Seasonal Fire Weather / Fire Danger Outlook

Northwest Geographic Area

(*Final Version*)

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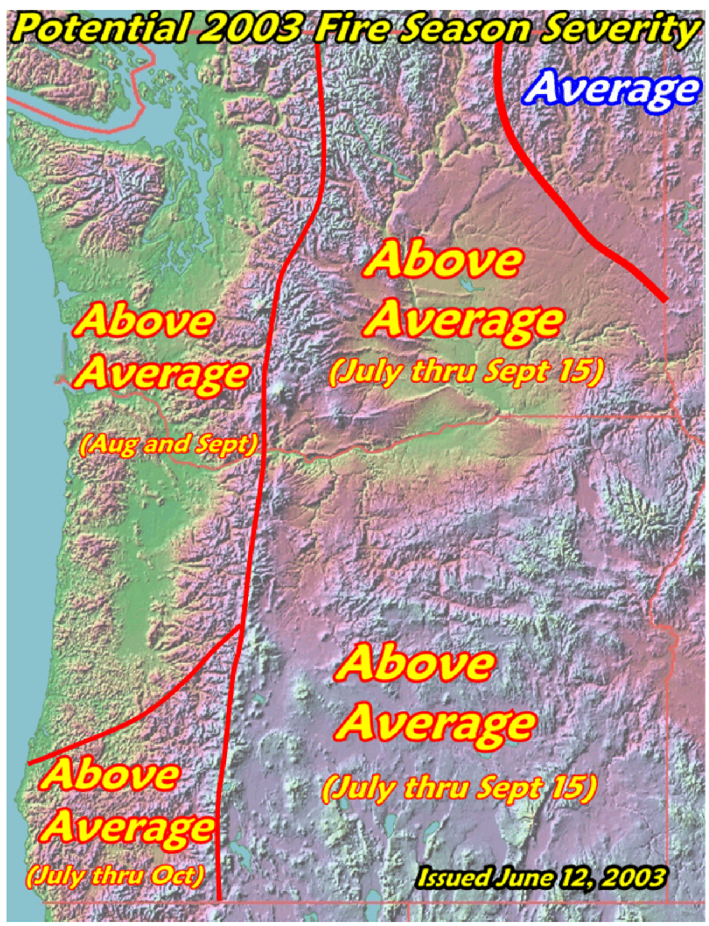
Executive Summary

The following report is a **fire season severity assessment** based upon seasonal precipitation patterns, winter snowpack, drought, snowmelt dates, fire danger indices, fuel moisture information and long-range weather forecasts for the summer and fall. The potential severity of the fire season is determined using techniques that correlate weather, fuel moisture, and fire danger information with historical fire and resource demand records.

Many weather factors affect fire season severity in the Northwest Geographic Area. Known factors include: winter precipitation, mountain snowpack, drought, snowmelt date, June rainfall, live and dead fuel moisture, and the amount of summer dry lightning.

Washington and Oregon experienced an unusually mild winter this year, due in part to the return of El Nino. Although the lower elevations of eastern Washington and southwestern Oregon experienced near to above normal precipitation, April 1 mountain snowpacks were only 54% of average in Oregon and 75% in Washington due to the mild temperatures. Normally, mountain snowpacks peak around April 1 and gradually melt through the middle of June. Cool, wet weather in April and early May slowed snowmelt, especially in the higher elevations. However, the weather turned warm and dry the latter half of May and June resulting in rapid melt of the remaining snow.

El Nino declined during the spring and La Nina conditions are now developing in the tropical Pacific Ocean. However, the full effects of La Nina may not be felt until this fall and winter. The long-range forecast for the coming summer is based on this decline. July, August and September are favored to be warmer and drier than normal, especially in eastern Oregon. Summers in the Northwest are typically warm and dry, and this summer should be no different. Drought conditions are expected to continue in eastern Oregon, and may expand north and westward into Washington and western Oregon during the summer. Statistics back to 1970 indicate Northwest summers tend to be drier than normal during transition from El Nino to La Nina conditions.



The following weather and fuel moisture factors correlate very well with past active fire seasons in the Northwest and are the basis for this year's fire season severity assessment. The 2003 outlook calls for an **ABOVE AVERAGE** fire season in the most of the Northwest (see map) for these reasons:

- Continued long term drought (4 consecutive years) in eastern Oregon

- Below normal winter snowpack throughout all of Washington and Oregon
- Early snowmelt, especially in the low and mid elevations
- A drier than normal May in most areas and a dry June
- Abundant fine fuel loadings due to early spring rains
- Lower fuel moisture and higher than normal fire danger indices for this time of year
- Long range forecasts and historical records that favor a drier than normal summer
- The two to three episodes of dry lightning that normally occur during the summer

Fire seasons following "El Nino" events typically result in a greater than average number of fires and acres burned on US Forest Service and State lands. These fires usually require a greater commitment of resources due to the complexity of terrain, fuels, values at risk, and threats to public and firefighter safety. An **ABOVE AVERAGE** 2003 fire season has the following management implications:

- A very active fire season in southern and eastern Oregon and most of eastern Washington, and a higher than normal risk west of the Cascades during "East Wind" episodes
- An elevated risk of long-duration timber fires
- An increased threat of extreme fire behavior conditions (i.e. crown fires, long range spotting, plume dominated fires)
- An increased threat to firefighter safety during critical fire weather and extreme fire behavior conditions
- A higher than normal demand for resources of all types
- An active fire season in multiple areas of the western United States resulting in stiff competition for resources
- Potential for limited availability of, or competition for air tankers and lead planes

With any fire season assessment, the occurrence of dry lightning is always a wild card. The amount and location of dry lightning can rapidly change the character of the fire season.

The following **2003 fire season severity assessment** is based upon seasonal precipitation patterns, winter snowpack, drought, snowmelt dates, fire danger indices, fuel moisture information and long-range weather forecasts for the summer and fall. The potential severity of the fire season is determined using techniques that correlate weather, fuel moisture, and fire danger information with historical fire and resource demand records.

Current Conditions - The 2002-2003 winter experienced a return of El Nino conditions in the tropical Pacific Ocean (figure 1). La Nina and El Nino are phases of a naturally-occurring climatic cycle in the tropical Pacific Ocean known as the Southern Oscillation, which occurs at intervals of two to seven years. El Nino occurs when sea surface temperatures (SST) are warmer than normal while La Nina is characterized by cooler than usual temperature. El Nino and La Nina affect global weather patterns, especially during the Northern Hemisphere's winter. El Nino tends to produce milder and drier than usual winters in the Pacific Northwest and wetter, cooler winters across the southern tier of states. This year's El Nino was classified as a weak to moderate event. El Nino declined during the spring and weak La Nina conditions are now developing. However, this trend will have only minimal effects on this summer's weather in the Pacific Northwest and the full impact may not be felt until this winter.

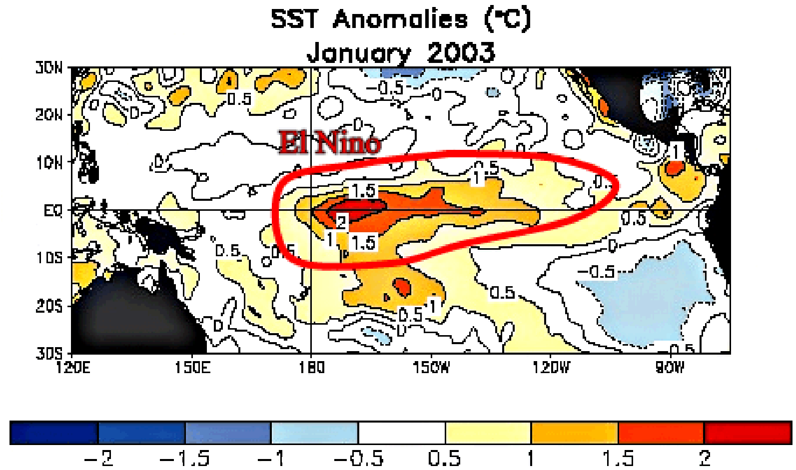
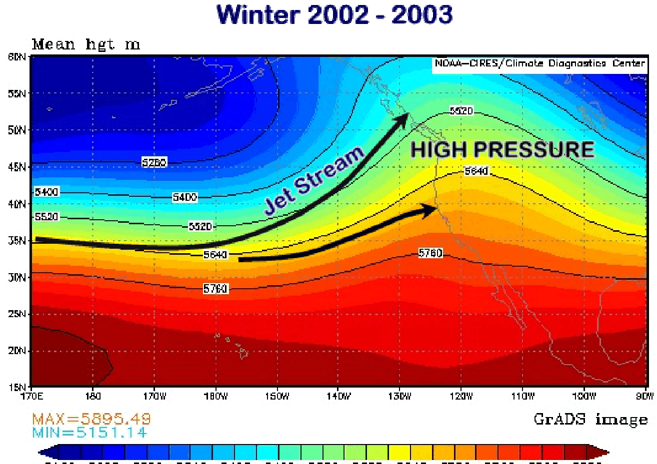


Fig. 1 Sea surface temperature (SST) anomalies during January 2003.

High pressure aloft dominated the weather pattern in the Western United States this past winter, (figure 2) resulting in unusually mild temperatures in the Pacific Northwest. Meanwhile, the jet stream oscillated along the Pacific Coast between British Columbia and California. November was very dry throughout the Pacific Northwest with little or no accumulation of mountain snow. December and January turned wet, but mild temperatures and high freezing levels held the snowpack well below normal. Little or no snow fell in the lower elevations. February turned dry again.

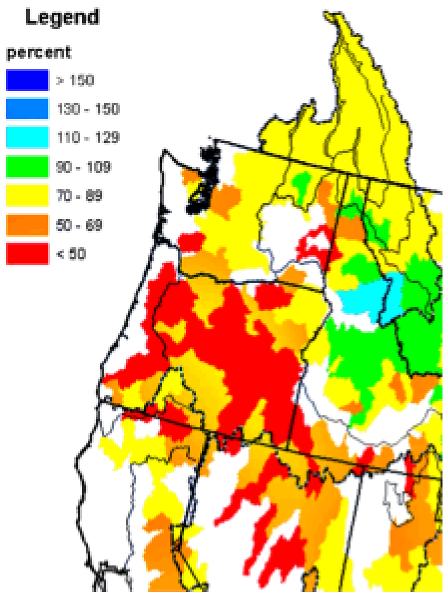
Fig. 2 Average 500mb Flow / Jet Stream
Winter 2002 - 2003



The pattern changed drastically in March when a series of Gulf of Alaska storms brought cool, wet weather to the entire Pacific Northwest. During this time, the snowpack significantly improved but still remained below average.

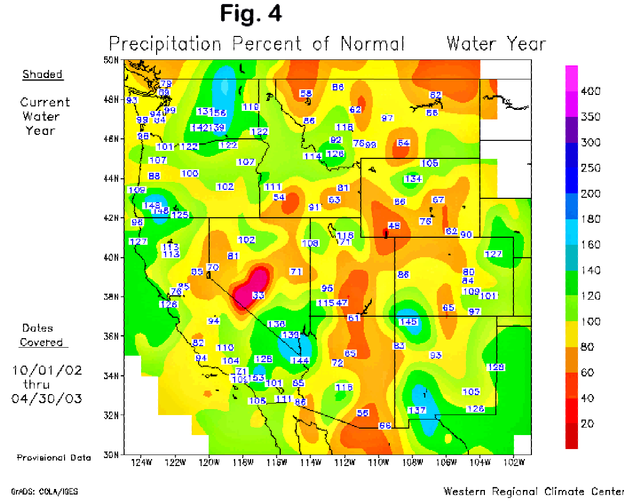
On April 1, the 2003 snowpack (figure 3) ranged from 80-89% of normal in the Yakima and Chelan/Wenatchee River basins to 38-58% of normal in much of eastern and southern Oregon. The Oregon statewide average was 54% of normal and 75% in Washington. This compared to last year's snowpack of 111% in Oregon and 123% in Washington. This year's low snowpack was due to unusually mild winter temperatures.

Fig. 3
Mountain Snowpack as of April 1, 2003



Cool, wet weather continued in April. This slowed the snowmelt rate and even added to the snowpack above 5000 ft msl. The Oregon statewide average increased to 82% of normal on May 1, which was similar to 2002. Meanwhile, Washington's 79% of normal was still far below that of last year. Contrary to the below average mountain snowpack, low elevation precipitation was near to above normal (figure 4) throughout most of the Pacific Northwest. Southwestern Oregon and eastern Washington received over 140% of average rainfall during the "water year" from October 1, 2002 through April 30, 2003.

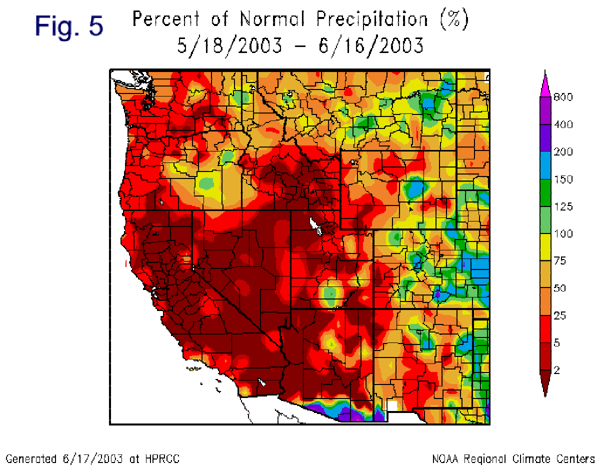
Fig. 4

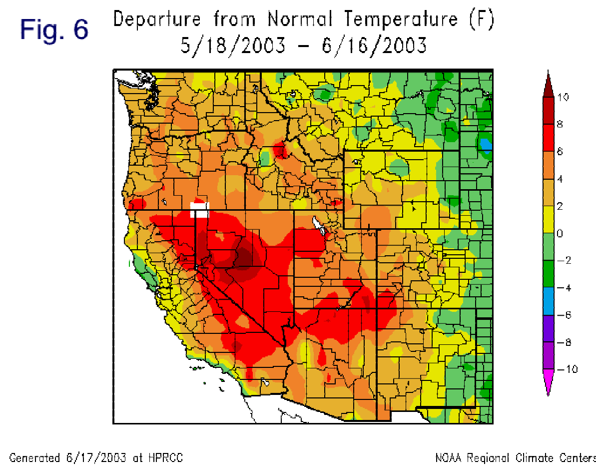


This winter was unusual because low elevation moisture was near to above average while the snowpack was below average. Normally, both the lower and higher elevations track together, either above or below average.

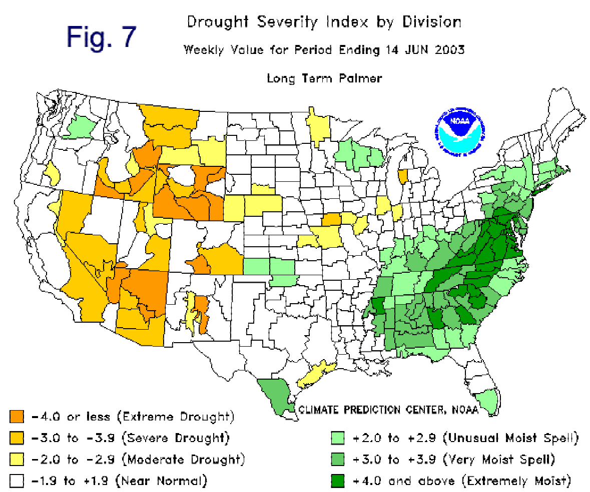
In the past 30 plus years, only 1970 and 1984 had the same winter signature that occurred this year. Although these two years had similar winter weather, the following fire seasons was drastically different. The Northwest experienced a severe fire season in 1970 (primarily the Wenatchee and Okanogan areas) while the 1984 fire season was benign except for a few large range fires. The difference between 1970 and 1984 was that April through June was dry in 1970 and very wet in 1984. June was particularly wet in 1984 with Portland recording over 4 inches of rain.

April and early May tracked very similar to 1984. Medford had its second wettest April with 3.53 inches. However, a drastic weather pattern change occurred in mid May. High pressure became entrenched over the Western States resulting in warm, dry weather. Rainfall amounts, from mid May to mid June, were well below normal (figure 5) throughout most of Washington and Oregon. Meanwhile, temperatures (figure 6) averaged 2-6 degrees Fahrenheit above normal. All of a sudden, the Northwest's weather tracked more like 1970 than 1984. A dry June can accelerate the fire season by curing live fuels and lowering the moisture content of large dead fuels (i.e. 1,000 hr FM) earlier than usual. A dry June can also lengthen the fire season, and thus, increase the risk of long-duration large fires.



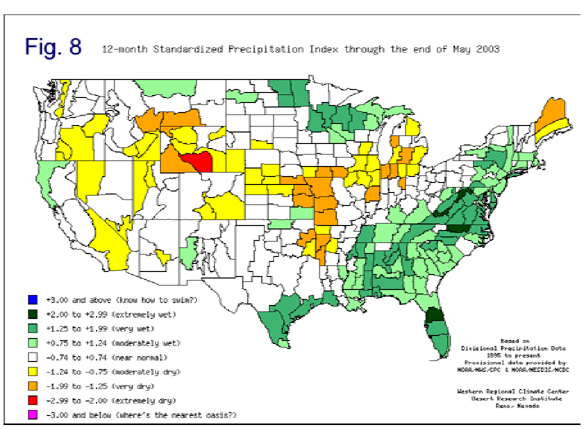


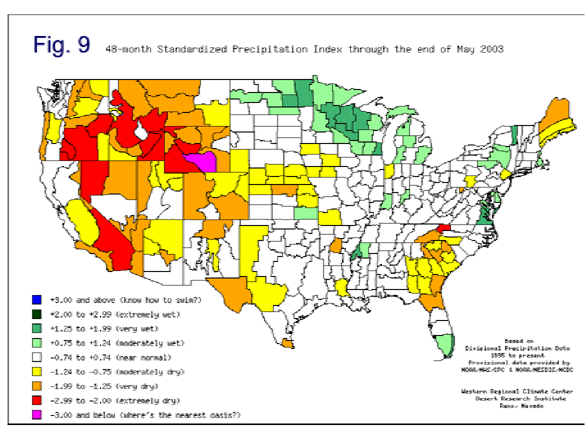
The late April Palmer Drought Index indicated moist conditions in eastern Washington and portions of eastern and northeastern Oregon. The June 14, Palmer Drought Index (figure 7) now shows near normal conditions throughout the Geographic Area except for an area of moderate drought in central Oregon and an area of moist conditions in central Washington. This change is the result of dry weather the past month.



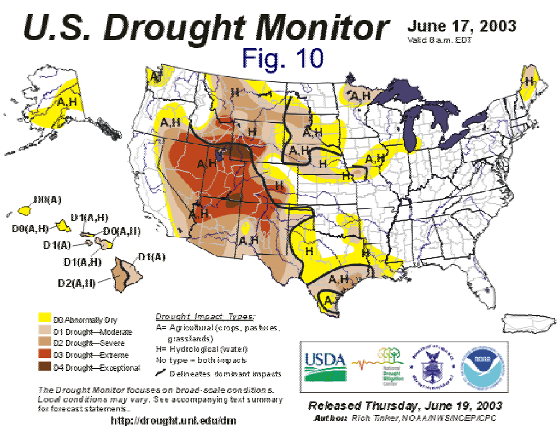
Another measure of drought is the Standardized Precipitation Index (SPI). The SPI calculation is based on the long-term precipitation for a desired period (one month the six years). The long-term period is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for a location is zero. Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation. Because the SPI is normalized, wetter and drier climates can be represented in the same way.

The SPI differs with the Palmer Drought Index in that it classifies eastern Oregon as "moderately dry" (figure 8) over the last 12 months. The effect of extended drought can be depicted by looking at the 48





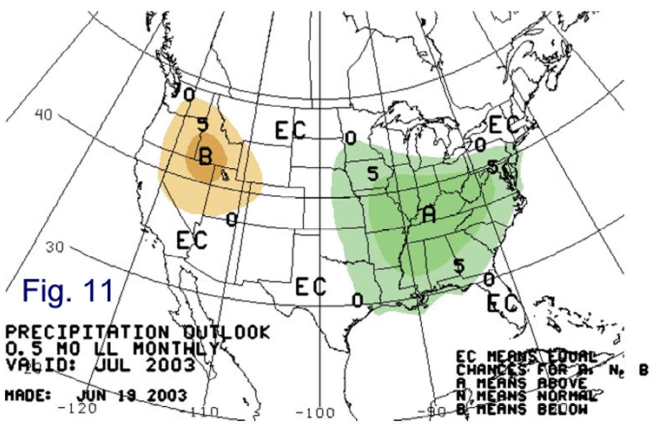
month SPI (figure 9). This drought index shows eastern Oregon as "extremely dry" and the east slopes of the Washington Cascades and the Okanogan area as "very dry". Four consecutive years of below normal snowpack has contributed to the severity of the drought in eastern Oregon.

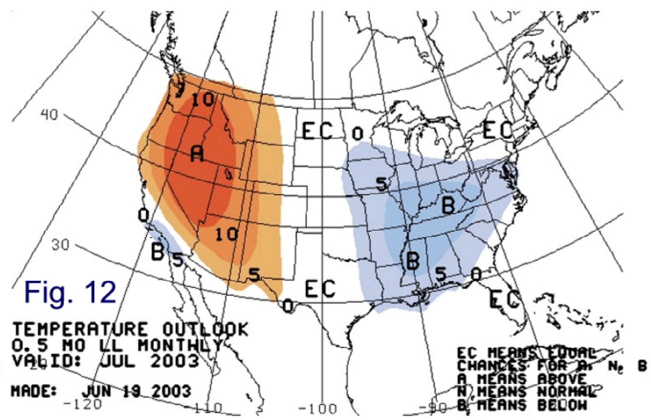


The June 17 U.S. Drought Monitor (figure 10) also shows drought conditions in eastern Oregon, which substantiates the SPI rather than the Palmer Drought Index.

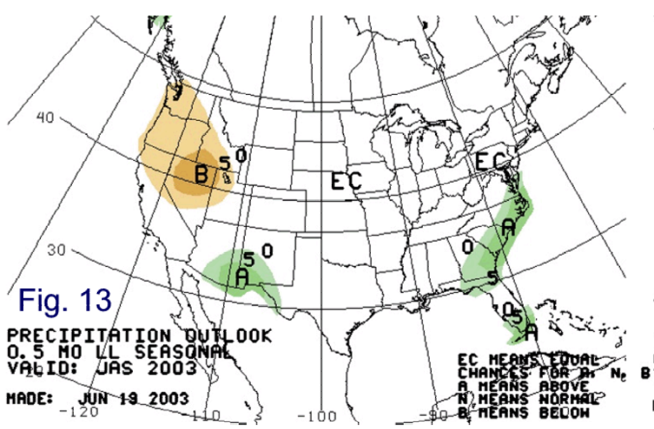
Climate and Weather Outlook -

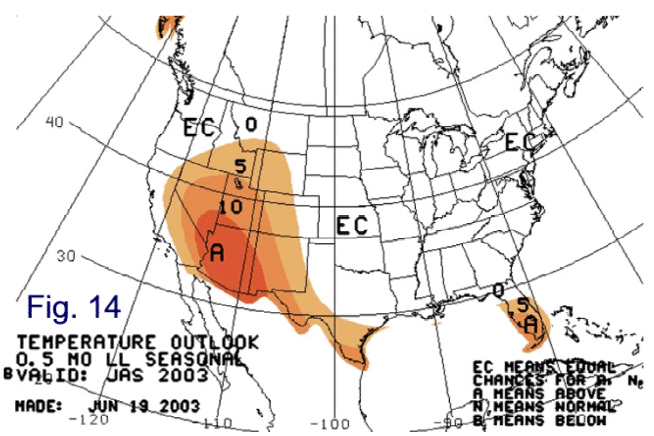
Long-range weather forecasts are based upon developing La Nina conditions. The outlook for July (figures 11 and 12) favors warmer temperatures throughout the area and drier than usual conditions in east of the Cascades.



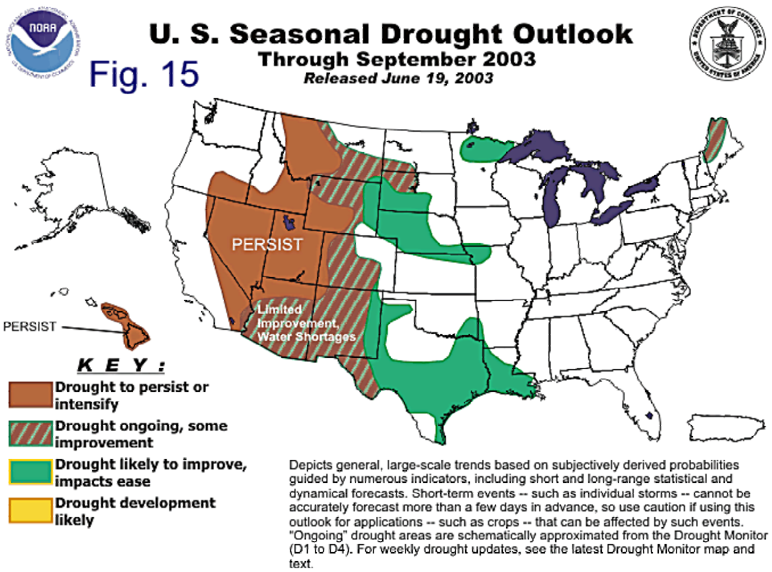


The extended outlook for July through September (figures 13 and 14), is for a drier and warmer than usual summer. This is consistent with local statistics that show the Northwest experiences a dry summer when El Nino transforms toward La Nina.





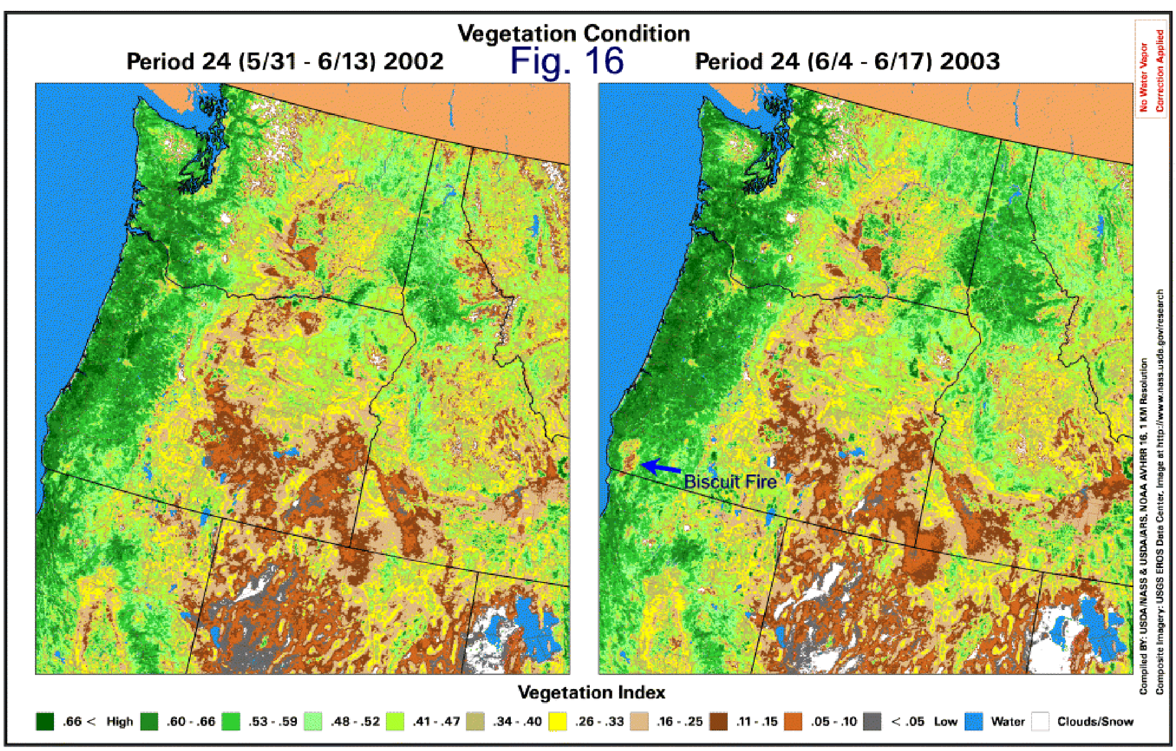
The U.S. Drought Outlook calls for ongoing drought conditions to persist in eastern Oregon through September (figure 15).



Vegetation Condition – Vegetation Condition images are created in two types, NDVI and Ratio. NDVI (Normalized Difference Vegetation Index) images are based directly on values created by the USGS's EROS Data Center in their biweekly composite of AVHRR sensor data from one of the NOAA weather satellites.

The NDVI measures vegetation vigor caused by chlorophyll activity; this is sometimes called "greenness." These data have proven valuable in monitoring vegetation condition. NDVI values can theoretically range from -1 to +1; high values represent healthy, vigorous vegetation while low values typically depict bare soil and water.

The Vegetative condition for June 4-17 2003, is shown in figure 16 along with a similar period in April 2002 for comparison. Mild winter temperatures and wetter than usual March and April weather has resulted in increased "greenness" across most of Washington and Oregon. This is especially evident in northeastern Oregon and the extreme eastern portion of Washington. The rangelands of



southeastern Oregon also appear to be slightly "greener" than last year. This increase in vegetative vigor may be caused by the additional growth of grasses and shrubs. Many locations report a heavier growth of grasses compared to last year. To properly interpret satellite "greenness" imagery, the pictures should be monitored on a weekly basis to track the vegetative stage from "green-up" to curing. (Note: the location of the Biscuit Fire can be seen on this year's "greenness" imagery as a brown area.)

Fire Occurrence and Resource Outlooks –

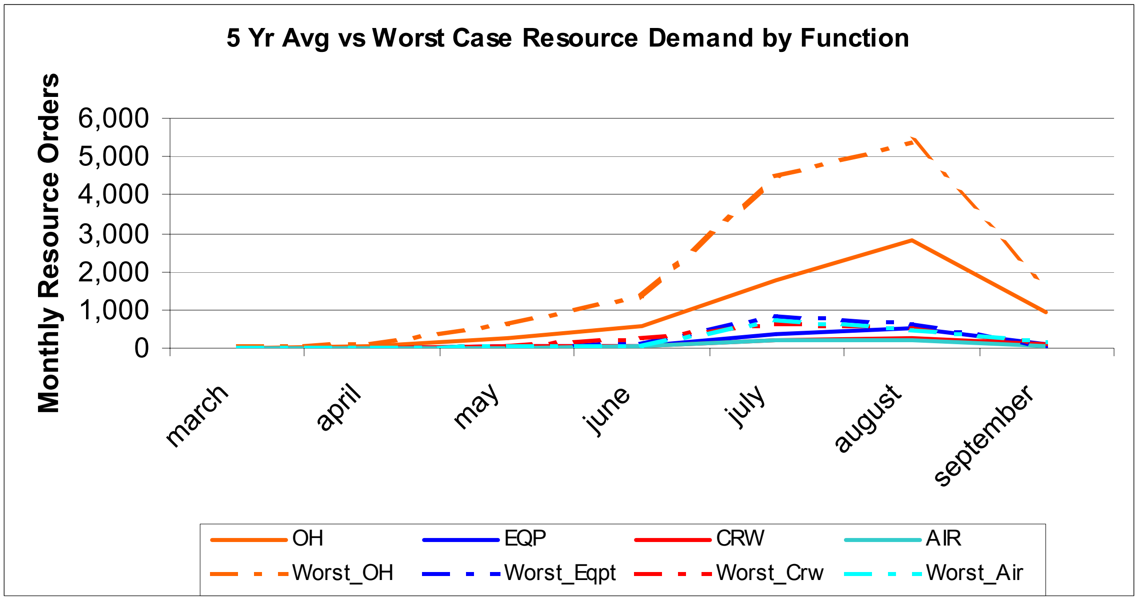
The best predictor of large (97^{th} percentile) fires in the PNW is … fires. In other words, our fire problem is the result of mass ignitions from lightning episodes.

Analysis has indicated the probabilities of a lightning episode (P(episode)), defined as 50 fires per day for 3 days, and is shown in the table below. The probability of multiple episodes in any month (P(multiEpi)) is also shown. Finally, looking at all lightning episode dates, the table shows the date around which lightning events have clustered over a 17-year period.

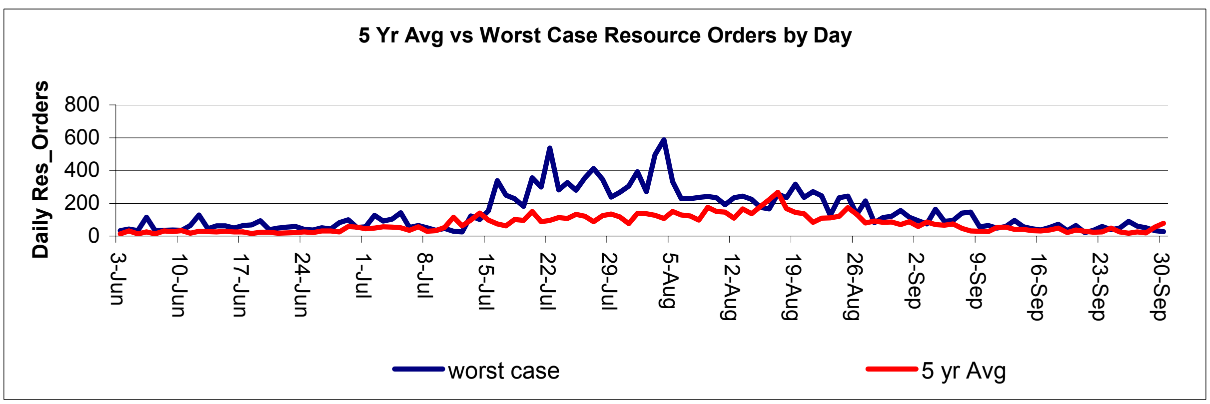
	May	June	July	August	Sept	Oct
P(episode)	0%	12%	71%	71%	35%	0%
P(multiEpi)	0%	6%	18%	35%	0%	0%
CenterDate		6/21	7/24	8/6	9/5	

The table below shows the average number of resource orders to the Northwest Coordination Center over a 5-year period. The year 2002 is used to illustrate the worst-case scenario.

	AVG Orders	WORST Orders	AVG OH	WORST OH	AVG EQP	WORST EQP	AVG CRW1	WORST CRW1	AVG CRW2	WORST CRW2	AVG HEL1	WORST HEL1	AVG HEL2	WORST HEL2
March	30	58	23	44	2	10	0	0	0	0	0	1	0	0
April	72	175	58	117	9	11	1	0	0	0	1	0	0	0
May	354	878	266	610	31	72	11	6	19	45	1	2	1	4
June	751	1,946	590	1,355	45	123	16	20	56	220	2	1	4	6
July	2,606	6,271	1,748	4,475	341	836	73	127	152	467	18	48	21	56
August	4,065	8,262	2,837	5,381	519	651	175	171	163	273	28	44	21	26
September	1,231	2,557	934	1,612	81	70	47	43	43	36	8	11	7	10



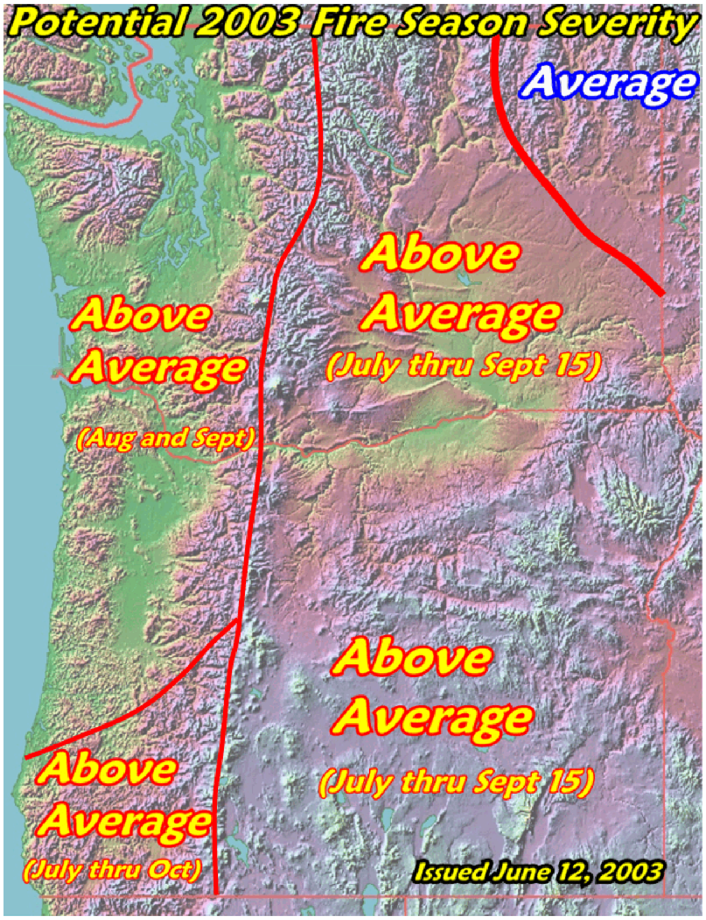
Resource demand by day coincides with calculated fire severity (a function of minimum relative humidity), lightning episodes and team deployments. The third week in July and the middle of August are most likely to show the highest severity index ratings, lightning episodes, multiple ignitions, large fire development, team deployments and, therefore, the greatest resource demand.



Fire Severity Assessment –

The following weather factors correlate well with fire season severity in the Northwest Geographic Area.: winter precipitation, mountain snowpack, drought, snowmelt date, June rainfall, live and dead fuel moisture, and the amount of summer dry lightning. The analogous years of 1970 and 1984 were used in the development of this assessment. Both of these years featured a declining El Nino, low mountain snowpack, near to above normal low-elevation moisture, and localized drought. However, the severity of the fire season was vastly different in those two years. The Geographic Area experienced a very active fire season in 1970 due to large fires in the Wenatchee and Okanogan areas. On the other hand, 1984 was rather benign with primarily grass and sagebrush fires. The primary difference between these two years was that 1970 experienced a dry spring that extended through June, July and August. However, 1984 experienced a wet spring and June before warming and drying in July and August. Due to a wet April and early May, this spring initially tracked more like 1984 than 1970. However, the weather turned warm and dry from mid May through mid June. The long range outlook for July through September is for continued warmer and drier through the summer. Thus, it appears that the summer of 2003 will approximate that of 1970.

The 2003 outlook calls for an **ABOVE AVERAGE** fire season in the most of the Northwest (see map) for these reasons:



- Continued long term drought (4 consecutive years) in eastern Oregon
- Below normal winter snowpack throughout all of Washington and Oregon
- Early snowmelt, especially in the low and mid elevations
- A drier than normal May in most areas and a dry June
- Abundant fine fuel loadings due to early spring rains
- Lower fuel moisture and higher than normal fire danger indices for this time of year
- Long range forecasts and historical records that favor a drier than normal summer
- The two to three episodes of dry lightning that normally occur during the summer

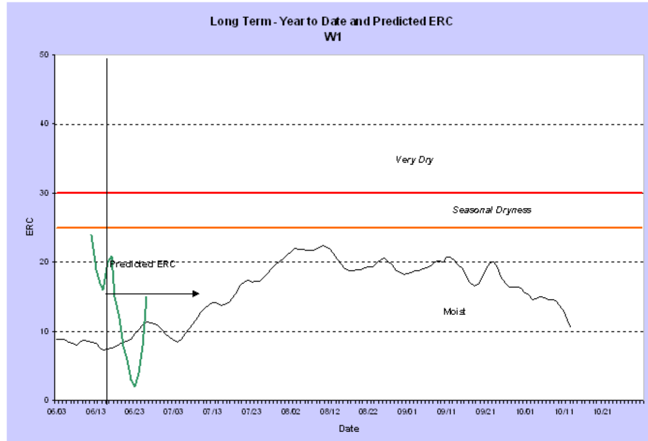
Fire seasons following "El Nino" events typically result in a greater than average number of fires and acres burned on US Forest Service and State lands. The peak of the fire season will likely occur between July and September 15 in eastern Oregon and eastern Washington. In southwestern Oregon, the fire season could extend well into October. The greatest fire threat in western Washington and western Oregon should occur during "East Wind" events that commonly occur during late summer and early fall.

Statistically, during above average fire seasons, the Northwest Geographic Area can expect about 4,000 fires and over 400,000 acres burned. Last year, 1.1 million acres burned in the Northwest.

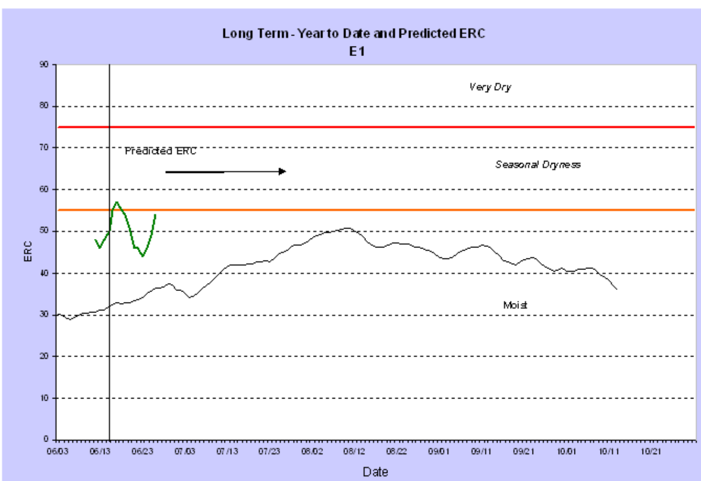
The following section will detail the potential fire season severity by areas within Washington and Oregon.

<u>Western Washington.</u> Winter snowpack was only 60-80% of normal in the Cascade and Olympic Mountains, well below what it was the previous winter. Warm, dry weather in May resulted in snowmelt dates that were 2-3 weeks earlier than last year. What snow that remains is above 5,000 ft msl. Dry weather continued into June with rainfall amounts generally less than 25% of normal.

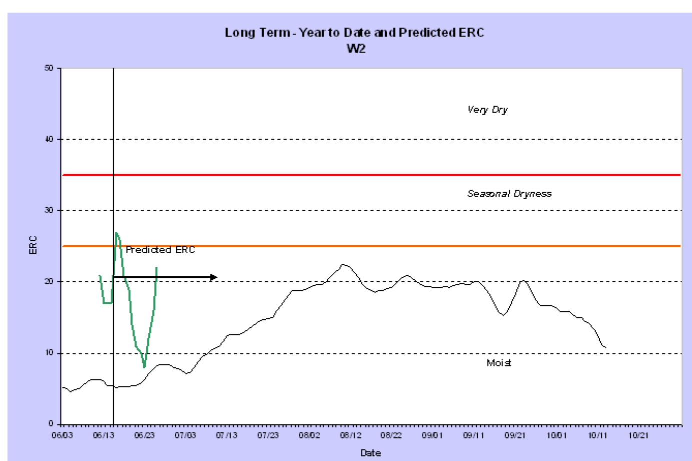
Olympia recorded only .11 inches as of June 20 and Seattle .18 inches. The U.S. Drought Monitor classifies western Washington as abnormally dry. The Energy Release Component (ERC) has been above normal most of June (see graph). The 1,000 HR FM is between 20 and 25%. The long-range outlook slightly favors a drier than normal summer. Current and forecast information indicates that Western Washington is at an above average risk of large fires. The greatest risk will be in late August and September during "East Wind" events.



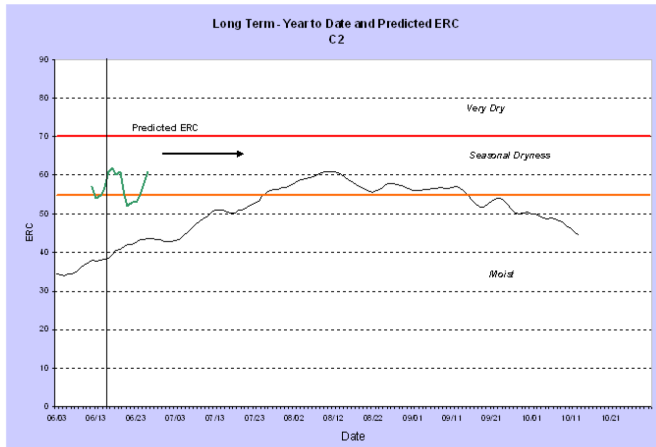
Eastern Washington. Winter snowpack was 75-85% of normal, well below that of the previous winter. However, low elevation moisture was above normal. Snowmelt dates were as much as 2 weeks earlier than usual. Snow still remains above 6,000 ft msl. May was generally dry; Wenatchee received only .01 of an inch. June has also been drier than normal except in the Colville area which has had periodic showers and thunderstorms. The Energy Release Component (ERC) has been well above normal for June (see graph). The 1,000 HR FM is between 8-11%, which is more typical of mid-summer rather than June values. The northeast corner has more seasonal values at around 15%. The east slopes of the Cascades northward to the Okanogan Valley have been drier than usual for last 4 years. The long-range outlook is for a drier than normal summer. Most of Eastern Washington has an above average risk of large fires with the greatest threat between July and September 15.



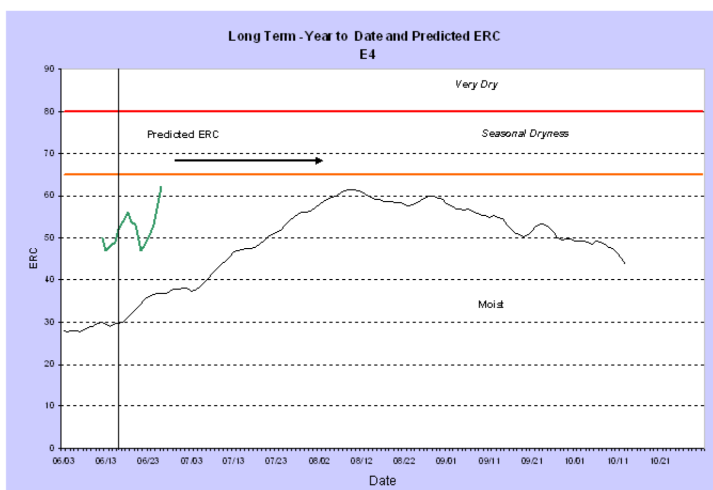
Western Oregon (except Southwest). Winter snowpack was only 55% of normal with little or no snow in the Cascade lower elevations. Valley rainfall was near normal due to the benefit of a wet spring. Snowmelt dates were 2-3 weeks earlier than last year. The Mt. Hood Snotel site at



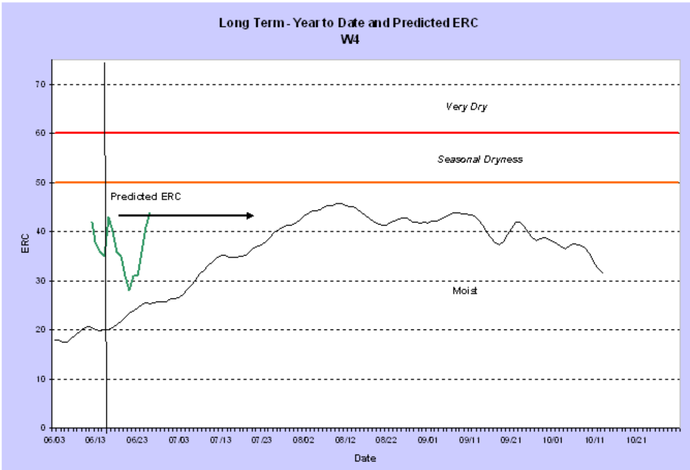
5,400 ft had a snowmelt date of June 19 this year compared to July 13 last year. Some snow still remains above the 5,500 ft level. The latter half of May and June were unusually dry with rainfall amount only of 10 to 30% of normal. The Energy Release Component (ERC) has been above normal most of June (see graph). The 1,000 HR FM is between 15 and 21%. The long-range outlook slightly favors a drier than normal summer. Based upon current and forecast information, Western Oregon has an above average risk of large fires with the greatest threat during "East Wind" events during late August and September.



Central Oregon. Winter snowpack was only 50-60% of normal in Central Oregon. The John Day River Basin recorded its 4th consecutive year of below normal snowpack. Snowmelt was 1-2 weeks earlier than last year. The only snow that still remains is above 5,500 ft in the Cascades. May and June have had near to above normal rainfall, primarily due to a few wet thunderstorms. The SPI drought index indicates "extremely dry" conditions over the past 4 years. The 1,000 HR FM is between 8 and 12%, values more typical of mid-summer. The Energy Release Component (ERC) has been above normal during June (see graph). The long-range outlook is for a warmer and drier than usual summer. Central Oregon, which includes the Ochoco and Deschutes NFs, the Prineville BLM and the Warm Springs Agency, has the potential for an above average fire season. The greatest threat will occur between July and September 15

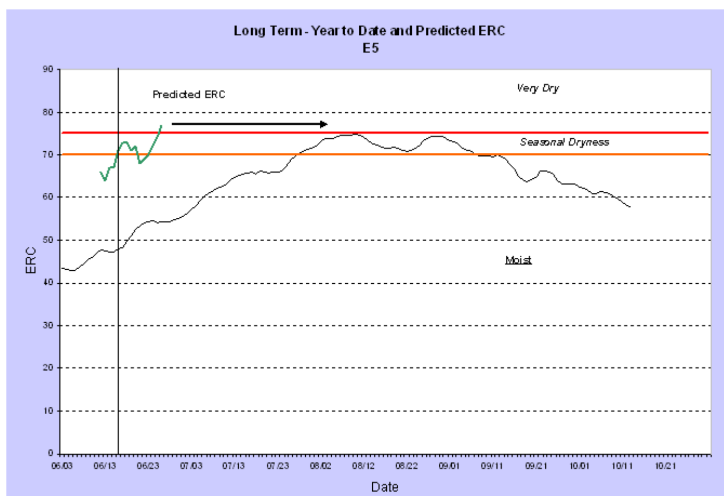


Northeast Oregon. Winter snowpack was 50-70% of normal, well below that of last winter. Low elevation precipitation was near normal. Snowmelt dates were similar to last year, about 1-2 weeks later than usual. The only snow that remains is above 7,500 ft. May and June have had near to above normal rainfall, primarily due to a few wet thunderstorms. The SPI drought index indicates "extremely dry" conditions over the past 4 years. The 1,000 HR FM are between 14 and 16%. The Energy Release Component (ERC) has been above normal during June (see graph). The long-range outlook is for a warmer and drier than usual summer. Northeast Oregon has the potential for an above average fire season. The greatest threat will be between July and September 15.



Southwest Oregon. Southwest Oregon was generally wet during the winter and spring. The snowpack in the Rogur/Umpqua River Basin was 50-70% of normal, well below that of the previous year. Snowmelt dates were 2-3 weeks earlier than usual. The latter half of May and June turned warm and very dry. Medford recorded its last rainfall on May 12. The Energy Release Component (ERC) has been above normal during June (see graph). The 1,000 HR FM is between 15 and 195 except as low as 11% near the California border. The long-range outlook is for a hot, dry summer. Southwest Oregon has an above average risk for large fires this summer extending well into October during "East Wind" events.

Southeast Oregon. Both low elevation precipitation and mountain snowpack were below normal this winter. However, the spring turned wet resulting in a larger than usual grass growth. The latter half of May and June turned warm and dry, except for a few wet thunderstorms. The Energy Release Component (ERC) has been above normal during June (see graph). Live fuel moisture on the Vale BLM District (measured through the Great Basin Live Fuel Moisture program), was measured at 115% in early June. The long-range outlook is for a hot, dry summer. Southeast Oregon has an above average risk for large fires this summer with the greatest threat between July and September 15.



Management Implications and Concerns –

The many repercussions of the extended drought (eastern Oregon and the eastern slopes of the Washington Cascades) and predicted summer dryness can affect the severity of the 2003 fire season. Long term drying allows large dead fuels to contribute to intense burning, plume development and long-range spotting. It also stresses live fuels, increasing the potential for combustion. Drought stressed live fuels are also more vulnerable to insects and disease, ultimately adding to the dead fuel load. Atmospheric dryness and low relative humidity will also have a negative impact on NFDRS indices, the energy release component (ERC), and 100 hour dead fuel moisture, all of which are associated with the potential for large fire development in the Northwest Geographic Area.

Fire seasons following "El Nino" events typically result in a greater than average number of fires and acres burned on US Forest Service lands. This is significant because these acres are often steeper, more remote and more heavily timbered than other Federal lands. Fire occurrence on State lands, which feature similar terrain, tends to mirror USFS occurrence. These fires usually require a greater commitment of resources due to the complexity of terrain, fuels, and values at risk. Type 1 resources, specifically crews and incident management teams, are especially in demand for these fires. Non-availability of rapid initial attack resources, specifically air tankers and lead planes, are a major concern in any scenario. While tankers alone cannot put out fires, they are effective when combined with ground attack resources to limit fire spread. Heavy lift helicopters offer replacement effectiveness where and when available, but availability and stand-by cost are major considerations. Other rapid response initial attack resources, such as smokejumpers and helicopters, have remained static in Washington and Oregon.

The wild card is always lightning occurrence. Early snowmelt, poor soil moisture, low stream flow, poor ground water and pond recharge, a dry airmass and dry fuels are all indicate a potentially severe fire season. However, they do not necessarily guarantee it. With the number of human-caused fires in the Northwest at a static level (due to an aggressive and successful prevention program), it would not be impossible for the Northwest to experience a near-normal fire season in the absence of dry lightning episodes. In addition, short-term (10 day) severity forecasts for well-defined sub-geographic areas (Predictive Service Areas) become increasingly important. Effective severity forecasts predicting atmospheric conditions most likely to result in lightning (breakdown of the upper level ridge) allow resources to be pre-positioned in areas of greatest potential. Previous experiences in the Northwest bear witness to the effectiveness of these forecasts in pre-positioning resources.

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