ROCKY MOUNTAIN AREA PREDICTIVE SERVICES

2004 Seasonal Fire Weather/Fire Danger Outlook

July 15, 2004

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Rocky Mountain Area (RMA) Predictive Services provides fire weather and intelligence support to the 10 cooperating agencies of the RMA, which are the USDI Bureau of Indian Affairs, the USDI Bureau of Land Management, the USDI Fish and Wildlife Service, the USDI National Park Service, the USDA Forest Service, and the states of Colorado, Kansas, Nebraska, South Dakota and Wyoming.

A. Executive Summary

The objective of this report is to assess factors in the 2004 wildland fire season for the Rocky Mountain Area (RMA) and provide information and recommendations that can improve preparedness for wildland fire management agencies. This report is based on past developments, current trends and conditions, and future predictions. Long-range predictions of fire weather and fire occurrence should be looked at with some degree of skepticism. **This report is the last of the season, and is a look at what the remainder of the RMA fire season may be.**

The drought has improved some from last year over western Colorado into west-central Wyoming. However, drought conditions over the high plains, the Black Hills, and northern and eastern sections of Wyoming have worsened from last year. An abnormally warm and dry month of May brought a trend of decreasing fuel moistures in the RMA, and by the end of the month critical values were common over Colorado into southwest Wyoming. During June however, above normal precipitation and below normal temperatures reversed the trend of drying fuel moistures, with the most dramatic increase in values occurring over the Colorado Front Range into southeast and central Wyoming.

There is some uncertainty on the strength of the Southwest Monsoon for the remainder of the summer. Long-range predictions do not support a wet or dry scenario for the RMA, but rather support climatological precipitation averages. Fuel projections, using average precipitation and near average temperatures, support decreasing fire potential across Colorado around the end of July and into August. Increasing fire potential is noted across portions of northeast Wyoming.

Overall, the RMA may have short duration periods of above normal fire potential during the remainder of the 2004 fire season, however long duration periods are not likely. Because of this, an above average fire season for the RMA in 2004 is an unlikely scenario. Average fire activity, which typically includes some large fires, is the most likely scenario. This fire activity should be captured in the 7 day fire weather/fire danger product issued by RMA Predictive Services late Monday afternoons.

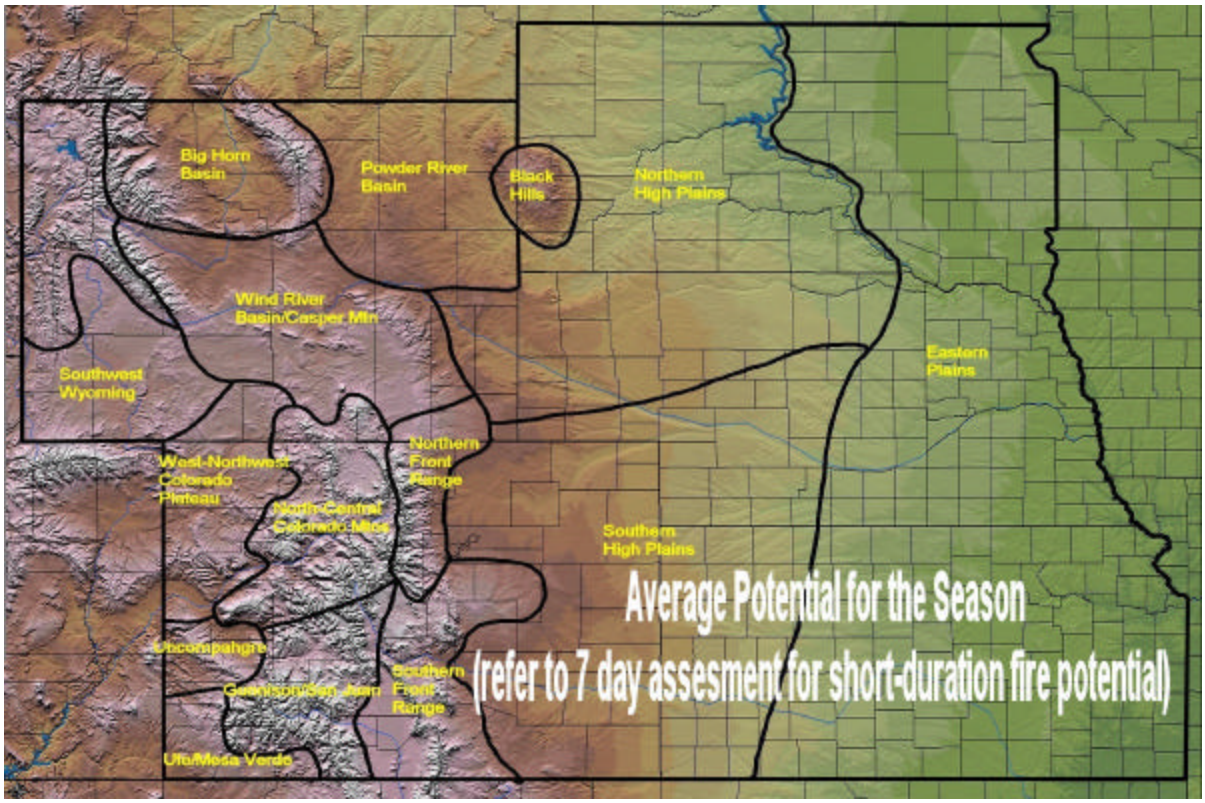


Figure 1. RMA Areas of Concern for Above Normal Fire Potential in the 2004 Wildland Fire Season

B. Current Conditions and Comparisons with Historical Records

The drought has improved from last year over western Colorado into west-central Wyoming (Figures 2 and 3). However, drought conditions over the high plains, the Black Hills, and northern and eastern sections of Wyoming have worsened from last year. The San Juan area of southwest Colorado experienced the greatest improvement, with extreme drought conditions early July of 2003 and only abnormally dry drought conditions in late June of 2004.

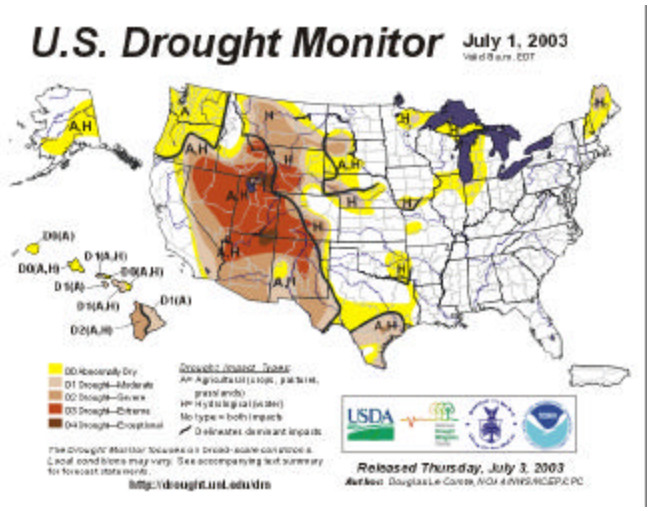


Figure 2. Drought Monitor for July 1, 2003.

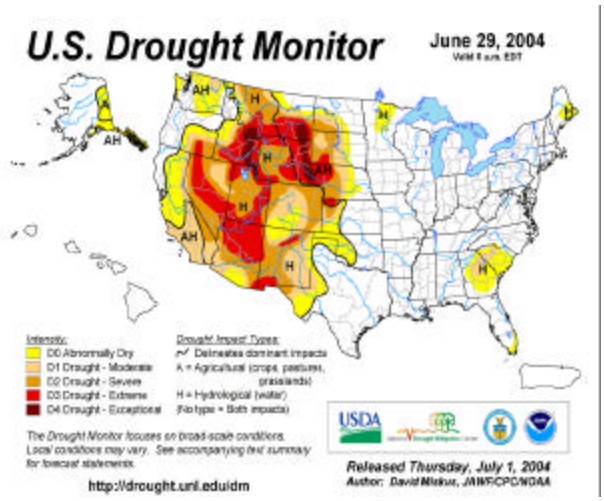


Figure 3. Drought Monitor for June 29, 2004.

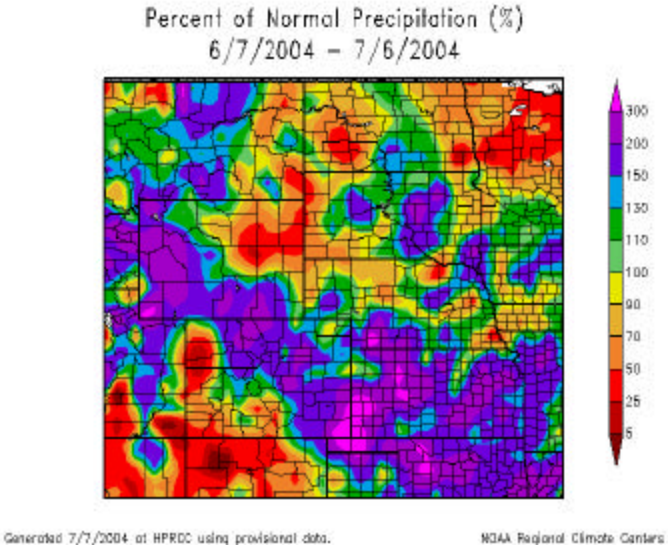


Figure 4. RMA 30 Day Percent of Normal Precipitation June 7, 2004 through July 6, 2004..

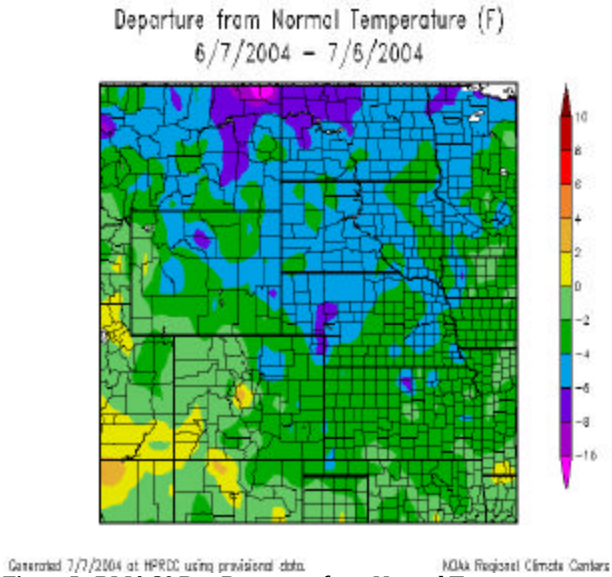


Figure 5. RMA 30 Day Departure from Normal Temperature June 7, 2004 through July 6, 2004..

Figure 4 shows the 30 day percent of normal precipitation from June 7th through July 6th for the entire RMA. Wetter than average conditions (blue and purple colors) during the past 30 days were noted across western Wyoming, the northern mountains of Colorado, eastern Colorado, Kansas, and eastern portions of South Dakota. In some cases, precipitation amounts were 150% to near 300% of average. Drier than normal conditions for the last 30 days were noted over western and southern sections of Colorado, northeast Wyoming, and the Black Hills of South Dakota, with amounts around 50% of average.

An active jet stream pattern for June also ushered in cooler than normal temperatures to much of the RMA (as shown in Figure 5). The northern plains and Black Hills region 30 day temperature departures ranged from 4 to 6 degrees below the seasonal norms. Elsewhere, 30 day temperature departures ranged from 2 to 4 degrees below normal across Kansas, southeast Nebraska, eastern Colorado and southwest Wyoming. Near normal readings were noted over western Colorado.

Much of last summer, fuels were at or near critical levels throughout many portions of the RMA due to below normal precipitation, above normal temperatures and the extended drought. At times the Energy Release Components (ERCs) were setting or very near record historic highs, which indicated the potential for extreme fire behavior. Combining the warm, dry fall of 2003, most notably in Colorado and Wyoming, and the continued long-term drought in 2004, fuels will likely remain stressed during this season, unless above average precipitation amount and duration is received; that scenario is not expected to occur this year.

The following map, Figure 6, is a visual representation of areas with tree mortality from forest insects and diseases. The map covers all forested lands in the Rocky Mountain Area, and is based on information from aerial survey data.

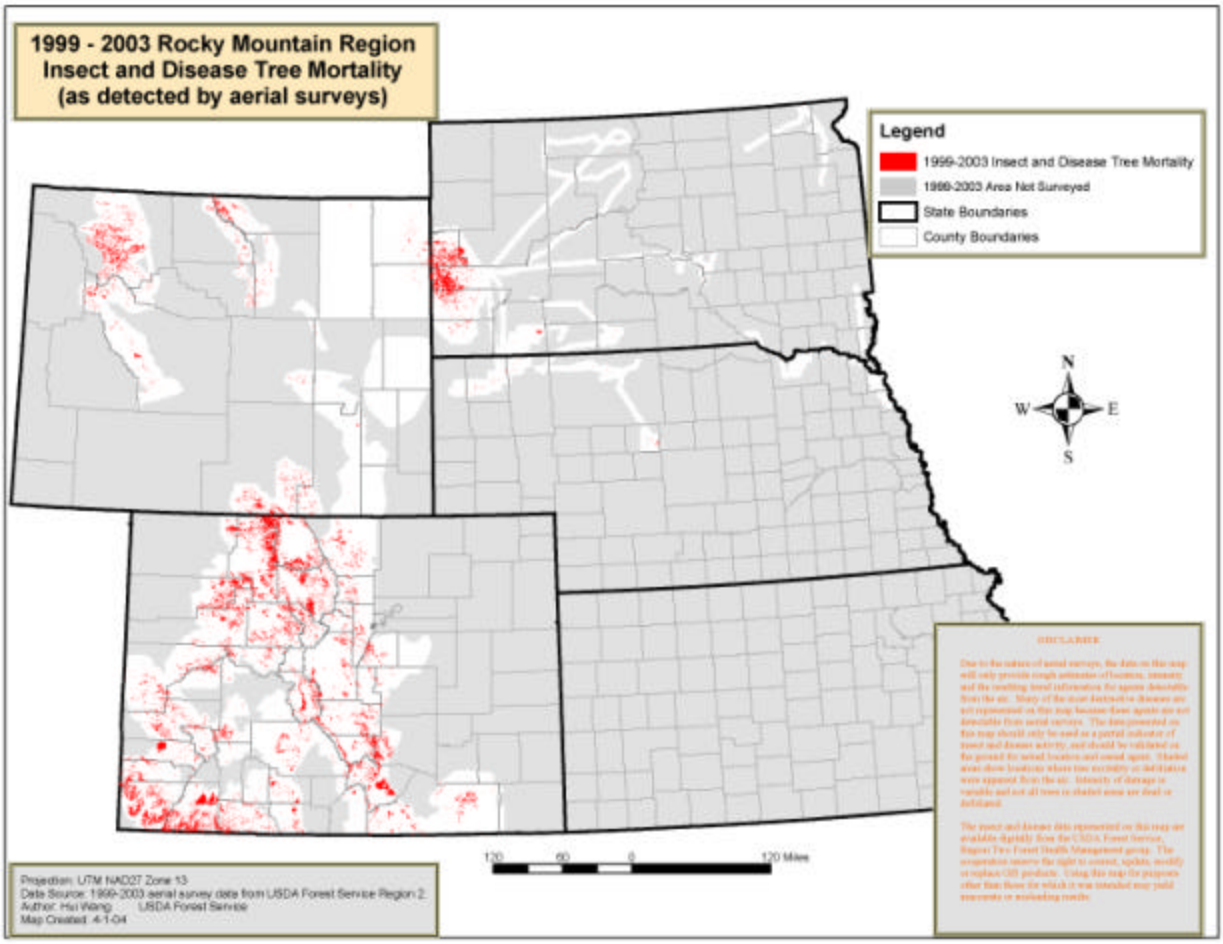


Figure 6. Tree Mortality on Forested Lands

As is apparent in Figure 6, insect infestations are becoming a fuels issues in the RMA. Ips Beetle, Spruce Beetle, Douglas fir Beetle and Mountain Pine Beetle infestations are occurring in

Colorado and a Spruce Beetle epidemic has been reported on the Shoshone National Forest in Wyoming. The main infestation showing on the map in the Black Hills of South Dakota is Mountain Pine Beetle. While dead needles are present on the trees that have been killed by the bugs, an aerial fuels problem exists, which may contribute to crown fire initiation leading to larger fires. After a few years, the needles will fall off, contributing to the fuel bed on the ground. Eventually, the dead trees will fall over significantly adding to the heavy dead fuel loading of the area, which may lead to potential control problems of fires in those areas.

Ips Beetles are attacking pinyon pine in southwest Colorado causing high mortality in stands. The Ips beetle is slowly moving northward in Colorado, however to date in west-central and northwest Colorado the areas of infestation are small and discontinuous. The Ips beetle infestations in west-central and northwest Colorado are not expected to lead to fire control problems this year, however the potential for problems will most likely exist in the next couple of years.

East of the Continental Divide in Colorado, the Spruce Beetle has reached epidemic proportions in the southern part of the Rio Grande National Forest. Significant Douglas fir and Mountain Pine Beetle infestations are also occurring there with the potential to become severe. On the Shoshone National Forest in Wyoming, the Spruce Beetle has also reached epidemic levels, while South Dakota's Black Hills has a major infestation of Mountain Pine Beetle.

Greenup has already occurred in the RMA. Figures 7 shows the Normalized Vegetation Difference Index (NDVI) Departure from Average Greenness for the first week of July 2004. This index compares the noted week in 2004 to the same week of the year from 1989-2003.

Figures 7 shows that much of the RMA is near to below average greenness levels; areas of below average greenness include western portions of Nebraska and South Dakota, as well as much of Wyoming.

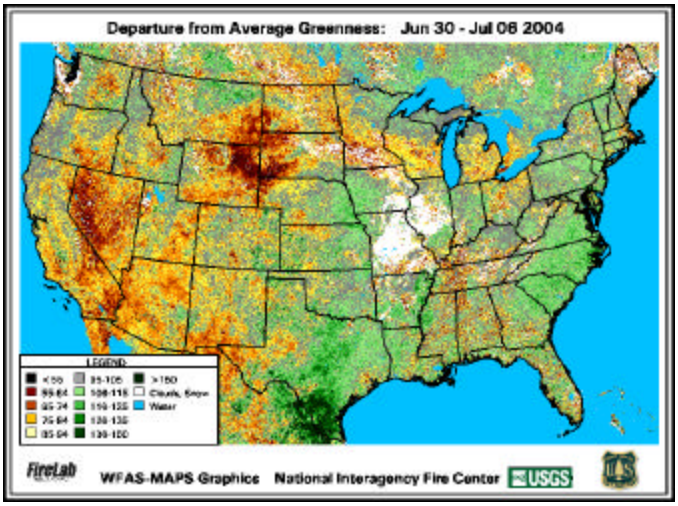


Figure 7. NDVI Departure from Average Greenness. June 30 – July 6, 2004.

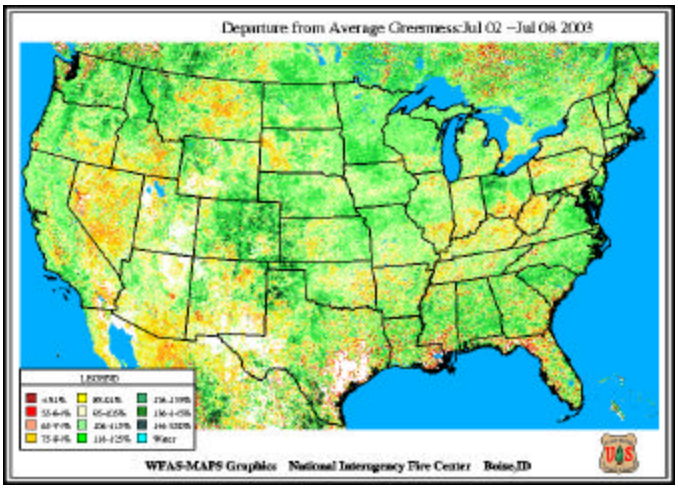


Figure 8. NDVI Departure from Average Greenness. July 2 – July 8, 2003.

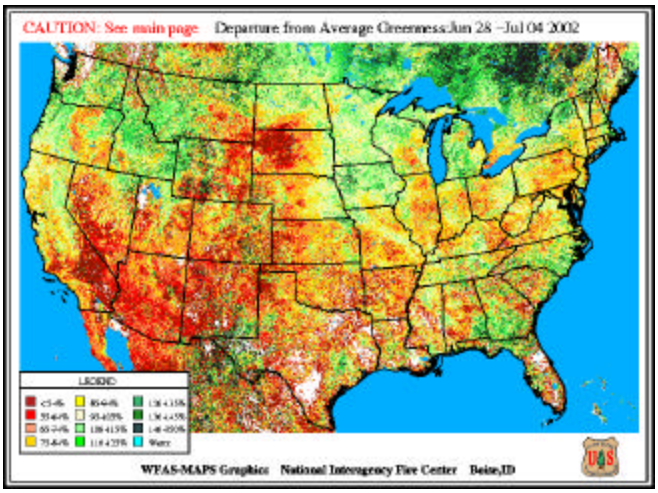


Figure 9. NDVI Departure from Average Greenness. June 28 – July 4, 2002.

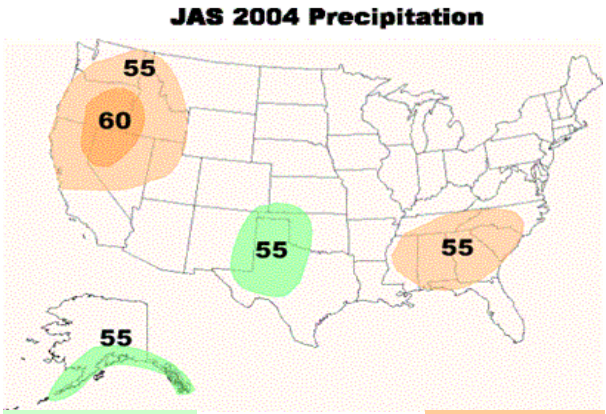
Comparing Figures 7 to Figures 8 and 9, which are the NDVI Departure from Average Greenness for the first week of July 2003 and July 2002 respectively, shows that overall the RMA's fuels are currently less green than they were at this same time in 2003, however they are currently not as available for ignition as they were at the same time in 2002.

C. <u>Southwest Monsoon and Outlooks For Summer</u>

A stronger than normal jet stream pattern over North America has suppressed the development of the Southwest Monsoon in late June and early July. The average onset date for southern Arizona is around July 3rd with Colorado typically benefiting from increased moisture and thunderstorms from the Southwest Monsoon around the second week of July, and late July or early August (if at all) for northern sections of the RMA. As of July 13, 2004, the Southwest Monsoon had officially developed. This is among the top 10 latest starts for Tucson, Arizona, and will mark the third consecutive year that the start of the monsoon has fallen in the top 10 latest. Although the monsoon start date was late over the southwest U.S., atmospheric flow patterns likely will push an initially surge of this subtropical moisture into the RMA by mid July.

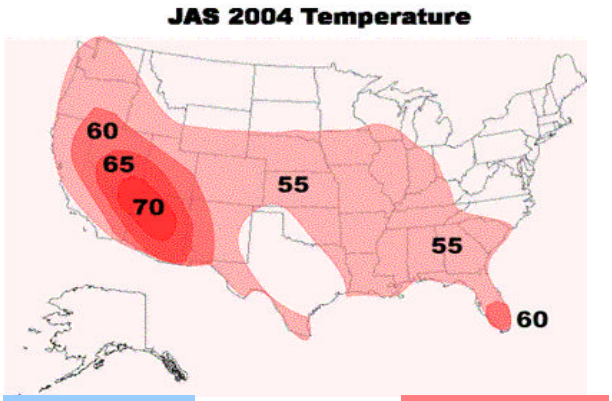
Unfortunately, there is no good predictor for how strong the Southwest Monsoon will be during the summer of 2004. Even more difficult to predict is the northern extent of the moisture and associated thunderstorm activity, which can vary from year to year. Various statistical analysis and consensus seasonal outlooks (Figure 10) do not tilt the odds towards a wet or dry period for the RMA during July, August and September, however seasonal temperature outlooks point towards above average temperatures (as shown in Figure 11).

The consensus summer precipitation forecast for July, August, and September (JAS, Figure 10) predicts equal chances (lack of confidence either way) for the entire RMA. Summer temperature probabilities (Figure 11) point towards above normal readings over all of the RMA except for equal chances over northern Wyoming and South Dakota.



Wetter than Average Drier than Average

Figure 10. Consensus Precipitation Forecast For Summer.



Cooler than Average Warmer than Average

Figure 11. Consensus Temperature Forecast For Summer.

D. Future Scenarios and Projections

The RMA Predictive Services group developed Predictive Service Areas (PSAs) based on historical RAWS data for all the available RAWS in the RMA. A statistical correlation test on minimum afternoon relative humidity resulted in PSA zones for the RMA shown in Figure 12.

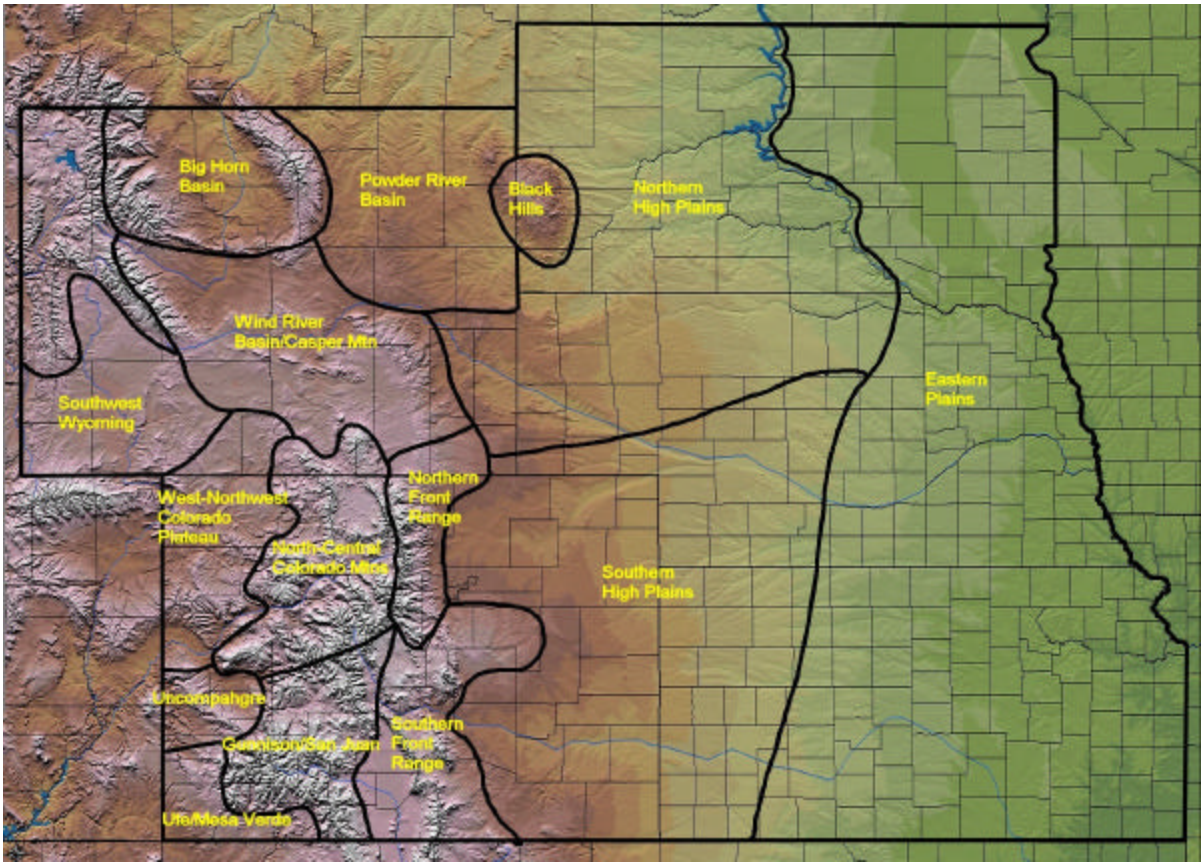


Figure 12. Rocky Mountain Predictive Service Areas (PSAs). Zones developed from RAWS statistical analysis.

SIG groups were developed for the PSA zones and Figures 13-36 are 1000-hour fuel moisture and ERC projections (using Fire Family Plus) for the related PSAs shown in Figure 12. These projections were based on the following weather and precipitation scenarios for summer 2004:

- July, August and September Precipitation Duration – average for the entire RMA.
- July, August and September Temperatures – average for the Big Horn Basin, Powder River Basin, Wind River/Casper Mountain and Black Hills PSAs, above average for the remainder of the RMA's PSAs.

At the end of March, many of the RMA's PSAs were showing record values for ERCs and 1000-hour fuel moistures, however the rain and snow received during April (especially over southern Colorado) alleviated the early season concerns for large fire potential that existed in March. Warm and dry conditions encountered during May did renew concerns for large fire potential by the latter half of the month over southern Colorado as ERCs and 1000-hour fuel moistures approached critical values. Several precipitation events in June reduced concerns for large fire potential in most of the RMA except for portions of Ute/Mesa Verde, Gunnison/San Juan and Uncompahgre PSAs where values remained near or above critical levels.

The projections for 1000-hour fuel moisture for all the PSAs show values decreasing to near or below the seasonal averages based on the precipitation and temperature trends mentioned above. The Black Hills' and much of Wyoming's and Colorado's trends hover near to average, exceptions include portions of Powder River Basin, West-Northwest Colorado Plateau, Uncompahgre and Ute/Mesa Verde PSAs where trends tend to deviate further below average. The decrease in 1000-hour fuel moisture values reflects the long-term drought conditions experienced by most of the RMA. Above average precipitation amounts and duration through the summer would be required for all PSA's 1000-hour fuel moistures to rebound to near average values; as previously stated this is not anticipated.

Again, based on precipitation and temperature trends mentioned above, ERCs show upward trends with a few areas spiking above the seasonal ERC average. These above average spikes are most noticeable over Colorado and the Powder River Basin PSA, while the remainder of Wyoming and the Black Hills stay closer to average values.

Overall, the projections indicate that the RMA will not be setting historic record ERCs and 1000-hour fuel moisture values during the <u>entire</u> 2004 fire season, although there is still potential in 2004 for periods of historic values to occur. Precipitation duration used in the projections was distributed throughout the month and did not take into account the possibility that one event could bring average monthly precipitation duration to the area. Also, the projections did not take into account extended dry periods, which are a distinct possibility, even with average precipitation duration for a specific month. Therefore, larger spikes upward (ERCs) or downward (1000-hour fuel moistures) than the projections show are likely to occur, with the possibility of setting historic record values.

In a non-drought year a 2-week warm and dry period may not have a significant impact on fuel moistures. However, a 2-week warm and dry period in a drought year may have a more significant impact on fuel moistures that could lead to a quicker onset of fire potential and activity.

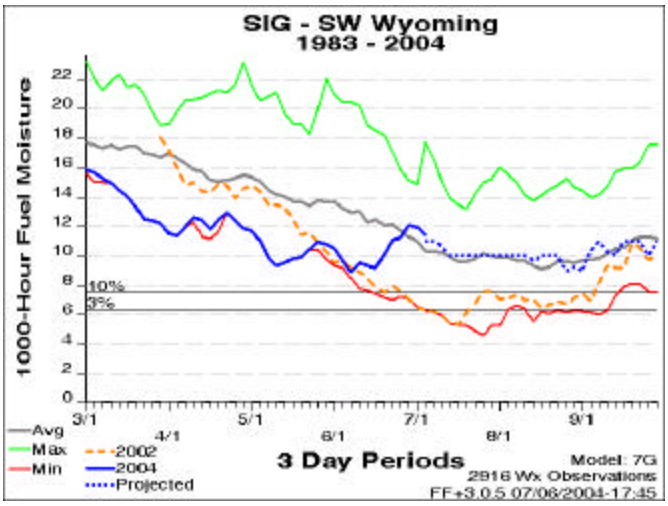


Figure 13. 1000-hour fuel moisture projections for the Southwest Wyoming PSA.

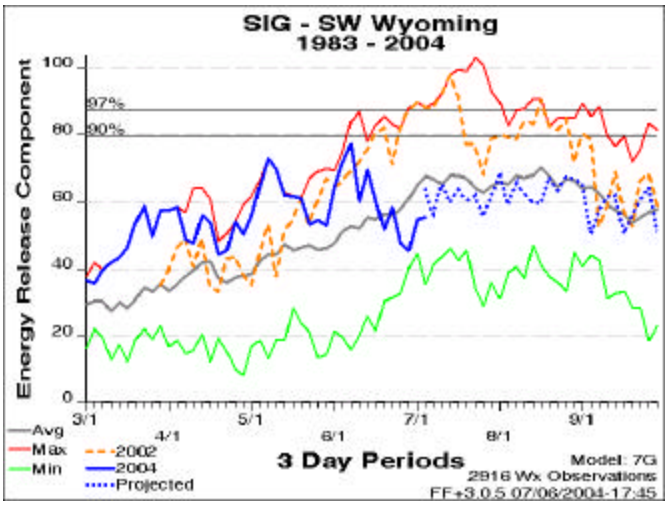


Figure 14. ERC projections for the Southwest Wyoming PSA.

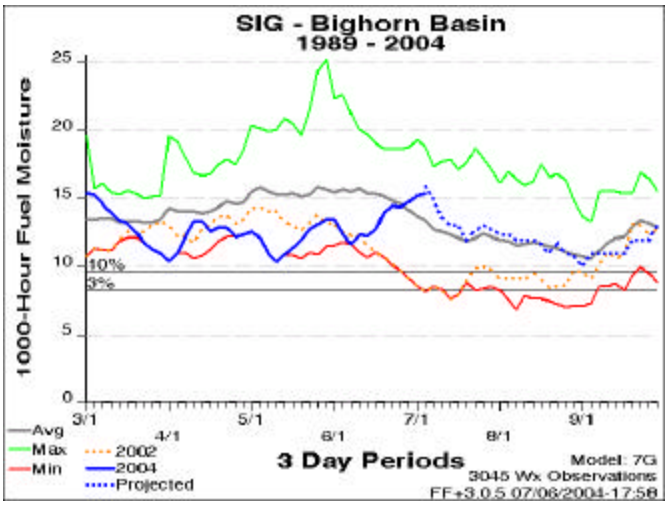


Figure 15. 1000-hour fuel moisture projections for the Big Horn Basin PSA.

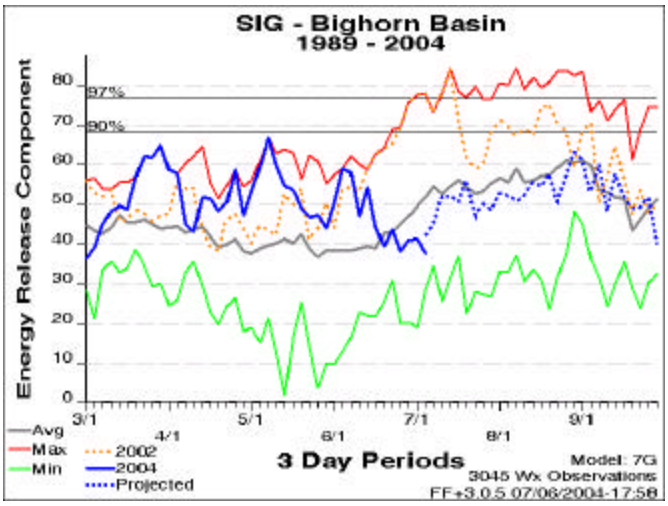


Figure 16. ERC projections for the Big Horn Basin PSA.

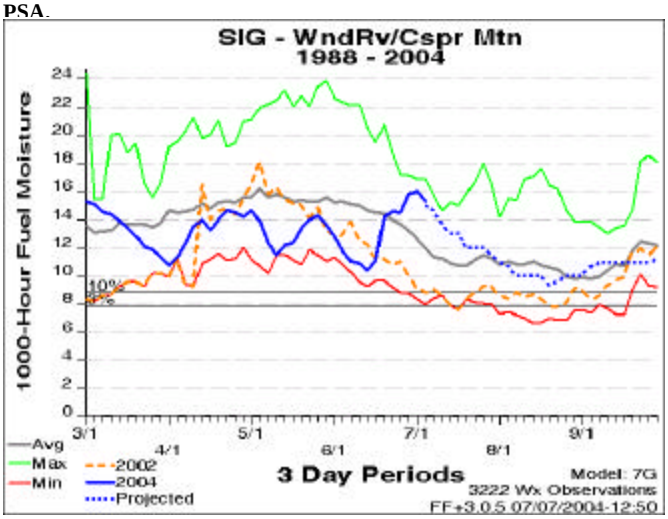


Figure 17. 1000-hour fuel moisture projections for the Wind River/Casper Mountain PSA.

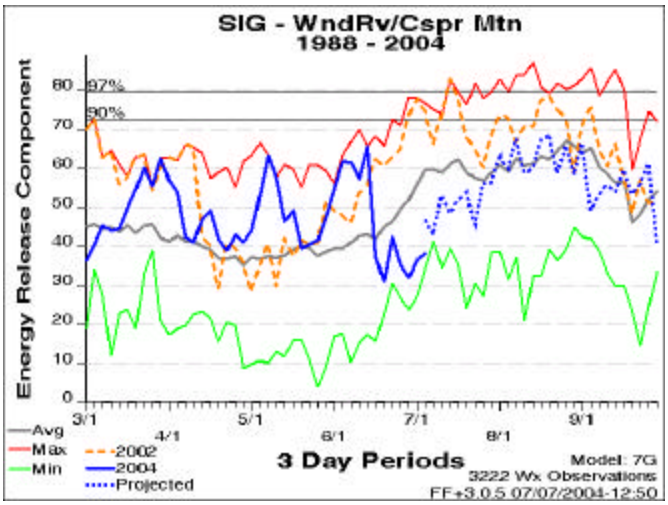


Figure 18. ERC projections for the Wind River/Casper Mountain PSA.

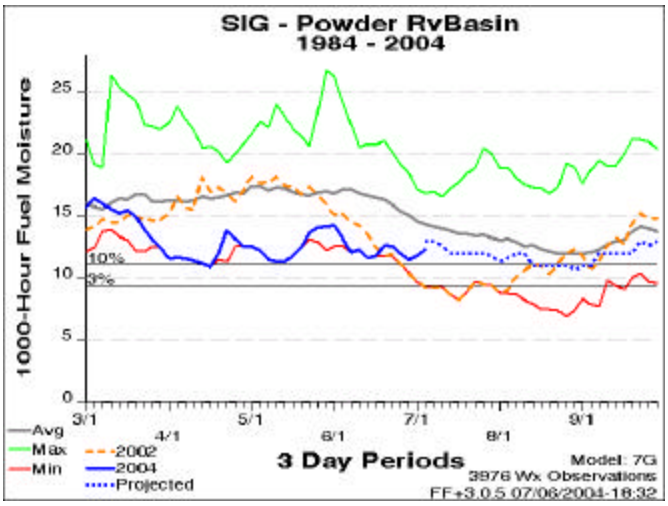


Figure 19. 1000-hour projections for the Powder River Basin PSA.

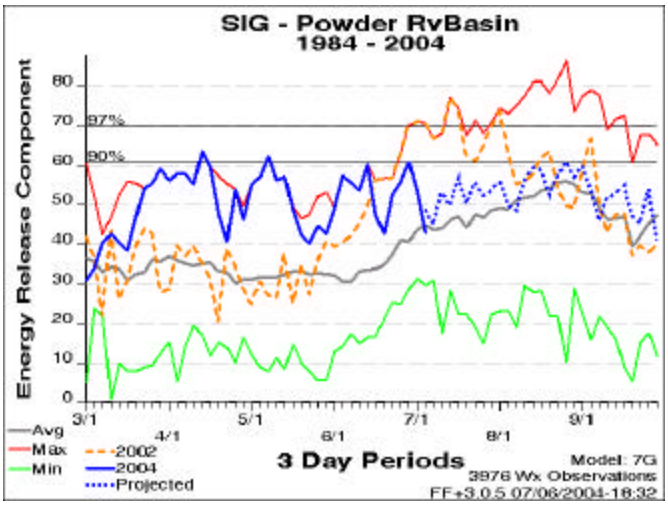


Figure 20. ERC projecti ons for the Powder River BasinPSA.

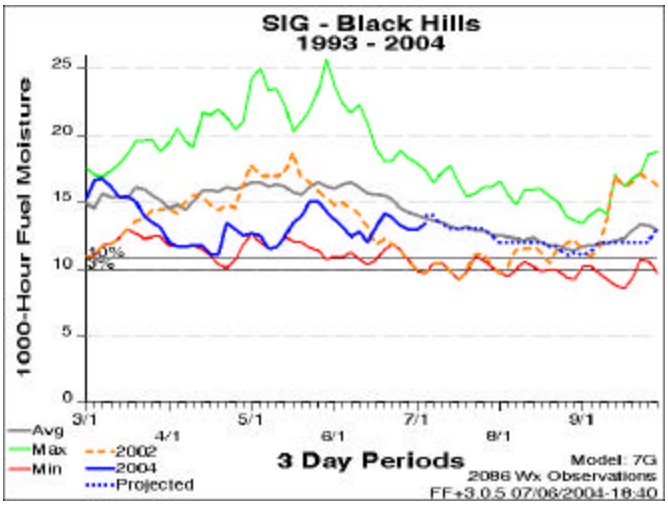


Figure 21. 1000-hour projections for the Black Hills PSA.

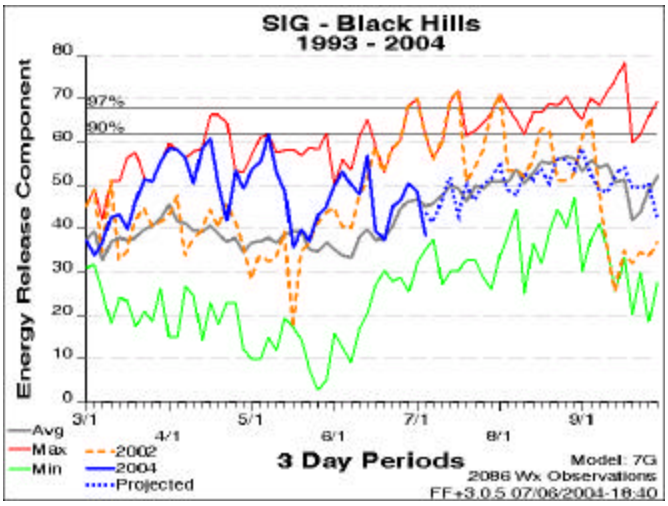


Figure 22. ERC projections for the Black Hills PSA.

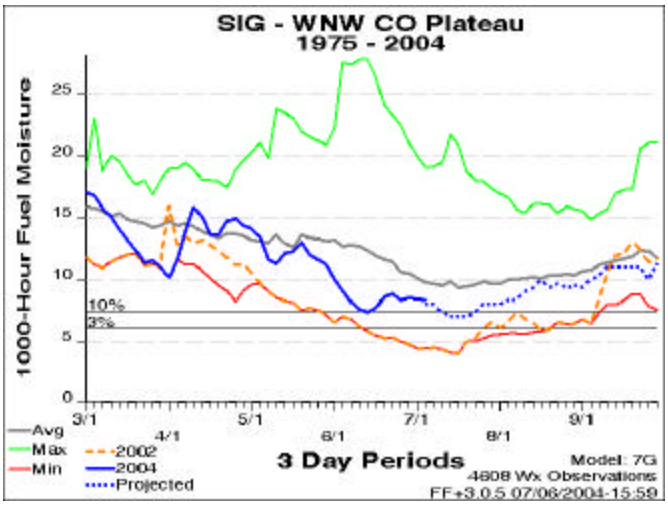


Figure 23. 1000-hour projections for the West-Northwest Colorado Plateau PSA.

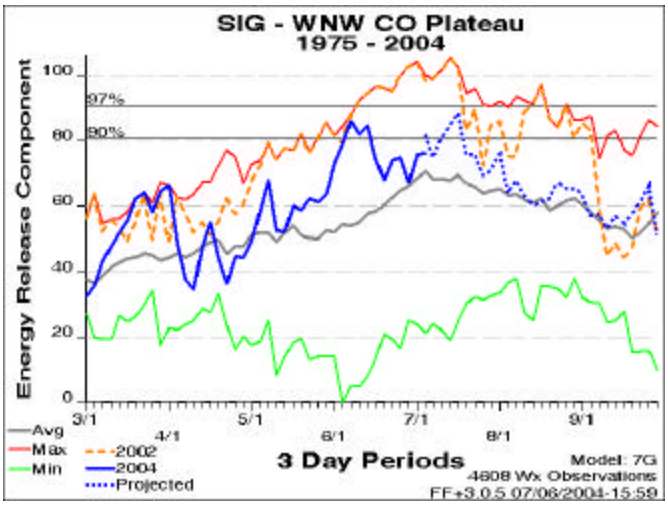


Figure 24. ERC projections for the West-Northwest Colorado Plateau PSA.

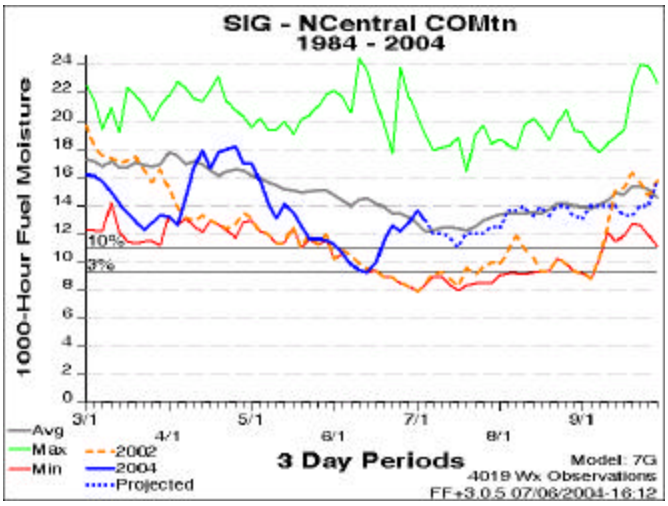


Figure 25. 1000-hour projections for the North Central Colorado Mountains PSA.

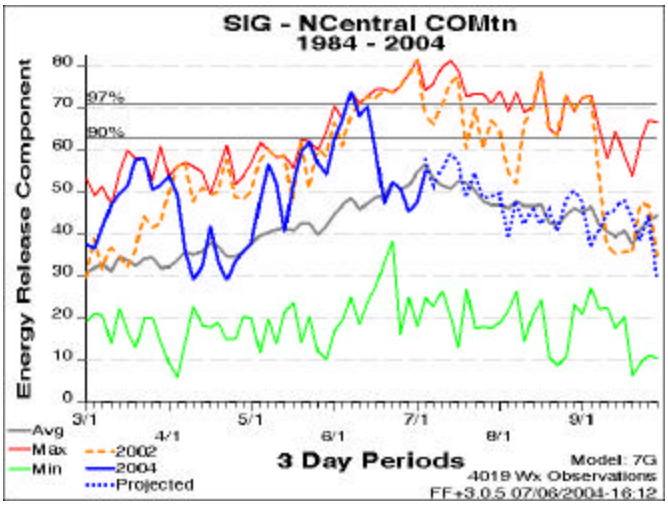


Figure 26. ERC projections for the North Central Colorado Mountains PSA.

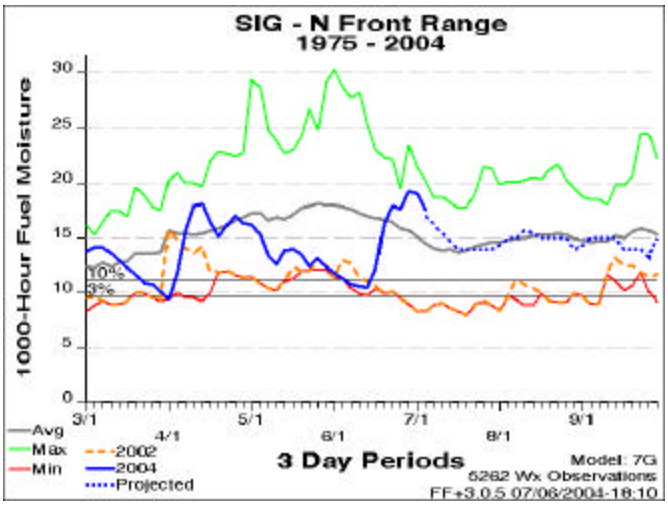


Figure 27. 1000-hour projections for the Northern Front Range PSA.

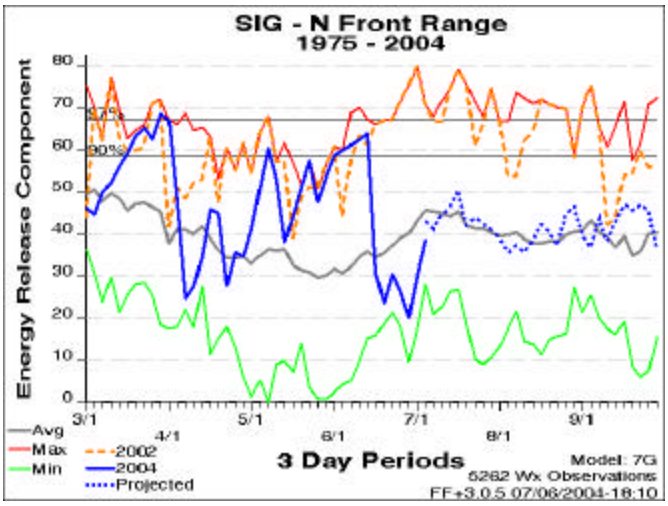


Figure 28. ERC projections for the Northern Front Range PSA.

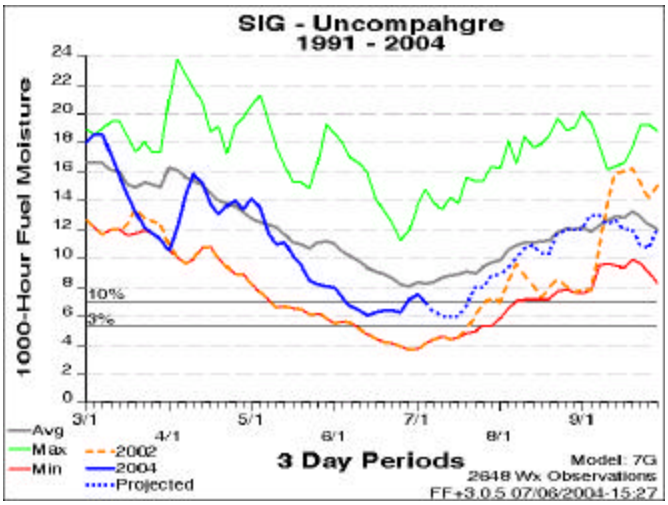


Figure 29. 1000-hour projections for the Umcompahgre PSA.

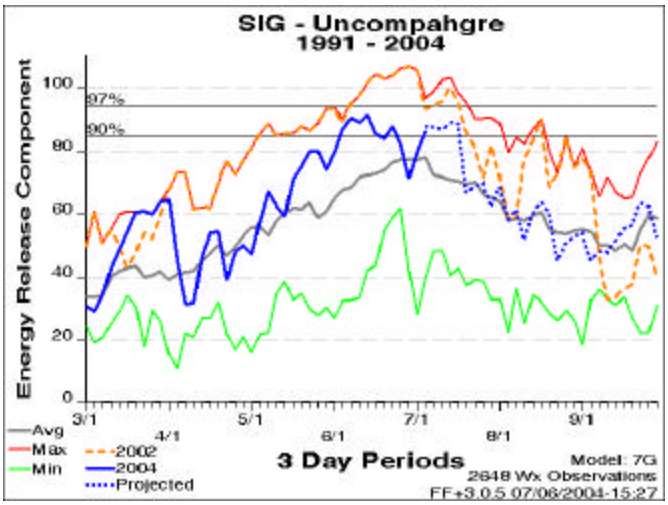


Figure 30. ERC projections for the Umcompahgre PSA.

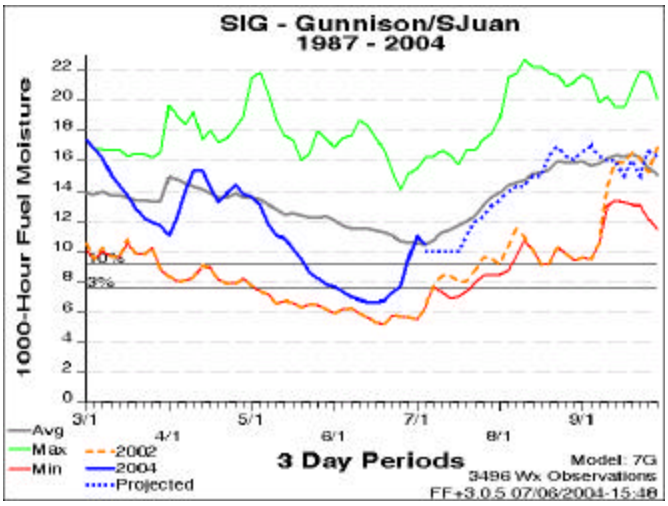


Figure 31. 1000-hour projections for the Gunnison/San Juan PSA.

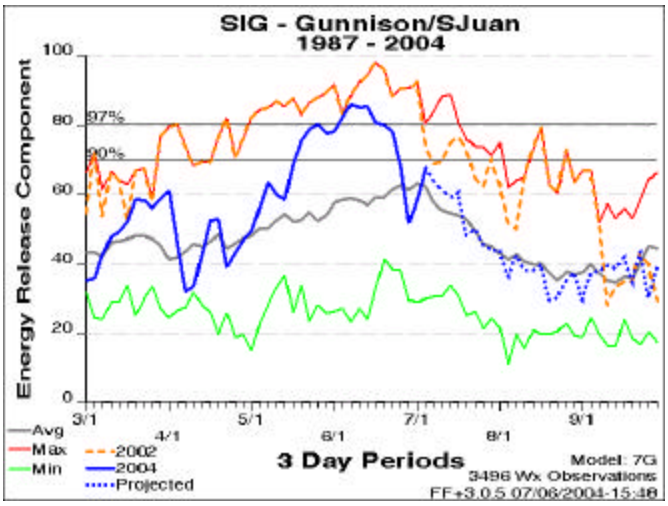


Figure 32. ERC projections for the Gunnison/San Juan PSA.

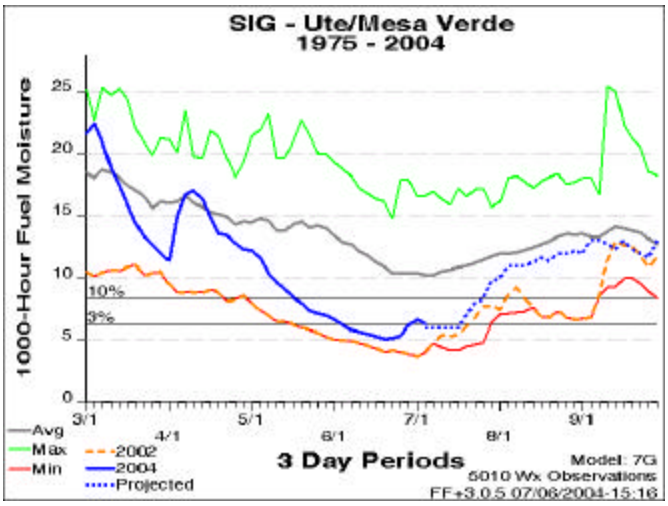


Figure 33. 1000-hour projections for the Ute/Mesa Verde PSA.

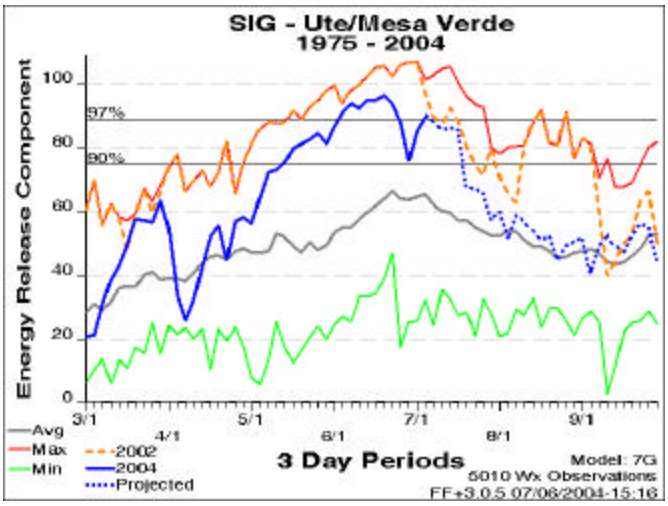


Figure 34. ERC projections for the Ute/Mesa Verde PSA.

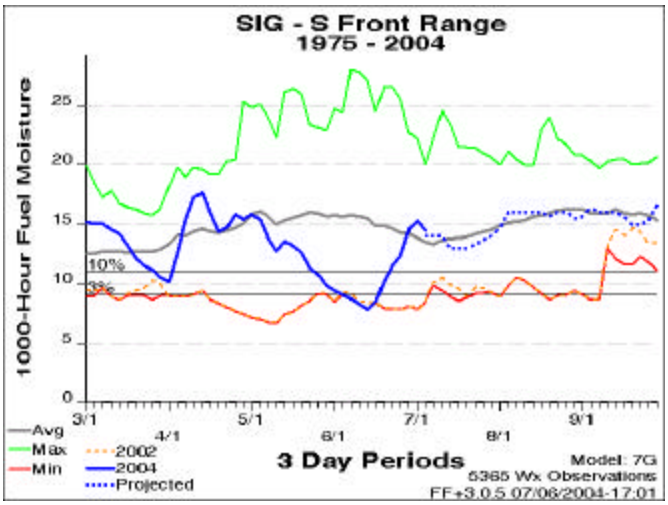


Figure 35. 1000-hour projections for the Southern Front Range PSA.

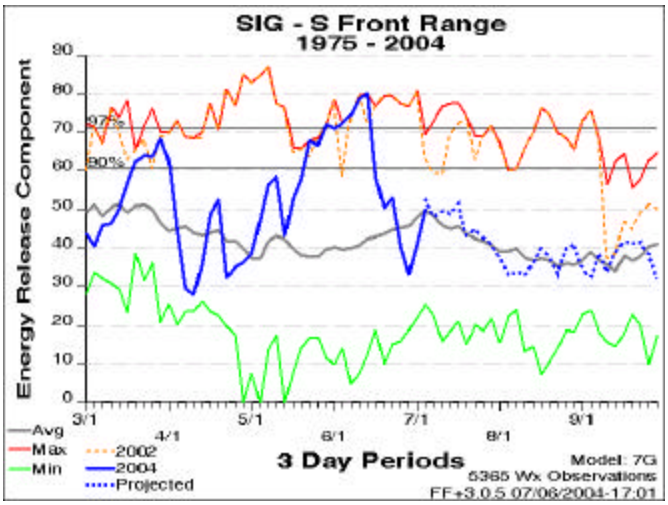


Figure 36. ERC projections for the Southern Front Range PSA.

E. Fire Occurrence and Resource Outlooks

In 2002, more than 1 million acres burned in the RMA. This was more than twice the RMA's 5-year average and about 3 times the RMA's 10-year average. Compared to 2002, the 2003 RMA fire season was much less severe. Although the number of fires in 2003 was 3% above the 10-year average, the number of acres burned in the RMA during 2003 was only 64% of the 10-year average. In 2003, the RMA had 11,533 fires that burned 322,368 acres.

During the extreme 2002 fire season, the RMA had very high resource demands. Almost 13,000 resource orders were filled by the Rocky Mountain Area Coordination Center (RMACC), including overhead, equipment, crews and aircraft. Over 60 Type 1 or Type 2 Incident Management Teams (IMTs) were assigned to incidents in the RMA during the season on over 40 of the area's large fires. In 2003, the resource demand in the RMA was not near the level of 2002. Only 4,268 resource orders were filled by the RMACC. No Type 1 IMTs were assigned within the RMA; only 18 Type 2 IMTs and 1 Fire Use Management Teams were assigned in the RMA in 2003.

Due to the fact that the RMA's 2004 spring weather pattern has been wetter than in 2002, the onset to full fire season has not been nearly as early as 2002. It is expected that fewer resource will be needed in the RMA than in 2002, however the number of resources needed in the RMA is expected to be similar or slightly higher than in 2003.

F. Management Implications and Concerns

The following are some issues for managers to consider based on the above analysis:

- There is a potential lack of air support this summer for both initial and extended attack.
- Combining the potential lack of air support nationwide and the continuing long-term drought in the West, ground resource may be much more heavily relied on than in the past. Amounts of these ground resource may be limited, whether due to lack of trained personnel or nationwide competition for resources, and fewer numbers of resources will be working for a longer season. Due to this, fatigue management for these resources should be continually monitored and addressed by fire managers.
- With tree mortality in Colorado, Wyoming, and the Black Hills' forested stands, the potential for extreme fire behavior in those dead trees will exist for about 1 year, or until the needles fall off. While the dead needles remain on the branches, several things should be anticipated: fires may be more numerous as the needles will act like 1-hour fuels and could be more receptive to lightning ignitions, fires may be larger than typically encountered as more fuel is readily available, and fires may be faster moving. After the needles are shed, the potential for extreme fire behavior may lessen until the dead trees fall over and contribute to heavy ground fuel loading.
- Typically, over 70% of the fires in the RMA are human caused, concentration on public education may help reduce fire risk.

G. Summary and Recommendations

This report is the last of the season, and is a look at what the remainder of the RMA fire season may be. The information provided in this report is the best information available at this time.

The drought has improved some from last year over western Colorado into west-central Wyoming. However, drought conditions over the high plains, the Black Hills, and northern and eastern sections of Wyoming have worsened from last year. An abnormally warm and dry month of May brought a trend of decreasing fuel moistures in the RMA, and by the end of the month critical values were common over Colorado into southwest Wyoming. During June however, above normal precipitation and below normal temperatures reversed the trend of drying fuel moistures, with the most dramatic increase in values occurring over the Colorado Front Range into southeast and central Wyoming.

The above normal rainfall in June also produced a second flush of green-up across portions of the Front Range into west-central Wyoming. By the beginning of July, the most critical fuel area of the RMA was in Colorado west of the Continental Divide.

Although the onset of the Southwest Monsoon officially began July 8th, there is still uncertainty about its strength and persistence for the remainder of fire season. One predictor includes El Nino Southern Oscillation (ENSO). The latest ENSO information does not show El Nino conditions to date. In the past El Nino conditions have shown some correlation to a wetter summer monsoon. Also, long-term climate modeling suggests average, and in some cases above average, precipitation across portions of the west from the monsoon. However, due to recent climate trends, climatologists are reluctant to trust these models.

Though there were some similarities between pre-fire season conditions this year as compared to the historic 2002 fire season, the relatively wet and cool months of April and June have greatly reduced those similarities.

Overall, the RMA may have short duration periods of above normal fire potential during the remainder of the 2004 fire season, however long duration periods are not likely. Because of this, an above average fire season for the RMA in 2004 is an unlikely scenario. Average fire activity, which typically includes some large fires, is the most likely scenario. This fire activity should be captured in the 7 day fire weather/fire danger product issued by RMA Predictive Services late Monday afternoons.

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Web Sites for Graphics in this Document

US Drought Monitor	http://www.drought.unl.edu/dm/monitor.html
Mountain NRCS Snotel Basin Average Snow Water Content	http://www.wrcc.dri.edu/snotelanom/basinswe.html
Colorado Statewide Snowpack	http://www.co.nrcs.usda.gov/snow/data/basinplotstate04.gif
Colorado Snow Water Equivalent by Basin	http://www.wcc.nrcs.usda.gov/cgibin/snowup-graph.pl?state=CO
Wyoming Snow Water Equivalent (Map)	http://www.wrds.uwyo.edu/wrds/nrcs/snowmap/snowmap.html
Wyoming Snow Water Equivalent by Basin	http://www.wcc.nrcs.usda.gov/cgibin/snowup-graph.pl?state=WY
Black Hills Snotel Sites	http://www.wcc.nrcs.usda.gov/snotel/South_Dakota/south_dakota.html
Percent of Normal Precipitation	http://www.hprcc.unl.edu/products/current.html
NDVI Departure from Average Greenness	http://www.fs.fed.us/land/wfas/wfas11.html