Priority areas requiring combinations of treatments (e.g., herbicide followed by seeding).
  - d. Include tables, maps or appropriate info.
- 2. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of restoration treatments.
- 3. Include a priority or implementation schedule for proposed restoration treatment

### **Fire Operations**

- 1. Spatially delineate priority areas for fire suppression, based upon criteria established in Step 2a. Priority areas for fire operations should be delineated by type, such as:
  - a. Initial attack priority areas
  - b. Resource pre-positioning and staging priority areas
- 2. Spatially delineate areas where opportunities exist to enhance or improve suppression capability.
- 3. Spatially delineate areas where wildfire can be managed to achieve land use plan and COT objectives.

### **Post-Fire Rehabilitation**

- 1. Spatially delineate priority areas for post-fire rehabilitation using criteria in Step 2a.
- 2. Priority areas for post-fire rehabilitation should be based on resistance and resiliency and pre-fire landscape sagebrush cover and include consideration of:
  - a. Seeding priority areas
  - b. Invasive annual grasses priority treatment areas (herbicide, mechanical, biological (herbivory or seeding),
  - c. Priority areas requiring combinations of treatments (e.g., herbicide followed by seeding)
- 3. Identify coordination needed between renewable resource, fire management, and fuels management staff to facilitate planning and implementation of post-fire rehabilitation treatments.

This completes the assessment process and sets the stage for more detailed project planning and NEPA associated with implementing on-the-ground treatments and management changes.

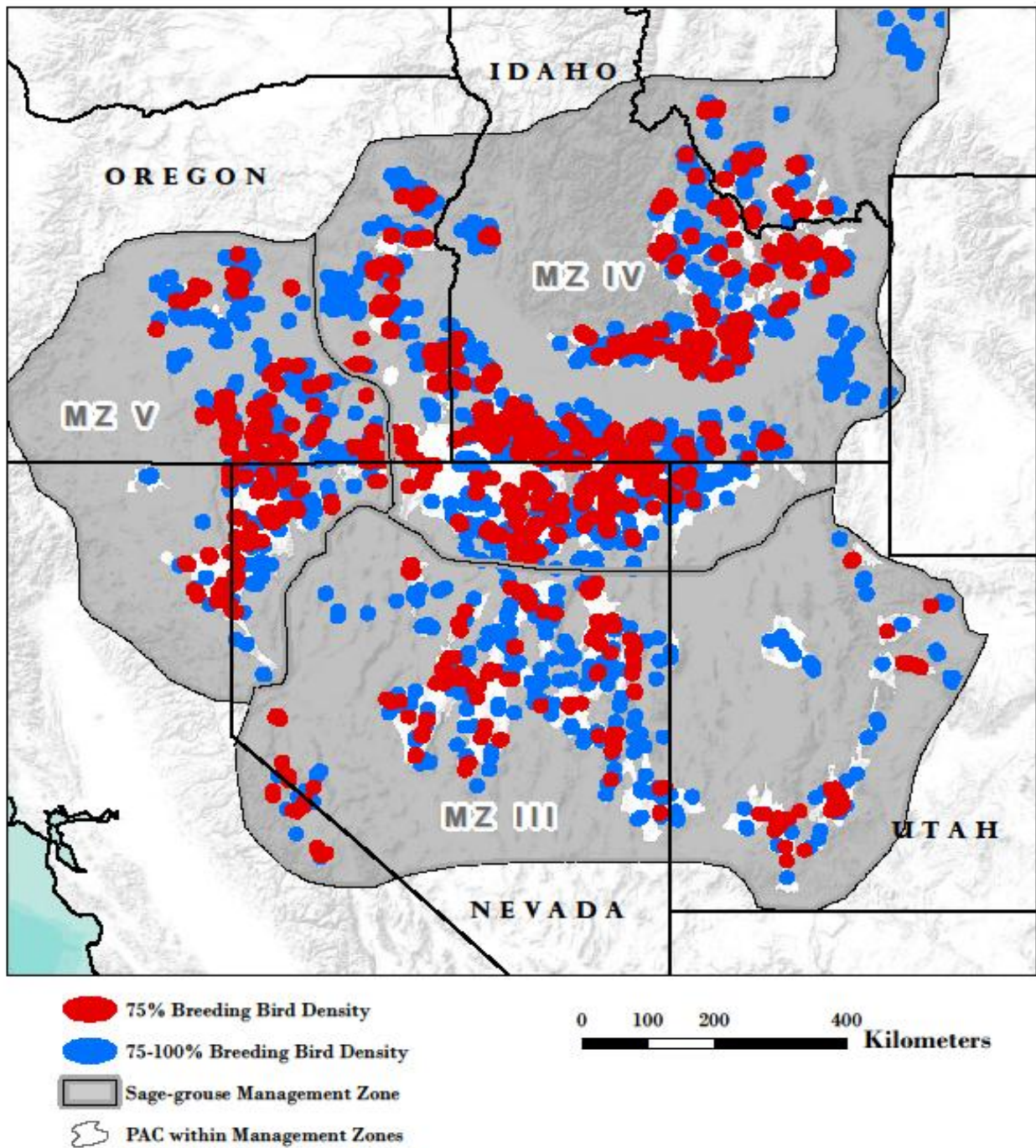
Members of the FIAT Development and Review teams are listed in Appendix 5.

## Literature Cited:

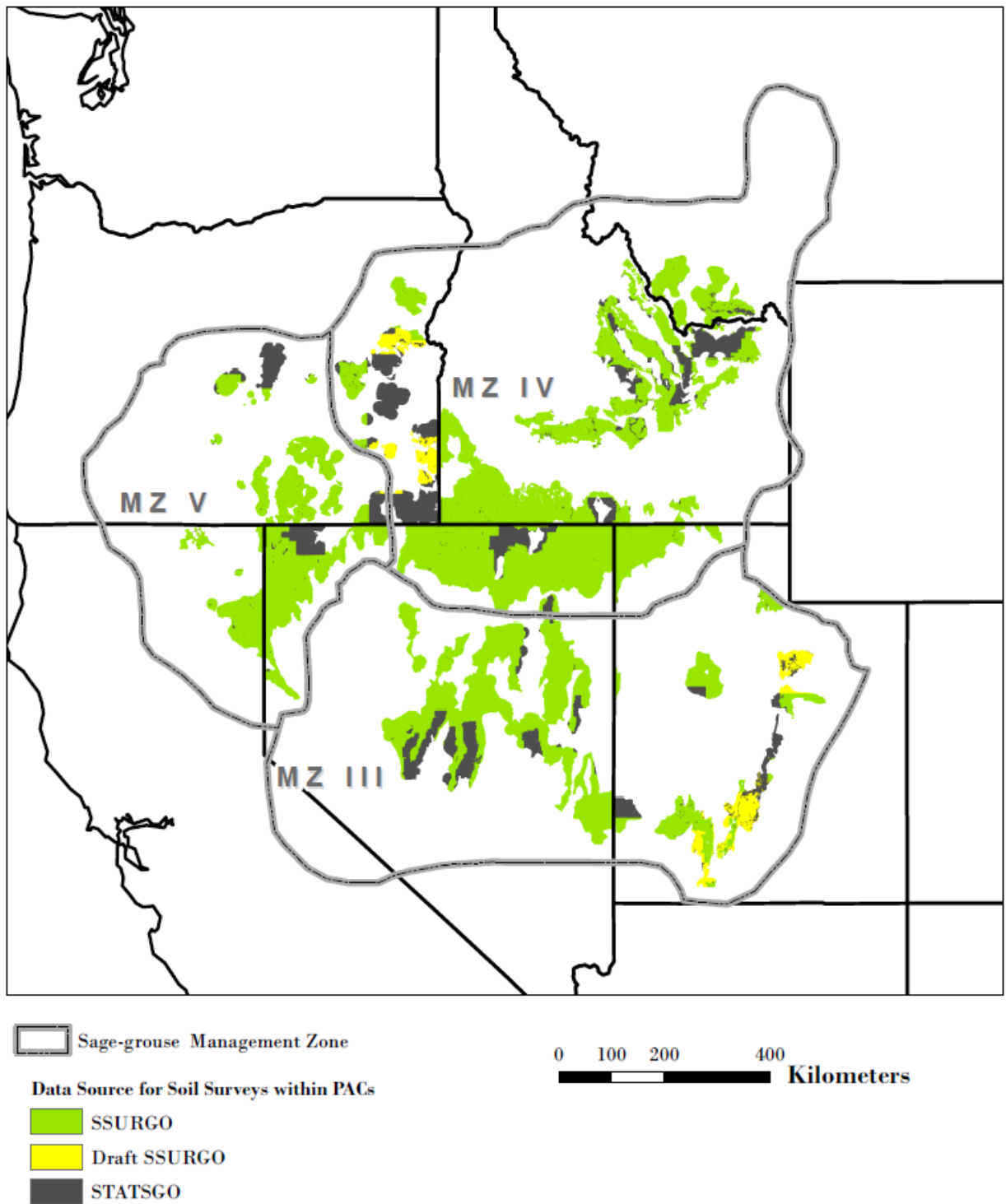
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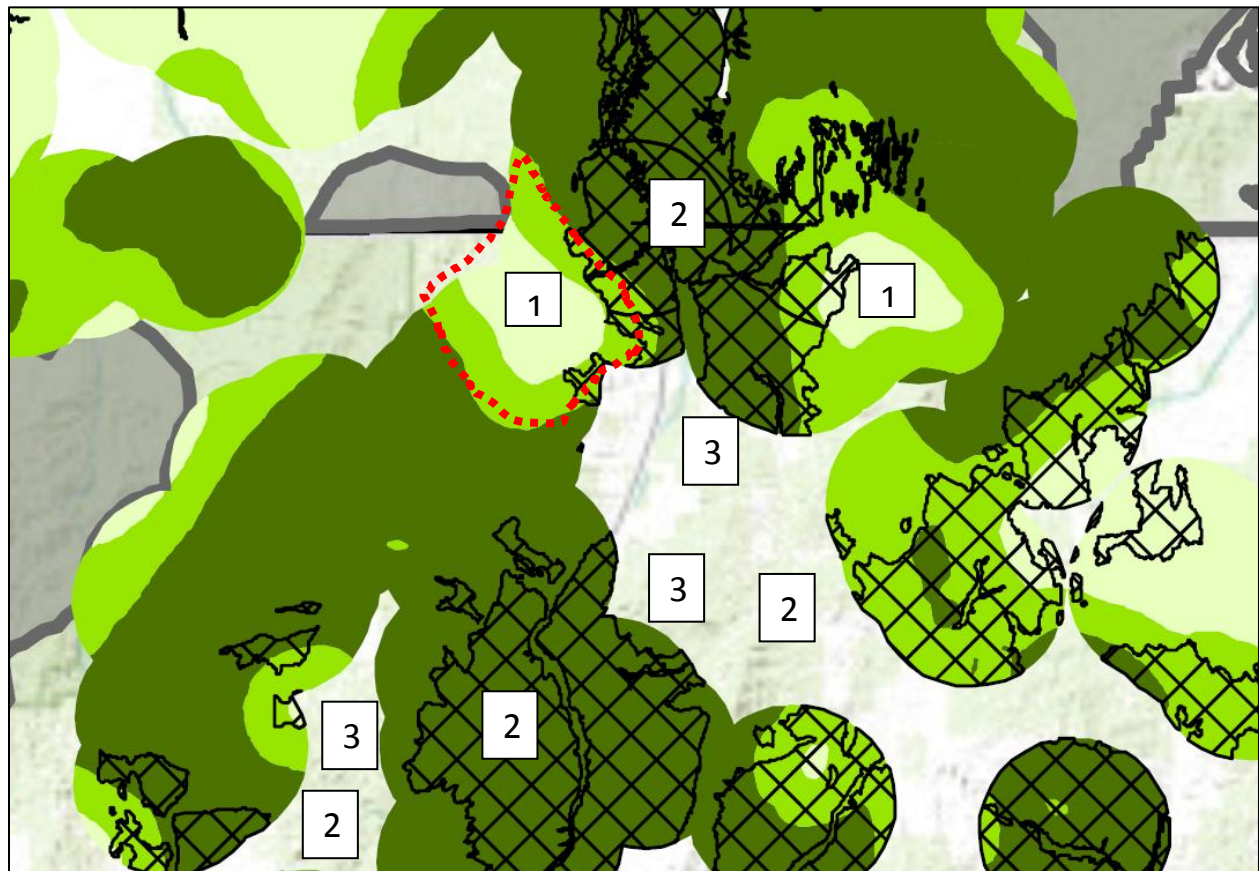
**Appendix 1.** Sage-grouse breeding bird density thresholds for 75% and 100% of the breeding birds, Management Zones, and PACs. Breeding bird density of 75 to 100% is included in this figure to provide context for local management units when making decisions concerning connectivity between populations and PACs.

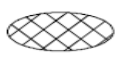




**Appendix 2.** Gaps in SSURGO soil survey data in Management Zones III, IV, and V. STATSGO2 soil survey data used to fill these gaps.

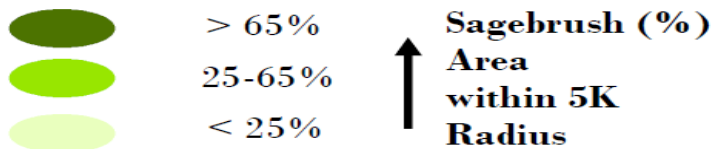


**Appendix 3.** Example of potential management strategies applied to Wildfire/Invasive Annual Grass Scenario.



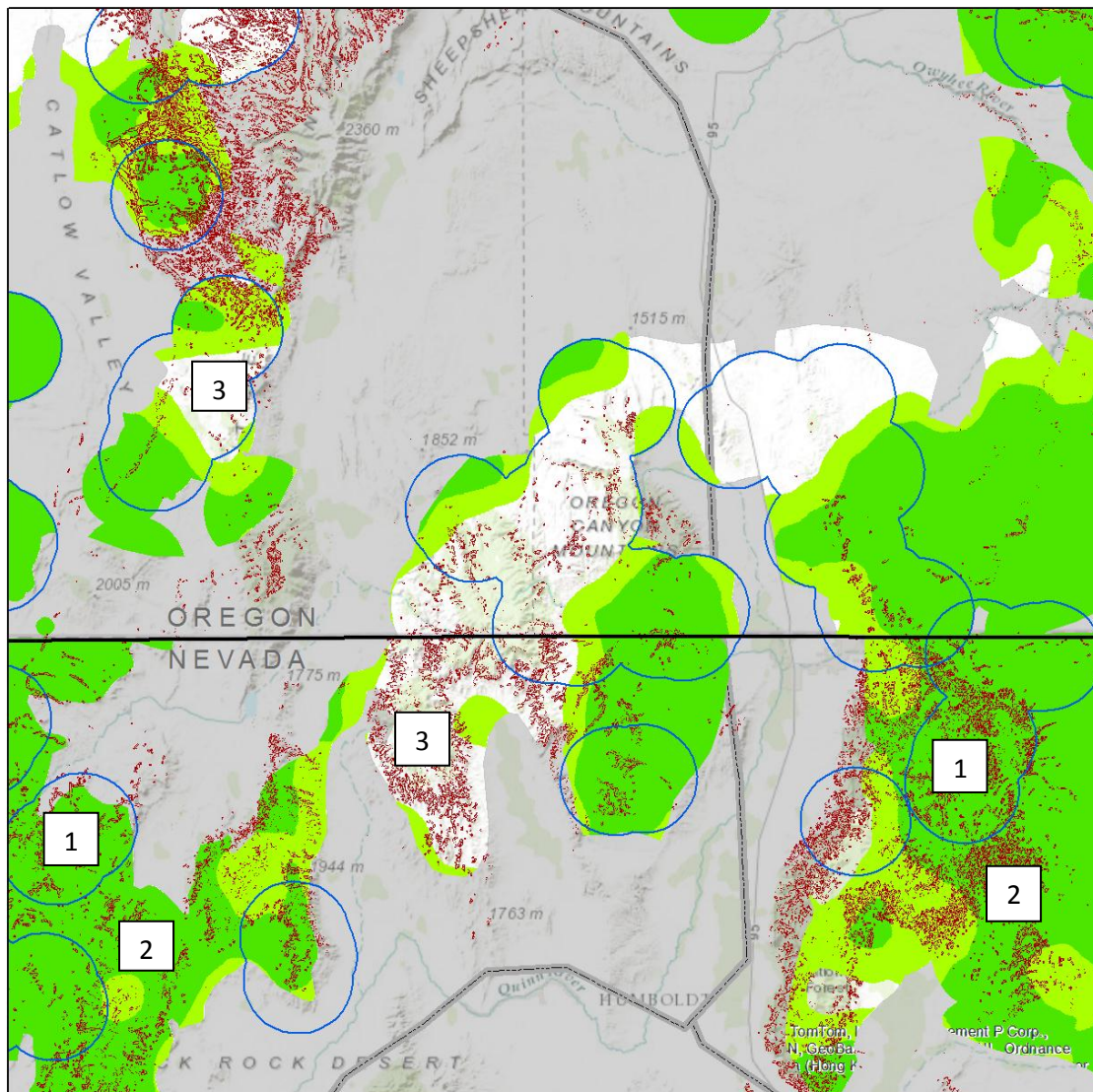
-  High Breeding Bird Density (75%)  
Overlapping Warm & Dry Regime
-  Sage-grouse Management Zone
-  Sage-grouse High Priority PAC within Management Zones

**High Sage-grouse Breeding Bird Density**



- 1** High priority for habitat restoration and post-fire rehabilitation to restore connectivity.
- 2** High priority for fire suppression within and around area given >65% sagebrush landscape cover and low resistance/resilience.
- 3** High priority for fuels management to reduce likelihood of wildfires in low resistance/resilience habitat with >65% landscape cover.

Appendix 4. Management strategy example for Western Juniper expansion.



- ◆ Conifer Expansion (risk model) surrounding PAC
- BB\_Density\_75\_Merge selection selection selection
- PAC within Management Zones
- Sage-grouse Management Zone
- Sagebrush (%) Area within a 5K Radius
  - > 65%
  - 25-65%
  - < 25%

0 12.5 25 50  
Kilometers

- 1 High priority (emphasis area) for juniper control (>25% landscape sagebrush cover & 75% BBD)
- 2 Moderate priority (emphasis area) for juniper control (>25% landscape sagebrush cover)
- 3 Very low priority (<25% landscape sagebrush cover)

## Appendix 5. Members of FIAT Development and Review Team

### Development Team

|                  |   |
|------------------|---|
| Mike Pellant*    | BLM, Team Lead, Boise, Idaho                                  |
| Dave Pyke*       | US Geological Survey, Scientist, Corvallis, Oregon            |
| Jeanne Chambers* | RMRS, Scientist, Reno, Nevada                                 |
| Jeremy Maestas*  | NRCS, Wildlife Biologist                                      |
| Chad Boyd*       | ARS, Scientist, Burns, Oregon                                 |
| Lou Ballard      | USFWS, NIFC, Boise, Idaho                                     |
| Randy Sharp      | Forest Service Management (retired)                           |
| Doug Havlina     | BLM, NIFC, NIFC Fire Ecologist                                |
| Tim Metzger      | Forest Service Fire Management Specialist                     |
| Todd Hopkins     | USFWS, Great Basin LCC, Reno, Nevada                          |
| Tom Rinkes       | BLM (retired biologist), Boise, Idaho                         |
| Clint McCarthy   | Forest Service, Biologist (retired)                           |
| Joe Tague        | BLM Management Liaison, Reno, Nevada                          |
| Steve Knick      | US Geological Survey, Team Technical Assistance, Boise, Idaho |
| Mina Wuenschel   | BLM Great Basin LCC GIS Specialist, Reno, Nevada              |
| Mike Gregg       | USFWS, Biologist, Burbank, Washington                         |

\* indicates member of the  
WAWFA Resistance and Resilience team.

### Review Team

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|-----------------------------|---|
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| Lauren Mermejo              | BLM, Great Basin Sage-Grouse Project Manager, Reno, Nevada              |
| Glen Stein                  | Forest Service National Sage Grouse Project Manager, Ogden, Utah        |
| Jessie Delia                | USFWS, Biologist (T&E), Portland, Oregon                                |
| Mike Ielimi                 | Forest Service, National Invasive Species Coordinator, Washington, D.C. |
| Tate Fisher/Krista Gollnick | BLM NIFC, Fire Planning, Boise, Idaho                                   |
| Ken Collum                  | BLM, Eagle Lake Field Office Manager, Susanville, California            |
| Chuck Mark                  | Forest Service Supervisor, Salmon-Challis Forest                        |
| Dave Repass                 | BLM, ES&R Coordinator, Washington Office                                |
| Peggy Olwell                | BLM Native Plant Initiative, Washington Office                          |
| Don Major                   | BLM Landscape Ecologist, Boise, Idaho                                   |
| Don Kemmer                  | Idaho Fish & Game, Boise, Idaho   |