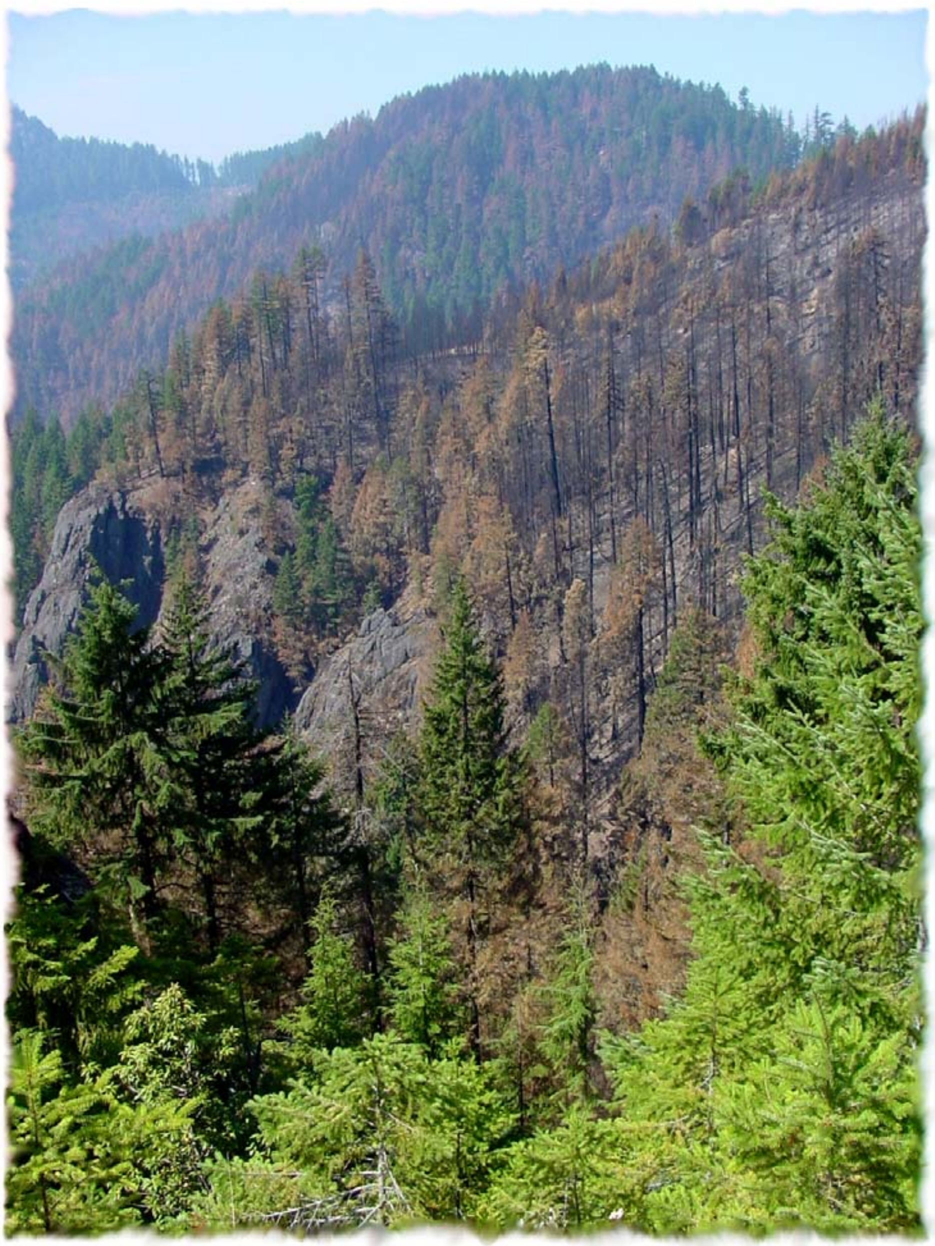
WILDFIRE EFFECTS EVALUATION PROJECT

APPENDIX A: VEGETATION



UMPQUA NATIONAL FOREST

April 2003

Appendix A: Vegetation

- Landunits and Landscape Areas
- Fire Severity/Intensity Maps
- RSAC Burn Severity Mapping Procedures
- Current Vegetation
- Noxious Weeds
- Sensitive Plants
- Morels

Appendix B: Fuels

- Fuel Model Map

Appendix C: Watershed

- Sub-Watershed Sensitivity Index
- Hydrologic Risk Map
- Peak Flow Influence on Stream Bank Erosion
- Slope Stability Hazard Map (SHALSTAB)
- Water Quality Limited Streams

Appendix D: Wildlife

- Snag Inventory Methodology
- Spotted Owl Habitat

Appendix E: Cultural Sites, Roads, Trails and BAER

- Cultural Sites
- Roads
- Trails and Recreation Facilities
- Burned Area Emergency Rehabilitation (BAER)

Appendix A: Vegetation

Landunits and Landscape areas

Landunits and Landscape areas were used to define areas of the forest that have similar vegetation types, climates, fire regimes and hydrologic processes. Landunits are defined by elevation, aspect and slope parameters (Table 1A: Cascade Section Landunits).

	Cascade Section Area Landunits							
Area	Land unit type	elevation	elev_code	slope	slope_code	aspect	aspect_code	assigned land unit
Willamette CGRD	cool/north/gentle	3900	>39	0-30	30	315-135	1,2,4	1
	cool/north/moderate	3900	>39	30-60	60	315-135	1,2,4	2
	cool/north/steep	3900	>39	>60	90	315-135	1,2,4	3
	cool/south/gentle	3900	>39	0-30	30	315-135	3	4
	cool/south/moderate	3900	>39	30-60	60	315-135	3	5
	cool/south/steep	3900	>39	>60	90	315-135	3	6
	warm/north/gentle	3900	<=39	0-30	30	135-315	1,2,4	7
	warm/north/moderate	3900	<=39	30-60	60	135-315	1,2,4	8
	warm/north/steep	3900	<=39	>60	90	135-315	1,2,4	9
	warm/south/gentle	3900	<=39	0-30	30	135-315	3	10
	warm/south/moderate	3900	<=39	30-60	60	135-315	3	11
	warm/south/steep	3900	<=39	>60	90	135-315	3	12
	cool/flat	3900	>39			-1	-1	13
	warm/flat	3900	<=39			-1	-1	14
NUmpqua NURD/DLRD	cool/north/gentle	4000	>40	0-30	30	315-135	1,2,4	1
	cool/north/moderate	4000	>40	30-60	60	315-135	1,2,4	2
	cool/north/steep	4000	>40	>60	90	315-135	1,2,4	3
	cool/south/gentle	4000	>40	0-30	30	315-135	3	4
	cool/south/moderate	4000	>40	30-60	60	315-135	3	5
	cool/south/steep	4000	>40	>60	90	315-135	3	6
	warm/north/gentle	4000	<=40	0-30	30	135-315	1,2,4	7
	warm/north/moderate	4000	<=40	30-60	60	135-315	1,2,4	8
	warm/north/steep	4000	<=40	>60	90	135-315	1,2,4	9
	warm/south/gentle	4000	<=40	0-30	30	135-315	3	10
	warm/south/moderate	4000	<=40	30-60	60	135-315	3	11
	warm/south/steep	4000	<=40	>60	90	135-315	3	12
	cool/flat	4000	>40			-1	-1	13
	warm/flat	4000	<=40			-1	-1	14
South UmpquaTLRD	cool/north/gentle	4100	>41	0-30	30	340-110	1	1
	cool/north/moderate	4100	>41	30-60	60	340-110	1	2
	cool/north/steep	4100	>41	>60	90	340-110	1	3
	cool/south/gentle	4100	>41	0-30	30	340-110	2,3,4	4
	cool/south/moderate	4100	>41	30-60	60	340-110	2,3,4	5
	cool/south/steep	4100	>41	>60	90	340-110	2,3,4	6
	warm/north/gentle	4100	<=41	0-30	30	110-340	1	7
	warm/north/moderate	4100	<=41	30-60	60	110-340	1	8
	warm/north/steep	4100	<=41	>60	90	110-340	1	9
	warm/south/gentle	4100	<=41	0-30	30	110-340	2,3,4	10
	warm/south/moderate	4100	<=41	30-60	60	110-340	2,3,4	11
	warm/south/steep	4100	<=41	>60	90	110-340	2,3,4	12
	cool/flat	4100	>41			-1	-1	13
	warm/flat	4100	<=41			-1	-1	14

Landscape Areas were mapped using patterns of landunits and geomorphic landtypes (Table 2A: Upper South Umpqua Landscape Area Descriptions and Figure 1A: Upper South Umpqua Landunit and Landscape Areas):

Landscape Area	Landunits	Fire regime	Geomorphic Landtypes	Elevation	Slope	Plant Series	
1 High Elevation	Cool	IV	Properties of 2 and 9	>4100	0-60%	Pacific silver fir/ white fir/ Shasta red fir	
1ss Steep High Elevation	Cool	IV, V	Properties of 3	>4100	>60%	Shasta red fir/ Pacific silver fir	
2 Gentle/Moist	Warm/Dry/Gentle Warm/Moist/Gentle	III	Landslide/earth flow deposits. Broken relief/ steep scarps with benches	<4100	0-30%	Western hemlock/ white fir	
3 Steep/Dry	Warm/Dry/Steep Warm/Moist/Steep	I, III	Highly dissected, long-steep linear slopes	<4100	Mostly >60%	Douglas-fir/ white fir	
9 Gentle Mountain Slopes	Warm/Moist/Gentle Warm/Dry/Gentle Warm/Moist/Moderate Warm/Dry/Moderate	III, I	Convex profile from ridge to bottom	<4100	Mostly <60%	White fir/ Douglas fir	

Fire Regimes:
- I – Frequent, low intensity underburn.
- III – Less frequent, low intensity with flare-ups.
- IV – Infrequent, moderate intensity with small-scale stand replacing effects.
- V – Infrequent, extreme intensity with large-scale stand replacing effects.

Table 2A: Upper South Umpqua Landscape Area Descriptions

Landscape Area Descriptions:

Landscape Area 1 occurs at elevations above 4100’ (a small portion drops below 4100’) on all aspects with mostly gentle to moderate slopes. The geomorphic features for this landscape area are similar to the properties of Landscape Area 2 and 9. The white fir and Pacific silver fir plant associations that occur in a cool climate define it. This landscape area receives the highest amount of precipitation. Its climate results in a relatively long fire return interval and high amounts of fuel and large wood accumulate between fire events.

Landscape Area 1ss occurs at elevations above 4100' on all aspects with mostly steep slopes. The geomorphic features for this landscape area are similar to the properties of Landscape Area 3. The Shasta red fir and Pacific silver fir (with mountain hemlock inclusions) plant associations that occur in a cool climate define it. This landscape area also receives the highest amount of precipitation. Its climate results in a long fire return interval and high amounts of fuel and large wood accumulate between fire events.

Landscape Area 2 occurs below 4100' elevation in the Western hemlock/white fir zone. Gentle slopes (30%) with both north (warm/moist) and south (warm/dry) aspects dominate it. Much of these gently sloping landscapes formed on large landslide/earth flow deposits. Deep soils in the valley bottoms make for productive forests. Its warm climate and gentle slopes result in a relatively frequent, low intensity fire regime. The moist valley bottoms act as the areas fire refugia. Moderate to high amounts of fuel and large wood accumulate between fire events.

Landscape Area 3 occurs below 4100' elevation in the white fir/Douglas-fir zone with Western hemlock inclusions on the north slopes. Long, steep linear slopes with both north (warm/moist) and south (warm/dry) aspects, highly dissected by streams in a pinnate pattern characterize it. Its steep slopes have many shallow, rocky soils and deep soil accumulations on foot slopes. The presence of low to high site productivity is a reflection of the contrasts in soil moisture availability on different aspects and on upper versus lower slope positions. Its warm climate and steep slopes result in a frequent, low intensity fire regime. Low to moderate amounts of fuel and large wood accumulate between fire events.

Landscape Area 9 occurs below 4100' elevation with gentle to moderate slopes on all aspects. The slope profile is convex from the ridge to the very bottom. Stream patterns are dendritic. The Western hemlock, white fir, and Douglas-fir plant associations characterize the vegetation. The warm climate and gentle slopes result in a relatively frequent, low intensity fire regime. Moderate to low amounts of fuel and large wood accumulate between fire events.

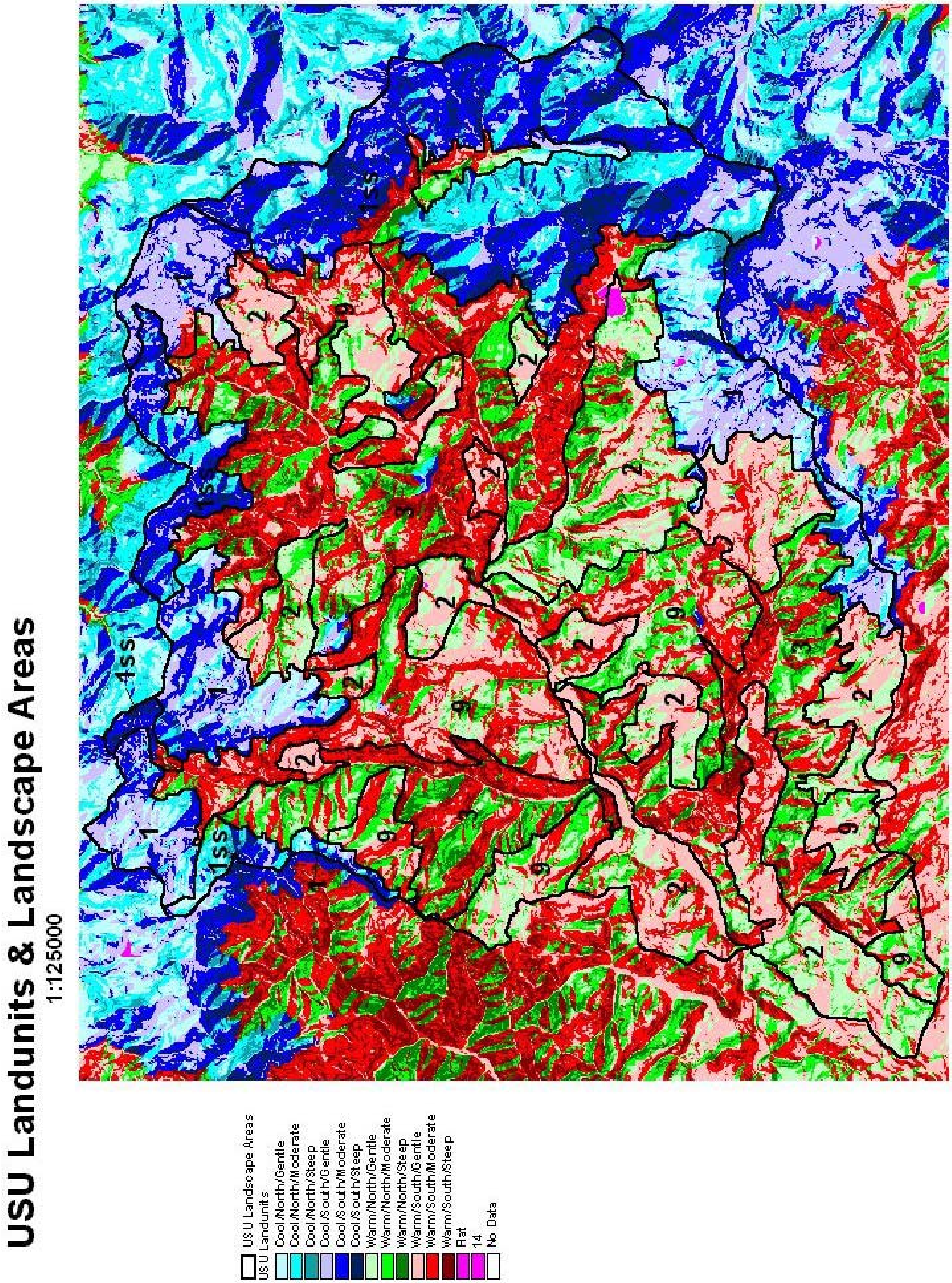


Figure 1A: Upper South Umpqua Landunit and Landscape Areas

Fire Intensity and Severity Maps

A Fire Severity Map (Wildfire Effects Evaluation Project, Figure 11) was created by combining two maps, Fire Intensity (9/15/02 Landsat image interpretation) and Extreme Heat (infrared aerial photography interpretation). Maps of Fire Severity and Fire Intensity are available online: ftp://ftp2/fs.fed.us/incoming/r6/ump/weep.

The following raster map analysis steps were used to derive Fire Severity (Table 3A: Fire Intensity/Heat Matrix):

<table>
<tr><th colspan="6">FIRE SEVERITY</th></tr>
<tr><th rowspan="5">EXTREME HEAT DAYS</th><th colspan="5">INTENSITY (Landsat severity)</th></tr>
<tr><td></td><td>None
0
(10)</td><td>Low
1
(20)</td><td>Moderate
2
(30)</td><td>High
3
(40)</td></tr>
<tr><td>0 day
(0)</td><td>0
(10)</td><td>1
(20)</td><td>2
(30)</td><td>3
(40)</td></tr>
<tr><td>1 day
(1)</td><td>1
(11)</td><td>1
(21)</td><td>2
(31)</td><td>2
(41)</td></tr>
<tr><td>2+ days
(2-6)</td><td>2
(12-16)</td><td>2
(22-26)</td><td>3
(32-36)</td><td>3
(42-46)</td></tr>
</table>

Table 3A: Fire Intensity/Heat Matrix

1) Assign new values for Landsat severity classes (none, low, moderate, high) shown in parentheses in the above table (10, 20, 30 & 40, respectively).
2) Add landsat severity and extreme heat grid values (resultant values shown in parentheses within the above matrix (10-46).
3) Reclassify combined grid values ranging from 10 to 46 into the four fire severity values as shown in the above matrix (none=0, 1=low, 2=moderate, 3=high).

The following field observations of fire intensity and severity were used to designate the Fire Severity values in the above matrix;

Areas mapped as "none" in the landsat severity coverage *under*estimated fire severity.

Areas mapped as "high" in the landsat severity coverage often *over*estimated fire severity, including plantation areas that experienced stand replacement fire effects.

The extreme heat mapping was used to upgrade or downgrade Landsat fire severity values in Table 1A in the following manner:

- For areas where "0 days" of extreme heat was detected, Landsat fire severity was not changed. This interpretation also included areas were there was no data for extreme heat.
- For areas where "1 day" of extreme heat was detected and Landsat fire severity was "none", Landsat severity was upgraded to "low" fire severity.
- For areas where "1 day" of extreme heat was detected and Landsat fire severity was "high", Landsat severity was downgraded to "moderate" fire severity. This classification included plantation areas with stand replacement fire effects where few severe fire effects were found on the forest floor.
- For areas were "2+ days" of extreme heat was detected and Landsat fire severity was "none" or "low", Landsat severity was upgraded to "moderate" fire severity.
- For areas were "2+ days" of extreme heat was detected and Landsat fire severity was "moderate", Landsat severity was upgraded to "high" fire severity.

Post-fire large wood inventory plots were used to validate the above fire severity classification scheme in the vicinity of the Apple Fire Salvage Planning Area (Appendix D, Snag Inventory). Fire intensity and severity were recorded on 120, ½ acre snag inventory plots located in two Landsat severity mapunits, high and moderate/low. Plot fire severity and intensity classifications were based on the following field observations (Table 4A: Fire Intensity/Severity Classification):

Fire intensity/severity classification				
	None	**Low**	**Moderate**	**High**
Intensity (canopy effects)	No fire effects	Most overstory tree crowns still green with some crown scorching	More dead than living trees in overstory. Extensive overstory crown scorching	Overstory canopy completely scorched or consumed
Severity (forest floor effects)		Duff is largely intact, although it can be charred on surface. Woody debris partially consumed or charred	Duff is deeply charred or consumed, but underlying mineral soil is not visibly altered, including fine roots near surface	Duff is completely consumed and top of mineral soil is reddish or orange. Logs can be completely consumed or deeply charred. Soil surface texture is changed and fine roots near surface consumed or deeply charred.

Table 4A: Fire Intensity/Severity Classification

The overall goal of fire severity mapping was to predict where and how much of the fire landscape experienced the more severe fire effects. The Snag Inventory data support the following conclusions about the accuracy and precision of the Fire Severity and Fire Intensity maps:

The Fire Severity mapping accuracy was evaluated by comparing plot observations with mapping for the plot area (Figure 2A). Eighteen plots had high severity and 14 were mapped as high; five of 14 were correctly mapped as high. Eighty-eight plots had moderate or low severity and 80 were mapped as such; 32 of 80 were correctly mapped as either moderate or low.

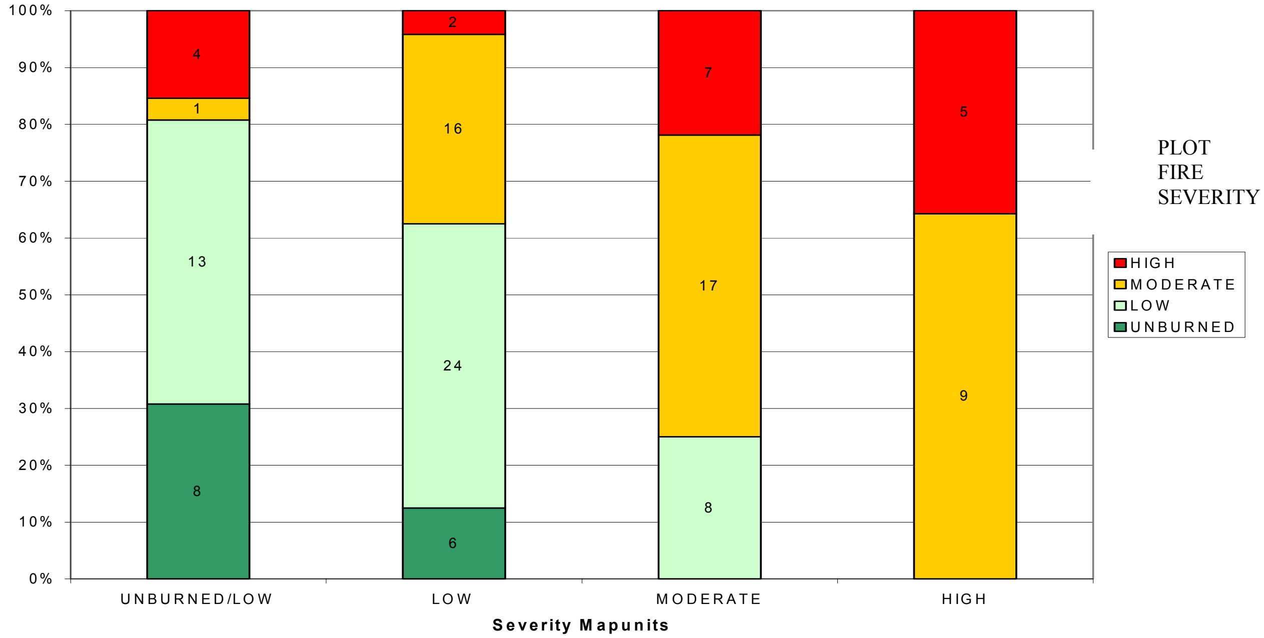


Figure 2A: Severity Mapping versus Plot Severity Data (plot counts listed on graph)

If one compares severity and intensity map values, then Fire Severity Mapping classified high and moderate severity fire effects with greater precision than the RSAC Intensity Mapunits (compare Figures 2A and 3A)

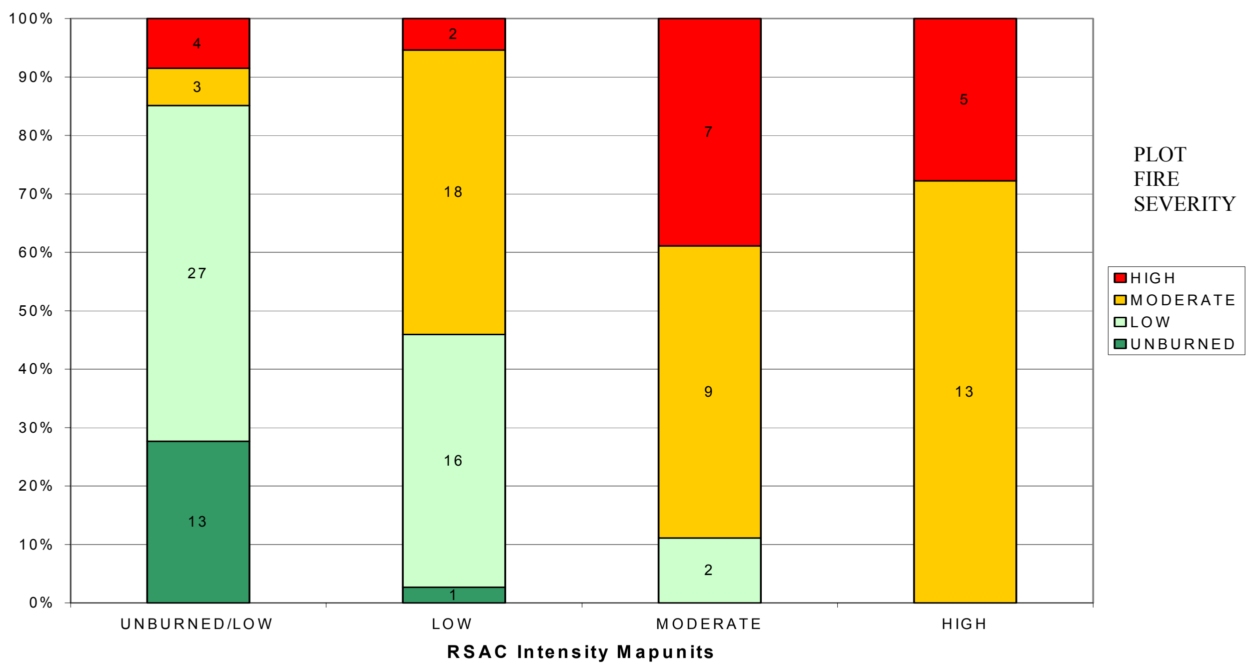


Figure 3A: Intensity Mapping (RSAC) versus Plot Severity Data (plot counts listed on graph)

The Fire Intensity mapping accuracy was evaluated by comparing plot observations and mapunits for the plot area (Figure 4A). Forty-eight plots had high severity and 18 were correctly mapped as high. Fifty-eight plots had moderate or low intensity and 55 were mapped moderate or low (28 of 55 were correctly mapped as either moderate of low). The Fire Intensity mapping clearly ***under***estimated the area that experienced high intensity fire effects.

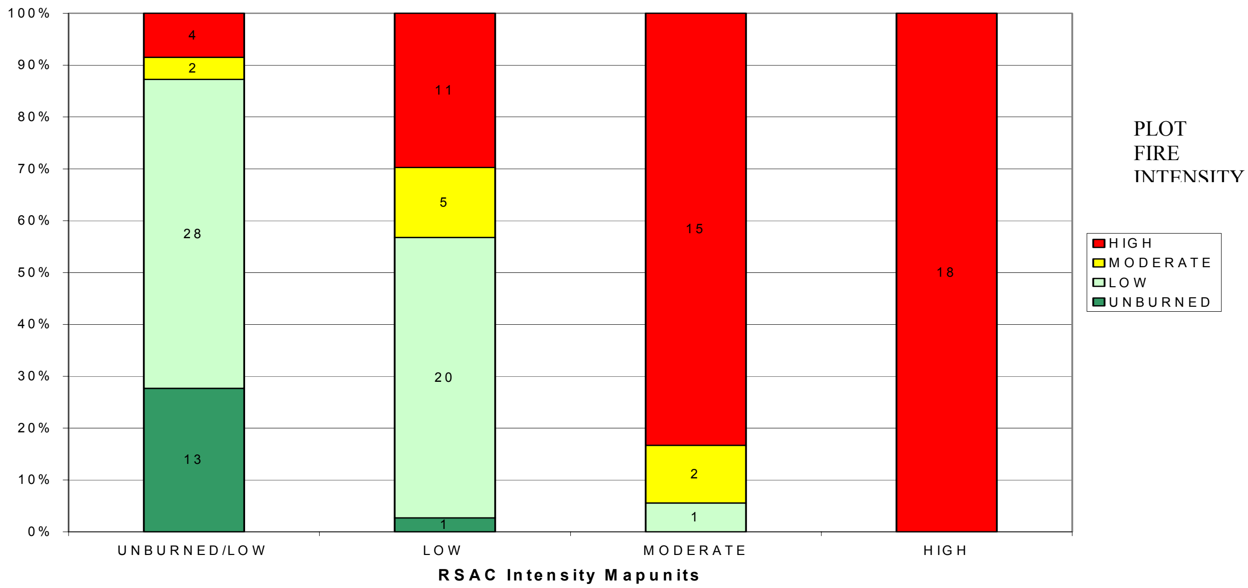


Figure 4A: Intensity Mapping (RSAC) versus Plot Intensity Data (plot counts listed on graph)

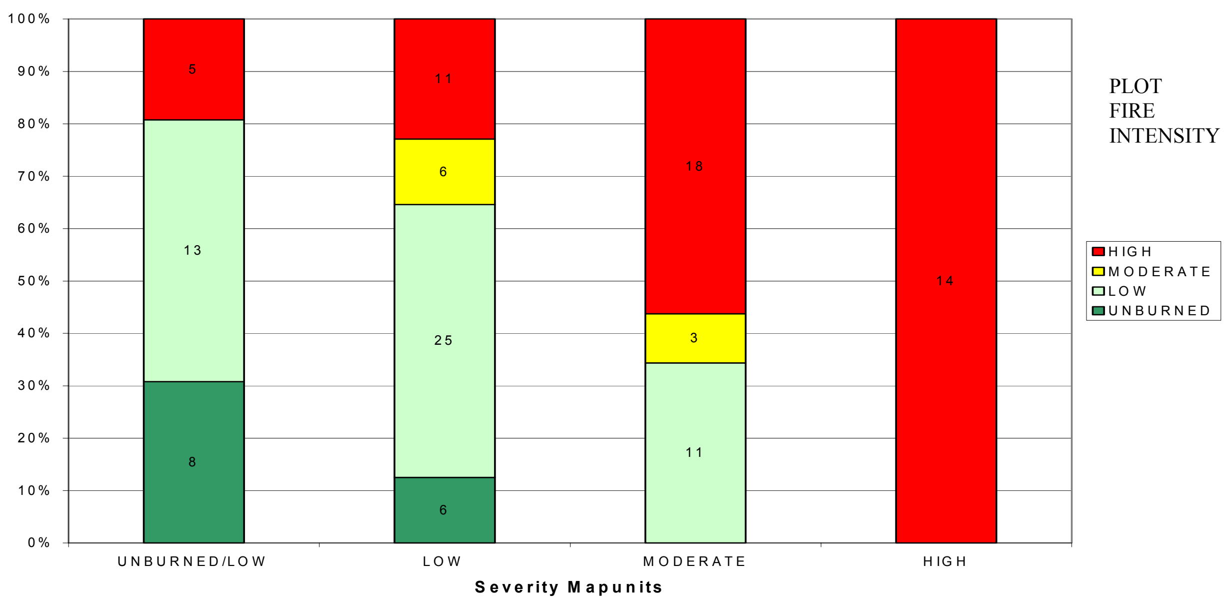


Figure 5A: Severity Mapping versus Plot Intensity Data (plot counts listed on graph)

If one compares severity and intensity map values, then the Fire Severity Mapping classified high intensity fire effects with greater precision than the RSAC Intensity Mapunits (by comparing Figures 4A and 5A, one can see that less high plot intensity was mapped as moderate/low/unburned).

The Fire Severity map decreased the areas mapped as high and unburned compared to RSAC Intensity Mapping and increased the amount of low and moderate areas (Figure 6A - compare the distribution of fire severity mapunits (graph colors) to bar graph heights for each RSAC mapunit).

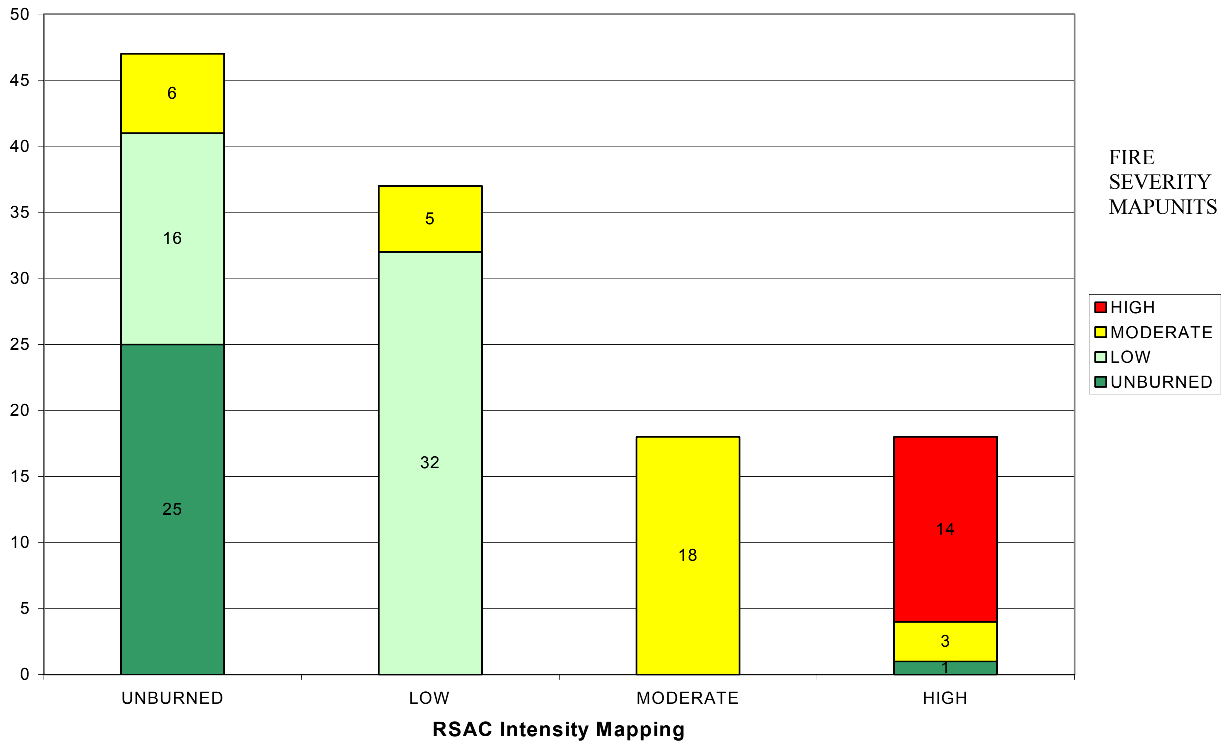


Figure 6A: Comparison of RSAC Intensity Mapping versus Fire Severity Mapping in Apple Fire Vicinity (severity mapunit counts listed on graph)

RSAC Burn Severity Mapping Procedures

RSAC Burn Severity Mapping Procedures

Remote Sensing Applications Center

This document provides information about the data provided to Forest Service BAER teams by the Remote Sensing Applications Center (RSAC). The document was developed by RSAC's BAER support team during the 2002 fire season.

What are these files?

Typically, three types of files are available for download from our ftp site. There are **quick looks**, **data files**, and **preliminary burn severity classification files**.

- The **quick looks** are simply pictures of the available data that can be easily viewed with any picture viewer—like Microsoft Photo Editor. The quick looks are not georeferenced and are not GIS ready products.
- The **data files** are satellite images in .tif or .img format. They are georeferenced and can be used in a GIS or in image processing software. The projection is typically UTM, NAD 27. Unless otherwise noted, the data are Landsat data and the files contain six bands. The best band combination for viewing burned areas is 6,4,3. Landsat data have 30-meter resolution. Depending on the size of the burned area, we will merge these data with a 15-meter panchromatic band resulting in a 15 meter image. The resolution of the image will be noted in the file name. The file name also contains the date on which the image was acquired. A typical file name might be "hayman_27june02_30m_utm".
- **Note to ArcView users: The Imagine and/or Tiff extensions must be active for these files to work in ArcView.**

- The **preliminary burn severity classification files** are products derived from the satellite data and contain information regarding possible areas of high, moderate, and low burn severity. The classification files are typically provided in .tif, .img, and .e00 format. The former two are raster files; the latter is a vector interchange file. The vector file will need to be imported. The classified files are georeferenced and can be used in a GIS or in image processing software. Unless otherwise noted, the projection is UTM, NAD 27. The raster files are color coded: Dark green for unburned/under-burned, aquamarine for low severity, yellow for moderate severity, red for high severity. The vector files are coded by number: 1=unburned/under-burned, 2=low, 3=moderate, 4=high. The "grid code" column in the attribute table contains these numbers. Some products will have a fifth class. This is usually a cloud, water, or active fire class. The feature should be obvious when the classified product is compared to the image file. In addition, any fifth class will be explained when we notify the end user of data availability.

What are these files good for and what can I do with them?

The image files can be used as a base map in a GIS; they can be used for image analysis in ERDAS Imagine; they can be plotted and used as a hardcopy map for sketching; they can be plotted and used for public meetings; they can be used with a DEM to create 3 dimensional models of the burned area; they can be used to delineate unburned islands, watersheds of concern, and areas of development at the urban/wildland interface. In short, the image files provide a synoptic view of the entire burned area that may serve a variety of information needs.

The burn severity classifications can be used to focus the efforts of the BAER team on areas of greatest concern; they can be used to derive a preliminary estimate of acres of high, medium, and low severity; they can be used in hydrologic models to predict runoff response; they can be used in GIS overlays to provide information about the possible relationships between severity and slope, or soils, or vegetation; they can be used in public meetings to show concerned citizens the possible locations of increased erosion. **WARNING: Most of these uses should not be attempted until a soil scientist and/or hydrologist has verified the burn severity product.**

How is the burn severity classification derived?

It is worth noting at the outset that, despite the high tech sounding nature of satellite image analysis, our classifications are more art than science. That is, they depend on visual interpretation by remote sensing specialists. While there are standardized and well accepted methods of determining burn severity using Landsat data—notably Benson and Key's Normalized Difference Burn Ratio (NDBR)—we do not rely exclusively on them for several reasons.

First, our primary purpose is to provide rapid response products to BAER teams during the short, initial-assessment period. For this reason, we are ready to purchase data from a wide range of providers, depending on timing and price. For example, in 2002 we obtained Landsat, SPOT, IKONOS, Quickbird, and Aster imagery at various times. Since each of these data sets has different characteristics, it is important for us to be flexible in our use of tools and techniques for interpreting these data.

Second, any standardized tool will generally require smoke free/cloud free/fire free imagery. We frequently acquire imagery with all three. As a result, we need to be prepared to take our best shot, despite a lack of high confidence in the outcome. We have adopted this approach under the theory that it is better to provide our best guess to field crews than to leave them without any information at all. That being said, we have developed a fairly **standard procedure** that we hope to continue refining for the sake of consistency. That procedure is as follows (note: we work exclusively in ERDAS Imagine):

1. Any imagery we purchase must first be georeferenced and terrain corrected if it does not arrive in that condition.
2. The imagery is subset to our area of interest using either field derived perimeters or our own.
3. A band ratio, or series of ratios, is run on the data. The most common of these are NDVI (NIR and Red) and NDBR (SWIR and NIR). Our choice of ratio depends on the characteristics of the imagery and the quality of that particular image.
4. The band ratio outputs are classified using an unsupervised classification. The resulting file attribute table will have all the areas of high severity clumped at one end while the unburned areas will be clumped at the other. Starting with this knowledge, a remote sensing analyst then interprets the likely cut-off points between high, moderate, and low to create a classified product.
5. The classified product is then filtered by pre-fire vegetation to avoid over classifying herbaceous and shrub communities.
6. Finally, the classified product is filtered to remove the “salt and pepper effect” of a typical classification and to provide more generalized areas of at least 10 to 20 acres.

Is the preliminary burn severity classification 100% accurate?

No. It is preliminary. It requires field verification. It is a tool to help BAER team members focus their efforts. We realize that there is a wide range of opinion on what constitutes the break between areas of high and moderate severity as well as areas of moderate and low.

Some may feel that our products do not conform well to the parameters they have in mind. If the classification is unhelpful, confusing, or just plain wrong, throw it out. Our feelings will not be hurt. In that case, the image itself, plotted at 1:24,000 scale, may be useful as a base map for sketch mapping.

If, on the other hand, the classification seems partially accurate, but requires some changes, feel free to make edits. Most BAER teams have GIS and image processing savvy members: put them to work making edits. Again, our feelings will not be hurt; we expect BAER teams to refine our products.

It may also be useful to keep in mind **several factors that may confuse our classification**. If any of these are present in your burned area, they may account for discrepancies between what you see on the ground and what the satellite seems to be telling you.

- Areas of **active fire**. If, at the time of the satellite pass, there were areas of active burning, the classification will typically show those as “high” severity. When you are ground truthing, however, the fire is presumably gone from those locations and you may find that there is actually nothing there but some lightly burned grass.
- Areas of **bare ground** and/or desiccated vegetation. In very arid locales, especially during drought years, unburned bare ground with sparse vegetation is easily confused with areas of low burn severity. This is also true of very bare ground in more temperate climes. These would include areas of recent timber harvest, residential development, gravel pits, and agricultural activity.
- Areas of **closed canopy** with low severity under-burn. Sometimes our classification will call a forested area unburned when it is actually lightly under-burned. This is because satellite sensors cannot penetrate a closed forest canopy to detect evidence of burning on the forest floor.
- Areas of **stark geologic contrast**. When a fire occurs in a geologically active and/or diverse area, there may be sharp boundaries between very different soil or rock types. These may occur at faults, uplifts, contacts, or other geologic features. Often these areas have different spectral reflectance values and, therefore, look distinct on the satellite imagery. For purposes of burn severity, however, the areas on either side of the feature may be uniform. For that reason, the satellite derived map may show different classes while a field observer finds that they should be in the same burn severity category. This happened several times during the 2002 fire season, especially in southern California.

Given this list of caveats, why use the preliminary burn severity product at all?

Based on our experience and a fair amount of anecdotal evidence, the preliminary severity product can significantly reduce the time required to develop a burn severity map, which is a key first step in the BAER assessment process. Moreover, in several comparisons, conducted with field verified burn severity maps, our products have achieved accuracies of 60 to 80 percent. This seems like it could be a good start, especially for very large fires like those that occurred during the 2002 season. In addition, we believe that these products can provide more locationally accurate and detailed information than can be achieved with traditional helicopter or overlook based sketch mapping. Finally, for especially remote fires in rugged areas, some managers have told us that this may be the only information they are able to gain about the burned area for some time.

Current Vegetation

Current Vegetation Mapping (Wildfire Effects Evaluation Project, Figure 6) was used to characterize the changes in forest structures before and after the fire (WEEP, Figure 15), to map the distribution of stand replacement fire effects in plantations and unmanaged stands (WEEP, Figure 17), to estimate the merchantable volume for trees killed (WEEP, Figure 18) and to map the fire effects on watershed canopy cover (Figure 25). Table 5A, **Post-Fire Vegetation Classes by Sub-Watershed,** summarizes the mortality acreage by sub-watershed areas. Maps of Current Vegetation and Stand Replacement Fire Mortality (Wildfire Effects Evaluation Project, Figures 17 and 19) are available online: ftp://ftp2/fs.fed.us/incoming/r6/ump/weep Map values for vegetation classes in Table 5A are described online in the metadata files for the Stand Replacement Fire Mortality Map.

		apple creek facial	panther creek	calf creek	quartz creek	black rock fork	boulder creek/msu	dumont creek	castle rock fork	skillet/emerson facial	ash/zinc facial	buckeye creek	jackson headwater	upper jackson facial	
	VALUE	1	2	3	4	5	6	7	8	9	10	11	12	13	
early	1	2255	1451	1293	2211	6727	1961	4432	2188	1346	2357	4420	3592	4365	
stem exclusion	2	1085	607	570	405	1535	787	2248	2758	1392	2650	1880	2660	1149	
late seral	3	7247	1993	2782	6982	11843	12927	10947	20582	6679	7722	8972	11883	12338	
early/BS	4	223	780	262	705	282	1089	537	398	1084	305	273	0	194	
early/S	5	171	1074	760	907	158	4881	1069	786	631	744	263	42	388	
early/BP	6	112	847	300	586	67	1216	519	126	172	359	220	0	112	
early/M	7	9	956	225	14	25	94	0	71	54	42	16	0	281	
early/B	8	32	806	111	20	0	370	68	113	3	19	4	7	3	
late/GS	9	684	2988	5772	0	11	0	0	8	0	0	0	0	0	
early/NO	11	6	115	242	0	0	0	0	0	0	0	0	0	0	
stem exclusion/UB	12	3	521	202	0	0	0	0	0	0	0	0	0	0	
early/HX	13	0	25	5	0	0	0	0	0	0	0	0	0	0	
MORTALITY SUMMARY by Sub-Watershed															
early/other	4,6,7,11,13	350	2724	1033	1305	374	2399	1056	594	1310	706	508	0	587	
early/snags	5,8	300	1880	871	927	158	5251	1138	899	634	763	267	50	391	
burned plantations	4,6,7	344	2584	787	1305	374	2399	1056	594	1310	706	508	0	587	12554
subwa_ac		11825	12165	12523	11830	20648	23326	19819	27030	11362	14198	16048	18184	18830	193798
POST-FIRE VEGETATION STAGES by Sub-Watershed (Acres)															
early	1,4,6,7,11,13	2604	4175	2326	3516	7101	4360	5487	2782	2656	3063	4929	3592	4952	
early/snag	5,8	300	1880	871	927	158	5251	1138	899	634	763	267	50	391	
stem exclusion	2,12	1088	1128	772	405	1535	787	2248	2758	1392	2650	1880	2660	1149	
late seral	3,9	7833	4981	8554	6982	11854	12927	10947	20590	6679	7722	8972	11883	12338	
		% of sub_wa													
early		22	34	19	30	34	19	28	10	23	22	31	20	26	
early/snag		3	15	7	8	1	23	6	3	6	5	2	0	2	
stem exclusion		9	9	6	3	7	3	11	10	12	19	12	15	6	
late seral		66	41	68	59	57	55	55	76	59	54	56	65	66	

Table 5A: Post-Fire Vegetation Classes by Sub-Watershed (figures in acres)

Noxious Weeds

Pre-fire Noxious Weed Distribution

Meadow knapweed (*Centaurea* x *pratensis*) is widely scattered throughout the Apple and Boulder fires and is the primary noxious weed species with potential to spread significantly as a result of the 2002 fire season. Other than the recent release of a biological control agent in areas within and adjacent to the Apple fire, there has been little previous or ongoing attempt to manage meadow knapweed in this area. Other pre-existing weeds within the perimeter of the Apple and Tiller fires include: scotch broom (*Cystisus scoparius*), tansy ragwort (*Senecio jacobaea*), St. Johnswort (*Hypericum perforatum*), bull thistle (*Cirsium vulgare*), Canada thistle (*Cirsium arvense*), and diffuse knapweed (*Centaurea diffusa*). There are only a few areas of scotch broom and diffuse knapweed are known from only a single location that may have already been eradicated. All known locations of diffuse knapweed have been subjected to manual removal. Scotch broom has also been manually treated as budget and opportunity allows. Tansy ragwort is well established in some areas while St. Johnswort is nearly ubiquitous throughout the Forest. Bull thistle and Canada thistle are widely distributed throughout the area. There has never been a systematic inventory of noxious weeds in these areas and lower priority weeds are not routinely mapped so there are likely more locations of noxious weeds than is currently known.

Potential Spread of Noxious Weeds resulting from 2002 Fires

Meadow knapweed is the noxious weed most likely to spread into burned areas and disrupt natural vegetative recovery. This weed is already widely established within the perimeter of the Apple fire and portions of the Boulder fire as well as along the South Umpqua Road near the Acker fire. Meadow knapweed is an aggressive, rhizomatous perennial that is known to spread aggressively into timber harvest units. There are recent sale units in the upper part of Calf and Panther Creek watersheds that are filled with meadow knapweed from one edge to the other.

Bull thistle is also known to heavily infest recently disturbed areas. This species however is a taprooted biennial plant that never persists in numbers for more than a few years. St. Johnswort and tansy ragwort will likely spread from the road into recently burned areas. Natural recovery of native vegetation will probably keep these species in check along lower to mid slopes where native species will respond most vigorously. Upper slopes and ridges associated with roads, where surface soil erosion is most pronounced, will be most at risk to spread of St. Johnswort and tansy ragwort.

The primary vector for long-distance movement of noxious weeds is vehicle traffic. Because vehicles used for fire suppression came from all over the United States there is potential for introduction of new noxious weed species into these areas. The potential for more local distribution of noxious weeds is even more likely. For instance, the fire camp at Milo was in a pasture known to contain yellow starthistle (*Centuarea solstitialis*), so this species in particular is likely to turn up on the Tiller complex.

Post-fire Noxious Weed and Revegetation Inventory & Treatments

The overall strategy for management of noxious weeds in both the Apple and Tiller Complex fires is the same. The focus for immediate treatments in 2002 was to provide vegetative recovery of areas disturbed by fire suppression activities and in the immediate vicinity of known sites of noxious weeds with high potential to spread into burned or otherwise disturbed areas. Fire lines, both hand and tractor, were largely managed by simply pulling back the berm along with the duff and topsoil. We've had good success in the past with natural recovery of sites in this manner from the native seed bank contained in the material pulled back into the disturbed areas. Parts of some tractor lines, staging areas, safety zones, and a spike camp were seeded or planted to native species. In addition, several locations in the immediate vicinity of meadow knapweed and scotch broom were seeded. These areas were all along roads. The objective in all cases is to provide cover of native species that will discourage invasion of noxious weeds. It should be noted that grass and forb cover can slow the spread of noxious weeds but reforestation of burned areas will ultimately be necessary to preclude noxious weed establishment.

On Tiller Complex, the species seeded were blue wildrye (*Elymus glaucus*), western fescue (*Festuca occidentale*), and big deervetch (*Lotus crassifolius*). A mycorrhizal innoculum called "Biogrow" was applied at all sites. In some areas, native grass plugs were planted. On some sites with some species, the higher survival and cover of planting plugs is thought to make them a more cost-effective strategy for revegetation than seeding. Blue wildrye, California oatgrass (*Danthonia californica*), and California fescue (*Festuca californica*) were all planted as plugs. On Apple, inoculated blue wildrye was seeded while California fescue and Idaho fescue were planted as plugs. Additional plantings of deerbrush (Ceanothus integerrimus) and big deervetch are planned for this spring. Weed-free straw was applied in some areas to provide mulch for emerging seedlings and limit soil erosion.

Some survey of noxious weed sites within the fire perimeter occurred this fall with additional survey of the burned areas planned for summer of 2003. Survey will probably need to be continued through at least 2005. BAER funding can be requested annually through this period for weed survey. Other than one site of meadow knapweed near a pump chance that was covered with black plastic (solarization), meadow knapweed sites within the fire perimeters will be mowed with a weed eater. Isolated plants will be hand-pulled. The objective is to prevent weeds from going to seed, otherwise the light, dandelion-like seeds would blow into the burned areas. Scotch broom sites will be treated manually and any new sites of high-priority weeds will be mapped and handpulled upon discovery. The objective for new sites is to eradicate them before they can become established.

Sensitive Plant Locations Affected by Apple & Tiller Complex Fires

There were no known sites or suspected habitat for Threatened or Endangered plant species affected by fires in 2002. Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*) is the only Federally listed plant species known to occur on the Umpqua National Forest. The only sensitive plant species known to occur within the perimeter of the Apple fire is Thompson's mistmaiden (*Romanzoffia thompsonii*). There are three known locations of this species within the Apple perimeter. The rocky seep habitat for this species is not anticipated to have been directly impacted by the fire but sites should be monitored next spring to verify persistence of the populations.

The Limpy fire was within a Research Natural Area that was established principally with rare plants in mind. Umpqua kalmiopsis (*Kalmiopsis fragrans*), northern spleenwort (*Asplenium septentrionale*), and California swordfern (*Polysticum californicum*) all occur within the fire perimeter. Kalmiopsis readily resprouts following a light to moderate underburn which appears to largely characterize the Limpy fire. Northern spleenwort, which occurs as small tufts in crevices of rock outcrops, is probably much more susceptible to mortality from light burns. California swordfern is also associated with rock outcrops. Locations of both species will need to be revisited to determine whether they were impacted by the fire.

The Boulder fire burned both populations of kalmiopsis in the South Umpqua drainage. One population was on rock outcrops at the edge of a plantation that burned hot but it appears that most of the population will survive. The other population is on a more open ridge that is inherently less susceptible to intense burns because of the sparse fuels. There are several populations of Columbia lewisia (*Lewisia columbiana* ssp. *columbiana*) on open ridges and peaks along the divide between the South Umpqua and Little River drainages. These populations are also not expected to have been impacted by fire because of the sparse fuels at the sites.

Little Boy fire has a known site of Thompson's mistmaiden and there is a mapped site of Umpqua swertia (Frasera umpquaensis) at the edge of the Crooked fire. The Thompson's mistmaiden site is anticipated to be largely unaffected for reasons discussed above. The Umpqua swertia site was not relocated in a review of the area this fall by the District botanist but there is a large, widely scattered population just outside the perimeter of this fire. This tall member of the Gentian family occurs in meadows and open forests along the Rogue-Umpqua divide and may respond favorably to opening of forests through underburning.

***As with noxious weeds, there has been no systematic survey for rare plants within all of these burned areas so there are likely additional locations of sensitive species within the fire perimeters*.**

Morels

Morels (*Morchella* spp.) are famous for their ability to respond, often in tremendous abundance, to forest fires. There is every reason to expect a flush of morels to occur this spring in the areas burned within the 2002 Apple and Tiller Complex fires. Because morels are among the most prized of edible mushrooms, this should generate interest by mushroom collectors for both commercial and personal use. The Bland Mountain fire which occurred in 1987 on BLM and private lands near the town of Tiller apparently yielded about 10,000 pounds of morels. At its height, prices for morels were as high as $10-16/lb. although the price dropped to as low as $4/lb. Over the last decade prices around the region have averaged around $5/lb. (Blatner & Alexander 1998, Pilz & Molina 2002). Because there were so many fires, particularly here in southwest Oregon, there is no way of knowing what prices will actually be or how many collectors will actually decide to make their way to the Umpqua area.

Morels are a spring mushroom. They will sprout with the first warm temperatures (60^{o} F has been suggested) of the year. Some have suggested that a cold period followed by a warm period is preferred but all mushroom experts agree that adequate spring moisture is important. The total amount of precipitation is probably less significant than having a continued mild, moist period for mushrooms to develop. At the lowest elevations morels may occur as early as February although on the Umpqua National Forest we are unlikely to see many morels before March. It is probable that the later part of April through May will be the peak of the season. Morels may continue to be collected as late as July at the highest elevations depending upon snowmelt and early summer precipitation.

All the local mushroom experts seem to think that the Tiller Complex will be better a better morel area than the Apple fire variously citing vegetation type, soils, and aspect as the reason why. But there is conflicting opinion among experts on elevations and habitat for morels (some of the conflicting information stems from the complexity of identification among different species of morels – see below). The areas dominated by white fir (at least before it burned) are generally considered to be more reliable than drier sites dominated by Douglas-fir and pines. The areas that burned completely will have morels only if the spring temperatures and precipitation are adequate for the mushrooms to develop to full size in this black, inhospitable environment. What is referred to as the "needle zone", where the fire killed the trees without consuming the canopies so that the unburnt needles drop to the ground, is believed by many to be the best place to collect morels (Weber 2003 personal communication).

Just how many morels eventually come up will depend on the weather. In the Blue Mountains of northwest Oregon about 200/acre has been reported as an average with a range of 80-480/acre. The average weight of morels collected in this same study was reported to be about ½ lb./acre (Pilz & Molina 2002). Morel production in the burned areas will be strong for the first couple of years and then drop off sharply by the third or fourth year.

There are several species of morel and precise identification is difficult even for experts. Although there are numerous species described in regional mushroom guides recent scientific evidence suggests there may only be as few as three "good" species with a lot of within species variation (Kou 2003). It appears there may be some types that only come up following a fire while others appear annually in undisturbed forest. Serious mushroom collectors sometimes have their own names based on the character they value most, - taste! The "gray" morel doesn't appear to have a good scientific name but is the most highly prized morel among collectors. This "species" apparently only grows at higher elevations and would be collected at the end of the morel season (Pilz 2003 personal communication). Fortunately, all morels are edible so identification to species is unimportant. Morels, as a group, tend to be a relatively easy mushroom to identify but there are a few species that occasionally are confused with morels by amateurs. The mushroom that is most commonly be mistaken for a morel is the false-morel (*Gyromitra esculenta*). This species is supposedly edible, but not recommended, when cooked but highly toxic if eaten raw. There are also several other species of false-morel, at least one of which is edible but nothing is considered to be as highly valued as morels.

Because so many mushrooms are deadly poisonous, collectors are strongly encouraged to eat only what can positively be identified. There are some good mushroom identification books that are available locally but there is no substitute for an experienced, knowledgeable mushroom expert. It should also be noted that most wild mushrooms should generally be cooked before eating. As noted above, some species that are edible when cooked may be toxic raw. Also be aware, that different people can have different sensitivity to mushrooms. Occasionally one person can become sick eating the same mushrooms other people can digest without problems. Moderation eating mushrooms is probably a good rule if you haven't eaten that particular species before.

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