Forest Composition and Structure Restoration Needs within the Clearwater Basin, Idaho

Clearwater Basin Collaborative Phase 2 Landscape Assessment

Photo: Kelley Creek, William H. Mullins

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Executive Summary - Background

Within the Clearwater Basin of northern Idaho, a diverse group of conservation, business, government, and tribal leaders have been working together through the Clearwater Basin Collaborative (CBC) since 2008 to resolve longstanding land management conflicts. The CBC sees great potential in the synergy between forest restoration and the forest industry to benefit the health of the Basin's forests, rivers, and its communities. Yet, due to a lack of comprehensive information on current ecological conditions across the entire Basin, it has not been possible to clearly define forest restoration needs or identify the long-term ecological, economic, and social outcomes of different forest management strategies. Without this information, it has been difficult for the CBC to reach shared understandings, articulate a clear vision, and speak with a unified voice on issues of forest management.

Working from the data, classifications, and models being used in the Nez Perce – Clearwater NF forest planning effort, *we have **documented current vegetation conditions and identified restoration needs in the forest landscapes encompassing the Nez Perce – Clearwater NF,*** across all forest ownerships and management designations. Ultimately, this information is intended to provide a foundation for the CBC and partners to develop and articulate a shared vision ***for where, how much and what types of forest management activities are needed across the Basin***. More immediately, this assessment defines forest restoration/management needs and provides ecological context for CBC conversations on forest management.

Executive Summary – Key Findings

- **Thirty five percent of all forested acres on the Nez Perce – Clearwater National Forest and adjacent ownerships (over 1.8 million ac.) are currently in need of disturbance to restore historic conditions**. These acres represent the actual footprint on which mechanical harvesting and/or fire is presently needed to modify present day forest structure and composition in order to place forest landscapes on a trajectory to their Natural Range of Variability.

- **Disturbance restoration needs were proportionally highest on lands classified as suitable for timber production within the Nez Perce – Clearwater National Forest (49% of coniferous forests / 353,000 ac.)**. In comparison, we found disturbance restoration needs on 35% of coniferous forests within no harvest zones (including inventoried roadless, wilderness, and riparian conservation areas) on the Nez Perce – Clearwater National Forest (982,000 ac.) and on 23% of private forests (176,000 ac.).

- **Disturbance restoration needs were dominated by the need for thinning / low severity fire within Dry and Low/Mid Moist forest biophysical settings.** Combined, the thinning / low severity fire and thinning / low severity fire then growth transitions accounted for approximately 70% of all identified restoration needs. However, the opening / high severity fire transition was also significant within the Low/Mid Moist and Subalpine biophysical settings and accounted for roughly 20% of all identified restoration needs.

- **Surprisingly, we found only 9% of all forested acres required time to grow into larger successional classes (alone or in combination with disturbance)**. However, the data and methods used in this analysis do not incorporate current or historic levels of old growth forest (sensu Green et al. 1992) and consequently local evaluations may identify greater levels of successional restoration needs.

- **Climate change will likely increase disturbance restoration needs.** When we used a subset of Warm / Dry years to represent the Natural Range of Variability reference conditions we found substantially greater disturbance restoration needs.

Executive Summary - Management Implications

This assessment provides a broad description of forest restoration needs across the Nez Perce – Clearwater National Forest and adjacent ownerships. These descriptions and associated data can both provide a foundation for developing and assessing progress towards restoration targets and provide context to incorporate landscape scale context into local restoration project planning. However, ***due to the limitation of the data and methods used, this assessment is not a replacement for the evaluation of local landscapes (1,000's to 10,000's of acres) and development of local landscape prescriptions***. Furthermore, this assessment focuses only upon forest condition as described by the abundance of successional classes within forest types and landscapes. ***Comprehensive ecological restoration must also consider a much broader range of ecological factors including terrestrial wildlife habitat, riparian and aquatic habitat, fire, insect, and disease frequency and severity***.

The results from this assessment indicate extensive forest restoration needs across all landscapes and management units. Consequently, ***achieving the scale and pace of landscape scale restoration needed within the Clearwater Basin will require attention and coordination amongst all forest ownerships and management designations and the entire suite of tools available to land managers, including timber harvests, prescribed fire, wildland fire, and protection***. The next challenge facing the Clearwater Basin Collaborative and Nez Perce – Clearwater National Forest land managers is determining a sustainable approach to address the forest restoration needs identified in this assessment while considering other ecological, social, and economic needs.

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Clearwater Basin Forest Restoration Needs

I. Objectives

Within the Clearwater Basin of northern Idaho, a diverse group of conservation, business, government, and tribal leaders have been working together through the Clearwater Basin Collaborative (CBC) since 2008 to resolve longstanding land management conflicts. The CBC sees great potential in the synergy between forest restoration and the forest industry to benefit the health of the basin's forests and its communities (e.g. Bollenbacher et al. 2014). Yet, due to a lack of comprehensive information on current ecological conditions across the Clearwater Basin, it has not been possible to clearly define forest restoration needs or identify the long-term ecological, economic, and social outcomes of different forest management strategies. Without this information, it has been difficult for the CBC to reach shared understandings and speak with a unified voice on issues of forest management.

Working from the data, classifications, and models being used in the Nez Perce – Clearwater NF forest planning effort, *we have* ***documented current vegetation conditions and identified restoration needs in the forest landscapes encompassing but not limited to the Nez Perce – Clearwater NF,*** across all forest ownerships and management designations. Ultimately, this information is intended to provide a foundation for the CBC and partners to develop and articulate a shared vision ***for where, how much and what types of forest management activities are needed across the basin***. More immediately, this assessment defines forest restoration/management needs and provides ecological context for CBC conversations on forest management.

II. Core Concepts

This assessment expands upon the methods of Haugo and Welch (2013) and Haugo et al (2015) and incorporates landscape scale data available from the US Forest Service Northern Region. Core concepts critical to interpreting and understanding the outputs of this assessment are described below.

Appropriate Spatial Scales: The data and methods used in this assessment are most appropriate at the scale of large landscapes (~100,000+ acres) and may be used to provide context within individual project areas (e.g, 10,000 – 50,000 ac. watersheds). However, the data and methods used in this study are not a replacement for local evaluations conducted during project planning. In particular, planning individual vegetation management and forest ecosystem restoration projects requires current condition data at a higher resolution and accuracy than the US Forest Service Northern Region Vegetation Mapping Program (VMap) v14 current condition data used in this study

Biophysical Setting: Biophysical settings represent the different types of forest found across the Clearwater Basin, based on factors including soils, climate, topography, species, and historic disturbance regimes. They are the natural building blocks that shape the inherent characteristics of forested landscapes. Within this study we have used the US Forest Service Region 1 Habitat Type Groups, as mapped by the US Forest Service Region 1 Potential Vegetation Type dataset (http://www.fs.usda.gov/detail/r1/landmanagement/gis/?cid=fsp5_030918) to represent forest biophysical settings (Figure 1).

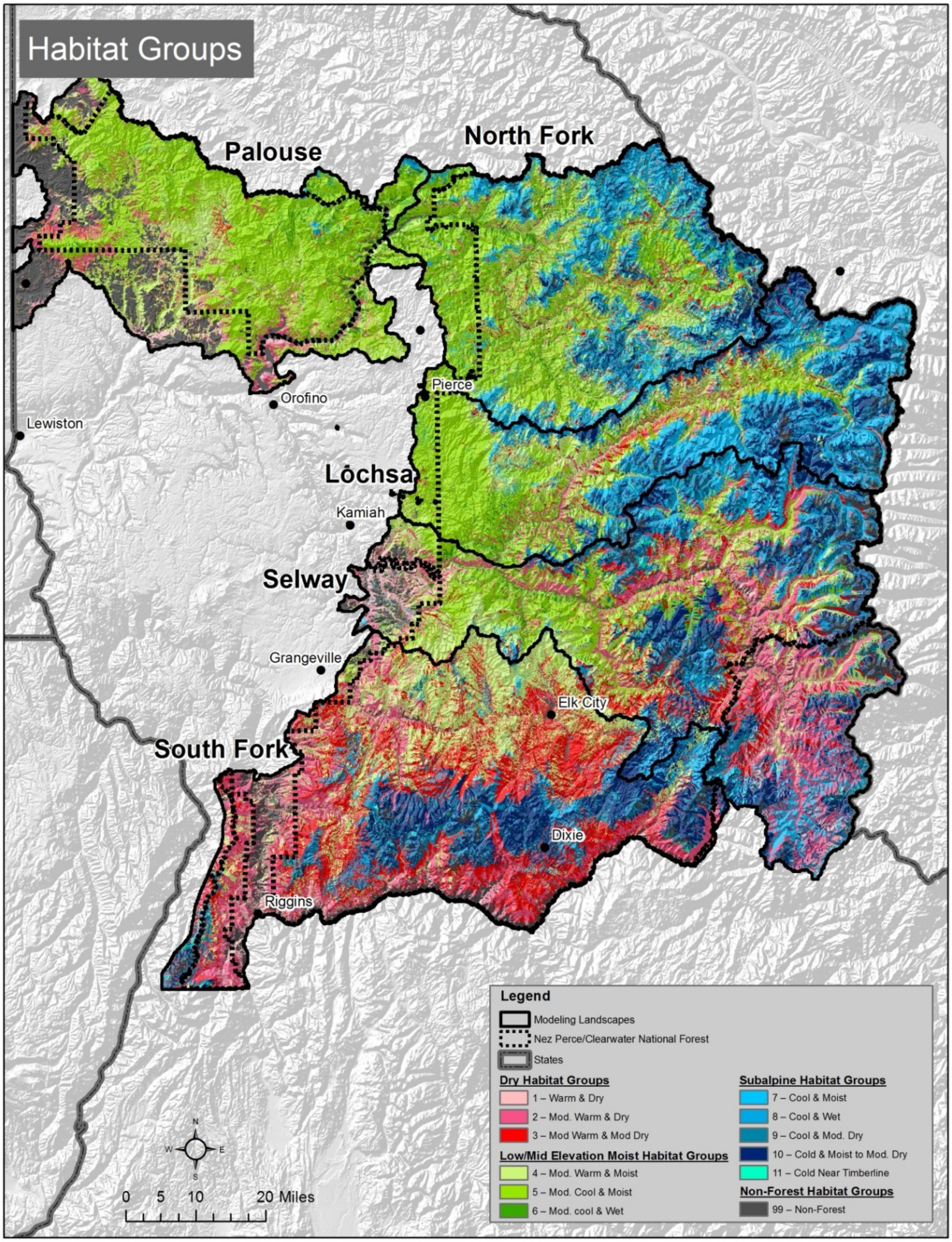


Figure 1. SIMPPLLE simulation Landscapes and Habitat Type Groups from the USFS R1 PVT data layer. The combination of landscape and Habitat Type Group forms the base analysis unit for this assessment.

Clearwater Basin Forest Restoration Needs

Successional Classes: All forests are in a continuous state of change. The forests we see today are shaped by many factors including but not limited to tree growth, fire, insects, disease, wind, and forest management. To capture the influence of these processes we have organized each Habitat Type Group into 9 successional classes based upon the size, canopy cover, and species composition of trees within a forested stand. ***Ecological condition (either current or historic) is based on the percentage of a Biophysical Setting in each successional class for a given landscape.*** These successional classes are based upon the Landfire / Fire Regime Condition Class Successional Class frameworks (Rollins 2009, Barrett et al. 2010), but are adapted to the US Forest Service Region 1 datasets. The successional classes used in this study are:

1) Grasses-shrubs-seedlings-saplings
2) Pole to medium sizes, closed canopy, shade intolerant species
3) Pole to medium sizes, closed canopy, shade tolerant species
4) Pole to medium sizes, open canopy, shade intolerant species
5) Pole to medium sizes, open canopy, shade tolerant species
6) Large to very-large sizes, closed canopy, shade intolerant species
7) Large to very-large sizes, closed canopy, shade tolerant species
8) Large to very-large sizes, open canopy, shade intolerant species
9) Large to very-large sizes, open canopy, shade tolerant species

See complete definitions for each successional class in the *Methods* section below. It is important to note that these successional classes and the data upon which they are based (VMap current conditions, SIMPPLLE NRV simulations) are not capable of identifying or assessing old growth forest conditions (Green et al. 1992).

Natural Range of Variability: The Natural Range of Variability (NRV) reference conditions represent how forested landscapes were shaped by succession and disturbance prior to European settlement (Landres et al. 1999, Keane et al. 2009). These data cannot be applied to any particular acre/pixel, but instead provide the expected distribution of successional classes across a landscape. NRV reference conditions were developed through SIMPPLLE simulations (http://www.fs.fed.us/rm/missoula/4151/SIMPPLLE/) for each forest planning landscape (Figure 1) as part of the Nez-Perce Clearwater NF forest planning process. The SIMPPLLE simulations were based upon pre-European settlement rates of succession and disturbance frequency and severity, determined from intensive literature and expert review. The resulting distribution of successional classes for each habitat type group does not represent a specific historical date, but instead approximates an equilibrium condition based upon the natural biological and physical processes. ***NRV provides a reference point to which we can compare today's forests. This does not mean that we must recreate NRV conditions across today's landscapes or that NRV represents desired future conditions.*** Desired future conditions must also account for a range of other ecological, social, and economic considerations. However, we are assuming that moving toward NRV conditions will result in increased forest health and resilience in the context of a changing climate.

Climate Change: During coming decades climate change will have a substantial impact on forest and aquatic ecosystems across the Northern Rockies and within the Clearwater Basin (EcoAdapt 2014). In evaluating forest restoration needs across the Nez Perce – Clearwater National Forest we consider climate change in two ways. While NRV reference conditions do not explicitly incorporate climate change, ***it is widely assumed that restoring forested landscapes to a NRV will increase forests' resilience and adaptive capacity to climate change*** (Agee 2003, Millar et al. 2007, Keane et al. 2009, Stephens et al. 2013). This is due to the fact that many of human caused impacts on forests over the past century (including wildfire suppression, harvesting of large fire and drought tolerant early seral tree species, increasing stand density) are in essence opposite the expected climate change impacts (e.g., increasing fire and drought stress). Second, we use the climatic cycles within our NRV simulations, based upon the Pacific Decadal Oscillation, to develop warm and dry reference conditions from a subset of simulation years (see detailed methods below). Consequently, we are able to compare forest restoration needs using all historic years as a reference point versus using only using warm-dry historic years as a reference point. While these warm and dry years do not completely capture projected climate change impacts, this allows us to evaluate how restoration needs may change if looking ahead to a warmer climate with decreased growing season soil moisture availability (Alder and Hostetler 2013).

Forest Restoration Needs: Simply assessing levels of forest departure does not describe WHY a forest is departed from historic conditions or what can be done to reduce departure. ***Our study evaluates where, how much, and what types of transitions are currently needed to move today's forested landscapes toward their NRV conditions.*** The restoration needs analysis determined for each biophysical setting and each landscape which s-classes were overrepresented and which were underrepresented compared to the NRV reference, and then how many acres would need to transition to a different s-class in order to move the present-day distribution of all s-classes to within the NRV reference. We categorized these specific transitions between s-classes as resulting from implementation of disturbance only, succession only, or disturbance then succession, based upon the identity of the excess and deficit classes (Figure 2). Disturbance transitions included a reduction in tree density / cover. Succession transitions included the growth of larger / older trees. Disturbance then succession transitions required both of these steps, reducing tree density / cover followed by growth of larger / older trees (Figure 2). ***Within this analysis we considered that the disturbance transitions between successional***

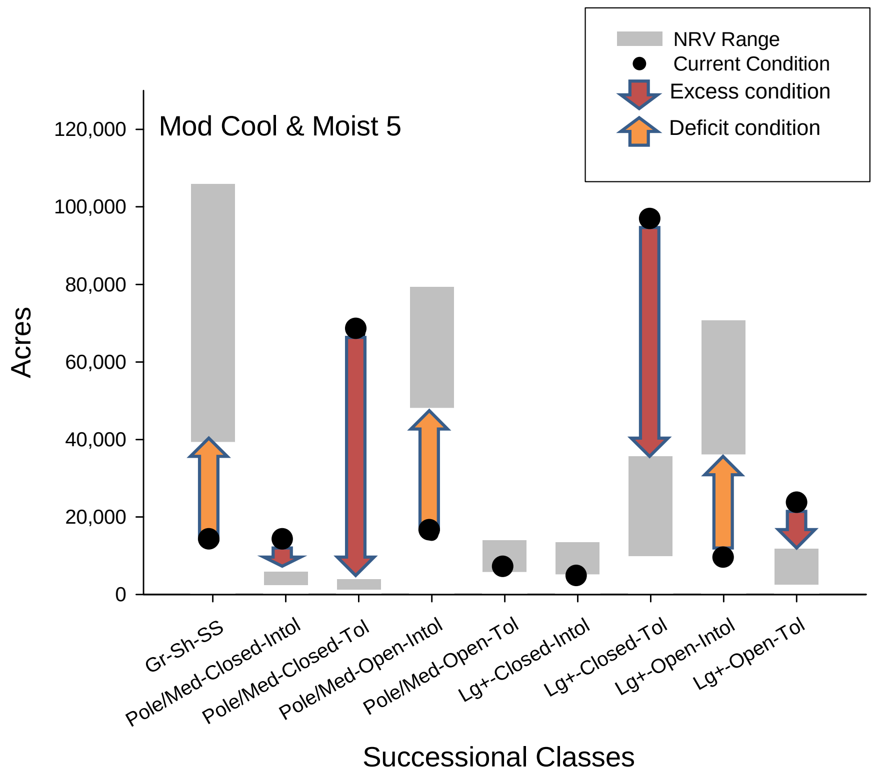


Figure 2. *Example of how the comparison of excess and deficit successional classes to Natural Range of Variability reference conditions (NRV) are determined for a strata (Habitat Type Group x Landscape Unit). NRV range from" all years" SIMPPLLE simulation. This example depicts the Habitat Type Group 5 – Moderately Cool and Moist in the Lochsa forest planning landscape.*

classes could be accomplished through either mechanical treatments or fire. Our intent is that these metrics of disturbance only, succession only, and disturbance then succession maybe used to track and characterize the impacts of harvests, fires, and other disturbances on the landscapes.

Western White Pine: The historical importance of western white pine (WWP) in the Clearwater Basin, both ecologically and economically, is widely noted (e.g., Fins et al. 2001, Harvey et al. 2008) and present day restoration of WWP is of great interest to both public land managers and the Clearwater Basin Collaborative. Unlike the Phase 1 Landscape Assessment (Haugo and Welch 2013), the presence/absence and abundance of WWP is incorporated into this assessment of forest restoration needs (see Detailed Methods below). The Phase 1 Landscape Assessment did not incorporate forest species composition and was based entirely upon forest structure (forest stand tree size and canopy cover). Within this assessment we consider restoration needs based upon departure of species composition, forest structure, and/or the combination of both structure and composition. Consequently, the landscape scale results presented in this assessment reflect the historic and present day dynamics of WWP. However, this framework does not provide a detailed assessment of site-specific WWP restoration opportunities or priorities. Instead, see the recent study by Crist et al. (2014) that provides a detailed assessment of WWP opportunities under current and potential future climate scenarios.

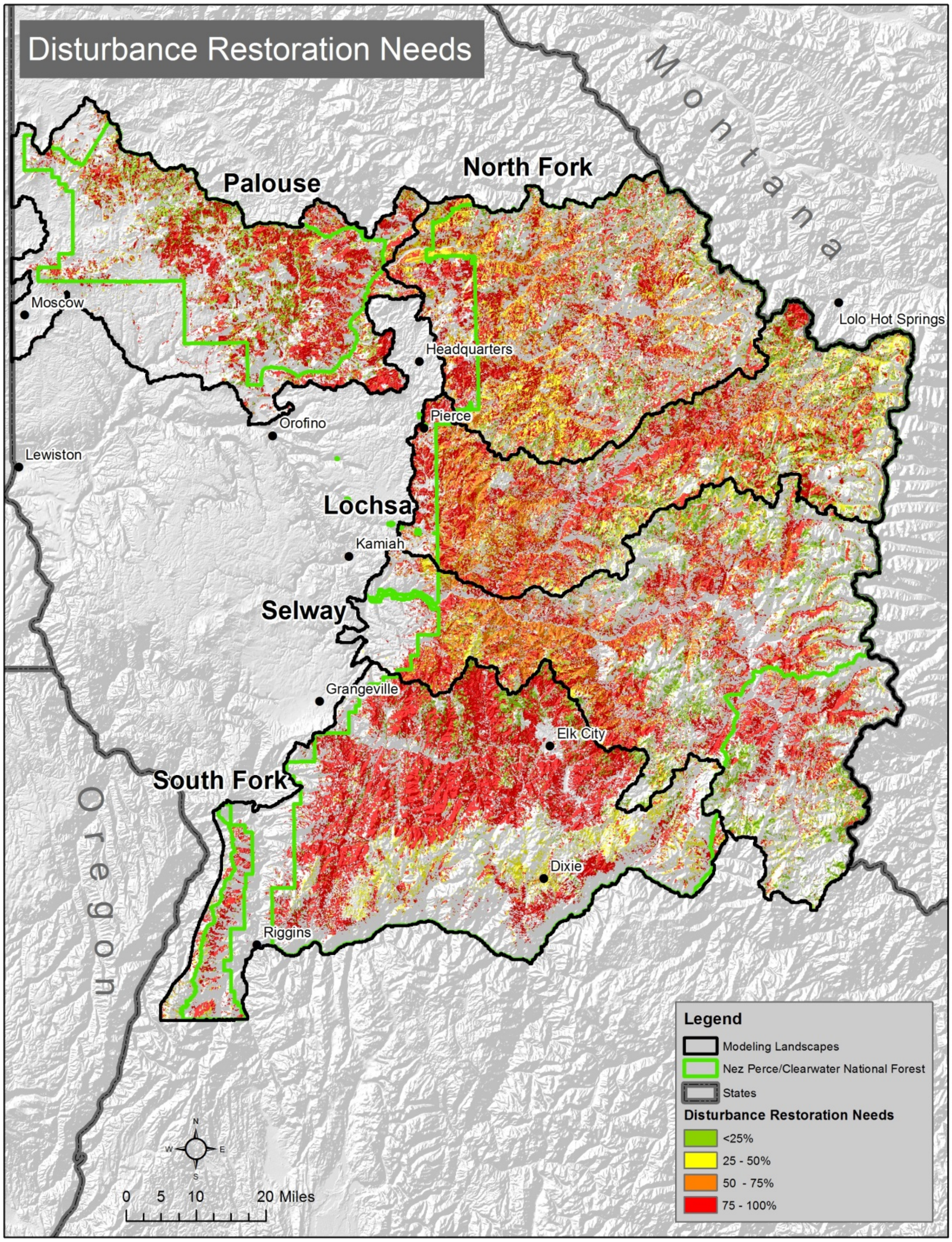


Figure 3. Disturbance restoration needs (Disturbance Only and Disturbance then Succession categories) across the Nez Perce – Clearwater Forest Planning landscapes. Values represent the percentage of strata (habitat type group by landscape unit) in need of a disturbance transition. Based upon All Years SIMPPLLE NRV simulation.

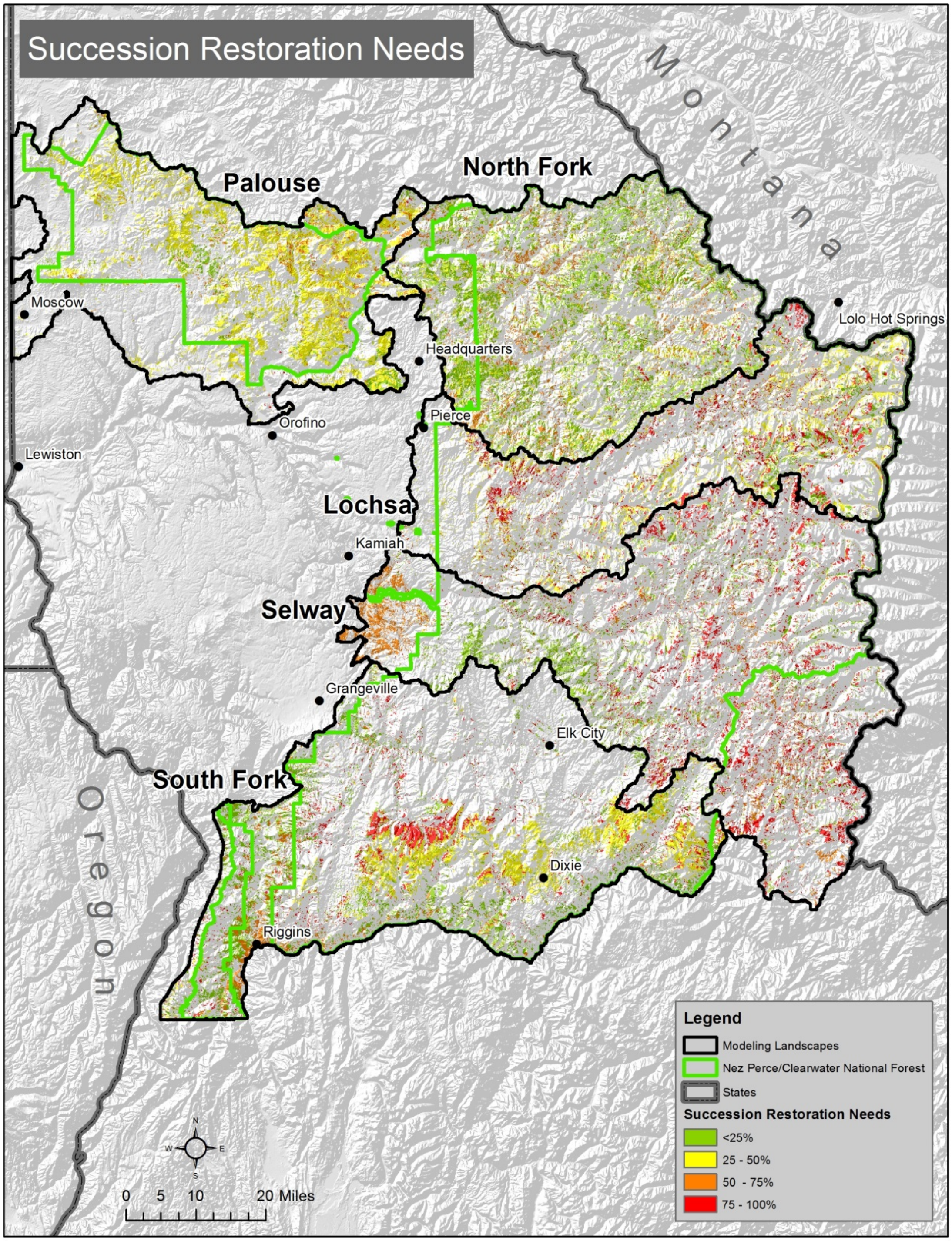


Figure 4. Succession restoration needs (Succession Only and Disturbance then Succession categories) across the Nez Perce – Clearwater Forest Planning landscapes. Values represent the percentage of strata (habitat type group by landscape unit) in need of a disturbance transition. Based upon All Years SIMPPLLE NRV simulation.

III. Results and Discussion

All Years NRV Restoration Needs.

Across all ownerships within our assessment area we found that approximately 37% of all forests (1.9 million ac.) are presently in need of transition to a different successional class in order to return to the All Years NRV reference condition (Figures 3 and 4). Disturbance was the most common restoration need with over 35% of all forests (1.8 million ac.) presently in need of disturbance (Disturbance Only plus Disturbance then Succession categories; Table 1).

Within the Nez Perce – Clearwater National Forest, we found disturbance restoration needs on nearly 1.5 million acres (Table 1). As percentage of all total forested area, disturbance restoration needs were higher on Nez Perce – Clearwater NF lands categorized as suitable for timber production (49% of forests; 353,000 ac.) and not suitable for timber production, some harvest[1] (45% of forests; 129,000 ac.) compared to lands characterized as not suitable for timber production, no harvest[2] (35% of forests; 982,000 ac.; Table 1). Private forests within our assessment had the lowest relative levels of disturbance restoration needs (23% of forests; Table 1).

Table 1. All Disturbance (Disturbance Only and Disturbance then Succession categories) and All Succession (Disturbance then Succession and Succession Only) restoration needs based upon the All Years NRV reference conditions by forest ownerships and by forest planning timber suitability categories on the Nez Perce – Clearwater National Forest. See Appendix A for summaries by landscape.

Ownership	Total Forest ac.	All Dist. Rest. Needs ac.	All Succ. Rest. Needs ac.
Federal Forests			
NP-CLW Suitable	724,000	353,000	47,000
NP-CLW Not Suitable, Some Harvest[a]	287,000	129,000	19,000
NP-CLW Not Suitable, No Harvest[b]	2,783,000	982,000	262,000
Other USFS Forests	374,000	95,000	43,000
Non Federal Forests			
Private	757,000	176,000	75,000
State, Tribal, Other	272,000	102,000	26,000
Total	**5,197,000**	**1,837,000**	**472,000**

[a] Includes landslide prone slopes, roadless within community protection zones, and municipal watersheds.
[b] Includes riparian conservation areas, inventoried roadless, wilderness, riparian conservation areas, wild and scenic rivers, and research natural areas.

The 1.5 million acres of disturbance restoration needs on the Nez Perce – Clearwater National forest in this study is substantially greater than the 768,000 acres of active restoration needs (analogous to Disturbance Only plus Disturbance then Succession) identified on the Nez Perce – Clearwater National

[1] Includes landscape prone slopes, roadless areas within community protection zones, and municipal watersheds.
[2] Includes riparian conservation areas, inventoried roadless, wilderness, wild and scenic rivers, and research natural areas.

Forest in the Phase 1 landscape assessment (Haugo and Welch 2013). The results of this study supersede those of the previous assessment due to the refinement of the restoration needs framework and the use of vegetation and current condition mapping and NRV simulations from local data sources compared to the national data sources used in Phase 1.

Surprisingly, we found successional restoration needs to be relatively low, with all successional restoration transitions (Disturbance then Succession plus Succession Only) combined equaling only 9% of all forests (472,000 ac.; Table 1). These results contrast with results from a similar study of forest structure restoration needs in fire dependent landscapes across Oregon and Washington where over 25% of all coniferous forests were in need of growing into larger/older successional classes (Haugo et al. 2015). The lack of successional restoration needs identified in this study may be the result of the size classes we have used to accommodate the SIMPPLLE and VMap data used in this study and the "mid-seral bulge" common in forests across northern Idaho. Across northern Idaho, extensive 20th century harvesting, wildfire suppression, and pervasive soil fungal pathogens have left many forested landscapes with a glut of stands ~60-90 years old, often known as the "mid-seral bulge" (Hagle et al. 2000, Hudson et al. 2001). While forest stands within our analysis may be part of a mid-seral based upon age, they are frequently large enough to be classified within our Large / Very Large (15+ inches diameter breast height). Given the limitations of our data sources, this analysis was unable to evaluate current or NRV reference levels of old-growth forest conditions (Green et al. 1992). In addition, the VMap current condition data set used in our analysis did differ in estimates of both size class and canopy cover abundance compared to Forest Inventory and Analysis (FIA) program plot data (see *Methods* below). It is beyond the scope of this study to determine whether these differences are due to recent wildfire and other disturbances, which are better represented in VMap than FIA, or other factors (see detailed comparison in *Methods* section below). Consequently, it is possible that local assessments will identify higher levels of successional restoration need within specific project areas. We do not believe, however, that these issues potentially impacting the levels of successional restoration needs also impact the identified disturbance restoration needs. The disturbance restoration transitions reflect either a needed transition to early seral (Grass-Shrub-Seedlings-Saplings), open canopy, and/or shade intolerant composition. None of these disturbance transition needs would be significantly influenced by the attribution of a stands as small/medium versus large/very large size class.

Overall restoration needs were highest within the South Fork, North Fork, and Lochsa landscapes where approximately 40% of all forests in each landscape were in need of transition to a different successional class to restore the "All Years" NRV conditions (Table 2, Figures 3 and 4). These levels are similar to the "active restoration needs" reported in the Phase 1 assessment for the South Fork and substantially greater than previously reported in North Fork and Lochsa (Haugo and Welch 2013). Within the South Fork and Selway landscapes, restoration needs were dominated by thin / low fire transitions within Dry habitat types (Habitat Type Groups 1-3; Table 2). Dry habitat types were much less common in the Lochsa, North Fork, and Palouse landscapes where restoration needs were again dominated by thin / low fire transitions, but instead in the Low/Mid Moist habitat types (Habitat Type Groups 3-6; Table 2). While the thin / low fire transition dominated restoration needs in each landscape and accounted for over 50% of all identified restoration needs, the opening / high fire and thin / low fire transitions were also significant with each accounting for roughly 20% of restoration needs (Table 2). Overall restoration needs were substantially lower within the subalpine habitat types (Habitat Type Groups 7-11; Table 2). As expected within the subalpine forests historically characterized by a high severity fire regime, opening /high fire was the most commonly needed transition (Table 2).

Table 2. Specific forest restoration need transitions based upon the All Years NRV reference conditions by Landscape and Habitat Types. Dry includes Habitat Type Groups 1-3, Low/Mid-Moist includes Habitat Type Groups 4-6, and Subalpine includes Habitat Type Groups 7-11. t = less than 500 acres.

		Disturbance Only			Disturbance then Succession		Succession Only	
Habitat Types	**Total Forest ac.**	**Thin / low fire ac.**	**Opening / high fire ac.**	**Overstory Thinning ac.**	**Thin / low fire + grow ac.**	**Other distrub. + growth ac.**	**Grow w/ fire ac.**	**Grow w/o fire ac.**
Lochsa								
Dry	65,000	26,000	10,000	0	1,000	t	t	t
Low/Mid Moist	400,000	156,000	21,000	0	27,000	0	0	1,000
Subalpine	414,000	3,000	63,000	0	41,000	0	1,000	0
North Fork								
Dry	54,000	18,000	8,000	0	2,000	0	t	0
Low/Mid Moist	549,000	172,000	24,000	0	65,000	0	0	0
Subalpine	335,000	10,000	52,000	0	23,000	0	1,000	0
Palouse								
Dry	99,000	22,000	2,000	0	t	t	1,000	1,000
Low/Mid Moist	651,000	130,000	0	0	77,000	0	0	0
Subalpine	7,000	1,000	1,000	0	1,000	0	0	0
Selway								
Dry	456,000	114,000	26,000	0	37,000	0	8,000	10,000
Low/Mid Moist	392,000	95,000	68,000	1,000	7,000	0	0	0
Subalpine	503,000	2,000	31,000	0	29,000	0	33,000	0
South Fork								
Dry	635,000	167,000	64,000	0	18,000	t	10,000	13,000
Low/Mid Moist	311,000	97,000	52,000	0	t	t	0	0
Subalpine	326,000	5,000	35,000	0	32,000	t	32,000	0
Total	**5,197,000**	**1,018,000**	**457,000**	**1,000**	**360,000**	**t**	**86,000**	**25,000**

Based upon the historic distribution of western white pine within the Clearwater Basin and the subsequent impacts of historical harvesting and white pine blister rust (Harvey et al. 2008), we assumed that current forest species composition would be a stronger driver of restoration needs in the Lochsa, North Fork, and Palouse landscapes than in the Selway and South Fork. Surprisingly, we found very few restoration needs due to species composition alone (Figure 5). Instead, within all landscapes the majority of the restoration needs that we identified were due to the combined departures of both present day species composition and forest structure compared to the All Years NRV reference conditions (Figure 5). Present day restoration needs are rarely simply the result of western white pine absence; there are also typically associated changes in stand structure. Outside the historic range of western white pine, we found comparatively higher levels of restoration need due to structural departures only in the Selway and South Fork Landscapes (Figure 5).

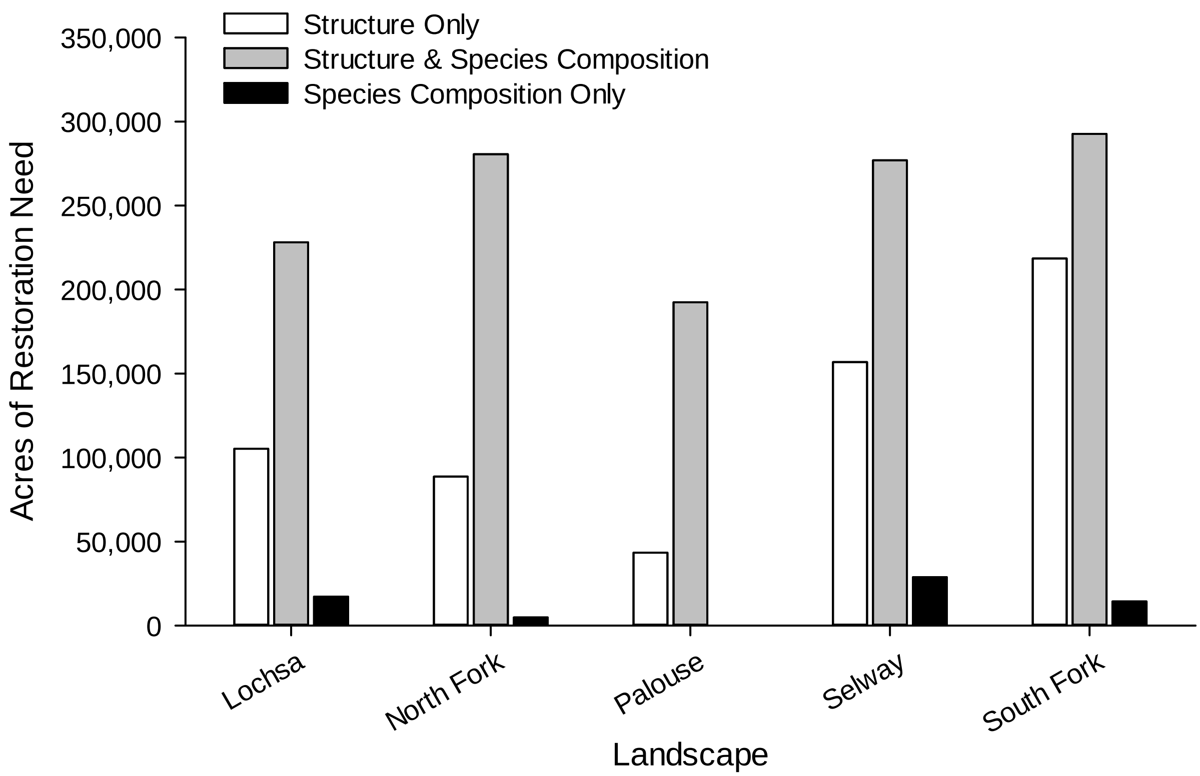


Figure 5. Restoration needs (combined Disturbance Only, Disturbance then Succession, and Succession Only) by landscape resulting from departure of presented day forest structure only (white bars), structure and species composition (gray bars), or species composition only (black bars) compared to All Years NRV reference conditions.

Warm-Dry and Cool-Moist NRV Restoration Needs

As expected, assessing restoration needs based upon the subset of Warm / Dry or Cool / Moist years from the SIMPPLLE NRV simulations compared to the All Years NRV reference condition dramatically altered the amount and type of transitions needed (Figure 6). These expected trends reflect the natural influence of climate variation on fire extent and severity, with more extensive and higher severity fires during Warm / Dry PDO cycles (Heyerdahl et al. 2008). Compared to the All Years NRV reference conditions, we found overall disturbance restoration needs (Disturbance Only and Disturbance then Succession; 1.8 million ac. All Years NRV) to be dramatically greater based upon the Warm / Dry reference conditions (2.5 million ac.) and reduced based upon the Cool / Moist reference conditions (1.5 million ac.) across our assessment landscapes (Figure 6). Restoration needs based upon the Warm / Dry reference conditions are also heavily concentrated within the Disturbance Only transitions (Figure 6), indicating expanded early seral and open canopy conditions with increased fire activity. Conversely, with Cool / Moist reference conditions the Succession Only transitions were a significantly greater proportion of overall restoration needs (Figure 6), indicating increased abundance of larger size classes, closed canopy conditions, and shade tolerant species with decreased fire activity.

Climate change projections for forests of the Northern Rockies generally indicate both increased drought stress and annual area burned (EcoAdapt 2014). The Warm-Dry reference conditions do not, and were not intended, to precisely capture projected climate change impacts. However, the Warm-Dry reference conditions do generally represent the trajectory that forests may take in response to climate change, an idea referred to by some as the Future Range of Variability (Gartner et al. 2008, Keane et al. 2009, Hessburg et al. 2013). That we found dramatically greater disturbance restoration needs with the Warm / Dry reference conditions demonstrates that the All Years restoration needs may be a conservative estimate and emphasizes the importance of meeting these needs.

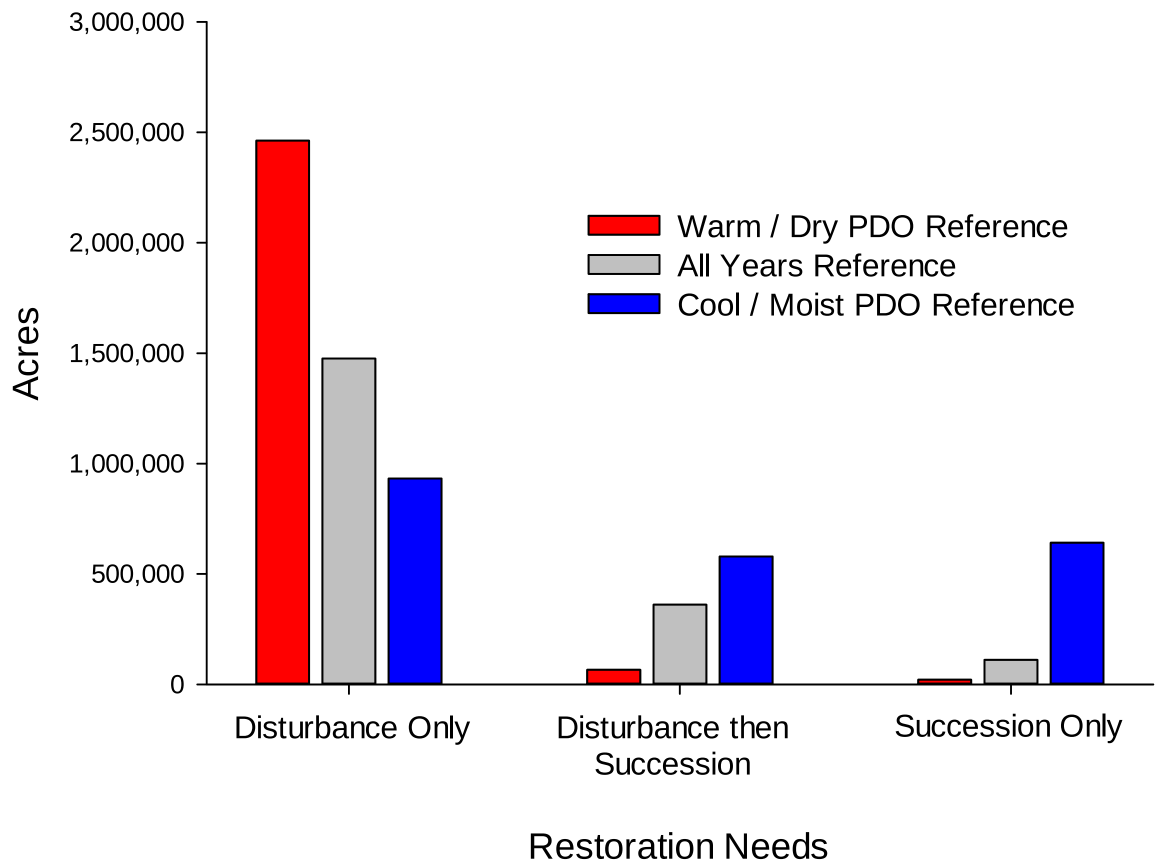


Figure 6. Comparison of restoration needs across the entire analysis geography for the entire All Years NRV reference conditions (gray bars) compared to the subset of Warm/Dry years only (red bars) and Cool/Moist years only.

Management Implications

The restoration needs that we have identified (Table 2, Figures 3 and 4) are consistent with our general understanding of past management and wildfire suppression impacts on fire-dependent forest ecosystems across western North America (Noss et al. 2006, Haugo et al. 2015), recent studies on the ecology and management needs of forests with a historically mixed severity fire regime (Halofsky et al. 2011, Franklin et al. 2013, Stine et al. in press), and recent acknowledgement of the importance of complex, early seral habitats (Hutto 2008, Swanson et al. 2011). However, ***it is important that the disturbance needs reported in this study are considered with respect to spatial patterns of patch size and arrangement at stand and landscape scales*** (Perry et al. 2011). Historically, spatial patterns within Dry and Low/Mid Moist forest stands were likely characterized by high levels of heterogeneity with individual trees, tree clumps, and openings (Larson and Churchill 2012, Churchill et al. 2013). At larger scales, reconstructions of complex forest landscapes in the Washington East Cascades reveal patch size distributions following a negative power law with many small (≤ 10s ac.) and few very large (1,000's ac.+) patches (Hessburg et al. 2000, Hessburg et al. 2007, Perry et al. 2011). Consequently, the opening / high fire transitions that we've identified are likely to be represented as smaller within-stand openings within the Dry forest types with possibility for also including some larger openings of early seral habitat within the Low/Mid Moist and Subalpine forest types. However, any creation of large openings to achieve disturbance restoration goals should also focus on preserving and promoting within patch complexity, biological legacies and landscape scale heterogeneity (Swanson et al. 2011, Franklin and Johnson 2012, Cansler and McKenzie 2014).

This study provides a broad description of forest restoration needs across the Nez Perce – Clearwater National Forest and adjacent ownerships. These descriptions and associated data can both provide a foundation for developing and assessing progress towards restoration targets and provide context for land managers to incorporate landscape scale context into local project planning. However, due to the limitation of the data and methods used (see *Core Concepts* above and *Detailed Methods* below), ***this assessment is not a replacement for the evaluation of local landscapes (1,000's to 10,000's of acres) and development of local landscape prescriptions*** (e.g., USDA Forest Service 2012).

Conclusion

Across the western US there is great interest in restoration within historically fire dependent forests to provide significant economic activity for local communities while enhancing ecosystem resilience, species conservation, and community safety in the face of a warming climate. The results from this study indicate extensive forest restoration needs across all landscapes and management units within the Clearwater Basin. Consequently, ***achieving the scale and pace of landscape scale restoration needed for forest ecosystems within the Clearwater Basin will require attention and coordination amongst all forest ownerships and management designations and the entire suite of tools available to land managers, including timber harvests, prescribed fire, wildland fire, and protection***.

This study focuses only upon forest condition as described by the abundance of successional classes within forest types and landscapes. ***Comprehensive ecological restoration must also consider a much broader range of ecological factors including terrestrial wildlife habitat, riparian and aquatic habitat, fire, insect, and disease frequency and severity***. The next challenge facing the Clearwater Basin Collaborative and Nez Perce – Clearwater National Forest land managers is determining a sustainable approach to address the forest restoration needs identified in this study while considering other ecological, social, and economic needs.

IV. Detailed Methods

Our assessment of restoration needs on the Nez Perce – Clearwater National Forest and adjacent forest lands in the Clearwater Basin is based upon four primary data inputs from the US Forest Service Northern Region: 1) a delineation of "forest planning landscapes", 2) a classification and map of forest biophysical settings, 3) NRV reference conditions for each biophysical setting within each forest planning landscape, and 4) a map of present day forest conditions.

Assessment Landscapes

This analysis covers approximately 5,197,000 ac of forest in the Palouse, North Fork, Lochsa, Selway, and South Fork landscapes (Figure 1, Table M1). These landscapes were designated by the US Forest Service for SIMPPLLE NRV simulations (see below) and are based approximately on 10 digit / 5th field watershed and 8 digit / 4th field subbasin boundaries. Within these landscapes is an incredibly broad array of climactic, edaphic, and topographic gradients, ranging from dry, low elevation, ponderosa pine forests to cold, high elevation subalpine fir and Engelmann spruce forests. These landscapes also capture important biophysical distinctions within the Clearwater Basin, including the historic distribution of the western white pine within the Lochsa, North Fork, and Palouse landscapes.

Methods Table M1. Ownership – timber suitability and Habitat Type Group summaries for each Landscape.

	Lochsa ac.	North Fork ac.	Palouse ac.	Selway ac.	South Fork ac.
Total Size	783,182	825,200	146,130	1,264,796	1,149,107
Ownership - Federal					
NP-CLW Suitable	117,727	82,432	82,448	53,025	388,648
NP-CLW Not Suitable, Some Harvest	125,990	82,432	14,441	129,665	201,405
NP-CLW Not Suitable, No Harvest	539,465	652,097	46,345	726,534	551,493
Other USFS Forests		8,239	2,895	355,572	7,561
Ownership - Non-Federal					
Private	80,199	75,710	449,943	60,529	90,658
State, Tribal, Other	15,515	37,522	160,611	25,608	32,636
Habitat Type Groups					
Warm & Dry1	1,863	2,274	15,391	70,529	44,947
Mod Warm & Dry2	42,156	22,089	76,451	264,676	237,161
Mod Warm & Mod Dry3	20,800	29,976	6,798	121,117	353,112
Mod Warm & Moist4	123,896	152,148	138,100	201,932	308,149
Mod Cool & Moist5	245,268	314,419	473,594	155,704	2,663
Mod Cool & Wet6	30,983	82,699	39,134	34,440	545
Cool & Moist7	152,124	241,400	4,871	125,507	42,259
Cool & Wet8	71,466	20,663	1,649	54,065	43,251
Cool & Mod Dry9	69,242	52,577	695	114,685	60,651
Cold & Moist to Mod Dry10	109,869	17,963		197,208	168,106
Cold Near Timberline11	11,230	2,224		11,072	11,557

Methods Table M2. Crosswalk of the Habitat Type Groups used in this analysis, Potential Vegetation Type (PVT) mapping units, SIMPPLLE HRV Habitat Types, and descriptions of each Habitat Type Group provided by Barry Bollenbacher (USFS Northern Region).

Habitat Type Group	USFS R1 PVT	SIMPPLLE Habitat Types	Description[a]
Warm & Dry - 1	PIPO, PSME1	A1, A2	Dry & open PP / DF with bunchgrass. Hot, low elevation west and south aspects. Fire interval 5-25 years. PP and dry DF climax species.
Mod. Warm & Dry - 2	PSME2, PSME3, ABGR 1	B1, B2, C1A	Open PP/DF with grass and brush. Low elevation, some higher on south and west aspects. Fire interval 5-50 years, typical low to mixed severity. PP, DF and some GF climax species.
Mod. Warm & Mod Dry - 3	ABGR2	C1B	Variable, representing transitions from dry to moist. PP, DF, WL, LP, GF. Fire intervals 15-50 years, typically mixed severity.
Mod. Warm & Moist - 4	ABGR3	C2, C3	Drier aspects at mid elevations with diverse conifer species. Fire interval 50-200 years. GF climate species.
Mod. Cool & Moist - 5	THPL2, THSE	D1	Upland cedar/hemlock with high species diversity. Fire return variable, intervals 50-200 yrs. WC and WH climax species.
Mod. Cold & Wet – 6	THPL1	E1	Forested riparian areas with long fire intervals 50-250 yrs+. PP, DF, and GF common. WC climax.
Cool & Moist – 7	Picea, ABLA2, TMSE1	D3	High species diversity, fire return intervals >120 years. WL, DF, WP, ES, LP, AF, GF all possible. AF, ES, WH climax species.
Cool & Wet - 8	ABLA1	E2	Very wet, forest riparian areas. Fire interval 90 - 150+ yrs. ES, AF, MH climax types.
Cool & Mod. Dry – 9	ABLA3, PICO, TSME2	F1	Cool / drier AF types. Fire intervals 50-130 yrs, typicall low to mixed severity. LP, DF, WL are seral species, replaced by LP. ES, AF, LP climax species.
Cold & Moist to Mod. Dry - 10	ABLA4, TSME3	G1	Upper elevations. WB, LP, MH, AF, ES, and AL common. Fire interval 35 - 300+ years. AF, AF-WB, MH, and LP climax types
Cold Near Timberline - 11	PIAL, LALY	G2	Timberline, WB, MH, AF, ES, and AL. Fire interval 35-300+ years. WB, AL climax types.

[a]Species: AF = subalpine fir, DF = Douglas fir, GF = grand fir, ES = Engelmann spruce, PP = ponderosa pine, LP = lodgepole pine, MH = mountain hemlock, WB = whitebark pine , WC = western red cedar, WH = western hemlock, WL = western larch

Forest Biophysical Settings (syn. Habitat Types)

As described in the Core Concepts above, biophysical settings represent the fundamental natural building blocks for forest landscapes based upon soils, climate, topography, species, and disturbance regimes. We consider each biophysical setting to have a unique suite of biological values and relationship with growth and disturbance processes. Within the Nez Perce – Clearwater National Forest there are currently several different approaches to mapping and classifying biophysical settings including Potential Vegetation Types (PVT's), Vegetation Response Units (VRU's), and Land Type Associations (LTA's). To ensure a consistent approach across our analysis geography including federal and non-federal ownerships, we based our analysis upon the US Forest Service Northern Region's 2004 PVT classification and mapping (http://www.fs.usda.gov/detail/r1/landmanagement/gis/?cid=fsp5_030918). Within this study we report results based upon 11 different "Habitat Type Groups" (Table M2), which represents aggregations of individual PVT's and are also crosswalked to the Habitat Types used in SIMPPLLE NRV modelling (see below). The crosswalk was developed in collaboration with US Forest Service Region 1 staff (Barry Bollenbacher and Eric Henderson).

Within their original classification of northern Idaho forest habitat types, (which was incorporated into the subsequent USFS R1 PVT classification used in this assessment), Cooper et al (1991) describe that majority of land within an individual habitat type (syn. biophysical settings) is likely to be recovering from disturbance and within a "seral state". Within this study, we describe both reference and current condition for each Habitat Type Group (Table M2) within each landscape by the relative abundance of 9 different successional classes (Table M3). Based upon the successional class framework developed by the Landfire and Fire Regime Condition Class programs (Rollins 2009, Barrett et al. 2010), our successional classes are defined based upon stand average tree size, canopy cover, and species composition (Table M3). While each Habitat Type Group will have a unique set of associated species, these successional classes represent broad categorizations that are applicable to each Habitat Type and are compatible with both our NRV modelling framework as well as current condition data (see below).

Natural Range of Variability Reference Conditions

Also as described in the Core Concepts section above, the Natural Range of Variability (NRV) represents our estimates of the range of conditions that existed upon a landscape prior to European settlement. NRV reference conditions were modeled for each forest planning landscape using SIMPPLLE v 2.5, a spatially explicit, dynamic, landscape simulation model (http://www.fs.fed.us/rm/missoula/4151/SIMPPLLE/). SIMPPLLE was developed by the US Forest Service Rocky Mountain Research Station and has been used extensively by the US Forest Service Northern Region for NRV simulation. SIMPPLLE simulations for the forest planning landscapes were based upon mapping of habitat types from the US Forest Service Northern Region PVT layer and initial starting conditions (stand composition size, composition, canopy cover) from the US Forest Service Northern Region VMap dataset (see below). A minimum stand size of 5-acres was set for SIMPPLLE simulations. Model logic for pre-European settlement rates and levels of forest growth & succession, insects and disease susceptibility and mortality, and fire growth and severity was determined specifically for the Nez Perce – Clearwater National Forest through a series of collaborative workshops and webinars with staff and specialists from the Nez Perce – Clearwater National Forest, US Forest Service Northern Region, and the Clearwater Basin Collaborative (E. Henderson unpublished data). Simulations were run using decadal time-steps for two, 70-decade periods. Climate variability was incorporated into the NRV simulations by superimposing a simplified 700 year Pacific Decadal Oscillation (PDO) signal (Figure M1) based upon a reconstruction by McDonald and Case (2005). The warm and cool PDO phases have been shown to have a significant influence on regional fire disturbance patterns within the Pacific

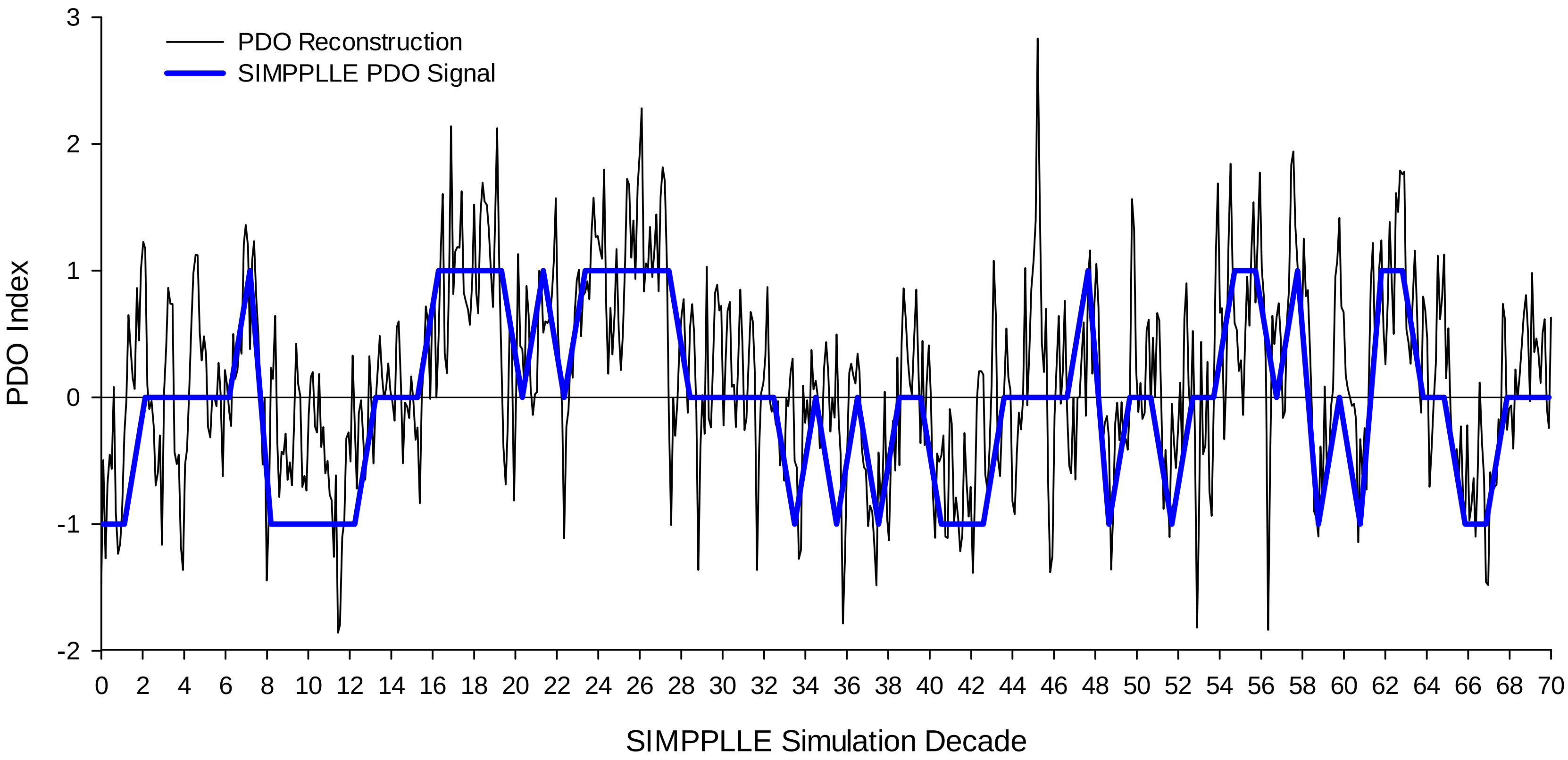
Northwest (Heyerdahl et al. 2008). Within our SIMPPLLE HRV simulations, disturbance severity and probabilities for each Habitat Type Group varied between decadal time steps based on whether the decade had a positive, neutral, or negative PDO signal (Figure M1). After allowing habitat conditions to stabilize during the first 70 decades (Provencher et al. 2008) we summarized 3 different NRV scenarios from the second 70 decades. Our first NRV scenario, "All Years", summarized the entire second 70 decades. We also summarized a "Warm-Dry" scenario that only included the extended warm/dry period in decades 25-28 and a "Cool/Moist" scenario that only included the extended cool/moist period in decades 41-43. Within each NRV scenario, we summarized conditions for the set of included decades as the abundance of each Successional Class within each Habitat Type within each Landscape. We set the lower and upper bounds for the successional class's range within the particular NRV scenario as the 25th to 75th quartile of the distribution of abundances from the included decades. This allowed us to capture the breadth of habitat conditions within a NRV scenario while avoiding outlier conditions that may be an artifact of the SIMPPLLE model and unlikely to carry meaning for land managers.

Methods Table M3. Definitions for Restoration Needs Successional Classes.

Successional Class (size class – canopy cover – shade tolerance)	**Avg. Tree Size (in.)**	**Canopy Cover (%)**	**Species Composition[a]**
Gr-Sh-SS	0-4.9	0-100	Any
Pole/Med Closed Intolerant	5-14.9	70-100	PP, DF, LP, WL
Pole/Med Closed Tolerant	5-14.9	70-100	GF, WC, AF, ES, AF-ES, AF-WB
Pole/Med Open Intolerant	5-14.9	0-69	PP, DF, LP, WL
Pole/Med Open Tolerant	5-14.9	0-69	GF, WC, AF, ES, AF-ES, AF-WB
Lg+ Closed Intolerant	15+	70-100	PP, DF, LP, WL
Lg+ Closed Tolerant	15+	70-100	GF, WC, AF, ES, AF-ES, AF-WB
Lg+ Open Intolerant	15+	0-69	PP, DF, LP, WL
Lg+ Open Tolerant	15+	0-69	GF, WC, AF, ES, AF-ES, AF-WB

[a]Species: AF = subalpine fir, DF = Douglas fir, GF = grand fir, ES = Engelmann spruce, PP = ponderosa pine, LP = lodgepole pine, MH = mountain hemlock, WB = whitebark pine , WC = western red cedar, WH = western hemlock, WL = western larch

Methods Figure M1. Pacific Decadal Oscillation reconstruction from McDonald and Case (2005; black lines) and the simplified PDO signal used in SIMPPLLE HRV simulations (blue lines. PDO Index values < 0 indicate generally cooler / wetter climate and PDO Index values >0 generally indicate warmer / drier climate. SIMPPLLE Simulation Decades include years 1301 to 1991 from MacDonald and Case (2006) PDO reconstruction.



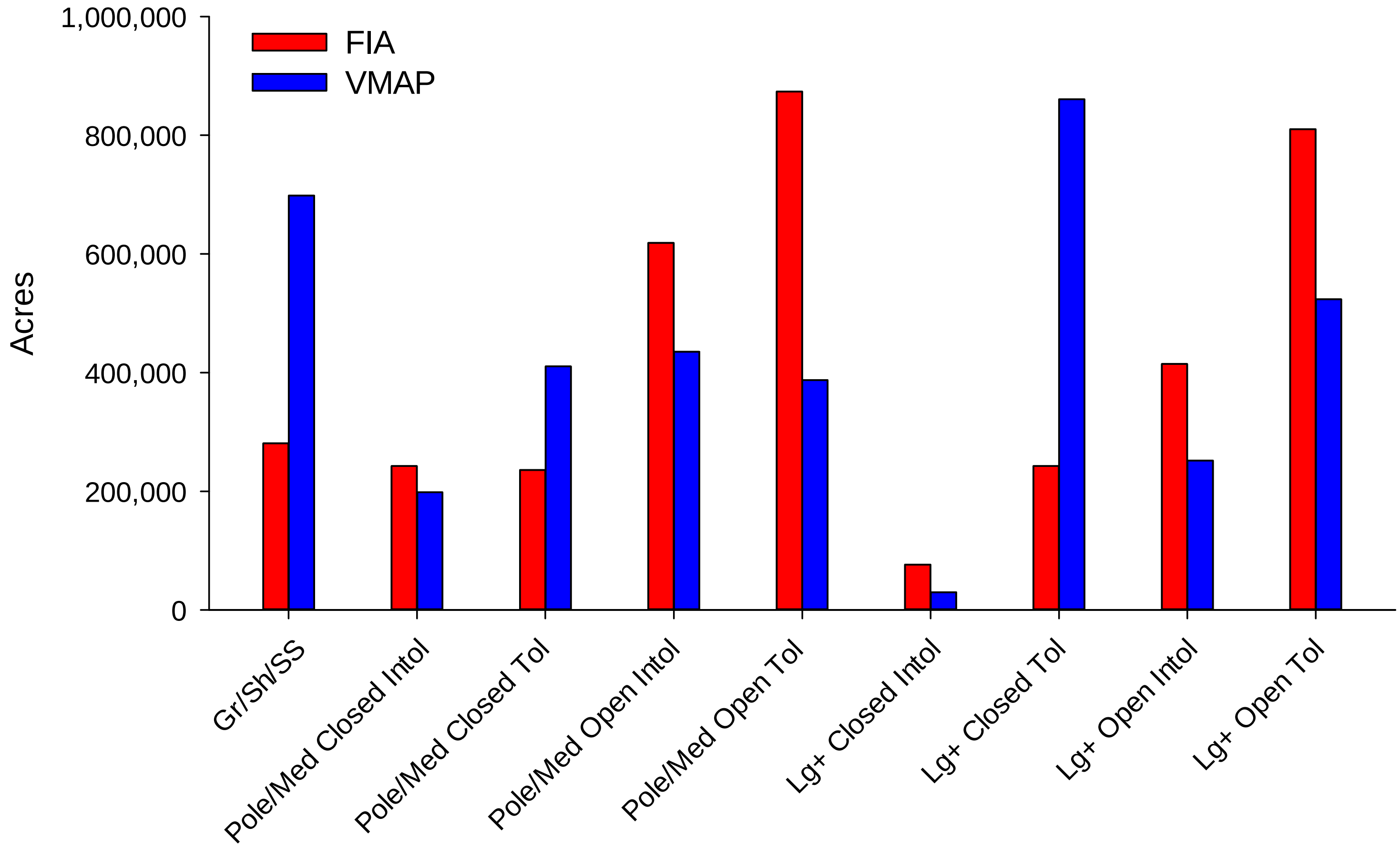
Current Forest Conditions

We characterized current forest vegetation conditions across our assessment landscapes using data from the US Forest Service Northern Region Vegetation Mapping Program (VMap; Berglund et al. 2009). VMap delineates and attributes forest patches based upon remotely sensed Landsat and NAIP imagery, environmental gradients, photo-interpreted training data, and inventory plot data (Brewer et al. 2004, Barber and Vanderzanden 2009). Our analysis used an updated version of VMap (version 14) developed for Nez Perce – Clearwater NF forest planning and incorporates the impacts of fire and other disturbances through 2013 on vegetation conditions. VMap characterizes individual forest stands based upon potential vegetation type, lifeform, basal area / size class, canopy cover, and dominant tree species composition (citation). We integrated the VMap data into our restoration needs framework by assigning each VMap stand polygon to a Habitat Type Group (Table M2) and successional class (Table M3) using the same criteria as for the SIMPPLLE HRV simulations.

To evaluate potential bias within the VMap data, we compared the VMap estimates of overall abundance of successional classes across the Nez Perce – Clearwater NF with estimates from Forest Inventory and Analysis (FIA) plot data (http://www.fia.fs.fed.us/). This comparison included 595 forested FIA plots; each plot represents an area of approximately 6,000 acres. Consequently, we could not base our restoration needs analysis at the Landscape x Habitat Type Group level upon FIA data due to insufficient plot density. It is difficult to determine which datasets provide a "true" representation of conditions across our assessment area. For example, comparison of the FIA estimated area of each Habitat Type Group with the actual mapped area of Habitat Type Groups from the US Forest Service Northern Region PVT (Table M4) demonstrates substantial differences for some Habitat Type Groups (particularly Mod Warm & Moist 4 and Cold & Moist to Mod Dry 10). Consequently, it is important to understand the potential limitations of all datasets used in landscape analysis. Nevertheless, FIA plots provide a useful comparison at the broader multi-landscape, forest-wide scale.

Comparison of successional class abundance estimates from FIA and VMap datasets (Figure M2) revealed several noteworthy differences. VMap estimated substantially more Grass–Shrub–Seedling–Sapling then did FIA (698,067 vs. 280,576 ac. respectively; Figure M2). FIA estimated a greater abundance of Pole/Medium size classes (1,970,405 vs. 1,430,790 ac. respectively) and more Open canopy cover conditions (2,716,481 vs. 1,597,476 ac. respectively) compared to VMap. FIA and VMap did not differ substantially in their estimates of species composition (2,161,707 ac shade tolerant for FIA vs. 2,181,337 ac for VMap). Combined, these differences lead to a substantial variance in the estimates of Pole/Med Open Intol, Pole/Med Open Tol, Lg+ Closed Tol, and Lg+ Open Tol successional class abundance by the FIA and VMap datasets (Figure M2). These differences between FIA and VMap may partially be explained by the fact that the impacts of recent wildfires and other disturbances that are included in the updated VMap data but are unlikely to be captured by the FIA plots. Other differences in canopy cover may be the result of ground based "canopy closure" vs. aerial "canopy from above (sensu Bergland 2011). Still, it is not possible to explain all differences between VMap and FIA estimates, and these differences should be considered when interpreting the restoration needs analysis results based upon VMap estimates.

Methods Figure M2. Estimates of current successional class abundance across the Nez Perce – Clearwater National Forest based upon Forest Inventory and Analysis (FIA) program (red bars) and US Forest Service Northern Region Vegetation Mapping Program (VMAP) version 14 datasets.



Methods Table M4. Comparison of Habitat Type Group area on the Nez Perce – Clearwater NF from USFS R1 Potential Vegetation Type mapping and Forest Inventory and Analysis (FIA) plots.

	Nez Perce - Clearwater NF		
Habitat Type Groups	**R1 PVT Mapping ac.**	**Total FIA Plots #**	**FIA Est. Area ac.**
Warm & Dry1	41,511	11	70,144
Mod Warm & Dry2	373,778	72	459,124
Mod Warm & Mod Dry3	467,397	86	548,398
Mod Warm & Moist4	716,641	78	497,384
Mod Cool & Moist5	679,526	107	682,309
Mod Cool & Wet6	125,349	14	89,274
Cool & Moist7	503,174	93	593,035
Cool & Wet8	177,063	35	223,185
Cool & Mod Dry9	250,706	96	612,165
Cold & Moist to Mod Dry10	427,110	1	6,377
Cold Near Timberline11	31,891	2	12,753
Total	**3,794,146**	**595**	**3,794,146**

Forest Restoration Needs Analysis

We calculated forest restoration needs based upon current successional class abundance compared to NRV reference conditions for each Habitat Type Group and Landscape, adapting the framework of Haugo and Welch (2013) and Haugo et al (2015). However, our current analysis extends these previous efforts by incorporating species composition into the successional class framework (Table M3). The specific restoration transitions that we considered to move acres overrepresented / excess to underrepresented / deficit successional classes are similar to the earlier studies (Figure 2, Table M5):

Disturbance Only

- **Thinning / low severity fire:** Transitions between Pole/Med and Large/VL closed canopy to open canopy successional classes, and from shade tolerant to shade intolerant compositions, through the removal of small and medium sized trees. May be accomplished through fire or mechanical treatment.
- **Opening / high severity fire:** Transition from any Pole/Med or Large/VL development s-class to "Grass-Shrub-Seedlings-Saplings" through removal of the major proportion of medium and large trees, generally to create a clearing. May be accomplished through fire or mechanical treatment.
- **Overstory Thinning:** Transition from Large/VL - closed-canopy – shade tolerant to Large/VL or Pole/Med - open canopy - shade tolerant successional class through removal of overstory cohort trees and retention of smaller understory cohort trees. This transition is likely to be accomplished through mechanical treatment, insects, or disease.

Disturbance then Succession

- **Thinning / low fire + grow with fire:** This is a two-step transition that first requires fire or mechanical treatment to first open the canopy layer and/or transition from shade tolerant to shade intolerant species followed by growth with fire to transition to a Large/VL successional class.

- **Other disturbance + growth:** Transition to Large/VL or Pole/Med, closed canopy, shade intolerant successional classes from other Large/VL and Pole/Med successional classes. The specific pathway varies by Habitat Type Group and the specific successional classes involved, but in all instances include both a disturbance and growth.

Succession Only

- **Growth with fire:** Transitions to Pole/Med and Large/VL – open canopy from smaller open canopy and Grass – Shrub – Seedling – Sapling successional classes. These transitions are considered succession only as fire disturbance is not immediate required to alter the successional trajectory.
- **Growth without fire:** All other transitions from smaller to larger closed canopy, and typically shade-tolerant successional classes.

We defined all possible transitions between successional classes with several exceptions: 1) transitions out from Large/VL open canopy, 2) transitions out from Large/VL shade intolerant, and 3) transitions from shade intolerant to shade tolerant. All transition definitions are captured in successional class transition "rules table" (Table M4). Our calculations of restoration needs for each Habitat Type Group x Landscape strata in the All Years, Warm-Dry, and Cool-Moist NRV climate scenarios used the same stepwise approach based the rules table (Table M4) as Haugo et al. (2015) and Haugo and Welch (2013). These calculations determined the number of acres to be "moved" and the specific transitions necessary to return the distribution successional classes for each Habitat Type Group x Landscape to NRV.

Forest Ownership and Management

After calculating forest restoration needs by Habitat Type Group and Landscape for the three NRV climate scenarios, we assessed how these needs are distributed across forest ownership and management categories using the same "equal distribution" approach as Haugo et al (2015). Outside of the Nez Perce – Clearwater NF we mapped ownership using the US Bureau of Land Management INSIDE Idaho dataset. Within the Nez Perce – Clearwater NF, we mapped both management designations (e.g., wilderness, roadless) and suitability for mechanical harvests using the Nez Perce – Clearwater Forest Planning timber suitability dataset, provided April 2014. Our restoration need calculations provide the percentage of total acres for each present day sub-strata (Landscape x Habitat Type Group x Successional class) currently in need of disturbance and/or successional restoration. We also determined for each present day sub-strata the number of acres within each ownership x management designation category. Our equal distribution approach is based upon the assumption that the overall percentage of a sub-strata in need of each restoration need transition is applied equally across ownership x management designation categories. Consequently, we calculated the number of acres in need of each restoration need transition for each ownership x management designation x sub-strata. Finally, we summed these values to total disturbance only, disturbance then succession, and succession only restoration need per ownership and management designation per landscape. We recognize in some areas with mixed federal and private lands (e.g., checkerboard ownership configurations), a more generalized and variable allocation of restoration needs by landowners could emerge.

Methods Table M5. Restoration needs rule table defining the transition category for all possible transitions between successional classes with the exception of: 1) transitions out from Large/VL open canopy, Large/VL shade intolerant, and from shade intolerant to shade tolerant.

Order	Excess Successional Class	Deficit Successional Class	Transition
1	Large/VL_Closed_Tol	Large/VL_Open_Intol	Thin / low fire
2	Large/VL_Closed_Tol	Pole/Med_Open_Intol	Thin / low fire
3	Large/VL_Closed_Intol	Large/VL_Open_Intol	Thin / low fire
4	Pole/Med_Closed_Tol	Pole/Med_Open_Intol	Thin / low fire
5	Pole/Med_Closed_Tol	Pole/Med_Open_Tol	Thin / low fire
6	Pole/Med_Closed_Intol	Pole/Med_Open_Intol	Thin / low fire
7	Pole/Med_Closed_Intol	Pole/Med_Open_Tol	Thin / low fire
8	Pole/Med_Open_Tol	Pole/Med_Open_Intol	Thin / low fire
9	Large/VL_Open_Tol	Large/VL_Closed_Intol	Thin / low fire + grow w/ fire
10	Large/VL_Open_Tol	Large/VL_Open_Intol	Thin / low fire + grow w/ fire
11	Pole/Med_Closed_Tol	Large/VL_Closed_Intol	Thin / low fire + grow w/ fire
12	Pole/Med_Closed_Tol	Large/VL_Open_Intol	Thin / low fire + grow w/ fire
13	Pole/Med_Closed_Tol	Large/VL_Open_Tol	Thin / low fire + grow w/ fire
14	Pole/Med_Closed_Intol	Large/VL_Open_Intol	Thin / low fire + grow w/ fire
15	Pole/Med_Closed_Intol	Large/VL_Open_Tol	Thin / low fire + grow w/ fire
16	Pole/Med_Open_Tol	Large/VL_Closed_Intol	Thin / low fire + grow w/ fire
17	Pole/Med_Open_Tol	Large/VL_Open_Intol	Thin / low fire + grow w/ fire
18	Large/VL_Closed_Tol	Gr/Sh/SS	Opening / high fire
19	Large/VL_Open_Tol	Gr/Sh/SS	Opening / high fire
20	Pole/Med_Closed_Intol	Gr/Sh/SS	Opening / high fire
21	Pole/Med_Closed_Tol	Gr/Sh/SS	Opening / high fire
22	Pole/Med_Open_Intol	Gr/Sh/SS	Opening / high fire
23	Pole/Med_Open_Tol	Gr/Sh/SS	Opening / high fire
24	Large/VL_Closed_Tol	Pole/Med_Open_Tol	Overstory Thinning
25	Large/VL_Closed_Tol	Large/VL_Open_Tol	Overstory Thinning
26	Large/VL_Closed_Tol	Large/VL_Closed_Intol	Other distrubance + growth
27	Large/VL_Closed_Tol	Pole/Med_Closed_Tol	Other distrubance + growth
28	Large/VL_Closed_Tol	Pole/Med_Closed_Intol	Other distrubance + growth
29	Large/VL_Closed_Intol	Pole/Med_Closed_Intol	Other distrubance + growth
30	Large/VL_Open_Tol	Pole/Med_Closed_Tol	Other distrubance + growth
31	Pole/Med_Closed_Tol	Pole/Med_Closed_Intol	Other distrubance + growth
32	Pole/Med_Open_Tol	Pole/Med_Closed_Intol	Other distrubance + growth
33	Pole/Med_Open_Intol	Large/VL_Open_Intol	Grow w/ fire
34	Pole/Med_Open_Intol	Large/VL_Open_Tol	Grow w/ fire
35	Pole/Med_Open_Tol	Large/VL_Open_Tol	Grow w/ fire
36	Gr/Sh/SS	Large/VL_Open_Intol	Grow w/ fire
37	Gr/Sh/SS	Large/VL_Open_Tol	Grow w/ fire

Methods Table M5. Continued.

Order	Excess Successional Class	Deficit Successional Class	Transition
38	Gr/Sh/SS	Pole/Med_Open_Intol	Grow w/ fire
39	Large/VL_Open_Tol	Large/VL_Closed_Tol	Grow w/o fire
40	Pole/Med_Closed_Tol	Large/VL_Closed_Tol	Grow w/o fire
41	Pole/Med_Closed_Intol	Large/VL_Closed_Tol	Grow w/o fire
42	Pole/Med_Closed_Intol	Large/VL_Closed_Intol	Grow w/o fire
43	Pole/Med_Open_Tol	Large/VL_Closed_Tol	Grow w/o fire
44	Pole/Med_Open_Tol	Pole/Med_Closed_Tol	Grow w/o fire
45	Pole/Med_Open_Intol	Large/VL_Closed_Tol	Grow w/o fire
46	Pole/Med_Open_Intol	Large/VL_Closed_Intol	Grow w/o fire
47	Pole/Med_Open_Intol	Pole/Med_Closed_Intol	Grow w/o fire
48	Gr/Sh/SS	Large/VL_Closed_Tol	Grow w/o fire
49	Gr/Sh/SS	Large/VL_Closed_Intol	Grow w/o fire
50	Gr/Sh/SS	Pole/Med_Closed_Tol	Grow w/o fire
51	Gr/Sh/SS	Pole/Med_Open_Tol	Grow w/o fire
52	Gr/Sh/SS	Pole/Med_Closed_Intol	Grow w/o fire

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Appendix A. Restoration Needs by Landscape and Forest Ownership – Management

Appendix Table A.1 All Disturbance (Disturbance Only and Disturbance then Succession categories) and All Succession (Disturbance then Succession and Succession Only) restoration needs based upon the All Years NRV reference conditions by forest planning landscape, forest ownerships and by forest planning timber suitability categories on the Nez Perce – Clearwater National Forest.

Ownership	Total Forest ac.	All Dist. Rest Needs ac.	All Succ. Rest Needs ac.
Lochsa			
NP-CLW Suitable	118,000	56,000	9,000
NP-CLW Not Suitable, Some Harvest[a]	64,000	28,000	5,000
NP-CLW Not Suitable, No Harvest[b]	602,000	234,000	54,000
Private	80,000	23,000	3,000
State, Tribal, Other	16,000	8,000	0
North Fork			
NP-CLW Suitable	82,000	38,000	10,000
NP-CLW Not Suitable, Some Harvest[a]	68,000	33,000	7,000
NP-CLW Not Suitable, No Harvest[b]	667,000	249,000	63,000
Other USFWS Forests	8,000	3,000	1,000
Private	76,000	32,000	7,000
State, Tribal, Other	38,000	18,000	3,000
Palouse			
NP-CLW Suitable	82,000	38,000	11,000
NP-CLW Not Suitable, Some Harvest[a]	14,000	5,000	2,000
NP-CLW Not Suitable, No Harvest[b]	46,000	22,000	7,000
Other USFWS Forests	3,000	1,000	0
Private	450,000	108,000	42,000
State, Tribal, Other	160,000	59,000	18,000
Selway			
NP-CLW Suitable	53,000	26,000	2,000
NP-CLW Not Suitable, Some Harvest[a]	42,000	20,000	1,000
NP-CLW Not Suitable, No Harvest[b]	815,000	265,000	69,000
Other USFWS Forests	356,000	88,000	40,000
Private	61,000	6,000	11,000
State, Tribal, Other	26,000	6,000	2,000

Table Appendix A.1 Continued.

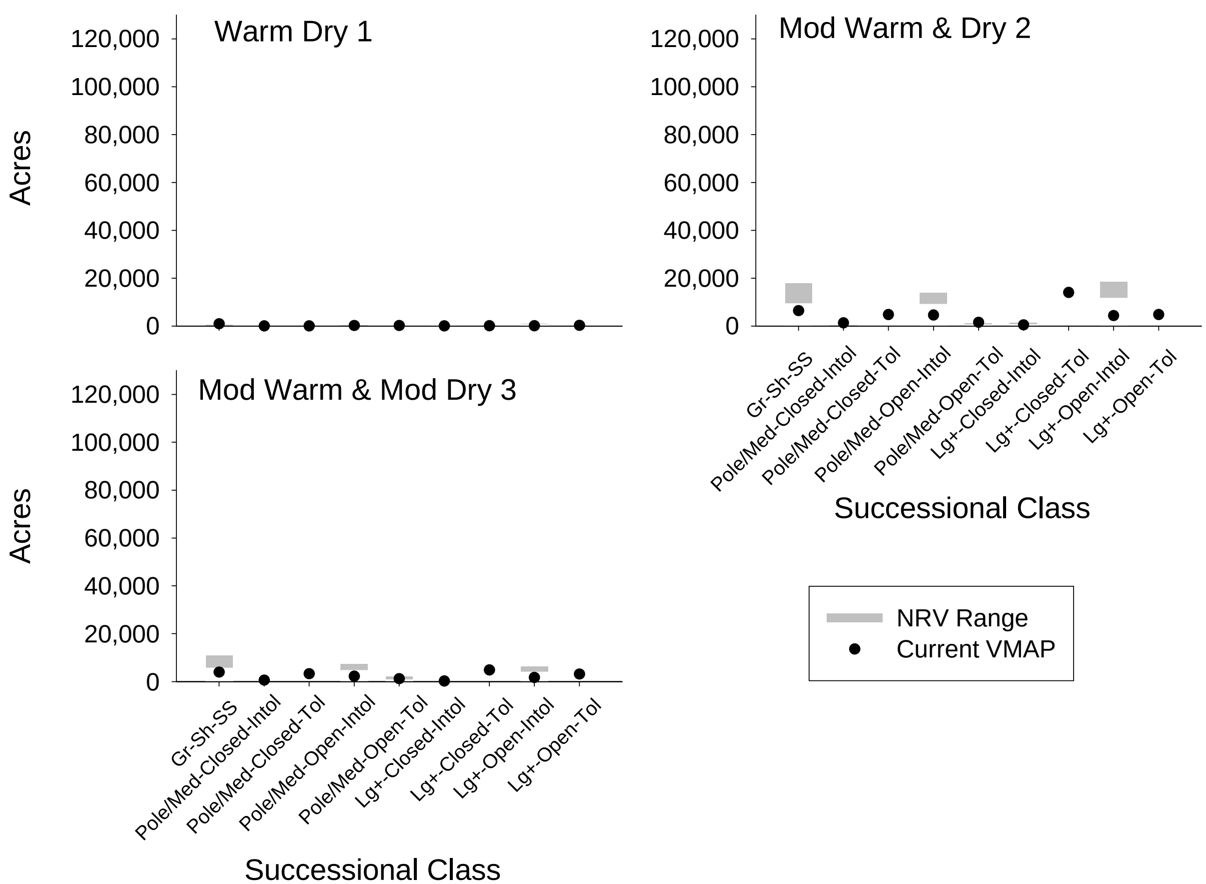
Ownership	Total Forest ac.	All Dist. Rest Needs ac.	All Succ. Rest Needs ac.
South Fork			
NP-CLW Suitable	389,000	196,000	15,000
NP-CLW Not Suitable, Some Harvest[a]	100,000	43,000	5,000
NP-CLW Not Suitable, No Harvest[b]	653,000	212,000	69,000
Other USFWS Forests	8,000	3,000	2,000
Private	91,000	7,000	12,000
State, Tribal, Other	33,000	10,000	2,000
Total	**5,197,000**	**1,837,000**	**472,000**

[a] *Includes landslide prone slopes, roadless within community protection zones, and municipal watersheds.*

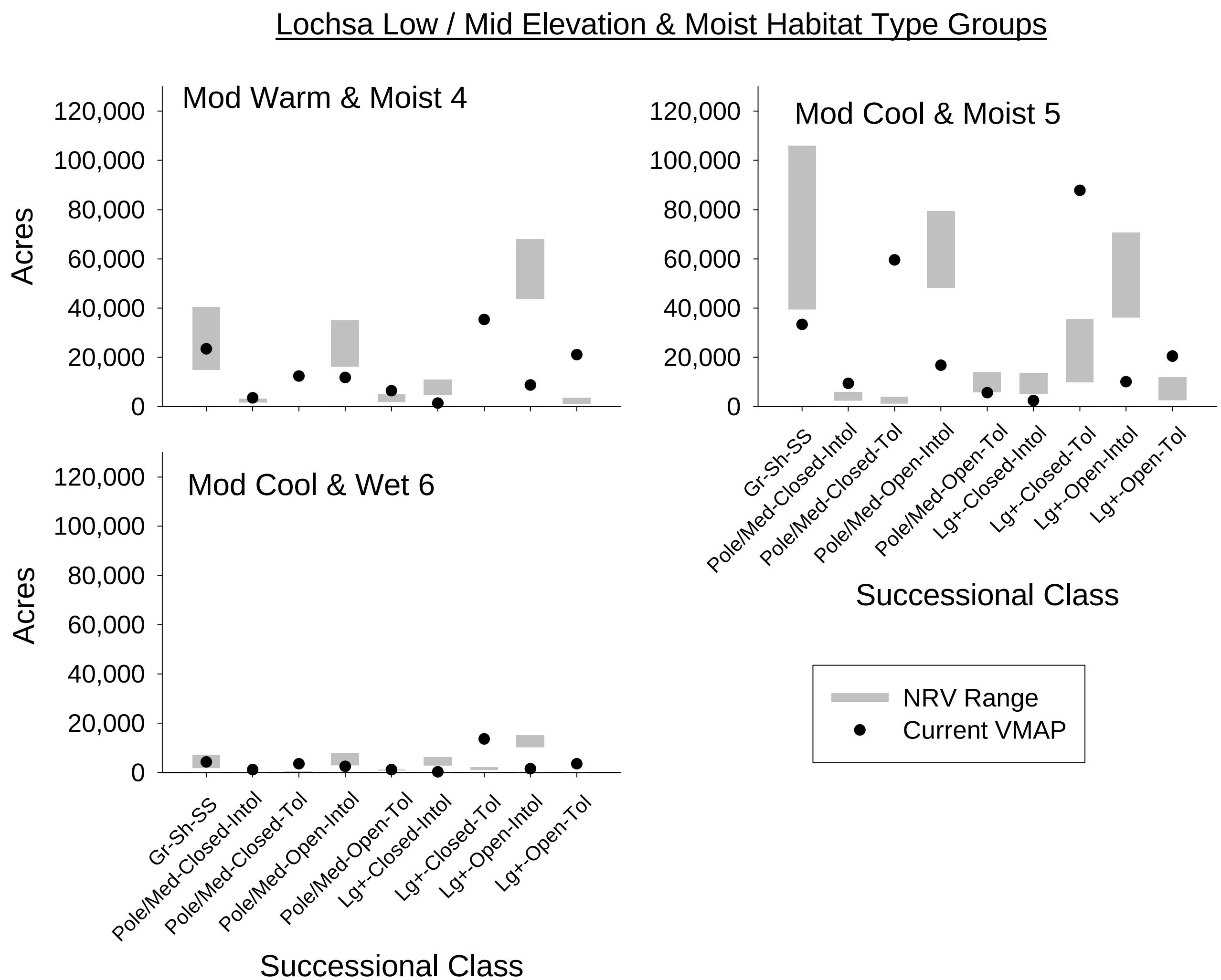
[b] *Includes riparian conservation areas, inventoried roadless, wilderness, riparian conservation areas, wild and scenic rivers, and research natural areas.*

Appendix B: Landscape by Habitat Type Current Conditions and "All Years" NRV

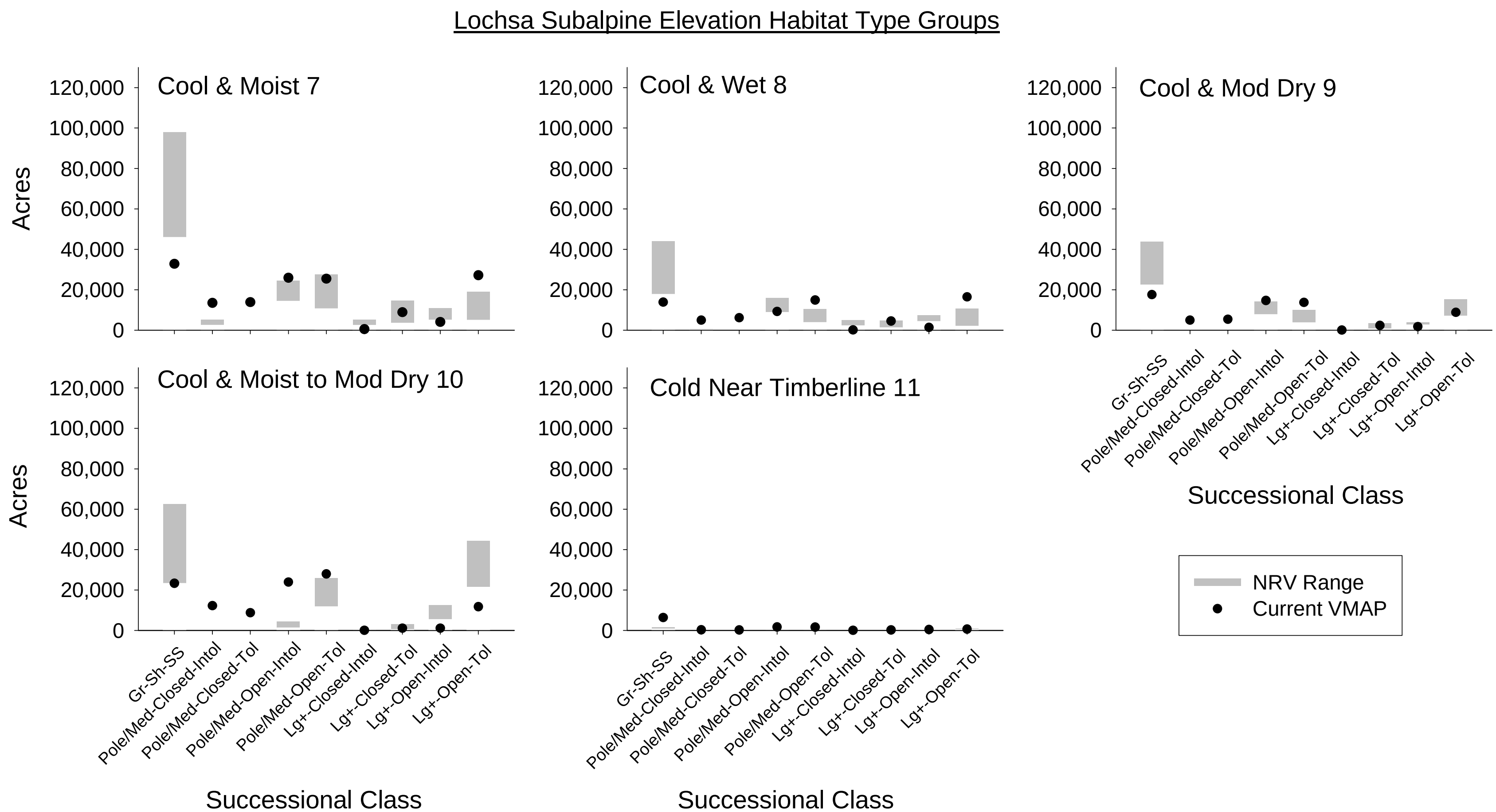
Lochsa Warm & Dry Habitat Type Groups



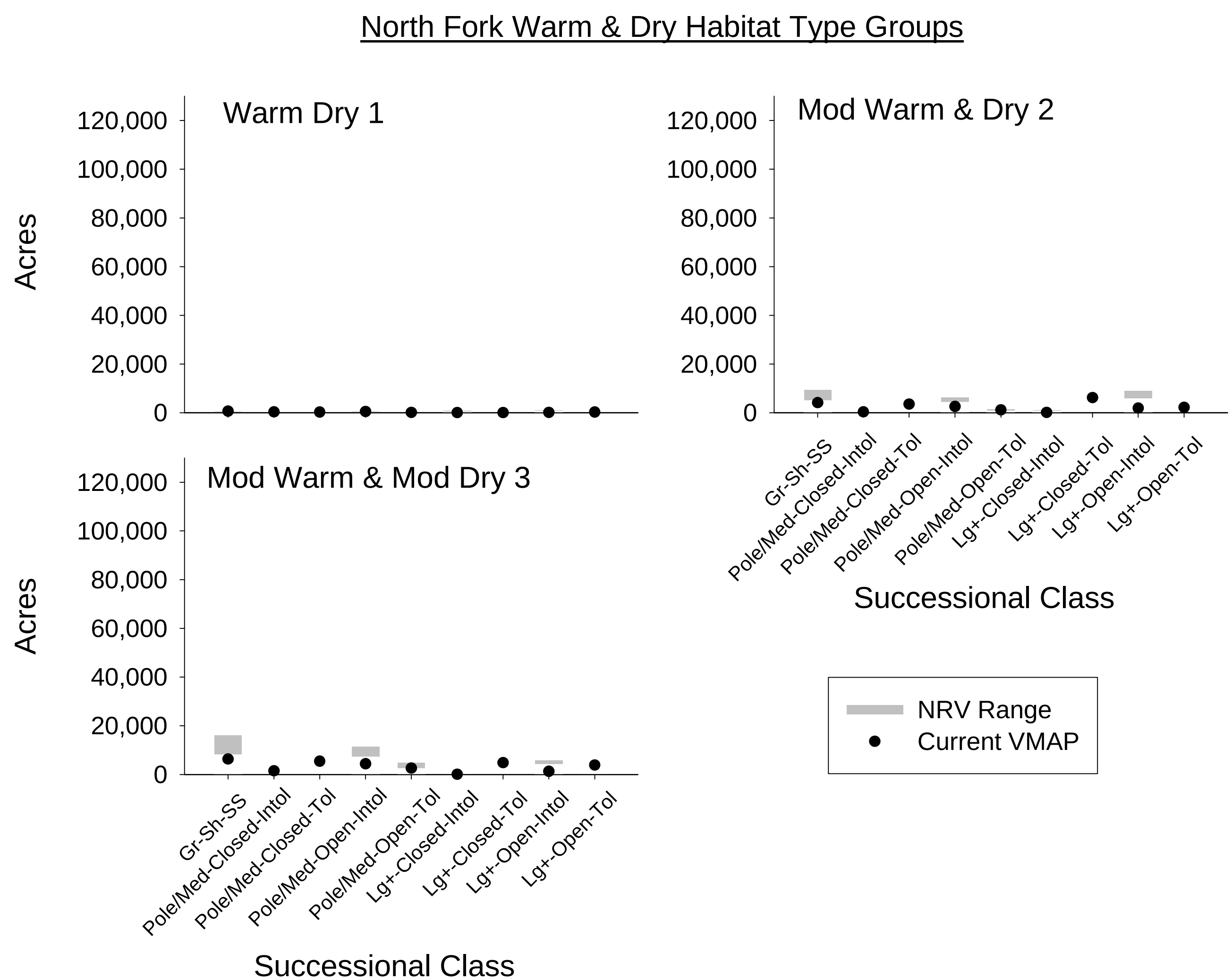
Appendix Figure B.1. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the warm and dry habitat type groups in the Lochsa forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades.



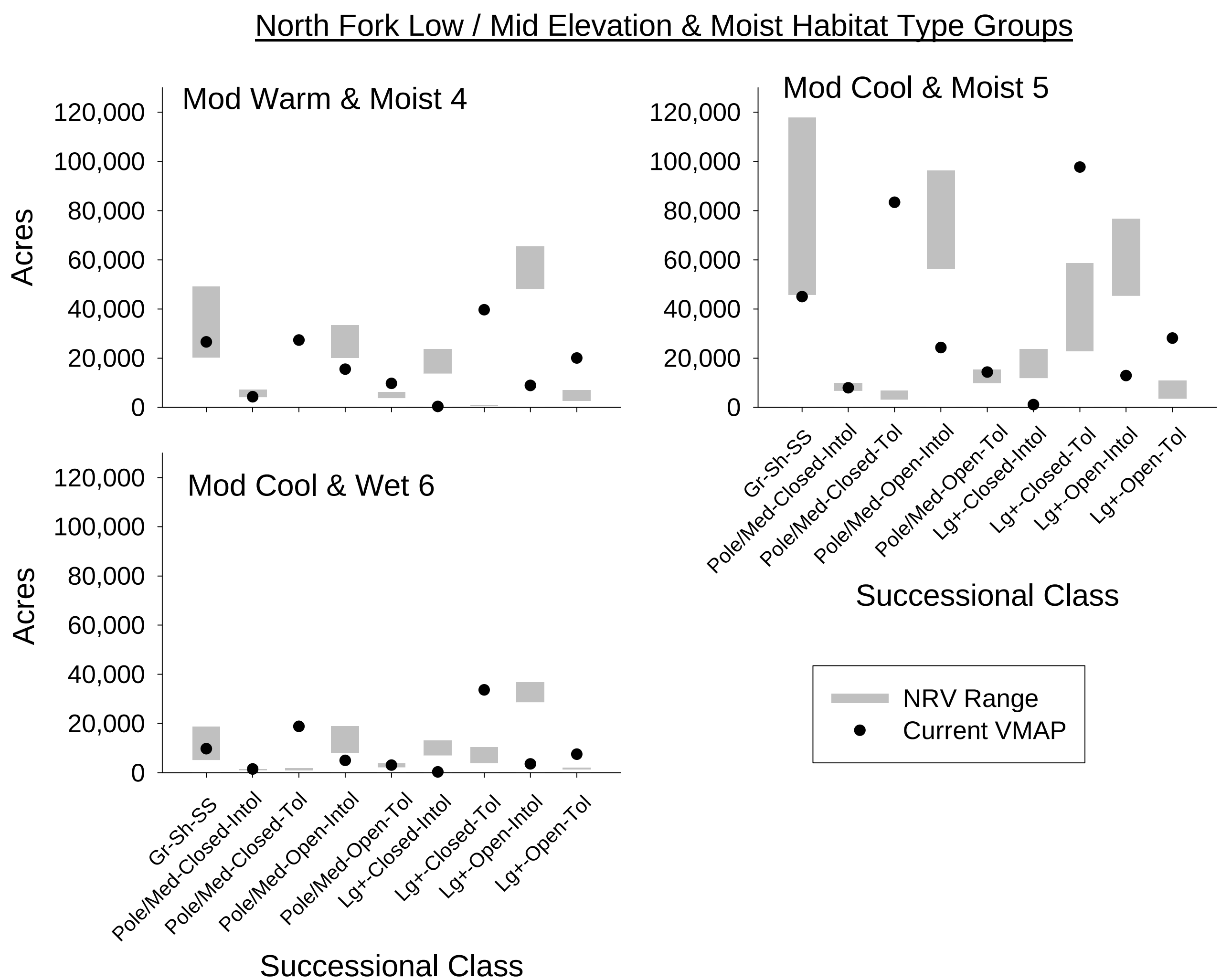
Appendix Figure B.2. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the low / mid elevation & moist habitat type groups in the Lochsa forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades.



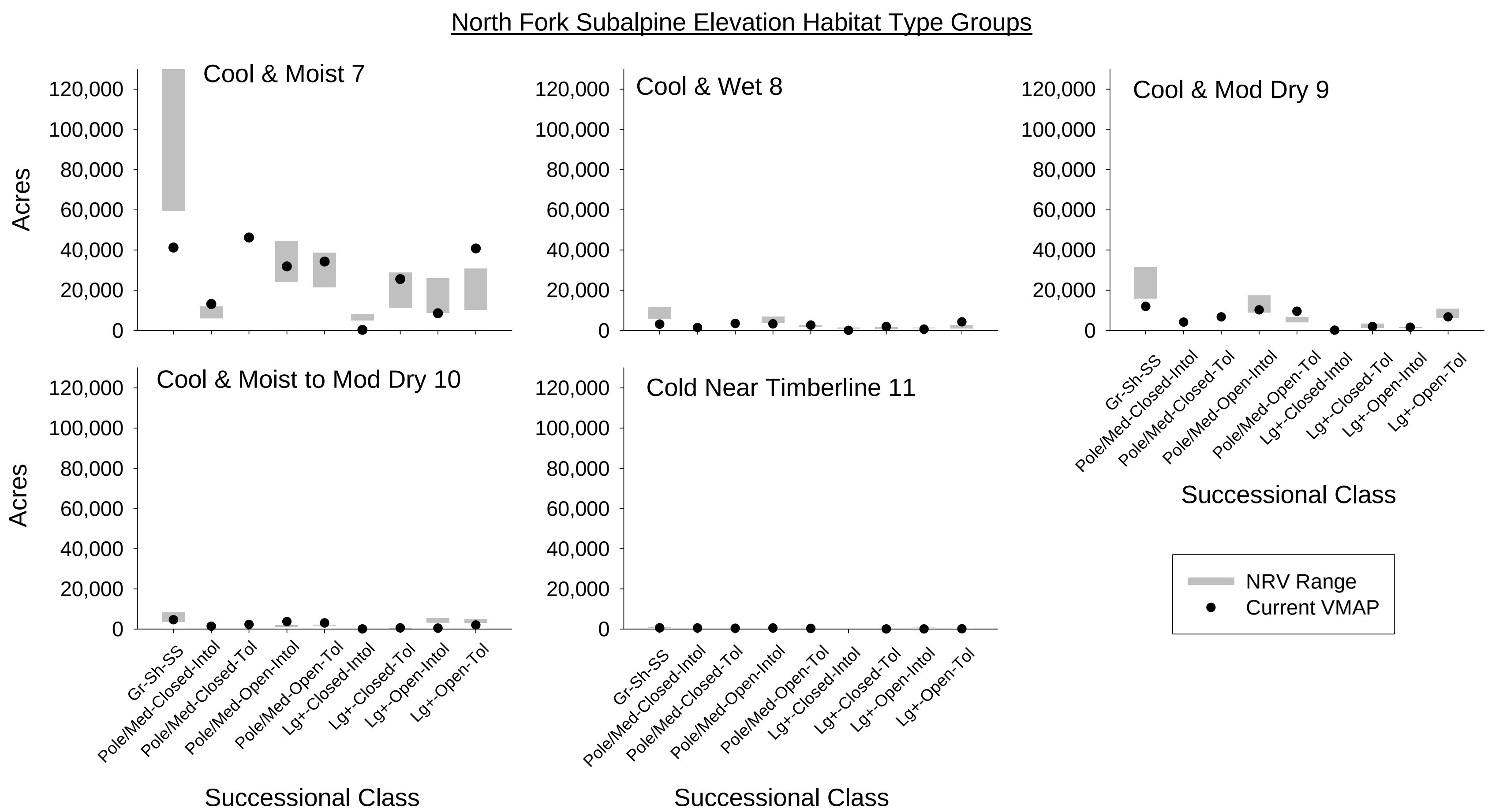
Appendix Figure B.3. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the subalpine elevation habitat type groups in the Lochsa forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades



Appendix Figure B.4. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the warm and dry habitat type groups in the North Fork forest planning landscape. NRV represents the 25^{th} to 75^{th} quartiles from SIMPPLLE simulation's second 70 decades



Appendix Figure B.5. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the low / mid elevation & moist habitat type groups in the North Fork forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades.



Appendix Figure B.6. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the subalpine elevation habitat type groups in the North Fork forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades

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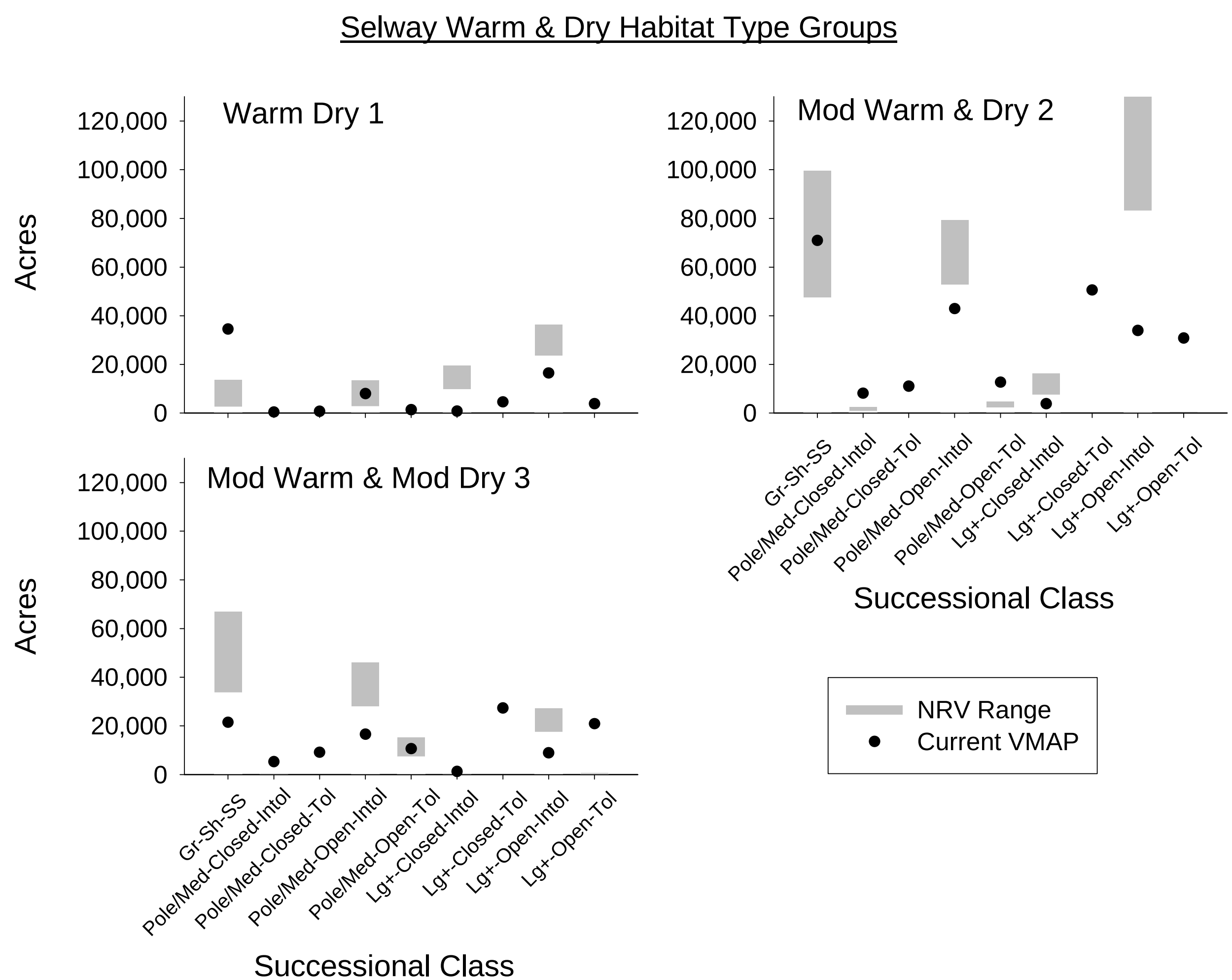
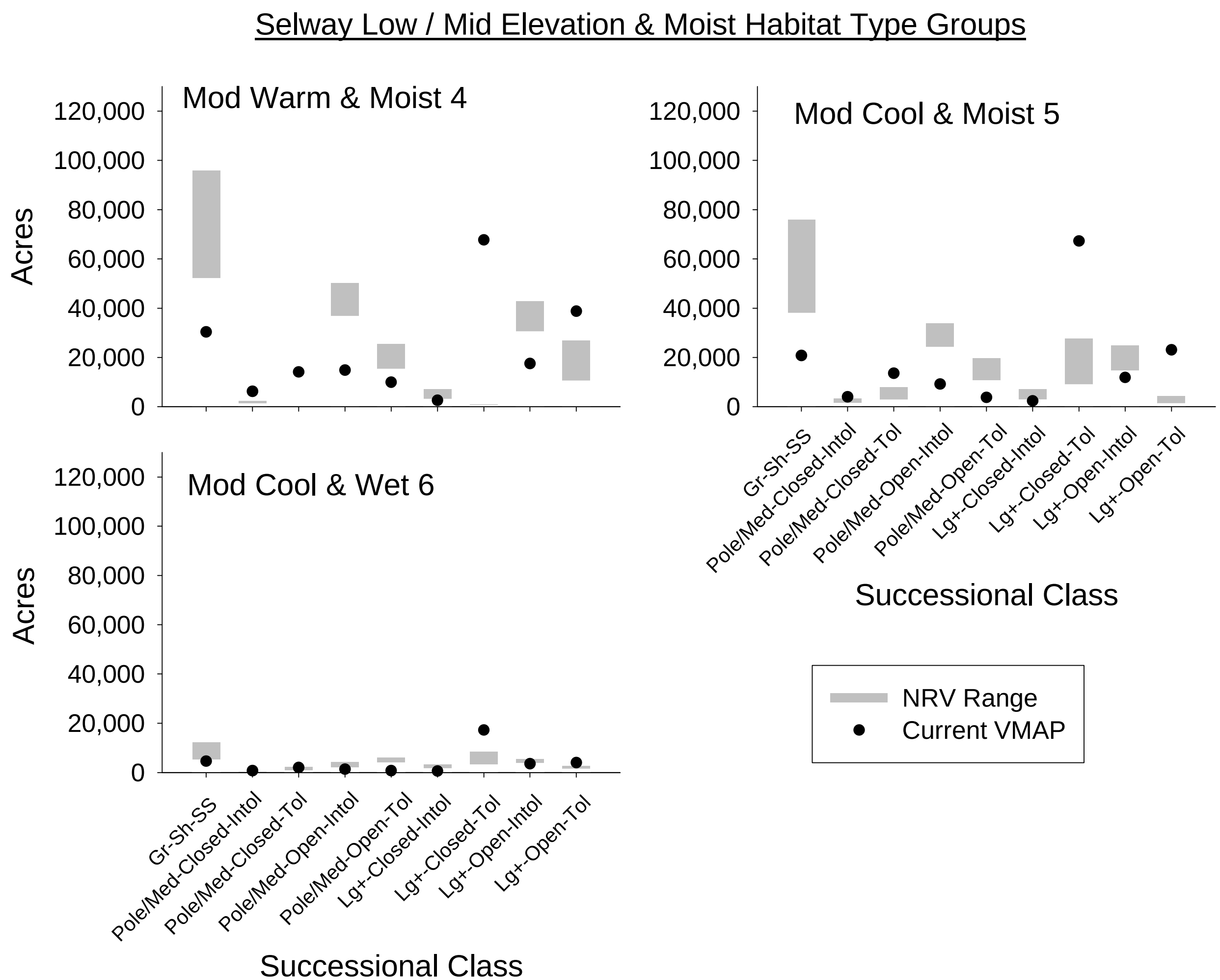
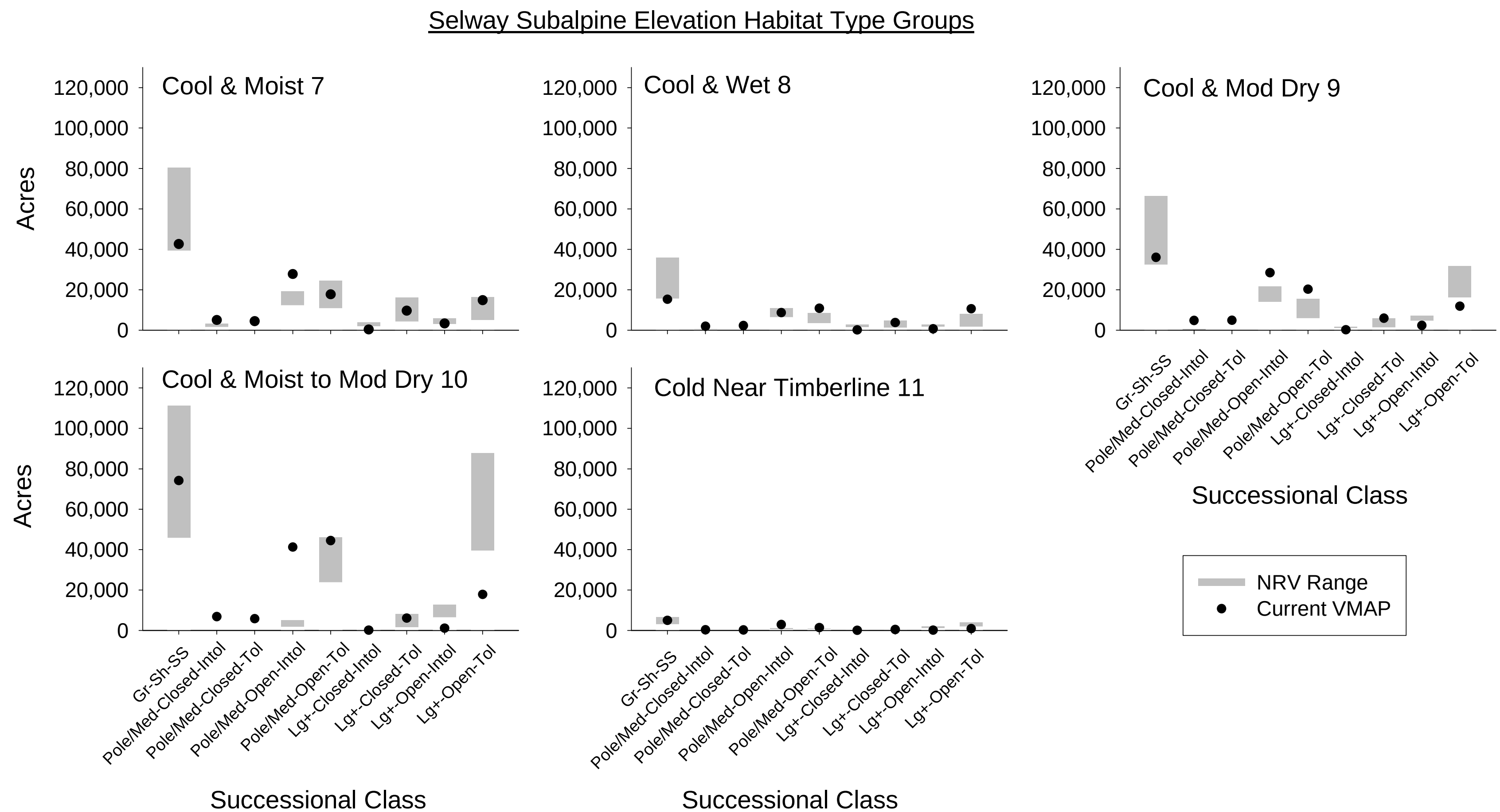


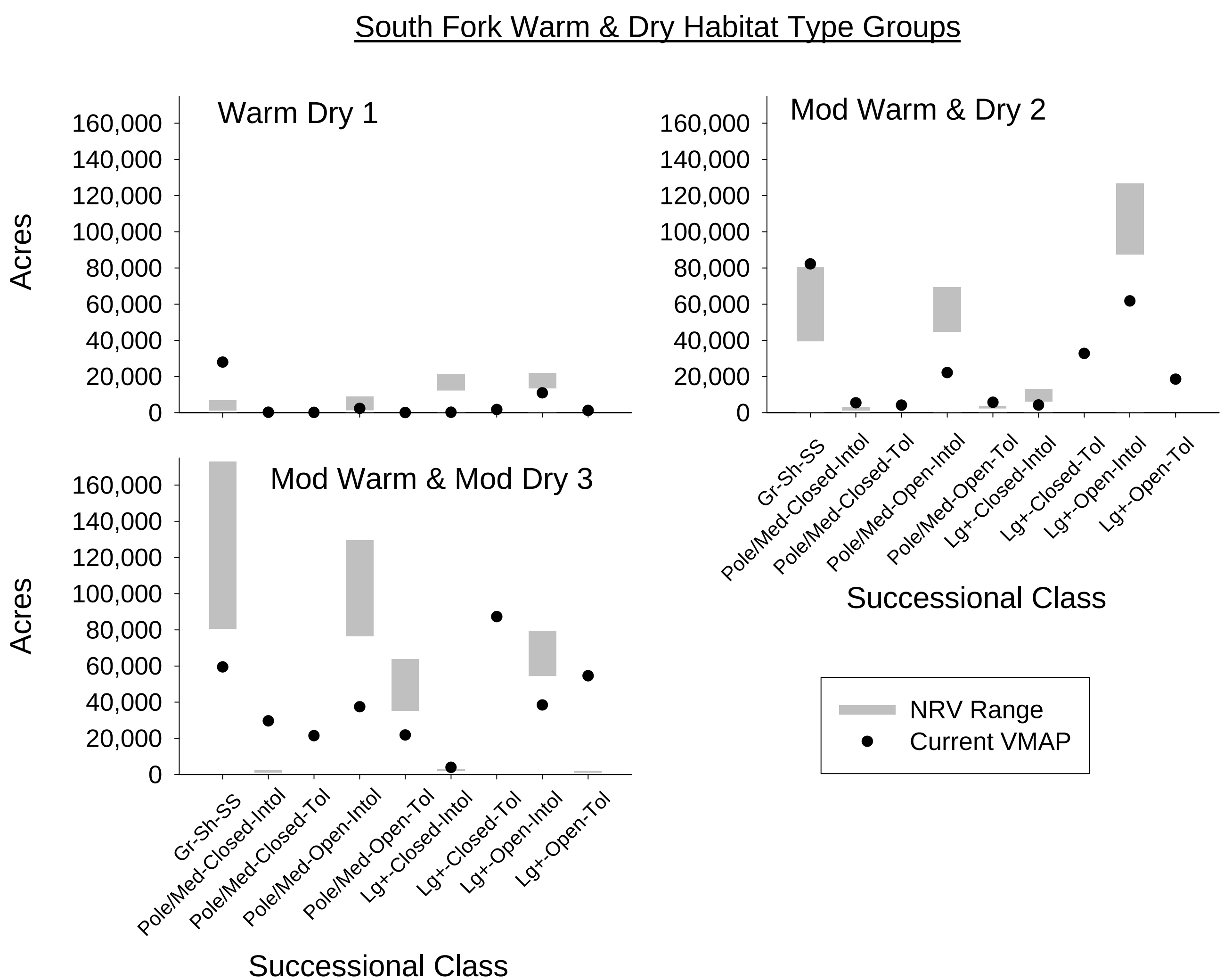
Appendix Figure B.7. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the warm and dry habitat type groups in the Selway forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades.



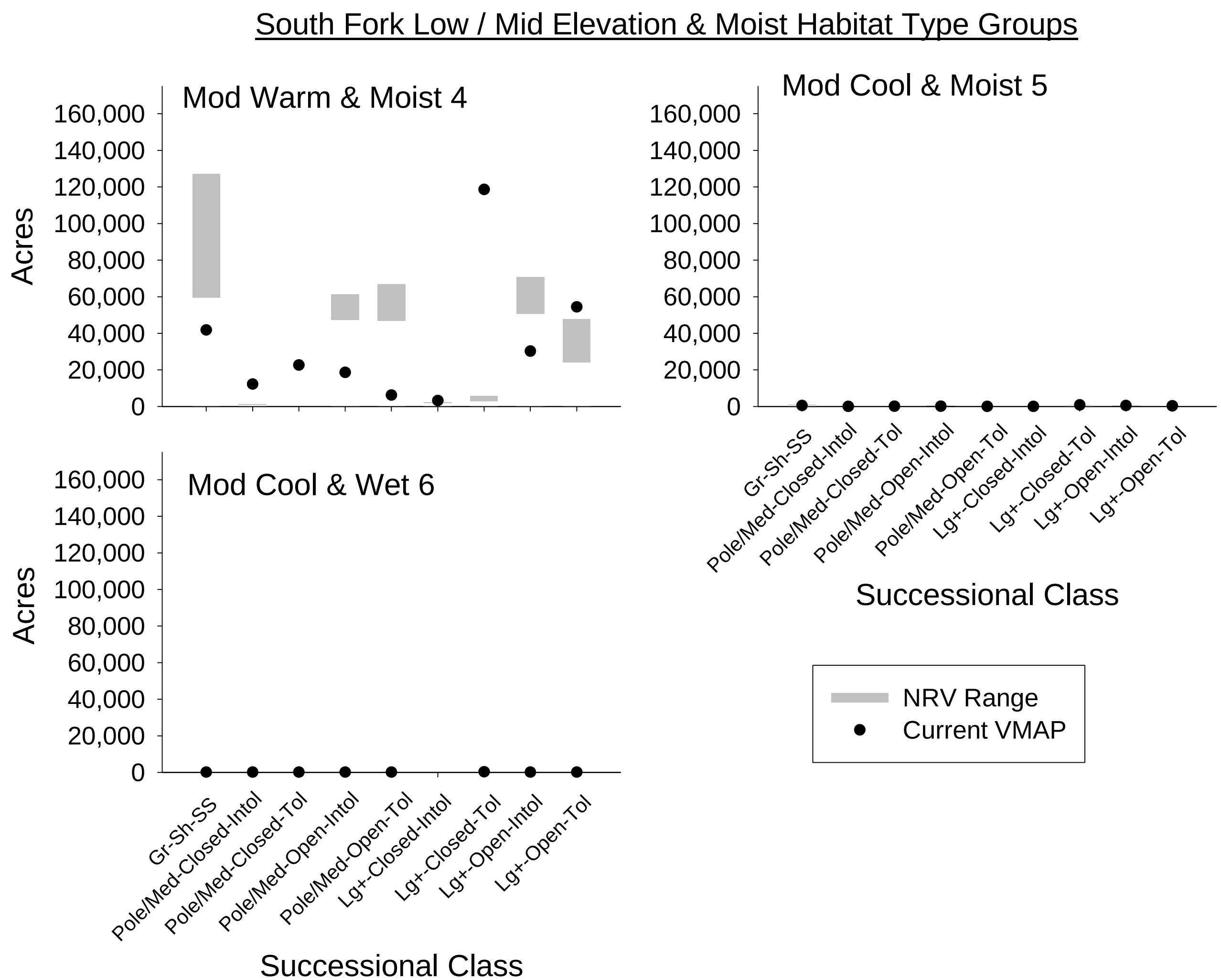
Appendix Figure B.8. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the low / mid elevation & moist habitat type groups in the Selway forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades.



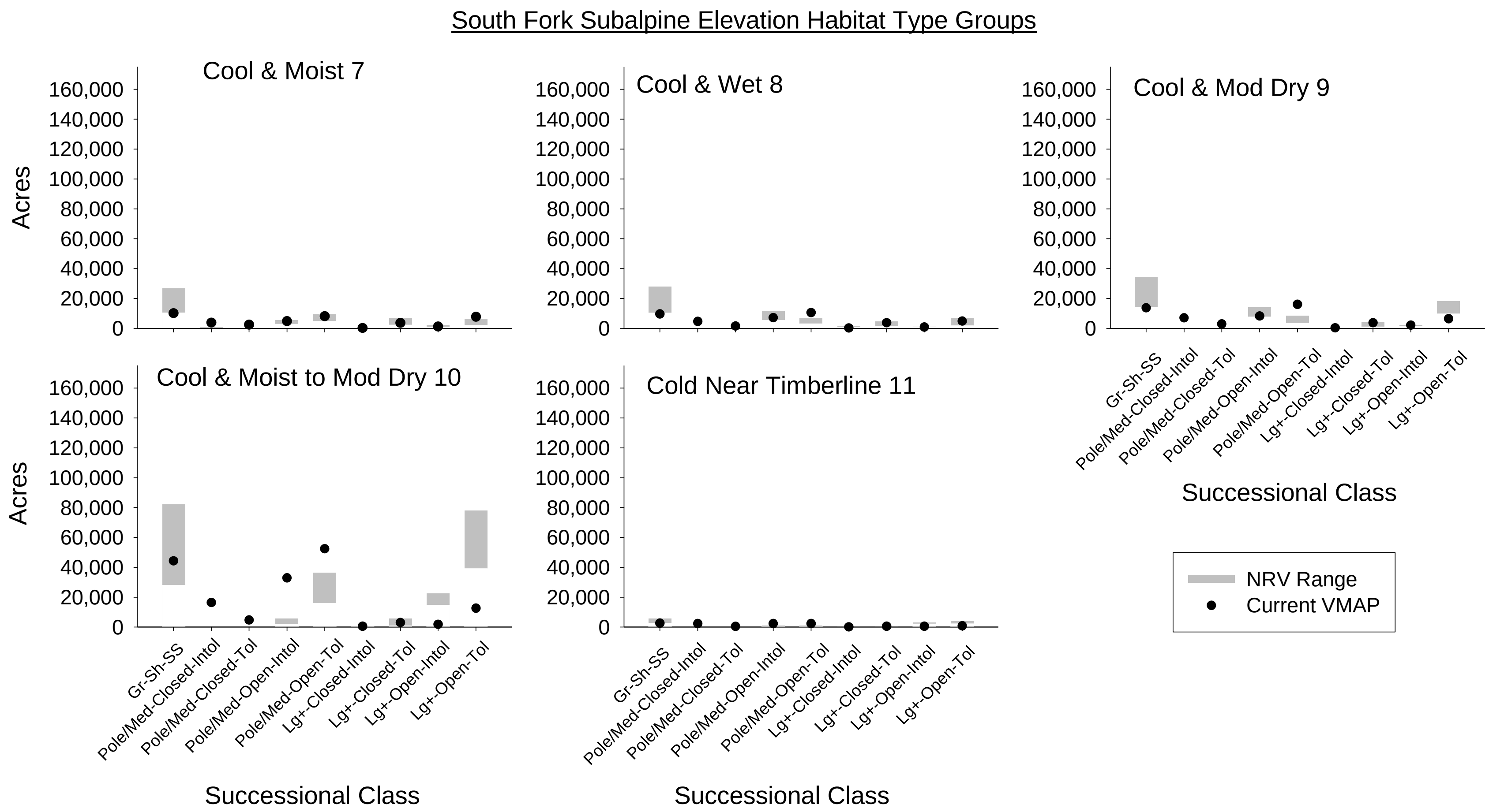
Appendix Figure B.9. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the subalpine elevation habitat type groups in the Selway forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades



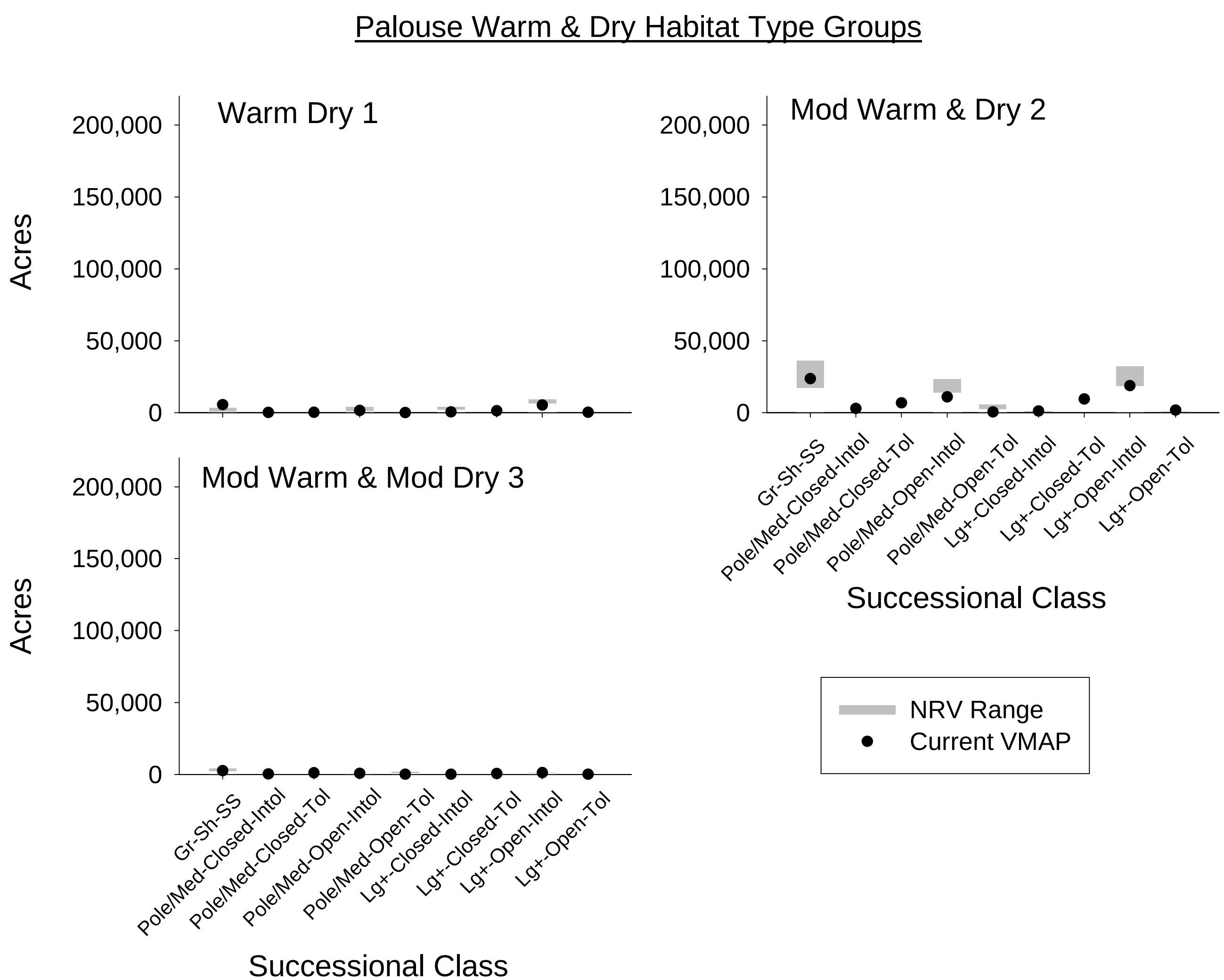
Appendix Figure B.10. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the warm and dry habitat type groups in the South Fork forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades



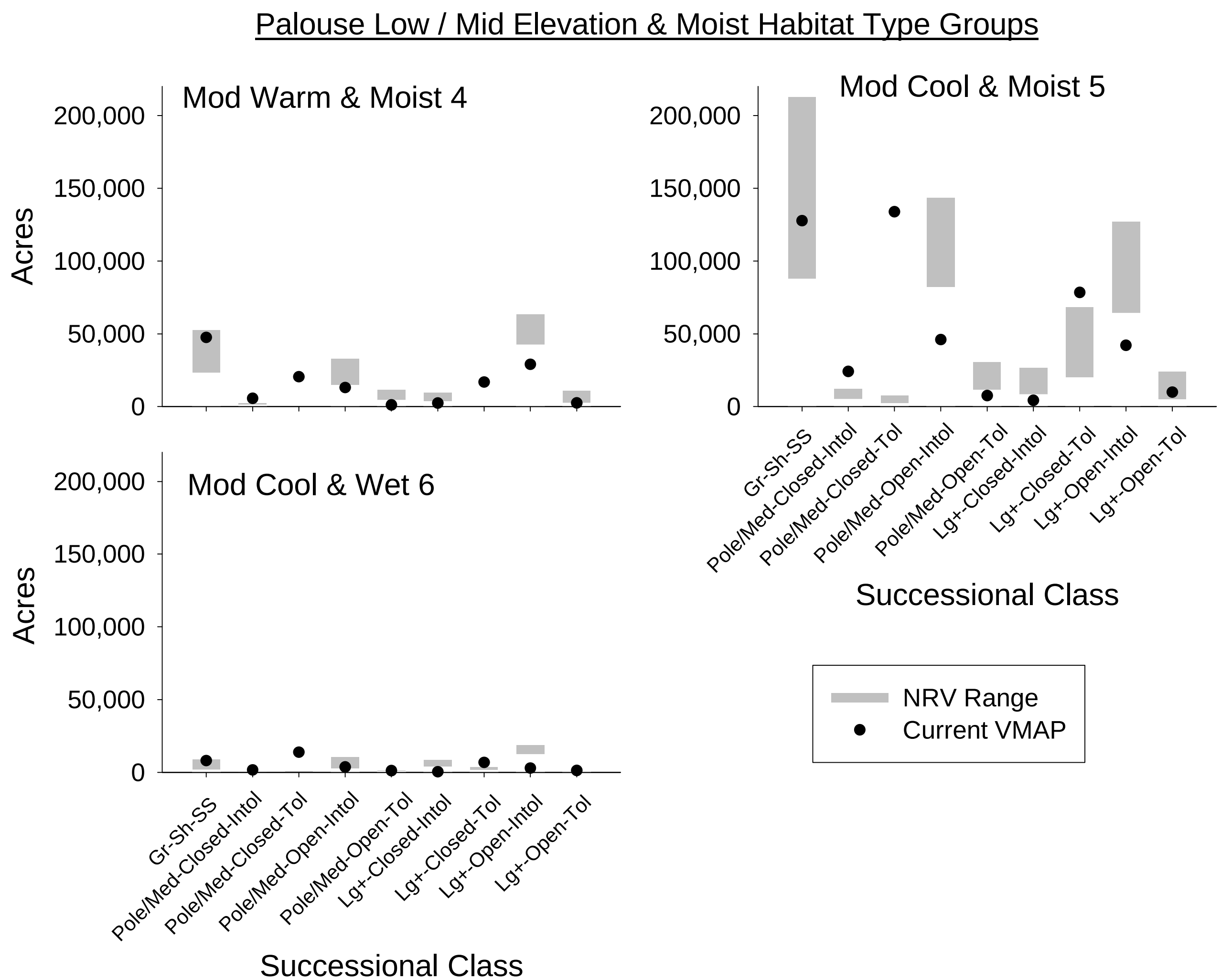
Appendix Figure B.11. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the low / mid elevation & moist habitat type groups in the South Fork forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades.



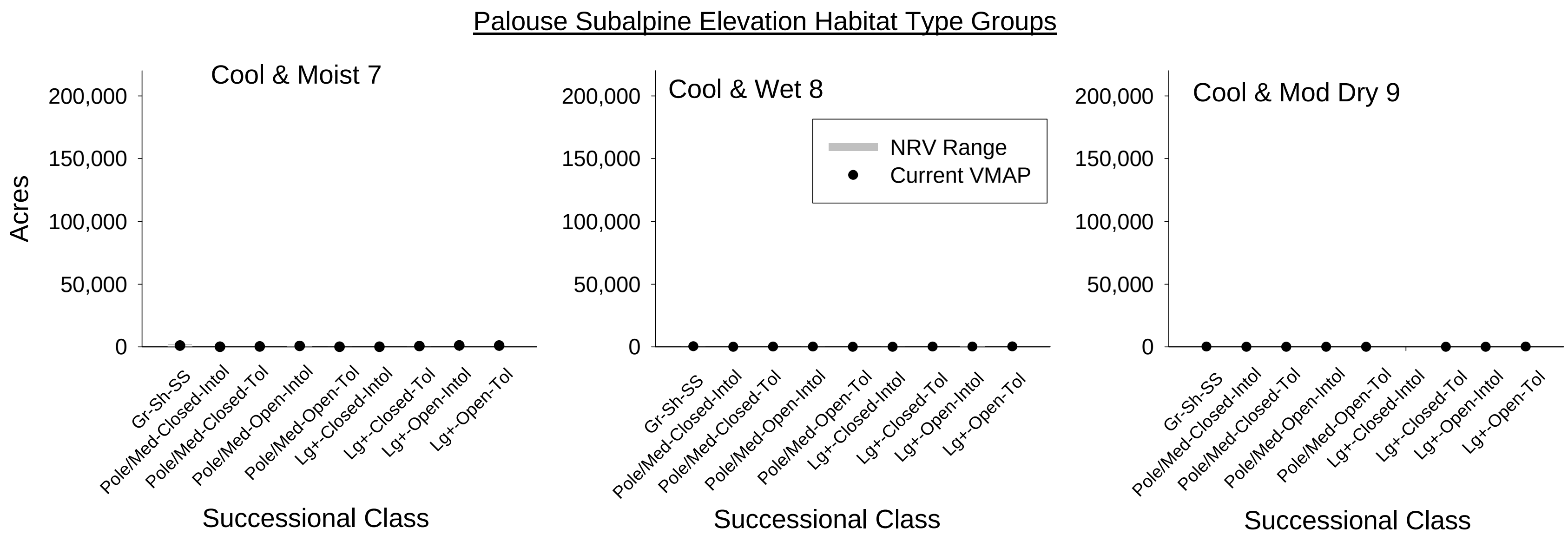
Appendix Figure B.12. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the subalpine elevation habitat type groups in the South Fork forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades



Appendix Figure B.13. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the warm and dry habitat type groups in the South Fork forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades



Appendix Figure B.14. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the low / mid elevation & moist habitat type groups in the Palouse forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades.



Appendix Figure B.15. Successional class Natural Range of Variability (NRV) reference conditions and current abundances (VMAP 14) within the subalpine elevation habitat type groups in the Palouse forest planning landscape. NRV represents the 25th to 75th quartiles from SIMPPLLE simulation's second 70 decades