2016

Blackfoot-Swan Landscape Restoration Project

LANDSCAPE ASSESSMENT FOR TERRESTRIAL FOREST ECOSYSTEMS – APPENDICES

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This landscape assessment was completed through a Challenge Cost Share Agreement between the Ecosystem Management Research Institute and the USDA Forest Service Lolo, Flathead, and Helena National Forests (#14-CS-11011000-037)

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APPENDIX A. DESCRIPTION OF THE CONSERVATION STRATEGY FOR BIODIVERSITY

Introduction

A biodiversity conservation strategy is a plan of action which if correctly and adequately implemented should result in ecological sustainability and the maintenance and/or restoration of the full complement of biodiversity in a defined area. Biodiversity, as defined by the U.S. Congress in 1991 is "the full range of variety and variability within and among living organisms and the ecological complexes in which they occur: encompasses ecosystems or community diversity, species diversity, and genetic diversity."

The objectives of this report are to provide:

1. A brief summary of the impetus for and history of landscape-level planning for ecological sustainability and biodiversity conservation,
2. A description of the science supporting conservation strategies for ecological sustainability and biodiversity,
3. A description of the conservation strategy used in the U.S. Forest Service planning rule and supported by the Ecosystem Restoration Policy, and
4. A discussion of the application of this conservation strategy to BSLRP.

Conservation Strategies: Ecological Sustainability and Biodiversity

History and Background

Beginning in the 1970's, increasing concerns about human impacts on the environment led to International discussions on ecological sustainability. These discussions culminated in the growing recognition of the importance of biodiversity and the desire to define ways to make anthropogenic development ecologically sustainable (Callicott et al. 1999). *Our Common Future*, also known as the Brundtland Report, from the United Nations World Commission on Environment and Development (UNWCED 1987), placed considerable emphasis on the concept of sustainable development. It defined sustainable as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." A primary focus of sustainable development was ecological sustainability which identified maintaining biodiversity as a central component.

These early discussions related to biodiversity led to the establishment of the Convention on Biological Diversity (CBD) in 1993, with 194 countries as signatories to the CBD, but with only 191 currently agreeing to be Parties to the Convention. The United States signed onto the CBD, but has not become a Party to the Convention. The CBD defined biodiversity as: "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." It calls for countries to help conserve biodiversity and identifies the following action items for CBD participants:

- Identify and monitor the important components of biological diversity which need to be conserved and used sustainably.
- Establish protected areas to conserve biological diversity while promoting environmentally sound development around these areas.

- Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species in collaboration with local residents.
- Respect, preserve and maintain traditional knowledge of the sustainable use of biological diversity with the involvement of indigenous peoples and local communities.
- Prevent the introduction of, control, and eradicate alien species that could threaten ecosystems, habitats or species.
- Control the risks posed by organisms modified by biotechnology.
- Promote public participation, particularly when it comes to assessing the environmental impacts of development projects that threaten biological diversity.
- Educate people and raise awareness about the importance of biological diversity and the need to conserve it.
- Report on how each country is meeting its biodiversity goals.

The last point has led to each Party (i.e., country) to the convention, having expectations to develop a national biodiversity conservation strategy. The U.S., not a Party to the Convention, has not prepared such a national biodiversity conservation strategy. However, the international discussions on biodiversity have had a strong influence on the development of approaches to biodiversity conservation currently being used in the U.S. and which is reflected in the scientific literature.

Establishment of protected areas has been a central component of the CBD. At its meeting in 1992, the CBD set a goal of establishing 10% of each ecoregion of the world in protected areas (McNeely et al. 2005). By 2005, approximately 12% of the world's land base was reported to be in some type of conservation status (McNeely et al. 2005), but Soutullo et al. (2008) noted that 63% of the world's terrestrial ecoregions had not achieved the 10% goal. Revisions to the CBD in 2010 called for 17% of terrestrial ecosystems to be designated for conservation by 2020. The 2014 Global Biodiversity Outlook 4 (Secretariat of the Convention on Biological Diversity, Montréal, Canada) reported that while the overall global goal of 17% measured as total area of protected areas may be reached, many ecological regions would remain underrepresented. Nearly midway in the 2010-2020 timeframe of CBD planning, Tittensor et al. (2014) have similarly reported the 2020 goals for biodiversity are unlikely to be met.

The CBD identified various approaches and activities for conserving biodiversity, and left latitude for each Party to the convention to develop their own overall strategy. However, the clear focus on protected areas by the CBD has led to this conservation strategy being a primary worldwide focus for biodiversity conservation. The basic assumption of this approach is that by establishing enough areas in a protected conservation status within all ecoregions, biodiversity will be sustained. In many areas of the world, protected areas are an essential conservation tool as the existing or projected levels of human use would not allow many species to survive outside such areas. This is particularly true in many developing countries. Consequently, much emphasis on conservation has been directed at developing tools to help identify the amounts, sizes, and distributions of protected areas needed to conserve biodiversity (Andrew et al. 2014, Burns et al. 2013, Soutullo et al. 2008, Leroux et al. 2007, Sarkar et al. 2006).

The Protected Area Strategy

A common theme in the conservation biology scientific literature is the discussion of various aspects of reserves or protected areas as central components of conservation planning (e.g., Andrew et al. 2014, Conlisk et al. 2014, Burns et al. 2013, Faleiro et al. 2013, Cox and Underwood 2011, Mora and Sale 2011, Rayfield et al. 2008, Leroux et al. 2007, Sarkar et al. 2006, Allen et al. 2005, Dietz and Czech 2005, Bengtsson et al. 2003, Groves 2003, Sierra et al. 2002, DellaSala et al. 1996, Blockstein 1995, DellaSala et al. 1995, Noss and Cooperrider 1994, Scott et al. 1993). A major focus of this literature is on methods to select reserve locations, as well as establish adequate numbers and sizes. The World Commission on Protected Areas proposed various criteria for the identification of conservation areas (Davey 1998). These included the following:

- Representativeness, comprehensiveness, and balance: the full range of biodiversity is represented in a balanced manner,
- Adequacy: sufficient amounts are included in conservation areas,
- Coherence and complementarity: areas complement each other and add to the composite set of conservation areas,
- Consistency: uniform application of decision processes in selecting areas, and
- Cost effectiveness, efficiency and equity: balancing the needs of other landscape objectives with conservation needs.

Shaffer and Stein (2000) discussed the need for conservation initiatives to emphasize representation, resiliency, and redundancy in the selection of conservation areas. To be representative, conservation areas need to address the range of environmental conditions within the planning area. To be resilient, conservation areas must be of sufficient quality and maintain appropriate processes to withstand expected natural and human perturbations. To safe guard against unpredictable events, conservation areas should be redundant, with sufficient number of areas to insure all will not be affected by a major perturbation event.

Cooperrider et al. (1999) stated the goals of the protected area or what they termed the bioreserve strategy are to: 1) represent in a reserve status all native ecosystem types including seral stages across their natural range of variability, 2) maintain viable populations of all native species in natural patterns of abundance and distribution, 3) maintain ecological and evolutionary processes, and 4) be responsive to short and long term environmental change. Noss and Cooperrider (1994) provided a template for protected lands, further described by Groves (2003), that emphasized reserves should contain full representation of native ecosystems. Noss and Cooperider (1994:9) stated: “The rationale for protecting ecosystems is compelling: if we can maintain intact, ecologically functional examples of each type of ecosystem in a region, then the species that live in these ecosystems will also persist.” They considered an ecosystem to be a specific biotic community plus its abiotic environment, and added that conservation at the ecosystem level requires attention to ecological processes. While Noss and Cooperider (1994) emphasized a reserve strategy and promoted maintaining representation of all native ecosystems and their functional processes in a system of reserves, the concept of providing representation of all native ecosystems is not constrained in application to only the bioreserve strategy. Groves (2003:228) defined representation or representativeness as “the need to represent occurrences of each community or ecosystem across the environmental gradients in which they occur in a system or portfolio of conservation areas."

In North America, the bioreserve strategy has been promoted by initiatives including the Wildlands Project (Noss and Cooperider 1994), the GAP initiative (Scott et al. 1993, Dietz and Czech 2005), and maintaining core reserves in Pacific Northwest forests (DellaSala et al. 1995). Similarly, The Nature Conservancy seeks to establish a conservation blueprint of protected areas within ecoregions (Shaffer and Stein 2000). Analyses of reserves and reserve networks have looked at the amounts and distributions of protected lands and how many species, types of vegetation conditions, or other measures of biodiversity are contained within these areas (Sarkar et al. 2006, Shaffer and Stein 2000, Scott 1999). Scott et al. (2001a, 2001b) reported many protected areas in the United States contain a disproportionate amount of rock and ice, and not enough of more highly productive ecosystems. Dietz and Czech (2005) reported poor rates of inclusion of a majority of vegetation cover types in the U.S. within GAP-defined protected areas. Thus in North America, and the United States specifically, the protected-area strategy, as it has been implemented to date, has in most examples not met its required needs for representation and adequacy (redundancy).

Alternative Conservation Strategies

The need and applicability of a strict protection or bioreserve strategy has been questioned, particularly for North America (Kareiva and Marvier 2012, Mora and Sale 2011, D'Eon et al. 2004). A basic difference in the assumption of many strategies is the necessity of the protection status of a conservation area versus an emphasis on its functional capabilities. The primary focus of conservation planning is the identification and delineation of areas that can contribute to the conservation of biodiversity. Conservation areas can be generally defined as areas in which the primary concern is with the conservation of biotic or environmental features (Groves 2003). Reserves can be defined in a similar manner, but typically imply a level of protection from various human activities. Many efforts, such as the GAP analysis initiative (Scott et al. 1993) and ecoregional planning by The Nature Conservancy (Groves 2003, Shaffer and Stein 2000) only consider an area as providing representation for biodiversity if it is in a wilderness area, national park, or similar protected status. Other efforts emphasize the maintenance, enhancement, and restoration of conservation areas based on their functional attributes, regardless of ownership or protection status. These efforts may address conservation objectives through use of such conservation tools as voluntary incentive programs (Haufler and Kernohan 2001, 2009). Callicott et al. (1999) discussed some of these differences and identified that both views recognize that wild areas and protected reserves are an important tool for some components of biodiversity, and that working landscapes can make important contributions to biodiversity conservation, the basic philosophical differences between the two views divide many specific conservation efforts. However, as noted above, the main body of conservation biology literature on a worldwide basis focuses more on protected areas in international conservation programs than on functional conservation areas.

This division of views continues, as evidenced by recent debates on approaches to conservation biology (Kareiva and Marvier 2012, Noss et al., 2013). Kareiva and Marvier (2012:962) stated: "Emerging priorities include pursuing conservation within working landscapes, rebuilding public support, working with the corporate sector, and paying better attention to human rights and equity." Noss et al. (2013:242) responded to Kareiva and Marvier (2012) stating: "We propose that a mature conservation ethic would recognize limits to growth and would ratchet back human domination of the biosphere, rather than embracing it." They advocated for protecting additional areas and expanding wild lands, consistent with the protection or bioreserve strategy. Harmsen and Foster (2014) summed up the opposing points well by stating: "In addressing "What is Conservation Science?" Kareiva and Marvier (2012) advocated increasingly pragmatic and socially acceptable tactics, incorporating human well-being as necessary to ensure conservation success. In response, Noss and colleagues (2013) argued that unlimited population growth and unregulated human development are incompatible with the preservation of natural ecosystems and indicated that economic gain in the pursuit of human well-being lies at the heart of biodiversity loss. The resulting debate is focused on two opposing philosophies: collaboration with corporations and work toward minimizing their detrimental activities (Kareiva and Marvier 2012) and opposition of corporate development and acceptance of limits to growth (Noss et al. 2013)."

Brancalion et al. (2013) discussed the need for ecosystem restoration in addition to protection of remaining functional ecosystems to maintain biodiversity. Brook et al. (2006) discussed the need for integrating ecological, economic, attitudinal and behavioral considerations in conservation strategies. Cox and Underwood (2011) and DellaSala et al. (1995) discussed the need for conservation actions occurring outside of reserves. D'Eon et al. (2004) identified how ecosystem representation should consider contributions from working lands. Mora and Sale (2011) discussed moving beyond a focus on protected areas to meet biodiversity objectives. Thus, while protected areas are recognized as an important tool or approach for biodiversity conservation, there is also recognition of the importance of alternative strategies which incorporate the contributions of all lands to representation goals, especially in North America.

An additional debate in conservation biology concerns what measures or metrics should be used in designing conservation areas. The most commonly discussed include two differing strategies that have been termed coarse filter and fine filter strategies. Coarse filter strategies refer to placing a primary emphasis on defining representation goals based on native ecosystem diversity, while fine filter strategies place a primary emphasis on having species represented in conservation areas. Coarse and fine filter strategies have been discussed extensively in the literature (Tingley et al. 2014, Hermoso et al. 2012, Schultz et al. 2013, Samways 2007, Lemelin and Darveau 2006, Schulte et al. 2006, Samson et al. 2003, Kintsch and Urban 2002, Haufler 1999a, 1999b, Schwartz 1999, Panzer and Schwartz 1998, Kaufmann et al. 1994). Coarse filter strategies have been identified in many publications as a primary direction for conservation planning (Berg et al. 2014, Yanahan and Taylor 2014, Hermoso et al. 2012, McIlwee et al. 2013, Schultz et al. 2013, Schulte et al. 2006, D'Eon et al. 2004, Haufler et al. 2002, Kintsch and Urban 2002, Panzer and Schwartz 1998, Kaufmann et al. 1994), although numerous fine filter strategies have also been promoted, such as the current emphasis on surrogate species by the U.S. Fish and Wildlife Service (http://www.fws.gov/mountain-prairie/science/surrogate_species.cfm).

2012 US Forest Service Planning Rule

The maintenance and restoration of biodiversity has been and continues to be a key emphasis of conservation efforts, and is a fundamental component of ecological sustainability. The 2012 USFS Planning

Rule defined sustainability as "the capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. For purposes of this part, "ecological sustainability" refers to the capability of ecosystems to maintain ecological integrity; "economic sustainability" refers to the capability of society to produce and consume or otherwise benefit from goods and services including contributions to jobs and market and nonmarket benefits; and "social sustainability" refers to the capability of society to support the network of relationships, traditions, culture, and activities that connect people to the land and to one another, and support vibrant communities" (U.S. Forest Service 2012 Planning Rule). The Rule further defined ecological integrity as "the quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence."

The U.S. Forest Service Ecosystem Restoration Policy further defined the expectations of restoration activities on Forest Service lands. This policy stressed the importance of recreating the ecosystem conditions that occurred prior to Euro-American settlement. It stated: "Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience and health…..The desired future conditions of an ecosystem should be informed by an assessment of spatial and temporal variation in ecosystem characteristics under historical disturbance regimes during a specified reference period." The policy recognized challenges to restoring historical conditions in some ecosystems, and added the term functional restoration for when it is not possible or desirable to reestablish key ecosystem characteristics within the NRV; the policy provides the flexibility to replace historical species or other characteristics with species or other characteristics that will be functionally similar but better suited for identified future climate or other conditions.

The diversity of plant and animal communities section of the planning rule identified a coarse filter conservation strategy as the primary mechanism for achieving ecological sustainability and ecosystem integrity. It emphasized the principles of representation of native ecosystem diversity, but did not rely on a protected area or bioreserve strategy in providing this representation. Rather, the conservation strategy identified in the Rule and reinforced in the Ecosystem Restoration Policy emphasizes an approach where maintaining representation of ecosystem diversity is the primary focus without regard to whether this representation occurs in strict protected areas, working lands, or other locations. It supported the need for representation of all native ecosystems, and clearly defined an ecosystem as a specifically defined assemblage of species with characteristic composition, structure, processes, and connectivity in terms of its landscape context.

The conservation strategy presented in the Rule secondarily applies a complementary species assessment to the primary coarse filter strategy. Combining a coarse-filter and fine filter strategy has several advantages. First, the coarse filter provides a sound scientific foundation for representation of native ecosystems and for identifying and quantifying the cumulative effects of post-settlement activities on this diversity (Kaufmann et al. 1994). Second, identifying desired ecosystem diversity based on reference conditions is more time and cost effective than to manage for ever-increasing numbers of endangered, threatened, proposed, candidate, or species of conservation concern (Kintsch and Urban 2002, Kaufmann et al. 1994). Third, a coarse filter provides the mechanism to make sense of conflicting habitat demands in a single landscape for multiple species of concern (Marcot et al. 1994). Finally, for many species, information on their distribution and specific habitat needs is inadequate to provide for their habitat requirements (Haufler 1999b). By applying the coarse filter strategy as the primary mechanism for conserving biodiversity, this strategy increases the likelihood that the habitat needs of all species will be represented in the landscape through ecosystem restoration or maintenance, thus promoting overall restoration and maintenance of biodiversity. However, linking the coarse-filter approach of providing ecosystem diversity with a fine filter analysis of species habitat allows for the assessment of habitat status of species of concern or focal species relative to the historical, current, and future ecosystem diversity conditions. In addition, the species assessment component allows for the evaluation of the effectiveness of the coarse filter for providing sufficient amounts of each ecosystem, as well as ecosystem patch-sizes and distribution or spatial arrangement in the landscape, as proposed and identified during the forest-level or project-level planning process.

Coarse Filter Component - Native Ecosystem Diversity

The coarse filter strategy, as described for this purpose, emphasizes maintaining or restoring native ecosystem diversity. There is substantial agreement in the literature on the science supporting this strategy through the concept of representation (Groves 2003, Kintsch and Urban 2002, Mac Nally et al. 2002, Poiani et al. 2000, Kaufmann et al. 1994, Noss and Cooperrider 1994). The Rule incorporates the underlying conservation guidelines for representation in addressing the coarse filter requirements for native ecosystems. The Rule and the Ecosystem Restoration Policy also emphasize the resiliency requirements in providing ecosystems that have the appropriate compositions, structures, functions and connectivity as defined by natural ranges of variation. Further, the needs for adequacy and redundancy are addressed in identifying that sufficient amounts and distributions of each ecosystem are needed to support all ecosystems and species into the future. Thus, the conservation strategy identifies these key elements of a coarse filter approach without the requirement that they be in specific protection status.

Numerous authors have identified the importance of ensuring the variety of ecosystems is considered in representation within a planning region (McIlwee et al. 2013, Groves 2003, Shaffer and Stein 2000, Lambeck and Hobbs 2002, Schwartz 1999, Pressey 1998, Kaufmann et al. 1994). Both biotic and abiotic factors should be included in identifying conservation areas (McIlwee et al. 2013, Groves 2003, Saxon 2003). McIlwee et al. (2013), de Blois et al. (2002), Poiani et al. (2000), and Haufler et al. (1996, 1999a) identified the importance of understanding both the role of abiotic factors in creating different types of ecological sites within a planning landscape, and how ecosystems react temporally following disturbance across these different ecological sites.

The fundamental assumption behind using representation of native ecosystems as a conservation strategy is if the full range of historical conditions and the processes influencing them can be maintained or restored in a planning area, then all of the native ecosystems that supported biodiversity at all scales or levels, will be present (Aplet and Keeton 1999, Kaufmann et al. 1994, Noss and Cooperrider 1994). A key part of this is to adequately represent native ecosystem diversity at appropriate landscape scales in terms of amounts, sizes and distributions and to adequately represent each native ecosystem in terms of having an appropriate composition, structure, and function including disturbance processes and connectivity (Haufler et al. 2002). Poiani et al. (2000) discussed the need for functional conservation areas which she defined as the "geographic domain that maintains focal ecosystems, species, and supporting ecological processes within their natural ranges of variability". Poiani et al. (2000) further discussed functional conservation areas as areas that: "maintains the focal biotic and abiotic patterns and processes within their natural ranges of variability over time frames relevant to conservation planning and management (e.g., 100-500 years)." For ecological sustainability, understanding, describing, and quantifying native ecosystem diversity at the landscape level and developing detailed reference descriptions at the ecosystem level are critical steps to forest planning. Both depend upon applying an appropriate scale and resolution of ecosystem diversity classification.

Various tests of coarse filter strategies have shown they can be effective for biodiversity conservation (Berg et al. 2014, Yanahan and Taylor 2014, McIlwee et al. 2013, Oliver et al. 2004, Kintsch and Urban 2002, Ben Wu and Smeins 2000, Wessels et al. 1999, Nichols et al. 1998, Panzer and Schwartz 1998). Several projects have conducted analyses of historical coarse filter conditions compared to current conditions. Haufler et al. (1996, 1999, 2000) and Kernohan and Haufler (1999) described a coarse filter process that used an historical reference to characterize native forest ecosystem diversity, and compared it to current conditions. Their method quantified historical amounts of ecosystems based on historical disturbance regimes, especially the role of fire, and compared these amounts to current conditions. These comparisons allowed for a prioritization of those ecosystems with the greatest need for conservation based on a deviation from historical amounts. Poiani et al. (2000) applied an historical analysis to a classification of ecosystems along the Yampa River in Colorado, and were able to identify focal ecosystems for setting restoration and maintenance goals based on historical flood events and their influences on riparian ecosystems. Hemstrom et al. (2001) used an historical reference approach to assess ecosystem conditions in the Upper Columbia River planning landscape based on conditions described in the mid-1900s. Another example of analyzing current and historical conditions for conservation planning was described by van Wyngaarden and Fandino-Lozano (2005) for Columbia. They mapped existing conditions with satellite imagery, investigated abiotic factors, and determined which native ecosystems were present. This allowed them to conduct comparisons of historical to existing conditions and to prioritize conservation efforts to most efficiently use limited conservation funds. All of these examples identified the feasibility of implementing coarse filter approaches based on historical references.

The use of natural or historical ranges of variability as identified in the Rule and the Ecosystem Restoration Policy, requires the development of information on native ecosystem diversity (Landres et al. 1999, Swetnam et al. 1999, Kaufmann et al. 1994, Morgan et al. 1994). This approach generally focuses on understanding how historical disturbance processes operated across different ecological sites within planning landscapes to produce the dynamics of native ecosystem diversity. This information is then used to determine the amounts and distributions of native ecosystems. Comparisons to current conditions based on the same ecosystem diversity classification allow analysis of cumulative changes caused by more recent human activities. This type of historical analysis can incorporate all levels of biodiversity in the natural or historical range of variability (Haufler et al. 2002). Conducting such an assessment provides the ecological reference for assessing the current status of a landscape in relation to its historical status, and helps identify the desired direction for management. Clewell and Aronson (2014) stated: “An ecological reference indicates the intended characteristics of an ecosystem after it has undergone ecological restoration.”

To ensure the effectiveness of the coarse filter, it is essential that the scientific foundation for this reference remains in the forefront of forest planning. Without adherence to the need to fully represent native ecosystem diversity as defined by both abiotic conditions and disturbance processes, in appropriate amounts, sizes, and distributions, and for each specific ecosystem to have the appropriate characteristics in terms of its composition, structure, function, and connectivity, then the basic scientific underpinnings of the coarse filter strategy are not met.

Ecosystems have and continue to be directly altered by human actions. Although Native Americans interacted and influenced ecosystems for thousands of years, these influences are generally incorporated in an historical reference. It is the extent of human influence occurring since major Euro-American settlement, generally over the last 150 years, which is of greatest conservation concern. Direct conversions to agriculture, urban, suburban, and rural developments are the most obvious impacts. However, there are also less obvious, yet in some instances more pervasive, human-induced changes at both the landscape and ecosystem levels as well, such as the implications of a century of anthropogenic alterations to and interruptions of historical disturbance processes as well as invasions of exotic species. Therefore, important reference information for the identification of ecosystems in need of restoration includes a description and assessment of historical conditions as influenced by historical disturbance processes. With such information, departure from historical amounts and distributions of ecosystems and corresponding species habitats can be mapped and quantified. This information can also be used to identify critical remaining areas of intact or “natural” ecosystems and highlight areas with greatest restoration potential.

Current social and economic demands such as protection of human lives or property from wildfire require that many areas of national forest land be managed for objectives other than restoration. However, where these constraints are not paramount, historical reference should be the starting point for setting direction in terms of ecological sustainability and biodiversity conservation. Deviations from the historical reference should be clearly identified and supported for why they are needed, either in response to changed environmental conditions or for their expected contributions to meeting social and economic needs in the landscape. Expected outcomes should then be evaluated on whether the remaining native ecosystem diversity goals (i.e., representation, resiliency, and redundancy) will support ecological sustainability and biodiversity objectives for the landscape.

As mentioned, the coarse filter applies the concept of representation at two levels of biodiversity organization, the ecosystem level that defines specific ecosystems and their reference conditions in terms of compositions, structures, and functions, and the landscape level which addresses the amounts, sizes, and distributions of specific ecosystems as arranged across the landscape. The amounts of each ecosystem that occurred historically can be estimated and used to help guide desired restoration objectives. As noted by Higgs et al. (2014), historical references remain vitally important to restoration efforts.

The historical spatial arrangements of ecosystems within landscapes are less well understood and documented than reference conditions such as species compositions, fire return intervals, and other ecosystem level metrics. This is especially true in landscapes dominated by mixed severity fire regimes. Setting desired future conditions for spatial arrangements of ecosystems also has additional challenges as past and current anthropogenic changes may place constraints on achieving desired spatial patterns.

Scale issues are an important consideration to ecological sustainability and biodiversity planning. Proper emphasis on identifying appropriate delineations and boundaries for planning areas, relative to both the grain and extent to be used (Caraher et al. 1999, Haufler et al. 1999b, Wiens 2002, Mayer and Cameron 2003) must be included. Bassett and Edwards (2003) analyzed how the selection of landscapes at different scales (EMAP hexagons, watershed, and county) influenced the number of species and ecosystems included in a selected area, and its ecological implications.

Representation based on a coarse filter strategy requires an appropriate classification of ecosystem diversity applied at an appropriate scale (Schwartz 1999, Mayer and Cameron 2003) and with adequate precision or grain (Mayer and Cameron 2003). Haufler et al. (1999b) discussed using hierarchical classifications for defining planning areas within which ecosystem diversity can be described and quantified, and suggested that the section level of the National Hierarchy of Ecological Units (Cleland et al. 1997) provided one example of the level of a hierarchical system that could serve to define boundaries of planning areas. Within each planning area, a more specific classification system that defines the abiotic and biotic components of ecosystems is needed (Grossman et al. 1999, Haufler et al. 1999b).

Grossman et al. (1999) reviewed ecological classification systems and stated that a hierarchical organization is important in ecosystem-based management. Hermoso et al. (2013) looked at using vegetation classes as a basis for representation and reported that the number of classification units and their ability to identify homogeneous vegetation communities were critical to the effectiveness of such systems. However, consideration of the effectiveness of the vegetation classification system to applying and implementing a coarse filter is often overlooked. Rather, the use of an ecosystem diversity classification for representation often falls to whatever vegetation classification system happens to be available or currently in use, which can produce an inadequate description of ecosystem diversity (Haufler et al. 2002). Marcoux et al. (2013) demonstrated how careful selection of a classification system is needed, as a comparison of two classification systems produced errors in describing fire regimes in British Columbia. Other authors have raised concerns about the use of various vegetation classification systems in coarse filter approaches to biodiversity conservation. Cushman et al. (2008) examined the use of selected vegetation characteristics for explaining the abundance of bird species placed in three broad groupings: open canopy species, closed canopy species, and generalist species. Their analysis did not test a coarse filter for representation, but rather looked at how well various vegetation community variables explained abundances of the different groupings of bird species. They found that variables collected at the plot, community type, and landscape explained only a small percentage of the variances in abundances of species in these groups. While the wide range of species requirements included in their species groupings and the lack of discrimination of variables used in comparison to their abundance estimates reduce the likelihood of significant relationships, their results still highlight the need to adequately consider the classification system selected for planning. Schlossberg and King (2009) looked at how well habitat relationship models based on vegetation cover types functioned in explaining species abundances, and found relatively low accuracy in in these models. They cautioned on the use of such models based on a vegetation classification system in conservation planning. However, as with Cushman et al. (2008), Schlossberg and King (2009) did not evaluate a coarse filter approach to biodiversity conservation but rather evaluated the use of a vegetation classification system in a simplistic wildlife habitat model.

Thus, the selection of an appropriate classification system for defining ecosystem diversity is critical to the success of the coarse filter approach to biodiversity conservation. The classification system must be sufficiently detailed to identify and incorporate the different environmental gradients occurring across the planning area as well as the various disturbance response states that occurred historically (Clewell and Aronson 2013, Groves 2003, Noss and Cooperrider 1994). As noted, relying on vegetation classification systems that do not adequately capture these components of ecosystem diversity are likely to result in errors in descriptions of disturbance processes, inadequate discernment of important ecosystem types needed to provide for biodiversity, and an inadequate basis for defining ecosystem integrity.

Fine Filter Component - Species Assessment

A fine filter or species assessment component can serve as a secondary analysis of whether the coarse filter is adequately maintaining the diversity of plant and animal communities a planning or project region. The proposed actions to achieve goals for ecosystem diversity or other plan objectives are assessed in terms of their ability to provide sufficient habitat quality for selected species.

Quantifying and mapping the ecosystem diversity conditions and other conditions resulting from planned management activities allows for the assessment of historical, current, and projected future changes to habitat conditions for identified species of concern or focal species. Assessing the habitat quality of historical conditions for a selected species provides the basis to understand the inherent capability of the landscape to support that species. Comparisons to current ecosystem conditions then reveal how habitat conditions for these species have changed. Planned ecosystem restoration or other management actions to influence habitat quality are then evaluated for the expected future status of these species relative to the inherent capabilities of the landscape.

Species assessments provide a check on the assumptions and proper functioning of the coarse filter or ecosystem diversity component. For example, if a species having a high probability of persistence under historical conditions was found to not have an acceptable probability of persistence under the proposed future conditions, then the targeted goals for ecosystem diversity, or impacts of other proposed actions, may need to be reevaluated and modified. However, if proposed future conditions are shown to provide an acceptable likelihood of persistence by the selected species, then the ecosystem diversity goals are supported in their function to maintain biological diversity and ecological sustainability in the landscape. If the assessment reveals the landscape historically had a low probability of persistence for a species (low inherent capability), then the coarse filter should only be expected to produce similar levels of persistence as the inherent capability. Management for a species beyond the identified inherent capability of the landscape would be a deviation from the coarse filter and would be expected to have impacts on the ecological sustainability and biodiversity outcomes.

Many species included in assessments are often rare, occur in low abundance, or may have large home ranges covering diverse landscapes. This makes determining the potential impacts of individual projects on many of these species difficult to evaluate. However, conducting a landscape assessment of planned activities allows for the needs of these species to be considered in a cumulative manner including the expected responses to restoration actions as well as other management activities. For far-ranging species such as many meso-carnivores, it may be necessary to combine the results of multiple landscape assessments to have a clear understanding of the habitat conditions for future persistence of some of these species.

Connectivity

Ecosystem sizes, distributions, and surrounding conditions are important to consider in order to address concerns for animal movements and thresholds of fragmentation (Flather et al. 2002). Species assessments are one of the best ways of assessing connectivity among ecosystems within a landscape, and can provide important information for planning of ecosystem diversity in terms of the pattern of ecosystems desired in the landscape.

Development of the landscape metrics tool FRAGSTATS (McGarigal and Marks 1995) encouraged a flurry of studies to calculate numerous landscape metrics and related these to various ecological variables. Many of these studies lacked rigor or proper review of causative relationships. Li and Wu (2004) prepared a perspective paper that reviewed landscape analyses, and discussed how the potential of these analyses have been largely unfilled. They noted one problem in particular, the improper use of landscape metrics, has contributed to this lack of progress. They noted many such landscape analyses have treated landscape pattern as an end in itself, without properly examining the cause and effect relationships. They further noted too many landscape indices and mapped data are used without any consideration of the ecological relevancy.

Tischendorf and Fahrig (2000) reviewed 33 studies relating to landscape connectivity. They discussed how terminology differences can cause confusion, and stressed the importance of understanding the difference between functional connectivity and structural connectivity- analogous to the differences between the concept of corridors and the concept of landscape linkages. Corridors assume habitat continuity, whereas linkages address movement capabilities, habitat patches, landscape configurations, matrix conditions, barriers, and their relationships in maintaining continuous populations. Hess and Fischer (2001) and Rosenburg et al. (1997) discussed corridors and related terminology and stressed the differences between functional and structural expectations. With (1999) reviewed information on corridors and reported on a number of studies that documented uses of corridors, but also discussed how, in many other studies, landscape connectivity was not a function of corridors.

Habitat for a species can be distributed in varying qualities and sizes across a planning landscape, with each species responding to similar environmental features in potentially different ways as influenced by patch, matrix, scale, and landscape characteristics (Wiens 2002, Fischer et al. 2004). Understanding the historical distribution of the habitat for a species in a landscape is important to its evaluation, as it provides an indication of how habitat of varying quality for a species may have occurred under historical disturbance regimes (Sallabanks et al. 1999). Most species have adapted to interact within patchy environments either spatially within a landscape (Wiens 1997), or temporally as amounts and quality of habitat within a landscape shifted over time (Camp et al. 1997, Wiens 1997). These factors add complexity to the evaluation of connectivity, and emphasize the importance of an historical reference. Conlisk et al. (2014) compared potential outcomes of increasing sizes of habitat patches for cactus wrens, minimizing anthropogenic disturbances, or increasing connectivity among habitat patches. They determined different actions might be taken depending upon the amount of resources available to a project. Hodgson et al. (2011) reported that maintaining large patches of high quality habitat was more important to population viability when compared to the spatial arrangement or matrix conditions in a planning or project area.

BSLRP – Application of the Conservation Strategy

Primary objectives of BSLRP include reducing the risk of uncharacteristic wildfire and maintaining terrestrial biodiversity in the project area. BSLRP should utilize the conservation strategy as described in the USFS Planning Rule and Ecosystem Restoration Policy. A landscape assessment that provides the historical reference conditions and cumulative changes to the landscape is an essential tool for implementation of this strategy. Such an assessment must identify historical reference conditions to define uncharacteristic wildfire and address ecological sustainability concerns as well as identify the native ecosystem diversity to be restored and maintained in the project area to address biodiversity objectives. The resulting description of native ecosystem diversity and its processes will provide the foundation for restoration treatments described in the project plan. The species assessment component can serve to evaluate the effectiveness of the coarse filter to provide adequate native ecosystem diversity in the landscape to support biodiversity objectives as well as sufficient habitat for all Endangered Species Act listed species where inherent capabilities exist in the project area to support quality habitat for these species.

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APPENDIX B. ECOREGIONAL BOUNDARIES

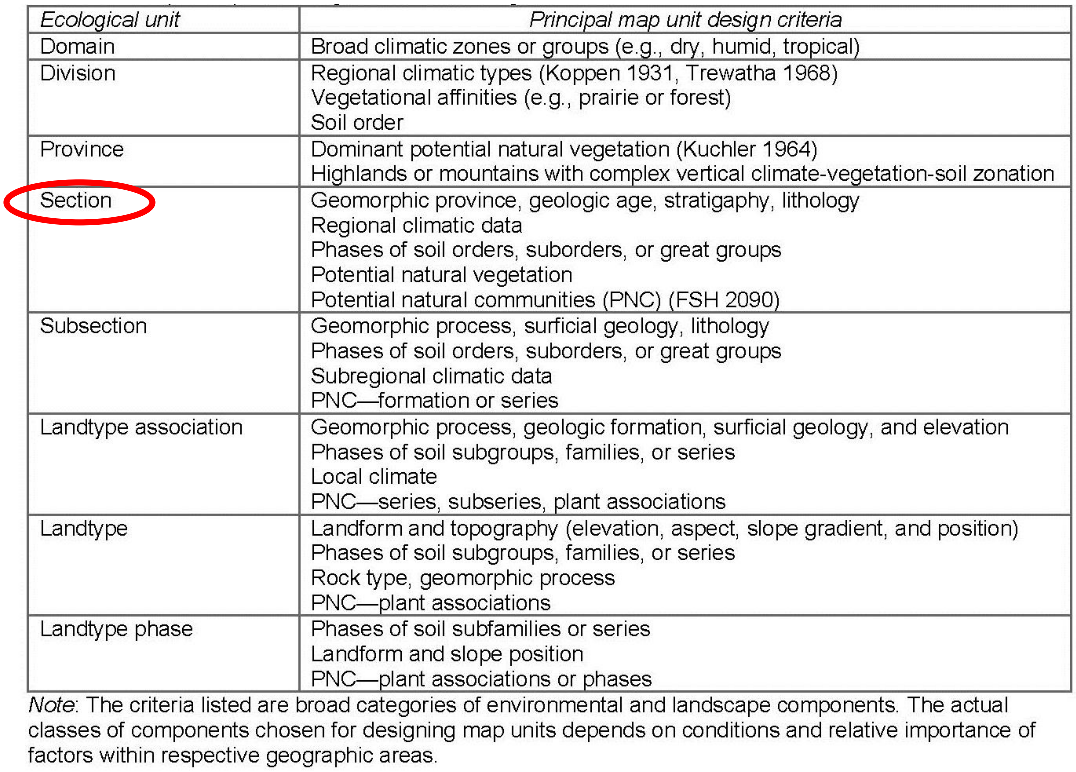
Methods

Existing landscape classification systems were reviewed relative to facilitating the ecological sustainability and biodiversity conservation goals of the conservation strategy. Emphasis was placed on selecting a landscape classification system to help define and describe historical ecosystem diversity. Existing landscape classification systems were reviewed relative to the following objectives:

1. The area delineated is large enough to encompass the primary processes needed to characterize historical ecosystem diversity but not so large to preclude classifying ecosystems with a sufficient level of detail; and
2. Use classification systems based on geo-climatic landscape boundaries to reduce variability in ecosystem diversity.

Specifically, two commonly used ecoregional-type classification systems were evaluated relative to the above objectives: USFS ECOMAP (Cleland et. al. 1997) and NRCS Major Land Resource Units (NRCS 2006). The ECOMAP Section-level (Table B-1) ecological unit delineation were selected for this landscape assessment as it provides the best scale and resolution for delineating the interaction of geomorphic and regional climate information that most influence potential natural vegetation in the project area.

Table B-1. Table 2 from Cleland et al. (1997) showing map unit design criteria for determining the appropriate ecological unit mapping scale for the project objectives. The Section-level ecological unit was used for the BSLRP landscape assessment.



Ecological unit	*Principal map unit design criteria*
Domain	Broad climatic zones or groups (e.g., dry, humid, tropical)
Division	Regional climatic types (Koppen 1931, Trewatha 1968) Vegetational affinities (e.g., prairie or forest) Soil order
Province	Dominant potential natural vegetation (Kuchler 1964) Highlands or mountains with complex vertical climate-vegetation-soil zonation
Section	Geomorphic province, geologic age, stratigaphy, lithology Regional climatic data Phases of soil orders, suborders, or great groups Potential natural vegetation Potential natural communities (PNC) (FSH 2090)
Subsection	Geomorphic process, surficial geology, lithology Phases of soil orders, suborders, or great groups Subregional climatic data PNC—formation or series
Landtype association	Geomorphic process, geologic formation, surficial geology, and elevation Phases of soil subgroups, families, or series Local climate PNC—series, subseries, plant associations
Landtype	Landform and topography (elevation, aspect, slope gradient, and position) Phases of soil subgroups, families, or series Rock type, geomorphic process PNC—plant associations
Landtype phase	Phases of soil subfamilies or series Landform and slope position PNC—plant associations or phases

Note: The criteria listed are broad categories of environmental and landscape components. The actual classes of components chosen for designing map units depends on conditions and relative importance of factors within respective geographic areas.

Several Section-level maps and associated GIS data have been developed over the years by the US Forest Service. First, is a map termed Bailey's Section-level boundaries (Bailey et al. 1994) that was used in the Interior Columbia Basin Ecosystem Management Project in the mid-90's (Figure B-2).

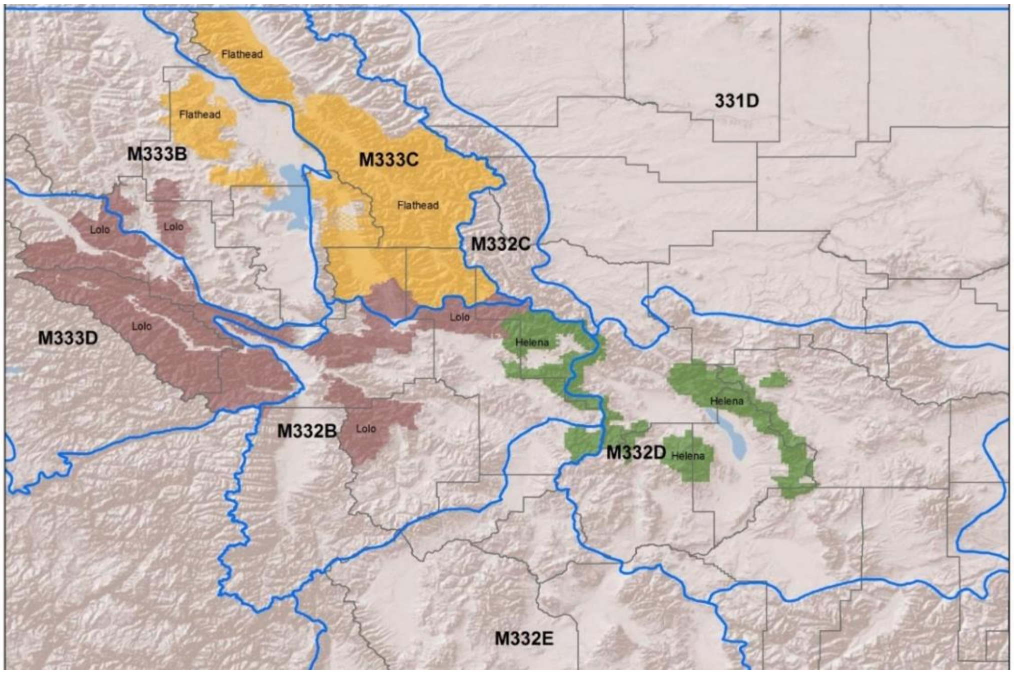


Figure B-2. Map of Bailey's Section-level boundaries (Bailey et al. 1994) for the project region. GIS Data source: Interior Columbia Basin Ecosystem Management Project.

Second, is a map developed by the ECOMAP team in the mid-2000's (Figure B-3).

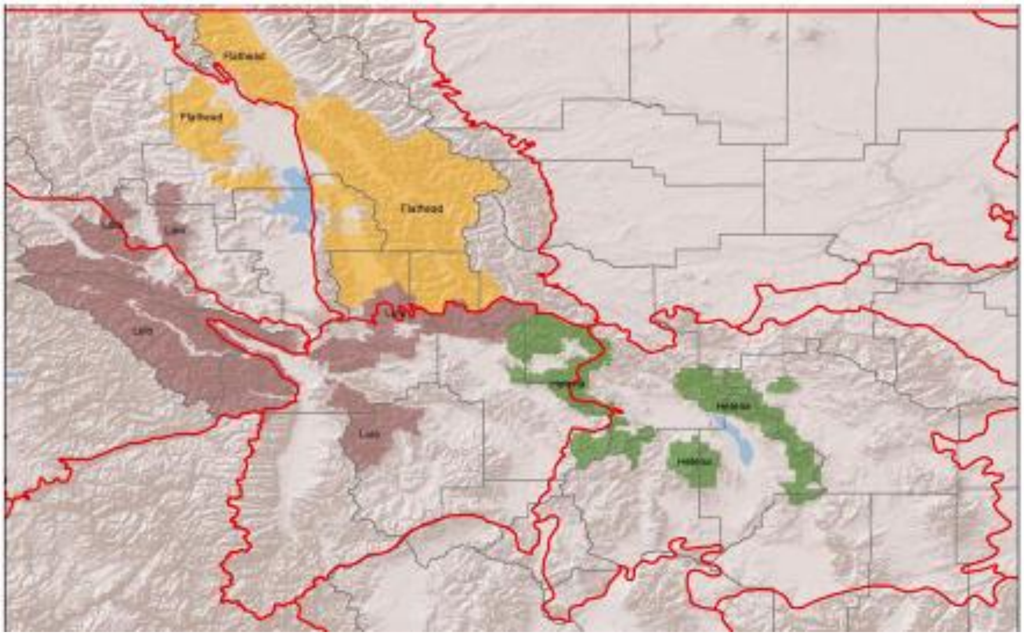


Figure B-3. Map of ECOMAP Section boundaries (ECOMAP TEAM 2007) for the project region. GIS Data source: http://data.fs.usda.gov/geodata/edw/edw_resources/meta/S_USA.EcomapSections.xml

While there are overlapping similarities in many of the boundaries between the two mapping efforts (Figure B-4), several major differences are noted in that the Bailey's map has divided unit M333C into 2 units at the continental divide and both have some boundaries that are generalized and some that have greater detail, such as following watershed boundaries.

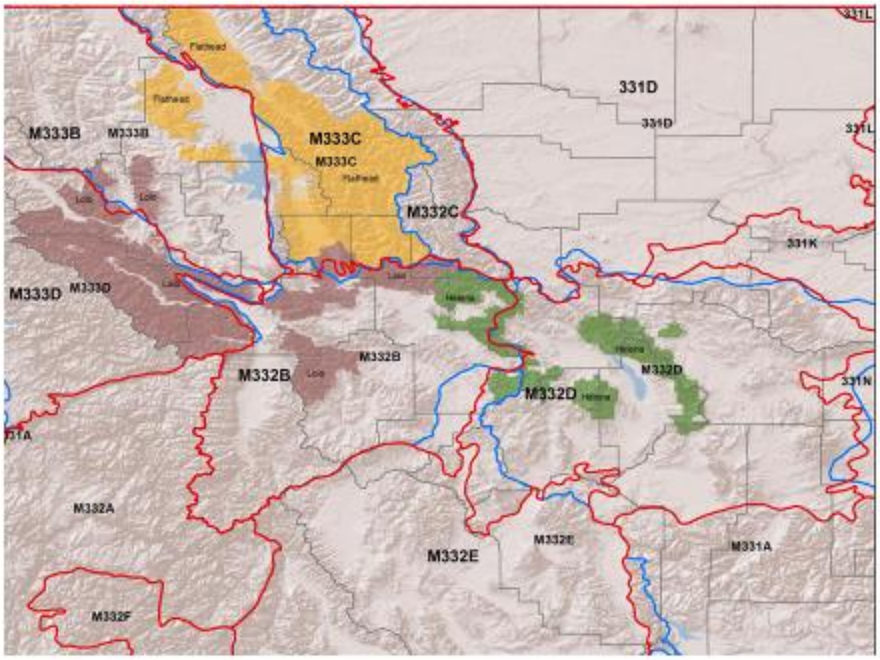


Figure B-4. Overlay of Bailey's and ECOMAP Section-level boundaries within the project region.

To facilitate the objectives of this assessment, each boundary was evaluated relative to existing information on potential vegetation and the most detailed boundary was selected. The resulting boundaries were further refined using 8-digit HUC watershed boundaries (USDA NRCS 2013; source - http://mslapps.mt.gov/Geographic_Information/Data/DataList/datalist_Details.aspx?did={e9120c8f-fc2b-4fe3-b5e4-fad4d5393ad9} where the Bailey's/ECOMAP boundary was clearly a generalized watershed boundary. Figure B-5 demonstrates how watershed boundaries were used in this manner.

Figure B-5. Illustration of a generalized Bailey's/ECOMAP boundary versus the more accurate watershed boundary (8-digit HUC).

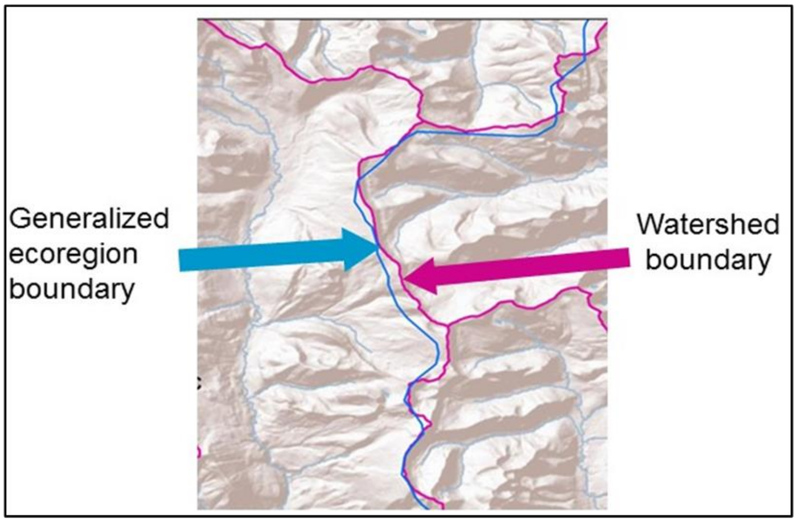


Figure B-6 represents the resulting refined ECOMAP section-level boundaries. Each resulting ecoregion boundary was further assessed for tree species distribution to ensure the appropriate resolution had been achieved.

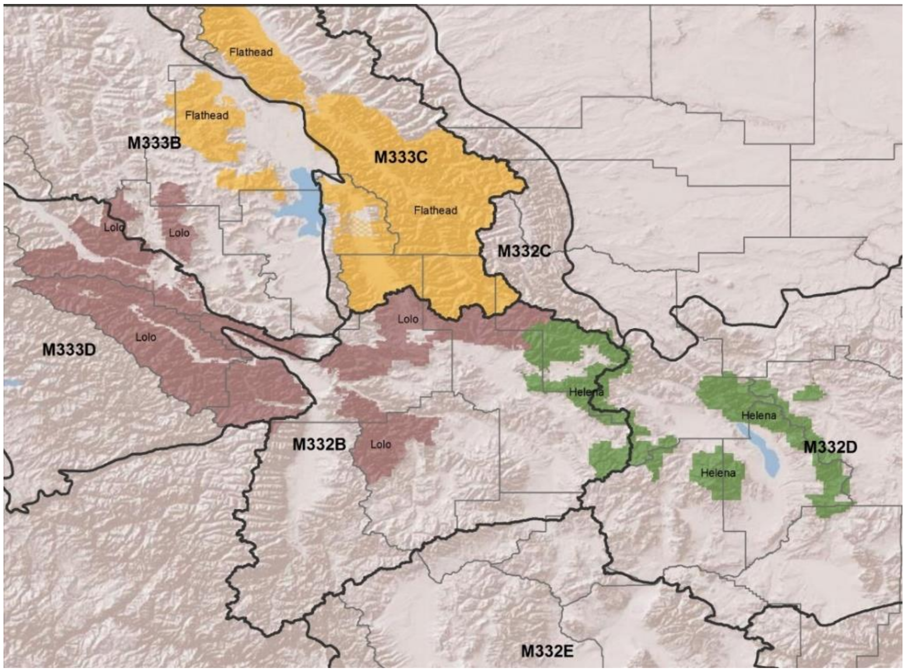


Figure B-6. ECOMAP section-level ecoregion boundaries resulting from refinement process described in the text.

FIA plot data were summarized by species groups to evaluate their distribution within the landscape assessment area ecoregion boundaries (Figure B-7). The first group (blue dots) included western larch, grand fir, western white pine, western red cedar, western hemlock, and mountain hemlock as these species were known to experience their most eastern and southern boundaries in ecoregion M332B. The second group (red dots) included limber pine and rocky mountain juniper which are known to experience their most western distribution in M332B as well. These plots were further

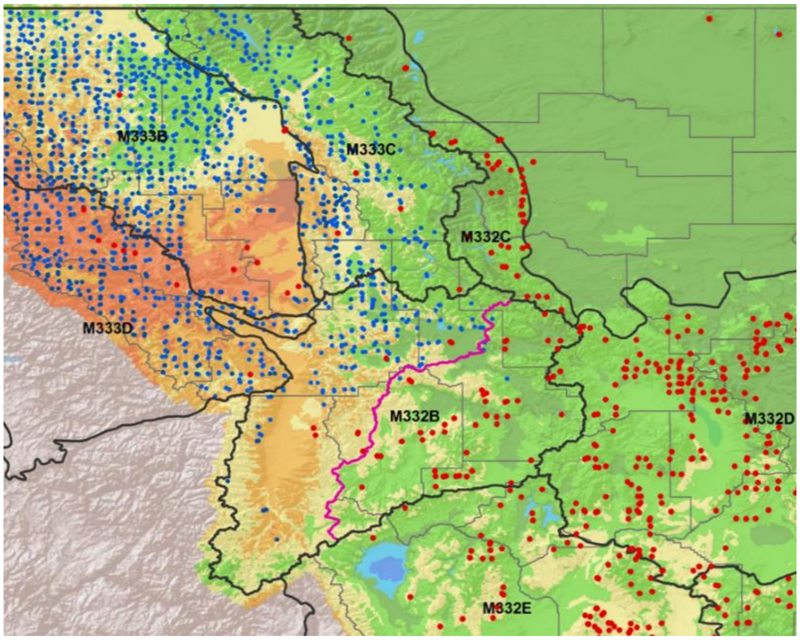


Figure B-7. FIA plots were used to display groupings of species distributions within the project region. See text for an explanation of map components and their interpretation.

overlayed with the USDA plant hardiness map where plant hardiness is considered a function of average low winter temperatures. In general, the map demonstrates this temperature gradient as the greens representing the more extreme average winter temperatures, grading to beiges and light oranges in the moderate average temperatures, and finally grading to the hotter and warmer or less extreme temperatures with the darker orange to reds. Northwest Montana is influenced by the Pacific Maritime climate which penetrates as far inland as the Continental Divide, though its influence is lessened the further east it goes. The first group of species listed above (blue dots) are distributed in northwest Montana resulting from this climatic influence. Conversely, the second group of species (red dots) are not distributed much further west due to this climatic influence. The relatively clear line in species distributions down the center of M332B is thus evident and requires an additional break to capture this difference in ecosystem conditions within this ecoregion. Watershed boundaries (8-digit HUCs) were used to delineate this split. The resulting 2 ecoregions were labeled M332B-East and M332B-West (Figure B-8).

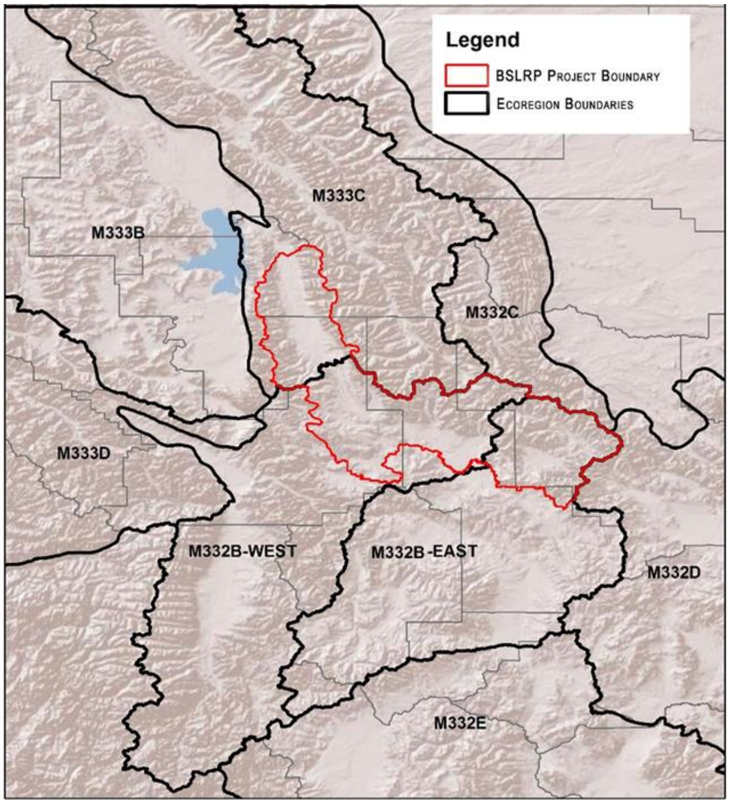


Figure B-8. Final ecoregion boundaries delineated for the terrestrial landscape assessment region.

Literature Cited

Bailey, R. G., P. E. Avers, T. King, and W. H. McNab, eds. 1994. Ecoregions and subregions of the United States (map; scale 1:7,500,000). Colored. Accompanied by a supplementary table of map unit descriptions compiled by W.H. McNab and R.G. Bailey., Washington, DC.

Cleland, D. T., P. E. Avers, W. H. McNab, M. E. Jensen, R. G. Bailey, T. King, and W. E. Russell. 1997. National hierarchical framework for ecological units. Pages 181-200 *in* M. S. Boyce, andA. Haney, editors. Ecosystem management applications for sustainable forest and wildlife resources. Yale University, New Haven, CT.

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APPENDIX C. ECOLOGICAL SITE CROSS-WALK TO REGION 1 POTENTIAL VEGETATION TYPES (FROM MILBURN ET AL. 2015, TABLE 1)

R1 FORESTED POTENTIAL VEGETATION GROUP CROSSWALK. LABELS IN PARENTHESIS ARE THE COLUMN NAME IN 01_LUT_HT_PVT IN THE *R1 INVENTORY DATA LOOK-UP TABLES DATABASE.*

Broad PVT (Broad_PVT)	R1 Habitat Type Groups (R1_Habitat_type_group)	R1 MT PVT [2] (PVT_MT04_A)	R1 ID PVT [2] (PVT_ID04_A)	ADP[1] Habitat Type Code
Warm Dry	Hot Dry	pifl	Pifl	000, 040, 050, 051, 052, 070, 090[6], 091[6], 092[6], 093[6], 094[6], 095[6]
	Warm Dry	pipo	pipo	100, 110, 130, 140, 141, 142, 160, 161, 162
			none	103[7], 104[7], 100032[8], 100033[8], 100034[8], 100035[8], 100037[8], 105[7], 106[7], 150
		psme1	psme1	200, 210, 220, 230
			none	205[7], 390[7]
		psme2	psme2	311, 380
		psme3	psme3	321
		pipo	pipo	180, 181, 182
	Mod Warm Dry	pipo	pipo	170, 171, 172, 190
		picea	picea	430
		abgr1	abgr1	505, 506, 507, 508
		none		
		psme2	psme2	240[7], 250, 260, 261, 262, 263, 280, 281, 282, 283, 292, 310, 312, 313
		psme3	psme3	360, 320, 322, 323, 324, 330, 350, 370, 340
	Mod Warm Mod Dry	abgr2	abgr2	510, 511, 512, 515, 590, 591, 592
		abgr3	abgr3	523
		psme2	psme2	290, 291, 293
Warm Moist	Mod Warm Moist	abgr3	abgr3	500, 516, 517, 518, 519, 520, 521, 522, 524, 525, 526, 529
	Mod Cool Moist to Wet	thpl1	thpl1	555
		thpl2	thpl2	501, 530, 531, 532, 533, 534, 535, 545, 546, 547, 548
		tshe	tshe	502, 565, 570, 571, 572, 573, 574, 575, 576, 577, 578
		thpl1	thpl1	540, 541, 542, 550, 560
		tshe	tshe	579
Cool Moist	Cool Moist	abla2	abla2	600, 620, 621, 622, 623, 624, 625, 660, 661, 662670, 671, 673, 740
		tsme1	tsme1	685, 686, 687
		tsme2	tsme2	682
			tsme3	680
		picea	picea	400, 420, 421, 422, 460, 461, 462, 470
			none	004[9], 472[7], 475[7]
	Cool Wet	abla1	abla1	610, 630, 635, 636, 637, 650, 651, 652, 653, 654, 655
			none	631, 632
		tsme1	tsme1	675, 677
		picea	picea	410, 440, 480
	Cool Mod Dry to Moist	abla2	abla2	663
		abla3	abla3	640, 691, 693, 700, 720, 750, 770, 780, 790, 791, 792
			abla4	690

Broad PVT (Broad_PVT)	R1 Habitat Type Groups (R1_Habitat_type_group)	R1 MT PVT [2] (PVT_MT04_A)	R1 ID PVT [2] (PVT_ID04_A)	ADP[1] Habitat Type Code
			none	607, 745
		picea	picea	450
		pico	pico	900, 910, 920, 930, 950
			none	960[7]
		tsme2	tsme2	710, 712
Cold (capable of WBP)	Cold	abla3	abla4	672, 692, 694, 731, 732, 733,
		abla4	abla4	674, 730, 800, 810, 820, 830, 831, 832
		tsme1	tsme1	676
		tsme2	tsme3	681, 711, 840, 841, 842
		tsme3	tsme3	713
		pico	pico	925, 940
	Timberline	laly	laly	860
		pial	pial	850, 870, 890

[1] *Automatic Data Processing Code (habitat type publications) - includes all codes from valid references in Region 1 for use with NRM FSVeg. Unless otherwise specified, code are from 101 (Forest Habitat Types of Montana, Pfister et al. 1977) or 110 (Forest Habitat Types of Northern Idaho: a Second Approximation, Cooper and others, 1991)*

[2] *R1 PVT's based on "Jones" metadata logic and labels.*

[3] *579 is in Group 7, Cool & Moist, in R1 HTG (2005) but is included in the Warm/Moist Broad PVT to maintain a connection with the other tshe types.*

[6] *Reference 199 = FSH 2409.21h R-1 Timber Management Data Handbook. Used in R1 until 2001.*

[7] *Reference 102= Key to Montana Forest/Woodland Habitat Types East of the Continental Divide. FIA use only.*

[8] *Reference 114= The Vegetation of the Grand River/Cedar River, Sioux, and Ashland Districts of the Custer NF: A Habitat Type Classification, Hansen and Hoffman.*

[9] *Reference 112= Classification and Management of Montana's Riparian and Wetland sites. Hansen, Boggs, Cook and others, 2005.*

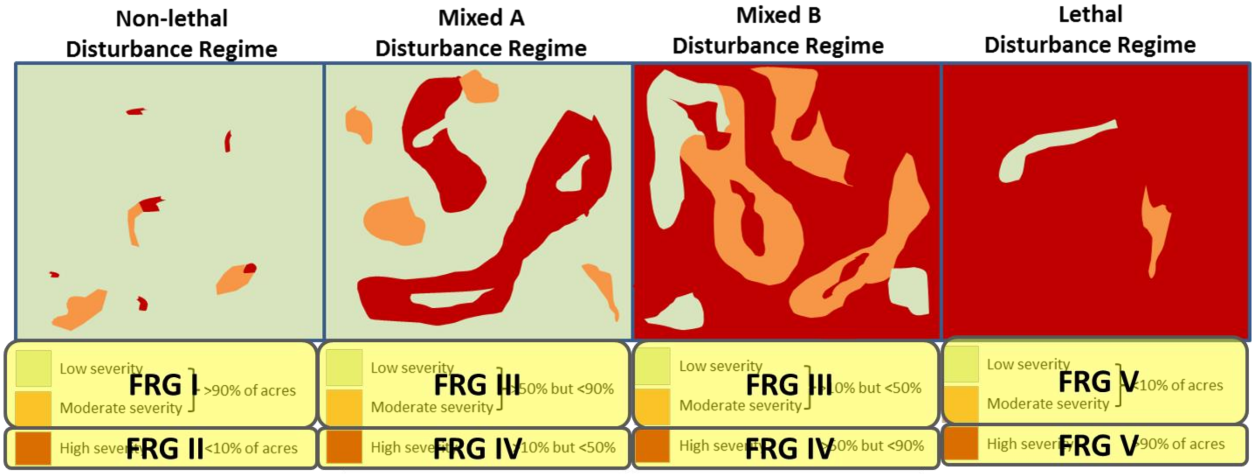
Milburn, A., B. Bollenbacher, and M. Manning. 2015. Region 1 Existing and potential vegetation groupings used for broad-level analysis and monitoring. USDA Forest Service, Report 15-4 v 1.0.

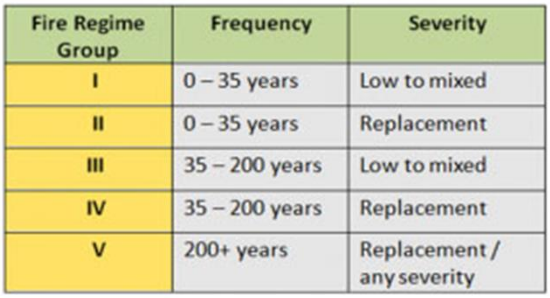
APPENDIX D. DISTURBANCE REGIMES AND FIRE SEVERITY

Table D-1. Relationship of Barrett and Jones (2001) fire history survey plot data historical fire regimes to those used in the BSLRP project.

Historical Fire Regimes[a]	**Severity (% Overstory Replacement)**	**Fire Interval**	**Landscape Assessment Fire Regime**
		------ Years-----	
NL -- non-lethal	low - <20%	10 to 25	NL -- non-lethal
MS1 -- mixed severity, short interval	low - 20-30%	20 to 40	MSA – mixed-severity A
MS2 -- mixed severity, long interval	mod - 30-80%	40 to 120	MSB – mixed-severity B
MS3 -- mixed severity; variable interval	variable - 10-90%	45 to 275	MSB – mixed-severity B
SR1 -- stand replacement, short interval	high - >80%	95 to 180	L -- Lethal
SR2 -- stand replacement, long interval	high - >80%	200 to 325	L -- Lethal

[a] Fire regime was assigned according to the predominant fire severity at a site, i.e. NL= low severity fire, MS = mixed severity fire, SR = high severity fire





Fire Regime Group	Frequency	Severity
I	0 – 35 years	Low to mixed
II	0 – 35 years	Replacement
III	35 – 200 years	Low to mixed
IV	35 – 200 years	Replacement
V	200+ years	Replacement / any severity

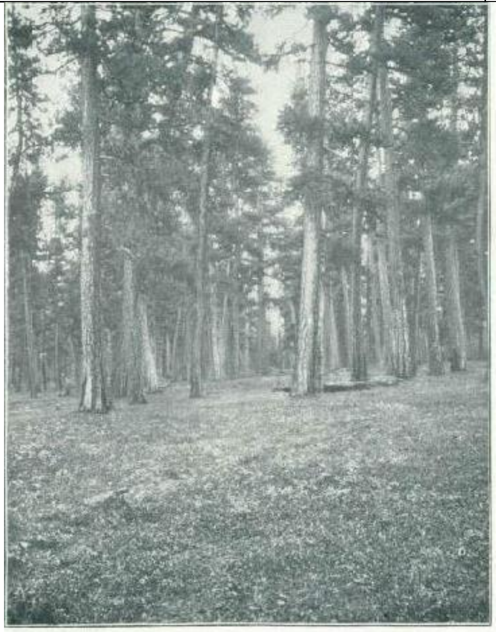
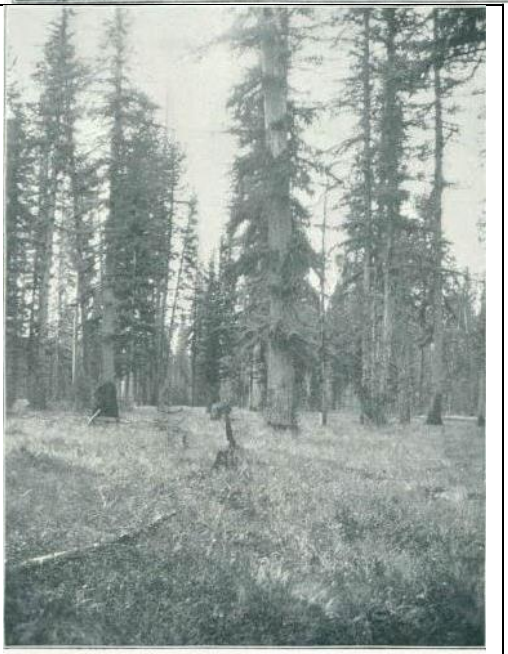
Figure D-2. Relationship of disturbance regimes identified for the terrestrial landscape assessment and the expected LANDIRE fire regime group.

Table D-4. A summary of fire history study studies and historical reconnaissance surveys conducted in or near the landscape assessment area.

Barrett 2002		
	Study Type	Fire scar analysis – fire regimes and severity
	Location	10 miles south of Condon (MLRA M333C)
	Forest Structure	The fire history data, in combination with 1934 aerial photographs and early-day pictures taken by early forest surveyor H.B. Ayres (Ayres 1900), verify that pre-settlement landscape conditions in the upper Swan contained a highly diverse mosaic of old stands that repeatedly underburned, interspersed with variable-sized openings from mixed-severity “hot spots”.
	Fire	Frequent in the study area until the early 1900’s. On average, a fire occurred every 8 years between 1586 and 1929 somewhere in the study area.
		Estimated fire years ranged from 3 to 23 years; these estimates are likely conservative.
		Many pre-settlement fires were limited in extent.
		Aside from occasional severe fires, most fires evidently burned with low-to moderate severity.
		In addition to lightening fires, traditional burning by Indians likely occurred.
		Results suggested that the forest in the valley bottom was dominated by mixed-severity fire regimes during the pre-settlement era.
		Low severity fires were restricted to the driest terrain (e.g., <5% of the total area).
		Stand replacement regimes….occupy an estimated 45% of the terrain, largely on steep slopes and moist canyon bottoms adjacent to the mountains.
Barrett 2012		
	Study Type	Fire regime assessment – fire scars
	Location	Dalton Mountain Analysis Area – Lincoln Ranger District, Helena NF
	Landscape-level Summary	From the period 1707 to 1919, an estimated 18 fire events occurred in the approximately 20,000 acre analysis area, yielding an average interval of about 13 years between natural fires.
		Fire interval lengths ranged from 3 to 27 years; current fire interval is 92 years, 7 times longer than the pre-settlement mean.
		Four fires between 136 and 1919 appeared to cover substantial acres in the analysis area. The MFI for these major events was 28 years, with an estimated range of 17 to 36 years. The current interval is 92 years (1919 to 2013) since the last major event, 3 x longer that the historical mean interval for major fires.
	Ecosystem-level	Differing fire frequencies and severity and differing effects of long term fire exclusion apply. See table x for a summary by ecological sites.
Barrett 2013		
	Study Type	Fire regime assessment – fire scars
	Location	Stemple-Flesher Analysis Area- Lincoln Ranger District, Helena NF
	Landscape-level Summary	From the period 1713 to 1934, an estimated 17 fire events occurred in the approximately 50,000 acre analysis area, yielding an average interval of about 14 years between natural fires.
		Fire interval lengths ranged from 5 to 27 years; current fire interval is 79 years, 6 times longer than the pre-settlement mean.
		Four fires between 1772 and 1889 appeared to cover substantial acres in the analysis area. The MFI for these major events was 39 years, with an estimated range of 21 to 79 years. The current interval is 124 years (1889 to 2013) since the last major event, 3 x longer that the historical mean interval for major fires.
	Ecosystem-level	Differing fire frequencies and severity and differing effects of long term fire exclusion apply. See table x for a summary by ecological sites.

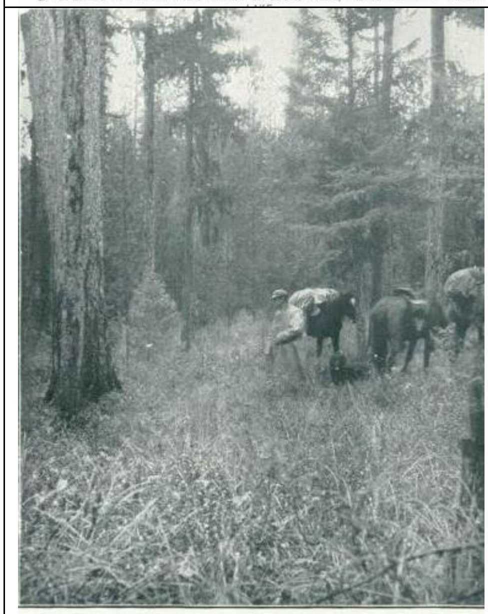
Arno et al. 2000		
	Study Type	Fire regime analysis
	Location	N. Rockies/NW MT
	Summary	Mixed-severity fire regimes characterized large areas of the N Rocky Mtns
		Mixed-severity regimes occupied 50% of area now in National Forests; non-lethal occupied 30%, and stand replacement 20%
		The presence of appreciable amounts of old trees with scars from pre-1900 fires is prima facie evidence of historical mixed-severity or non-lethal fire regimes.
		In N. Rockies, non-lethal regimes are primarily confined to forests where ponderosa pine was historically dominant
		Mixed-severity regimes were found across a broad range of forest types, including western larch, Douglas-fir, western white pine, lodgepole pine, and whitebark pine and some moist ponderosa pine types. Other areas of these same forests were characterized by stand replacement fire regimes.
		Forests associated with MS regimes were often dominated by early seral, fire dependent tree species but also had a substantial component of late successional trees. Individual stands were often uneven-aged and multi-layered.
		As a result of the moderately frequent fires and variable fire severities, stands often formed a complex and intricate mosaic on the landscape.
		Young seral stands and young seral components of mixed-aged stands were abundant.
Ayres 1900		
	Location	Swan Valley and Clearwater Valleys
	Study Type	Reconnaissance-level for timber supply
	Species Distribution	Western larch, Douglas-fir, and ponderosa pine confined to the valley bottoms, benches, and lower foothills.
		Whitebark pine and sub-alpine fir usually limited to the mountain ranges.
		Hemlock, cedar, white pine found only in sheltered damp places such as ravines on the lower mountain sides
		Spruce prefers consistent moisture and avoids dry subsoil
	Tree size	Largest trees found were about 4’ dbh and 100’ high
		Lodgepole rarely seen over 14” dbh and 70’ high
		Spruce seldom over 30” dbh and 90’ high
		Ponderosa pine seldom more than 3’ dbh and 90’ high, often fire scarred
		Whitebark pine sometimes large enough for saw logs
		Limber pine may reach a diameter of 28”, though rarely
		Western larch seldom more than 30” dbh with none being seen over 3’
		Douglas-fir of good size and quality but subject to dry rot
		Alpine larch found 15” dbh and 70’ high
		Subalpine fir none more than 15” dbh and 80’ high
		Cedar found 3’ dbh and 80’ high; nowhere abundant, small areas
		Aspen seldom over 10” dbh and 60’ high
		Grand fir, hemlock, cottonwood – small and isolated
	Regeneration/ Small Trees	Abundant, except where repeatedly burned…lower (northern) portion of (swan) valley is well stocked
		The condition and distribution of the young growth is much affected by fire. It is not only thinned by it, but the composition of the forest is made very irregular, and we find it patched by stock of various ages and by areas imperfectly occupied, or occupied by species promising no value. As a rule the tendency in the valley is toward a stock of more valuable species. In the lower or northern portion spruce and red fir are coming in where the older species subside, and in the higher or southern portion of the valley larch is becoming more abundant as the lodgepole pine is injured by fire. An exception to this general tendency is

		found on the more severely burned portions. These almost invariably have been preempted by lodgepole pin in varying degrees of density, often to be completely denuded in succeeding fire. The yellow-pine lands, both about the headwaters of the Swan River and the Clearwater drainage, are, as usual, more free from young stock than the forests of other species, yet some of these tracts have a fair sprinkling of red fir, larch, and spruce coming in underneath the pine. As a rule these species do not reach tree size, being killed by small repeated fires, while the yellow pine standing over them, protected by it thick bark, remains and furnishes favorable conditions for a new lot of seedlings, such as those destroyed, to start again.
		The lower (northern) portion of the (Swan) valley, or that within 16 miles of Swan Lake, which is more clayey, has with few exceptions a heavy covering of vegetation. This is in contrast with the lands of the upper (southern) (Swan) valley, where the rather scant covering of larch and lodepole pine at first gives the impression of a very poor soil, but upon close examination it is found that the sparseness of tree growth is largely due to frequently occurring fires which have thinned the forest.
		The stock on lightly burned regions, as a rule, is not only mixed to species, but also as to size.
		Probably 90% of the Swan-Clearwater valley's has been burned over within the past 100 years
		Light severity fires - large areas have been recently burned over without showing much effect of the fire. Map indicates only the most recent severe burns but there is evidence of older or less severe burns over much of the area, ("600 square miles have probably burned within past 100 years but only about 240 square miles, or approx. one third of the whole area, are shown on the map as burned")
	Fire	Severe fires - first been covered with lodgepole pine, under which spruce, white pine, larch, balsam, and other shade-enduring trees have sometimes started; a very dense stand...does not readily admit other species, and lodgepole pine in such cases is apt to remain until the trees begin to die of old age.
		Moderate fires - may thin out the species most sensitive to fire and leave those protected by thick bark; a notable instance of this was found in the upper portion of the Swan River Valley, where a mixed stock of larch and lodgepole pine had been run through by light fires, which killed the thin-barked lodgepole pine, but left the thick-barked larch but slightly injured.
		Fire Intensity - fires have been severe enough to kill all, or nearly all, the trees and to consume the humus. But many light fires have also occurred; these have crept over extensive areas, killing brush and the smaller and tenderer trees. The fires have varied through all degrees of intensity. The severest have rushed through the tree tops consuming the needles and smaller twigs and igniting the humus lying on the surface, which even when burning slowly, has made fire enough to consume the roots that were in the humus. Many other fires have occurred, doing much less damage to the forest. Creeping slowly along they have killed much of the vegetation and even some of the large trees, but the lightest of them have merely thinned the forest, injuring many trees, but still leaving many seed trees and a favorable surface for seeds to start.
		There are some areas on old burns which are occupied by lodgepole pine only, but these are the exception and are not large.
		Looking over valley from mountainside in October, the upper Swan Valley seemed almost entirely wooded with larch
	Understory	Low to moderate elevations - In general, the underbrush is not dense. With the exception of some of the damper ravines…, the brush would offer no serious difficulty to taking horses anywhere.
		Higher elevations - except where kept in subjection by light fires brush is usually abundant enough to be a serious hindrance…

	Snags/CWD/ Litter	Areas not visited by recent fires has very small amount of deadwood, usually much less than is found on the burn, but these areas have much more fine litter, such as leaves, twigs, and moss.
		Litter is correspondingly light on recent burns and abundant in areas too damp to burn; 75% of the valley has less than 2” of litter, primarily due to fires.
		Deadwood - the amount of material standing dead is roughly estimated at 128,000 cords. No effort was made to estimate the material that was down.
	Ayres 1900 - photos in the BSLRP area	U. S. GEOLOGICAL SURVEY  TWENTY-FIRST ANNUAL REPORT PART V PL. VII   B. YELLOW PINE, NEAR HOLLAND'S RANCH, UPPER SWAN RIVER VALLEY.  B. YELLOW PINE FREQUENTLY AND LIGHTLY BURNT.

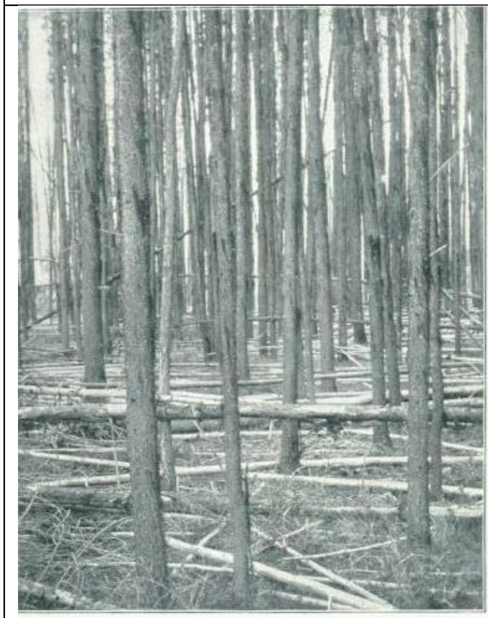
B. OPENING IN YELLOW-PINE FOREST ON JOCKO TRAIL, 1 MILE NORTH OF PLACID LAKE.

B. YELLOW PINE ON SHORE OF PLACID LAKE.



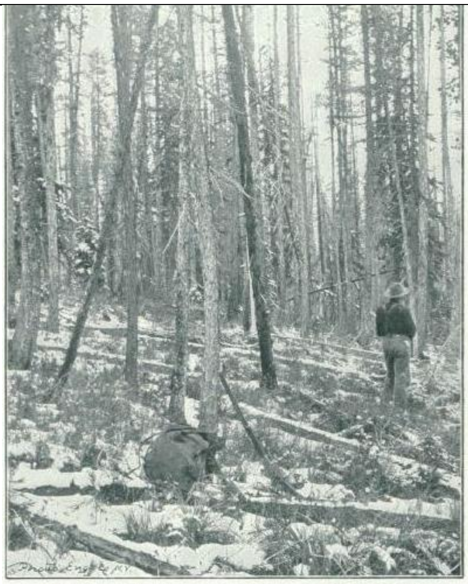
A. EFFECT OF MODERATE FIRES; SURVIVING LARCH WITH UNDERGROWTH OF LODGEPOLE PINE, RED FIR, AND LARCH.

B. YOUNG LARCH AND LODGEPOLE COMING IN AFTER FIRE UNDER SURVIVING LARCH, NORTH OF HOLLAND LAKE, LOOKING EAST TOWARD GORDON PASS.



B. NATURAL THINNING AMONG LODGEPOLE PINE, UPPER SWAN RIVER VALLEY.

A. LODGEPOLE PINE FOLLOWING LARCH AND YELLOW PINE, KILLED BY FIRE.

		 A. MODERATE BURN IN LODGEPOLE PINE AND LARCH, MOUNTAIN RIDGE WEST OF NORTH END OF ELBOW LAKE	 B. LARGE YELLOW PINE, SUBORDINATE LODGEPOLE, JOCKO TRAIL, NEAR PLACID LAKE.
		 B. LARCH AND LODGEPOLE PINE ON BURN OF 1889.	 A. ENGELMANN SPRUCE ON MOUNTAIN SIDE, SOUTH OF UPPER MONTOUR CREEK.

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APPENDIX E. HISTORICAL REFERENCE CONDITIONS

The following information summarizes the reference conditions developed for historical ecosystem diversity in the landscape assessment area using the best available information. Key ecosystem characteristics are presented by ecoregion using the ecosystem diversity framework and state and transition models by ecological sites, as appropriate. The key characteristics include:

- Species composition
    - Trees
    - understory vegetation (i.e., grass, forbs, shrubs)
- Structural components
    - live trees,
    - dead trees, and
    - general ecosystem characteristics including basal area weighted diameter, coarse woody debris, and percent canopy cover of grass, forbs, shrubs

Species composition across ecological sites and disturbance states was developed using the following information and assumptions:

1) Pfister et al. (1977) used plot information to develop the habitat type classification that is the basis for ecological sites used in this assessment. Species composition across ecological sites was developed using Appendix B for trees and Appendix C-1 in Pfister et al. (1977) for understory species. These appendices were developed from plot data with a non-random sampling design that targeted a specific habitat type. In addition, plot locations were selected that represented for the most part, relatively low anthropogenic impacts except to disturbance regimes. To develop tree compositions and distributions across ecoregions, FIA (ref) plot data were used to identify individual habitat type occurrence within an ecoregion and Pfister et al.'s information on those habitat types were then used to develop species composition by ecological site groupings. For example, the individual habitat types included in the Cool and Moist ecological site are different between ecoregions M333C and M332B-East and therefore, species composition may differ as well. Species composition for understory species was linked more generally to the ecological site and therefore was not variable across ecoregions. FIA data were not used to describe species composition as this information is obtained using a randomized sampling design that often include inclusions of other ecological sites thus making it less useful as a true representation of an ecological site for species composition purposes. In addition, anthropogenic influences are particularly problematic when using today's plot data for species composition reference purposes.

2) The best available information on species response to disturbance was used to develop an understanding of possible species occurrence by disturbance state (i.e., size class x canopy cover (%)) for an ecological site. For trees, disturbance response most applicable to the ecosystem diversity framework was relative fire resistance of a species and relative shade tolerance of a species. We assumed disturbance response was most appropriately reflected in the canopy cover

variable with more fire resistant and shade intolerant species occurring at lower canopy cover and less fire resistant and more shade intolerant species occurring at higher canopy cover. Moderate canopy cover could have a mix of fire resistance and shade tolerance characteristics. As an example, Table E-1 summarizes this information for principle tree species occurring in the project area. In general, the assumption is species distribution across disturbance state. Fire tolerance information for understory species, where available, was developed from Fischer and Bradley (1997) and USDA PLANTS database. Shade tolerance information for understory species, where available, was also developed using USDA PLANTS database. Insect and disease, while intermittently problematic, were considered less influential, on average, to the predominant species occurrence by disturbance state.

Table E-1. Relative fire resistance of the principle tree species occurring in the landscape assessment area

Species	**Degree of Fire Resistance**		**Shade Tolerance**
	Medium-size or greater	***Seedlings/Saplings***	
Western larch	Very High	Moderate	Low
Ponderosa pine	High	Moderate	Low
Douglas-fir	High	Low	Intermediate
Grand fir	Moderate	Low	High
Lodgepole pine	Moderate	Low	Low
Western white pine	Moderate	Low	High
Western redcedar	Moderate	Low	High
Whitebark pine	Moderate	Low	Intermediate
Alpine larch	Moderate	Low	Low
Engelmann spruce	Low	Low	High
Mountain hemlock	Low	Low	High
Western hemlock	Low	Low	High
Subalpine fir	Very low	Low	High
Limber pine	Moderate	Low	Low
Rocky Mountain Juniper	Low	Low	Low

Northern Rockies (M333C)

Species Composition

Grass-Forbs-Shrubs

Table E-2. Moderately Warm and Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state based on the described methods.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Antelope bitterbrush	*Purshia tridentata*	PUTR2	Shrub				X			X			X		
big sagebrush	*Artemisia tridentata*	ARTRV	Shrub				X			X			X		
broom snakeweed	*Gutierrezia sarothrae*	GUSA2	Shrub				X			X			X		
chokecherry	*Prunus virginiana*	PRVI	Shrub	X	X			X			X			X	
common juniper	*Juniperus communis*	JUCO6	Shrub				X	X		X	X		X	X	
common snowberry	*Symphoricarpos albus*	SYAL	Shrub				X	X		X	X		X	X	
creeping juniper	*Juniperus horizontalis*	JUHO2	Shrub				X	X		X	X		X	X	
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
Lewis's mock orange	*Philadelphus lewisii*	PHLE4	Shrub	X	X		X			X			X		
mallow ninebark	*Physocarpus malvaceus*	PHMA5	Shrub						X			X			X
mountain snowberry	*Symphoricarpos oreophilus*	SYOC	Shrub					X			X			X	
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
prairie sagewort	*Artemisia frigida*	ARFR4	Shrub					X			X			X	
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
shrubby cinquefoil	*Dasiphora fruticosa*	DAFR6	Shrub				X	X		X	X		X	X	
skunkbush sumac	*Rhus trilobata*	RHTR	Shrub	X	X			X			X			X	
wax currant	*Ribes cereum*	RICE	Shrub				X			X			X		X
white sagebrush	*Artemisia ludoviciana*	ARLU	Shrub				X			X			X		X
white spiraea	*Spiraea betulifolia*	SPBE2	Shrub	X	X	X			X			X			X
Wood's rose	*Rosa woodsii*	ROWO	Shrub					X			X			X	
bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSPS	Grass				X			X			X		
Idaho fescue	*Festuca idahoensis*	FEID	Grass				X	X		X	X		X	X	
needleandthread	*Hesperostipa comata*	HECO26	Grass				X	X		X	X		X	X	
pinegrass	*Calamagrostis rubescens*	CARU	Grass					X	X		X	X		X	X
prairie Junegrass	*Koeleria macrantha*	KOMA	Grass	X	X	X	X	X		X	X		X	X	

Table E-2, continued. Moderately Warm and Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
thimbleberry	*Rubus parviflorus*	RUPA	Shrub	X	X	X		X	X		X	X		X	X
thinleaf huckleberry	*Vaccinium membranaceum*	VAME	Shrub						X			X			X
twinflower	*Linnaea borealis*	LIBO3	Shrub					X	X		X	X		X	X
Utah honeysuckle	*Lonicera utahensis*	LOUT2	Shrub					X	X		X	X		X	X
white spiraea	*Spiraea betulifolia*	SPBE2	Shrub	X	X	X			X			X			X
Wood's rose	*Rosa woodsii*	ROWO	Shrub					X			X			X	
Geyer's sedge	*Carex geyeri*	CAGE2	Sedge	X	X	X		X	X		X	X		X	X
northwestern sedge	*Carex concinnoides*	CACO11	Sedge					X			X			X	
Ross's sedge	*Carex rossi*	CARO5	Sedge	X	X			X			X			X	
blue wildrye	*Elymus glaucus*	ELGL	Grass				X	X		X	X		X	X	
bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSPS	Grass				X			X			X		
Idaho fescue	*Festuca idahoensis*	FEID	Grass					X	X		X	X		X	X
pinegrass	*Calamagrostis rubescens*	CARU	Grass						X			X			X
prairie Junegrass	*Koeleria macrantha*	KOMA	Grass	X	X	X	X	X		X	X		X	X	
rough fescue	*Festuca campestris*	FECA4	Grass				X	X		X	X		X	X	
western fescue	*Festuca occidentalis*	FEOC	Grass					X	X		X	X		X	X
Wheeler bluegrass	*Poa nervosa*	PONE2	Grass				X	X		X	X		X	X	
Alberta beardtongue	*Penstemon albertinus*	PEAL11	Forb					X			X			X	
arrowleaf balsamroot	*Balsamorhiza sagittata*	BASA3	Forb	X	X		X	X		X	X		X	X	
aspen fleabane	*Erigeron speciosus*	ERSP4	Forb												
ballhead sandwort	*Arenaria congesta*	ARCO5	Forb					X	X		X	X		X	X
Bonneville shootingstar	*Dodecatheon conjugens*	DOCO	Forb												
bride's bonnet	*Clintonia uniflora*	CLUN2	Forb					X	X		X	X		X	X
broadleaf arnica	*Arnica latifolia*	ARLA8	Forb												
common beargrass	*Xerophyllum tenax*	XETE	Forb					X	X		X	X		X	X
common gaillardia	*Gaillardia aristata*	GAAR	Forb	X	X		X			X			X		
common yarrow	*Achillea millefolium*	ACMI2	Forb	X	X	X		X			X			X	

Table E-2, continued. Moderately Warm and Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
dwarf bilberry	*Vaccinium cespitosum*	VACE	Forb						X			X			X
elegant piperia	*Piperia elegans*	PIELE4	Forb												
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
fireweed	*Chamerion angustifolium*	CHANA2	Forb	X	X		X	X		X	X		X	X	
harebell	*Campanula rotundifolia*	CARO2	Forb					X			X			X	
heartleaf arnica	*Arnica cordifolia*	ARCO9	Forb					X	X		X	X		X	X
Holboell's rockcress	*Arabis holboellii*	ARHO2	Forb					X			X			X	
hookedspur violet	*Viola adunca*	VIAD	Forb												
Howell's pussytoes	*Antennaria howellii*	ANHOH	Forb					X			X			X	
maiden blue eyed Mary	*Collinsia parviflora*	COPA3	Forb	X	X	X			X			X			X
marsh valerian	*Valeriana dioica*	VADI	Forb												
Menzie's campion	*Silene menziesii*	SIME	Forb												
Missouri goldenrod	*Solidago missouriensis*	SOMI2	Forb	X	X		X	X		X	X		X	X	
Mountain deathcamas	*Zigadenus elegans*	ZIEL2	Forb					X	X		X	X		X	X
narrowleaf mountain trumpet	*Collomia linearis*	COLI2	Forb					X			X			X	
nineleaf biscuitroot	*Lomatium triternatum*	LOTR2	Forb					X			X			X	
nodding onion	*Allium cernuum*	ALCE2	Forb				X			X			X		
northern bedstraw	*Galium boreale*	GABO2	Forb					X			X			X	
pipsissewa	*Chimaphila umbellata*	CHUM	Forb						X			X			X
pointed tip mariposa lily	*Calochortus apiculatus*	CAAP	Forb					X			X			X	
prairie smoke	*Geum triflorum*	GETR	Forb						X			X			X
raceme pussytoes	*Antennaria racemosa*	ANRA	Forb						X			X			X
red baneberry	*Actaea rubra*	ACRU2	Forb						X			X			X
rock clematis	*Clematis columbiana*	CLPS2	Forb					X			X			X	
rosy pussytoes	*Antennaria rosea*	ANRO2	Forb				X			X			X		
roughfruit fairybells	*Prosartes trachycarpa*	PRTR4	Forb												
roundleaf alumroot	*Heuchera cylindrica*	HECY2	Forb					X			X			X	

Table E-2, continued. Moderately Warm and Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Scouler's woollyweed	*Hieracium scouleri*	HISCA	Forb				X			X			X		
sidebells wintergreen	*Orthilia secunda*	ORSE	Forb												
silky lupine	*Lupinus sericeus*	LUSE4	Forb				X	X		X	X		X	X	
spreading dogbane	*Apocynum androsaemifolium*	APAN2	Forb	X	X	X			X			X			X
starry false lily of the valley	*Maianthemum stellatum*	MAST4	Forb												
sticky purple cinquefoil	*Potentilla glandulosa*	POGL9	Forb					X			X			X	
sticky purple geranium	*Geranium viscosissimum*	GEVI2	Forb	X	X	X			X			X			X
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
timber milkvetch	*Astragalus miser*	ASMI9	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western meadow-rue	*Thalictrum occidentale*	THOC	Forb						X			X			X
western rattlesnake plantain	*Goodyera oblongifolia*	GOOB2	Forb												
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
western stoneseed	*Lithospermum ruderale*	LIRU4	Forb				X			X			X		
white hawkweed	*Hieracium albiflorum*	HIAL2	Forb												
white sweetvetch	*Hedysarum sulphurescens*	HESU	Forb	X	X			X			X			X	
wild sarsaparilla	*Aralia nudicualis*	ARNU2	Forb						X			X			X
woodland strawberry	*Fragaria vesca*	FRVE	Forb				X	X		X	X		X	X	
wormleaf stonecrop	*Sedum stenopetalum*	SEST2	Forb						X			X			X
yellow avalanche-lily	*Erythronium grandiflorum*	ERGR9	Forb												

Table E-3. Moderately Warm and Moderately Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state based on the described methods.

Common name	**Scientific name**	**PLANTS Code[a]**	**Lifeform**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**	**DS6**	**DS7**	**DS8**	**DS9**	**DS10**	**DS11**	**DS12**
Greene's mountain ash	*Sorbus scopulina*	SOSCS	Shrub/Tree	X	X	X		X	X		X	X		X	X
Antelope bitterbrush	*Purshia tridentata*	PUTR2	Shrub				X			X			X		
big sagebrush	*Artemisia tridentata*	ARTRV	Shrub				X			X			X		
chokecherry	*Prunus virginiana*	PRVI	Shrub	X	X			X			X			X	
common juniper	*Juniperus communis*	JUCO6	Shrub				X	X		X	X		X	X	
common snowberry	*Symphoricarpos albus*	SYAL	Shrub				X	X		X	X		X	X	
creeping juniper	*Juniperus horizontalis*	JUHO2	Shrub				X	X		X	X		X	X	
grouse whortleberry	*Vaccinium scoparium*	VASC	Shrub						X			X			X
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
Lewis's mock orange	*Philadelphus lewisii*	PHLE4	Shrub	X	X		X			X			X		
mallow ninebark	*Physocarpus malvaceus*	PHMA5	Shrub						X			X			X
oceanspray	*Holodiscus discolor*	HODI	Shrub	X	X		X	X		X	X		X	X	
Oregon boxleaf	*Pachistima myrsinites*	PAMY	Shrub						X			X			X
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
prickly currant	*Ribes lacustre*	RILA	Shrub	X	X	X			X			X			X
prickly rose	*Rosa acicularis*	ROAC	Shrub						X			X			X
pygmy rose	*Rosa bridgesii*	ROBR3	Shrub												
redosier dogwood	*Cornus sericea*	COCA13	Shrub				X			X			X		
Rocky Mountain maple	*Acer glabrum*	ACGL	Shrub	X	X	X		X	X		X	X		X	X
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
rusty menziesia	*Menziesia ferruginea*	MEFE	Shrub						X			X			X
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
Scouler's willow	*Salix scouleriana*	SASC	Shrub	X	X			X			X			X	
shrubby cinquefoil	*Dasiphora fruticosa*	DAFR6	Shrub												
Sitka alder	*Alnus viridis spp sinuata*	ALVIS	Shrub	X	X	X		X			X			X	
snowbrush ceanothus	*Ceanothus velutinus*	CEVE	Shrub	X	X		X			X			X		
sticky currant	*Ribes viscosissimum*	RIVI3	Shrub	X	X		X			X			X		

Table E-3, continued. Moderately Warm and Moderately Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
rough fescue	*Festuca campestris*	FECA5	Grass				X	X		X	X		X	X	
arrowleaf balsamroot	*Balsamorhiza sagittata*	BASA3	Forb	X	X		X	X		X	X		X	X	
bride's bonnet	*Clintonia uniflora*	CLUN2	Forb					X	X		X	X		X	X
broadleaf arnica	*Arnica latifolia*	ARLA8	Forb				X	X		X	X		X	X	
common beargrass	*Xerophyllum tenax*	XETE	Forb					X	X		X	X		X	X
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
Mountain deathcamas	*Zigadenus elegans*	ZIEL2	Forb					X	X		X	X		X	X
northern bedstraw	*Galium boreale*	GABO2	Forb					X			X			X	
pipsissewa	*Chimaphila umbellata*	CHUM	Forb						X			X			X
red baneberry	*Actaea rubra*	ACRU2	Forb						X			X			X
sidebells wintergreen	*Orthilia secunda*	ORSE	Forb												
spreading dogbane	*Apocynum androsaemifolium*	APAN2	Forb						X			X			X
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western meadow-rue	*Thalictrum occidentale*	THOC	Forb						X			X			X
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
wild sarsaparilla	*Aralia nudicualis*	ARNU2	Forb						X			X			X

Table E-4. Moderately Warm and Moist ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Greene's mountain ash	*Sorbus scopulina*	SOSCS	Shrub/Tree	X	X	X		X	X		X	X		X	X
common snowberry	*Symphoricarpos albus*	SYAL	Shrub				X	X		X	X		X	X	
devil's club	*Oplopanax horridum*	OPHO	Shrub						X			X			X
grouse whortleberry	*Vaccinium scoparium*	VASC	Shrub						X			X			X
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
Lewis's mock orange	*Philadelphus lewisii*	PHLE4	Shrub	X	X		X			X			X		
mallow ninebark	*Physocarpus malvaceus*	PHMA5	Shrub						X			X			X
oceanspray	*Holodiscus discolor*	HODI	Shrub	X	X		X	X		X	X		X	X	
Oregon boxleaf	*Pachistima myrsinites*	PAMY	Shrub						X			X			X
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
Pacific yew	*Taxus brevifolia*	TABR2	Shrub						X			X			X
prickly currant	*Ribes lacustre*	RILA	Shrub	X	X	X			X			X			X
redosier dogwood	*Cornus sericea*	COCA13	Shrub				X			X			X		
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
rusty menziesia	*Menziesia ferruginea*	MEFE	Shrub						X			X			X
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
Scouler's willow	*Salix scouleriana*	SASC	Shrub	X	X			X			X			X	
Sitka alder	*Alnus viridis spp sinuata*	ALVIS	Shrub	X	X	X		X			X			X	
snowbrush ceanothus	*Ceanothus velutinus*	CEVE	Shrub	X	X		X			X			X		
thimbleberry	*Rubus parviflorus*	RUPA	Shrub	X	X	X		X	X		X	X		X	X
thinleaf huckleberry	*Vaccinium membranaceum*	VAME	Shrub						X			X			X
twinflower	*Linnaea borealis*	LIBO3	Shrub					X	X		X	X		X	X
Utah honeysuckle	*Lonicera utahensis*	LOUT2	Shrub					X	X		X	X		X	X
white spiraea	*Spiraea betulifolia*	SPBE2	Shrub	X	X	X		X	X		X	X		X	X
Geyer's sedge	*Carex geyeri*	CAGE2	Sedge	X	X	X		X	X		X	X		X	X

Table E-4, continued. Moderately Warm and Moist ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Ross's sedge	*Carex rossi*	CARO5	Sedge	X	X			X	X		X	X		X	X
pinegrass	*Calamagrostis rubescens*	CARU	Grass					X	X		X	X		X	X
arrowleaf ragwort	*Senecio triangularis*	SETR	Forb												
bride's bonnet	*Clintonia uniflora*	CLUN2	Forb					X	X		X	X		X	X
broadleaf arnica	*Arnica latifolia*	ARLA8	Forb				X	X		X	X		X	X	
common beargrass	*Xerophyllum tenax*	XETE	Forb					X	X		X	X		X	X
darkwoods violet	*Viola orbiculata*	VIOR	Forb						X			X			X
dwarf bilberry	*Vaccinium cespitosum*	VACE	Forb						X			X			X
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
fragrant bedstraw	*Galium triflorum*	GATR3	Forb					X			X			X	
heartleaf arnica	*Arnica cordifolia*	ARCO9	Forb					X	X		X	X		X	X
liverleaf wintergreen	*Pyrola asarifolia*	PYAS	Forb												
northern bedstraw	*Galium boreale*	GABO2	Forb					X			X			X	
pipsissewa	*Chimaphila umbellata*	CHUM	Forb						X			X			X
red baneberry	*Actaea rubra*	ACRU2	Forb						X			X			X
sidebells wintergreen	*Orthilia secunda*	ORSE	Forb												
silky lupine	*Lupinus sericeus*	LUSE10	Forb				X	X		X	X		X	X	
starry false lily of the valley	*Maianthemum stellatum*	MAST4	Forb												
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
timber milkvetch	*Astragalus miser*	ASMI9	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western meadow-rue	*Thalictrum occidentale*	THOC	Forb						X			X			X
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
wild sarsaparilla	*Aralia nudicualis*	ARNU2	Forb						X			X			X
common ladyfern	*Athyrium filix-femina*	ATFI	Fern						X			X			X

Table E-5. Moderately Cool and Moist ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Greene's mountain ash	*Sorbus scopulina*	SOSCS	Shrub/Tree	X	X	X		X	X		X	X		X	X
common snowberry	*Symphoricarpos albus*	SYAL	Shrub				X	X		X	X		X	X	
devil's club	*Oplopanax horridum*	OPHO	Shrub						X			X			X
grouse whortleberry	*Vaccinium scoparium*	VASC	Shrub						X			X			X
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
Lewis's mock orange	*Philadelphus lewisii*	PHLE4	Shrub	X	X		X			X			X		
mallow ninebark	*Physocarpus malvaceus*	PHMA5	Shrub						X			X			X
oceanspray	*Holodiscus discolor*	HODI	Shrub	X	X		X	X		X	X		X	X	
Oregon boxleaf	*Pachistima myrsinites*	PAMY	Shrub						X			X			X
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
Pacific yew	*Taxus brevifolia*	TABR2	Shrub						X			X			X
prickly currant	*Ribes lacustre*	RILA	Shrub	X	X	X			X			X			X
redosier dogwood	*Cornus sericea*	COCA13	Shrub				X			X			X		
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
rusty menziesia	*Menziesia ferruginea*	MEFE	Shrub						X			X			X
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
Scouler's willow	*Salix scouleriana*	SASC	Shrub	X	X			X			X			X	
Sitka alder	*Alnus viridis spp sinuata*	ALVIS	Shrub	X	X	X		X			X			X	
snowbrush ceanothus	*Ceanothus velutinus*	CEVE	Shrub	X	X		X			X			X		
thimbleberry	*Rubus parviflorus*	RUPA	Shrub	X	X	X		X	X		X	X		X	X
thinleaf huckleberry	*Vaccinium membranaceum*	VAME	Shrub						X			X			X
twinflower	*Linnaea borealis*	LIBO3	Shrub					X	X		X	X		X	X
Utah honeysuckle	*Lonicera utahensis*	LOUT2	Shrub					X	X		X	X		X	X
white spiraea	*Spiraea betulifolia*	SPBE2	Shrub	X	X	X			X			X			X
Geyer's sedge	*Carex geyeri*	CAGE2	Sedge	X	X	X		X	X		X	X		X	X
Ross's sedge	*Carex rossi*	CARO5	Sedge	X	X			X			X			X	

Table E-5, continued. Moderately Cool and Moist ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
pinegrass	*Calamagrostis rubescens*	CARU	Grass					X	X		X	X		X	X
American trailplant	*Adenocaulon bicolor*	ADBI	Forb						X			X			X
bride's bonnet	*Clintonia uniflora*	CLUN2	Forb					X	X		X	X		X	X
broadleaf arnica	*Arnica latifolia*	ARLA8	Forb				X	X		X	X		X	X	
common beargrass	*Xerophyllum tenax*	XETE	Forb					X	X		X	X		X	X
darkwoods violet	*Viola orbiculata*	VIOR	Forb						X			X			X
dwarf bilberry	*Vaccinium cespitosum*	VACE	Forb						X			X			X
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
fragrant bedstraw	*Galium triflorum*	GATR3	Forb					X			X			X	
heartleaf arnica	*Arnica cordifolia*	ARCO9	Forb					X	X		X	X		X	X
liverleaf wintergreen	*Pyrola asarifolia*	PYAS	Forb												
northern bedstraw	*Galium boreale*	GABO2	Forb					X			X			X	
pipsissewa	*Chimaphila umbellata*	CHUM	Forb						X			X			X
red baneberry	*Actaea rubra*	ACRU2	Forb						X			X			X
sidebells wintergreen	*Orthilia secunda*	ORSE	Forb												
silky lupine	*Lupinus sericeus*	LUSE11	Forb				X	X		X	X		X	X	
starry false lily of the valley	*Maianthemum stellatum*	MAST4	Forb												
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
threeleaf foamflower	*Tiarella trifoliata*	TITR	Forb												
timber milkvetch	*Astragalus miser*	ASMI9	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western meadow-rue	*Thalictrum occidentale*	THOC	Forb						X			X			X
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
wild sarsaparilla	*Aralia nudicualis*	ARNU2	Forb						X			X			X
common ladyfern	*Athyrium filix-femina*	ATFI	Fern						X			X			X
western oakfern	*Gymnocarpium dryopteris*	GYDR	Fern												

Table E-6. Cool and Moist ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Antelope bitterbrush	*Purshia tridentata*	PUTR2	Shrub				X			X			X		
bunchberry dogwood	*Cornus canadensis*	COCA13	Shrub						X			X			X
chokecherry	*Prunus virginiana*	PRVI	Shrub	X	X			X			X			X	
common juniper	*Juniperus communis*	JUCO6	Shrub				X	X		X	X		X	X	
common snowberry	*Symphoricarpos albus*	SYAL	Shrub				X	X		X	X		X	X	
devil's club	*Oplopanax horridum*	OPHO	Shrub						X			X			X
grouse whortleberry	*Vaccinium scoparium*	VASC	Shrub						X			X			X
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
mallow ninebark	*Physocarpus malvaceus*	PHMA5	Shrub						X			X			X
oceanspray	*Holodiscus discolor*	HODI	Shrub	X	X		X	X		X	X		X	X	
Oregon boxleaf	*Pachistima myrsinites*	PAMY	Shrub						X			X			X
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
Pacific yew	*Taxus brevifolia*	TABR2	Shrub						X			X			X
prickly currant	*Ribes lacustre*	RILA	Shrub	X	X	X			X			X			X
prickly rose	*Rosa acicularis*	ROAC	Shrub						X			X			X
pygmy rose	*Rosa bridgesii*	ROBR3	Shrub												
red elderberry	*Sambucus racemosa*	SARA2	Shrub				X			X			X		
redosier dogwood	*Cornus sericea*	COCA13	Shrub				X			X			X		
Rocky Mountain maple	*Acer glabrum*	ACGL	Shrub	X	X	X		X	X		X	X		X	X
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
rusty menziesia	*Menziesia ferruginea*	MEFE	Shrub						X			X			X
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
Scouler's willow	*Salix scouleriana*	SASC	Shrub	X	X			X			X			X	
shrubby cinquefoil	*Dasiphora fruticosa*	DAFR6	Shrub				X	X		X	X		X	X	
Sitka alder	*Alnus viridis spp sinuata*	ALVIS	Shrub	X	X	X		X			X			X	
snowbrush ceanothus	*Ceanothus velutinus*	CEVE	Shrub	X	X		X			X			X		
sticky currant	*Ribes viscosissimum*	RIVI3	Shrub	X	X		X			X			X		
thimbleberry	*Rubus parviflorus*	RUPA	Shrub	X	X	X		X	X		X	X		X	X
thinleaf huckleberry	*Vaccinium membranaceum*	VAME	Shrub						X			X			X

Table E-6, continued. Cool and Moist ecological site- Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
twinflower	*Linnaea borealis*	LIBO3	Shrub					X	X		X	X		X	X
Utah honeysuckle	*Lonicera utahensis*	LOUT2	Shrub					X	X		X	X		X	X
white spiraea	*Spiraea betulifolia*	SPBE2	Shrub	X	X	X			X			X			X
Geyer's sedge	*Carex geyeri*	CAGE2	Sedge	X	X	X		X	X		X	X		X	X
northwestern sedge	*Carex concinnoides*	CACO11	Sedge					X			X			X	
Ross's sedge	*Carex rossi*	CARO5	Sedge	X	X			X			X			X	
Alaska oniongrass	*Melica subulata*	MESU	Grass						X			X			X
blue wildrye	*Elymus glaucus*	ELGL	Grass				X	X		X	X		X	X	
Columbia brome	*Bromus vulgaris*	BRVU	Grass						X			X			X
Idaho fescue	*Festuca idahoensis*	FEID	Grass				X	X		X	X		X	X	
pinegrass	*Calamagrostis rubescens*	CARU	Grass						X			X			X
prairie Junegrass	*Koeleria macrantha*	KOMA	Grass	X	X	X	X	X		X	X		X	X	
rough fescue	*Festuca campestris*	FECA6	Grass				X	X		X	X		X	X	
roughleaf ricegrass	*Oryzopsis asperifolia*	ORAS	Grass												
western fescue	*Festuca occidentalis*	FEOC	Grass						X			X			X
American trailplant	*Adenocaulon bicolor*	ADBI	Forb						X			X			X
bride's bonnet	*Clintonia uniflora*	CLUN2	Forb					X	X		X	X		X	X
broadleaf arnica	*Arnica latifolia*	ARLA8	Forb				X	X		X	X		X	X	
claspleaf twistedstalk	*Streptopus amplexifolius*	STAM2	Forb												
common beargrass	*Xerophyllum tenax*	XETE	Forb					X	X		X	X		X	X
darkwoods violet	*Viola orbiculata*	VIOR	Forb						X			X			X
dwarf bilberry	*Vaccinium cespitosum*	VACE	Forb						X			X			X
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
fireweed	*Chamerion angustifolium*	CHANA2	Forb	X	X		X	X		X	X		X	X	
fragrant bedstraw	*Galium triflorum*	GATR3	Forb					X			X			X	
heartleaf arnica	*Arnica cordifolia*	ARCO9	Forb					X	X		X	X		X	X
heartleaf twayblade	*Listera cordata*	LICO6	Forb												
Hitchcock's smooth woodrush	*Luzula glabrata*	LUGL2	Forb												
liverleaf wintergreen	*Pyrola asarifolia*	PYAS	Forb												

Table E-6, continued. Cool and Moist ecological site- Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	**Scientific name**	**PLANTS Code[a]**	**Lifeform**	**DS1**	**DS2**	**DS3**	**DS4**	**DS5**	**DS6**	**DS7**	**DS8**	**DS9**	**DS10**	**DS11**	**DS12**
Mountain deathcamas	*Zigadenus elegans*	ZIEL2	Forb					X	X		X	X		X	X
northern bedstraw	*Galium boreale*	GABO2	Forb					X			X			X	
northwestern twayblade	*Listera caurina*	LICA10	Forb												
Oregon drops of gold	*Prosartes hookeri*	PRHOO	Forb												
Pacific trillium	*Trillium ovatum*	TROV2	Forb												
Piper's anemone	*Anemone piperi*	ANPI	Forb						X			X			X
pipsissewa	*Chimaphila umbellata*	CHUM	Forb						X			X			X
raceme pussytoes	*Antennaria racemosa*	ANRA	Forb						X			X			X
red baneberry	*Actaea rubra*	ACRU2	Forb						X			X			X
rock clematis	*Clematis columbiana*	CLPS2	Forb					X			X			X	
roughfruit fairybells	*Prosartes trachycarpa*	PRTR4	Forb												
sickletop lousewort	*Pedicularis racemosa*	PERA	Forb												
sidebells wintergreen	*Orthilia secunda*	ORSE	Forb												
silky lupine	*Lupinus sericeus*	LUSE6	Forb				X	X		X	X		X	X	
spreading dogbane	*Apocynum androsaemifolium*	APAN2	Forb						X			X			X
starry false lily of the valley	*Maianthemum stellatum*	MAST4	Forb												
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
threeleaf foamflower	*Tiarella trifoliata*	TITR	Forb												
timber milkvetch	*Astragalus miser*	ASMI9	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western meadow-rue	*Thalictrum occidentale*	THOC	Forb						X			X			X
western rattlesnake plantain	*Goodyera oblongifolia*	GOOB2	Forb												
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
white hawkweed	*Hieracium albiflorum*	HIAL2	Forb												
wild sarsaparilla	*Aralia nudicualis*	ARNU2	Forb						X			X			X
woodland strawberry	*Fragaria vesca*	FRVE	Forb				X	X		X	X		X	X	
common ladyfern	*Athyrium filix-femina*	ATFI	Fern						X			X			X
western brackenfern	*Pteridium aquilinum*	PTAQ	Fern	X	X	X			X			X			X
western oakfern	*Gymnocarpium dryopteris*	GYDR	Fern												

Table E-7. Cool and Moderately Dry ecological site- Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Antelope bitterbrush	*Purshia tridentata*	PUTR2	Shrub				X			X			X		
common juniper	*Juniperus communis*	JUCO6	Shrub				X	X		X	X		X	X	
grouse whortleberry	*Vaccinium scoparium*	VASC	Shrub						X			X			X
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
mallow ninebark	*Physocarpus malvaceus*	PHMA5	Shrub						X			X			X
Oregon boxleaf	*Pachistima myrsinites*	PAMY	Shrub						X			X			X
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
prickly currant	*Ribes lacustre*	RILA	Shrub	X	X	X			X			X			X
prickly rose	*Rosa acicularis*	ROAC	Shrub						X			X			X
pygmy rose	*Rosa bridgesii*	ROBR3	Shrub												
red elderberry	*Sambucus racemosa*	SARA2	Shrub				X			X			X		
Rocky Mountain maple	*Acer glabrum*	ACGL	Shrub	X	X	X		X	X		X	X		X	X
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
rusty menziesia	*Menziesia ferruginea*	MEFE	Shrub						X			X			X
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
Scouler's willow	*Salix scouleriana*	SASC	Shrub	X	X			X			X			X	
shrubby cinquefoil	*Dasiphora fruticosa*	DAFR6	Shrub				X	X		X	X		X	X	
Sitka alder	*Alnus viridis spp sinuata*	ALVIS	Shrub	X	X	X		X			X			X	
snowbrush ceanothus	*Ceanothus velutinus*	CEVE	Shrub	X	X		X			X			X		
sticky currant	*Ribes viscosissimum*	RIVI3	Shrub	X	X		X			X			X		
thimbleberry	*Rubus parviflorus*	RUPA	Shrub	X	X	X		X	X		X	X		X	X
thinleaf huckleberry	*Vaccinium membranaceum*	VAME	Shrub						X			X			X
twinflower	*Linnaea borealis*	LIBO3	Shrub					X	X		X	X		X	X
Utah honeysuckle	*Lonicera utahensis*	LOUT2	Shrub					X	X		X	X		X	X
white spiraea	*Spiraea betulifolia*	SPBE2	Shrub	X	X	X			X			X			X
whortleberry	*Vaccinium myrtillus*	VAMY2	Shrub												
Geyer's sedge	*Carex geyeri*	CAGE2	Sedge	X	X	X		X	X		X	X		X	X
northwestern sedge	*Carex concinnoides*	CACO11	Sedge					X			X			X	
Ross's sedge	*Carex rossi*	CARO5	Sedge	X	X			X			X			X	

Table E-7, continued. Cool and Moderately Dry ecological site- Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Idaho fescue	*Festuca idahoensis*	FEID	Grass				X	X		X	X		X	X	
pinegrass	*Calamagrostis rubescens*	CARU	Grass					X	X		X	X		X	X
prairie Junegrass	*Koeleria macrantha*	KOMA	Grass	X	X	X	X	X		X	X		X	X	
rough fescue	*Festuca campestris*	FECA7	Grass				X	X		X	X		X	X	
arrowleaf balsamroot	*Balsamorhiza sagittata*	BASA3	Forb	X	X		X	X		X	X		X	X	
bride's bonnet	*Clintonia uniflora*	CLUN2	Forb					X	X		X	X		X	X
broadleaf arnica	*Arnica latifolia*	ARLA8	Forb					X	X		X	X		X	X
dwarf bilberry	*Vaccinium cespitosum*	VACE	Forb						X			X			X
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
fireweed	*Chamerion angustifolium*	CHANA2	Forb	X	X		X	X		X	X		X	X	
fragrant bedstraw	*Galium triflorum*	GATR3	Forb					X			X			X	
greenflowered wintergreen	*Pyrola chlorantha*	PYCH	Forb												
harebell	*Campanula rotundifolia*	CARO2	Forb					X			X			X	
heartleaf arnica	*Arnica cordifolia*	ARCO9	Forb					X	X		X	X		X	X
Hitchcock's smooth woodrush	*Luzula glabrata*	LUGL2	Forb												
Mountain deathcamas	*Zigadenus elegans*	ZIEL2	Forb					X	X		X	X		X	X
northern bedstraw	*Galium boreale*	GABO2	Forb					X			X			X	
pipsissewa	*Chimaphila umbellata*	CHUM	Forb						X			X			X
raceme pussytoes	*Antennaria racemosa*	ANRA	Forb						X			X			X
red baneberry	*Actaea rubra*	ACRU2	Forb						X			X			X
rock clematis	*Clematis columbiana*	CLPS2	Forb					X			X			X	
sidebells wintergreen	*Orthilia secunda*	ORSE	Forb												
silky lupine	*Lupinus sericeus*	LUSE5	Forb				X	X		X	X		X	X	
spreading dogbane	*Apocynum androsaemifolium*	APAN2	Forb						X			X			X
starry false lily of the valley	*Maianthemum stellatum*	MAST4	Forb												
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
timber milkvetch	*Astragalus miser*	ASMI9	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
woodland strawberry	*Fragaria vesca*	FRVE	Forb				X	X		X	X		X	X	
yellow avalanche-lily	*Erythronium grandiflorum*	ERGR9	Forb												

Table E-8. Cold ecological site- Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Greene's mountain ash	*Sorbus scopulina*	SOSCS	Shrub/Tree	X	X	X		X	X		X	X		X	X
common juniper	*Juniperus communis*	JUCO6	Shrub				X	X		X	X		X	X	
grouse whortleberry	*Vaccinium scoparium*	VASC	Shrub						X			X			X
grouse whortleberry	*Vaccinium scoparium*	VASC	Shrub					X	X		X	X		X	X
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
rusty menziesia	*Menziesia ferruginea*	MEFE	Shrub						X			X			X
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
Scouler's willow	*Salix scouleriana*	SASC	Shrub	X	X			X			X			X	
shrubby cinquefoil	*Dasiphora fruticosa*	DAFR6	Shrub				X	X		X	X		X	X	
Sitka alder	*Alnus viridis spp sinuata*	ALVIS	Shrub	X	X	X		X			X			X	
thinleaf huckleberry	*Vaccinium membranaceum*	VAME	Shrub						X			X			X
Utah honeysuckle	*Lonicera utahensis*	LOUT2	Shrub					X	X		X	X		X	X
whortleberry	*Vaccinium myrtillus*	VAMY2	Shrub												
Geyer's sedge	*Carex geyeri*	CAGE2	Sedge	X	X	X		X	X		X	X		X	X
Ross's sedge	*Carex rossi*	CARO5	Sedge	X	X		X	X		X	X		X	X	
blue wildrye	*Elymus glaucus*	ELGL	Grass				X	X		X	X		X	X	
pinegrass	*Calamagrostis rubescens*	CARU	Grass					X	X		X	X		X	X
rough fescue	*Festuca campestris*	FECA8	Grass				X	X		X	X		X	X	
Wheeler bluegrass	*Poa nervosa*	PONE2	Grass				X	X		X	X		X	X	
Alberta beardtongue	*Penstemon albertinus*	PEAL11	Forb					X			X			X	
arrowleaf balsamroot	*Balsamorhiza sagittata*	BASA3	Forb	X	X		X	X		X	X		X	X	
arrowleaf ragwort	*Senecio triangularis*	SETR	Forb												
bracted lousewort	*Pedicularis bracteosa*	PEBR	Forb												

Table E-8, continued. Cold ecological site- Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
broadleaf arnica	*Arnica latifolia*	ARLA8	Forb					X	X		X	X		X	X
coiled lousewort	*Pedicularis contorta*	PECO	Forb												
common beargrass	*Xerophyllum tenax*	XETE	Forb					X	X		X	X		X	X
common yarrow	*Achillea millefolium*	ACMI2	Forb	X	X	X		X			X			X	
darkwoods violet	*Viola orbiculata*	VIOR	Forb						X			X			X
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
fireweed	*Chamerion angustifolium*	CHANA2	Forb	X	X		X	X		X	X		X	X	
green false hellebore	*Veratrum viride*	VEVI	Forb												
heartleaf arnica	*Arnica cordifolia*	ARCO9	Forb					X	X		X	X		X	X
Hitchcock's smooth woodrush	*Luzula glabrata*	LUGL2	Forb												
Mountain deathcamas	*Zigadenus elegans*	ZIEL2	Forb					X	X		X	X		X	X
pale agoseris	*Agoseris glauca*	AGGL	Forb					X	X		X	X		X	X
pink mountainheath	*Phyllodoce empetriformis*	PHEM	Forb												
pipsissewa	*Chimaphila umbellata*	CHUM	Forb						X			X			X
raceme pussytoes	*Antennaria racemosa*	ANRA	Forb						X			X			X
sidebells wintergreen	*Orthilia secunda*	ORSE	Forb												
silky lupine	*Lupinus sericeus*	LUSE8	Forb				X	X		X	X		X	X	
Sitka valerian	*Valeriana sitchensis*	VASI	Forb												
slender hawkweed	*Hieracium gracile*	HIGRG	Forb												
starry false lily of the valley	*Maianthemum stellatum*	MAST4	Forb												
subalpine fleabane	*Erigeron peregrinus*	ERPE3	Forb					X			X			X	
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
timber milkvetch	*Astragalus miser*	ASMI9	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western meadow-rue	*Thalictrum occidentale*	THOC	Forb						X			X			X
western rattlesnake plantain	*Goodyera oblongifolia*	GOOB2	Forb												
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
yellow avalanche-lily	*Erythronium grandiflorum*	ERGR9	Forb												

Table E-9. Timberline ecological site- Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Greene's mountain ash	*Sorbus scopulina*	SOSCS	Shrub/Tree	X	X	X		X	X		X	X		X	X
common juniper	*Juniperus communis*	JUCO6	Shrub				X	X		X	X		X	X	
grouse whortleberry	*Vaccinium scoparium*	VASC	Shrub					X	X		X	X		X	X
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
Scouler's willow	*Salix scouleriana*	SASC	Shrub	X	X			X			X			X	
shrubby cinquefoil	*Dasiphora fruticosa*	DAFR6	Shrub				X	X		X	X		X	X	
Sitka alder	*Alnus viridis spp sinuata*	ALVIS	Shrub	X	X	X		X			X			X	
thinleaf huckleberry	*Vaccinium membranaceum*	VAME	Shrub						X			X			X
Utah honeysuckle	*Lonicera utahensis*	LOUT2	Shrub					X	X		X	X		X	X
western Labrador tea	*Ledum glandulosum*	LEGL	Shrub						X			X			X
black alpine sedge	*Carex nigricans*	CANI2	Sedge					X			X			X	
Geyer's sedge	*Carex geyeri*	CAGE2	Sedge	X	X	X		X	X		X	X		X	X
Payson's sedge	*Carex paysonis*	CAPA31	Sedge												
Ross's sedge	*Carex rossi*	CARO5	Sedge	X	X		X	X		X	X		X	X	
Parry's rush	*Juncus parryi*	JUPA	Grass					X			X			X	
pinegrass	*Calamagrostis rubescens*	CARU	Grass					X	X		X	X		X	X
rough fescue	*Festuca campestris*	FECA9	Grass				X	X		X	X		X	X	
Wheeler bluegrass	*Poa nervosa*	PONE2	Grass				X	X		X	X		X	X	
arrowleaf balsamroot	*Balsamorhiza sagittata*	BASA3	Forb	X	X		X	X		X	X		X	X	
ballhead sandwort	*Arenaria congesta*	ARCO5	Forb					X	X		X	X		X	X
broadleaf arnica	*Arnica latifolia*	ARLA8	Forb					X	X		X	X		X	X
common yarrow	*Achillea millefolium*	ACMI2	Forb	X	X	X		X			X			X	

Table E-9, continued. Timberline ecological site- Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
heartleaf arnica	*Arnica cordifolia*	ARCO9	Forb						X			X			X
Hitchcock's smooth woodrush	*Luzula glabrata*	LUGL2	Forb												
Mountain deathcamas	*Zigadenus elegans*	ZIEL2	Forb					X	X		X	X		X	X
pale agoseris	*Agoseris glauca*	AGGL	Forb				X			X			X		
pink mountainheath	*Phyllodoce empetriformis*	PHEM	Forb												
pipsissewa	*Chimaphila umbellata*	CHUM	Forb						X			X			X
rosy pussytoes	*Antennaria rosea*	ANRO2	Forb				X			X			X		
silky lupine	*Lupinus sericeus*	LUSE7	Forb				X	X		X	X		X	X	
starry false lily of the valley	*Maianthemum stellatum*	MAST4	Forb												
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
timber milkvetch	*Astragalus miser*	ASMI9	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
woolly pussytoes	*Antennaria lanata*	ANLA3	Forb					X			X			X	

Information sources used to develop understory species tables:

1) Pfister et al. (1977), Appendix C-1 – species associated with an ecological site
2) Fisher and Bradley (1997) – target species information on disturbance response, where available
3) NRCS PLANTS Database – target species information on shade tolerance and disturbance response, where available

Structure

Live Trees

Table E-10. Moderately Warm and Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

<table>
<tr><th>SIZE-CLASS</th><th>DBH RANGE</th><th colspan="2">OPEN
(<40% Canopy Cover)</th><th colspan="2">MODERATE
(40-60% Canopy Cover)</th><th colspan="2">CLOSED
(>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="5">AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="5">9633 (0 - 19266)</td><td rowspan="5">2</td></tr>
<tr><td>1.0-4.9"</td><td colspan="5">0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="5">6 (0 - 12)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="5">0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td colspan="5">3 (0 - 6)</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="3">AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="3">1499 (1499 - 1499)</td><td rowspan="5">1</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td colspan="3">225 (225 - 225)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td>931 (0 - 2657)</td><td rowspan="5">17</td><td>100 (0 - 375)</td><td rowspan="5">6</td><td>218 (0 - 900)</td><td rowspan="5">5</td></tr>
<tr><td>1.0-4.9"</td><td>177 (0 - 686)</td><td>300 (0 - 600)</td><td>748 (75 - 1414)</td></tr>
<tr><td>5.0-14.9"</td><td>87 (19 - 224)</td><td>203 (138 - 265)</td><td>449 (200 - 683)</td></tr>
<tr><td>15.0-19.9"</td><td>2 (0 - 8)</td><td>1 (0 - 6)</td><td>1 (0 - 6)</td></tr>
<tr><td>20.0+"</td><td>1 (0 - 6)</td><td>0 (0 - 2)</td><td>1 (0 - 6)</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td><1.0"</td><td>557 (0 - 3523)</td><td rowspan="5">8</td><td>259 (0 - 1071)</td><td rowspan="5">10</td><td>257 (0 - 514)</td><td rowspan="5">2</td></tr>
<tr><td>1.0-4.9"</td><td>25 (0 - 86)</td><td>115 (0 - 343)</td><td>21 (0 - 43)</td></tr>
<tr><td>5.0-14.9"</td><td>57 (30 - 165)</td><td>152 (90 - 235)</td><td>293 (231 - 355)</td></tr>
<tr><td>15.0-19.9"</td><td>16 (6 - 24)</td><td>21 (12 - 30)</td><td>13 (12 - 15)</td></tr>
<tr><td>20.0+"</td><td>3 (0 - 6)</td><td>2 (0 - 6)</td><td>0 (0 - 0)</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td><1.0"</td><td>536 (300 - 771)</td><td rowspan="5">2</td><td>705 (0 - 2186)</td><td rowspan="5">6</td><td>75 (75 - 75)</td><td rowspan="5">1</td></tr>
<tr><td>1.0-4.9"</td><td>193 (86 - 300)</td><td>171 (0 - 900)</td><td>0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td>19 (15 - 24)</td><td>72 (12 - 139)</td><td>108 (108 - 108)</td></tr>
<tr><td>15.0-19.9"</td><td>13 (12 - 14)</td><td>15 (2 - 26)</td><td>42 (42 - 42)</td></tr>
<tr><td>20.0+"</td><td>11 (10 - 13)</td><td>19 (10 - 30)</td><td>24 (24 - 24)</td></tr>
</table>

Table E-11. Moderately Warm and Moderately Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
				AVG (MIN-MAX)	**#PLOTS**		
	<1.0"			NA	0		
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	NA	0			NA	0
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	262 (0 - 525)	2	0 (0 - 0)	1	37 (0 - 75)	2
	1.0-4.9"	137 (75 - 200)		150 (150 - 150)		150 (75 - 225)	
	5.0-14.9"	113 (96 - 130)		307 (307 - 307)		358 (319 - 397)	
	15.0-19.9"	1 (0 - 2)		0 (0 - 0)		6 (6 - 6)	
	20.0+"	6 (6 - 6)		0 (0 - 0)		0 (0 - 0)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	NA	0	693 (0 - 1274)	4	NA	0
	1.0-4.9"			306 (100 - 600)			
	5.0-14.9"			172 (96 - 273)			
	15.0-19.9"			19 (11 - 30)			
	20.0+"			4 (0 - 6)			
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	NA	0	236 (0 - 900)	4	NA	0
	1.0-4.9"			150 (86 - 214)			
	5.0-14.9"			85 (21 - 183)			
	15.0-19.9"			16 (5 - 34)			
	20.0+"			17 (8 - 28)			

Table E-12. Moderately Warm and Moist ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	43 (43 - 43)	1				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	7 (7 - 7)					
	15.0-19.9"	5 (5 - 5)					
	20.0+"	1 (1 - 1)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	1			NA	0
	1.0-4.9"	200 (200 - 200)					
	5.0-14.9"	15 (15 - 15)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	1363 (0 - 5014)	5	2174 (2174 - 2174)	1	2079 (0 - 4157)	2
	1.0-4.9"	241 (0 - 675)		750 (750 - 750)		521 (343 - 700)	
	5.0-14.9"	93 (36 - 160)		205 (205 - 205)		334 (308 - 359)	
	15.0-19.9"	3 (0 - 6)		0 (0 - 0)		5 (3 - 7)	
	20.0+"	1 (0 - 3)		0 (0 - 0)		0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"	825 (825 - 825)	1	NA	0	1217 (0 - 3523)	3
	1.0-4.9"	0 (0 - 0)				180 (150 - 200)	
	5.0-14.9"	60 (60 - 60)				166 (114 - 224)	
	15.0-19.9"	6 (6 - 6)				27 (19 - 42)	
	20.0+"	6 (6 - 6)				8 (6 - 9)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	NA	0	315 (0 - 1574)	5	0 (0 - 0)	1
	1.0-4.9"			455 (200 - 800)		600 (600 - 600)	
	5.0-14.9"			95 (59 - 144)		128 (128 - 128)	
	15.0-19.9"			10 (0 - 15)		19 (19 - 19)	
	20.0+"			17 (10 - 19)		15 (15 - 15)	

Table E-13. Moderately Cool and Moist ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	2661 (1949 - 3373)	2				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	6 (6 - 6)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	225 (225 - 225)	1			NA	0
	1.0-4.9"	300 (300 - 300)					
	5.0-14.9"	12 (12 - 12)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	525 (0 - 1724)	5	1349 (0 - 2999)	6	150 (0 - 450)	3
	1.0-4.9"	105 (0 - 300)		391 (75 - 1424)		2058 (675 - 3000)	
	5.0-14.9"	112 (19 - 211)		244 (150 - 337)		228 (58 - 344)	
	15.0-19.9"	0 (0 - 0)		2 (0 - 6)		2 (0 - 6)	
	20.0+"	2 (0 - 6)		0 (0 - 0)		0 (0 - 1)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	17271(17271-17271)	1	954 (0 - 4573)	11	1612 (0 - 6372)	4
	1.0-4.9"	43 (43 - 43)		241 (43 - 450)		1193 (225 - 2249)	
	5.0-14.9"	16 (16 - 16)		182 (84 - 313)		188 (132 - 307)	
	15.0-19.9"	12 (12 - 12)		16 (10 - 30)		24 (9 - 56)	
	20.0+"	0 (0 - 0)		3 (0 - 6)		4 (0 - 9)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	NA	0	1925 (525 - 3300)	3	942 (0 - 2774)	7
	1.0-4.9"			357 (150 - 471)		407 (0 - 750)	
	5.0-14.9"			111 (31 - 181)		201 (83 - 361)	
	15.0-19.9"			7 (0 - 12)		29 (18 - 54)	
	20.0+"			12 (12 - 12)		19 (12 - 24)	

Table E-14. Cool and Moist ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	86 (0 - 257)	3				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	5 (0 - 14)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	2 (0 - 3)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	1626 (0 - 6386)	11			1243 (1243 - 1243)	1
	1.0-4.9"	278 (75 - 814)				3514 (3514 - 3514)	
	5.0-14.9"	4 (0 - 13)				0 (0 - 0)	
	15.0-19.9"	0 (0 - 3)				0 (0 - 0)	
	20.0+"	0 (0 - 3)				0 (0 - 0)	
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	1882 (0 - 13329)	66	1954 (0 - 8771)	55	1507 (0 - 9986)	47
	1.0-4.9"	307 (0 - 1100)		562 (0 - 2324)		887 (0 - 4029)	
	5.0-14.9"	79 (12 - 236)		200 (12 - 355)		348 (22 - 692)	
	15.0-19.9"	1 (0 - 7)		2 (0 - 8)		2 (0 - 7)	
	20.0+"	1 (0 - 6)		1 (0 - 9)		1 (0 - 6)	
LARGE		DS7		DS8		DS9	
	<1.0"	1556 (0 - 10045)	18	1376 (0 - 7971)	60	1571 (0 - 6660)	37
	1.0-4.9"	124 (0 - 480)		275 (0 - 1799)		382 (0 - 1949)	
	5.0-14.9"	67 (0 - 127)		138 (48 - 271)		282 (106 - 425)	
	15.0-19.9"	11 (2 - 18)		18 (4 - 42)		23 (4 - 71)	
	20.0+"	4 (0 - 9)		4 (0 - 10)		4 (0 - 10)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	447 (43 - 1114)	9	739 (0 - 3373)	41	809 (0 - 3257)	36
	1.0-4.9"	64 (0 - 150)		182 (0 - 1199)		385 (0 - 2249)	
	5.0-14.9"	43 (18 - 72)		81 (6 - 187)		180 (39 - 376)	
	15.0-19.9"	8 (0 - 19)		17 (0 - 40)		22 (0 - 60)	
	20.0+"	14 (10 - 24)		18 (10 - 42)		23 (11 - 49)	

Table E-15. Cool and Moderately Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	5572 (675 - 14243)	3				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	10 (6 - 12)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	1508 (0 - 4423)	9			NA	0
	1.0-4.9"	121 (60 - 225)					
	5.0-14.9"	7 (0 - 12)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	1508 (0 - 7029)	43	1863 (0 - 8150)	35	912 (0 - 7122)	25
	1.0-4.9"	238 (0 - 1349)		419 (0 - 1949)		880 (0 - 3598)	
	5.0-14.9"	78 (12 - 301)		215 (65 - 328)		351 (114 - 592)	
	15.0-19.9"	1 (0 - 6)		2 (0 - 6)		1 (0 - 6)	
	20.0+"	0 (0 - 6)		0 (0 - 5)		0 (0 - 6)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	1406 (75 - 3600)	8	1771 (0 - 8471)	11	848 (75 - 2914)	9
	1.0-4.9"	125 (0 - 450)		112 (0 - 257)		464 (150 - 943)	
	5.0-14.9"	74 (36 - 119)		135 (64 - 217)		262 (102 - 451)	
	15.0-19.9"	11 (6 - 18)		22 (12 - 36)		22 (8 - 47)	
	20.0+"	3 (0 - 6)		3 (0 - 10)		2 (0 - 6)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	1380 (1380 - 1380)	1	2849 (1424 - 5547)	4	800 (75 - 1499)	3
	1.0-4.9"	60 (60 - 60)		355 (60 - 686)		600 (150 - 900)	
	5.0-14.9"	69 (69 - 69)		105 (54 - 169)		255 (223 - 295)	
	15.0-19.9"	13 (13 - 13)		9 (0 - 25)		8 (0 - 12)	
	20.0+"	10 (10 - 10)		16 (13 - 18)		20 (12 - 36)	

Table E-16. Cold ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	NA	0				
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	1232 (0 - 2024)	3			NA	0
	1.0-4.9"	113 (60 - 150)					
	5.0-14.9"	2 (0 - 6)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	1 (0 - 3)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	2358 (0 - 5997)	18	1456 (0 - 3298)	11	2734 (257 - 4048)	3
	1.0-4.9"	436 (86 - 1424)		462 (43 - 1349)		650 (300 - 825)	
	5.0-14.9"	76 (13 - 185)		212 (111 - 277)		427 (295 - 607)	
	15.0-19.9"	1 (0 - 6)		3 (0 - 9)		0 (0 - 0)	
	20.0+"	1 (0 - 5)		1 (0 - 6)		0 (0 - 0)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	2279 (300 - 7272)	4	1014 (0 - 2143)	3	2384 (0 - 5700)	7
	1.0-4.9"	21 (0 - 86)		288 (150 - 500)		740 (150 - 1600)	
	5.0-14.9"	52 (22 - 78)		95 (78 - 105)		237 (193 - 328)	
	15.0-19.9"	15 (4 - 24)		26 (17 - 39)		22 (12 - 48)	
	20.0+"	5 (0 - 8)		5 (3 - 6)		3 (0 - 7)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	13200 (13200-13200)	1	939 (75 - 1500)	3	825 (375 - 1124)	4
	1.0-4.9"	360 (360 - 360)		175 (129 - 225)		600 (225 - 1274)	
	5.0-14.9"	47 (47 - 47)		55 (34 - 96)		179 (132 - 271)	
	15.0-19.9"	6 (6 - 6)		26 (10 - 37)		21 (12 - 30)	
	20.0+"	13 (13 - 13)		17 (12 - 19)		20 (12 - 30)	

Table E-17. Timberline ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	NA	0				
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	1124 (1124 - 1124)	1			NA	0
	1.0-4.9"	75 (75 - 75)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	6 (6 - 6)					
	20.0+"	0 (0 - 0)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	2480 (0 - 10045)	25	1780 (257 - 2571)	7	1633 (1080 - 2186)	2
	1.0-4.9"	293 (0 - 1157)		427 (214 - 857)		964 (300 - 1629)	
	5.0-14.9"	68 (18 - 138)		186 (121 - 325)		187 (155 - 218)	
	15.0-19.9"	2 (0 - 10)		1 (0 - 6)		3 (0 - 6)	
	20.0+"	0 (0 - 6)		0 (0 - 0)		2 (0 - 4)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	4948 (4948 - 4948)	1	3007 (1029 - 5443)	3	NA	0
	1.0-4.9"	675 (675 - 675)		225 (43 - 375)			
	5.0-14.9"	66 (66 - 66)		139 (129 - 144)			
	15.0-19.9"	6 (6 - 6)		21 (12 - 36)			
	20.0+"	6 (6 - 6)		3 (0 - 9)			
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	1414 (1414 - 1414)	1	NA	0	2542 (2460 - 2624)	2
	1.0-4.9"	300 (300 - 300)				945 (840 - 1050)	
	5.0-14.9"	76 (76 - 76)				249 (132 - 366)	
	15.0-19.9"	4 (4 - 4)				21 (18 - 24)	
	20.0+"	11 (11 - 11)				12 (11 - 12)	

Dead Trees

Table E-18. Moderately Warm and Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	0 (0 - 0)	2				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	42 (24 - 60)					
	15.0-19.9"	12 (6 - 18)					
	20.0+"	9 (0 - 18)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	1			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	48 (48 - 48)					
	15.0-19.9"	18 (18 - 18)					
	20.0+"	30 (30 - 30)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	17	0 (0 - 0)	6	0 (0 - 0)	5
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	16 (0 - 175)		5 (0 - 18)		12 (0 - 42)	
	15.0-19.9"	2 (0 - 14)		0 (0 - 3)		2 (0 - 6)	
	20.0+"	1 (0 - 6)		0 (0 - 0)		2 (0 - 6)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	8	0 (0 - 0)	10	0 (0 - 0)	2
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	48 (0 - 223)		29 (0 - 102)		110 (95 - 125)	
	15.0-19.9"	5 (0 - 18)		3 (0 - 12)		0 (0 - 0)	
	20.0+"	1 (0 - 6)		0 (0 - 0)		0 (0 - 0)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	2	0 (0 - 0)	6	0 (0 - 0)	1
	1.0-4.9"	0 (0 - 0)		17 (0 - 100)		0 (0 - 0)	
	5.0-14.9"	19 (9 - 29)		14 (0 - 32)		18 (18 - 18)	
	15.0-19.9"	1 (0 - 3)		1 (0 - 6)		0 (0 - 0)	
	20.0+"	2 (0 - 5)		2 (0 - 6)		0 (0 - 0)	

Table E-19. Moderately Warm and Moderately Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

<table>
<tr><th>SIZE-CLASS</th><th>DBH RANGE</th><th colspan="2">OPEN
(<40% Canopy Cover)</th><th colspan="2">MODERATE
(40-60% Canopy Cover)</th><th colspan="2">CLOSED
(>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="4">AVG (MIN-MAX)</td><td colspan="2">#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="4" rowspan="5">NA</td><td colspan="2" rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td></tr>
<tr><td>5.0-14.9"</td></tr>
<tr><td>15.0-19.9"</td></tr>
<tr><td>20.0+"</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="2">AVG (MIN-MAX)</td><td colspan="2">#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="2" rowspan="5">NA</td><td colspan="2" rowspan="5">0</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td></tr>
<tr><td>5.0-14.9"</td></tr>
<tr><td>15.0-19.9"</td></tr>
<tr><td>20.0+"</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td>0 (0 - 0)</td><td rowspan="5">2</td><td>0 (0 - 0)</td><td rowspan="5">1</td><td>0 (0 - 0)</td><td rowspan="5">2</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td>3 (0 - 5)</td><td>150 (150 - 150)</td><td>99 (30 - 169)</td></tr>
<tr><td>15.0-19.9"</td><td>3 (0 - 6)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td>1 (0 - 1)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td><1.0"</td><td rowspan="5">NA</td><td rowspan="5">0</td><td>0 (0 - 0)</td><td rowspan="5">4</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td>89 (0 - 211)</td></tr>
<tr><td>15.0-19.9"</td><td>6 (0 - 12)</td></tr>
<tr><td>20.0+"</td><td>0 (0 - 0)</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td><1.0"</td><td rowspan="5">NA</td><td rowspan="5">0</td><td>0 (0 - 0)</td><td rowspan="5">4</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td>25 (0 - 100)</td></tr>
<tr><td>5.0-14.9"</td><td>6 (0 - 12)</td></tr>
<tr><td>15.0-19.9"</td><td>6 (0 - 20)</td></tr>
<tr><td>20.0+"</td><td>2 (0 - 7)</td></tr>
</table>

Table E-20. Moderately Warm and Moist ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	0 (0 - 0)	1				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	1			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	5 (5 - 5)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	1 (1 - 1)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	5	0 (0 - 0)	1	0 (0 - 0)	2
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		50 (0 - 100)	
	5.0-14.9"	15 (0 - 31)		78 (78 - 78)		4 (0 - 8)	
	15.0-19.9"	0 (0 - 0)		0 (0 - 0)		1 (0 - 3)	
	20.0+"	0 (0 - 0)		6 (6 - 6)		2 (0 - 4)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)	1	NA	0	0 (0 - 0)	3
	1.0-4.9"	0 (0 - 0)				33 (0 - 100)	
	5.0-14.9"	0 (0 - 0)				36 (12 - 70)	
	15.0-19.9"	0 (0 - 0)				12 (0 - 19)	
	20.0+"	0 (0 - 0)				5 (0 - 8)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	NA	0	0 (0 - 0)	5	0 (0 - 0)	1
	1.0-4.9"			0 (0 - 0)		200 (200 - 200)	
	5.0-14.9"			18 (0 - 48)		29 (29 - 29)	
	15.0-19.9"			4 (2 - 6)		5 (5 - 5)	
	20.0+"			2 (0 - 7)		0 (0 - 0)	

Table E-21. Moderately Cool and Moist ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

<table>
<tr><th>SIZE-CLASS</th><th>DBH RANGE</th><th colspan="2">OPEN
(<40% Canopy Cover)</th><th colspan="2">MODERATE
(40-60% Canopy Cover)</th><th colspan="2">CLOSED
(>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="5">AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="5">0 (0 - 0)</td><td rowspan="5">2</td></tr>
<tr><td>1.0-4.9"</td><td colspan="5">0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="5">340 (205 - 475)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="5">6 (0 - 12)</td></tr>
<tr><td>20.0+"</td><td colspan="5">6 (0 - 12)</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="3">AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="3">0 (0 - 0)</td><td rowspan="5">1</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td>0 (0 - 0)</td><td rowspan="5">5</td><td>0 (0 - 0)</td><td rowspan="5">6</td><td>0 (0 - 0)</td><td rowspan="5">3</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td>12 (0 - 42)</td><td>34 (0 - 90)</td><td>10 (5 - 18)</td></tr>
<tr><td>15.0-19.9"</td><td>4 (0 - 12)</td><td>2 (0 - 6)</td><td>2 (0 - 6)</td></tr>
<tr><td>20.0+"</td><td>0 (0 - 0)</td><td>1 (0 - 6)</td><td>1 (0 - 2)</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td><1.0"</td><td>0 (0 - 0)</td><td rowspan="5">1</td><td>0 (0 - 0)</td><td rowspan="5">11</td><td>0 (0 - 0)</td><td rowspan="5">4</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td><td>50 (0 - 200)</td></tr>
<tr><td>5.0-14.9"</td><td>7 (7 - 7)</td><td>25 (0 - 54)</td><td>45 (6 - 90)</td></tr>
<tr><td>15.0-19.9"</td><td>0 (0 - 0)</td><td>5 (0 - 36)</td><td>1 (0 - 4)</td></tr>
<tr><td>20.0+"</td><td>0 (0 - 0)</td><td>6 (0 - 18)</td><td>0 (0 - 1)</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td><1.0"</td><td rowspan="5">NA</td><td rowspan="5">0</td><td>0 (0 - 0)</td><td rowspan="5">3</td><td>0 (0 - 0)</td><td rowspan="5">7</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td><td>14 (0 - 100)</td></tr>
<tr><td>5.0-14.9"</td><td>20 (0 - 42)</td><td>29 (0 - 69)</td></tr>
<tr><td>15.0-19.9"</td><td>6 (0 - 12)</td><td>4 (0 - 10)</td></tr>
<tr><td>20.0+"</td><td>5 (0 - 12)</td><td>2 (0 - 6)</td></tr>
</table>

Table E-22. Cool and Moist ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	0 (0 - 0)	3				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	11			0 (0 - 0)	1
	1.0-4.9"	0 (0 - 0)				0 (0 - 0)	
	5.0-14.9"	22 (0 - 175)				23 (23 - 23)	
	15.0-19.9"	1 (0 - 6)				0 (0 - 0)	
	20.0+"	1 (0 - 6)				0 (0 - 0)	
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	66	0 (0 - 0)	55	0 (0 - 0)	47
	1.0-4.9"	2 (0 - 100)		13 (0 - 600)		19 (0 - 500)	
	5.0-14.9"	27 (0 - 295)		52 (0 - 431)		40 (0 - 182)	
	15.0-19.9"	1 (0 - 18)		2 (0 - 26)		1 (0 - 9)	
	20.0+"	1 (0 - 12)		1 (0 - 16)		0 (0 - 8)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)	18	0 (0 - 0)	60	0 (0 - 0)	37
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	40 (0 - 193)		40 (0 - 294)		46 (0 - 235)	
	15.0-19.9"	7 (0 - 42)		3 (0 - 18)		2 (0 - 18)	
	20.0+"	3 (0 - 24)		2 (0 - 12)		1 (0 - 12)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	0 (0 - 0)	9	0 (0 - 0)	41	0 (0 - 0)	36
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		3 (0 - 100)	
	5.0-14.9"	9 (0 - 36)		19 (0 - 96)		34 (0 - 169)	
	15.0-19.9"	1 (0 - 6)		5 (0 - 36)		3 (0 - 30)	
	20.0+"	3 (0 - 6)		3 (0 - 24)		4 (0 - 18)	

Table E-23. Cool and Moderately Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	0 (0 - 0)	3				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	46 (0 - 78)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	2 (0 - 6)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	9			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	5 (0 - 30)					
	15.0-19.9"	1 (0 - 12)					
	20.0+"	1 (0 - 6)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	43	0 (0 - 0)	35	0 (0 - 0)	25
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		16 (0 - 300)	
	5.0-14.9"	48 (0 - 355)		35 (0 - 169)		60 (0 - 409)	
	15.0-19.9"	1 (0 - 6)		0 (0 - 6)		1 (0 - 12)	
	20.0+"	0 (0 - 6)		0 (0 - 2)		0 (0 - 6)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	8	0 (0 - 0)	11	0 (0 - 0)	9
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	20 (0 - 84)		37 (0 - 108)		71 (0 - 298)	
	15.0-19.9"	1 (0 - 4)		1 (0 - 8)		1 (0 - 8)	
	20.0+"	2 (0 - 7)		0 (0 - 3)		1 (0 - 6)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	1	0 (0 - 0)	4	0 (0 - 0)	3
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	7 (7 - 7)		20 (6 - 43)		30 (12 - 48)	
	15.0-19.9"	4 (4 - 4)		5 (0 - 10)		4 (0 - 12)	
	20.0+"	3 (3 - 3)		2 (0 - 5)		2 (0 - 6)	

Table E-24. Cold ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	NA	0				
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	3			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	10 (0 - 30)					
	15.0-19.9"	4 (0 - 12)					
	20.0+"	2 (0 - 5)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	18	0 (0 - 0)	11	0 (0 - 0)	3
	1.0-4.9"	0 (0 - 0)		27 (0 - 300)		0 (0 - 0)	
	5.0-14.9"	30 (0 - 181)		89 (0 - 283)		100 (48 - 150)	
	15.0-19.9"	3 (0 - 27)		4 (0 - 18)		2 (0 - 6)	
	20.0+"	2 (0 - 12)		2 (0 - 6)		0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	4	0 (0 - 0)	3	0 (0 - 0)	7
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	8 (0 - 30)		32 (11 - 72)		55 (11 - 120)	
	15.0-19.9"	2 (0 - 6)		14 (0 - 30)		5 (0 - 12)	
	20.0+"	2 (0 - 6)		0 (0 - 0)		2 (0 - 6)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	1	0 (0 - 0)	3	0 (0 - 0)	4
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	0 (0 - 0)		58 (0 - 90)		36 (6 - 90)	
	15.0-19.9"	0 (0 - 0)		24 (10 - 36)		12 (0 - 24)	
	20.0+"	1 (1 - 1)		1 (0 - 4)		3 (0 - 6)	

Table E-25. Timberline ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	NA	0				
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	1			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	30 (30 - 30)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	25	0 (0 - 0)	7	0 (0 - 0)	2
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	14 (0 - 96)		65 (0 - 209)		8 (0 - 16)	
	15.0-19.9"	2 (0 - 18)		2 (0 - 12)		2 (0 - 4)	
	20.0+"	1 (0 - 12)		0 (0 - 0)		0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	1	0 (0 - 0)	3	NA	0
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)			
	5.0-14.9"	30 (30 - 30)		52 (0 - 95)			
	15.0-19.9"	6 (6 - 6)		5 (0 - 9)			
	20.0+"	6 (6 - 6)		4 (0 - 12)			
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	1	NA	0	0 (0 - 0)	2
	1.0-4.9"	0 (0 - 0)				0 (0 - 0)	
	5.0-14.9"	0 (0 - 0)				31 (18 - 44)	
	15.0-19.9"	0 (0 - 0)				8 (4 - 12)	
	20.0+"	2 (2 - 2)				0 (0 - 0)	

General Ecosystem Characteristics

Table E-26. Moderately Warm and Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	21 (11 - 31)	2				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	9 (7 - 11)	2				
	GRASS (CC%)	6 (2 - 11)	2				
	SHRUBS (CC%)	5 (3 - 7)	2				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	1 (1 - 1)	1			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	12 (12 - 12)	1			NA	0
	GRASS (CC%)	15 (15 - 15)	1			NA	0
	SHRUBS (CC%)	14 (14 - 14)	1			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	10 (5 - 25)	17	9 (6 - 10)	6	7 (6 - 9)	5
	CWD (TONS/AC)	5 (0 - 14)	3	NA	0	NA	0
	FORBS (CC%)	8 (1 - 19)	7	9 (2 - 23)	5	16 (9 - 23)	2
	GRASS (CC%)	8 (3 - 16)	7	6 (1 - 14)	5	1 (1 - 1)	2
	SHRUBS (CC%)	10 (2 - 17)	7	20 (10 - 52)	5	23 (15 - 32)	2
LARGE		DS7		DS8		DS9	
	BA WTD DIA	15 (10 - 17)	8	13 (10 - 15)	10	11 (11 - 12)	2
	CWD (TONS/AC)	24 (24 - 24)	1	0 (0 - 0)	1	10 (0 - 20)	2
	FORBS (CC%)	14 (5 - 33)	6	11 (2 - 21)	5	NA	0
	GRASS (CC%)	11 (2 - 21)	6	6 (1 - 15)	5	NA	0
	SHRUBS (CC%)	15 (4 - 29)	6	25 (7 - 69)	5	NA	0
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	18 (18 - 19)	2	19 (15 - 25)	6	21 (21 - 21)	1
	CWD (TONS/AC)	0 (0 - 0)	1	3 (0 - 7)	2	NA	0
	FORBS (CC%)	NA	0	15 (12 - 17)	2	10 (10 - 10)	1
	GRASS (CC%)	NA	0	7 (6 - 9)	2	6 (6 - 6)	1
	SHRUBS (CC%)	NA	0	34 (20 - 47)	2	15 (15 - 15)	1

Table E-27. Moderately Warm and Moderately Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	NA	0				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	NA	0				
	GRASS (CC%)	NA	0				
	SHRUBS (CC%)	NA	0				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	NA	0			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	NA	0			NA	0
	GRASS (CC%)	NA	0			NA	0
	SHRUBS (CC%)	NA	0			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	13 (13 - 13)	2	7 (7 - 7)	1	8 (8 - 9)	2
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	4 (4 - 4)	1	7 (7 - 7)	1	13 (5 - 21)	2
	GRASS (CC%)	1 (1 - 1)	1	3 (3 - 3)	1	3 (2 - 5)	2
	SHRUBS (CC%)	40 (40 - 40)	1	2 (2 - 2)	1	11 (8 - 14)	2
LARGE		DS7		DS8		DS9	
	BA WTD DIA	NA	0	12 (9 - 15)	4	NA	0
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	23 (18 - 27)	3	NA	0
	GRASS (CC%)	NA	0	1 (0 - 1)	3	NA	0
	SHRUBS (CC%)	NA	0	23 (13 - 42)	3	NA	0
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	NA	0	18 (14 - 22)	4	NA	0
	CWD (TONS/AC)	NA	0	0 (0 - 0)	1	NA	0
	FORBS (CC%)	NA	0	NA	0	NA	0
	GRASS (CC%)	NA	0	NA	0	NA	0
	SHRUBS (CC%)	NA	0	NA	0	NA	0

Table E-28. Moderately Warm and Moist ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	19 (19 - 19)	1				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	NA	0				
	GRASS (CC%)	NA	0				
	SHRUBS (CC%)	NA	0				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	4 (4 - 4)	1			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	NA	0			NA	0
	GRASS (CC%)	NA	0			NA	0
	SHRUBS (CC%)	NA	0			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	10 (9 - 13)	5	8 (8 - 8)	1	8 (7 - 9)	2
	CWD (TONS/AC)	NA	0	NA	0	0 (0 - 0)	1
	FORBS (CC%)	9 (6 - 12)	2	30 (30 - 30)	1	NA	0
	GRASS (CC%)	7 (5 - 9)	2	2 (2 - 2)	1	NA	0
	SHRUBS (CC%)	30 (27 - 32)	2	5 (5 - 5)	1	NA	0
LARGE		DS7		DS8		DS9	
	BA WTD DIA	16 (16 - 16)	1	NA	0	17 (17 - 17)	1
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	15 (15 - 15)	1	NA	0	42 (42 - 42)	1
	GRASS (CC%)	10 (10 - 10)	1	NA	0	2 (2 - 2)	1
	SHRUBS (CC%)	25 (25 - 25)	1	NA	0	4 (4 - 4)	1
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	NA	0	16 (13 - 22)	5	14 (13 - 15)	3
	CWD (TONS/AC)	NA	0	NA	0	0 (0 - 0)	1
	FORBS (CC%)	NA	0	6 (6 - 6)	1	NA	0
	GRASS (CC%)	NA	0	2 (2 - 2)	1	NA	0
	SHRUBS (CC%)	NA	0	6 (6 - 6)	1	NA	0

Table E-29. Moderately Cool and Moist ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	BA WTD DIA	11 (10 - 13)	2				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	23 (8 - 39)	2				
	GRASS (CC%)	3 (2 - 5)	2				
	SHRUBS (CC%)	13 (12 - 13)	2				
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	BA WTD DIA	4 (4 - 4)	1			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	23 (23 - 23)	1			NA	0
	GRASS (CC%)	1 (1 - 1)	1			NA	0
	SHRUBS (CC%)	20 (20 - 20)	1			NA	0
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	BA WTD DIA	9 (5 - 15)	5	8 (6 - 10)	6	7 (6 - 8)	3
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	13 (6 - 23)	4	8 (1 - 21)	5	4 (4 - 4)	1
	GRASS (CC%)	3 (1 - 4)	4	2 (1 - 4)	5	2 (2 - 2)	1
	SHRUBS (CC%)	36 (26 - 44)	4	24 (4 - 58)	5	25 (25 - 25)	1
LARGE		**DS7**		**DS8**		**DS9**	
	BA WTD DIA	14 (14 - 14)	1	11 (9 - 14)	11	8 (7 - 10)	3
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	9 (4 - 20)	7	3 (1 - 6)	2
	GRASS (CC%)	NA	0	2 (1 - 4)	7	1 (1 - 1)	2
	SHRUBS (CC%)	NA	0	13 (7 - 29)	7	12 (8 - 17)	2
VERY LARGE		**DS10**		**DS11**		**DS12**	
	BA WTD DIA	NA	0	15 (14 - 17)	3	15 (11 - 19)	8
	CWD (TONS/AC)	NA	0	48 (48 - 48)	1	NA	0
	FORBS (CC%)	NA	0	6 (2 - 11)	2	3 (0 - 10)	5
	GRASS (CC%)	NA	0	3 (0 - 6)	2	0 (0 - 1)	5
	SHRUBS (CC%)	NA	0	10 (8 - 13)	2	5 (0 - 11)	5

Table E-30. Cool and Moist ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	24 (7 - 40)	3				
	CWD (TONS/AC)	31 (31 - 31)	1				
	FORBS (CC%)	NA	0				
	GRASS (CC%)	NA	0				
	SHRUBS (CC%)	NA	0				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	5 (1 - 14)	11			3 (3 - 3)	1
	CWD (TONS/AC)	0 (0 - 0)	2			NA	0
	FORBS (CC%)	8 (5 - 12)	4			NA	0
	GRASS (CC%)	5 (1 - 8)	4			NA	0
	SHRUBS (CC%)	16 (1 - 51)	4			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	9 (4 - 22)	66	8 (3 - 11)	54	7 (3 - 11)	47
	CWD (TONS/AC)	19 (0 - 31)	7	8 (0 - 32)	10	10 (0 - 27)	14
	FORBS (CC%)	11 (1 - 27)	36	13 (2 - 48)	24	15 (1 - 50)	15
	GRASS (CC%)	4 (0 - 32)	36	3 (0 - 20)	24	1 (0 - 2)	15
	SHRUBS (CC%)	22 (2 - 95)	36	26 (3 - 69)	24	15 (5 - 32)	15
LARGE		DS7		DS8		DS9	
	BA WTD DIA	15 (10 - 25)	16	13 (8 - 22)	55	11 (8 - 15)	33
	CWD (TONS/AC)	0 (0 - 0)	4	8 (0 - 32)	10	10 (0 - 30)	7
	FORBS (CC%)	19 (6 - 60)	7	17 (0 - 59)	37	15 (4 - 55)	19
	GRASS (CC%)	2 (0 - 4)	7	2 (0 - 16)	37	2 (0 - 11)	19
	SHRUBS (CC%)	38 (10 - 80)	7	36 (6 - 86)	37	24 (4 - 76)	19
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	19 (13 - 23)	11	19 (13 - 27)	47	16 (9 - 27)	40
	CWD (TONS/AC)	9 (0 - 18)	2	20 (0 - 52)	11	7 (0 - 29)	6
	FORBS (CC%)	18 (3 - 51)	6	17 (1 - 57)	21	16 (5 - 35)	19
	GRASS (CC%)	6 (1 - 18)	6	2 (0 - 9)	21	2 (0 - 9)	19
	SHRUBS (CC%)	39 (13 - 79)	6	40 (6 - 86)	21	28 (4 - 71)	19

Table E-31. Cool and Moderately Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	8 (5 - 10)	3				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	15 (3 - 23)	3				
	GRASS (CC%)	10 (1 - 21)	3				
	SHRUBS (CC%)	7 (7 - 7)	3				
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	6 (2 - 11)	9			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	23 (6 - 42)	5			NA	0
	GRASS (CC%)	6 (2 - 11)	5			NA	0
	SHRUBS (CC%)	17 (9 - 31)	5			NA	0
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	8 (3 - 17)	43	8 (3 - 11)	35	7 (4 - 15)	25
	CWD (TONS/AC)	6 (0 - 13)	5	4 (0 - 20)	5	0 (0 - 0)	4
	FORBS (CC%)	15 (3 - 59)	28	18 (6 - 38)	18	18 (5 - 41)	15
	GRASS (CC%)	4 (1 - 23)	28	3 (1 - 7)	18	2 (0 - 13)	15
	SHRUBS (CC%)	17 (3 - 36)	28	18 (6 - 40)	18	27 (3 - 61)	15
LARGE		**DS7**		**DS8**		**DS9**	
	BA WTD DIA	13 (10 - 17)	8	13 (12 - 15)	8	11 (9 - 12)	9
	CWD (TONS/AC)	0 (0 - 0)	1	NA	0	8 (8 - 8)	1
	FORBS (CC%)	9 (2 - 26)	7	25 (10 - 48)	6	12 (4 - 19)	5
	GRASS (CC%)	11 (1 - 24)	7	3 (1 - 6)	6	10 (0 - 40)	5
	SHRUBS (CC%)	26 (5 - 68)	7	39 (18 - 66)	6	15 (7 - 38)	5
VERY LARGE		**DS10**		**DS11**		**DS12**	
	BA WTD DIA	18 (18 - 18)	1	18 (13 - 21)	7	14 (11 - 19)	3
	CWD (TONS/AC)	0 (0 - 0)	1	0 (0 - 0)	1	NA	0
	FORBS (CC%)	NA	0	12 (4 - 20)	2	12 (9 - 18)	3
	GRASS (CC%)	NA	0	6 (0 - 11)	2	1 (0 - 2)	3
	SHRUBS (CC%)	NA	0	34 (33 - 35)	2	23 (6 - 50)	3

Table E-32. Cold ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	NA	0				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	NA	0				
	GRASS (CC%)	NA	0				
	SHRUBS (CC%)	NA	0				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	11 (3 - 28)	3			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	4 (4 - 4)	1			NA	0
	GRASS (CC%)	6 (6 - 6)	1			NA	0
	SHRUBS (CC%)	5 (5 - 5)	1			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	9 (4 - 15)	18	9 (6 - 15)	11	8 (7 - 8)	3
	CWD (TONS/AC)	3 (0 - 6)	4	5 (0 - 15)	3	NA	0
	FORBS (CC%)	10 (3 - 25)	9	21 (16 - 27)	4	6 (3 - 9)	2
	GRASS (CC%)	6 (1 - 18)	9	5 (1 - 12)	4	1 (0 - 1)	2
	SHRUBS (CC%)	15 (1 - 76)	9	30 (1 - 59)	4	40 (17 - 63)	2
LARGE		DS7		DS8		DS9	
	BA WTD DIA	18 (14 - 24)	4	14 (12 - 17)	3	11 (9 - 13)	7
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	8 (4 - 11)	3	17 (17 - 17)	1	6 (2 - 14)	3
	GRASS (CC%)	2 (0 - 4)	3	2 (2 - 2)	1	4 (1 - 11)	3
	SHRUBS (CC%)	39 (3 - 76)	3	27 (27 - 27)	1	41 (20 - 62)	3
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	18 (18 - 18)	1	17 (17 - 19)	3	15 (11 - 20)	4
	CWD (TONS/AC)	NA	0	0 (0 - 0)	1	NA	0
	FORBS (CC%)	NA	0	29 (29 - 29)	1	12 (6 - 27)	4
	GRASS (CC%)	NA	0	6 (6 - 6)	1	9 (1 - 19)	4
	SHRUBS (CC%)	NA	0	12 (12 - 12)	1	10 (3 - 22)	4

Table E-33. Timberline ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING				DS1			
				AVG (MIN-MAX)	#PLOTS		
	BA WTD DIA			NA	0		
	CWD (TONS/AC)			NA	0		
	FORBS (CC%)			NA	0		
	GRASS (CC%)			NA	0		
	SHRUBS (CC%)			NA	0		
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	17 (17 - 17)	1			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	31 (31 - 31)	1			NA	0
	GRASS (CC%)	12 (12 - 12)	1			NA	0
	SHRUBS (CC%)	10 (10 - 10)	1			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	8 (4 - 12)	25	8 (6 - 9)	7	9 (6 - 11)	2
	CWD (TONS/AC)	8 (0 - 19)	4	NA	0	NA	0
	FORBS (CC%)	15 (4 - 36)	16	7 (2 - 15)	3	NA	0
	GRASS (CC%)	7 (1 - 27)	16	5 (1 - 9)	3	NA	0
	SHRUBS (CC%)	7 (2 - 18)	16	6 (3 - 8)	3	NA	0
LARGE		DS7		DS8		DS9	
	BA WTD DIA	12 (12 - 12)	1	11 (11 - 11)	2	NA	0
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	3 (3 - 3)	1	9 (9 - 9)	1	NA	0
	GRASS (CC%)	9 (9 - 9)	1	6 (6 - 6)	1	NA	0
	SHRUBS (CC%)	5 (5 - 5)	1	12 (12 - 12)	1	NA	0
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	18 (18 - 18)	1	15 (15 - 15)	1	13 (12 - 15)	2
	CWD (TONS/AC)	0 (0 - 0)	1	20 (20 - 20)	1	NA	0
	FORBS (CC%)	NA	0	NA	0	16 (16 - 16)	1
	GRASS (CC%)	NA	0	NA	0	1 (1 - 1)	1
	SHRUBS (CC%)	NA	0	NA	0	53 (53 - 53)	1

Northern Rockies and Bitterroot, West (M332B-West)

Species Composition

Grass-Forbs-Shrubs

Table E-34. Warm and Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Antelope bitterbrush	*Purshia tridentata*	PUTR2	Shrub				X			X			X		
big sagebrush	*Artemisia tridentata*	ARTRV	Shrub				X			X			X		
broom snakeweed	*Gutierrezia sarothrae*	GUSA2	Shrub				X			X			X		
chokecherry	*Prunus virginiana*	PRVI	Shrub	X	X			X			X			X	
common juniper	*Juniperus communis*	JUCO6	Shrub				X	X		X	X		X	X	
common snowberry	*Symphoricarpos albus*	SYAL	Shrub				X	X		X	X		X	X	
creeping juniper	*Juniperus horizontalis*	JUHO2	Shrub				X	X		X	X		X	X	
kinnikinnick	*Arctostaphylos uva-ursi*	ARUV	Shrub					X	X		X	X		X	X
Lewis's mock orange	*Philadelphus lewisii*	PHLE4	Shrub	X	X		X			X			X		
mallow ninebark	*Physocarpus malvaceus*	PHMA5	Shrub						X			X			X
mountain snowberry	*Symphoricarpos oreophilus*	SYOC	Shrub					X			X			X	
Oregon grape	*Berberis repens*	BERE	Shrub						X			X			X
prairie sagewort	*Artemisia frigida*	ARFR4	Shrub					X			X			X	
russet buffaloberry	*Shepherdia canadensis*	SHCA	Shrub				X	X		X	X		X	X	
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
shrubby cinquefoil	*Dasiphora fruticosa*	DAFR6	Shrub				X	X		X	X		X	X	
skunkbush sumac	*Rhus trilobata*	RHTR	Shrub	X	X			X			X			X	
wax currant	*Ribes cereum*	RICE	Shrub				X			X			X		X
white sagebrush	*Artemisia ludoviciana*	ARLU	Shrub				X			X			X		X
white spiraea	*Spiraea betulifolia*	SPBE2	Shrub	X	X	X			X			X			X
Wood's rose	*Rosa woodsii*	ROWO	Shrub					X			X			X	
bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSPS	Grass				X			X			X		
Idaho fescue	*Festuca idahoensis*	FEID	Grass				X	X		X	X		X	X	
needleandthread	*Hesperostipa comata*	HECO26	Grass				X	X		X	X		X	X	
pinegrass	*Calamagrostis rubescens*	CARU	Grass					X	X		X	X		X	X
prairie Junegrass	*Koeleria macrantha*	KOMA	Grass	X	X	X	X	X		X	X		X	X	

Table E-34, continued. Warm and Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
rough fescue	*Festuca campestris*	FECA4	Grass				X	X		X	X		X	X	
Wheeler bluegrass	*Poa nervosa*	PONE2	Grass				X	X		X	X		X	X	
Geyer's sedge	*Carex geyeri*	CAGE2	Sedge	X	X	X		X	X		X	X		X	X
Ross's sedge	*Carex rossi*	CARO5	Sedge	X	X			X			X			X	
Alberta beardtongue	*Penstemon albertinus*	PEAL11	Forb					X			X			X	
arrowleaf balsamroot	*Balsamorhiza sagittata*	BASA3	Forb	X	X		X	X		X	X		X	X	
ballhead sandwort	*Arenaria congesta*	ARCO5	Forb					X	X		X	X		X	X
buckwheat	*Eriogonum umbellatum*	ERUM	Forb				X			X			X		
common gaillardia	*Gaillardia aristata*	GAAR	Forb	X	X		X			X			X		
common yarrow	*Achillea millefolium*	ACMI2	Forb	X	X	X		X			X			X	
cutleaf anemone	*Pulsatilla patens*	PUPAM	Forb												
Douglas' knotweed	*Polygonum douglasii*	PODO4	Forb												
feathery false lily of the valley	*Maianthemum racemosum*	MARAA	Forb												
field chickweed	*Cerastium arvense*	CEAR4	Forb				X	X		X	X		X	X	
hairy false goldenaster	*Heterotheca villosa*	HEVI4	Forb				X			X			X		
harebell	*Campanula rotundifolia*	CARO2	Forb					X			X			X	
harsh Indian paintbrush	*Castilleja hispida*	CAHI9	Forb				X			X			X		
heartleaf arnica	*Arnica cordifolia*	ARCO9	Forb					X	X		X	X		X	X
Holboell's rockcress	*Arabis holboellii*	ARHO2	Forb					X			X			X	
houndstongue hawkweed	*Hieracium cynoglossoides*	HICY	Forb												
Howell's pussytoes	*Antennaria howellii*	ANHOH	Forb					X			X			X	
littleleaf pussytoes	*Antennaria microphylla*	ANMI3	Forb				X			X			X		
maiden blue eyed Mary	*Collinsia parviflora*	COPA3	Forb	X	X	X			X			X			X
Missouri goldenrod	*Solidago missouriensis*	SOMI2	Forb	X	X		X	X		X	X		X	X	
Mountain deathcamas	*Zigadenus elegans*	ZIEL2	Forb					X	X		X	X		X	X
narrowleaf mountain trumpet	*Collomia linearis*	COLI2	Forb					X			X			X	
nineleaf biscuitroot	*Lomatium triternatum*	LOTR2	Forb					X			X			X	

Table E-34, continued. Warm and Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
nodding onion	*Allium cernuum*	ALCE2	Forb				X			X			X		
northern bedstraw	*Galium boreale*	GABO2	Forb					X			X			X	
Pacific anemone	*Anemone multifida*	ANMU	Forb						X			X			X
pale agoseris	*Agoseris glauca*	AGGL	Forb				X			X			X		
prairie smoke	*Geum triflorum*	GETR	Forb						X			X			X
rosy pussytoes	*Antennaria rosea*	ANRO2	Forb				X			X			X		
rush pussytoes	*Antennaria luzuloides*	ANLU2	Forb				X			X			X		
silky lupine	*Lupinus sericeus*	LUSE9	Forb				X	X		X	X		X	X	
slender hawksbeard	*Crepis atribarba*	CRATO	Forb												
spreading dogbane	*Apocynum androsaemifolium*	APAN2	Forb	X	X	X			X			X			X
spreading fleabane	*Erigeron divergens*	ERDI4	Forb												
starry false lily of the valley	*Maianthemum stellatum*	MAST4	Forb												
sweetcicely	*Osmorhiza berteroi*	OSBE	Forb												
tall annual willowherb	*Epilobium brachycarpum*	EPBR3	Forb												
tapertip hawksbeard	*Crepis acuminata*	CRAC2	Forb					X			X			X	
threadleaf phacelia	*Phacelia linearis*	PHLI	Forb												
timber milkvetch	*Astragalus miser*	ASMI9	Forb												
tufted fleabane	*Erigeron caespitosus*	ERCA2	Forb												
Virginia strawberry	*Fragaria virginiana*	FRVI	Forb				X	X		X	X		X	X	
western showy aster	*Eurybia conspicua*	EUCO36	Forb												
western stoneseed	*Lithospermum ruderale*	LIRU4	Forb				X			X			X		
western sweetvetch	*Hedysarum occidentale*	HEOC	Forb												
Wilcox's penstemon	*Penstemon wilcoxii*	PEWI	Forb				X			X			X		
woolly groundsel	*Packera cana*	PACA15	Forb				X			X			X		
wormleaf stonecrop	*Sedum stenopetalum*	SEST2	Forb						X			X			X
brittle bladderfern	*Cystopteris fragilis*	CYFR2	Fern												

Moderate Warm and Dry ecological site – see Table E-2.
Cool and Moist ecological site – see Table E-6.
Cool and Moderately Dry ecological site – see Table E-7
Cold ecological site – see Table E-8
Timberline ecological site – see Table E-9

Structure

Live Trees

Table E-35. Warm and Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	562 (0 - 2249)	4				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	5 (0 - 6)					
	15.0-19.9"	3 (0 - 6)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	75 (75 - 75)	2			NA	0
	1.0-4.9"	187 (75 - 300)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	84 (0 - 960)	14	75 (75 - 75)	1	NA	0
	1.0-4.9"	125 (0 - 480)		75 (75 - 75)			
	5.0-14.9"	58 (18 - 120)		223 (223 - 223)			
	15.0-19.9"	3 (0 - 6)		0 (0 - 0)			
	20.0+"	1 (0 - 5)		0 (0 - 0)			
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	8	750 (0 - 1499)	2	NA	0
	1.0-4.9"	191 (0 - 800)		337 (0 - 675)			
	5.0-14.9"	47 (0 - 108)		105 (66 - 143)			
	15.0-19.9"	12 (6 - 24)		28 (24 - 32)			
	20.0+"	3 (0 - 7)		2 (0 - 5)			
VERY LARGE		DS10		DS11		DS12	
	<1.0"	250 (0 - 1574)	9	337 (300 - 375)	2	NA	0
	1.0-4.9"	55 (0 - 375)		37 (0 - 75)			
	5.0-14.9"	34 (0 - 66)		69 (60 - 78)			
	15.0-19.9"	11 (0 - 21)		15 (6 - 24)			
	20.0+"	13 (9 - 20)		15 (12 - 18)			

Table E-36. Moderately Warm and Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	229 (0 - 1199)	7				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	5 (0 - 12)					
	15.0-19.9"	1 (0 - 3)					
	20.0+"	1 (0 - 3)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	915 (75 - 1860)	4			NA	0
	1.0-4.9"	247 (75 - 540)					
	5.0-14.9"	3 (0 - 6)					
	15.0-19.9"	1 (0 - 5)					
	20.0+"	2 (0 - 6)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	433 (0 - 5772)	89	680 (0 - 5847)	25	220 (0 - 1260)	15
	1.0-4.9"	121 (0 - 900)		306 (0 - 1140)		838 (180 - 4100)	
	5.0-14.9"	80 (12 - 252)		198 (102 - 371)		399 (238 - 638)	
	15.0-19.9"	2 (0 - 9)		3 (0 - 9)		2 (0 - 8)	
	20.0+"	0 (0 - 6)		1 (0 - 4)		0 (0 - 5)	
LARGE		DS7		DS8		DS9	
	<1.0"	659 (0 - 5940)	46	845 (0 - 9820)	30	733 (0 - 4920)	14
	1.0-4.9"	51 (0 - 500)		143 (0 - 750)		206 (0 - 600)	
	5.0-14.9"	52 (0 - 120)		146 (60 - 271)		270 (60 - 527)	
	15.0-19.9"	14 (4 - 24)		22 (6 - 38)		24 (10 - 78)	
	20.0+"	3 (0 - 7)		2 (0 - 7)		2 (0 - 7)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	236 (0 - 2100)	22	417 (0 - 3420)	20	660 (0 - 2100)	6
	1.0-4.9"	64 (0 - 420)		86 (0 - 540)		309 (0 - 840)	
	5.0-14.9"	33 (0 - 84)		73 (12 - 189)		115 (37 - 205)	
	15.0-19.9"	11 (0 - 35)		18 (0 - 43)		39 (14 - 62)	
	20.0+"	13 (8 - 18)		16 (9 - 25)		17 (9 - 28)	

Table E-37. Cool and Moist ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	656 (0 - 2624)					
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	11 (6 - 12)	4				
	15.0-19.9"	0 (0 - 0)					
	20.0+"	2 (0 - 6)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	660 (660 - 660)					
	1.0-4.9"	240 (240 - 240)					
	5.0-14.9"	0 (0 - 0)	1			NA	0
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	1277 (0 - 6480)		3237 (0 - 16320)		3186 (0 - 12000)	
	1.0-4.9"	230 (0 - 700)		596 (0 - 1574)		585 (0 - 1140)	
	5.0-14.9"	102 (17 - 175)	18	213 (112 - 341)	15	364 (183 - 655)	20
	15.0-19.9"	2 (0 - 6)		2 (0 - 6)		2 (0 - 10)	
	20.0+"	1 (0 - 6)		1 (0 - 6)		1 (0 - 9)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	1781 (0 - 7422)		4535 (240 - 29280)		2315 (0 - 15518)	
	1.0-4.9"	72 (0 - 240)		283 (0 - 750)		401 (0 - 1199)	
	5.0-14.9"	62 (25 - 145)	9	164 (64 - 306)	18	277 (187 - 540)	24
	15.0-19.9"	18 (10 - 29)		18 (4 - 55)		21 (6 - 55)	
	20.0+"	4 (0 - 9)		3 (0 - 7)		2 (0 - 7)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	50 (0 - 75)		4098 (60 - 24840)		814 (0 - 2400)	
	1.0-4.9"	50 (0 - 150)		265 (120 - 720)		223 (75 - 525)	
	5.0-14.9"	28 (18 - 42)	3	95 (13 - 193)	9	122 (54 - 235)	10
	15.0-19.9"	10 (0 - 30)		17 (6 - 30)		27 (11 - 48)	
	20.0+"	14 (12 - 18)		16 (10 - 30)		18 (12 - 25)	

Table E-38. Cool and Moderately Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	262 (225 - 300)	2				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	12 (12 - 12)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	7610 (2640 - 18591)	4			NA	0
	1.0-4.9"	814 (525 - 1050)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	2 (0 - 6)					
	20.0+"	0 (0 - 0)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	1720 (0 - 16920)	30	2180 (0 - 10800)	25	1314 (0 - 9420)	34
	1.0-4.9"	171 (0 - 800)		455 (0 - 1920)		651 (0 - 2400)	
	5.0-14.9"	80 (12 - 205)		191 (43 - 313)		360 (188 - 554)	
	15.0-19.9"	1 (0 - 6)		2 (0 - 6)		1 (0 - 6)	
	20.0+"	1 (0 - 10)		0 (0 - 6)		1 (0 - 8)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	667 (0 - 3060)	11	1471 (0 - 7047)	9	3531 (225 - 13680)	7
	1.0-4.9"	189 (0 - 450)		239 (0 - 675)		585 (75 - 1260)	
	5.0-14.9"	46 (12 - 102)		162 (68 - 210)		229 (89 - 337)	
	15.0-19.9"	14 (6 - 24)		17 (9 - 33)		22 (12 - 48)	
	20.0+"	2 (0 - 6)		4 (0 - 9)		2 (0 - 6)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	510 (420 - 600)	2	966 (225 - 1274)	7	1334 (0 - 5398)	6
	1.0-4.9"	30 (0 - 60)		126 (0 - 300)		551 (0 - 975)	
	5.0-14.9"	49 (12 - 86)		102 (42 - 162)		217 (96 - 413)	
	15.0-19.9"	10 (5 - 15)		12 (0 - 36)		22 (6 - 36)	
	20.0+"	15 (14 - 17)		16 (12 - 21)		15 (10 - 24)	

Table E-39. Cold ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	375 (375 - 375)	1				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	12 (12 - 12)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	1980 (1980 - 1980)	1			NA	0
	1.0-4.9"	240 (240 - 240)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	4 (4 - 4)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	1538 (225 - 2999)	9	1866 (480 - 4860)	9	2767 (2100 - 3373)	4
	1.0-4.9"	197 (60 - 525)		398 (75 - 750)		930 (300 - 1500)	
	5.0-14.9"	106 (30 - 153)		213 (128 - 301)		402 (175 - 613)	
	15.0-19.9"	2 (0 - 6)		2 (0 - 7)		0 (0 - 0)	
	20.0+"	0 (0 - 0)		0 (0 - 0)		2 (0 - 6)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	1580 (540 - 2460)	3	8013 (375 - 21215)	5	2940 (2400 - 3480)	2
	1.0-4.9"	300 (180 - 540)		666 (0 - 1499)		270 (60 - 480)	
	5.0-14.9"	86 (59 - 123)		118 (78 - 199)		327 (304 - 349)	
	15.0-19.9"	14 (11 - 15)		16 (12 - 21)		11 (5 - 17)	
	20.0+"	3 (0 - 5)		2 (0 - 6)		6 (5 - 6)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	630 (300 - 960)	2	7695 (525 - 15540)	3	600 (600 - 600)	1
	1.0-4.9"	180 (0 - 360)		520 (300 - 720)		60 (60 - 60)	
	5.0-14.9"	36 (0 - 72)		53 (0 - 108)		114 (114 - 114)	
	15.0-19.9"	0 (0 - 0)		11 (0 - 18)		15 (15 - 15)	
	20.0+"	12 (12 - 12)		23 (17 - 30)		44 (44 - 44)	

Table E-40. Timberline ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

<table>
<tr><th>SIZE-CLASS</th><th>DBH RANGE</th><th colspan="2">OPEN
(<40% Canopy Cover)</th><th colspan="2">MODERATE
(40-60% Canopy Cover)</th><th colspan="2">CLOSED
(>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="3">AVG (MIN-MAX)</td><td colspan="3">#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="3" rowspan="5">NA</td><td colspan="3" rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td></tr>
<tr><td>5.0-14.9"</td></tr>
<tr><td>15.0-19.9"</td></tr>
<tr><td>20.0+"</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="2">AVG (MIN-MAX)</td><td colspan="2">#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="2">1949 (1424 - 2474)</td><td colspan="2" rowspan="5">2</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td colspan="2">337 (225 - 450)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="2">6 (0 - 12)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="2">0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td colspan="2">0 (0 - 0)</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td>893 (0 - 2820)</td><td rowspan="5">13</td><td>607 (375 - 840)</td><td rowspan="5">2</td><td>1080 (1080 - 1080)</td><td rowspan="5">1</td></tr>
<tr><td>1.0-4.9"</td><td>135 (0 - 600)</td><td>37 (0 - 75)</td><td>1080 (1080 - 1080)</td></tr>
<tr><td>5.0-14.9"</td><td>52 (12 - 143)</td><td>297 (287 - 307)</td><td>305 (305 - 305)</td></tr>
<tr><td>15.0-19.9"</td><td>1 (0 - 6)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td>1 (0 - 9)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td><1.0"</td><td>1775 (525 - 2880)</td><td rowspan="5">3</td><td rowspan="5">NA</td><td rowspan="5">0</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td>20 (0 - 60)</td></tr>
<tr><td>5.0-14.9"</td><td>24 (7 - 45)</td></tr>
<tr><td>15.0-19.9"</td><td>15 (5 - 30)</td></tr>
<tr><td>20.0+"</td><td>7 (6 - 9)</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td><1.0"</td><td rowspan="5">NA</td><td rowspan="5">0</td><td rowspan="5">NA</td><td rowspan="5">0</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td></tr>
<tr><td>5.0-14.9"</td></tr>
<tr><td>15.0-19.9"</td></tr>
<tr><td>20.0+"</td></tr>
</table>

Dead Trees

Table E-41. Warm and Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	**DBH RANGE**	**OPEN (<40% Canopy Cover)**		**MODERATE (40-60% Canopy Cover)**		**CLOSED (>60% Canopy Cover)**	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	0 (0 - 0)	4				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	12 (0 - 48)					
	15.0-19.9"	6 (0 - 24)					
	20.0+"	2 (0 - 6)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	2			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	14	0 (0 - 0)	1	NA	0
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)			
	5.0-14.9"	3 (0 - 30)		12 (12 - 12)			
	15.0-19.9"	2 (0 - 12)		0 (0 - 0)			
	20.0+"	0 (0 - 1)		0 (0 - 0)			
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)	8	0 (0 - 0)	2	NA	0
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)			
	5.0-14.9"	2 (0 - 6)		12 (0 - 24)			
	15.0-19.9"	0 (0 - 3)		0 (0 - 0)			
	20.0+"	0 (0 - 2)		0 (0 - 0)			
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	0 (0 - 0)	9	0 (0 - 0)	2	NA	0
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)			
	5.0-14.9"	2 (0 - 8)		0 (0 - 0)			
	15.0-19.9"	0 (0 - 0)		0 (0 - 0)			
	20.0+"	0 (0 - 1)		0 (0 - 0)			

Table E-42. Moderately Warm and Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	0 (0 - 0)	7				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	5 (0 - 30)					
	15.0-19.9"	1 (0 - 6)					
	20.0+"	2 (0 - 15)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	4			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	8 (0 - 30)					
	15.0-19.9"	2 (0 - 6)					
	20.0+"	0 (0 - 0)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	89	0 (0 - 0)	25	0 (0 - 0)	15
	1.0-4.9"	0 (0 - 0)		32 (0 - 300)		33 (0 - 500)	
	5.0-14.9"	15 (0 - 199)		8 (0 - 64)		27 (0 - 107)	
	15.0-19.9"	1 (0 - 30)		1 (0 - 17)		0 (0 - 0)	
	20.0+"	1 (0 - 12)		0 (0 - 6)		0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	46	0 (0 - 0)	30	0 (0 - 0)	14
	1.0-4.9"	2 (0 - 100)		7 (0 - 100)		43 (0 - 600)	
	5.0-14.9"	11 (0 - 132)		21 (0 - 95)		16 (0 - 54)	
	15.0-19.9"	2 (0 - 24)		1 (0 - 14)		1 (0 - 6)	
	20.0+"	1 (0 - 18)		0 (0 - 6)		0 (0 - 1)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	22	0 (0 - 0)	20	0 (0 - 0)	6
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	8 (0 - 42)		8 (0 - 42)		7 (0 - 29)	
	15.0-19.9"	1 (0 - 18)		1 (0 - 12)		4 (0 - 11)	
	20.0+"	1 (0 - 7)		1 (0 - 6)		2 (0 - 7)	

Table E-43. Cool and Moist ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	0 (0 - 0)	4				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	24 (0 - 96)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 1)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	1			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	18	0 (0 - 0)	15	0 (0 - 0)	20
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		10 (0 - 200)	
	5.0-14.9"	41 (0 - 289)		52 (0 - 157)		27 (0 - 93)	
	15.0-19.9"	3 (0 - 24)		0 (0 - 0)		0 (0 - 6)	
	20.0+"	1 (0 - 12)		1 (0 - 6)		0 (0 - 2)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	9	0 (0 - 0)	18	0 (0 - 0)	24
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	28 (0 - 120)		44 (0 - 175)		52 (0 - 209)	
	15.0-19.9"	4 (0 - 23)		1 (0 - 11)		1 (0 - 10)	
	20.0+"	2 (0 - 7)		1 (0 - 24)		0 (0 - 4)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	3	0 (0 - 0)	9	0 (0 - 0)	10
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	24 (12 - 48)		33 (0 - 87)		30 (0 - 85)	
	15.0-19.9"	0 (0 - 0)		7 (0 - 15)		2 (0 - 12)	
	20.0+"	0 (0 - 0)		2 (0 - 4)		1 (0 - 3)	

Table E-44. Cool and Moderately Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	**DBH RANGE**	**OPEN** (<40% Canopy Cover)		**MODERATE** (40-60% Canopy Cover)		**CLOSED** (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	0 (0 - 0)	2				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	99 (12 - 187)					
	15.0-19.9"	6 (0 - 12)					
	20.0+"	9 (0 - 18)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	4			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	36 (0 - 96)					
	15.0-19.9"	2 (0 - 6)					
	20.0+"	0 (0 - 0)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	30	0 (0 - 0)	25	0 (0 - 0)	34
	1.0-4.9"	3 (0 - 100)		8 (0 - 200)		15 (0 - 200)	
	5.0-14.9"	40 (0 - 217)		52 (0 - 283)		54 (0 - 289)	
	15.0-19.9"	3 (0 - 26)		3 (0 - 30)		0 (0 - 6)	
	20.0+"	1 (0 - 9)		0 (0 - 6)		0 (0 - 6)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)	11	0 (0 - 0)	9	0 (0 - 0)	7
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	29 (0 - 102)		45 (0 - 84)		47 (6 - 91)	
	15.0-19.9"	4 (0 - 24)		5 (0 - 18)		4 (0 - 23)	
	20.0+"	2 (0 - 12)		1 (0 - 6)		1 (0 - 4)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	0 (0 - 0)	2	0 (0 - 0)	7	0 (0 - 0)	6
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	16 (16 - 16)		28 (0 - 96)		36 (0 - 78)	
	15.0-19.9"	5 (5 - 6)		4 (0 - 18)		3 (0 - 12)	
	20.0+"	2 (0 - 4)		0 (0 - 2)		2 (0 - 6)	

Table E-45. Cold ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	0 (0 - 0)	1				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	36 (36 - 36)					
	15.0-19.9"	6 (6 - 6)					
	20.0+"	6 (6 - 6)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	1			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	1 (1 - 1)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	9	0 (0 - 0)	9	0 (0 - 0)	4
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	50 (0 - 176)		42 (0 - 90)		133 (52 - 198)	
	15.0-19.9"	0 (0 - 4)		2 (0 - 5)		6 (0 - 18)	
	20.0+"	2 (0 - 12)		0 (0 - 4)		0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	3	0 (0 - 0)	5	0 (0 - 0)	2
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	98 (0 - 284)		84 (0 - 162)		65 (51 - 80)	
	15.0-19.9"	0 (0 - 0)		19 (6 - 37)		0 (0 - 0)	
	20.0+"	0 (0 - 1)		4 (0 - 18)		0 (0 - 0)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	2	0 (0 - 0)	3	0 (0 - 0)	1
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	71 (36 - 105)		53 (0 - 129)		14 (14 - 14)	
	15.0-19.9"	12 (0 - 23)		12 (5 - 25)		10 (10 - 10)	
	20.0+"	6 (0 - 12)		5 (3 - 6)		0 (0 - 0)	

Table E-46. Timberline ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
				AVG (MIN-MAX)	**#PLOTS**		
	<1.0"						
	1.0-4.9"						
	5.0-14.9"			NA	0		
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)					
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	3 (0 - 6)	2			NA	0
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	13 (0 - 84)	13	22 (18 - 26)	2	0 (0 - 0)	1
	15.0-19.9"	2 (0 - 18)		0 (0 - 0)		0 (0 - 0)	
	20.0+"	2 (0 - 14)		0 (0 - 0)		0 (0 - 0)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)					
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	19 (0 - 50)	3	NA	0	NA	0
	15.0-19.9"	3 (0 - 9)					
	20.0+"	6 (0 - 11)					
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"						
	1.0-4.9"						
	5.0-14.9"	NA	0	NA	0	NA	0
	15.0-19.9"						
	20.0+"						

General Ecosystem Characteristics

Table E-47. Warm and Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

<table>
<tr><th>SIZE-CLASS</th><th>ECOSYSTEM CHARACTERISTIC</th><th colspan="2">OPEN
(<40% Canopy Cover)</th><th colspan="2">MODERATE
(40-60% Canopy Cover)</th><th colspan="2">CLOSED
(>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="3">AVG (MIN-MAX)</td><td colspan="3">#PLOTS</td></tr>
<tr><td>BA WTD DIA</td><td colspan="3">13 (5 - 18)</td><td colspan="3">4</td></tr>
<tr><td>CWD (TONS/AC)</td><td colspan="3">NA</td><td colspan="3">0</td></tr>
<tr><td>FORBS (CC%)</td><td colspan="3">18 (9 - 26)</td><td colspan="3">4</td></tr>
<tr><td>GRASS (CC%)</td><td colspan="3">31 (21 - 58)</td><td colspan="3">4</td></tr>
<tr><td>SHRUBS (CC%)</td><td colspan="3">5 (1 - 13)</td><td colspan="3">4</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="2">AVG (MIN-MAX)</td><td colspan="2">#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td>BA WTD DIA</td><td colspan="2">2 (2 - 3)</td><td colspan="2">2</td><td>NA</td><td>0</td></tr>
<tr><td>CWD (TONS/AC)</td><td colspan="2">NA</td><td colspan="2">0</td><td>NA</td><td>0</td></tr>
<tr><td>FORBS (CC%)</td><td colspan="2">4 (3 - 5)</td><td colspan="2">2</td><td>NA</td><td>0</td></tr>
<tr><td>GRASS (CC%)</td><td colspan="2">35 (16 - 55)</td><td colspan="2">2</td><td>NA</td><td>0</td></tr>
<tr><td>SHRUBS (CC%)</td><td colspan="2">13 (8 - 19)</td><td colspan="2">2</td><td>NA</td><td>0</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td>BA WTD DIA</td><td>11 (6 - 15)</td><td>14</td><td>8 (8 - 8)</td><td>1</td><td>NA</td><td>0</td></tr>
<tr><td>CWD (TONS/AC)</td><td>NA</td><td>0</td><td>NA</td><td>0</td><td>NA</td><td>0</td></tr>
<tr><td>FORBS (CC%)</td><td>7 (1 - 23)</td><td>6</td><td>1 (1 - 1)</td><td>1</td><td>NA</td><td>0</td></tr>
<tr><td>GRASS (CC%)</td><td>14 (5 - 32)</td><td>6</td><td>4 (4 - 4)</td><td>1</td><td>NA</td><td>0</td></tr>
<tr><td>SHRUBS (CC%)</td><td>17 (0 - 60)</td><td>6</td><td>7 (7 - 7)</td><td>1</td><td>NA</td><td>0</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td>BA WTD DIA</td><td>14 (10 - 19)</td><td>8</td><td>12 (10 - 14)</td><td>2</td><td>NA</td><td>0</td></tr>
<tr><td>CWD (TONS/AC)</td><td>NA</td><td>0</td><td>NA</td><td>0</td><td>NA</td><td>0</td></tr>
<tr><td>FORBS (CC%)</td><td>5 (3 - 10)</td><td>3</td><td>18 (18 - 18)</td><td>1</td><td>NA</td><td>0</td></tr>
<tr><td>GRASS (CC%)</td><td>28 (21 - 41)</td><td>3</td><td>30 (30 - 30)</td><td>1</td><td>NA</td><td>0</td></tr>
<tr><td>SHRUBS (CC%)</td><td>15 (2 - 24)</td><td>3</td><td>40 (40 - 40)</td><td>1</td><td>NA</td><td>0</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td>BA WTD DIA</td><td>20 (17 - 29)</td><td>9</td><td>24 (18 - 29)</td><td>2</td><td>NA</td><td>0</td></tr>
<tr><td>CWD (TONS/AC)</td><td>0 (0 - 0)</td><td>1</td><td>NA</td><td>0</td><td>NA</td><td>0</td></tr>
<tr><td>FORBS (CC%)</td><td>4 (1 - 8)</td><td>4</td><td>6 (4 - 7)</td><td>2</td><td>NA</td><td>0</td></tr>
<tr><td>GRASS (CC%)</td><td>13 (6 - 22)</td><td>4</td><td>21 (21 - 21)</td><td>2</td><td>NA</td><td>0</td></tr>
<tr><td>SHRUBS (CC%)</td><td>4 (2 - 9)</td><td>4</td><td>4 (0 - 8)</td><td>2</td><td>NA</td><td>0</td></tr>
</table>

Table E-48. Moderately Warm and Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	18 (11 - 38)	7				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	6 (3 - 12)	3				
	GRASS (CC%)	11 (1 - 19)	3				
	SHRUBS (CC%)	23 (2 - 63)	3				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	9 (1 - 22)	4			NA	0
	CWD (TONS/AC)	4 (4 - 4)	1			NA	0
	FORBS (CC%)	10 (3 - 16)	3			NA	0
	GRASS (CC%)	17 (3 - 32)	3			NA	0
	SHRUBS (CC%)	24 (4 - 35)	3			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	10 (4 - 20)	89	9 (5 - 13)	25	7 (4 - 9)	15
	CWD (TONS/AC)	19 (19 - 19)	1	30 (30 - 30)	1	15 (15 - 15)	1
	FORBS (CC%)	7 (1 - 36)	54	6 (1 - 18)	6	7 (5 - 11)	5
	GRASS (CC%)	12 (1 - 36)	54	25 (1 - 72)	6	6 (1 - 17)	5
	SHRUBS (CC%)	14 (0 - 62)	54	14 (1 - 35)	6	18 (4 - 50)	5
LARGE		DS7		DS8		DS9	
	BA WTD DIA	15 (11 - 20)	46	13 (10 - 16)	30	12 (9 - 15)	14
	CWD (TONS/AC)	7 (0 - 37)	5	0 (0 - 0)	1	0 (0 - 0)	1
	FORBS (CC%)	7 (1 - 51)	23	6 (1 - 20)	12	5 (1 - 8)	4
	GRASS (CC%)	18 (1 - 45)	23	16 (1 - 33)	12	15 (1 - 28)	4
	SHRUBS (CC%)	15 (1 - 38)	23	16 (2 - 30)	12	17 (3 - 40)	4
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	19 (15 - 27)	22	18 (13 - 32)	20	16 (12 - 19)	6
	CWD (TONS/AC)	0 (0 - 0)	2	NA	0	24 (24 - 24)	1
	FORBS (CC%)	8 (1 - 21)	12	5 (2 - 10)	8	9 (6 - 11)	2
	GRASS (CC%)	23 (4 - 80)	12	17 (7 - 26)	8	14 (6 - 22)	2
	SHRUBS (CC%)	12 (1 - 31)	12	20 (2 - 44)	8	7 (4 - 10)	2

Table E-49. Cool and Moist ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

<table>
<tr><th>SIZE-CLASS</th><th>ECOSYSTEM CHARACTERISTIC</th><th colspan="2">OPEN
(<40% Canopy Cover)</th><th colspan="2">MODERATE
(40-60% Canopy Cover)</th><th colspan="2">CLOSED
(>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="3">AVG (MIN-MAX)</td><td colspan="3">#PLOTS</td></tr>
<tr><td>BA WTD DIA</td><td colspan="3">12 (5 - 21)</td><td colspan="3">4</td></tr>
<tr><td>CWD (TONS/AC)</td><td colspan="3">NA</td><td colspan="3">0</td></tr>
<tr><td>FORBS (CC%)</td><td colspan="3">11 (11 - 11)</td><td colspan="3">2</td></tr>
<tr><td>GRASS (CC%)</td><td colspan="3">14 (12 - 16)</td><td colspan="3">2</td></tr>
<tr><td>SHRUBS (CC%)</td><td colspan="3">5 (2 - 8)</td><td colspan="3">2</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="2">AVG (MIN-MAX)</td><td colspan="2">#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td>BA WTD DIA</td><td colspan="2">2 (2 - 2)</td><td colspan="2">1</td><td>NA</td><td>0</td></tr>
<tr><td>CWD (TONS/AC)</td><td colspan="2">9 (9 - 9)</td><td colspan="2">1</td><td>NA</td><td>0</td></tr>
<tr><td>FORBS (CC%)</td><td colspan="2">NA</td><td colspan="2">0</td><td>NA</td><td>0</td></tr>
<tr><td>GRASS (CC%)</td><td colspan="2">NA</td><td colspan="2">0</td><td>NA</td><td>0</td></tr>
<tr><td>SHRUBS (CC%)</td><td colspan="2">NA</td><td colspan="2">0</td><td>NA</td><td>0</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td>BA WTD DIA</td><td>9 (5 - 15)</td><td>18</td><td>8 (6 - 12)</td><td>15</td><td>8 (6 - 11)</td><td>19</td></tr>
<tr><td>CWD (TONS/AC)</td><td>NA</td><td>0</td><td>14 (14 - 14)</td><td>1</td><td>0 (0 - 0)</td><td>4</td></tr>
<tr><td>FORBS (CC%)</td><td>17 (4 - 48)</td><td>11</td><td>15 (5 - 35)</td><td>7</td><td>10 (2 - 23)</td><td>6</td></tr>
<tr><td>GRASS (CC%)</td><td>7 (0 - 19)</td><td>11</td><td>4 (0 - 10)</td><td>7</td><td>9 (0 - 39)</td><td>6</td></tr>
<tr><td>SHRUBS (CC%)</td><td>22 (4 - 54)</td><td>11</td><td>32 (14 - 60)</td><td>7</td><td>10 (2 - 26)</td><td>6</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td>BA WTD DIA</td><td>16 (10 - 23)</td><td>8</td><td>12 (8 - 17)</td><td>18</td><td>11 (8 - 14)</td><td>24</td></tr>
<tr><td>CWD (TONS/AC)</td><td>NA</td><td>0</td><td>33 (33 - 33)</td><td>1</td><td>0 (0 - 0)</td><td>3</td></tr>
<tr><td>FORBS (CC%)</td><td>6 (3 - 8)</td><td>3</td><td>10 (2 - 24)</td><td>8</td><td>11 (2 - 29)</td><td>12</td></tr>
<tr><td>GRASS (CC%)</td><td>4 (1 - 8)</td><td>3</td><td>1 (0 - 6)</td><td>8</td><td>1 (0 - 5)</td><td>12</td></tr>
<tr><td>SHRUBS (CC%)</td><td>30 (21 - 46)</td><td>3</td><td>22 (5 - 63)</td><td>8</td><td>26 (1 - 62)</td><td>12</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td>BA WTD DIA</td><td>21 (17 - 26)</td><td>4</td><td>18 (12 - 23)</td><td>9</td><td>17 (13 - 19)</td><td>11</td></tr>
<tr><td>CWD (TONS/AC)</td><td>NA</td><td>0</td><td>22 (22 - 22)</td><td>1</td><td>25 (25 - 25)</td><td>1</td></tr>
<tr><td>FORBS (CC%)</td><td>5 (1 - 10)</td><td>3</td><td>11 (6 - 20)</td><td>3</td><td>6 (1 - 13)</td><td>5</td></tr>
<tr><td>GRASS (CC%)</td><td>9 (2 - 20)</td><td>3</td><td>3 (1 - 6)</td><td>3</td><td>1 (0 - 2)</td><td>5</td></tr>
<tr><td>SHRUBS (CC%)</td><td>19 (6 - 33)</td><td>3</td><td>25 (11 - 45)</td><td>3</td><td>35 (21 - 74)</td><td>5</td></tr>
</table>

Table E-50. Cool and Moderately Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	12 (11 - 13)	2				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	25 (23 - 28)	2				
	GRASS (CC%)	20 (16 - 25)	2				
	SHRUBS (CC%)	12 (5 - 20)	2				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	4 (1 - 10)	4			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	18 (7 - 30)	2			NA	0
	GRASS (CC%)	12 (10 - 13)	2			NA	0
	SHRUBS (CC%)	12 (9 - 14)	2			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	9 (5 - 13)	29	9 (4 - 13)	25	8 (4 - 11)	34
	CWD (TONS/AC)	14 (0 - 39)	3	22 (0 - 45)	2	3 (0 - 8)	4
	FORBS (CC%)	14 (2 - 39)	19	16 (4 - 71)	18	11 (1 - 33)	17
	GRASS (CC%)	4 (1 - 23)	19	2 (0 - 7)	18	2 (0 - 12)	17
	SHRUBS (CC%)	13 (1 - 53)	19	20 (1 - 62)	18	24 (5 - 75)	17
LARGE		DS7		DS8		DS9	
	BA WTD DIA	13 (10 - 21)	11	13 (10 - 16)	8	11 (9 - 14)	7
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	18 (3 - 55)	8	11 (3 - 20)	5	8 (5 - 12)	3
	GRASS (CC%)	4 (0 - 9)	8	5 (0 - 12)	5	6 (4 - 8)	3
	SHRUBS (CC%)	18 (3 - 43)	8	20 (10 - 25)	5	6 (3 - 10)	3
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	20 (17 - 24)	3	18 (13 - 26)	8	14 (11 - 17)	6
	CWD (TONS/AC)	8 (8 - 8)	1	NA	0	NA	0
	FORBS (CC%)	NA	0	11 (4 - 18)	5	22 (12 - 33)	4
	GRASS (CC%)	NA	0	8 (2 - 17)	5	3 (1 - 7)	4
	SHRUBS (CC%)	NA	0	18 (3 - 43)	5	19 (11 - 27)	4

Table E-51. Cold ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	BA WTD DIA	7 (7 - 7)	1				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	13 (13 - 13)	1				
	GRASS (CC%)	26 (26 - 26)	1				
	SHRUBS (CC%)	4 (4 - 4)	1				
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	BA WTD DIA	10 (10 - 10)	1			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	NA	0			NA	0
	GRASS (CC%)	NA	0			NA	0
	SHRUBS (CC%)	NA	0			NA	0
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	BA WTD DIA	9 (8 - 12)	9	8 (7 - 10)	9	7 (6 - 9)	4
	CWD (TONS/AC)	0 (0 - 0)	1	9 (9 - 9)	1	0 (0 - 0)	1
	FORBS (CC%)	18 (4 - 41)	4	11 (1 - 27)	3	4 (2 - 6)	2
	GRASS (CC%)	6 (2 - 13)	4	1 (1 - 1)	3	2 (1 - 4)	2
	SHRUBS (CC%)	16 (2 - 24)	4	34 (7 - 67)	3	41 (26 - 56)	2
LARGE		**DS7**		**DS8**		**DS9**	
	BA WTD DIA	14 (11 - 15)	3	11 (9 - 12)	5	11 (11 - 11)	2
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	7 (1 - 22)	4	NA	0
	GRASS (CC%)	NA	0	12 (2 - 35)	4	NA	0
	SHRUBS (CC%)	NA	0	38 (5 - 63)	4	NA	0
VERY LARGE		**DS10**		**DS11**		**DS12**	
	BA WTD DIA	22 (17 - 27)	2	17 (16 - 19)	3	21 (21 - 21)	1
	CWD (TONS/AC)	0 (0 - 0)	1	NA	0	NA	0
	FORBS (CC%)	20 (20 - 20)	1	10 (10 - 10)	1	NA	0
	GRASS (CC%)	1 (1 - 1)	1	3 (3 - 3)	1	NA	0
	SHRUBS (CC%)	73 (73 - 73)	1	59 (59 - 59)	1	NA	0

Table E-52. Timberline ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING				DS1			
				AVG (MIN-MAX)	#PLOTS		
	BA WTD DIA			NA	0		
	CWD (TONS/AC)			NA	0		
	FORBS (CC%)			NA	0		
	GRASS (CC%)			NA	0		
	SHRUBS (CC%)			NA	0		
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	3 (3 - 4)	2			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	3 (1 - 6)	2			NA	0
	GRASS (CC%)	3 (1 - 5)	2			NA	0
	SHRUBS (CC%)	6 (2 - 11)	2			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	9 (6 - 15)	12	8 (8 - 8)	2	7 (7 - 7)	1
	CWD (TONS/AC)	14 (14 - 14)	1	NA	0	NA	0
	FORBS (CC%)	4 (1 - 11)	6	11 (11 - 11)	1	NA	0
	GRASS (CC%)	2 (1 - 7)	6	1 (1 - 1)	1	NA	0
	SHRUBS (CC%)	15 (1 - 42)	6	25 (25 - 25)	1	NA	0
LARGE		DS7		DS8		DS9	
	BA WTD DIA	19 (15 - 23)	2	NA	0	NA	0
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	5 (5 - 5)	1	NA	0	NA	0
	GRASS (CC%)	10 (10 - 10)	1	NA	0	NA	0
	SHRUBS (CC%)	17 (17 - 17)	1	NA	0	NA	0
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	22 (19 - 26)	2	NA	0	NA	0
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	NA	0	NA	0
	GRASS (CC%)	NA	0	NA	0	NA	0
	SHRUBS (CC%)	NA	0	NA	0	NA	0

Northern Rockies and Bitterroot, East (M332B-East)

Species Composition

Grass-Forbs-Shrubs

Table E-53. Hot and Dry ecological site - Historically occurring herbaceous and shrub species distribution by disturbance state.

Common name	Scientific name	PLANTS Code[a]	Lifeform	DS1	DS2	DS3	DS4	DS5	DS6	DS7	DS8	DS9	DS10	DS11	DS12
Antelope bitterbrush	*Purshia tridentata*	PUTR2	Shrub				X			X			X		
big sagebrush	*Artemisia tridentata*	ARTRV	Shrub				X			X			X		
common juniper	*Juniperus communis*	JUCO6	Shrub				X	X		X	X		X	X	
common snowberry	*Symphoricarpos albus*	SYAL	Shrub				X	X		X	X		X	X	
creeping juniper	*Juniperus horizontalis*	JUHO2	Shrub				X	X		X	X		X	X	
Saskatoon serviceberry	*Amelanchier alnifolia*	AMAL2	Shrub	X	X	X		X			X			X	
shrubby cinquefoil	*Dasiphora fruticosa*	DAFR6	Shrub				X	X		X	X		X	X	
thimbleberry	*Rubus parviflorus*	RUPA	Shrub	X	X	X		X	X		X	X		X	X
white spiraea	*Spiraea betulifolia*	SPBE2	Shrub	X	X	X			X			X			X
bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSPS	Grass				X			X			X		
Idaho fescue	*Festuca idahoensis*	FEID	Grass				X	X		X	X		X	X	
rough fescue	*Festuca campestris*	FECA9	Grass				X	X		X	X		X	X	
arrowleaf balsamroot	*Balsamorhiza sagittata*	BASA3	Forb	X	X		X	X		X	X		X	X	
northern bedstraw	*Galium boreale*	GABO2	Forb					X			X			X	

Warm and Dry ecological site – see Table E-34
Moderately Warm and Dry ecological site – see Table E-2
Cool and Moist ecological site – see Table E-6
Cool and Moderately Dry ecological site – see Table E-7
Cold ecological site – see Table E-8
Timberline ecological site – see Table E-9

Structure

Live Trees

Table E-54. Hot and Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	NA	0				
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	NA	0			NA	0
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	1799 (0 - 5397)	3	NA	0	1949 (600 - 3298)	2
	1.0-4.9"	200 (0 - 300)				450 (0 - 900)	
	5.0-14.9"	56 (48 - 72)				481 (385 - 578)	
	15.0-19.9"	0 (0 - 0)				0 (0 - 0)	
	20.0+"	0 (0 - 0)				0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"	NA	0	NA	0	NA	0
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
VERY LARGE		DS10		DS11		DS12	
	<1.0"	NA	0	NA	0	NA	0
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						

Table E-55. Warm and Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

<table>
<tr><th>SIZE-CLASS</th><th>DBH RANGE</th><th colspan="2">OPEN
(<40% Canopy Cover)</th><th colspan="2">MODERATE
(40-60% Canopy Cover)</th><th colspan="2">CLOSED
(>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="4">AVG (MIN-MAX)</td><td colspan="2">#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="4">60 (60 - 60)</td><td colspan="2" rowspan="5">1</td></tr>
<tr><td>1.0-4.9"</td><td colspan="4">0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="4">8 (8 - 8)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="4">4 (4 - 4)</td></tr>
<tr><td>20.0+"</td><td colspan="4">2 (2 - 2)</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="3">AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="3">0 (0 - 0)</td><td rowspan="5">1</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td colspan="3">100 (100 - 100)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="3">10 (10 - 10)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td colspan="3">2 (2 - 2)</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td>201 (0 - 825)</td><td rowspan="5">21</td><td>250 (0 - 600)</td><td rowspan="5">3</td><td>150 (0 - 300)</td><td rowspan="5">2</td></tr>
<tr><td>1.0-4.9"</td><td>98 (0 - 900)</td><td>300 (300 - 300)</td><td>450 (0 - 900)</td></tr>
<tr><td>5.0-14.9"</td><td>64 (24 - 156)</td><td>187 (120 - 289)</td><td>275 (260 - 289)</td></tr>
<tr><td>15.0-19.9"</td><td>1 (0 - 6)</td><td>2 (0 - 6)</td><td>0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td>1 (0 - 5)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td><1.0"</td><td>45 (0 - 225)</td><td rowspan="5">5</td><td>431 (0 - 1499)</td><td rowspan="5">4</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td><td>87 (0 - 200)</td></tr>
<tr><td>5.0-14.9"</td><td>54 (14 - 78)</td><td>128 (86 - 178)</td></tr>
<tr><td>15.0-19.9"</td><td>17 (12 - 24)</td><td>21 (18 - 30)</td></tr>
<tr><td>20.0+"</td><td>1 (0 - 4)</td><td>2 (0 - 6)</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td><1.0"</td><td>0 (0 - 0)</td><td rowspan="5">3</td><td>2568 (0 - 8096)</td><td rowspan="5">4</td><td>0 (0 - 0)</td><td rowspan="5">1</td></tr>
<tr><td>1.0-4.9"</td><td>50 (0 - 150)</td><td>212 (0 - 450)</td><td>75 (75 - 75)</td></tr>
<tr><td>5.0-14.9"</td><td>48 (18 - 85)</td><td>115 (48 - 172)</td><td>301 (301 - 301)</td></tr>
<tr><td>15.0-19.9"</td><td>13 (12 - 14)</td><td>7 (0 - 16)</td><td>0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td>14 (11 - 18)</td><td>17 (9 - 24)</td><td>12 (12 - 12)</td></tr>
</table>

Table E-56. Moderately Warm and Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

<table>
<tr><th>SIZE-CLASS</th><th>DBH RANGE</th><th colspan="2">OPEN
(<40% Canopy Cover)</th><th colspan="2">MODERATE
(40-60% Canopy Cover)</th><th colspan="2">CLOSED
(>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="3">AVG (MIN-MAX)</td><td colspan="3">#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="3">928 (0 - 5397)</td><td colspan="3" rowspan="5">8</td></tr>
<tr><td>1.0-4.9"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="3">5 (0 - 12)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="3">0 (0 - 4)</td></tr>
<tr><td>20.0+"</td><td colspan="3">0 (0 - 0)</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="2">AVG (MIN-MAX)</td><td colspan="2">#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="2">546 (0 - 1124)</td><td colspan="2" rowspan="5">7</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td colspan="2">464 (100 - 1050)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="2">1 (0 - 6)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="2">0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td colspan="2">0 (0 - 0)</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td>782 (0 - 5248)</td><td rowspan="5">56</td><td>1312 (0 - 11700)</td><td rowspan="5">26</td><td>526 (0 - 3298)</td><td rowspan="5">28</td></tr>
<tr><td>1.0-4.9"</td><td>107 (0 - 975)</td><td>186 (0 - 750)</td><td>720 (0 - 2999)</td></tr>
<tr><td>5.0-14.9"</td><td>83 (12 - 241)</td><td>199 (113 - 336)</td><td>366 (201 - 523)</td></tr>
<tr><td>15.0-19.9"</td><td>1 (0 - 6)</td><td>2 (0 - 6)</td><td>1 (0 - 8)</td></tr>
<tr><td>20.0+"</td><td>1 (0 - 6)</td><td>0 (0 - 6)</td><td>0 (0 - 6)</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td><1.0"</td><td>871 (0 - 2849)</td><td rowspan="5">16</td><td>745 (0 - 7721)</td><td rowspan="5">24</td><td>676 (0 - 5640)</td><td rowspan="5">25</td></tr>
<tr><td>1.0-4.9"</td><td>76 (0 - 375)</td><td>130 (0 - 1124)</td><td>496 (0 - 2460)</td></tr>
<tr><td>5.0-14.9"</td><td>54 (0 - 96)</td><td>134 (48 - 216)</td><td>261 (144 - 445)</td></tr>
<tr><td>15.0-19.9"</td><td>21 (8 - 48)</td><td>22 (5 - 48)</td><td>23 (6 - 72)</td></tr>
<tr><td>20.0+"</td><td>1 (0 - 6)</td><td>3 (0 - 7)</td><td>2 (0 - 6)</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td><1.0"</td><td>1065 (0 - 2324)</td><td rowspan="5">7</td><td>2404 (0 - 20091)</td><td rowspan="5">13</td><td>455 (0 - 4273)</td><td rowspan="5">12</td></tr>
<tr><td>1.0-4.9"</td><td>86 (0 - 600)</td><td>105 (0 - 500)</td><td>198 (0 - 900)</td></tr>
<tr><td>5.0-14.9"</td><td>38 (0 - 66)</td><td>74 (24 - 144)</td><td>199 (72 - 313)</td></tr>
<tr><td>15.0-19.9"</td><td>17 (0 - 24)</td><td>19 (0 - 48)</td><td>24 (4 - 48)</td></tr>
<tr><td>20.0+"</td><td>16 (9 - 24)</td><td>15 (8 - 24)</td><td>18 (8 - 36)</td></tr>
</table>

Table E-57. Cool and Moist ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	3161 (0 - 13794)	6				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	3 (0 - 12)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	900 (900 - 900)	1			16492 (16492-16492)	1
	1.0-4.9"	300 (300 - 300)				300 (300 - 300)	
	5.0-14.9"	0 (0 - 0)				0 (0 - 0)	
	15.0-19.9"	0 (0 - 0)				0 (0 - 0)	
	20.0+"	0 (0 - 0)				0 (0 - 0)	
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	3935 (0 - 14700)	16	3887 (0 - 13644)	12	3717 (0 - 9296)	17
	1.0-4.9"	165 (0 - 780)		321 (0 - 900)		1169 (0 - 4498)	
	5.0-14.9"	110 (24 - 265)		231 (96 - 385)		332 (102 - 744)	
	15.0-19.9"	0 (0 - 0)		1 (0 - 6)		1 (0 - 6)	
	20.0+"	0 (0 - 0)		0 (0 - 4)		0 (0 - 4)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)	1	2547 (825 - 3898)	8	2612 (0 - 12894)	15
	1.0-4.9"	0 (0 - 0)		292 (0 - 600)		901 (60 - 3298)	
	5.0-14.9"	24 (24 - 24)		165 (48 - 229)		284 (144 - 417)	
	15.0-19.9"	24 (24 - 24)		21 (6 - 48)		24 (8 - 48)	
	20.0+"	0 (0 - 0)		2 (0 - 9)		3 (0 - 8)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	N/A	0	1110 (720 - 1499)	2	1938 (75 - 4980)	4
	1.0-4.9"			30 (0 - 60)		247 (0 - 540)	
	5.0-14.9"			79 (72 - 85)		265 (108 - 361)	
	15.0-19.9"			34 (19 - 48)		20 (0 - 42)	
	20.0+"			26 (24 - 27)		21 (12 - 30)	

Table E-58. Cool and Moderately Dry ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	4988 (0 - 39881)	17				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	1 (0 - 10)					
	15.0-19.9"	1 (0 - 6)					
	20.0+"	0 (0 - 5)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	2666 (75 - 7646)	9			6447 (0 - 12894)	2
	1.0-4.9"	970 (75 - 2699)				2100 (900 - 3300)	
	5.0-14.9"	1 (0 - 12)				7 (0 - 13)	
	15.0-19.9"	1 (0 - 6)				0 (0 - 0)	
	20.0+"	0 (0 - 0)				0 (0 - 0)	
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	2436 (0 - 10120)	47	3817 (0 - 37140)	39	3518 (0 - 66269)	58
	1.0-4.9"	175 (0 - 900)		502 (0 - 1799)		837 (0 - 3100)	
	5.0-14.9"	98 (12 - 265)		205 (66 - 481)		405 (24 - 771)	
	15.0-19.9"	1 (0 - 6)		1 (0 - 6)		1 (0 - 9)	
	20.0+"	0 (0 - 0)		0 (0 - 6)		0 (0 - 4)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	915 (0 - 2399)	5	1093 (0 - 2220)	8	5623 (0 - 15180)	14
	1.0-4.9"	195 (0 - 600)		117 (0 - 375)		559 (180 - 1500)	
	5.0-14.9"	55 (0 - 144)		150 (0 - 283)		361 (187 - 511)	
	15.0-19.9"	16 (6 - 24)		26 (6 - 96)		14 (9 - 24)	
	20.0+"	1 (0 - 6)		3 (0 - 9)		2 (0 - 6)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	1267 (960 - 1574)	2	2894 (75 - 7497)	5	3330 (2880 - 3780)	2
	1.0-4.9"	150 (0 - 300)		60 (0 - 150)		630 (600 - 660)	
	5.0-14.9"	64 (50 - 78)		125 (72 - 193)		312 (232 - 392)	
	15.0-19.9"	7 (0 - 15)		24 (18 - 30)		3 (0 - 6)	
	20.0+"	11 (10 - 12)		19 (12 - 24)		12 (11 - 13)	

Table E-59. Cold ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	54275 (54275-54275)	1				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	NA	0			NA	0
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	3280 (600 - 6000)	4	3319 (0 - 17040)	16	3919 (225 - 15720)	10
	1.0-4.9"	109 (0 - 375)		514 (0 - 1649)		1032 (75 - 2700)	
	5.0-14.9"	113 (31 - 313)		231 (89 - 409)		334 (162 - 606)	
	15.0-19.9"	2 (0 - 6)		1 (0 - 6)		1 (0 - 6)	
	20.0+"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	1560 (1560 - 1560)	1	2418 (300 - 3840)	5	5488 (3120 - 9071)	3
	1.0-4.9"	60 (60 - 60)		333 (75 - 600)		650 (300 - 1124)	
	5.0-14.9"	110 (110 - 110)		142 (78 - 234)		367 (313 - 421)	
	15.0-19.9"	14 (14 - 14)		13 (10 - 18)		18 (6 - 31)	
	20.0+"	3 (3 - 3)		2 (0 - 6)		4 (0 - 6)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	NA	0	4020 (4020 - 4020)	1	2519 (900 - 3660)	3
	1.0-4.9"			180 (180 - 180)		290 (0 - 750)	
	5.0-14.9"			107 (107 - 107)		227 (205 - 265)	
	15.0-19.9"			12 (12 - 12)		15 (6 - 24)	
	20.0+"			24 (24 - 24)		18 (12 - 24)	

Table E-60. Timberline ecological site – average, minimum, and maximum live trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING				DS1			
				AVG (MIN-MAX)	#PLOTS		
	<1.0"			NA	0		
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	300 (300 - 300)	1			NA	0
	1.0-4.9"	300 (300 - 300)					
	5.0-14.9"	0 (0 - 0)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	NA	0	1974 (1199 - 2774)	3	5623 (1500 - 8996)	3
	1.0-4.9"			425 (150 - 825)		2889 (450 - 6897)	
	5.0-14.9"			245 (199 - 271)		214 (120 - 349)	
	15.0-19.9"			2 (0 - 6)		0 (0 - 0)	
	20.0+"			0 (0 - 0)		0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"	540 (540 - 540)	1	610 (0 - 1649)	3	225 (225 - 225)	1
	1.0-4.9"	120 (120 - 120)		413 (240 - 600)		150 (150 - 150)	
	5.0-14.9"	67 (67 - 67)		154 (138 - 163)		229 (229 - 229)	
	15.0-19.9"	14 (14 - 14)		19 (11 - 35)		18 (18 - 18)	
	20.0+"	8 (8 - 8)		3 (0 - 5)		0 (0 - 0)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	NA	0	NA	0	1965 (1349 - 2580)	2
	1.0-4.9"					847 (720 - 975)	
	5.0-14.9"					207 (144 - 269)	
	15.0-19.9"					26 (4 - 48)	
	20.0+"					12 (11 - 12)	

Dead Trees

Table E-61. Hot and Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"						
	1.0-4.9"						
	5.0-14.9"	NA	0				
	15.0-19.9"						
	20.0+"						
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"						
	1.0-4.9"						
	5.0-14.9"	NA	0			NA	0
	15.0-19.9"						
	20.0+"						
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)				0 (0 - 0)	
	1.0-4.9"	0 (0 - 0)				0 (0 - 0)	
	5.0-14.9"	24 (0 - 48)	3	NA	0	84 (48 - 120)	2
	15.0-19.9"	0 (0 - 0)				0 (0 - 0)	
	20.0+"	0 (0 - 0)				0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"						
	1.0-4.9"						
	5.0-14.9"	NA	0	NA	0	NA	0
	15.0-19.9"						
	20.0+"						
VERY LARGE		DS10		DS11		DS12	
	<1.0"						
	1.0-4.9"						
	5.0-14.9"	NA	0	NA	0	NA	0
	15.0-19.9"						
	20.0+"						

Table E-62. Warm and Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
				AVG (MIN-MAX)	#PLOTS		
	<1.0"			0 (0 - 0)	1		
	1.0-4.9"			0 (0 - 0)			
	5.0-14.9"			0 (0 - 0)			
	15.0-19.9"			0 (0 - 0)			
	20.0+"			0 (0 - 0)			
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	1			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	7 (7 - 7)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	1 (1 - 1)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	21	0 (0 - 0)	3	0 (0 - 0)	2
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	2 (0 - 12)		2 (0 - 6)		24 (0 - 48)	
	15.0-19.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	20.0+"	0 (0 - 6)		0 (0 - 0)		0 (0 - 1)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	5	0 (0 - 0)	4	N/A	0
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)			
	5.0-14.9"	0 (0 - 0)		0 (0 - 0)			
	15.0-19.9"	0 (0 - 0)		0 (0 - 0)			
	20.0+"	1 (0 - 6)		2 (0 - 6)			
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	3	0 (0 - 0)	4	0 (0 - 0)	1
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	14 (0 - 30)		0 (0 - 0)		12 (12 - 12)	
	15.0-19.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	20.0+"	0 (0 - 0)		1 (0 - 2)		0 (0 - 0)	

Table E-63. Moderately Warm and Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	<1.0"	0 (0 - 0)	8				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	102 (0 - 457)					
	15.0-19.9"	13 (0 - 96)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	7			NA	0
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	7 (0 - 36)					
	15.0-19.9"	3 (0 - 18)					
	20.0+"	1 (0 - 6)					
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	<1.0"	0 (0 - 0)	56	0 (0 - 0)	26	0 (0 - 0)	28
	1.0-4.9"	5 (0 - 300)		15 (0 - 400)		43 (0 - 900)	
	5.0-14.9"	50 (0 - 481)		73 (0 - 457)		34 (0 - 144)	
	15.0-19.9"	3 (0 - 48)		1 (0 - 24)		0 (0 - 2)	
	20.0+"	0 (0 - 2)		0 (0 - 2)		0 (0 - 0)	
LARGE		DS7		DS8		DS9	
	<1.0"	0 (0 - 0)	16	0 (0 - 0)	24	0 (0 - 0)	25
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		8 (0 - 100)	
	5.0-14.9"	40 (0 - 337)		50 (0 - 313)		38 (0 - 168)	
	15.0-19.9"	2 (0 - 24)		2 (0 - 12)		1 (0 - 18)	
	20.0+"	1 (0 - 12)		0 (0 - 1)		0 (0 - 2)	
VERY LARGE		DS10		DS11		DS12	
	<1.0"	0 (0 - 0)	7	0 (0 - 0)	13	0 (0 - 0)	12
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	10 (0 - 48)		26 (0 - 120)		17 (0 - 70)	
	15.0-19.9"	0 (0 - 0)		0 (0 - 3)		3 (0 - 24)	
	20.0+"	1 (0 - 6)		1 (0 - 4)		1 (0 - 6)	

Table E-64. Cool and Moist ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	0 (0 - 0)	6				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	126 (0 - 361)					
	15.0-19.9"	12 (0 - 48)					
	20.0+"	4 (0 - 24)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	1			0 (0 - 0)	1
	1.0-4.9"	0 (0 - 0)				0 (0 - 0)	
	5.0-14.9"	120 (120 - 120)				72 (72 - 72)	
	15.0-19.9"	48 (48 - 48)				0 (0 - 0)	
	20.0+"	0 (0 - 0)				0 (0 - 0)	
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	16	0 (0 - 0)	12	0 (0 - 0)	17
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		29 (0 - 500)	
	5.0-14.9"	164 (12 - 433)		71 (0 - 144)		76 (0 - 289)	
	15.0-19.9"	1 (0 - 12)		3 (0 - 24)		0 (0 - 0)	
	20.0+"	0 (0 - 5)		2 (0 - 18)		0 (0 - 0)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)	1	0 (0 - 0)	8	0 (0 - 0)	15
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	313 (313 - 313)		48 (0 - 118)		86 (0 - 241)	
	15.0-19.9"	0 (0 - 0)		7 (0 - 24)		0 (0 - 0)	
	20.0+"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	NA	0	0 (0 - 0)	2	0 (0 - 0)	4
	1.0-4.9"			0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"			24 (0 - 48)		62 (24 - 120)	
	15.0-19.9"			2 (0 - 4)		4 (0 - 17)	
	20.0+"			0 (0 - 0)		1 (0 - 3)	

Table E-65. Cool and Moderately Dry ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	DBH RANGE	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	0 (0 - 0)					
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	128 (0 - 409)	17				
	15.0-19.9"	3 (0 - 24)					
	20.0+"	6 (0 - 48)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)				0 (0 - 0)	
	1.0-4.9"	0 (0 - 0)				150 (0 - 300)	
	5.0-14.9"	57 (0 - 337)	9			12 (0 - 24)	2
	15.0-19.9"	0 (0 - 0)				0 (0 - 0)	
	20.0+"	0 (0 - 0)				0 (0 - 0)	
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	6 (0 - 300)		0 (0 - 0)		5 (0 - 300)	
	1.0-4.9"	6 (0 - 300)		0 (0 - 0)		52 (0 - 2099)	
	5.0-14.9"	108 (0 - 481)	47	80 (0 - 289)	39	47 (0 - 218)	58
	15.0-19.9"	2 (0 - 48)		2 (0 - 24)		1 (0 - 24)	
	20.0+"	0 (0 - 6)		1 (0 - 48)		1 (0 - 24)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	117 (0 - 229)	5	46 (0 - 120)	8	67 (10 - 159)	14
	15.0-19.9"	1 (0 - 6)		4 (0 - 24)		2 (0 - 6)	
	20.0+"	5 (0 - 24)		2 (0 - 18)		0 (0 - 6)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	1.0-4.9"	0 (0 - 0)		120 (0 - 600)		0 (0 - 0)	
	5.0-14.9"	15 (0 - 30)	2	124 (0 - 337)	5	56 (0 - 113)	2
	15.0-19.9"	3 (0 - 6)		11 (0 - 24)		7 (6 - 9)	
	20.0+"	0 (0 - 0)		0 (0 - 0)		3 (0 - 7)	

Table E-66. Cold ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

SIZE-CLASS	**DBH RANGE**	**OPEN (<40% Canopy Cover)**		**MODERATE (40-60% Canopy Cover)**		**CLOSED (>60% Canopy Cover)**	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	<1.0"	0 (0 - 0)	1				
	1.0-4.9"	0 (0 - 0)					
	5.0-14.9"	530 (530 - 530)					
	15.0-19.9"	0 (0 - 0)					
	20.0+"	0 (0 - 0)					
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	NA	0			NA	0
	1.0-4.9"						
	5.0-14.9"						
	15.0-19.9"						
	20.0+"						
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	<1.0"	0 (0 - 0)	4	0 (0 - 0)	16	0 (0 - 0)	10
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	147 (0 - 516)		102 (0 - 505)		55 (0 - 168)	
	15.0-19.9"	1 (0 - 6)		2 (0 - 24)		0 (0 - 0)	
	20.0+"	0 (0 - 2)		0 (0 - 3)		0 (0 - 0)	
LARGE		**DS7**		**DS8**		**DS9**	
	<1.0"	0 (0 - 0)	1	0 (0 - 0)	5	0 (0 - 0)	3
	1.0-4.9"	0 (0 - 0)		0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"	14 (14 - 14)		80 (12 - 219)		96 (24 - 156)	
	15.0-19.9"	0 (0 - 0)		13 (5 - 24)		8 (0 - 18)	
	20.0+"	0 (0 - 0)		3 (0 - 12)		0 (0 - 0)	
VERY LARGE		**DS10**		**DS11**		**DS12**	
	<1.0"	NA	0	0 (0 - 0)	1	0 (0 - 0)	3
	1.0-4.9"			0 (0 - 0)		0 (0 - 0)	
	5.0-14.9"			56 (56 - 56)		80 (12 - 154)	
	15.0-19.9"			23 (23 - 23)		8 (0 - 19)	
	20.0+"			6 (6 - 6)		0 (0 - 0)	

Table E-67. Timberline ecological site – average, minimum, and maximum dead trees per acre by DBH range within each disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA – data not available.

<table>
<tr><th>SIZE-CLASS</th><th>DBH RANGE</th><th colspan="2">OPEN (<40% Canopy Cover)</th><th colspan="2">MODERATE (40-60% Canopy Cover)</th><th colspan="2">CLOSED (>60% Canopy Cover)</th></tr>
<tr><td rowspan="7">GRASS-FORB-SHRUB-SEEDLING</td><td></td><td colspan="6">DS1</td></tr>
<tr><td></td><td colspan="3">AVG (MIN-MAX)</td><td colspan="3">#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="3" rowspan="5">NA</td><td colspan="3" rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td></tr>
<tr><td>5.0-14.9"</td></tr>
<tr><td>15.0-19.9"</td></tr>
<tr><td>20.0+"</td></tr>
<tr><td rowspan="7">SAPLING/ SMALL</td><td></td><td colspan="4">DS2</td><td colspan="2">DS3</td></tr>
<tr><td></td><td colspan="2">AVG (MIN-MAX)</td><td colspan="2">#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td colspan="2">0 (0 - 0)</td><td colspan="2" rowspan="5">1</td><td rowspan="5">NA</td><td rowspan="5">0</td></tr>
<tr><td>1.0-4.9"</td><td colspan="2">0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td colspan="2">0 (0 - 0)</td></tr>
<tr><td>15.0-19.9"</td><td colspan="2">0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td colspan="2">0 (0 - 0)</td></tr>
<tr><td rowspan="7">MEDIUM</td><td></td><td colspan="2">DS4</td><td colspan="2">DS5</td><td colspan="2">DS6</td></tr>
<tr><td></td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td><td>AVG (MIN-MAX)</td><td>#PLOTS</td></tr>
<tr><td><1.0"</td><td rowspan="5">NA</td><td rowspan="5">0</td><td>0 (0 - 0)</td><td rowspan="5">3</td><td>0 (0 - 0)</td><td rowspan="5">3</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td>46 (24 - 72)</td><td>26 (0 - 72)</td></tr>
<tr><td>15.0-19.9"</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td>20.0+"</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td rowspan="6">LARGE</td><td></td><td colspan="2">DS7</td><td colspan="2">DS8</td><td colspan="2">DS9</td></tr>
<tr><td><1.0"</td><td>0 (0 - 0)</td><td rowspan="5">1</td><td>0 (0 - 0)</td><td rowspan="5">3</td><td>0 (0 - 0)</td><td rowspan="5">1</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td>0 (0 - 0)</td><td>36 (12 - 73)</td><td>54 (54 - 54)</td></tr>
<tr><td>15.0-19.9"</td><td>0 (0 - 0)</td><td>1 (0 - 2)</td><td>18 (18 - 18)</td></tr>
<tr><td>20.0+"</td><td>2 (2 - 2)</td><td>0 (0 - 0)</td><td>0 (0 - 0)</td></tr>
<tr><td rowspan="6">VERY LARGE</td><td></td><td colspan="2">DS10</td><td colspan="2">DS11</td><td colspan="2">DS12</td></tr>
<tr><td><1.0"</td><td rowspan="5">NA</td><td rowspan="5">0</td><td rowspan="5">NA</td><td rowspan="5">0</td><td>0 (0 - 0)</td><td rowspan="5">2</td></tr>
<tr><td>1.0-4.9"</td><td>0 (0 - 0)</td></tr>
<tr><td>5.0-14.9"</td><td>3 (0 - 6)</td></tr>
<tr><td>15.0-19.9"</td><td>5 (5 - 6)</td></tr>
<tr><td>20.0+"</td><td>4 (0 - 7)</td></tr>
</table>

General Ecosystem Characteristics

Table E-68. Hot and Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING				DS1			
				AVG (MIN-MAX)	#PLOTS		
	BA WTD DIA			NA	0		
	CWD (TONS/AC)			NA	0		
	FORBS (CC%)			NA	0		
	GRASS (CC%)			NA	0		
	SHRUBS (CC%)			NA	0		
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	NA	0			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	NA	0			NA	0
	GRASS (CC%)	NA	0			NA	0
	SHRUBS (CC%)	NA	0			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	9 (7 - 10)	3	NA	0	8 (6 - 9)	2
	CWD (TONS/AC)	7 (4 - 9)	3	NA	0	7 (5 - 9)	2
	FORBS (CC%)	2 (0 - 4)	3	NA	0	15 (4 - 26)	2
	GRASS (CC%)	10 (4 - 16)	3	NA	0	2 (0 - 3)	2
	SHRUBS (CC%)	15 (7 - 20)	3	NA	0	12 (9 - 15)	2
LARGE		DS7		DS8		DS9	
	BA WTD DIA	NA	0	NA	0	NA	0
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	NA	0	NA	0
	GRASS (CC%)	NA	0	NA	0	NA	0
	SHRUBS (CC%)	NA	0	NA	0	NA	0
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	NA	0	NA	0	NA	0
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	NA	0	NA	0
	GRASS (CC%)	NA	0	NA	0	NA	0
	SHRUBS (CC%)	NA	0	NA	0	NA	0

Table E-69. Warm and Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	19 (19 - 19)	1				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	NA	0				
	GRASS (CC%)	NA	0				
	SHRUBS (CC%)	NA	0				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	13 (13 - 13)	1			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	NA	0			NA	0
	GRASS (CC%)	NA	0			NA	0
	SHRUBS (CC%)	NA	0			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	10 (0 - 18)	21	7 (6 - 10)	3	9 (7 - 12)	2
	CWD (TONS/AC)	2 (2 - 2)	1	12 (9 - 14)	2	20 (20 - 20)	1
	FORBS (CC%)	8 (0 - 27)	13	4 (1 - 6)	3	5 (5 - 5)	1
	GRASS (CC%)	20 (5 - 42)	13	11 (4 - 16)	3	21 (21 - 21)	1
	SHRUBS (CC%)	4 (0 - 11)	13	5 (1 - 7)	3	7 (7 - 7)	1
LARGE		DS7		DS8		DS9	
	BA WTD DIA	15 (14 - 17)	5	14 (12 - 17)	4	NA	0
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	5 (1 - 11)	3	7 (3 - 11)	2	NA	0
	GRASS (CC%)	15 (10 - 22)	3	17 (8 - 27)	2	NA	0
	SHRUBS (CC%)	2 (1 - 3)	3	1 (1 - 1)	2	NA	0
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	18 (18 - 19)	3	15 (12 - 17)	4	14 (14 - 14)	1
	CWD (TONS/AC)	NA	0	9 (9 - 9)	1	NA	0
	FORBS (CC%)	1 (1 - 1)	1	12 (12 - 12)	1	2 (2 - 2)	1
	GRASS (CC%)	6 (6 - 6)	1	20 (20 - 20)	1	15 (15 - 15)	1
	SHRUBS (CC%)	5 (5 - 5)	1	0 (0 - 0)	1	3 (3 - 3)	1

Table E-70. Moderately Warm and Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	11 (0 - 40)	8				
	CWD (TONS/AC)	13 (3 - 29)	3				
	FORBS (CC%)	7 (0 - 15)	5				
	GRASS (CC%)	21 (0 - 65)	5				
	SHRUBS (CC%)	21 (3 - 36)	5				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	2 (1 - 4)	7			NA	0
	CWD (TONS/AC)	6 (6 - 6)	1			NA	0
	FORBS (CC%)	7 (2 - 11)	6			NA	0
	GRASS (CC%)	10 (5 - 17)	6			NA	0
	SHRUBS (CC%)	7 (2 - 18)	6			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	9 (0 - 17)	56	10 (6 - 14)	26	8 (4 - 13)	28
	CWD (TONS/AC)	16 (2 - 45)	14	24 (7 - 46)	9	26 (16 - 49)	5
	FORBS (CC%)	6 (0 - 29)	40	7 (1 - 29)	13	3 (1 - 10)	14
	GRASS (CC%)	15 (0 - 60)	40	12 (1 - 47)	13	9 (0 - 26)	14
	SHRUBS (CC%)	13 (0 - 72)	40	16 (0 - 53)	13	10 (1 - 29)	14
LARGE		DS7		DS8		DS9	
	BA WTD DIA	14 (10 - 18)	16	13 (9 - 17)	24	11 (7 - 15)	26
	CWD (TONS/AC)	15 (2 - 32)	6	21 (10 - 32)	5	19 (5 - 33)	6
	FORBS (CC%)	9 (0 - 30)	12	5 (1 - 9)	16	3 (0 - 15)	13
	GRASS (CC%)	14 (0 - 41)	12	16 (0 - 40)	16	8 (1 - 33)	13
	SHRUBS (CC%)	9 (1 - 62)	12	16 (1 - 65)	16	5 (1 - 18)	13
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	17 (13 - 19)	7	17 (14 - 20)	13	15 (12 - 19)	11
	CWD (TONS/AC)	8 (3 - 18)	3	19 (4 - 38)	3	21 (21 - 21)	1
	FORBS (CC%)	5 (0 - 8)	4	10 (5 - 21)	3	3 (0 - 13)	6
	GRASS (CC%)	19 (1 - 35)	4	16 (0 - 40)	3	13 (1 - 28)	6
	SHRUBS (CC%)	9 (7 - 12)	4	6 (4 - 8)	3	4 (1 - 13)	6

Table E-71. Cool and Moist ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	3 (0 - 12)	6				
	CWD (TONS/AC)	34 (7 - 70)	4				
	FORBS (CC%)	22 (8 - 55)	5				
	GRASS (CC%)	12 (1 - 50)	5				
	SHRUBS (CC%)	8 (1 - 17)	5				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	3 (3 - 3)	1			1 (1 - 1)	1
	CWD (TONS/AC)	33 (33 - 33)	1			36 (36 - 36)	1
	FORBS (CC%)	10 (10 - 10)	1			20 (20 - 20)	1
	GRASS (CC%)	1 (1 - 1)	1			6 (6 - 6)	1
	SHRUBS (CC%)	27 (27 - 27)	1			12 (12 - 12)	1
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	8 (4 - 10)	16	8 (7 - 10)	12	7 (3 - 10)	17
	CWD (TONS/AC)	16 (3 - 28)	9	23 (0 - 50)	4	25 (4 - 46)	7
	FORBS (CC%)	11 (1 - 18)	13	19 (2 - 42)	10	11 (2 - 27)	11
	GRASS (CC%)	2 (0 - 18)	13	1 (0 - 6)	10	1 (0 - 4)	11
	SHRUBS (CC%)	27 (1 - 65)	13	32 (5 - 58)	10	19 (1 - 70)	11
LARGE		DS7		DS8		DS9	
	BA WTD DIA	15 (15 - 15)	1	12 (10 - 16)	7	10 (8 - 13)	14
	CWD (TONS/AC)	24 (24 - 24)	1	30 (23 - 37)	2	46 (27 - 77)	4
	FORBS (CC%)	25 (25 - 25)	1	7 (1 - 19)	5	11 (5 - 27)	7
	GRASS (CC%)	1 (1 - 1)	1	2 (0 - 6)	5	8 (0 - 49)	7
	SHRUBS (CC%)	10 (10 - 10)	1	17 (2 - 34)	5	9 (1 - 18)	7
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	NA	0	17 (13 - 19)	3	15 (11 - 24)	5
	CWD (TONS/AC)	NA	0	28 (28 - 28)	1	30 (30 - 30)	1
	FORBS (CC%)	NA	0	7 (7 - 7)	1	6 (2 - 15)	3
	GRASS (CC%)	NA	0	0 (0 - 0)	1	1 (0 - 1)	3
	SHRUBS (CC%)	NA	0	5 (5 - 5)	1	9 (5 - 16)	3

Table E-72. Cool and Moderately Dry ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	4 (0 - 27)	17				
	CWD (TONS/AC)	20 (4 - 44)	13				
	FORBS (CC%)	14 (4 - 26)	13				
	GRASS (CC%)	5 (1 - 23)	13				
	SHRUBS (CC%)	11 (0 - 39)	13				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	3 (2 - 8)	9			2 (1 - 3)	2
	CWD (TONS/AC)	17 (7 - 28)	2			52 (52 - 52)	1
	FORBS (CC%)	12 (4 - 21)	7			1 (1 - 1)	1
	GRASS (CC%)	5 (0 - 24)	7			0 (0 - 0)	1
	SHRUBS (CC%)	23 (3 - 66)	7			5 (5 - 5)	1
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	8 (0 - 13)	47	8 (4 - 11)	39	7 (3 - 11)	58
	CWD (TONS/AC)	16 (0 - 61)	23	18 (4 - 41)	10	14 (2 - 20)	12
	FORBS (CC%)	9 (1 - 35)	40	13 (1 - 59)	27	10 (1 - 28)	27
	GRASS (CC%)	7 (0 - 30)	40	7 (0 - 30)	27	2 (0 - 29)	27
	SHRUBS (CC%)	16 (0 - 67)	40	18 (2 - 65)	27	25 (0 - 76)	27
LARGE		DS7		DS8		DS9	
	BA WTD DIA	14 (11 - 17)	5	13 (8 - 16)	7	10 (9 - 11)	14
	CWD (TONS/AC)	12 (8 - 15)	2	21 (9 - 33)	2	20 (20 - 20)	1
	FORBS (CC%)	12 (7 - 19)	5	21 (1 - 40)	5	18 (4 - 42)	5
	GRASS (CC%)	5 (1 - 12)	5	7 (2 - 17)	5	6 (1 - 21)	5
	SHRUBS (CC%)	14 (2 - 26)	5	10 (5 - 30)	5	14 (9 - 23)	5
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	16 (15 - 16)	2	15 (14 - 17)	6	11 (11 - 11)	2
	CWD (TONS/AC)	NA	0	12 (5 - 19)	3	NA	0
	FORBS (CC%)	19 (19 - 19)	1	6 (1 - 15)	5	NA	0
	GRASS (CC%)	4 (4 - 4)	1	7 (0 - 20)	5	NA	0
	SHRUBS (CC%)	25 (25 - 25)	1	8 (1 - 16)	5	NA	0

Table E-73. Cold ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	ECOSYSTEM CHARACTERISTIC	OPEN (<40% Canopy Cover)		MODERATE (40-60% Canopy Cover)		CLOSED (>60% Canopy Cover)	
GRASS-FORB-SHRUB-SEEDLING		DS1					
		AVG (MIN-MAX)	#PLOTS				
	BA WTD DIA	0 (0 - 0)	1				
	CWD (TONS/AC)	3 (3 - 3)	1				
	FORBS (CC%)	1 (1 - 1)	1				
	GRASS (CC%)	3 (3 - 3)	1				
	SHRUBS (CC%)	6 (6 - 6)	1				
SAPLING/ SMALL		DS2				DS3	
		AVG (MIN-MAX)	#PLOTS			AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	NA	0			NA	0
	CWD (TONS/AC)	NA	0			NA	0
	FORBS (CC%)	NA	0			NA	0
	GRASS (CC%)	NA	0			NA	0
	SHRUBS (CC%)	NA	0			NA	0
MEDIUM		DS4		DS5		DS6	
		AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS	AVG (MIN-MAX)	#PLOTS
	BA WTD DIA	10 (5 - 12)	4	8 (4 - 10)	16	7 (4 - 9)	10
	CWD (TONS/AC)	22 (16 - 29)	2	25 (14 - 36)	2	10 (10 - 10)	1
	FORBS (CC%)	1 (0 - 1)	3	5 (0 - 19)	10	3 (2 - 7)	4
	GRASS (CC%)	10 (0 - 16)	3	2 (0 - 5)	10	1 (0 - 3)	4
	SHRUBS (CC%)	7 (5 - 11)	3	24 (4 - 60)	10	44 (28 - 70)	4
LARGE		DS7		DS8		DS9	
	BA WTD DIA	13 (13 - 13)	1	12 (10 - 13)	5	11 (10 - 12)	3
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	8 (1 - 16)	3	10 (1 - 20)	2
	GRASS (CC%)	NA	0	3 (0 - 9)	3	2 (0 - 4)	2
	SHRUBS (CC%)	NA	0	9 (2 - 18)	3	45 (33 - 57)	2
VERY LARGE		DS10		DS11		DS12	
	BA WTD DIA	NA	0	19 (19 - 19)	1	14 (12 - 16)	3
	CWD (TONS/AC)	NA	0	NA	0	41 (41 - 41)	1
	FORBS (CC%)	NA	0	NA	0	15 (1 - 29)	2
	GRASS (CC%)	NA	0	NA	0	2 (0 - 3)	2
	SHRUBS (CC%)	NA	0	NA	0	4 (1 - 6)	2

Table E-74. Timberline ecological site – average, minimum, and maximum values for general ecosystem characteristics by disturbance state. #Plots represents the number of FIA plots used to summarize this information. NA = data not available, BA WTD DIA= Basal area weighted diameter and CWD = coarse woody debris.

SIZE-CLASS	**ECOSYSTEM CHARACTERISTIC**	**OPEN (<40% Canopy Cover)**		**MODERATE (40-60% Canopy Cover)**		**CLOSED (>60% Canopy Cover)**	
GRASS-FORB-SHRUB-SEEDLING		**DS1**					
		AVG (MIN-MAX)	**#PLOTS**				
	BA WTD DIA	NA	0				
	CWD (TONS/AC)	NA	0				
	FORBS (CC%)	NA	0				
	GRASS (CC%)	NA	0				
	SHRUBS (CC%)	NA	0				
SAPLING/ SMALL		**DS2**				**DS3**	
		AVG (MIN-MAX)	**#PLOTS**			**AVG (MIN-MAX)**	**#PLOTS**
	BA WTD DIA	1 (1 - 1)	1			NA	0
	CWD (TONS/AC)	9 (9 - 9)	1			NA	0
	FORBS (CC%)	6 (6 - 6)	1			NA	0
	GRASS (CC%)	1 (1 - 1)	1			NA	0
	SHRUBS (CC%)	4 (4 - 4)	1			NA	0
MEDIUM		**DS4**		**DS5**		**DS6**	
		AVG (MIN-MAX)	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**	**AVG (MIN-MAX)**	**#PLOTS**
	BA WTD DIA	NA	0	8 (5 - 10)	3	6 (4 - 8)	3
	CWD (TONS/AC)	NA	0	NA	0	50 (50 - 50)	1
	FORBS (CC%)	NA	0	2 (1 - 5)	3	0 (0 - 0)	1
	GRASS (CC%)	NA	0	1 (0 - 2)	3	0 (0 - 0)	1
	SHRUBS (CC%)	NA	0	11 (10 - 12)	3	20 (20 - 20)	1
LARGE		**DS7**		**DS8**		**DS9**	
	BA WTD DIA	NA	0	11 (10 - 12)	3	11 (11 - 11)	1
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	19 (19 - 19)	1	1 (1 - 1)	1
	GRASS (CC%)	NA	0	6 (6 - 6)	1	2 (2 - 2)	1
	SHRUBS (CC%)	NA	0	6 (6 - 6)	1	4 (4 - 4)	1
VERY LARGE		**DS10**		**DS11**		**DS12**	
	BA WTD DIA	16 (16 - 16)	1	NA	0	14 (13 - 14)	2
	CWD (TONS/AC)	NA	0	NA	0	NA	0
	FORBS (CC%)	NA	0	NA	0	1 (1 - 1)	1
	GRASS (CC%)	NA	0	NA	0	5 (5 - 5)	1
	SHRUBS (CC%)	NA	0	NA	0	37 (37 - 37)	1

APPENDIX F. MODELING AND QUANTIFYING THE HISTORICAL RANGE OF VARIABILITY

Model Description

Simulating Patterns and Processes at Landscape Scales (SIMPPLLE) (Chew et al. 2004) is a computer modeling program that simulates vegetation patterns and processes emphasizing the dynamics of landscaped level change. It was developed for the U.S. Forest Service, Region 1, as a management tool and is recommended and used by the region when conducting landscape assessments. SIMPPLLE's purpose is to help provide an understanding of the dynamics of where processes will occur across a landscape. SIMPPLLE was selected for use in the BSLRP landscape assessment because it is both spatially and temporally explicit, meaning that landscape level ecosystem changes can be explored in relation to location and neighboring ecosystems, as well as over time. SIMPPLLE was used to simulate ecosystem dynamics as a result of primary historical disturbance events (e.g., fire, insects, and disease), climate, and landscape elements (e.g., ecological site, fire breaks, proximity to water, and elevation). SIMPPLLE uses process probabilities in a stochastic manner and disturbance response parameters that are specified by the user to assign disturbance patterns. The probability of a disturbance process originating or spreading from a specific unit on the landscape is determined not just by the ecosystem attributes, but also by what exists around it, what processes are occurring around it and what processes have occurred in the past.

Although SIMPPLLE has a variety of potential applications in forest planning and management, it was specifically used in this landscape assessment to quantify the historical range of variability (HRV) for each terrestrial forest ecosystem relative to the ecosystem diversity framework described in this assessment, while using the best available information to inform and calibrate the model.

Methods

The process to quantify HRV for the BSLRP project area involved the following steps:

1. SIMPPLLE Input Data – 1) obtained the starting landscape conditions from the BSLRP project team, and 2) obtained existing system knowledge files from Flathead National Forest and Helena National Forest as a starting point for ecological and disturbance processes logic, as well as historical climate information.
2. Run initial, single model simulation for 100 decades (1000 years) to remove bias toward existing ecosystem conditions. Run a test single model simulation using the end result of the initial model simulation.
3. Evaluate test simulation results relative to best available information on historical ecosystem conditions and disturbance regimes. Test results are used to develop an understanding of the interaction and relationship of the various system knowledge inputs and their influence on model results, requiring an iterative process of re-running test simulations and modifying input data until results make sense relative to best available historical information. Specifically, this involved calculating HRV for each ecosystem, calculating fire return intervals, and evaluating disturbance regime patterns against historical fire scar study and tree mapping results, as well historical

observations. Where results were inconsistent, system knowledge file inputs were re-calibrated to achieve a more consistent output.

4. At the completion of the calibration process, 3 final 100 decade/1000 year simulations were conducted for the same time frame and the results were averaged.
5. Results were summarized relative to ecosystem diversity framework for HRV, disturbance regime patterns, fire return intervals, and patch size statistics.
6. Primary model limitations were identified and discussed.

SIMPPLLE Input Files

Starting Landscape Condition

SIMPPLLE requires an initial landscape file be developed in a GIS that provides information on polygon topology and attributes such as starting vegetation, ecological sites, water features, non-vegetated sites, and other information as pertinent to project objectives. The USFS BSLRP Team developed the initial landscape GIS layer from the existing regional VMAP product using a uniform polygon size of 5.6 acres. Since the BSLRP project area represented two SIMPPLLE model variants (Westside Region 1 zone and Eastside Region 1 zone), we split the initial landscape into 2 landscapes for SIMPPLLE modeling consistent with ecoregional boundaries – M333C and M332B-West were included in the Westside Region 1 zone and M332B-East was included for the Eastside Region 1 zone. Some modifications were made to the initial starting vegetation attributes, specifically dominant species and size-class, to be consistent with the ecosystem diversity framework and modifications to vegetative pathways (discussed in a later section). A Digital Elevation Model (DEM) was also used to develop a neighbor file of spatial relationships and topographic features for each of the polygons.

System Knowledge File

The USFS BSLRP Team provided an initial system knowledge file for each of the model zones. The Flathead National Forest system knowledge file was used as a starting point for ecoregions M333C and M332B-West (Westside Region 1 zone). A draft Helena National Forest system knowledge file was provided and used as an initial starting point for M332B-East (Eastside Region 1 zone).

Through iterative reviews of incremental changes in system knowledge file logic, each of the 2 initial system knowledge files were modified to obtain model results consistent with historical information developed from empirical studies and historical observations, as described and summarized in other sections of this report. Graham et al. (2004) provides a comprehensive summary for much of the existing research on fire behavior in forested systems of the Western United States. They identified 4 primary environmental factors known to interact to influence fire spread and fire severity in a landscape.

1. Forest structure (both live and dead) and continuity both horizontally and vertically
2. Physical setting/ecological site
3. Extreme weather events (such as high winds)
4. Climate (regional patterns of precipitation and temperatures)

These 4 factors are further discussed below relative to Graham et al.’s (2004) description of their importance to fire behavior and our interpretation of their importance to quantifying HRV. This is followed by a stated assumption of how these factors are incorporated and considered relative to the system knowledge components of SIMPPLLE.

1. **Forest Structure**
   - Horizontal and vertical gaps - larger gaps between vegetation patches or individual trees/shrubs both horizontally and vertically are less likely to provide the continuity of fuels that would allow a fire to build intensity; smaller gaps provide continuity of fuels that allow a fire to build intensity, and
   - There is generally a warmer, drier microclimate (i.e., ground surface-level humidity and air temperature) present in a more open forest and cooler, moister conditions present in a more closed forest.

   Assumption - Canopy Cover (CC) is the best representation of vegetation density and continuity available in the model.

2. **Physical Setting/Ecological Site**
   - Ecological sites represent a classification of similar abiotic conditions that influence disturbance processes and the vegetation of a site,
   - The extreme conditions at both ends of the forest environmental gradient represent more harsh conditions in terms of moisture availability and temperatures such as hot and dry at low elevation ecological sites and cold and dry at high elevation ecological sites; consequently, vegetation productivity is characteristically lower on these sites leading to patchier conditions and less canopy cover (larger horizontal and vertical gaps),
   - Highest vegetation productivity frequently occurs around the middle of the environmental gradient,
   - Vegetation/fuels dry out sooner each year at lower elevation sites so the period that fire can burn each year is longer, and
   - Fire break features such as streams, lakes, riparian areas, rock formations, etc. can all act as impediments to fire spread (this is user defined by the original GIS layer).

   Assumption:
   1. Hot and Dry, Warm and Dry, Warm and Moderately Dry, Moderately Warm and Moderately Dry, Cold Moderately Dry and Timberline Ecological Sites represent less productive growing conditions in the project area;
   2. Hot and Dry, Cold and Moderately Dry, and Timberline represent patchier vegetative conditions due to poor, scabby soils, rock outcrops, talus slopes, etc.

3. **Weather Events**
   - Extreme fire weather, such as low humidity and high winds, can lead to higher severity fires and larger fire sizes than would occur under normal weather conditions.

   Assumption: Extreme weather events lead to more fire spread than under normal conditions and depending on the interaction of ecological site, canopy cover/density levels, and climate, more severe fires than would normally occur.

4. **Climate**

- Influences fire occurrence since moisture in the air and soil directly affects the moisture content of vegetation/fuel and thereby, the probability it will ignite.

Assumption: Climate
Warmer and Drier ↔ Cooler and Wetter
More fire *Less fire*

Modifications

The following paragraphs summarize the modifications to the system knowledge file components resulting from the use of the ecosystem diversity framework and the incorporation of Graham et al. (2004) primary factors influencing fire spread and severity.

Vegetative Pathways

This component of the system knowledge file represents the disturbance states developed for each ecological site. They were used to determine the time spent within a size-class, when density changes over time, and the successional or disturbance processes that can influence each state and the resulting disturbance state should a process occur.

The primary modifications made to pathways include:

a. Species compositions, size classes and densities resulting from disturbance processes were made compatible with the ecosystem diversity framework developed for the BSLRP landscape assessment,
b. The light-severity-fire (LSF) disturbance process effects on historical stand conditions were assumed to support the maintenance of the existing size class (unless at the time step to transition to the next size class) and density.
c. The moderate-severity fire (MSF) (called mixed-severity fire in model inputs but we use moderate severity to describe fire intensity and mixed severity in reference to fire pattern) disturbance process effects on stand conditions were assumed to represent moderate severity fire where some of the overstory-trees are killed and the density of the stand is subsequently reduced but enough overstory trees remain to not change the existing size class (unless at the time-step to transition to the next size class).
d. The high severity fire (HSF) (model inputs refer to this as stand-replacement fire) disturbance process effects on stand conditions were assumed to remove all or most (>90%) of the overstory-trees and set the stand back successionally to a grass-forb-shrub-seedling size-class at time step 1.
e. Decadal time-step transitions were standardized across all size classes, densities, and ecological sites as identified in Table 1. Ecological sites on the extreme ends of the environmental gradient, specifically Hot Dry, Warm Dry, Moderately Warm Dry, Cold Moderately Dry and Timberline, were assumed to represent less productive conditions due to limitations in moisture or extreme temperatures, and required more time steps.
f. The resulting influence of a disturbance process on the originating state, in terms of size-class/time step, density, and species where applicable, was standardized as provided in Table 2.

Table E-1.

SIZE CLASS	TIME STEPS*	
	HD, WD, MWD, MWMD, COLD, TIM	All other ecological sites
GFS	3	3-5**
SMALL	3	3
MEDIUM	7	5
LARGE***	7	6
VERY-LARGE	Unlimited	Unlimited

*Each time step = 10 year period

** More time steps may be required on moister ecological sites where dense shrubs can shade incoming trees and slow stand initiation

***Species and species-combinations of AF, AL, BP, CW, LP, QA, PF, and WB, do not progress beyond LARGE due to maximum average diameter constraints.

Table E-2.

DISTURBANCE PROCESS	SIZE CLASS/TIME STEP	DENSITY	SPECIES*
Succession	+1	+1; no change at density 4	ALL
High-severity fire	Reset to step 1 of GFS size class	Not applicable	ALL
Moderate-severity fire	+1	-1; no change at density 2	ALL
Light-severity fire	+1	no change	ALL
DE-Beetle	+1	-1; no change at density 2	DF
Light-WSBW	+1	no change	DF,GF,AF,ES,L
Severe-WSBW	+1	-1; no change at density 2	DF,GF,AF,ES,L
PP-MPB	+1	-1; no change at density 2	PP
Light-LP-MPB	+1	-1; no change at density 2	LP
Severe-LP-MPB	+1	-2; no change at density 2	LP
Spruce Beetle	+1	-2; no change at density 2	ES
Root Disease	+1	-2; no change at density 2	DF,GF,AF

*includes any combinations of these species

Fire Event Logic

Fire Spread

Along with vegetative pathways, the fire spread logic screen was observed to be a primary driver of HRV results. The fire spread logic screen presents the opportunity to incorporate the interaction of forest structure, ecological setting, extreme weather events, and climate to influence the way fire spreads in the landscape and the severity of the resulting fire. Table E-3 presents the assumed interactions of the primary environmental variables as discussed previously. They are presented in a modified framework of the fire spread logic screen. This table includes the interaction of ecological site and forest structure (i.e., density) with the interaction of climate (i.e., wetter, normal, and drier) and average or extreme weather events. Information on ecological site relative to the environmental gradient in mid to late July and August, was used to develop expected fire spread type (LSF, MSF, HSF) in combination with climate/wind conditions. Groupings of ecological sites were developed from the USFS Region 1 classification system (Milburn et al.

2015), with the assumption these groupings represented most similar environmental conditions and vegetation response to fire.

Table E-3. The fire spread logic interactions between forest structure, ecological setting, extreme weather events, and climate that were assumed to influence the way fire spreads in the landscape and the severity of the resulting fire..

CLIMATE	Hot-Dry		Warm-Dry, Mod Warm-Dry, Mod Warm-Mod Dry		Mod Warm-Moist, Mod Cool Moist		Cool-Moist, Cool Mod-Dry		Cold Mod-Dry, Timberline	
	Weather Event									
	AVG	EXTREME	AVG	EXTREME	AVG	EXTREME	AVG	EXTREME	AVG	EXTREME
CLOSED (Canopy Cover >60%)										
WETTER	NONE	MSF	LSF	MSF	NONE	MSF	NONE	NONE	NONE	NONE
NORM	MSF	MSF	MSF	MSF	MSF	MSF	MSF	HSF	MSF	HSF
DRIER	MSF	HSF	MSF	HSF	MSF	HSF	HSF	HSF	MSF	HSF
MODERATE (Canopy Cover 40-60%)										
WETTER	NONE	NONE	LSF	MSF	NONE	LSF	NONE	NONE	NONE	NONE
NORMAL	LSF	MSF	LSF	MSF	LSF	MSF	LSF	MSF	NONE	MSF
DRIER	MSF	MSF	MSF	MSF	MSF	MSF	MSF	HSF	MSF	HSF
OPEN (Canopy Cover <40%)										
WETTER	NONE	NONE	LSF	LSF	NONE	LSF	NONE	NONE	NONE	NONE
NORMAL	NONE	NONE	LSF	MSF	LSF	LSF	LSF	LSF	NONE	LSF
DRIER	LSF	MSF	LSF	MSF	LSF	MSF	LSF	MSF	LSF	MSF

Fire Type

The fire type logic screen identifies the way a fire will burn (LSF, MSF or HSF) in a polygon at the point of ignition. This screen uses the same assumptions on the interaction of ecological sites (although grouped further) and forest structure to identify a fire severity for wetter, normal, and drier climate conditions.

Fire Spotting

The fire spotting logic screen identifies if and how an existing fire might spot at a distance out in front of itself and ignite a new fire. This screen uses similar assumptions on the interaction of ecological sites, forest structure, and extreme weather events to identify a probability for fire spotting.

Extreme Fire Spread

No change to the original inputs.

Fire Occurrence Input

One modification was made to the initial system knowledge files for fire occurrence input. Both ecoregion M333C and M332B-East had included a low elevation zone of higher fire occurrence (50% more occurrence) due to Native American influence. For consistency, an additional zone was developed for ecoregion M332B-West.

Fire Season

No change to the original inputs.

Fire Suppression Logic

No change to the original inputs.

Weather Ending Events

< 0.25 Acres – no change to the original inputs.
> 0.25 Acres

The Weather Ending Events (WEE) input screen was determined to be another important driver of HRV results. We initially started with WEE logic provided by the FNF and HNF system knowledge files, however, results indicate percentages were overly conservative and would not allow enough fire spread to simulate historical disturbance patterns. We also tried the default logic but these percentages were too lenient and caused too much fire and fire spread in the landscape. We then used the results of multiple test runs to calibrate the WEE logic to allow expected fire return intervals for fire severity type. Our assumption for needing to deviate from FNF and HNF developed logic is that this information was likely based on data developed from current fire weather ending event patterns which include fire suppression efforts. Fire suppression efforts are expected to reduce the size of the fire before it experiences a weather ending event, making the values too conservative, particularly in the larger fire size classes.

Species Attributes

No change to original inputs.

Regeneration

Fire – removed due to inconsistent size class outputs with the ecosystem diversity framework.
Succession – No change to the original inputs.

Regional Climate

No change to the original inputs.

Quantification of Historical Range of Variability

The SIMPPLLE model results were averaged within each of the 3-1000 year simulations by ecosystem. Standard error was calculated at 95% confidence intervals around the mean. The resulting mean and minimum-maximum standard error was then averaged across the 3 simulations by ecosystem and presented for each of the 3 ecoregions using the ecosystem diversity framework.

Quantification of Fire Return Interval

SIMPPLE model results were evaluated and summarized using calculations of fire return intervals for ecological sites for each of the 3 fire severity types (LSF, MSF, HSF) used in SIMPPLLE, as well as the overall fire return interval. The use of decadal time-frames for simulations impacted the ability to develop more precise fire return intervals as referenced in fire scar studies for the project area. Thus, the minimum fire return interval for a pixel in SIMPPLLE is 10 years, as only one fire event would occur in each decadal time step. The combination of fire return intervals and amounts of each historical ecosystem modeled by SIMPPLLE was evaluated compared to best available fire information for ecological sites applicable to the project area, and was considered adequate given the inherent limitations of landscape models.

APPENDIX G. ANALYSIS OF SCALE FOR QUANTIFYING FIRE REGIMES.

Fire regimes involve a pattern of fire severities that are assigned based on the distribution of these severities assessed at a specified scale. The criteria for designating the scale used when defining fire regimes does not have a sound foundation in the literature. This is particularly true when dealing with mixed severity fire regimes that are defined by a mix of different fire severities occurring across an area. Thus, defining the area of analysis for quantifying the fire regime of an area is an important component of historical fire analysis. In addition to the spatial component of a fire regime, there is also a potential temporal component, in that fire severity patterns may vary over time and location, complicating the designation of fire regimes.

The SIMPPLE model results were used to quantify the historical disturbance regime patterns for each of the 3 ecoregions occurring within the BSLRP project area. A moving window analysis was conducted in a GIS on the spatial output of 5 time-steps from one simulation. The results of the analysis were averaged and presented by ecological site. Steps used in this process included:

1) Using SOAP (USFS tool) to provide the x-y output from the SIMPPLLE results to develop a GIS layer for 5 time-steps (200, 400, 600, 800, and 1000 years) in one simulation.
2) The disturbance regime pattern was evaluated using a moving window approach in a GIS to evaluate the conditions surrounding each pixel. An evaluation of moving window size was conducted for 5 sizes – 3x3 pixels (~50 acres), 4x4 pixels (~90 acres), 5x5 pixels (~140 acres), 6x6 pixels (~200 acres), and 10x10 pixels (~560 acres). Disturbance states correspond to the 12 disturbance states representing tree size class and canopy cover presented in the ecosystem diversity framework. Table G-1 identifies which disturbance states were assumed to represent a low to moderate severity disturbance condition and high severity disturbance condition. Depending on the amount of low/mod severity vs high severity influenced disturbance states in the surrounding window, a disturbance regime would be assigned to the target pixel based on the criteria identified in Table G-2. The percentage of pixels representing each of the 4 disturbance regimes are presented for each ecological site.

Table G-1. Assumed distribution of disturbance states as influenced by low and moderate severity fires and high severity fires.

Low and Moderate Severity	High Severity
DS4, DS5,DS7, DS8, DS10,DS11	DS1, DS2, DS3, DS6, DS9, DS12

Table G-2. Criteria for designating a disturbance regime to an individual pixel.

Disturbance Regime	Low-Moderate Severity (% of pixels)	High Severity (% of pixels)
Non-lethal	>90%	≤10%
Mixed-severity A	≥ 50 but < 90	≥ 10 but <50
Mixed-severity B	≥ 10 but < 50	≥ 50 but < 90
Lethal	≤ 10	> 90

We evaluated scale of analysis relative to the pixel designation assigned for each using the criteria described in Tables G-1 and G-2, for each of the 5 moving window sizes. The minimum scale that could be assigned a fire severity was the pixel size of 2.4 ha (5.6 acres). While many fire starts may never reach 2.4 ha in size, this was a constraint in using the Region 1 version of the SIMPPLLE model. We found very similar results at the 50 versus 90 acre scales. However, as we increased the scale beyond 90 acres, we began to see declines in the non-lethal and lethal fire regimes. This indicated a greater homogenization of fire severities at these larger scales, with fewer areas containing <10% high severity or >90% high severity fire, which were the determinants of the non-lethal and lethal fire regimes. As there was little difference between the 50 and 90 acre scales, we conducted our fire regime determinations using the 90 acre scale. Table G-3 displays these comparisons for the M333C ecoregion. Analysis of the other two ecoregions produced similar results.

Table G-3. Comparison of fire regimes by ecological site determined for different sized analysis areas in the M333C ecoregion.

Moving Window Size/Fire Regime	**Ecological Site**							
	MWD	**MWMD**	**MWM**	**MCM**	**CM**	**CMD**	**COLD**	**TIM**
3X3 Window (~50 Acres)								
Non-lethal	56.7	41.4	35.9	49.4	35.8	23.8	28.0	13.0
Mixed-severity A	33.4	24.9	21.8	26.4	24.0	31.2	26.6	29.2
Mixed-severity B	9.5	29.3	33.0	19.7	30.1	39.0	25.5	42.2
Lethal	0.3	4.4	9.3	4.5	10.1	6.0	19.9	15.6
4X4 Window (~90 Acres)								
Non-lethal	34.6	28.6	28.1	36.5	26.2	15.1	17.7	8.0
Mixed-severity A	51.6	37.6	29.3	38.1	33.3	39.5	37.2	33.4
Mixed-severity B	13.4	29.4	33.7	21.2	30.5	39.2	25.7	43.3
Lethal	0.4	4.3	8.9	4.3	10.0	6.2	19.4	15.3
5X5 Window (~140 Acres)								
Non-lethal	28.4	27.0	26.7	34.0	23.7	13.3	14.0	3.2
Mixed-severity A	57.3	43.6	33.2	43.7	38.6	44.6	41.4	39.3
Mixed-severity B	13.7	26.8	33.0	19.0	29.6	37.0	27.0	45.8
Lethal	0.6	2.7	7.1	3.4	8.1	5.1	17.6	11.7
6X6 Window (~200 Acres)								
Non-lethal	24.4	22.0	24.0	31.6	21.2	11.9	13.4	3.5
Mixed-severity A	59.6	50.1	35.5	45.4	41.2	46.9	42.9	37.5
Mixed-severity B	15.3	25.3	35.3	19.8	30.9	36.5	27.4	50.2
Lethal	0.7	2.6	5.3	3.2	6.7	4.6	16.4	8.8
10x10 Window (~560 Acres)								
Non-lethal	41.6	36.6	58.9	57.5	23.6	15.3	9.7	2.3
Mixed-severity A	54.1	51.5	29.2	29.1	54.4	59.8	51.4	37.2
Mixed-severity B	4.1	9.4	7.8	11.0	19.5	22.9	33.6	49.9
Lethal	0.1	2.4	4.0	2.4	2.5	2.0	5.2	10.6

APPENDIX H. CURRENT CONDITIONS GIS DATA

Developed by the BSLRP SIMPPLLE Model GIS Data Preparation and used for both current condition analysis and the initial input file to the SIMPPLLE model (contact Chip Fisher)

This document describes the BSLRP SIMPPLLE Model GIS data preparation done and GIS data transfer to EMRI as part of the partner agreement. The BSLRP project area has portions of the Flathead, Helena, and Lolo Forests and separate SIMPPLLE model data preparation was used for each portion. The Flathead and Helena Forest portions of the BSLRP project area were being modeled in SIMPPLLE as part of the Forest Plan Revision process. Flathead and Helena portions were filled in using each Forests SIMPPLLE model data. The Lolo area was processed in a similar method as the Flathead SIMPPLLE model data preparation. This work was coordinated by Eric Henderson in the Northern Regional Office. An ArcGIS Toolbox with several models was used for most of the GIS processing *(SIMPPLLE_Toolbox.tbx).* All GIS data was in UTM 12N projection, NAD83 datum.

The Flathead, Helena, and Lolo SIMPPLLE model data preparation all had the same general process. Start with VMap polygon data, add SIMPPLLE model attributes, and then assign them using VMap attributes. Then create 150m polygon cells across the analysis area and attribute them from the VMap data.

GIS Datasets:

BSLRP VMap polygons (from Flathead, Helena, and Lolo VMap datasets)
BSLRP 150m polygons (150m cells created across BSLRP project area boundary)
BSLRP 150m polygon centroids (used to identify which VMap polygon a 150m polygon fell in)

Processing Steps:

1. Create project area VMap data set from Flathead FPR VMap dataset, Helena-LewisClark VMap FPR dataset, and Lolo base VMap dataset (based on 2012 Seeley Lake revision),
2. Attribute VMap polygons with Jones 2004 PVT 90m raster value based on majority occurrence in the polygon using LoadPvt model in SIMPPLLE_Toolbox
3. Attribute VMap polygons with tree species posterior probabilities from VMap data Random Forest Classification (done when VMap data was produced) using LoadSpecProb model in SIMPPLLE_Toolbox,
4. Attribute VMap polygons with three elevation classes and two aspect classes.
5. Add SIMPPLLE model attributes to VMap dataset using AddSimpAttributes model in the SIMPPLLE_Toolbox

a.	STAND_ID	Not assigned in VMap
b.	ACRES	Polygon Acres
c.	OWNERSHIP	General Ownership (FS-OTHER, NE-WILDERNESS, OTHER)
d.	FMZ	Fire management zone
e.	SP_AREA	Special Area (used to identify FLATHEAD, LOLO, and HELENA areas)

f.	LANDTYPE	Not used
g.	HT_GRP	Habitat type group (Jones PVT grouped up)
h.	SPECIES	Dominant non-forest or conifer tree species in polygon (1-4 conifer species)
i.	SIZE_CLASS	Size class of shrub or tree
j.	DENSITY	Canopy cover of shrub or tree
k.	PROCESS	Not used
l.	TREATMENT	Not used

6. Fill in SIMPPLLE model attributes added above from VMap attributes using several process steps

Note: The process below describes how the Lolo VMap data was processed. The same process was used on the Flathead and Helena VMap data for their SIMPPLLE model data preparation for FPR analysis. The SIMPPLLE model attributes for the Flathead and Helena portions were filled in from their FPR data using the FOREST_ID attribute to join the two datasets.

1. STAND_ID – This was not assigned in VMap data
2. ACRES – acres of VMap polygon but not used in 150m polygons (was recalculated)
3. OWNERSHIP – This was assigned based on an intersection of the project ownership layer and the VMap polygons. Three values were used: FS-OTHER (all non-wilderness Forest Service lands), NE-WILDERNESS (wilderness areas within Forest Service lands), OTHER (all non-Forest Service lands).
4. FMZ – This was assigned from the Flathead or Helena FPR VMap data used for their SIMPPLLE model attributing. For the Lolo a value of "1" was used.
5. SP_AREA – This was filled in from the VMap VMAP_FOREST attribute (FLATHEAD, LOLO, HELENA)
6. LANDTYPE – This was not filled in
7. HT_GRP – This was assigned from the Flathead or Helena Simple using the VMap PVT attribute (Jones 2004 PVT) cross walked to SIMPPLLE habitat type groups. The R1 FIA Summary Data was used to set goals for HT_GRP occurrence on each forest area and the HT_GRP assignments were adjusted by either Forest Staff or Eric Henderson to meet the goals.
8. SPECIES – This was assigned using a multi-step process and several additional attributes. For conifer vegetation types the SPECIES attribute is a list of dominant conifer tree species in the polygon. For example SPECIES = DE-L-LP indicates Douglas-fir, Western Larch, and Lodgepole Pine occur. The SPECIES attribute may have 1-4 conifer species in it from pure PP to WB-DE-ES-AF combinations. VMap polygons are labeled with a single dominant conifer type (for example PSME (Douglas-fir with >= 60% dominance or MX_PSME (Douglas-fir with 40-60% dominance mixed with other conifer species). To help assign multiple conifer species to VMap polygons conifer species posterior probabilities from Random Forest were attributed in the VMap data. The following conifer species posterior probabilities were added: PP (Ponderosa Pine), DF (Douglas-fir), GF (Grand Fir), L (Western Larch), LP (Lodgepole Pine), AF (Subalpine Fir), ES (Engelmann Spruce), WP (White Pine), C (Cedar), WB (Whitebark Pine), CW (Cottonwood), QA (Quaking Aspen), BP (Paper Birch), and PF (Limber Pine). The VMap polygon attribute data was

exported to a table and provided to Eric Henderson who ran an algorithm to assign multiple conifer species using the species posterior probabilities. The R1 FIA Summary Data was used to set goals for conifer specie assignments in the algorithm.

9. SIZE_CLASS – this was assigned using the VMap TREESIZE attribute cross walked to SIMPPLLE model SIZE_CLASS values. For non-conifer species Flathead and Helena-LewisClark Forest staff developed a SIZE_CLASS value based on Habitat Type Group and SPECIES combinations.
10. DENSITY – This was assigned using the VMap TREECANOPY attribute cross walked to SIMPPLLE model DENSITY values.
11. PROCESS – This was not filled in
12. TREATMENT – This was not filled in

APPENDIX I. WILDLIFE MODELS USED IN THE SPECIES ASSESSMENT

Black-backed Woodpecker (*Picoides arcticus*)

Habitat Description

The black-backed woodpecker is a relatively uncommon bird that breeds in the coniferous forests of the northern Rockies (Bock and Bock 1974, Dixon and Saab 2000). Multiple studies have documented irruptions in response to forest disturbance in the form of fire (Hutto 1995, Villard and Schieck 1996, Murphy and Lehnhausen 1998, Saab and Dudley 1998, Saab et al. 2007, Hutto 2008, Latif et al. 2013, Rota et al. 2014a), insects and disease (Lester et al. 1980, Goggans et al. 1988, Rota et al. 2014a), and wind (Wickman 1965).

Black-backed Woodpeckers are most commonly associated with recently burned stands (Hutto 1995, Kotliar et al. 2002). Black-backed Woodpeckers were 20 times more abundant in burned stands then unburned stands in northeast Washington (Kreisel and Stein 1999). Burned stands were typically used for breeding <7 years post fire, with the highest use in the first 3-4 years (Caton 1996). Murphy and Lehnhausen (1998) looked at black-backed woodpecker numbers for 3 years post-burn in Alaska and found high numbers the first two years with declining numbers in the third year. Similarly, Nappi and Drapeau (2009) studied black-backed woodpecker use of burns in boreal forest in Quebec, and reported high numbers in the first year post burn with declines in years 2 and 3. They also reported that nest success was 84% the first year post burn, declining to 73% in year 2 and 25% in year 3. Nest success was higher in burned mature forest than in burned younger forest. Hoyt and Hannon (2002) found that black-backed woodpeckers in boreal forests of Alberta occurred equally in 3-4 and 8 year old burns, but were not found in a 16 year old burn. Saab et al. (2007) reported that nest densities of black-backed woodpeckers peaked 4-5 years post-burn in an Idaho study area. Saracco et al. (2011) examined black-backed woodpecker numbers in different aged burns in the Sierra Nevada and found 4 times greater numbers in early years post-burn than 10 years post burn.

Tingley et al. (2014) reported home ranges of black-backed woodpeckers in areas within the Sierra Nevada that burned 2-5 years previously as ranging from 24-301 ha. Snag basal area was the best predictor of home range sizes with an exponential decrease in home range size with an increase in snag basal area, a relationship that explained 54-62% of the variation in home range sizes. Russell et al. (2007) found that areas that supported black-backed woodpecker nests in Idaho averaged 312 snags/ha compared to random locations that only contained 165 snags/ha. Russell et al. (2007) also found that pre-burn canopy closure was also greater in areas selected post-burn by nesting black-backed woodpeckers.

Black-backed woodpeckers also nest in unburned stands, but these stands usually have some degree of insect infestation or are adjacent to a burned stand (Goggans et al. 1988, Dudley 2005, Bonnot et al. 2009). Hoyt and Hannon (2002) did not detect any black-backed woodpeckers in old conifer forest stands in Alberta that were located within 50 km of a recent burn, but did find black-backed woodpeckers in old conifer stands that were 75 and 150 km from any recent burns. This could indicate that populations shift when recent burns are available, but can persist in areas without recent burns. However, Siegel et al. (2016) examined ages of black-backed woodpeckers in burns that were from 1-10 years old, and found that the age structure was heavily to young birds in the more recent burns while older birds were in higher proportion in the older burns, indicating that dispersal of young birds was the primary mode of occupancy in recent burns.

Rota et al. (2014a) examined summer wildfires, areas with mountain pine beetle infestations, and areas treated with fall prescribed fires in the Black Hills of South Dakota and found black-backed woodpeckers in all three types of conditions. However, nest success and juvenile survival were highest in the summer wildfire, intermediate in mountain pine beetle infestations, and lowest in fall prescribed burns. Rota et al. (2015) examined prey densities in these three types of conditions in South Dakota and found that foraging in summer wildfire areas would produce 2.2 and 2.0 times more beetles than in fall burns or mountain pine beetle infested areas, respectively. Rota et al. (2014b) examined home range sizes in these same three types of areas and reported the smallest home range sizes in 1-2 year post burn summer wildfire areas (mean 79 ha), and in 2-year old fall prescribed burn areas (mean 143 ha), with larger home range sizes in mountain pine beetle infested areas (mean 307 ha) and largest in 3-4 year post fire summer wildfire and fall prescribed burns (430 ha and 460 ha, respectively). They stated that recent summer burns were clearly important habitat for black-backed woodpeckers, but mountain pine beetle infested areas served as important post-fire habitat. Another study in the Black Hills of South Dakota (2009) examined black-baked woodpecker use of mountain pine beetle infested areas. They evaluated habitat selection at the scales of the territory (250m), nest site (12.5 m) and nest tree. At the territory scale, density of trees infested with pine beetles provided the best indicator of habitat quality. At the nest site, density of snags was the best indicator of habitat quality. The best indicator of quality for nest trees was the presence of aspen or ponderosa pine snags that were 3-5 years old. Nappi et al (2010) found that areas of low severity burns in Quebec provided snag conditions suitable for long-term presence of dead-wood associated insects and birds. They reported black-backed woodpeckers still abundant 6-8 years post-burn in these low-severity burns, a finding they attributed to the presence of beetle species such as *Arhopalus foveicollis,* a cermbycid with a long life cycle in dead wood. Tremblay et al. (2009) studied black-backed woodpeckers in unburned forests in Quebec and reported home ranges averaged 152 ha in the areas they surveyed. They found that home range sizes were influenced by the amount of old conifer forest, with smaller home ranges having larger amounts of old conifer forests and larger home ranges having lower amounts of old conifer forests and increased distances among old forest patches. Tremblay et al. (2014) looked at weights of black-backed woodpecker nestlings in unburned forests of Quebec and found higher weights of nestlings in home ranges with higher amounts of old conifer forest. These studies reveal that black-backed woodpeckers can persist in areas without recent burns if old conifer forests area present.

Nests have been documented in a wide range of tree species including ponderosa pine, Douglas-fir, western larch, spruce, lodgepole pine, mountain hemlock, and quaking aspen (Dixon and Saab 2000). Goggans et al. (1988) documented black-backed woodpeckers nesting in mature and old growth lodgepole pine stands following a mountain pine beetle epidemic. Lorenz et al. (2015) examined trees selected for nesting compared to random trees and found that trees having soft interior wood were the most influential factor in selection of nest trees. They cautioned that not accounting for the presence of trees with this characteristic may result in an over-estimation of available habitat for black-backed woodpeckers as well as other primary cavity nesters. Seavy et al. (2012) compared black-backed woodpecker nest trees to random trees in the Sierra Nevada. They found that the number of snags >10" DBH around a nest tree (within 11.3 m radius) was important. Preferred nest trees were dead but not heavily decayed and with diameters from 12- 25" DBH. Rota et al. (2014a) reported that black-backed woodpeckers in the Black Hills increased use of trees with increasing diameter and greater surrounding basal area of snags. Nappi and Drapeau (2011, 2009) studied black-backed woodpecker nesting and foraging sites in burned forests in Quebec and found that both pre-fire forest condition and fire severity influenced the use of areas post-burn. Nest success was higher in burned mature forest than in burned younger forest. Black-backed woodpeckers selected snags >8" DBH for nesting especially "degraded" snags and selected moderately burned snags >6" DBH for foraging. Snags selected for foraging were less decayed (Nappi et al. 2003) and had died more recently (Nappi et al. 2015). High density burned stands composed of ponderosa pine and Douglas-fir with a mean DBH of 39 cm were used for nesting in southwest Idaho (Saab and Dudley 1998).

A synthesis of the above findings shows that black-backed woodpecker habitat can be varied. In the northern Rockies, recent high severity burns are the preferred habitat of the species, where their home ranges are smallest and reproductive rates the highest. Rota et al. (2014a) suggested that burns of >200 ha in size are preferable. Preferred burn areas will have had fairly high densities of trees >8" DBH in pre-burn conditions resulting in high basal areas of snags in post burn conditions. Rota et al. (2014a) recommended areas with basal areas of >27 m^2/ha (117 ft^2/ac) comprised of trees >11" DBH. Saracco et al. (2011) reported that the importance of high basal areas of snags increased with time since burn, while Tingley et al. (2014) found that basal area of snags within recent burns was the primary factor influencing home range sizes. Recent burns are the preferred habitat, and may draw in black-backed woodpeckers from the surrounding landscape (up to 50 km) (Hoyt and Hannon 2002). However, black-backed woodpeckers can also persist in areas without recent high severity burns. Areas of old conifer forest can support black-backed woodpeckers. In unburned old conifer forests in Quebec, Tremblay et al. (2009) suggested that for optimum conditions these areas should contain considerable dead wood with at least some of this wood in an early decay state. Tremblay et al. (2010) recommended that in areas lacking burns in Quebec that management should maintain areas of at least 100ha of old conifer forest to provide enough recently dead snags to sustain black-backed woodpeckers in these areas. Saracco et al. (2011) found black-backed woodpeckers in the Sierra Nevada using a range of canopy covers, suggesting that they occurred in a range of fire severities, and that such heterogeneity may provide habitat longevity for the species. Rota et al. (2014a) found lower numbers in mountain pine beetle infested areas and areas of lower severity burn, but found that these areas could support black-backed woodpeckers and are important areas where recent high severity burns may be lacking. Nappi et al. (2010) reported that low severity burns are important as well as high severity burns as the varied burn intensities can help to maintain persistence of black-backed woodpeckers.

HSI Model

Excellent quality (1.0) black-backed woodpecker habitat is considered to be recently burned (less than 10 years post burn) high density stands with an average DBH greater than 8" that burned with high severity fire. These areas should be at least 200 ac in size. Recently burned moderate density stands that burned with high severity fire would be considered very good quality habitat (0.8), while stands that burned with moderate severity fire would be considered good quality habitat (0.6). Stands of similar compositions and structures that burned with low severity fire would be rated 0.6. These relationships are shown in Figures I-1 and I-2.

For unburned forest, the black-backed woodpecker model is based on patches of mature, dense conifer forest. Stands with a mean canopy tree diameter >8 inches DBH with preferred stands being >11” DBH, snag basal areas with good habitat having a high snag basal area as indicated by numbers of snags, and stands with high amounts of tree canopy cover (>60% preferable). The model variables used were mean DBH of canopy trees (Figure I-3), snags per acre (Figure I-4), and tree canopy cover (Figure I-5). The final HSI grid was calculated by multiplying the DBH HSI, snag HSI, and the canopy cover HSI. Only recent burns are considered to provide optimum habitat, with the highest quality habitat for black-backed woodpeckers in unburned stands set to a maximum of 0.5. Insect infested forest stands have been shown to be higher quality, but this is reflected in the number of snags occurring in these stands.

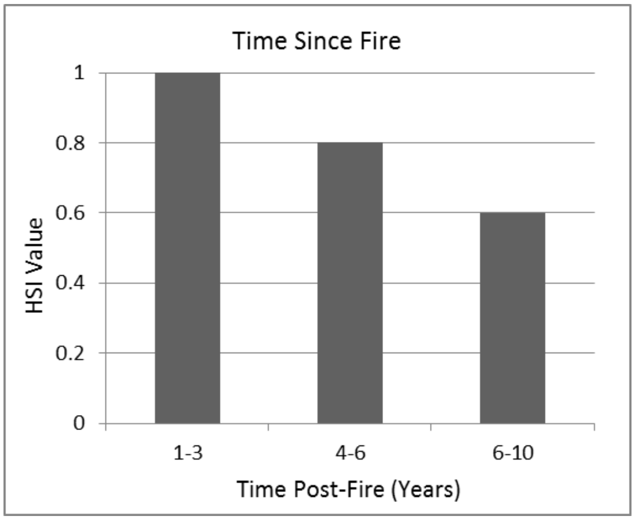


Figure I-1. Habitat quality ratings related to time since burn for stands that prior to burning had average DBH >8 in and were high density. Moderate density stands would reduce these values by 0.2 for each year post burn.

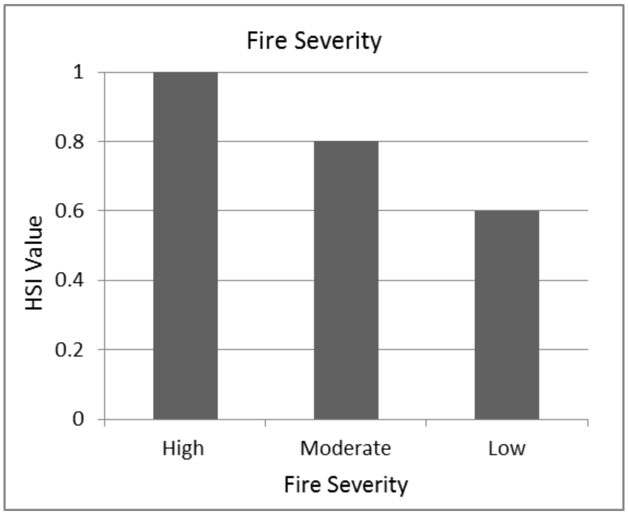
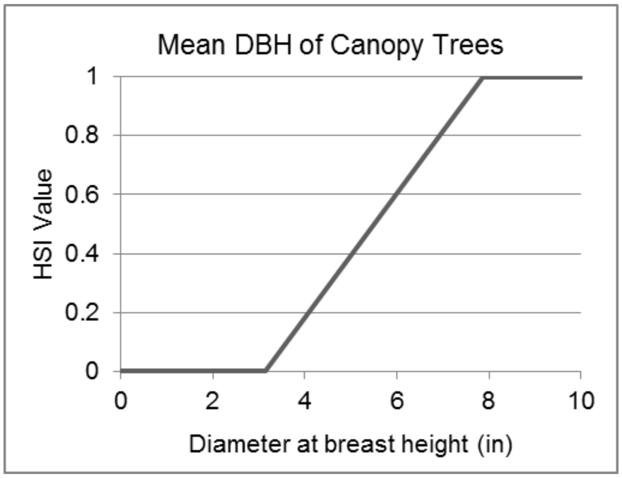


Figure I-2. Habitat quality of black-backed woodpecker habitat post burn adjusted for types of fire severity.



FigureI-3. Relationship between mean diameter at breast height of canopy trees and HSI values for black-backed woodpecker. The equation between 3.15 and 7.87 is *y=0.211x-0.667.*

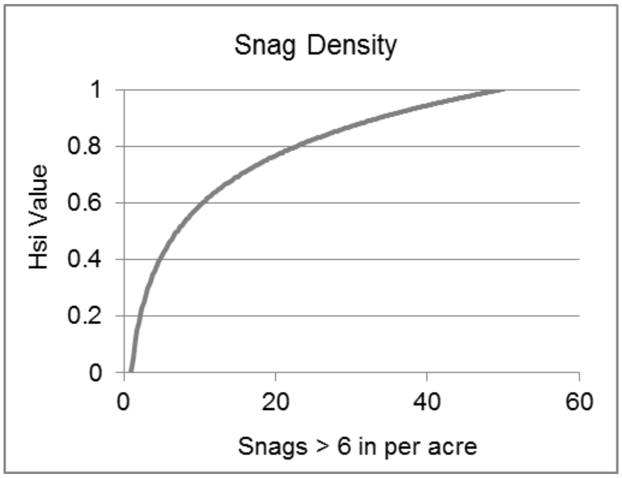


Figure I-4. Relationship between snag density and HSI values for black-backed woodpecker. The equation between 1 and 50 is *y=0.255ln(x)+0.002*. When x>50, y=1.

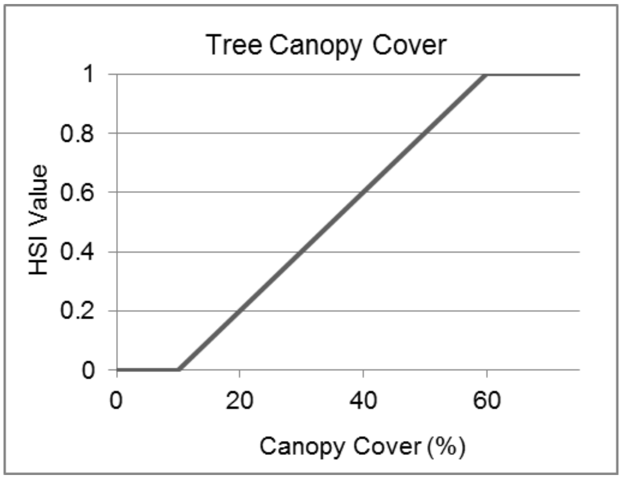


Figure I-5. Relationship between tree canopy cover and HSI values for black-backed woodpecker. The equation between 10 and 60 is *y=0.02x-0.2*.

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Fisher (Pekania pennanti)

The fisher is a medium sized forest carnivore that was nearly extirpated from the intermountain west, but was reintroduced in the mid 1960's (Powell 1993, Powell and Zielinski 1994). The current range of fisher is shown in Figure I-6.

Figure I-6. Current range of the fisher in North America (Patterson et al. 2005).

Habitat Description

In general, fisher habitat quality is highest in late-successional conifer stands (USFWS 2004). Specifically, fishers select for stands with canopy cover >50% (preferably 80-100%), large diameter trees (>18.5 in. DBH), multi-story stands, and high levels of coarse woody debris (Jones 1991, Powell 1993, Powell and Zielinski 1994, Purcell et al. 2009, Schwartz et al. 2013). Some studies, particularly in the southern Sierra, have found a preference for closer proximity to riparian areas (Jones 1991, Powell and Zielinski 1994, Zielinski et al. 2004). In north-central Idaho, old stands dominated by grand fir and Engelmann spruce were preferentially selected in the summer (Jones 1991, Jones and Garton 1994) while both younger and older stands were used in the winter. Fishers avoid non-forested areas (Jones and Garton 1994, USFWS 2004, Weir and Corbould 2010). Schwartz et al. (2013) studied fishers in eastern Idaho and western Montana. They reported that fishers selected areas that had the maximum DBH at stand scales and the largest proportion of stands with large trees at the landscape scale as well as selecting areas with higher canopy cover at the landscape scale. They noted, however, that there was support for stands with structural diversity including a mix of tree sizes. They also reported that fishers avoided ponderosa pine and lodgepole pine forests, and selected areas with snags and cavities present. Schwartz et al. (2013) did not find a preference for high canopy cover at the stand level in their study area, but noted that average stand conditions in their area had greater than 50% canopy cover.

Fishers require prey populations in proximity to two primary habitat features, resting sites and denning sites (Powell and Zielinski 1994). Resting sites provide protection from weather and predators and are preferred in close proximity to areas containing prey (Zielinski et al. 2004, Purcell et al. 2009, Aubry et al. 2013, Schwartz et al. 2013). It has been suggested that resting habitat is more important than foraging or traveling habitat with fisher consistently selecting mature trees even when in younger aged stands (USFWS 2011). Aubry et al. (2013) conducted a meta-analysis of studies that collected habitat information for fisher resting sites in the western U.S. and Canada. They reported that "selected sites for resting had steeper slopes, cooler microclimates, denser overhead cover, a greater volume of logs, and a greater prevalence of large trees and snags than were generally available." Purcell et al. (2009) reported that in the southern Sierras that fisher resting sites occurred more frequently on steeper slopes and closer to streams. Zielinski et al. (2004) studied fisher resting sites in several locations in California. They found that fishers selected resting sites that had dense canopies, large maximum tree sizes, and steep slopes.

Preferred nesting structures were large trees with live conifers averaging 117 cm DBH, conifer snags averaging 120 cm DBH, and hardwoods averaging 69 cm DBH. Zielinski et al. (2012) evaluated resting sites of fishers in northern California and reported that the best fit model included variables for canopy cover, tree age, total basal area, volume of large wood, and basal area of hardwoods.

Females use den sites for raising young. Den sites typically occur in large snags or live trees that offer a cavity or other structure for a female to den (Weir et al. 2012, Niblett et al. 2015). In Northeast British Columbia, all located den sites occurred in cavities in large aspen or balsam poplar (Weir et al. 2012), while a previous study in British Columbia (Weir and Harestad 2003) found den sites in large black cottonwoods.

Fisher et al. (2013) reported that fisher and marten appeared to avoid occupying the same area. The mechanism for this avoidance (i.e., was habitat selection different, was one species driving the other away, or was it mutual avoidance) was not determined, but if fisher were avoiding marten, this could be an additional factor to consider beyond habitat quality. Raine (Raine 1983) reported that fisher avoided soft thick snow, while marten was not limited by these conditions, providing one explanation of why fisher may not be found in some areas supporting marten, at least during those times and locations where deep soft snow may be present. Halsey et al. (2015) identified potential fisher reintroduction sites and reported that these sites should be outside of bobcat occurrence areas, as this felid predator on fisher could compromise reintroduction success. LaPoint et al. (2015) hypothesized that reductions in mesopredator populations that could effectively compete for larger food items of fisher could affect the ability of fisher to exist or expand into areas containing substantial competing mesopredator populations. Wengert et al. (2013) used molecular methods to confirm that bobcat, coyote, mountain lion, and domestic dogs were responsible for predation on fishers. These studies all point to additional factors that could influence fisher occurrence or densities in an area beyond the existing habitat quality identified for fisher. Similarly, trapping of fisher has been identified as a significant factor in their past extirpation from many areas, including Montana, and the residual influences of these past impacts can have a strong effect on fisher locations (Weckwert.Rp and Wright 1968, Vinkey et al. 2006).

Allen (Allen 1983) developed a fisher HSI model as did Olsen et al. (1999). Winter habitat is generally considered the limiting factor for fisher. Optimum winter habitat was assigned to mature stands with high tree canopy cover, and a diverse understory. Proulx (2011) tested a winter fisher habitat model by examining locations of fisher tracks in British Columbia compared to estimated values of stands. He rated the various cover types on British Columbia's vegetation mapping system for fisher habitat quality using a point system where he assigned to following values: "forest disturbance (presence: 0; absence: 4 points), age (≤ 60 years: 0; 61-80: 1; 81-100: 2; 101-120: 3; and >120: 5 points), presence of mature or old structural stages (2 points), basal area ≥ 20 m^2/ha in mature trees (1 point), ≥ 30% canopy closure (2 points), shrub cover (0%: 0; 5-20%: 1; 20-40%: 2; > 40: 3 points), and dbh ≥ 27.5 cm: 1 point." He found 66% of fisher tracks in polygons that were rated excellent quality and another 23% in polygons rated high quality and concluded that the rating system worked effectively for ranking fisher habitat quality within the project area. On average, stands with fisher tracks were 138 years old, had canopy closures of 54%, 38 m^2/ha (166 ft^2/ac) of basal area, average DBH of 27.8 cm (10.9"), and 11% shrub cover.

Zielinski et al. (2006) developed a fisher habitat model for California designed to be used with forest inventory plot data. This model included the following variables: average canopy closure, basal area of trees <51 cm DBH, average hardwood DBH, maximum tree DBH, percentage slope, and the DBH of the largest conifer snag. The model worked fairly well on the modeled data set, but less well on an independent data set.

Sauder and Rachlow (2014) studied fisher habitat use in northcentral Idaho using radio-telemetry. They found that fishers selected areas with the largest patches of mature forest that were in close proximity to similar patches and avoided areas with open areas. They found a rapid decrease in habitat selection for home ranges with increasing amounts of open area, with 20% of an area in open conditions having a probability of use of less than 0.2, a similar finding to that of Weir and Corbould (2010). The variable they found to best explain occupancy was a proximity index for mature forest that considered not only amounts of mature forest but also its configuration within a landscape, selecting areas that had large patches of mature forest arranged in complex but highly connected patches. They suggested that high quality fisher habitat consists of >50% mature forest with less than 5% open areas. Weir and Corbould (2010) reported that a 5% increase in open areas (recently logged areas or wetlands in their study area) would decrease fisher occupancy by 50%. Sauder and Rachlow (2015) examined fisher core use areas within home ranges of fishers and found that while fishers heavily utilized mature forests, they selected for areas that had habitat heterogeneity rather than uniform conditions. They attributed this to the need for fishers to have areas containing good den or rest sites mixed with areas that supported good prey populations. A landscape edge variable best accounted for this core area heterogeneity. Weir and Harestad (2003) found that fishers selected habitat components at stand, patch, and element scales. When desired habitat at larger scales was lacking, they reported that fishers could compensate by selecting desired elements of higher quality at finer scales, for example selecting larger trees in a stand for resting or denning sites where the stand had smaller that optimal tree sizes.

Olson et al. (2014) modeled existing and predicted future fisher habitat in Idaho and Montana. They used LANDFIRE vegetation maps for their model mapping, and used selected variables including tree height in 3 classes, canopy cover in 5 classes, and existing vegetation in terms of dominant species. Their model found that tree heights were the best predictor of fisher occurrences, likely a relationship to mature forests required by this species as reported in numerous other studies. They also found measures of proximity to riparian areas to be important. The coarse scale of these variables and their mapping in this study reduces the applicability of their model to habitat interpretations. The primary focus of Olson et al. (2014) was to evaluate potential future habitat conditions as influenced by climate change, with their modeling outputs considered at broad landscape scales and evaluating the role of future climate changes.

Home ranges of fishers have been estimated in several studies. Sauder and Rachlow (2014) reported home ranges of males averaged 98 km^2 while females averaged 49 km^2 in their study in northcentral Idaho. Sauder and Rachlow (2015) found that "core areas" in their Idaho study area averaged 33 km^2 for males and 19 km^2 for females. Weir (1995) reported winter home ranges for female fishers in British Columbia to be 26 km^2 during one year and 25 km^2 the next, with what he described as core use areas averaged 4.4 km^2 and 5.4 km^2 for the two years. Weir et al. (2009) studied home range sizes for fishers in British Columbia and found that females ranged from 10-81 km^2 with a mean of 38 km^2, while male home ranges ranged from 49-225 km^2 with a mean of 161 km^2. Weir et al. (2003) estimated that winter home ranges of females averaged 25 km^2 in their study area in British Columbia. Davis et al. (2007) used a home range size of 10 km^2 in modeling and evaluating habitat for fishers in California.

HSI Model

We developed an HSI model for fisher habitat based on the variables most applicable to fisher habitat in the northern Rockies. The primary variables we selected were tree canopy cover, overstory DBH, shrub cover, percentage of true firs, spruce, larch, and western red cedar in a stand, and a measure of landscape edge as reported by Sauder and Rachlow (2015).

The first variable is tree canopy cover (Figure I-7). Fishers have been found to avoid open areas and their prevalence increases with decreasing amounts of open areas in the landscape (Weir and Corbould 2010). In a regional assessment of fisher that reviewed studies through the Pacific Northwest, including research conducted in Montana and Idaho, it was shown that the most consistent predictor of fisher occurrence has been a preference for areas with a minimum of 30% tree canopy cover with use increasing with amounts of canopy cover both in Idaho (Jones and Garton 1994) and in the lake states (Thomasma et al. 1994). Proulx (2006) reported that fisher in British Columbia used stands with 30-60% canopy cover. Fisher in southeast British Columbia selected stands with >40% canopy cover (mean of 53%) in both summer and winter (Fontana and Teske 2000). Purcell et al. (Purcell et al. 2009) found that canopy cover was the most important variable in identifying fisher resting sites in southern Sierras. They reported selected canopy cover in the 55-60% range depending upon method of measurement.

The second habitat variable for fisher is mean DBH of overstory trees (Figure I-8). This variable helps address stand age and successional state as fisher occurring in heavy snow regions have been shown to prefer older, mid- to late-successional stands (Powell and Zielinski 1994). Fisher prefer stands with mean tree diameter >8" and suitability increases with tree diameter (Jones 1991, Jones and Garton 1994, Thomasma et al. 1994, Proulx 2006). Niblett et al. (2015) similarly found that fishers selected large trees for den sites in their study area in California, but that only a small proportion of an area needed to be in a late successional state with these large trees present. In their area, home ranges of 5 female fisher contained 25% of the plots containing large trees compared to only 6% of the plots containing large trees in the overall forest. Swartz et al. (2013) found that landscapes selected for use by fisher in Idaho averaged 47% stands of large trees while comparable available landscapes only had 29% of stands with large trees. Purcell et al. (2009) found that fishers selected the largest available trees for resting sites in the southern Sierras.

The third variable is canopy cover of shrubs ≥3 ft. in height (Figure I-9). In the Pacific states and northern Rocky Mountains fisher have been shown to prefer multi-layer stands and areas with high canopy cover (Powell and Zielinski 1994, Weir and Harestad 2003). Higher levels of horizontal cover created by shrubs and/or small trees are also important habitat for snowshoe hares (Litvaitis et al. 1985). Snowshoe hares have been shown to be the primary food source for fisher in Idaho and Montana (Jones 1991). During the winter months in western Montana snowshoe hares are most abundant in early successional stands and late successional heterogeneous stands with high levels of horizontal cover (Carreker 1985, Koehler and Aubry 1994, Thomas et al. 1997, Griffin and Mills 2007, 2009). Hare use reaches the highest levels when horizontal cover of above snow vegetation is ≥50% (Carreker 1985). Dense cover provides the hares with critical food, cover, and thermal protection (Litvaitis et al. 1985, Hodges 2000). When horizontal cover drops below 10% the habitat is considered unsuitable (Thomas et al. 1997). Horizontal cover has not been included as a variable in the fisher model at this time, but it may be desirable to add this variable to the model to better assess the potential abundance of snowshoe hare in an area.

In the intermountain west riparian areas have been shown to be preferred by fisher due to decreased snow depths, prevalence of spruce, moderating temperatures, or topographic features (Jones 1991, Powell and Zielinski 1994, Olson et al. 2014). However, this relationship may not be as important in areas supporting mixed conifer forests including areas with spruce and fir outside of riparian zones, so a riparian variable is not included in the HSI model. An additional variable could be added if additional research on this relationship applicable to the northern Rockies shows a definite selection for riparian areas in this area. Similarly, steep slopes have been noted by some researchers to be selected for fisher resting sites. However, as with selection for riparian areas, this selection may be landscape specific, so was not included in this habitat model.

A fourth variable is the absolute canopy cover of spruce and true fir (Figure I-10). Ecosites that contain spruce and true fir have been shown to be preferred by fisher for foraging and resting (Powell and Zielinski 1994, Proulx 2006). These types of stands have also been shown to provide good habitat for snowshoe hares (Griffin 2004).

In addition, based on the findings of Sauder and Rachlow (2015) and Weir and Corbould (2010) a variable was added to be applied at the home range scale that addresses the amount of openings within the area. This relationship (Figure I-11) was quantified by Sauder and Rachlow (2015), and would be a modification of the overall habitat quality value of the aggregate of stands within the home range area.

The HSI grid for fisher was calculated with the following formula:
$Fisher\ HSI=(Tree\ Canopy\ HSI \times DBH\ HSI \times (Min\ (1,\ [0.2+0.55 \times Shrub\ HSI+0.85 \times Spruce/Fir\ HSI])^{0.333}$

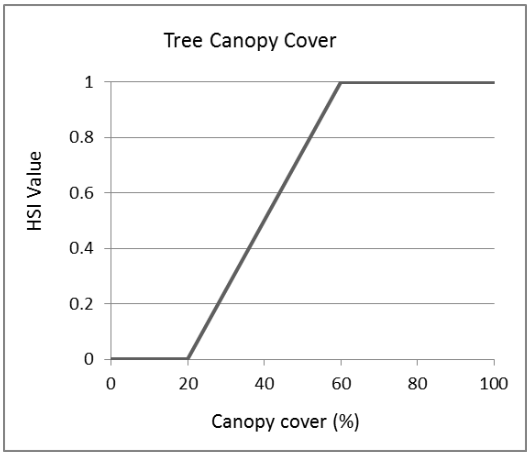

Figure I-7. Relationship between tree canopy cover and HSI values for fisher. The equation between 20% and 60% is $y=0.025x-0.5.$

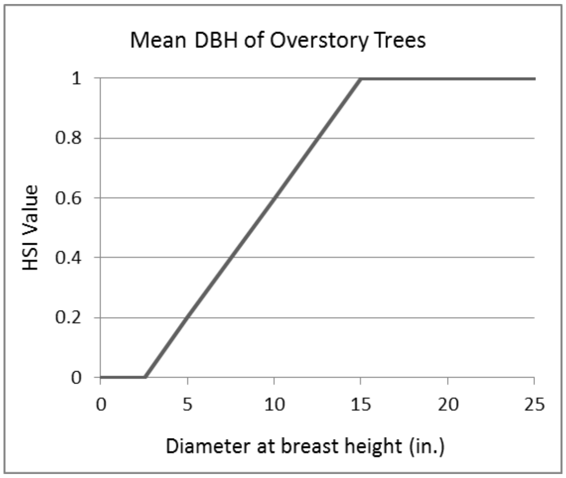

Figure I-8. Relationship between mean diameter at breast height of overstory trees and HSI values for fisher. The equation between 2.5 and 15 in. is *y=0.08x-0.2*.

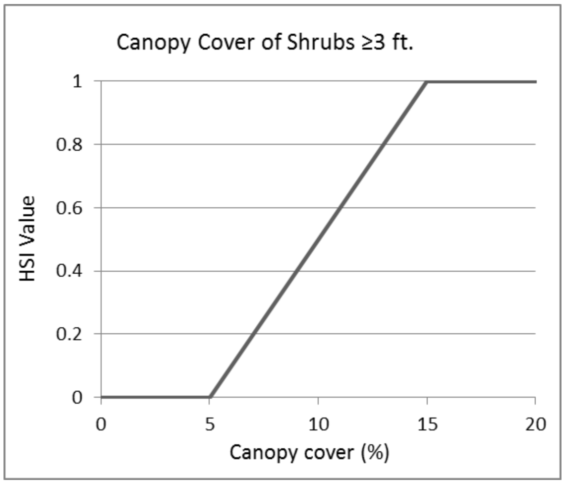

Figure I-9. Relationship between canopy cover of shrubs and HSI values for fisher. The equation between 5% and 15% is *y=0.1x-0.5*.

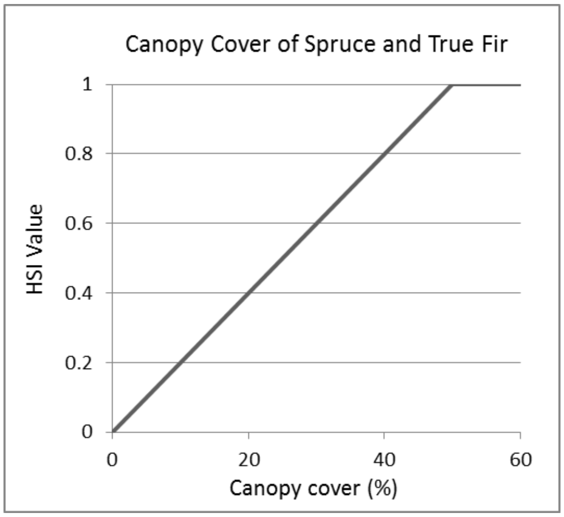

Figure 10. Relationship between the absolute canopy cover of spruce and true fir and HSI values for fisher. The equation between 0% and 50% is *y=0.02x*.

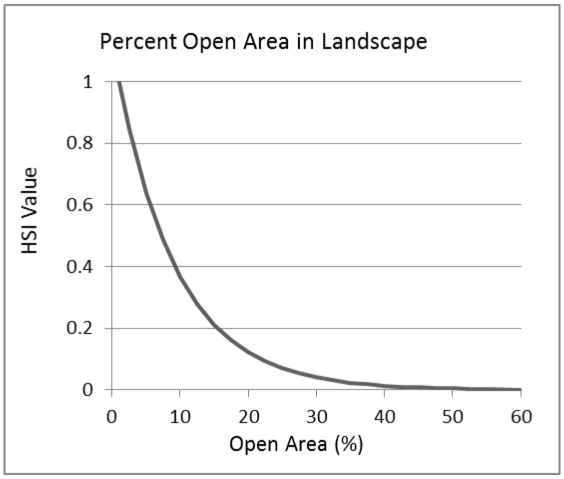

Figure I-11. Relationship between the percentage of open area in the landscape and HSI values for fisher. The equation between 0% and 50% is $y = 1.1146e^{-0.111x}$.

HSI values were determined for each vegetation category in the Southwest Crown of the Continent project area. Values for specific stand types were determined from FIA plot data applicable to the project area. For vegetation classes missing stand data values for each variable were estimated from the most similar vegetation conditions that had empirical data. HSI scores were then aggregated and contoured using a moving window analysis to produce the final input layer needed for HOMEGROWER. The size of the moving window is equal to the allometric home range (Roloff and Haufler 1997). The allometric home range for a 2.25 kg female fisher is 246 ha (Lindstedt et al. 1986).

Three iterations were done in HOMEGROWER. The target home range area was 5 times the allometric home range or 1233 ha. The number of seeds was 600,000 and the growth window was 10 cells. The final run results are presented below. The number of very low quality home ranges was not delineated because the high medium and low home ranges used up the available habitat for the 600,000 starting seeds.

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Flammulated Owl (*Otus flammeolus*)

Habitat Description

Figure I-12. Current range of the flammulated owl; red represents breeding resident (Ridgely et al. 2005).

Flammulated owls are a small owl found throughout the lower elevation valleys of western Montana (Figure I-12), but typically are limited to dry, conifer dominated stands (Groves et al. 1997). These low elevation stands are dominated by mature (age 50 to 100 years) to old (age > 120 years) ponderosa pine and Douglas-fir with multiple canopies, low stocking rates, open canopies, and moderate shrub cover (McCallum 1994, Groves et al. 1997). Flammulated owls have also been documented nesting successfully in stands dominated by Douglas-fir or mixed with trembling aspen and lacking ponderosa pine (Howie and Ritcey 1987, Powers et al. 1996). The mature trees are important for nesting while the younger trees and shrubs in the understory provide roosting areas and the openings facilitate foraging (Goggans 1986, Reynolds and Linkhart 1987). For example, tree densities in stands where males responded to callback surveys (typically roosting areas) averaged 202 trees per acre with a mean diameter at breast height from 11.1-15 inches (Groves et al. 1997). Due to their preference for dry conditions and intolerance of high humidity, riparian areas are considered non-habitat (McCallum 1994).

HSI Model

The flammulated owl model is based on optimum conditions for nesting, roosting, and foraging, however nesting habitat is considered the primary determinant of flammulated owl habitat. Flammulated owls prefer xeric, open, mature-old ponderosa pine and Douglas-fir with scattered clumps of dense younger trees (roosting areas) and a component of large snags (Christie and van Woudenberg 1997, Linkhart 2001). The habitat variables selected for this model characterize stands based on these optimum conditions.

The first habitat variable is ponderosa pine, western larch, and Douglas fir snags >20 in. DBH per acre (Figure I-13). As secondary cavity nesters it is critically important that flammulated owls have access to suitable nesting trees (McCallum 1994). Bull et al. (1990) found 88% of nest trees in Oregon (n=33) to be >20 in. DBH and 97% of nest trees to be either ponderosa pine or western larch. Occupied nest trees in south-central Idaho were found in either Douglas fir or aspen with a mean diameter of 19.6 in. (Powers et al. 1996). Douglas fir or ponderosa pine was the preferred nesting trees in both south-central British Columbia (Christie and van Woudenberg 1997) and Colorado (Linkhart et al. 1998). The purpose of this variable is to insure enough snags are present in a stand to keep the lack of nest sites from being a limiting factor.

The second variable is total canopy cover of the tree overstory (Figure I-14). Flammulated owls prefer open to semi-open stands for both nesting and foraging (McCallum 1994). Stands surrounding nest sites in Oregon had a mean canopy cover of 55% (n=33) (Bull et al. 1990). In British Columbia canopy cover surrounding nest sites ranged from 30-50% (n=35) (Christie and van Woudenberg 1997). In the Blue Mountains of Oregon stands used by nesting owls all had canopy cover <50% (n=20) (Goggans 1986). Callback surveys in Idaho found male owls occupying stands with canopy cover ranging from 52-64% (Groves et al. 1997), which was likely to represent roosting habitat. Samson (2006) considered stands capable of supporting flammulated owls when the canopy cover was between 35-85%. Based on these studies the canopy cover variable gives stands an optimum suitability rating when cover is between 30% and 50%.

The third variable used in the flammulated owl model was percent of maximum stand density index ($SDI_{\%max}$) (Figure I-15). The $SDI_{\%max}$ is a variable that provides more detail about stand conditions than trees per acre or basal area (Woodall and Miles 2006). SDI is a function of stand density based on the average specific gravity of trees in the stand. Each stand has a maximum density. The percent of maximum of the stand's current condition provides an accurate measure of stand characteristics and stand potential (Long and Daniel 1990). This variable allows the model to assign higher suitability to stands that are characterized by both large trees and open canopies. It also avoids assigning high suitability to stands that meet one criteria, such as basal area, while not meeting another, such as trees per acre. A $SDI_{\%max}$ of 25 indicates the onset of inter-tree competition, a $SDI_{\%max}$ of 35 indicates the lower limit of full site occupancy, and a $SDI_{\%max}$ of 60 indicates the lower limit of self-thinning (Long 1985). For flammulated owl, optimum nesting and foraging conditions are found between 10 and 20 percent of $SDI_{\%max}$.

The final habitat variable is ecological site (Figure I-16). This variable identifies ecological sites and disturbance regimes that are used by flammulated owl. They are consistently found in low elevation stands dominated by ponderosa pine and Douglas fir with open canopies and large trees (McCallum 1994, Christie and van Woudenberg 1997, Linkhart 2001). Sites can be further characterized by the lack of moist site indicator species such as *Salix* and *Vaccinium* (Wright et al. 1997). The habitat type HSI was based on the relative moisture of a site as indicated by the presence of understory species such as *Salix* and *Vaccinium*. In stands were these species are present the value for this variable is always zero.

The final HSI grid was calculated by multiplying the geometric mean of the snag HSI, canopy cover HSI, and SDI HSI by the habitat type HSI.

Samson (2006) developed a regional wildlife habitat relationship model for flammulated owls designed to assign habitat values to mapped classes of vegetation. The model used dominance group, canopy cover, aspect, structure class, snag density, and a relationship between basal area and tree diameter as variables. The dominance group and aspect variables are captured by the ecological site variable used above. Snag density and canopy cover are used in both models. The SDI variable used above provides a similar measure of stand density and structural diversity as the basal area/tree diameter variable used in the Samson model.

Figure I-13. Relationship between ponderosa pine, Douglas fir, and western larch snags per acre > 20 in. DBH and HSI values for flammulated owl. The equation between 0 and 1.5 is *y=0.6667x.*

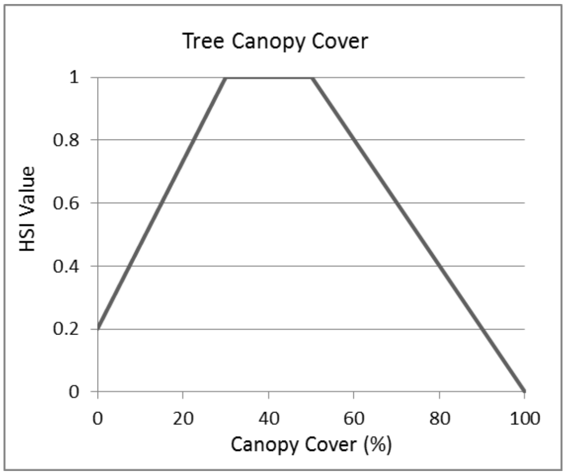

Figure I-14. Relationship between overstory tree canopy cover and HSI values for flammulated owl. The equation between 0 and 30 is *y=0.0267x+0.2* and the equation between 50 and 100 is *y=-0.02x+2*.

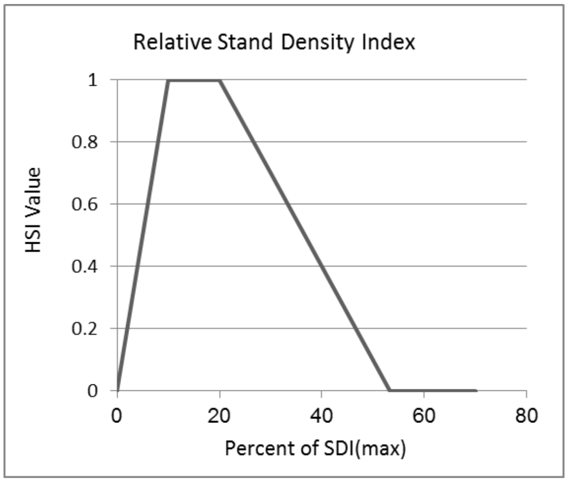

Figure I-15. Relationship between relative stand density index (for trees >6 in DBH) and HSI values for flammulated owl. The equation between 0 and 10 is *y=0.1x* and the equation between 20 and 53.333 is *y=-0.03x+1.6*.

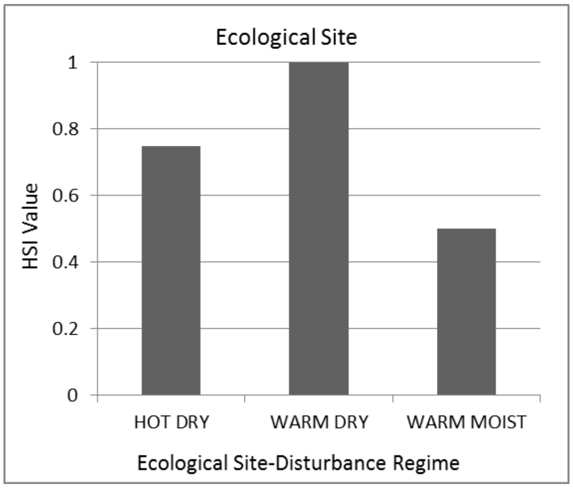

Figure I-16. Relationship between ecological site and HSI values for flammulated owl. Ecological sites (habitat type groupings) not listed received a rating of zero.

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Northern Goshawk (*Accipiter gentilis*)

Habitat Description

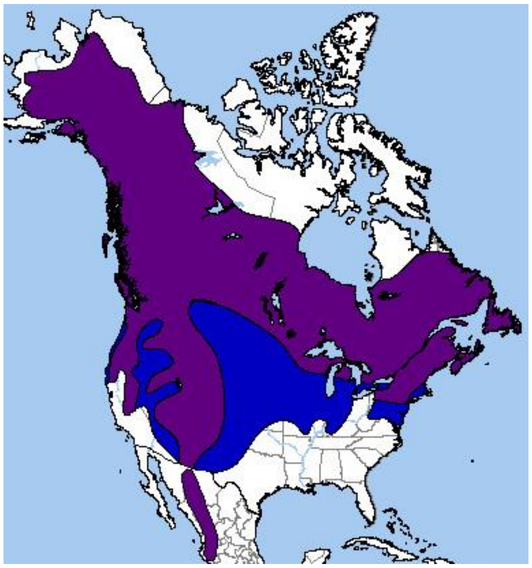

Figure I-17. Current range of the Northern Goshawk in North America; purple indicates permanent resident and blue indicates non-breeding range (Ridgely et al. 2005).

Northern goshawks are a large accipiter found in forested areas throughout the Rocky Mountains (Figure I-17) (Squires and Reynolds 1997). Northern goshawks have long been considered sympatric with mid-aged to old (140 years to >240 years) conifer stands and the bulk of available literature supports this (Reynolds et al. 1992, Daw and DeStefano 2001, Finn et al. 2002, Desimone and DeStefano 2005, Greenwald et al. 2005). The availability of small openings within mature stands has been suggested as important for both prey densities and foraging efficiency (Reynolds et al. 1992, Daw and DeStefano 2001), (Reynolds et al. 2008). Nest sites in particular require mature stands with high canopy cover, large trees, and multiple canopies (Crocker-Bedford and Chaney 1988, Hayward and Escano 1989, Squires and Reynolds 1997, Daw and DeStefano 2001, Greenwald et al. 2005) (Squires and Kennedy 2006, Reynolds et al. 2008). The size of the nest area varies considerably by region, but an area of 30 acres has been proposed as an acceptable average (Reynolds et al. 1992). Daw and DeStefano (Daw and DeStefano 2001) found similar conditions for nesting in 30-60 ac areas surrounding nests they studied in Oregon. In northern Idaho, the mean nest height was 41 feet, in trees with a mean height of 85.3 feet and a mean diameter at breast height of 19.7 inches (Hayward and Escano 1989). Also, the canopy cover around the nest was higher than the mean cover for the stand.

Ideal conditions for foraging are stands with a closed canopy, but an open understory that provides clear flight corridors (Reynolds et al. 1982, Hayward and Escano 1989). Goshawks in Oregon and Washington have been found to avoid open areas, such as meadows, shrublands, and logged early seral stands (<30 years in age) (Austin 1993, Bloxton 2002). Avoidance of mature stands with <40% canopy cover has also been documented (Austin 1993, Bright-Smith and Mannan 1994, Beier and Drennan 1997).

HSI Model

Separate nesting and foraging models were developed for goshawks. They were based on the framework described by Shaffer et al. (1999). Goshawk prefer mature stands with complex canopies, high canopy cover, a mix of deciduous and conifer species, and minimal human disturbance.

The first variable used in the nesting model is mean overstory tree height (Figure I-18). The purpose of this variable is to help predict the availability of large trees in the stand that are suitable for nesting. It also provides a measure of stand maturity. Goshawks in western Montana and Idaho nested in trees ranging from 39.4-157.5 feet (n=17) in height (Hayward and Escano 1989). Further work in the interior Pacific Northwest found a similar range of heights for nest trees (40.4-157.5 ft; n=82) (McGrath et al. 2003). A study in the Yellowstone region of Wyoming measured the heights of 49 nest trees and found a range from 39.4-124.7 feet with a mean height of 82 feet (Patla 1997).

The second nesting variable is overstory tree canopy cover (Figure I-19). Goshawks have been found to nest in stands with closed canopies (Crocker-Bedford and Chaney 1988, Hayward and Escano 1989, Squires and Reynolds 1997, Greenwald et al. 2005). Dense canopies provide protection both from predation (Reynolds et al. 1992) and weather extremes during the early portion of the nesting season (Moore and Henry 1983). Hayward and Escano (Hayward and Escano 1989) looked at 17 nest sites in Montana and Idaho that had mean canopy cover of 80% and a range from 65-90%. At 82 nest sites in Oregon and Idaho the mean canopy cover was 53.1% (McGrath (McGrath et al. 2003). In south-central Wyoming on higher elevation sites characterized by subalpine pine, Engelmann spruce, and lodgepole pine the mean cover at 39 nest sites was 66.7% (Squires and Ruggiero 1996). Also in Wyoming, Patla (1997) measured canopy cover at 44 nest sites and found average canopy cover to be 73%.

The third variable in the nesting model is basal area (Figure I-20). In eastern Oregon and Washington basal area was found to be a strong factor in the selection of nest sites, and was found to be more predictive of nest locations than stand structure (McGrath et al. 2003). Samson (2006) created a regional goshawk nesting model that used basal area as one variable. This study identified a range of basal areas from 104.5-257 ft^2/ac. A subsequent study (unpublished) on the Helena, Lewis and Clark, and Custer National Forests found that goshawks nest in stands with both higher and lower amounts of basal area. For this model the range of 104.5-257 ft^2/ac will be considered optimal habitat while recognizing that values on either side of this range can still support successful nest sites.

The final nesting HSI grid was calculated by using the geometric mean of the three preceding habitat variables. The second component of the goshawk model is the foraging HSI grid. The variables used for the foraging grid are discussed below.

The first variable is overstory tree canopy cover (Figure I-21). Northern goshawk physiology requires them to have somewhat open forest conditions to forage effectively (Reynolds et al. 1992). As the bulk of most goshawk diets in North America consist of mammals (86-94%) an open understory promotes foraging efficiency by making ground based prey vulnerable to goshawk predation (Shaffer et al. 1999).

The second variable in the foraging model is mean overstory tree height (Figure I-22). The variable is also used to target older, more mature stands that will have optimal habitat for goshawk foraging. The final foraging HSI grid was calculated by taking the geometric mean of these two variables.

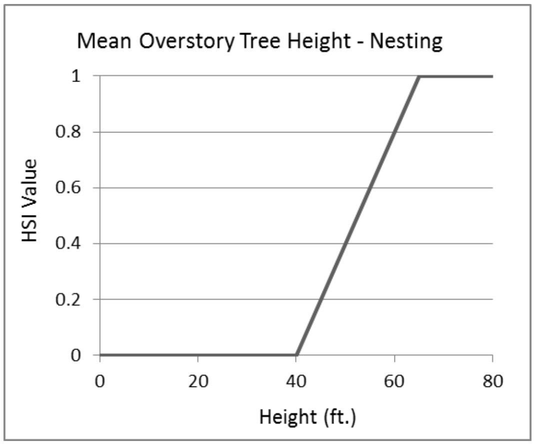

Figure I-18. Relationship between mean overstory tree height and HSI values for northern goshawk nesting. The equation between 40 and 65 ft. is *y=0.04x-1.6*.

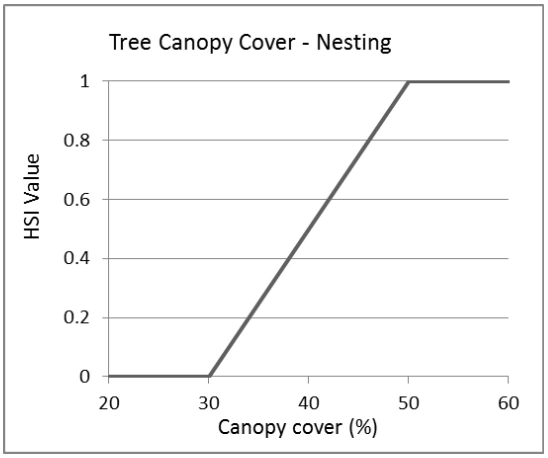

Figure I-19. Relationship between overstory tree canopy cover and HSI values for northern goshawk nesting. The equation between 30 and 50 is *y=0.05x-1.5*.

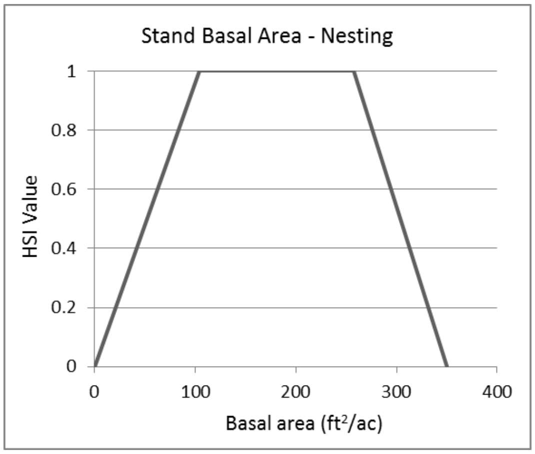

Figure I-20. Relationship between basal area and HSI values for northern goshawk nesting. The equation between 0 and 104.5 is *y=0.0096x* and the equation between 257 and 350 is *y=-0.0108x+3.7636*.

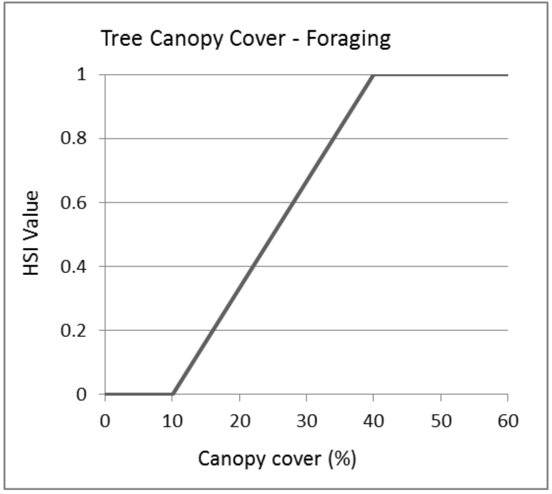

Figure I-21. Relationship between tree canopy cover and HSI values for northern goshawk foraging. The equation between 10 and 40 is *y=0.0333x-0.333*.

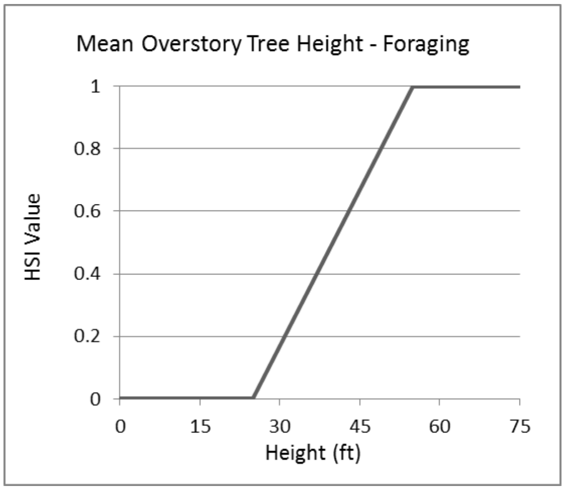

Figure I-22. Relationship between mean overstory tree height and HSI values for northern goshawk foraging. The equation between 25 and 55 ft. is *y=0.0333x-0.8333*

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Pileated Woodpecker (*Dryocopus pileatus*)

Habitat Description

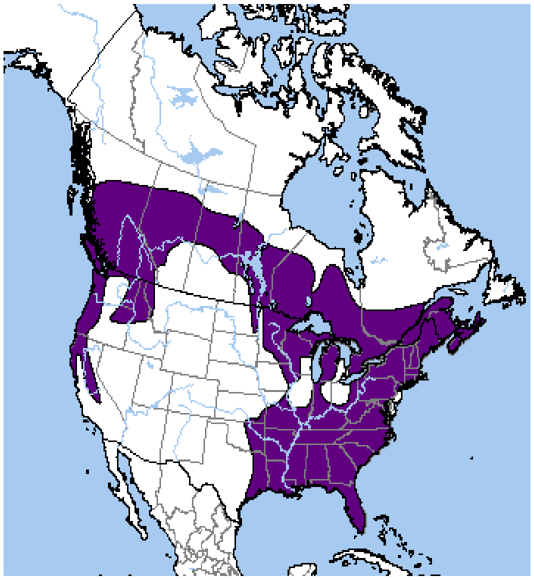

Figure I-23. Current range of the pileated woodpecker in North America (Ridgely et al. 2005).

Pileated woodpeckers are a primary cavity nester found throughout the United States (Figure I-23) in forested vegetation types (Bull and Jackson 1995). They generally occur in mature forests with partially closed to closed canopies and large diameter trees (Bull 1987, Aney and McClelland 1990). For nesting, tree size seems to be the most important variable with a variety of tree species used (Bull 1987, Aney and McClelland 1990, McClelland and McClelland 1999, Bonar 2001, Aubrey and Raley 2002).

Pileated woodpeckers primarily feed on ants (*Camponatus* and *Formica* spp.) (Beckwith and Bull 1985, Bull et al. 1992a, Bonar 2001). Thus, habitat that provides high suitability for ants should be suitable for woodpecker foraging, especially if it also provides overhead cover for protection from aerial predators. Avian predators are one of the leading causes of mortality for adult pileated woodpeckers (Bull et al. 1992b). Ideal ant habitat, and thus foraging habitat, consists of a mix of standing snags, stumps, and downed logs (Aney and McClelland 1990, Torgerson and Bull 1995).

The other important habitat characteristic for pileated woodpeckers is roost trees (Bull et al. 1992b, Aubrey and Raley 2002). Roost trees provide year round protection for mature birds and are important both for thermoregulation in the winter and protection from predation (Bull et al. 1992b). Roost trees differ from nest trees in that they can be completely hollow and have multiple entrances; however sizes are similar to nest trees (Bull et al. 1992b).

HSI Model

Roloff (2004) updated the pileated model developed by Aney and McClelland (1990) in order to account for new research and better integrate the requirements for roosting trees into a habitat model. The model presented here follows the framework of Roloff (2004). The first variable for the nesting component of the model is overstory tree canopy cover of preferred nesting species (Figure I-24). For the purpose of this model overstory trees are defined as trees ≥ 65 feet tall. Pileated woodpeckers require large trees for nesting and these are generally found in stands with low to moderate canopy closure (Bull 1987, Aney and McClelland 1990, McClelland and McClelland 1999). Moderate amounts of canopy closure provide better protection from avian predators (Bull et al. 1992b). Preferred tree species for nesting are western larch and ponderosa pine, likely due to the fact they quickly lose their bark and lower branches (Bull 1987). Other tree species used for nesting include cottonwood, aspen, Douglas fir, western white pine, and grand fir (McClelland and McClelland 1999, Bonar 2001, Aubrey and Raley 2002).

The second and third nesting variables are the densities of small snags (Figure I-25) and large snags (Figure I-26). Pileated woodpeckers nest in snags and decadent trees with a range of diameters and seem to prefer a mix of available size classes (McClelland and McClelland 1999, Bonar 2001, Aubrey and Raley 2002). Having two size class variables insures there is a good diversity of size classes present in the landscape.

The fourth variable for the nesting portion of the model is the average size of suitable nesting trees (Figure I-27). This variable supports the snag density variable by insuring that the majority of dead and decadent trees are suitably sized for nesting. Pileated woodpecker nest tree selection has been positively correlated to increasing tree diameter (Bull 1987). A minimum size of 15 in has been used in other models (Samson 2006).

The nesting HSI value is calculated with the following formula:

$$\mathit{Nesting\ HSI} = (((\mathit{Min}\ 1,(\mathit{Snag\ Density}_{small}\ \mathit{HSI} + \mathit{Snag\ Density}_{large}\ \mathit{HSI}) + \mathit{Snag\ DBH\ HSI})/2) * \mathit{Canopy\ Cover\ HSI})\text{\textasciicircum}0.5$$

The second component of the pileated woodpecker model is foraging habitat. Ants have been shown to be the primary food source for pileated woodpeckers during the breeding season (Beckwith and Bull 1985, Bull et al. 1992a, Bonar 2001) thus ideal foraging habitat provides optimal conditions for ants while also providing some overhead cover to protect woodpeckers from aerial predation (Bull et al. 1992b). The foraging component is composed of three habitat variables. The first variable is tree canopy cover (Figure I-28). Moderate amounts of canopy cover provide cover from predation while allowing open flight lines to facilitate foraging. This variable also helps insure the site being rated has forest cover.

The second variable in the foraging model is the density of preferred foraging sites (Figure I-29). As the amount of standing snags and downed debris increases so does the population of ants (Torgerson and Bull 1995). Downed wood has been found to be as important for foraging as standing dead wood (Bull 1987, Aney and McClelland 1990).

The final foraging variable is average tree size (Figure I-30). Pileated woodpeckers have shown a preference for foraging or large standing trees, with preference increasing with tree diameter (Raley and Aubrey 2006). Woodpeckers in Alberta also selected large trees for foraging (Bonar 2001).

The final foraging HSI score is calculated by taking the geometric mean of the three foraging habitat variables. The final pileated HSI is calculated with the following formula:

$$\mathit{Final\ HSI} = (((2 * \mathit{Nest\_HSI}) * \mathit{Forage\_HSI})\text{\textasciicircum}0.33$$

Samson (2006) developed a regional wildlife habitat relationship model for pileated woodpecker nesting and winter foraging. The model used dominance group, tree size (for nesting), and snag, log, and stump size (for winter foraging) as variables. The variables used in the habitat suitability model presented here are finer scale than those described for a Samson model, which was designed as a regional wildlife habitat relationship model.

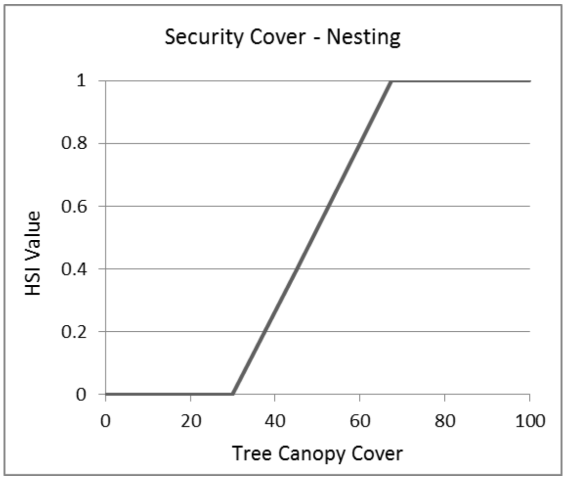

Figure I-24. HSI values for pileated woodpecker nesting based on overstory canopy cover of preferred tree species. The equation between 30 and 67 is *y=0.0267x-0.8*.

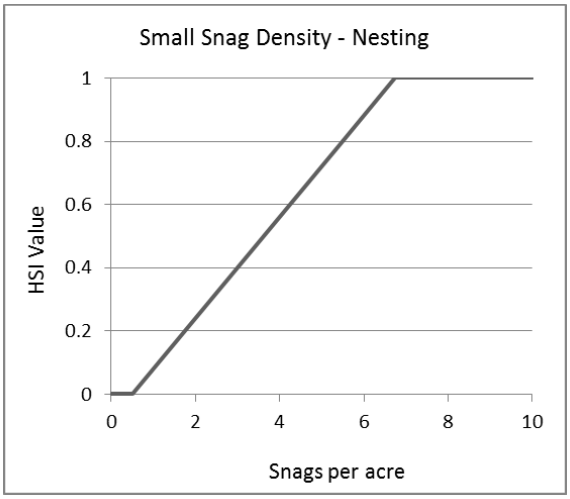

Figure I-25.HSI values for nesting habitat based on density of dead and defective larch, grand fir, ponderosa pine, and quaking aspen >15 in. DBH and >60 ft. tall. The equation between 0.5 and 6.75 is *y=0.16x-0.08*.

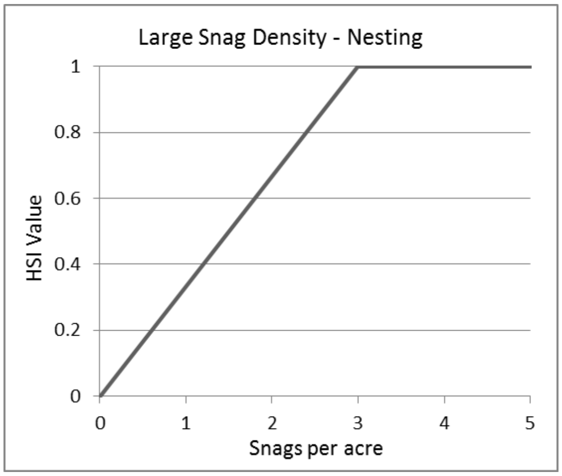

Figure I-26. HSI values for pileated woodpecker nesting based on density of dead and defective larch, grand fir, ponderosa pine, and quaking aspen >30 in. DBH and >60 ft. tall. The equation between 0 and 3 is *y=0.333x*.

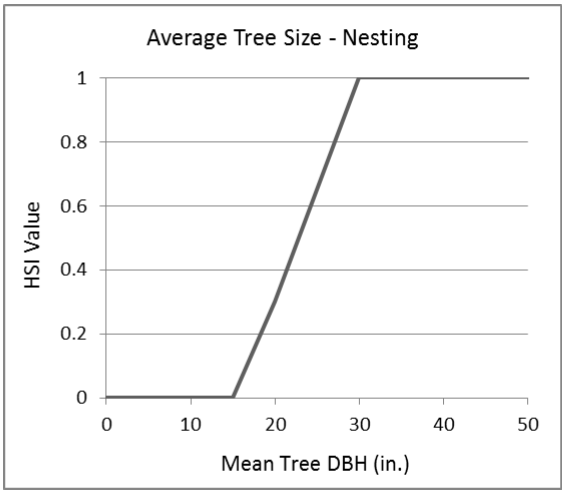

Figure I-27. HSI values for pileated woodpecker nesting based on average DBH (cm) of live and dead western larch, grand fir, ponderosa pine, and quaking aspen >20 in. DBH and >60 ft. tall. The equation between 15 and 30 in. is *y=0.07x-1.1*.

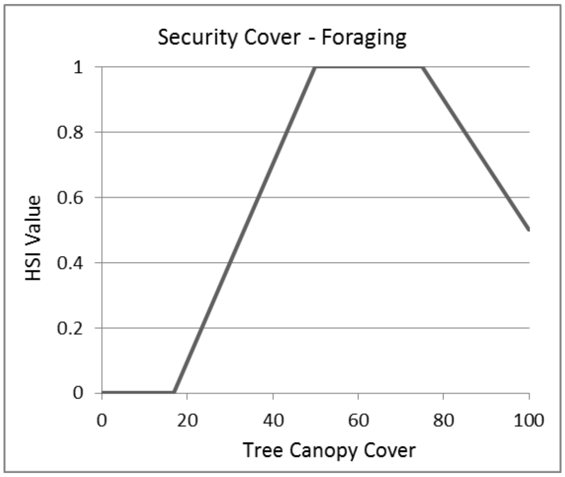

Figure I-28. HSI values for pileated woodpecker foraging based on overstory canopy cover. The equation between 16.67 and 50 is *y=0.03x-0.5* and the equation between 80 and 100 is *y=-0.02x+2.5*.

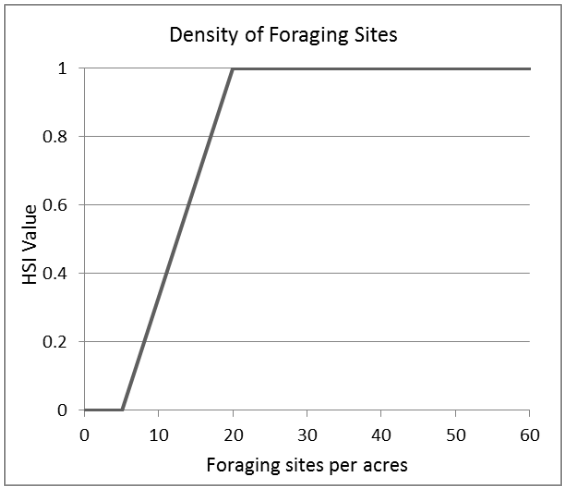

Figure I-29. HSI values for pileated woodpecker foraging based on density of dead trees >10 in. DBH plus logs >10 in. diameter and >6 ft. long. The equation between 5 and 20 is *y=0.0667x-0.3333*.

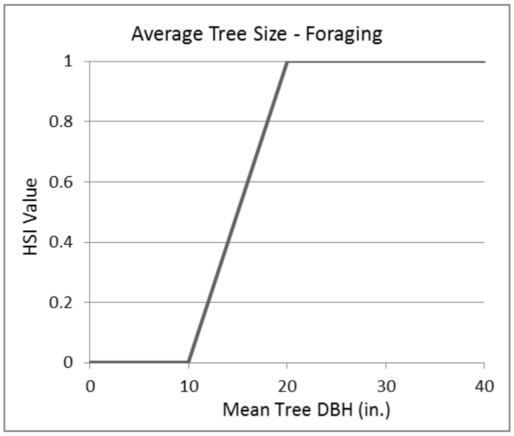

Figure I-30. HSI values for pileated woodpecker foraging based on the average DBH (in.) of overstory trees. The equation between 10 and 20 in. is *y=0.00394x-0.2333*.

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