Case Study 2: Pacific Northwest Hemlock – Douglas-Fir Forests & Northern Rockies Ponderosa Pine – Douglas-Fir Forests

Trend:

- LANDFIRE FRCC is higher for maritime Douglas-fir - western hemlock systems in the Oregon Coast Range and western Cascades than for ponderosa pine – Douglas-fir systems in the Northern Rockies.
- FRCC potentially under-represents the effect of advanced regeneration[1] due to fire suppression in dry conifer systems in Idaho and western Montana.

Theme:

- LANDFIRE FRCC is driven by primarily by structural change, which may be more easily detected in areas where the overstory structure is heavily influenced by harvesting than in areas where the understory structure is affected by fire suppression.
- LANDFIRE FRCC does not account for changes to current fire regime as a result of understory structural characteristics, such as advanced regeneration.
- LANDFIRE SClass mapping may be confounded by the aggregation of species of different successional states into a single LANDFIRE EVT unit.

Conclusion:

FRCC was different for maritime Douglas-fir - western hemlock systems in the Pacific Northwest than for ponderosa pine – Douglas-fir systems in the Northern Rockies because:

- BpS vegetation dynamics models were entirely different between PNW and N. Rockies map zones; these models differed strongly in terms of fire regime and reference conditions.
- High departure in the PNW was driven by a very large proportion of mid-successional closed forests in the current conditions compared to the very large proportion of late-successional closed forests expected in the reference conditions, resulting in a low degree of similarity.
- Moderate departure in the Northern Rockies was driven by increased canopy cover compared to reference conditions; however, this effect was more subtle because the reference conditions were more evenly spread across SClasses than in the PNW.
- LANDFIRE Canopy Cover and Height layers did not appear to capture the spatial trends in advanced regeneration in the Northern Rockies compared to the LANDFIRE training plots.

Discussion:

LANDFIRE FRCC appeared to correctly capture departure in for maritime Douglas-fir - western hemlock systems in the Pacific Northwest but showed less departure than expected in ponderosa pine – Douglas fir systems in the Northern Rockies (Figure 1 and Figure 3). This difference in departure measurements between systems in these study areas suggests that departure may more strongly respond to significant, spatially homogenous changes in overstory structural characteristics, such as timber harvest, than gradual increases in canopy cover and changes in understory structural characteristics that would result from fire suppression in historically frequent fire regime systems. The lack of expected departure in the Northern Rockies study area may also reflect how these systems were mapped out in the BpS layer, how their characteristics

---

[1] Advanced regeneration is defined as recruitment of fairly high densities of ponderosa pine, Douglas-fir, grand fir, western larch, and other tree species in the understories of historically open ponderosa pine – Douglas-fir systems.

were represented in the BpS vegetation dynamics models, how well canopy cover and height were captured in the maps, and the possible aggregation of seral types in the EVTs.

As shown in Figure 7 and Figure 8, canopy cover mapped entirely to one class (60-100%) for both study areas, and canopy height mapped in two moderately high categories (10-25m trees and 25-50 m trees) in the Pacific Northwest and primarily in the 10-25m tree category in the Northern Rockies. In the maritime Douglas-fir - western hemlock systems in the Pacific Northwest, these mapped values of cover and height resulted in a strong dominance of SClass B (mid-successional closed forests) in most areas, which resulted in significant departure from reference conditions (Figure 5). The reference conditions for these systems showed a strong dominance of SClass E (late-successional closed forests). In the ponderosa pine – Douglas fir systems in the Northern Rockies, these homogeneous values of cover and height corresponded with a distribution of SClasses in the different BpS units (Figure 2 and Figure 6 rather than one predominant SClass as in the Pacific Northwest BpS units.

LANDFIRE FRCC appears reasonable for BpS units 10452, 10453, 10530, and 11662(11665) in the Northern Rockies (Figure 3). BpS units 10451 and 11661(11660) also had historically frequent fire regimes and are expected to have much greater current densities of Douglas-fir according to model descriptions, but showed lower departure than expected. BpS 10451 shows low departure (FRCC I) in the north half of Zone 10 and moderate departure (FRCC II) in the south of Zone 10 and most of Zone 19, while BpS 11661(11660) shows moderate departure (FRCC II) in most of the study area (Figure 3). While FRCC values were lower than expected for these models, departures were actually near FRCC thresholds in many subsections. For instance, 10451 had a departure value of 30 in the Clark Fork Valley and Mountains subsection and 11661 had a departure value of 55 in the Boulder-Elkhorn Mountains subsection and 50 in the Little Belt-Snowy-Judith Mountains subsection.

Another possible source of lower departure measurements in ponderosa pine – Douglas fir systems in the Northern Rockies could be the multi-successional nature of some EVTs mapped in this area. These EVTs aggregated both early-, mid-, and late-successional species together, which could have confounded SClass mapping. In these cases, EVT was not necessarily applicable to distinguishing successional status. This may further compound the difficulty in correctly assigning SClass based on cover and height, which may not show strong relationships to successional status. It is possible that more area should have been mapped to late-successional states on the basis of greater densities of later-successional species.

It is also possible that the current conditions on the ground, which may be dominated by a mid-successional overstory with high densities of advanced regeneration in the understory represent uncharacteristic conditions that would not have been expected in the reference conditions. The LANDFIRE training plots generally show advanced regeneration in Northern Rockies as expected, but these spatial trends do not appear to be reflected in the cover and height layers used for SClass mapping. Structurally complex systems that are defined primarily by differences in understory structure (e.g., sparse vs. dense understory under moderately open overstory) are difficult to distinguish using satellite data. For instance, it is essentially impossible to determine what tree canopy cover in the LANDFIRE Cover layer is contributed by the overstory versus understory trees detected through gaps in the overstory. The more closed the overstory, the more difficult it is to detect understory conditions with satellite imagery. Therefore, even though advanced regeneration may have significant effects on current vegetation dynamics and fire regimes, this phenomenon may not likely be reflected adequately in LANDFIRE FRCC, because the overstory canopy cover, height, and EVT available for SClass mapping do not necessarily reflect such understory characteristics.

Zone	BpS unit (Figure 2)	Dominant FRCC (Figure 3)	Dominant Fire Regime Group (Figure 4)	Reference or Current?	Dominant SClass	Dominant Cover Range (Figure 7)	Dominant Height (Figure 8)	SClass instructions from review
PNW (1,2,7)	**10370** : North Pacific Maritime Dry-Mesic Douglas-fir Western Hemlock Forest	I-II	III & V	**RC**	E	60-100%	Tall-Giant Trees (>25 m)	• Should show some of >50 m height class in OR Coast Range ➢ Special layer developed to map biggest trees
				CC	B (Figure 5)	60-100%	Tall Trees (25-50 m)	
	10390 : North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	III	V	**RC**	E	60-100%	Giant Trees (>50 m)	• Should show 10-20% of area in this type in >50m height class • Canopy cover OK ➢ Special layer developed to map biggest trees
				CC	B (Figure 5)	60-100%	Medium-Tall Trees (10-50 m)	
Northern Rockies (10,19,20)	**10451** : Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (Ponderosa Pine-Douglas-fir)	I-II	I & III	**RC**	D	20-60%	Tall Trees (25-50 m)	
				CC	B (Figure 6)	60-100%	Medium Trees (10-25 m)	
	10452 : Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (Larch)	II-III	I & III	**RC**	D	10-40%	Tall Trees (25-50 m)	
				CC	B (Figure 6)	60-100%	Medium Trees (10-25 m)	

Zone	BpS unit (Figure 2)	Dominant FRCC (Figure 3)	Dominant Fire Regime Group (Figure 4)	Reference or Current?	Dominant SClass	Dominant Cover Range (Figure 7)	Dominant Height (Figure 8)	SClass instructions from review
	10453 : Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (Grand Fir)	II	III	**RC**	E	40-100%	Medium-Tall Trees (10-50 m)	
				CC	E (Figure 6)	60-100%	Medium Trees (10-25 m)	
	10530 : Northern Rocky Mountain Ponderosa Pine Woodland and Savanna	II-III	I	**RC**	D	10-40%	Tall Trees (25-50 m)	• Move non-ponderosa pine EVTs 40-60% cover to E • Cover of non-ponderosa pine EVTs >60% is UN
				CC	UN (Figure 6)	60-100%	Medium Trees (10-25 m)	
	11661 (11660) : Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	II	III	**RC**	C	20-40%	Short Trees (5-10 m)	
				CC	E (Figure 6)	60-100%	Medium Trees (10-25 m)	
	11662 (11650) : Middle Rocky Mountain Montane Douglas-Fir Forest and Woodland (Fire Maintained Savannah)	III	I	**RC**	D	10-30%	Medium-Tall Trees (10-50 m)	
				CC	B (Figure 6)	10-100%	Shrubs, grass, or Medium Trees (10-25 m), but very mixed	

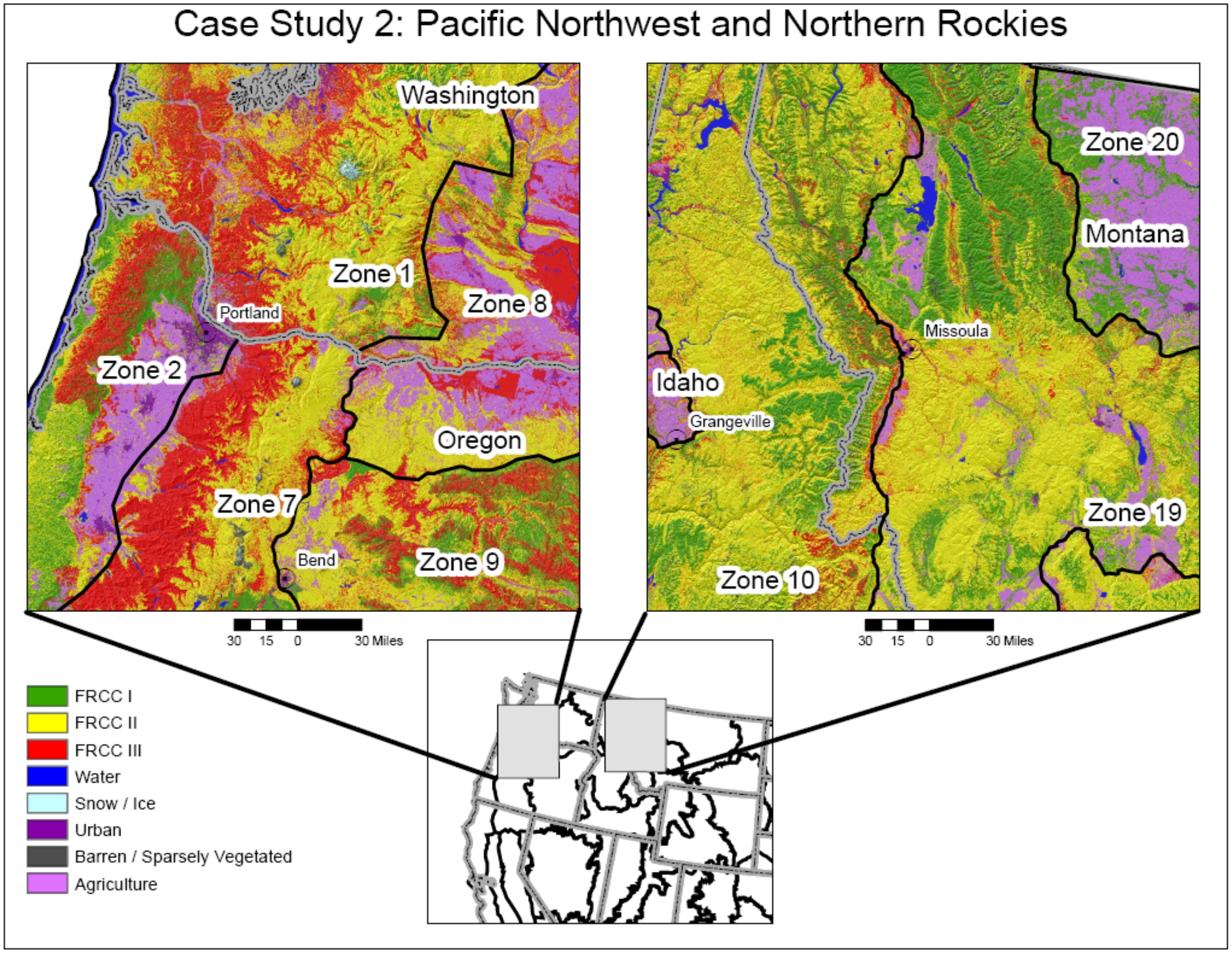

Figure 1: LANDFIRE FRCC for Zones 2,7,8 and 9 in Oregon and Washington and Zones 10,19, and 20 in Idaho and Montana.

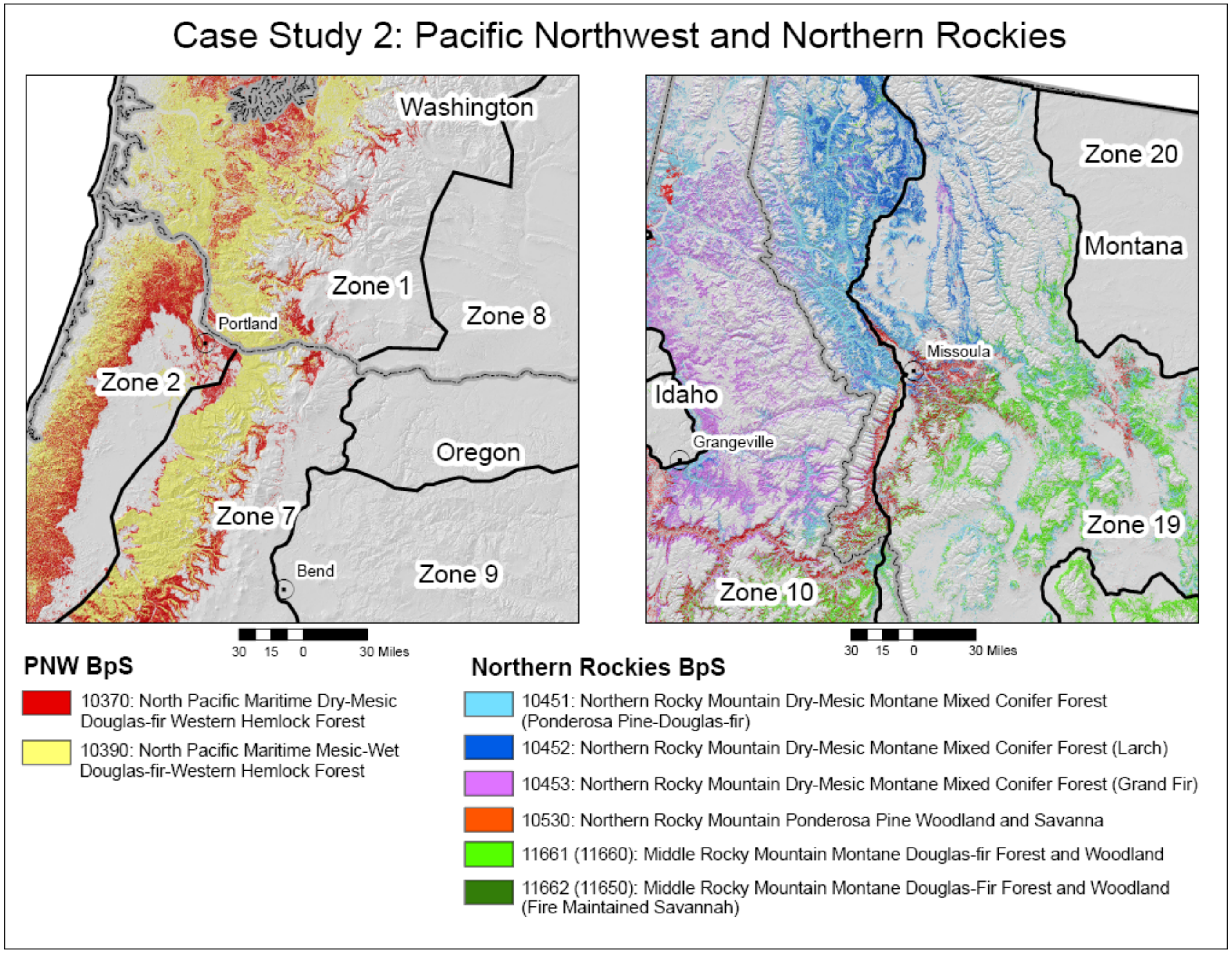

Figure 2: LANDFIRE BpS for maritime Douglas-fir - western hemlock systems in the Pacific Northwest and ponderosa pine - Douglas-fir systems in the Northern Rockies.

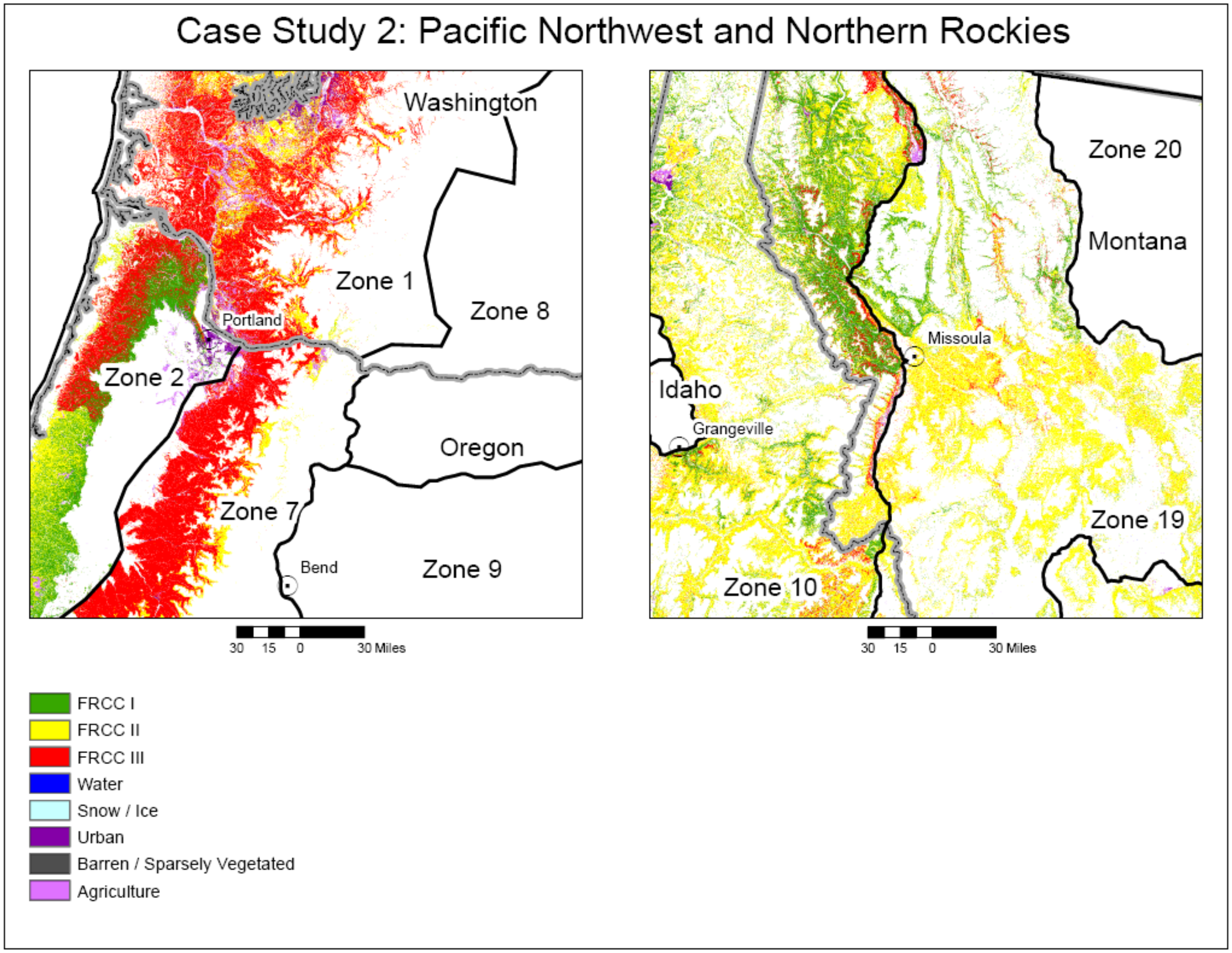

Figure 3: LANDFIRE FRCC for maritime Douglas-fir - western hemlock systems in the Pacific Northwest and ponderosa pine - Douglas-fir systems in the Northern Rockies (see Figure 2 for details on BpS units used).

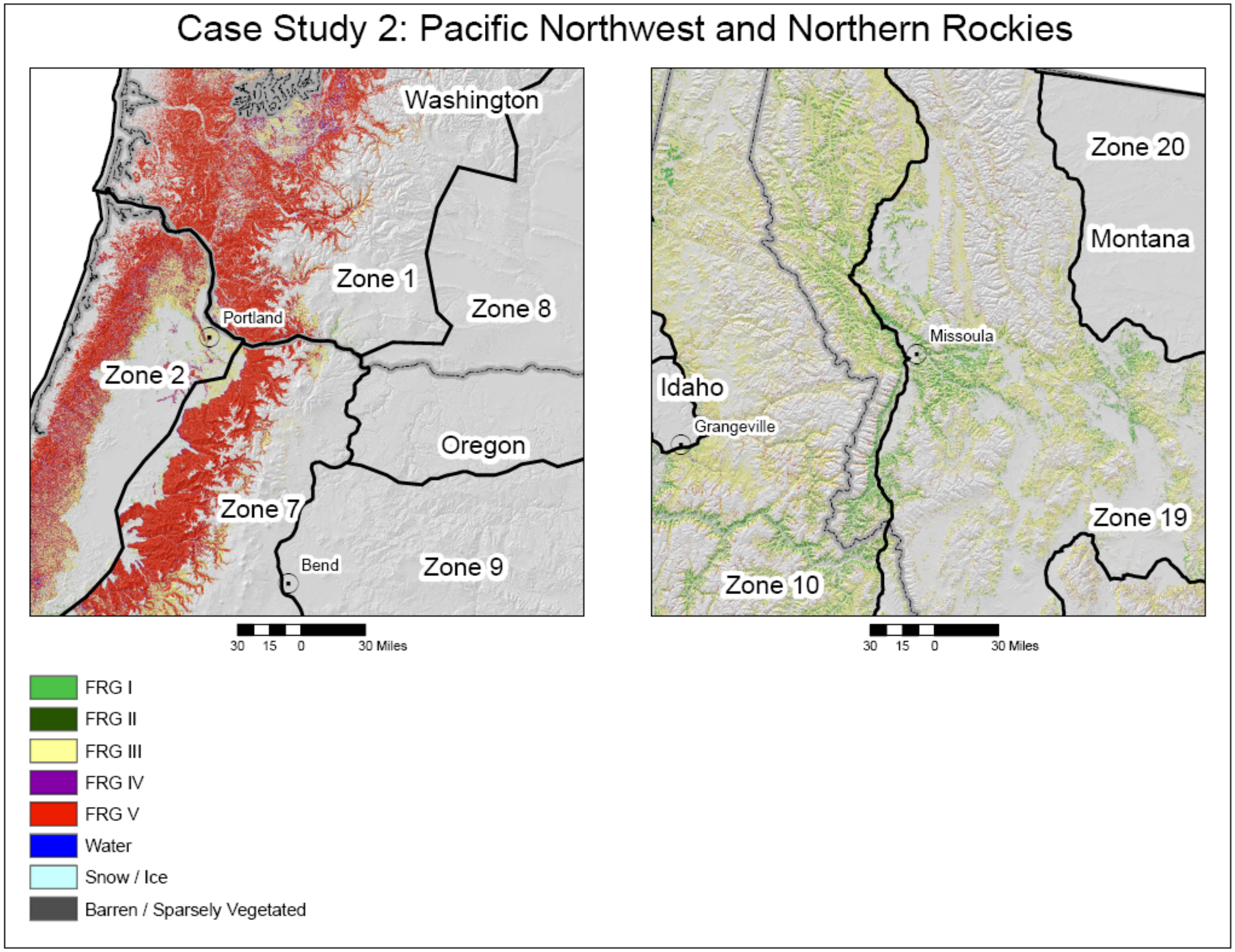

Figure 4: LANDFIRE Fire Regime Groups for maritime Douglas-fir - western hemlock systems in the Pacific Northwest and ponderosa pine - Douglas-fir systems in the Northern Rockies (see Figure 2 for BpS units used).

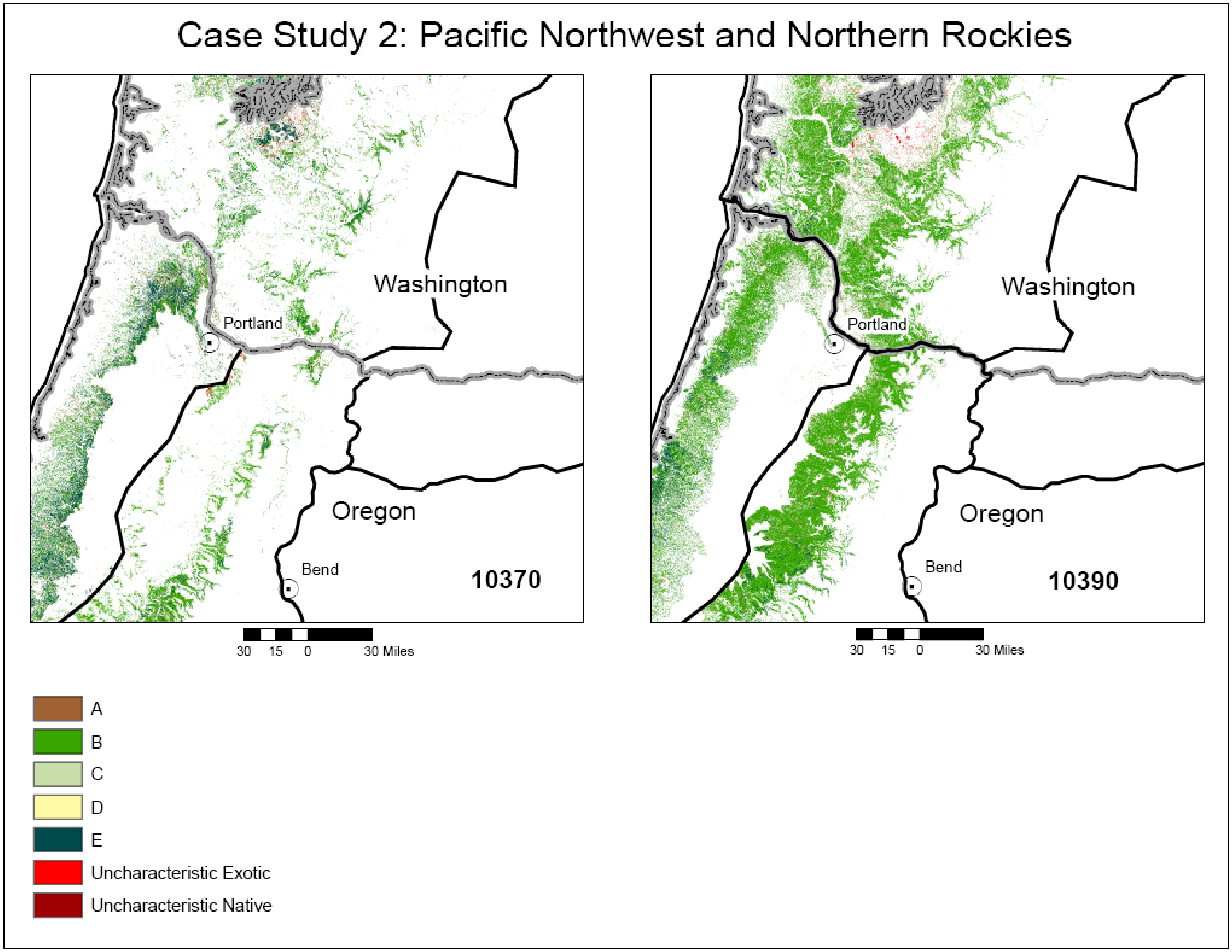

Figure 5: LANDFIRE Succession Class for maritme Douglas-fir - western hemlock systems in the Pacific Northwest (see Figure 2 for BpS units used). Only wildland areas are shown for clarity.

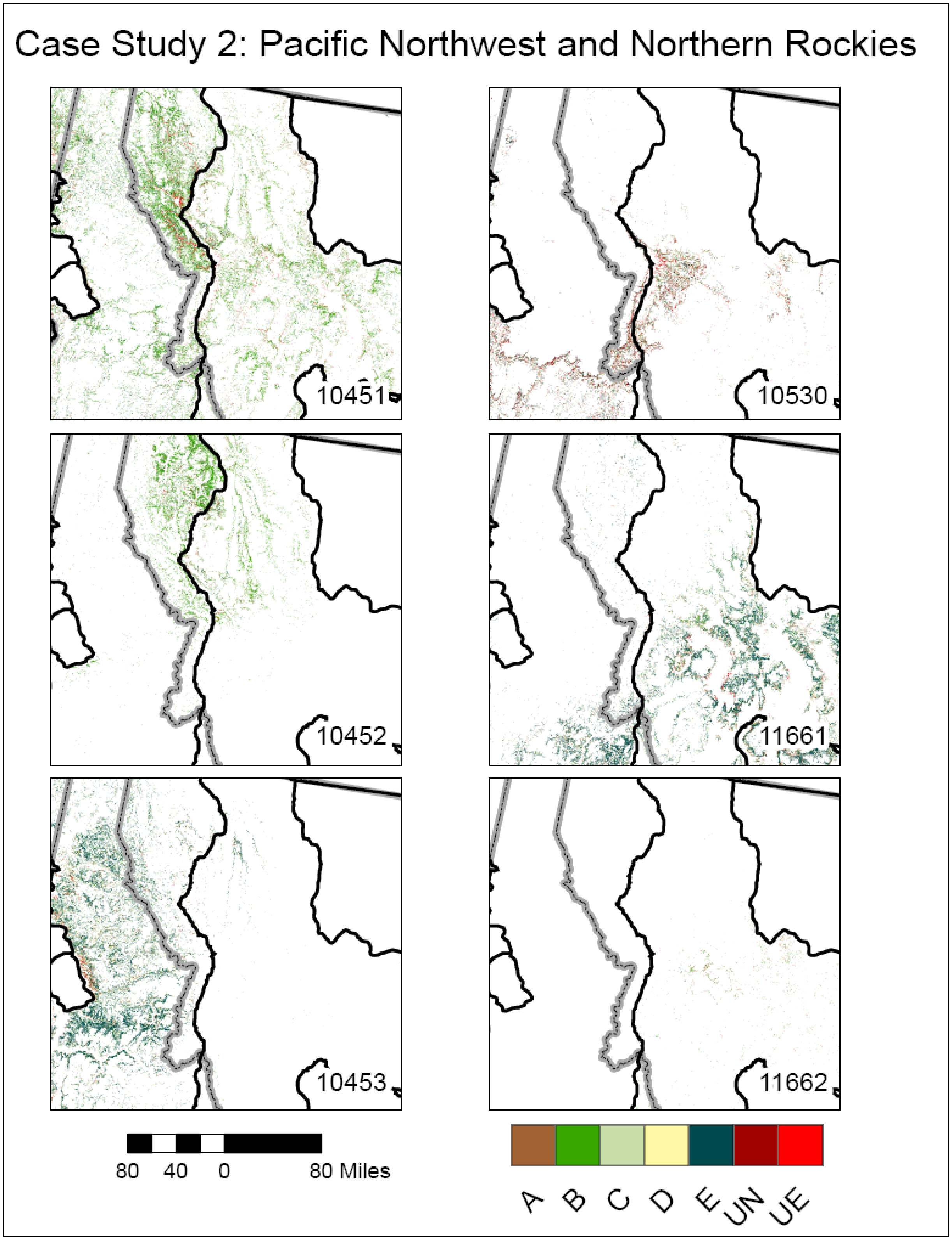

Figure 6: LANDFIRE Succession Class for ponderosa pine - Douglas-fir systems in the Northern Rockies (see Figure 2 for BpS units used). Only wildland areas are shown for clarity.

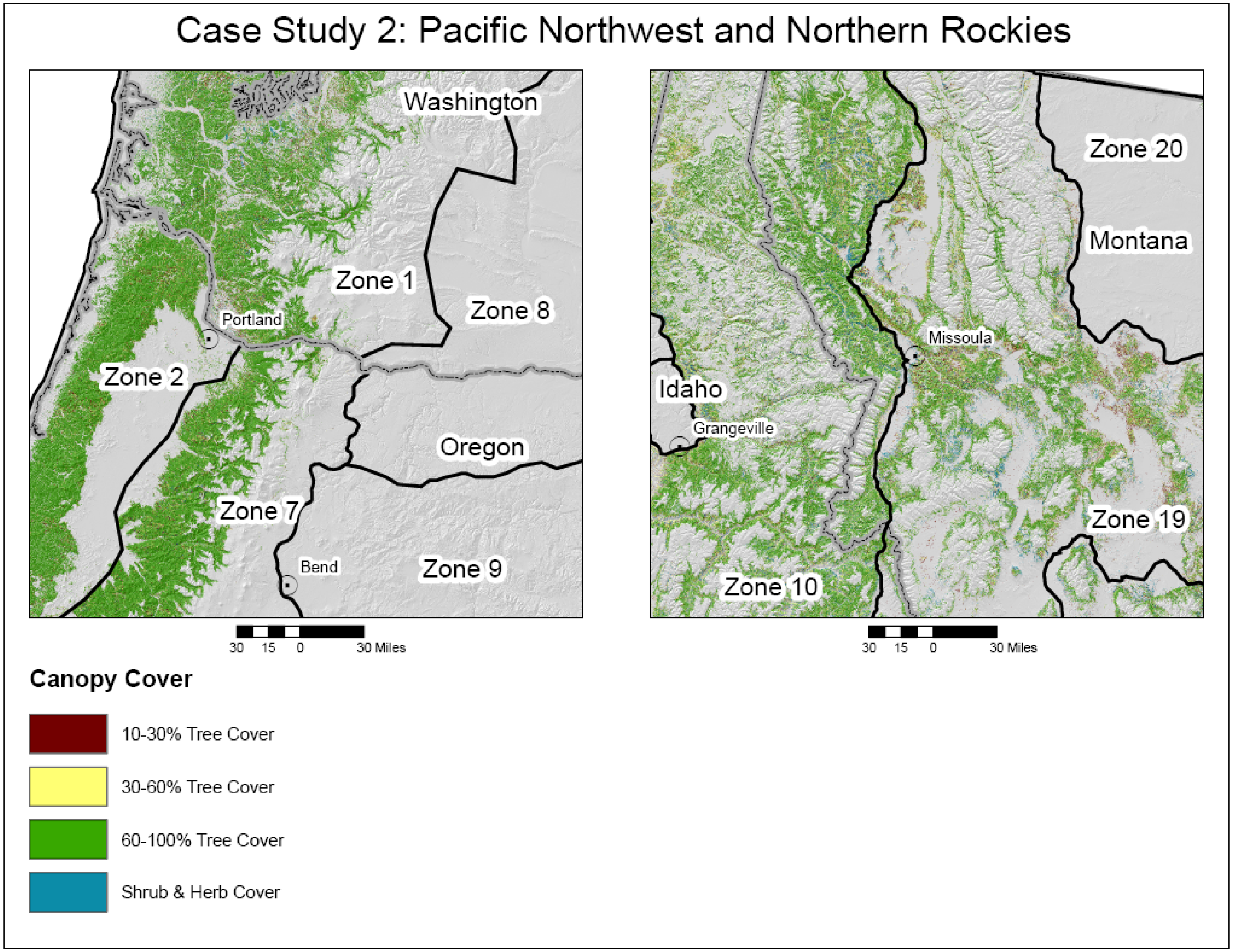

Figure 7: LANDFIRE Canopy Cover for maritime Douglas-fir - western hemlock systems in the Pacific Northwest and ponderosa pine - Douglas-fir systems in the Northern Rockies (see Figure 2 for BpS units used). Only wildland areas are show for clarity.

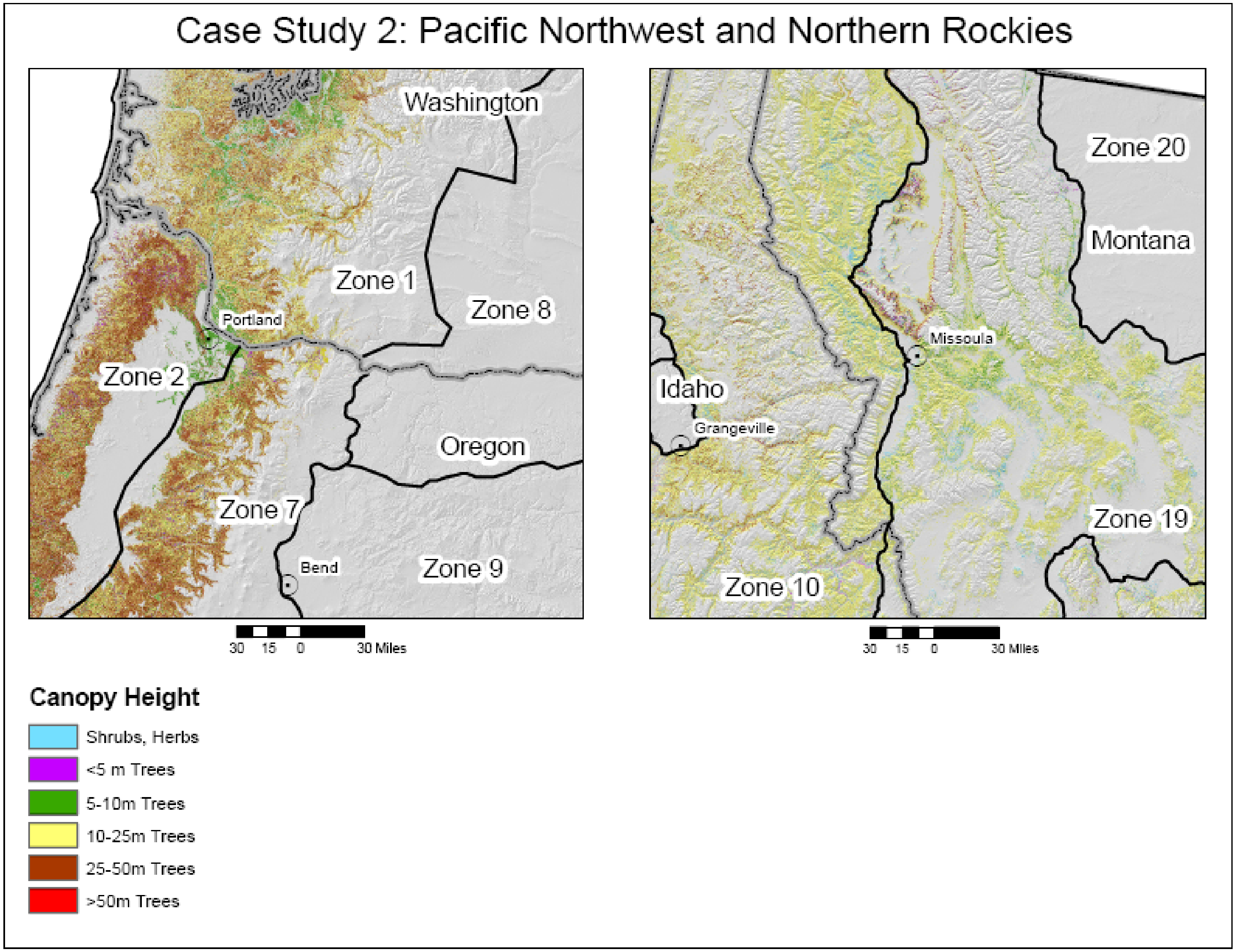

Figure 8: LANDFIRE Canopy Height for maritime Douglas-fir - western hemlock systems in the Pacific Northwest and ponderosa pine - Douglas-fir systems in the Northern Rockies (see Figure 2 for BpS units used). Only wildland areas are show for clarity.

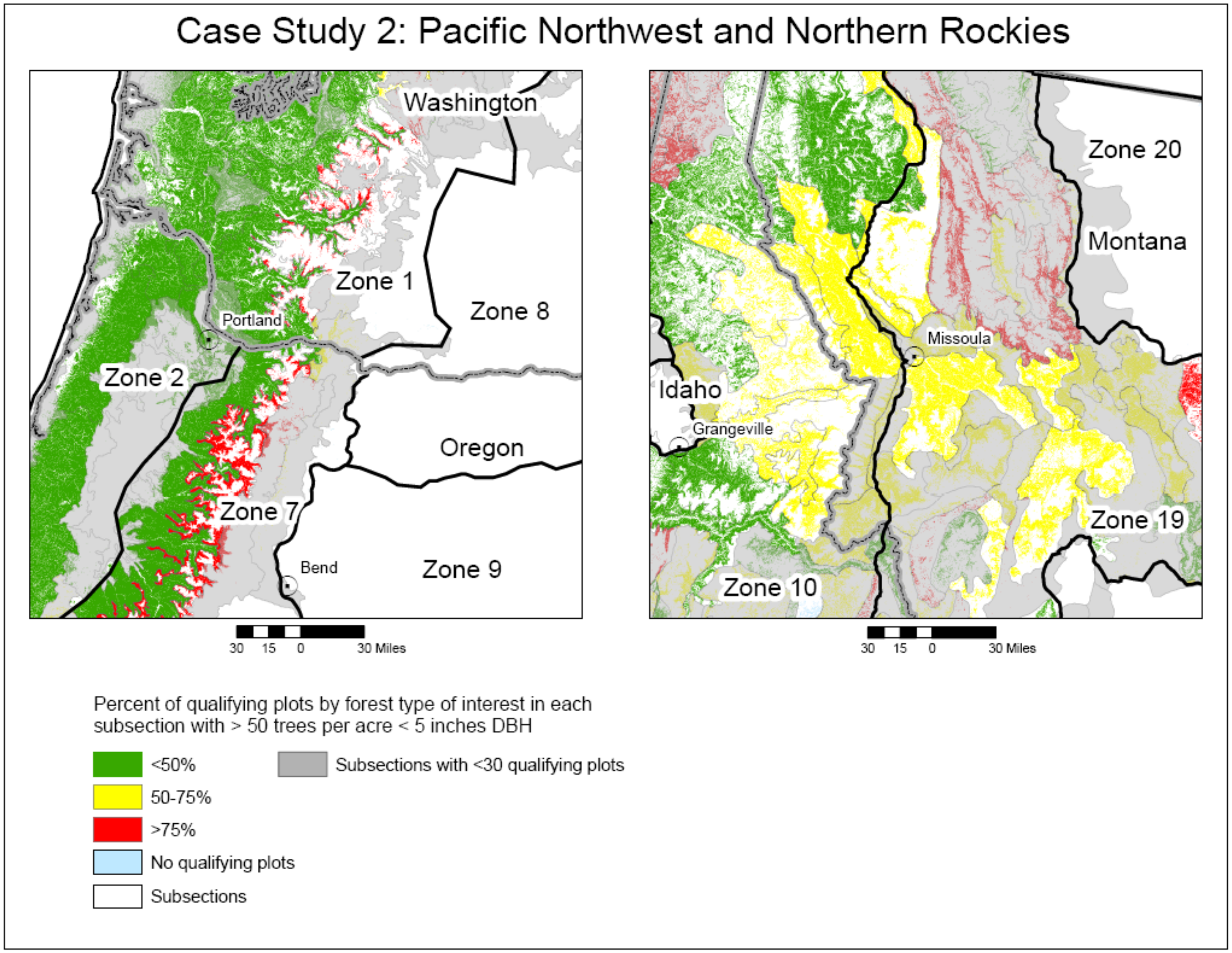

Figure 9: Estimate of advanced regeneration in maritime Douglas-fir -western hemlock systems in the Pacific Northwest and ponderosa pine - Douglas-fir systems in the Northern Rockies (see Figure 2 for BpS units used). Estimates are based on percent of qualifying plots per subsection; to qualify, a plot must be mapped to a one of the case study BpSs and have at least 10 trees per acre >21 inches DBH