**FINAL REPORT**

**CONTRACT # 98-305**

# Ambient Ozone Patterns and Ozone Injury Risk to Ponderosa and Jeffrey pines in the Sierra Nevada

**February 22, 2002**

Submitted to:

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**Abstract**

Spatially explicit estimates of ambient ozone exposure to the Sierra Nevada were developed using data from an extensive survey of passive ozone monitors. The study area included the Sierra Nevada subregion, and extended from the Sequoia National Forest in the south through the Lassen National Forest in the north. Both Westside and Eastside forests were included in the ambient ozone survey. This survey provided data at a total of 94 locations across the Sierra Nevada, of which nine were collocated with active ozone monitors. In addition digital elevation maps, and spatial maps of temperatures and precipitation were developed as part of the analysis.

The unique data set generated from the passive monitor network elicited widespread interest. As a result three analysts were given the data set to develop relationships and estimate spatial patterns of ambient ozone for the Sierra Nevada. Spatial models of biweekly and seasonal ozone distribution were constructed by each group using topographical, weather and other information.

Modeling efforts resulted in a spatial model with an estimated of $R^2$=0.58 and with an average standard deviation of 6.68 ppb-hour. Further improvements in the accuracy of predictions are possible because residual analysis indicates unexplained spatial patterns in the data.

The results of these studies also suggest that almost 94% of the study area was reliably estimated for the Sierra Nevada, although the distribution of the measurement sites could still be improved (there was clearly insufficient number of sites on the eastern side of the mountain range). The availability of the weather data and presence of strong correlations between maximum temperatures and elevation with ozone contributed to low sampling site densities being needed to obtain reliable spatial surface estimates in the Sierra Nevada.

Along with monitoring ambient ozone, evaluations of crown injury were performed at 25 sites. Eight Project FOREST sites and 15 other sites located near selected passive monitor sites were evaluated using the Forest Pest Management (FPM) method. All sites were located along the western side of the Sierra Nevada in Jeffrey, ponderosa or mixed conifer forest types.

The number of sites sampled for this study was low, and the distribution of the sample sites did not represent the distribution of the pines. In spite of these deficiencies, patterns of ozone injury generally followed patterns of ozone exposure risk. Although the design of the FPM survey portion precluded a detailed spatial comparison with the ambient ozone samplers, it was of great value for development of future long-term ozone injury monitoring system for the Sierra Nevada.

## Introduction

In 1990-1991 a regional program was initiated, the Sierra Cooperative Ozone Impact Assessment Study (SCOIAS), to monitor ambient ozone ($O_3$) and meteorological variables at six Sierra Nevada sites (Van Ooy and Carroll 1995). Yosemite, Sequoia-Kings Canyon and Lassen Volcanic National Parks, joined SCOIAS by contributing ambient ozone data at three locations within each Park, and the U.S. Forest Service, Pacific Southwest Research Station, provided four years (1992-1995) of ambient ozone data from a site in the San Bernardino Mountains. Van Ooy and Carroll (1995) examined patterns at six SCOIAS sites along the western Sierra Nevada, and observed that some sites had strong diurnal patterns, and some sites had little diurnal variation. In general they concluded that diurnal patterns varied considerably between sites, related primarily to distance from sources, elevation and airflow patterns.

Recent developments in ozone sampler technology have resulted in low-cost samplers useful for large regional surveys (Koutrakis and others 1993). The most widely used passive ozone sampler (Ogawa & Company, USA, Inc., Pompano Beach, FL) was designed for ambient (Koutrakis and others 1993) and indoor (Liu and others 1994) monitoring. The principal component of the coating on the filter medium is the nitrite anion, which in the presence of ozone is oxidized to nitrate. After sample collection, the filters are extracted with ultrapure water, and analyzed by ion chromatography. It has been shown that fluctuations in relative humidity (from 10-80 percent) and temperature (from 0-40 °C) do not influence sampler performance at typical ambient levels of ozone (40-100 ppb-hr) (Koutrakis and others 1993).

In 1993, measurements made with Ogawa passive ozone samplers were compared with those from UV-photometric ozone analyzers at five sites in two National Parks, by the National Park Service (Ray and Flores, 1994). Passive sampler measurements agreed well for each site and were within ±10 percent accuracy for each measurement period. Excellent agreement between an active ozone monitor (Dasibi Model 1003) and Ogawa passive ozone samplers has also been reported for sites in Mount Rainier National Park ($R^2 = 0.997$, Brace and Peterson 1994). In Europe, Ogawa samplers have been used successfully in the Krakow Region in

southern Poland (Godzik, 1997), in the Carpathian Mountains and Kiev Region in the Ukraine (Blum et al., 1997), and at Praha Peak in the Czech Republic ($R^2 = 0.911$, Bytnerowicz and others 1995). Currently, Ogawa samplers are being used to measure ozone levels throughout the entire range of the Carpathian Mountains in Central Europe (Bytnerowicz, unpublished).

Reports of ozone injury to ponderosa and Jeffrey pines in the 1970s (Miller and Millecan 1971), and subsequent surveys using 10-tree trend plots (Pronos and Vogler 1981), are among the earliest accounts describing the extent and severity of ozone injury in the Sierra Nevada. For example, Pronos and Vogler (1981) reported that between 1977-1980, the general trend was an increase in the amount of ozone injury present on pine foliage in the southern Sierra Nevada.

Peterson and others (1991) sampled crown condition and derived basal area growth trends from cores collected from ponderosa pines in seven federal administrative units in the Sierra Nevada. From north to south, samples were collected in the Tahoe National Forest, Eldorado National Forest, Stanislaus National Forest, Yosemite National Park, Sierra National Forest, Sequoia-Kings Canyon National Park, and Sequoia National Forest. Overall, the results of this study documented the regional nature of the ozone pollution problem originating primarily from the San Joaquin Valley Air Basin, as well as from the San Francisco Bay Area further to the west.

In 1986, 3,120 ponderosa or Jeffrey pines were examined in a cruise survey conducted in Sequoia National Park and Yosemite National Park (Duriscoe and Stolte 1989). More than one-third of these trees exhibited chlorotic mottle. At Sequoia National Park, symptomatic trees comprised 39 percent of the sample (574 out of 1,470) and at Yosemite National Park they comprised 29 percent (479 out of 1,650). Ponderosa pines were generally more severely injured than Jeffrey pines. The calculated Forest Pest Management (FPM) method scores were 3.09 for ponderosa and 3.62 for Jeffrey pine; in this method, a lower score indicates a higher amount of ozone injury (Pronos and others 1978). These cruise surveys characterized the spatial distribution of injury in Sequoia and Yosemite National Parks, and indicated that trees in drainages nearest the San Joaquin Valley experienced the most ozone injury.

The Lake Tahoe Basin is located at the northern end of the Sierra Nevada sampling transect near the Eldorado National Forest (Peterson and others 1991). The basin has distinct air quality problems resulting from a combination of local and remote pollution sources. This is in contrast to most other Sierra Nevada sites where pollution results only from long-range transport. In 1987, a survey of 24 randomly selected plots in the basin found foliar injury on 105 of 360 trees (29.2 percent, Pedersen 1989). For 17 plots, calculated FPM injury scores placed the affected trees in the slight injury category. Sixteen cruise plots (containing 190 trees) were also established to the east of the basin, in an attempt to extend the range of the in-basin observations. Injury at these plots was lower than within the basin, as only 21.6 percent of trees were injured.

Since 1992, Project FOREST has monitored the condition of pines and ozone air quality at ten locations along a north to south transect in the Sierra Nevada from Lassen Volcanic National Park in the north to Sequoia National Forest in the south. One additional site is located in the San Bernardino Mountains in southern California. Injury amounts in the Sierra Nevada range from almost no crown injury (near zero OII values) in the north to moderate crown injury in the south. At the site in the San Bernardino Mountains, located about midway along a west to east gradient of ozone exposure, the amount of crown injury is moderate.

Tree response has been analyzed in Project FOREST in relation to several ozone exposure indices from the nearest monitoring site (Arbaugh and others 1998). Significant associations were found between OII and 4-year, 24 hr summer SUM0, SUM06, W126 and HRS80 ozone indices. These statistical associations were not adjusted for the influence of variable seasonal ozone flux to foliage, which differs each year depending on soil moisture availability (Temple and Miller 1996).

**Project Objectives**

The first objective of this project was to produce mapped distributions of seasonal accumulated ozone (SUM0) using spatial analysis over the Sierra Nevada using a combination of passive ozone samplers and active ozone monitoring stations. This area includes all locations

from the Lassen National Forest (the northern most area) to the Sequoia National Forest (the southern most area). Western and eastern sides of the Sierra Nevada over 1000 meters in elevation were included in the analysis, as well as the interior of the Sierra Nevada. Information from the active monitoring stations alone was not sufficient to develop a meaningful spatial map of ambient ozone for this region. An extensive network of passive monitors augmented the network of active monitoring stations for one summer to identify the key spatial relationships for locations between active monitoring stations.

Part of this objective was also to examine, compare and develop analytical methods useful for spatial estimation in remote mountain areas. Similar studies (Phillips and Herstrom, 1997) have indicated that geospatial analysis (Kriging), or modern regression techniques such as locally weighted regression may have value for this type of data. As part of this study several analysts independently modeled the data, thereby providing a comparison of different analysis approaches.

The second objective was to develop mapped estimates of ponderosa and Jeffrey pine crown injury based on projected summer season ambient ozone exposure. Using the ambient ozone map developed in the first objective, spatial estimates of ozone exposure risk were developed for the Sierra Nevada from the Lassen National Forest to the Sequoia National Forest. This ambient ozone map was then compared with crown injury estimates from 25 sites to examine the ability of spatial exposure maps to estimate ozone injury for sensitive pines of the Sierra Nevada.

**Study Design**

*Site Selection for Passive Monitors and Forest Pest Management (FPM) Surveys*

Sites for passive monitors were selected at three general elevations along the north to south gradient of air pollution on the western side of the Sierra Nevada. It was important for spatial extrapolation that sample sites extend below and above the areas for which ozone exposures are to be estimated. Accordingly, low elevation monitor sites were located mostly in

oak-chaparral areas below the mixed conifer zone at 1,000-1,400 m elevation. Upper elevation sites were located above the upper boundary of urban transported ozone. The passive and active ozone monitoring sites ranged in elevation from 223 to 2796 meters above sea level (Figure 1).

***Figure 1.*** *Locations of passive and collocated active monitoring stations used in this analysis scattered throughout the national forests and parks of the Sierra Nevada. There are 3 active/passive monitor sites located along an elevational gradient in Sequoia-Kings National Park.*

All sites were located at least 200 m from frequently used roads, in open areas that had good vertical mixing of air. Nine passive monitor sites were collocated with active monitors that were operated continuously over the summer season. Seventeen additional mid-elevation sites were collocated at or near stands of ponderosa or Jeffrey pines that were used for FPM surveys. Digital elevation data (DEM) was used as a collateral data to enhance the quality of the geostatistical estimation of the primary variable – $O_3$. The relevant, fine resolution elevation data for many topoquads was downloaded from the United States Geological Survey (USGS) web site http://edcwww.cr.usgs.gov/webglis/, resampled to a coarser resolution and merged into a single map. An effort was made to determine the optimal resolution of the DEM for this study. Depending on the purpose of the analysis, the capacity of a computer disk, and the speed of its processing unit, the resolutions from 30 meters to 1 km were found to be valuable for spatial surface estimation.

Meteorological data from 62 weather stations also provided information critical for this study (National Climatic Data Center, WIMS). The meteorological monitoring stations were located across a wide variety of elevations (52 to 2551 meters). The maximum temperature was utilized as a secondary variable for the analyses. Surfaces were generated using the cokriging by the Environmental Systems Research Institute (ESRI) group, while the Pacific Southwest Research Station (PSW) group used a smoothed scatter plot approach. Sample maps of estimated maximum temperatures differed slightly for the two studies, but both indicated that low elevation areas had higher temperatures, while high elevation interior locations were generally cooler.

*Passive Ozone Monitors*

A single passive ozone sampler, containing two cellulose filters saturated with nitrite was installed at each site (Ogawa & Co.). The samplers were located at about 1.5-2.5 m above ground level in forest clearings (about 20 m or more from the dense forest). At eight to ten monitoring sites in each collection period, two blank filters were also tested. Blank unexposed

filters were kept at room temperature in tightly closed plastic vials. In the field, the filters were changed every two weeks during the summer growing season. After the exposures, the filters were placed in plastic vials, and refrigerated until analyzed. Ozone concentrations were continuously monitored by UV absorption (Thermo Environmental Model 49, Cambridge, MA, or an equivalent instrument), at nine active monitoring stations for comparison with the passive samplers.

In the lab, exposed filters were extracted in plastic vials with 5 mL of double-deionized water (i.e., ultrapure water). The filters were shaken for 15 minutes with a wrist action shaker. The extract from each vial was transferred to a 15 mL centrifuge tube, and centrifuged at 5000 rpm for 15 minutes. A 1 mL sample was removed from the centrifuge tube and transferred to a Dionex sample vial, and mixed with 4 mL of double-deionized water. Nitrate concentrations were determined in the diluted extracts by ion chromatography (Dionex 4000i Ion Chromatograph). Ambient ozone concentrations were calculated using an equation derived from comparisons between the readings generated by the active monitor along the transect and nitrate concentrations in filter extracts from the collocated passive sampler. Concentrations of nitrate increase proportionally with increases in ambient ozone concentration (resulting from the oxidation of nitrite by ozone).

*Crown Injury Evaluation*

Twenty-five sites, near selected passive ozone samplers, were surveyed using the Forest Pest Management (FPM) method. The FPM method is less costly perform than the OII evaluation used for Project FOREST, and the results of both survey types can be related to each other with a high degree of accuracy at the plot level (Arbaugh and others 1998). The FPM method quantifies ozone injury by noting the youngest whorl of needles that shows chlorotic mottle. The index has a range from 0 to 4 for each tree. If there is injury on current year needles, the FPM score is 0. If there is no injury on the current year needles but injury on the 1-year old needles, the FPM score is 1. If there is no injury on either the current year or 1-year old needles,

but there is injury on the 2-year old needles, the FPM score is 2. This evaluation is applied through the 4-year old needles, where if no injury has occurred, the FPM score is 4, and the tree is considered to be uninjured by ozone. Thirty trees per site were used to provide a representative sample in the FPM method. All tree observations were made between August 15 and September 15 when injury development is the most apparent (Table 1).

***Table 1.*** *Site locations and average tree characteristics for 25 FPM evaluated sites along the western side of the Sierra Nevada. FPM scores were calculated from three branches averaged to to plot. Any visible injury caused the whorl to be counted as an injured whorl. Crown position 2 is intermediate, 3 codominant, and 4 indicates open growing trees.*

| FOREST | SITE | North to South Order | Crown Position (Median) | Whorl Retention (Median) | DBH (Average, cm) | Live Crown Ratio (Average) | Height (Aveage, ft.) | FPM Score (Average) |
|---|---|---|---|---|---|---|---|---|
| Lassen NF | Hat Creek | 1 | 3.0 | 4.17 | 13.72 | 58.83 | 58.6 | 3.38 |
| Lassen Volcanic NP | *Manzanita Lake*** | 2 | 3.0 | 4.00 | 14.78 | 63.67 | 59.0 | 2.86 |
| Lassen NF | Mineral | 3 | 3.0 | 4.00 | 10.82 | 52.83 | 49.6 | 2.78 |
| Plumas NF | Bucks Lake | 4 | 2.0 | 4.33 | 11.91 | 70.57 | 54.3 | 3.82 |
| Plumas NF | Little Grass Valley Reservoir | 5 | 3.0 | 3.50 | 12.18 | 71.17 | 60.3 | 3.43 |
| Tahoe NF | Downieville | 6 | 3.0 | 3.33 | 13.38 | 48.33 | 103.7 | 3.13 |
| Tahoe NF | *White Cloud*** | 7 | 3.0 | 3.33 | 14.48 | 60.50 | 73.9 | 2.61 |
| Tahoe NF | Foresthill Seed Orchard | 8 | 3.0 | 3.00 | 18.48 | 70.83 | 77.0 | 2.30 |
| Tahoe/Eldorado NF | Blodgett** | 9 | 3.5 | 3.00 | 13.74 | 69.00 | 101.0 | 3.34 |
| Eldorado NF | Sly Park | 10 | 3.0 | 2.83 | 19.08 | 53.33 | 103.0 | 2.46 |
| Eldorado NF | Bear/Lumberyard | 11 | 3.0 | 4.33 | 22.91 | 69.50 | 81.0 | 3.11 |
| Stanislaus NF | Avery | 12 | 3.0 | 3.00 | 17.53 | 52.67 | 105.5 | 2.67 |
| Stanislaus NF | *Five Mile*** | 13 | 4.0 | 3.33 | 11.27 | 58.62 | 81.5 | 2.58 |
| Stanislaus NF | Reed Creek | 14 | 4.0 | 3.83 | 14.52 | 46.67 | 95.2 | 2.87 |
| Yosemite NP | Mather | 15 | 3.0 | 3.33 | 13.04 | 52.83 | 78.8 | 2.78 |
| Yosemite NP | *Turtleback Dome*** | 16 | 2.0 | 4.00 | 20.17 | 63.67 | 75.4 | 2.82 |
| Yosemite NP | Wawona | 17 | 3.0 | 3.67 | 21.73 | 63.00 | 110.6 | 2.66 |
| Sierra NF | Poison Meadow | 18 | 3.0 | 4.67 | 23.28 | 57.83 | 82.4 | 2.18 |
| Sierra NF | *Shaver*** | 19 | 3.0 | 4.67 | 19.11 | 55.17 | 101.0 | 3.01 |
| Sierra NF | Teakettle | 20 | 3.0 | 4.33 | 20.20 | 58.00 | 78.0 | 3.16 |
| Sequoia NP | Stony Creek | 21 | 2.5 | 2.83 | 18.69 | 58.00 | 77.5 | 2.81 |
| Sequoia NP | *Lower Kaweah*** | 22 | 3.0 | 2.67 | 11.83 | 48.17 | 91.2 | 2.89 |
| Sequoia NF | Mountain Home | 23 | 3.0 | 3.33 | 13.83 | 62.50 | 70.8 | 0.62 |
| Sequoia NF | Parker Pass | 24 | 3.0 | 4.83 | 17.48 | 68.83 | 74.0 | 2.48 |
| Sequoia NF | Liebel/Piutes | 25 | 3.0 | 5.33 | 20.90 | 65.00 | 91.3 | 3.70 |

*** Collocated Active Monitor*

**Data Analyses and Model Development**

Interest in the unique data set created through this project led to three different data analysts working with ambient ozone data. Each analyst approached the data set differently, and although some of the analysis approaches were similar, modelers considered slightly different aspects of the dataset. At this time two of the modelers have completed their analyses, and the third, United States Environmental Protection Agency (USEPA), is awaiting agency approval before the report can be released.

This section will report the results of Forest Service Statistician, Haiganoush Preisler's results (PSW), and those of Witold Frączek's (ESRI). Results of E. Henry Lee (EPA) was not available at the time of this report. W. Frączek used an analysis approach that incorporated a spatial analysis program that included kriging, splines and inverse distance weighted smoothing. In contrast, H. Preisler used locally weighted non-parametric regression, and kriging as a residual analysis technique. Each analysis approach will be presented separately, and results of both will be reported in the Results section. Separate analysis results from all three analysts will be presented in more detail in an upcoming Elsevier Book, 'Ozone Air Pollution in the Sierra Nevada', A. Bytnerowicz, M. Arbaugh and R. del Allonso (eds).

*Relationship between ambient ozone and nitrate oxidation rates*

Passive samplers are based on ozone oxidizing nitrite ions, which are coated onto filters, into nitrate ions. The chemical reaction in the filters is

$$NO_2 + O_3 \xrightarrow{\beta} NO_3 + O_2$$

where $\beta$ is the rate of the reaction. Consequently, the amount of $NO_3$ in a filter at a given time is

$$NO_3 = \alpha + \beta \times O_3$$

where $\alpha$ is the combined 'background' amount of nitrate already in the filter and local site effects, and $\beta$ is as above. In practice $\alpha$ due to nitrate in filters = 0, because blanks are used to determine the starting nitrate in the filter. Estimation of $\alpha$ and $\beta$ is done using simple linear

regression. Original estimates of $\beta$ were developed by Koutrakis et al. (1993) in controlled laboratory conditions, but estimates were found not to be accurate in field studies and $\alpha$ was assumed = 0. There are several choices to estimate the values of $\beta$ and $\alpha$ for field applications: 1) Use a common slope and intercept estimated from all collocated sites; 2) Use a separate slope and intercept for each collocated site. At sites with no collocated active monitors use the slope and intercept from the nearest active site; 3) Include covariates (e.g., elevation and maximum temperature) in the estimation of slopes, intercepts to convert passive sampler observations to ambient ozone levels.

In this study a plot of the linear regression lines of observed nitrate levels versus ozone levels from nine collocated sites (Figure 2) indicated that slopes and intercepts were significantly different at the various sites. The Shaver Lake active monitor appeared to be an outlier. Nitrite oxidation rates were over 50% greater than at other sites for similar ambient ozone levels. It is likely that the monitor needs to be calibrated, or that some local effect related to the monitor is causing the unusually low ozone measurements. Observations from the Shaver Lake active monitor were not used in either analysis.

Additional analysis of the relationships between the estimated slopes and intercepts, and explanatory variables (elevation, maximum temperature, precipitation) indicated that the intercept was increasing with maximum temperature and that intercept at elevations higher than 1500m were lower than average. All other relationships between the slopes and intercepts and the covariates were found to be not significant or only marginally significant. These results may indicate that passive samplers have undocumented sensitivity to temperature, and to humidity or atmospheric pressure extremes. Some variability, especially to high temperature, is consistent with the chemical kinetics involved with the passive monitor approach. This sensitivity, and development of adjustment factors for these environmental differences will be developed in a future study at Riverside Forest Fire Research Laboratory.

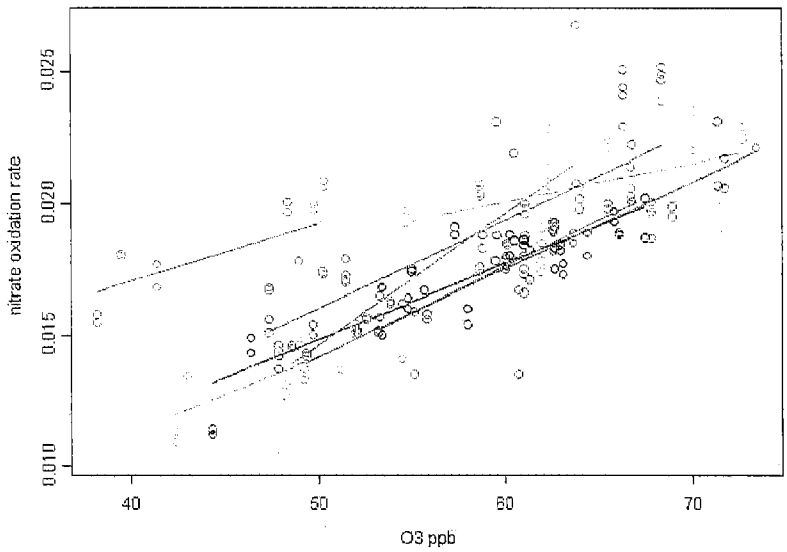


***Figure 2.*** *Relationships between ozone levels observed at active monitors and those observed by passive samplers at the collocated sites. Shaver Lake (red points and line separate from other lines) appears to be an outlier.*

Environmental measurements were not available at passive sampler locations, and few continuous monitoring sites had meteorological instrumentation, thus method (3) was not possible to explore. A preliminary analysis was conducted to compare analysis results using method (1) and (2). Results indicated that using separate values, method (2), did not affect final maps describing estimated spatial ozone patterns. Based on these results both PSW and ESRI used the simpler method (1) for this study.

*Geostatistical Analysis (ESRI)*

Maps showing spatial distribution of $O_3$ concentration were created with the Geostatistical Analyst Extension to ArcGIS 8.1 software produced by Environmental Systems Research Institute (ESRI), Redlands, California. The Geostatistical Analyst uses sample points at

different locations in a landscape and interpolates the values measured at these sites into a continuous surface. Using this approach, a spatial model of prediction or estimation of $O_3$ concentrations was derived. The Geostatistical Analyst provides a comprehensive set of tools for data exploration and for creating surfaces that can be used to visualize, analyze, and understand the geographic phenomena of interest.

*Testing of Geostatistical Analyst*

A preliminary evaluation of Geostatistical Analyst (ESRI Inc.) was performed to decide which modeling methods (e.g. inverse distance weighting [IDW], Spline) or geostatistical methods (kriging, cokriging) along with their geostatistical algorithms (e.g. ordinary kriging, simple kriging, universal kriging, disjunctive kriging) and semivariogram models (e.g., spherical, exponential, Gaussian, J-Bessel) would provide the most accurate estimation of $O_3$ concentration surface. A total of 28 methods of data interpolation were applied and compared. The selection of a geostatistical interpolation algorithm to generate maps of ozone concentration distribution was based on the statistical characteristics of each output surface using cross-validation measures. Six cross-validation prediction error parameters were taken into account: mean, root-mean-square, root-mean-square standardized, average standard, mean standardized, and a difference between root-mean-square standardized and average standard errors for geostatistical algorithms. Only the first two statistical characteristics could be calculated for the IDW and spline methods. A minimum of 5 of the nearest measurement points were used for calculating predicted ozone values at any given location.

Comparison of various parameters describing the quality of prediction did not provide a clear, unequivocal answer on what method most accurately estimated ozone spatial distribution. Based on the lowest prediction parameters error criteria, the best eight outputs were: spherical and K-Bessel models of cokriging with elevation as supplementary data set; best fitted representatives of spherical, exponential, Gaussian, and circular models of kriging; IDW with 15 neighbors; and spline with tension. Statistical prediction errors were similar for all final eight

season average $O_3$ prediction candidate maps for the 1999 season. The spherical model of cokriging with elevation and maximum temperature as secondary variables were evaluated to be the overall best and was utilized in this study to generate all maps of ozone predictions.

Geostatistical Analyst also identified a strong correlation between temperature and elevation above sea level. Consequently, both the maximum temperature and elevation were included as secondary and tertiary variables for the applied ordinary cokriging model. In order to generate a dependable surface of maximum temperatures that could be used for the model of the $O_3$ distribution, cokriging was used. The map of estimated maximum temperatures was based on the measurements from the weather stations cokriged with the elevation data (DEM) applied as the secondary variable. This map was very similar to the elevation map because of the strong relationship between elevation and temperature that was taken into account by the cokriging method.

The Geostatistical Analyst included an option to calculate the standard error of predicted of $O_3$ concentrations. That allowed creating maps of predicted standard error using the same interpolation algorithm that was used to generate the $O_3$ distribution maps. A threshold distance from monitoring sites at which estimated values linearly depend on the measured values was set to delineate areas of estimated $O_3$ concentrations with sufficient confidence. The continuous reliability surface of the entire study area was then classified into four categories of potential error of prediction. The zones closest to the areas of the highest density of monitoring sites were considered satisfactory in terms of the density of the sites and consequently, the accuracy of prediction of $O_3$ concentrations.

*Spatial Estimation of Ambient Ozone (PSW)*

The PSW group used locally weighted regression models to estimate spatial and temporal patterns of ozone and the relationships between auxiliary (explanatory) variables and ambient ozone. The model used was as follows:

Let $Y_{ijk}$ be the amount of nitrate per hour of the $k^{th}$ sample (replicate), at the $i^{th}$ site, and time $t_{ij}$. A locally weighted regression model with random effects was used to characterize the relationship between the amounts $Y_{ijk}$ and the explanatory variables. Specifically, we used the model

$$Y_{ijk} = g_0(lon_i, lat_i, t_{ij}) + \sum_l g_l(X_{lij}) + \tau_i + \varepsilon_{ijk} \quad (1)$$

where

$X_{lij}$ = value of the $l^{th}$ explanatory variable (e.g., temperature or elevation),

$lon_i, lat_i$ = longitude and latitude of the $i^{th}$ site, the location of the $i^{th}$ passive sampler,

$\tau_i$ = unobserved random site effect assumed to be Gaussian with mean zero and variance $\sigma_\tau^2$,

$\varepsilon_{ijk}$ = unobserved independent random noise with mean zero and variance $\sigma_\varepsilon^2$,

$g(.)$ = a non-parametric smooth function.

Four explanatory variables ($l$ =1,...,4), average maximum temperature and precipitation, ambient ozone level at nearest active site, and elevation were used in the model. The first three variables were spatially and temporally explicit (i.e., had different values at different locations and times) while the fourth variable (elevation) was spatially explicit. The smooth function of location and time, $g_0(lon_i, lat_i, t_{ij})$, was included in the regression line to account for general spatial patterns not explained by any of the four covariates (e.g., patterns due to wind). A random site effect was included in the model to account for site-specific characteristics due to unknown or unobserved site covariates. The between record error terms, ε, were assumed to be independent. Similarities between observations at different sites were partially accounted for by including a smooth function of location in the equation of expected values. In contrast, other approaches, e.g., kriging, universal kriging, or polynomial trend surface models, assume the error terms to be spatially correlated (Phillips and others, 1997). In the latter approaches an overall polynomial regression is usually used to fit a trend surface to the data and a nonzero covariance matrix is

estimated via restricted likelihood function (Cressie, 1993). The present approach uses locally weighted polynomial regression. This has the advantage of overcoming problems associated with the trend surface and kriging estimation technique due to unevenly spaced data, boundary problems, or anisotropy (Venables and Ripley 1997). Locally weighted regression models, such as `loess` or `gam` in SPLUS (S-PLUS 1997), may be used to estimate the smooth functions in the model above. However, the standard versions of these programs do not include allowances for the presence of random effects such as the random site effect assumed in model (1). In order to estimate the random effects component of the model an iterative procedure was used based on the EM-algorithm (Hastie 1992, Dempster and others 1997) and the equations given in Brillinger and Preisler (1985).

*Standard error estimation(PSW)*

A modification of the grouped jackknife procedure (Efron and Tibshirani 1993) was used to estimate standard errors of the predicted values. The grouped jackknife procedure is based on leaving a subset of observations out at a time then running the estimation procedure on the remaining observations. The standard errors of the predicted estimates are then calculated from the pseudo-values $\hat{\mu}_k = k\hat{\mu}\text{-}(k\text{-}1)\hat{\mu}_{(k)}$ where $\hat{\mu}$ is an estimate using all the data and $\hat{\mu}_{(k)}$ is an estimate with the $k^{th}$ group removed. A natural grouping of the nitrate data was groups of observations from each site. However, the variability in the pseudo-values obtained by dropping one site at a time was very large. Some of the sites had a large influence on the estimated values with the effect that standard error estimates calculated in this fashion were too large. This was verified with a simulation study where we were able to compare the estimated jackknife standard errors with the true standard errors. As a result the standard error calculations were made using a modified jackknife procedure where the observations from deleted sites were replaced by their expected values estimated from the rest of the data (Brillinger, 1966).

*Assessing goodness of fit of model (PSW)*

Normal probability plots of the residuals were produced to assess the Gaussian assumption of model (1). Cross-validation techniques were used to produce plots of observed versus expected values, with expected values at a given site calculated using data from all other sites. Another useful set of plots for assessing overall goodness of fit were those of the estimated ozone values compared with the observed ozone values at the collocated sites. Estimated directional variograms of residuals plotted against distance were used to assess the assumption of spatial independence of the error terms. The resulting plots from this study will be discussed in the following sections.

*Estimating probability maps for SUM0 (PSW)*

Air resource managers are interested in spatial patterns of risk to air quality related values (Air Resource Management, 1998, Campbell and others 2000). Previous studies (Miller and others 1996; Salardino 1996; Arbaugh and others 1998) have shown that foliar injury and cumulative ozone exposure are linearly related. Thus, probability maps of cumulative summer season 24hr ozone levels (SUM0) exceeding critical levels are the starting place to estimate risk of ozone injury to pines.

Using the model described in equation (1), the probability of SUM0 for a given period of time exceeding a critical amount is given by

$$\Pr[SUM0_i > C] = 1 - \Phi\left(\frac{C - \hat{M}_i}{\sqrt{\text{var}(SUM0_i)}}\right)$$

where

$C$ = a critical total amount of ozone over a particular period of $N$ days.

$\Phi$ = standard Gaussian distribution function.

$$\hat{M}_i = E(SUM0_i) = 24 \times 14 \sum_{j=1}^{J} \hat{\mu}_{ij}$$

$\hat{\mu}_{ij}$ = estimated amount of hourly ambient ozone level at site $i$ and for the $j^{th}$ 2-week collection period.

$J = N/14$

$\text{var}(SUM0_i)$ = variance of the cumulative ozone level at site $i$.

An estimate of the variance of *SUM0* for the random effect model used in this study is given by the formula

$$\hat{\text{var}}(SUM0_i) = (24 \times 14)^2 J[\hat{\text{var}}(\hat{\mu}_{ij}) + \hat{\sigma}_{\varepsilon}^2 + J\hat{\sigma}_{\tau}^2]$$

The resulting surfaces indicate areas of high and low risk for fixed ozone exposure levels, which can be expressed as seasonal cumulative or daily average ozone concentrations. Comparison of these surfaces with ozone injury scores can also indicate whether the surfaces are useful as estimates of ozone injury risk, as well as for ozone exposure risk.

**Results and Discussion**

Maps of estimated hourly ambient ozone levels estimated in the ESRI study indicated that ozone levels in 1999 were highest in the western, south-western and south-eastern regions of the Sierra (Figure 3). This result is consistent with previous reports of active monitors and observed foliar injury studies (Miller 1996, Salardino 1996, Arbaugh and others 1998). The estimated spatial surface of ozone concentrations (Figure 3) were detailed for the study area, but reliability of prediction in the northeastern and southeastern parts of the map is questionable due to a lack of measurement sites in these remote areas.

Temporal changes in ambient ozone occurred throughout the study season. Early season mean ambient ozone from continuous monitors ranged from 40-60 ppb-hr (May 15) and increased to a level of approximately 50-70 ppb-hr during mid-summer. In early August ambient ozone dropped abruptly for one 2-week period to spring levels, then gradually increased to

previous summer levels. At the end of the season ozone levels were still slightly elevated above spring levels. Spatial patterns estimated by PSW indicated that both spatial distribution and mean amounts of ozone varied over the study season (Figure 4), probably as a result of mesoscale changes in weather. The western Sierra Nevada may experience several types of seasonal wind patterns, which is complicated by changes in eastside and southerly wind patterns, and mountain precipitation due to seasonal convection storms.

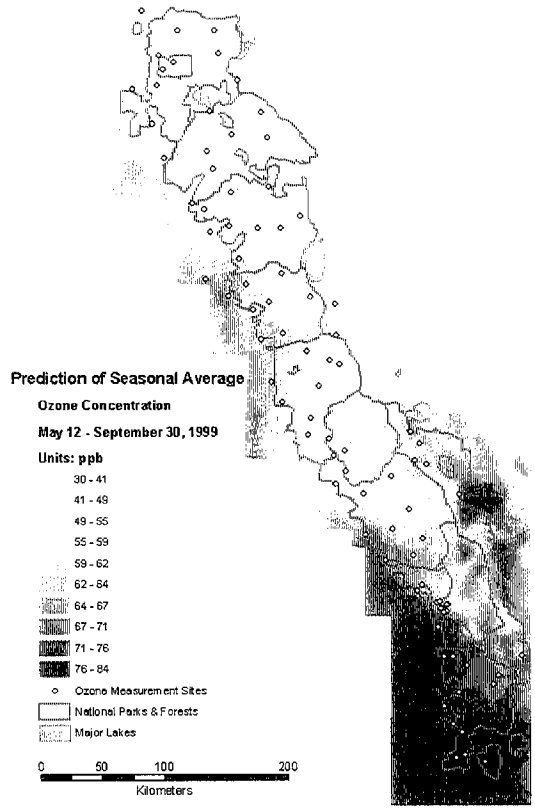


***Figure 3.*** *Prediction of ozone concentration based on cokriging of ozone, maximum temperature and elevation from ESRI study.*

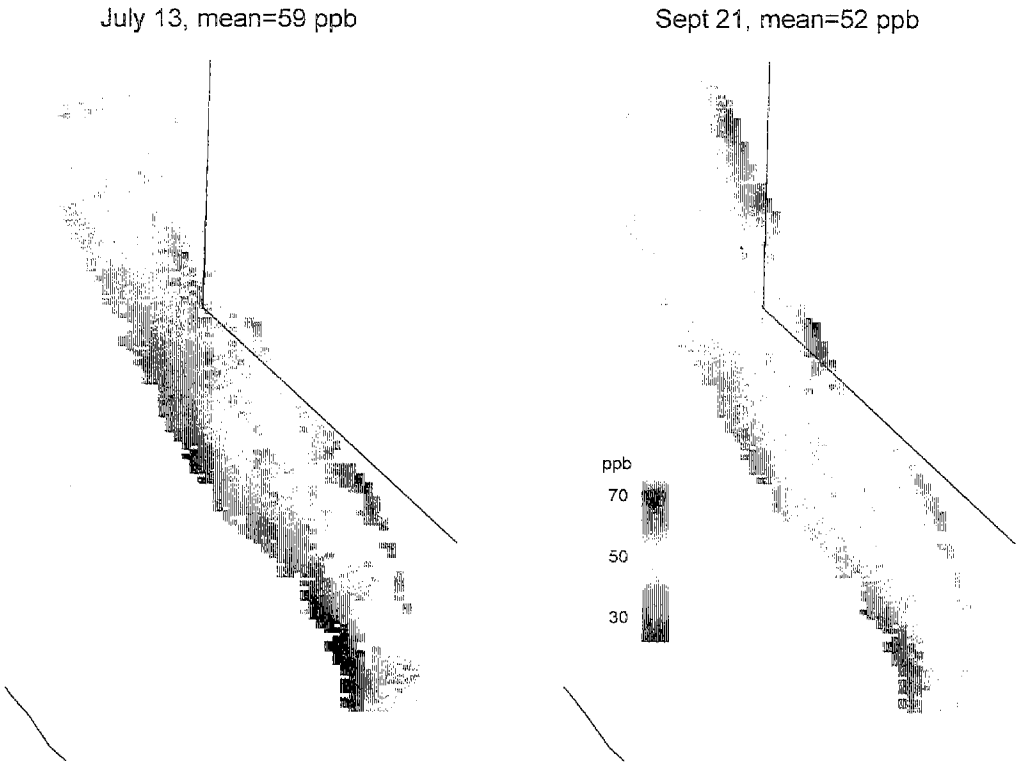


***Figure 4.*** *PSW estimated spatial patterns of ambient ozone for two time periods. Notice that both spatial pattern and mean ambient ozone differ for the two graphs.*

A prediction standard error map was generated in ESRI study to examine the extent that predictions should be made between sample locations (Figure 5). The lightest areas on the map represent the highest confidence of prediction of $O_3$ concentration. The dark areas represent areas with the low confidence. The estimated standard error of prediction was assumed to vary continuously over the study area, gradually increasing and decreasing rather than abruptly changing over small geographic distances.

The goodness-of-fit of the generalized regression ambient ozone model (PSW) indicated that there were 24 values (outliers) in the normal probability plot (Figure 6) that appeared to be smaller or larger than expected under the assumed model. These values may indicate either the need for more accurate or additional explanatory variables. For example, the maximum

temperature values used at each site were the values of the smoothed surface of temperatures estimated using weather station data. Site specific temperatures produced in this fashion are usually not good estimates of extreme values. Even with using estimated temperatures, only 1.4% of the observations seemed to be outliers. The additional expense of locating meteorological stations with each passive monitor may not be justified.

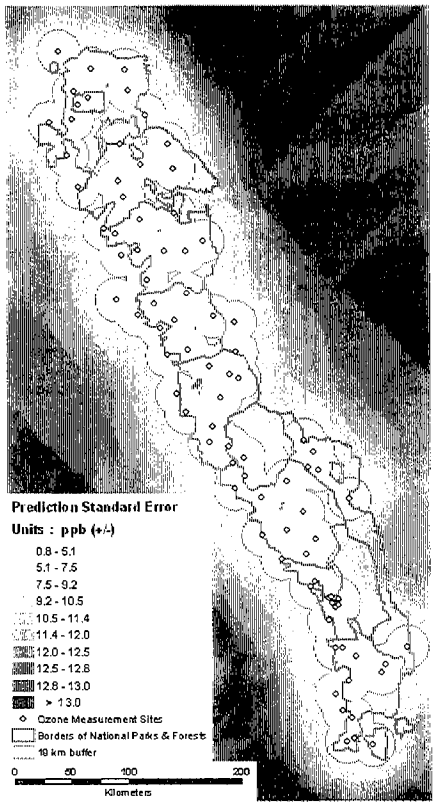


***Figure 5.*** *Predicted standard error of estimation of ozone concentration in Sierra Nevada Mountains for ESRI study.*

Estimates of directional variograms of model residuals from the PSW study indicated that

the assumption of spatial independence of the error terms was adequate. The variograms in all direction were basically flat, indicating no autocorrelation. Approximately 94% of the observed values were within the estimated point-wise 95% confidence bounds produced by the cross validation study. Some of the points outside the 95% bands were the extreme values already discussed above. However, a new group of outliers (all from the Woodsford site in Eldorado Forest) were detected. All the observed values at this site were greater than two standard deviations from the expected values.

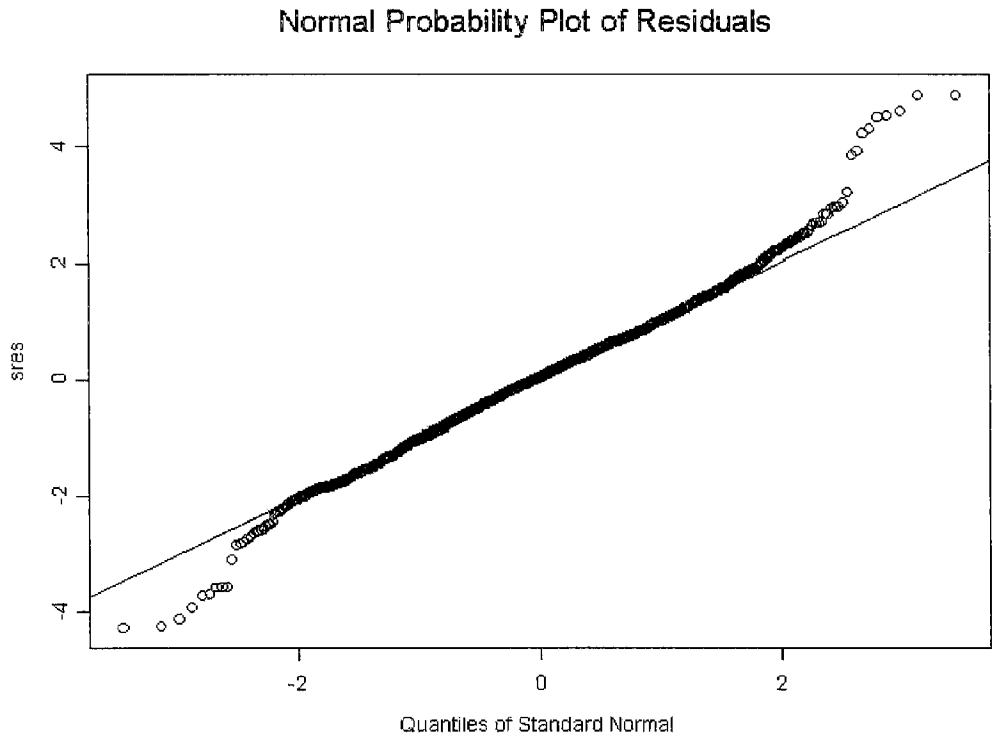


***Figure 6.*** *Normal probability plot of the residuals after fitting model (1) to the bi-weekly nitrate data observed at passive monitors over 5 months. Circles at the bottom and top of the graph indicate model residual outliers.*

Estimated between site variation ($\hat{\sigma}_\tau$ =3.8 ppb-hr) was significant when compared with

the record-to-record variation ($\hat{\sigma}_{\varepsilon}$ =5.4 ppb-hr). Approximately 33% of the total variation was due to between site variations in the PSW study. Comparison of observed and fitted values of ambient ozone at 8 of the collocated sites (Figure 7) indicates that at four of the eight active monitor sites model estimates of ambient ozone were biased. This may indicate either that a landscape scale explanatory variable is missing from the analysis, or that there is a micro-site influence affecting some of the passive monitors.

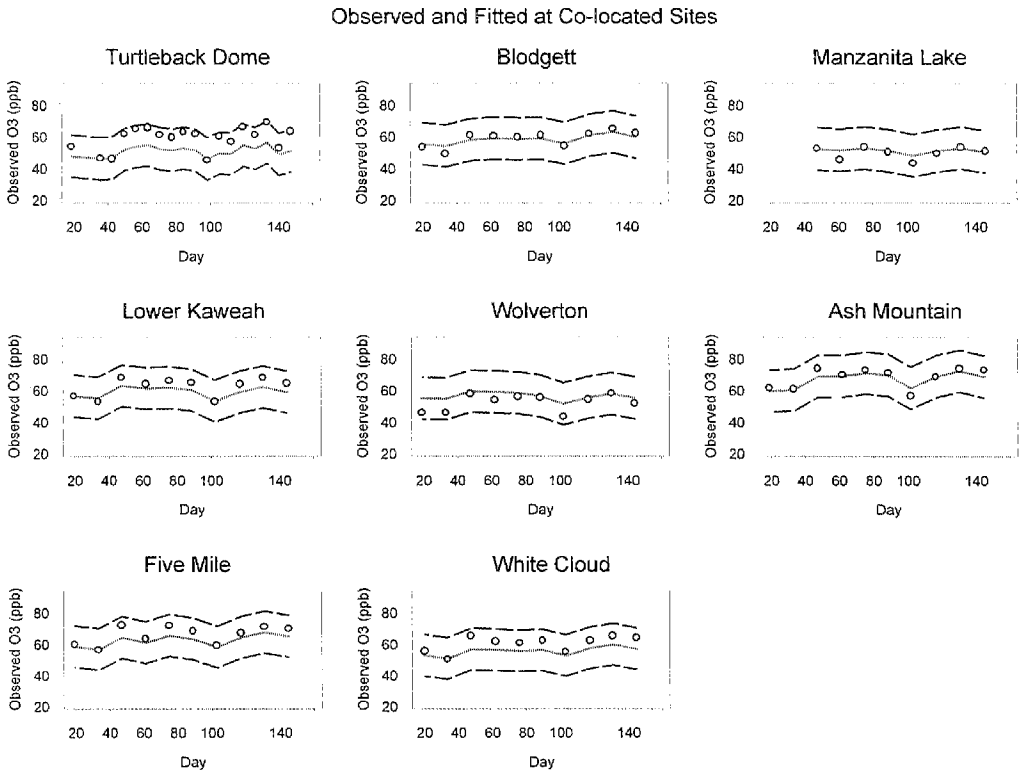


***Figure 7.*** *Observed versus estimated ozone levels at collocated sites. The red circles are the actual bi-weekly average ozone levels recorded by the active monitor. The blue lines are the expected ozone levels and their corresponding 95% confidence bands. Biased estimates occur when red circles are consistently above or below the blue line.*

The conditional effects of each of the explanatory variables (including spatial location)

after removing the effects of the other variables (Figure 8) indicate that although all 6 variables were significant at the 5% level, the variables with the largest effect on ozone levels were maximum temperature and elevation. Explanatory variables were not independent, hence relationships may differ from those obtained from single variable analysis. For example, part of the effect of elevation commonly observed is due to lower temperature values at higher elevation. Consequently, the increasing effect of elevation on ozone seen in Figure 8 is the residual effect after controlling for all other variables including temperature, precipitation, spatial location and Julian day.

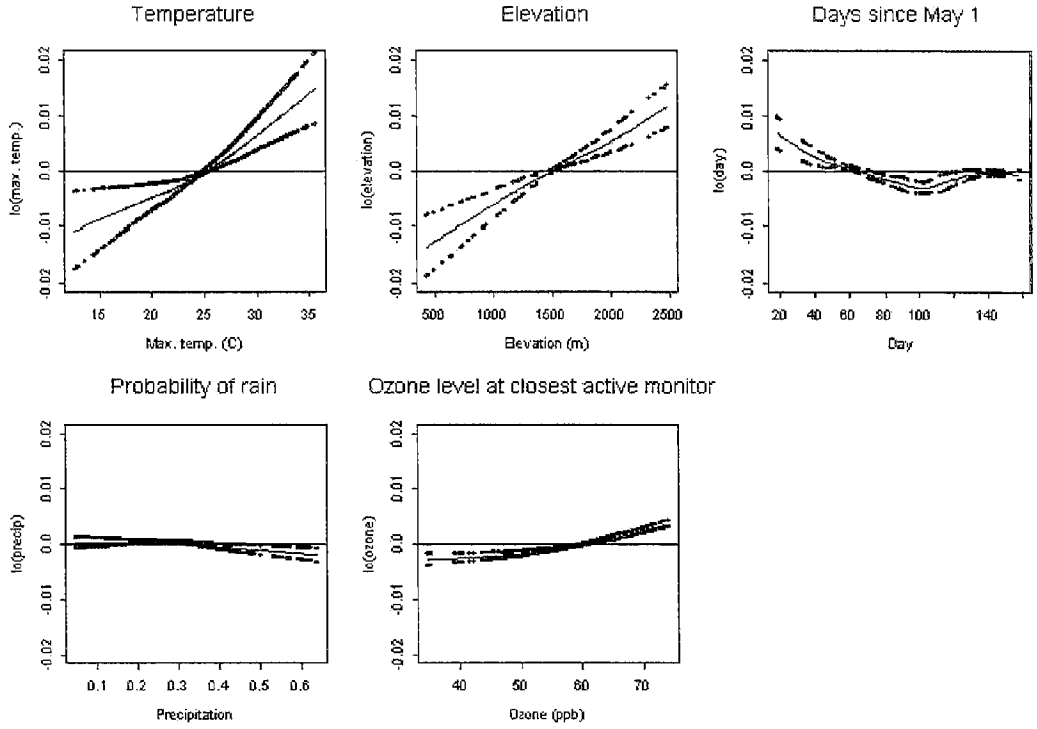


***Figure 8.*** *Estimated conditional effects (and 95% confidence bands) of the explanatory variables. Days since May 1 is the cumulative number of days from the beginning of the study. Notice that temperature and elevation have the greatest difference from the 0 line, indicating they are the most important explanatory variables in the analysis.*

Based upon the semivariogram analysis that was used to estimate prediction errors in the ESRI study (Figure 5), it was found that $O_3$ concentrations could be confidently estimated within a radius of 19 km from the nearest measurement site toward the direction where the extrapolation techniques would be required. The value of prediction standard error at that distance was about ±8.2 ppb-hr. This value indicates that most of the National Forest and National Park area of the Sierra Nevada was adequately covered by the sample locations used in this study (Figure 5). Only the southeastern and some of the central-eastern areas were not adequately sampled.

Maps of estimated probabilities for cumulative ozone levels for a period of 140 days starting May 25 indicate that the central- and south-western Sierra Nevada were likely to have been exposed to SUM0 values greater than 201.6 ppm (average 60 ppb-hr) (Figure 9). A south-eastern area of the Sierra Nevada also is estimated to have high exposure (SUM0>201.6 ppm) with 95% probabilities. This may be due to valley wind patterns transporting air pollution over the southern end of the Sierra Nevada, or northerly winds transporting air pollution from the Los Angeles Basin to the southeastern edge of the mountain range, or both.

These maps also may be useful as indicators of potential crown injury. Several previous studies (Miller et al., 1996; Salardino, 1996; Arbaugh et al., 1998) found linear relationships between ambient ozone and foliar injury in the Sierra Nevada. Thus a probability graph such as the SUM0>50 ppb-hr with 95% probabilities may be a possible predictor of FPM injury ratings, and the SUM0>60 ppb-hr with 95% probabilities may be an indicator of sites that have severe injury. Further analysis is needed, however, to confirm the usefulness of these maps for indicating spatial patterns of ozone injury.

High exposure risk areas did not always result in moderate or high injury to pines (Figure 10). It appeared that a clear relationship between exposure and injury only appeared when cumulative seasonal ambient ozone exceeded 60 ppb-hr. Site specific factors, such as aspect, soil water balance and phenotypic response by local populations also affect expression of visible injury (Arbaugh and others 1999, Grulke 1999). In addition differences in the experience or

judgment of the evaluating crews can also affect the severity of injury reported.

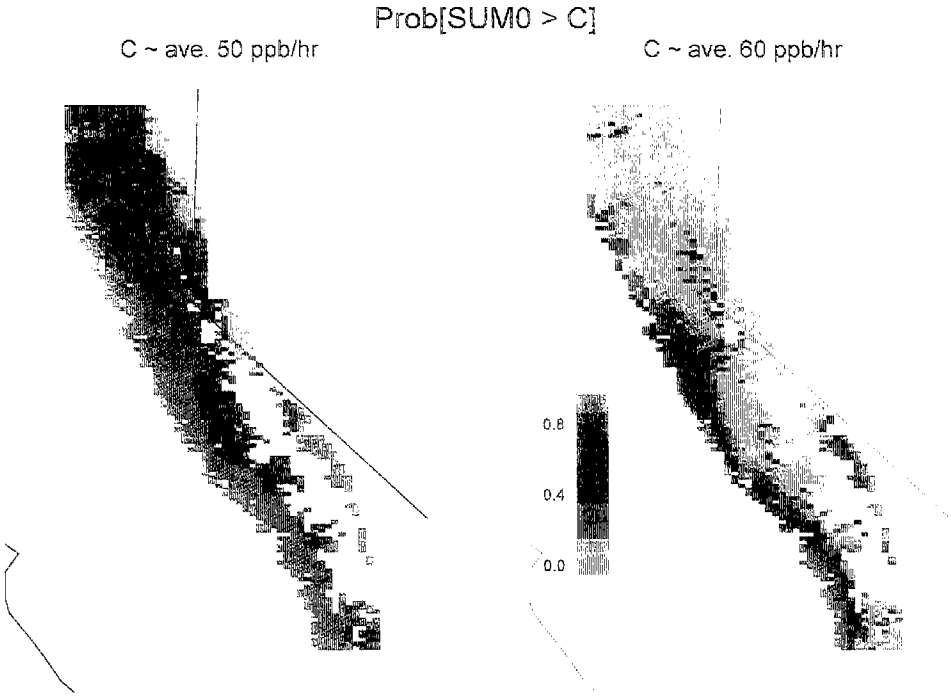


***Figure 9.*** *Estimated probabilities of SUM0 values exceeding two critical levels, average seasonal ppb-hr >50 and >60. SUM0 was calculated for a period of 140 days starting May 25, 1999.*

A limitation of the FPM surveys became apparent during the analysis. The FPM surveys were located only on the western side of the Sierra Nevada, thus do not match the area of the passive ozone survey. While it is generally assumed that interior and eastern side sites have little or no injury due to ozone, the lack of data reduces our ability to quantify the spatial relationship between ambient ozone and foliar injury. This problem is a legacy of the FOREST system that was also designed for the western side of the Sierra Nevada.

## Conclusions

Development of statistical models describing patterns of ambient ozone over space and time are now practical due to the development of low-cost passive sampler systems. In these initial modeling efforts a spatial model with an estimated of $R^2$=58% and with an average standard deviation of 6.68 ppb-hour was obtained. Further improvements in the accuracy of predictions are possible because residual analysis indicates unexplained spatial patterns in the data.

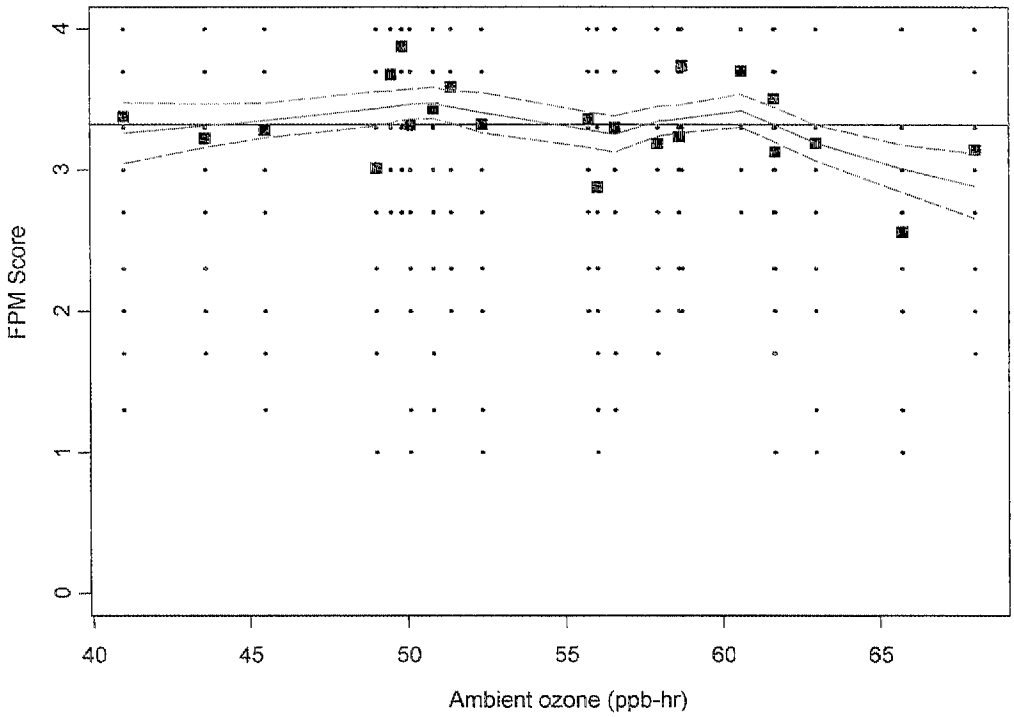


***Figure 10.*** *Forest Pest Management (FPM) ozone injury scores (squares) compared with average seasonal ambient ozone (ppb-hr) estimated from passive samplers. All injury sites were within 2 miles of passive ozone samplers. Points are the individual two-week passive ozone values, the solid line is the average ambient ozone estimate, and the dashed line is the ± 2 standard errors.*

The results of these parallel studies also suggest that the majority of the study area was reliably estimated for the Sierra Nevada, although the distribution of the measurement sites could

still be improved (there was clearly insufficient number of sites on the eastern side of the mountain range). The availability of the weather data and presence of strong correlations between maximum temperatures and elevation with $O_3$ contributed to lower sampling site densities being needed to obtain reliable spatial surface estimates in the Sierra Nevada.

In theory the best analytical choice for analysis depends on whether variation is local, which favors using Geostatistical approaches, or whether regional trends dominate the variation between sample locations, which indicates that localized regression may be more appropriate. Air pollution formation consists of multiple local processes, but regional atmospheric processes dominate transport in the San Joaquin Valley. Little information exists, however, about the effect of the complex topography and surface friction characteristics present in mountainous environments on large scale pollution transport. The lack of spatial autocorrelation after using locally weighted regression modeling indicate that large scale trends likely continue to dominate the variability. This conclusion is supported by the slightly lower variations resulting from the PSW analysis. In practice, however, the final spatial patterns developed from the analyses had few differences, especially if only significant spatial patterns are considered. This lack of difference may indicate that the choice of analysis approach may not be as important as a careful application of the approach chosen.

The design of the foliar survey segment of this study was less adequate. The distribution of the sample sites used in this study was not based on the spatial distribution of sensitive trees in the Sierra Nevada, rather centered around an existing network of sites located along the western side. Interior and eastside sites were not sampled, making it difficult to quantify the ability of the ozone exposure risk maps to estimate spatial patterns of ozone injury to sensitive pines.

The foliar survey information did have great value for developing future foliar survey work. Both Forest Health Management (Campbell and others 2000) and the Forest Service Air Quality Management (Air Resource Management 1998) are developing long-term foliar monitoring networks for the Sierra Nevada. The results of this study have had great value for design of these monitoring systems. In the future information from these networks will be used

to develop models of spatial risk estimation to pine and understory plant injury based on patterns of ozone exposure.

## Glossary of Acronyms

DEM Digital Elevation Model, the format of USGS digital elevation data sets used from map production in many GIS applications.

ESRI Environmental Systems Research Institute (ESRI), Redlands, California

FOREST The Forest Ozone REsponse STudy. The FOREST project was developed as a companion project to SCOIAS through an agreement between the Forest Service, Region 5, Air Resource Management and the California Air Resources Board. This agreement led to the establishment of forest vegetation plots in the vicinity of SCOIAS monitoring stations for the purpose of annual assessments of ozone injury to ponderosa and Jeffrey pine populations. Other participants, including Yosemite, Sequoia-Kings Canyon and Lassen Volcanic National Parks, joined FOREST by establishing and assessing tree conditions at three plots in each Park; and the Forest Service, Pacific Southwest Research Station, by including four years (1992-1995) of OII evaluations from three sites at Barton Flats in the San Bernardino Mountains.

FPM Forest Pest Management system for ozone injury evaluation of ponderosa and Jeffrey pines. The FPM method quantifies ozone injury by noting the youngest whorl of needles that shows chlorotic mottle. The index has a range from 0 to 4 for each tree. If there is injury on current year needles, the FPM score is 0. If there is no injury on the current year needles but injury on the 1-year old needles, the FPM score is 1. If there is no injury on either the current year or 1-year old needles, but there is injury on the 2-year old needles, the FPM score is 2. This evaluation is applied through the 4-year old needles, where if no injury has occurred, the FPM score is 4, and the tree is considered to be uninjured by ozone.

GIS Geographical Information System. A comprehensive set of software designed for the interpretation, analysis and display of spatially related data.

HRS80 The total number of hours in the exposure period equal to or greater than 80 ppb-hr of ozone.

OII Ozone Injury Index. The OII method (Miller and others 1996b) employs a five branch sample pruned from the lower crown of each ponderosa or Jeffrey pine. Several variables are counted, estimated visually or measured on each branch, namely, number of annual needle whorls, amount of chlorotic mottle on the needles of each annual whorl, and the length of needles in each annual whorl. Percent live crown is determined for each tree. These variables are entered into an algorithm for computing the OII for each tree (the range of the index is from 0 to 100 where higher values indicate more injury). The four main components used to compute the index are weighted as follows: needle whorl retention (40 percent), chlorotic mottle percent of each whorl (40 percent), needle length (10 percent) and percent live crown (10 percent).

PSW Pacific Southwest Research Station.

SBGS San Bernardino Mountains Air Pollution Gradient Study. A series of 18 sites established in 1972-1973 in the San Bernardino Mountains along a west to east gradient of air pollution by Paul Miller and Joe McBride. Periodic remeasurments and numerous cooperative studies at these sites have made them some of the most valuable long-term forest air pollution sites in the world.

SCOIAS The Sierra Cooperative Ozone Impact Assessment Study. SCOIAS's principal activity was to monitor ambient ozone and meteorological variables at six Sierra

Nevada sites (Van Ooy and Carrol 1995).

SNEP Sierra Nevada Ecosystem Study. A large scale program designed to assess the current status, and develop options for future management of ecosystems contained in the Sierra Nevada.

SPAM Sierra Provinces Assessment Monitoring. A Region 5, USDA - Forest Service, program to implement protection and monitoring programs in the Sierra Nevada, based on the results of SNEP

SUM0 The cumulative sum of all hourly ozone concentrations over an exposure period. In this report it is represented as a 24 hr sum of ppb-hr over either 2-week sample periods, or over the sampling season (May 12 – September 28).

SUM06 The sum of all ozone concentrations 60 ppb-hr or greater over the exposure period.

USEPA United States Environmental Protection Agency.

USGS United States Geological Survey.

W126 The sum of differentially weighted concentrations (40 and 60 ppb-hr concentrations are weighted using a sigmoidal function and concentrations above 100 ppb-hr are all given a weight of 1).

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## Appendix A.

Table A-1. Ambient ozone sites, beginning and ending exposure dates, oxidation rates and corresponding estimate ambient ozone for sites used in this report. All samplers were changed on a two-week cycle except for samplers in Yosemite National Park, which were changed weekly to match existing National Park Service passive monitors.

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Yosemite NP | Turtleback Dome | 12-May | 25-May | 0.0164 | 0.0160 | 50.5 |
| Yosemite NP | Turtleback Dome | 1-Jun | 8-Jun | 0.0112 | 0.0114 | 35.2 |
| Yosemite NP | Turtleback Dome | 8-Jun | 15-Jun | 0.0180 | 0.0188 | 57.4 |
| Yosemite NP | Turtleback Dome | 15-Jun | 22-Jun | 0.0173 | 0.0177 | 54.6 |
| Yosemite NP | Turtleback Dome | 22-Jun | 29-Jun | 0.0186 | 0.0184 | 57.7 |
| Yosemite NP | Turtleback Dome | 29-Jun | 6-Jul | 0.0167 | 0.0167 | 52.1 |
| Yosemite NP | Turtleback Dome | 6-Jul | 13-Jul | 0.0187 | 0.0202 | 60.6 |
| Yosemite NP | Turtleback Dome | 13-Jul | 20-Jul | 0.0184 | 0.0182 | 57.1 |
| Yosemite NP | Turtleback Dome | 20-Jul | 27-Jul | 0.0193 | 0.0191 | 59.9 |
| Yosemite NP | Turtleback Dome | 27-Jul | 3-Aug | 0.0151 | 0.0152 | 47.2 |
| Yosemite NP | Turtleback Dome | 3-Aug | 10-Aug | 0.0149 | 0.0143 | 45.5 |
| Yosemite NP | Turtleback Dome | 10-Aug | 17-Aug | 0.0174 | 0.0175 | 54.4 |
| Yosemite NP | Turtleback Dome | 17-Aug | 24-Aug | 0.0183 | 0.0175 | 55.8 |
| Yosemite NP | Turtleback Dome | 24-Aug | 31-Aug | 0.0154 | 0.0160 | 49.0 |
| Yosemite NP | Turtleback Dome | 31-Aug | 7-Sep | 0.0197 | 0.0193 | 60.8 |
| Yosemite NP | Turtleback Dome | 7-Sep | 14-Sep | 0.0188 | 0.0189 | 58.8 |
| Yosemite NP | Turtleback Dome | 14-Sep | 21-Sep | 0.0188 | 0.0191 | 59.1 |
| Yosemite NP | Turtleback Dome | 21-Sep | 28-Sep | 0.0168 | 0.0150 | 49.6 |
| Yosemite NP | Hodgdon Meadow | 12-May | 25-May | 0.0089 | 0.0090 | 27.9 |
| Yosemite NP | Hodgdon Meadow | 1-Jun | 8-Jun | 0.0070 | 0.0069 | 21.7 |
| Yosemite NP | Hodgdon Meadow | 8-Jun | 15-Jun | 0.0094 | 0.0095 | 29.5 |
| Yosemite NP | Hodgdon Meadow | 15-Jun | 22-Jun | 0.0105 | 0.0092 | 30.7 |
| Yosemite NP | Hodgdon Meadow | 22-Jun | 29-Jun | 0.0112 | 0.0110 | 34.6 |
| Yosemite NP | Hodgdon Meadow | 29-Jun | 6-Jul | 0.0098 | 0.0098 | 30.6 |
| Yosemite NP | Hodgdon Meadow | 6-Jul | 13-Jul | 0.0103 | 0.0112 | 33.5 |
| Yosemite NP | Hodgdon Meadow | 13-Jul | 20-Jul | 0.0094 | 0.0088 | 28.4 |
| Yosemite NP | Hodgdon Meadow | 20-Jul | 27-Jul | 0.0106 | 0.0106 | 33.1 |
| Yosemite NP | Hodgdon Meadow | 27-Jul | 3-Aug | 0.0072 | 0.0087 | 24.8 |
| Yosemite NP | Hodgdon Meadow | 3-Aug | 10-Aug | 0.0080 | 0.0081 | 25.1 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Yosemite NP | Hodgdon Meadow | 10-Aug | 17-Aug | 0.0094 | 0.0089 | 28.5 |
| Yosemite NP | Hodgdon Meadow | 17-Aug | 24-Aug | 0.0093 | 0.0108 | 31.3 |
| Yosemite NP | Hodgdon Meadow | 24-Aug | 31-Aug | 0.0070 | 0.0078 | 23.1 |
| Yosemite NP | Hodgdon Meadow | 31-Aug | 7-Sep | 0.0102 | 0.0098 | 31.2 |
| Yosemite NP | Hodgdon Meadow | 7-Sep | 14-Sep | 0.0105 | 0.0107 | 33.1 |
| Yosemite NP | Hodgdon Meadow | 14-Sep | 21-Sep | 0.0093 | 0.0099 | 29.9 |
| Yosemite NP | Hodgdon Meadow | 21-Sep | 28-Sep | 0.0069 | 0.0068 | 21.4 |
| Yosemite NP | Mosquito Creek | 12-May | 28-May | 0.0132 | 0.0133 | 41.3 |
| Yosemite NP | Mosquito Creek | 3-Jun | 10-Jun | 0.0121 | 0.0118 | 37.3 |
| Yosemite NP | Mosquito Creek | 10-Jun | 17-Jun | 0.0173 | 0.0171 | 53.6 |
| Yosemite NP | Mosquito Creek | 17-Jun | 24-Jun | 0.0188 | 0.0181 | 57.5 |
| Yosemite NP | Mosquito Creek | 24-Jun | 1-Jul | 0.0176 | 0.0170 | 53.9 |
| Yosemite NP | Mosquito Creek | 1-Jul | 8-Jul | 0.0160 | 0.0170 | 51.4 |
| Yosemite NP | Mosquito Creek | 8-Jul | 15-Jul | 0.0182 | 0.0182 | 56.7 |
| Yosemite NP | Mosquito Creek | 15-Jul | 22-Jul | 0.0153 | 0.0176 | 51.3 |
| Yosemite NP | Mosquito Creek | 22-Jul | 29-Jul | 0.0226 | 0.0192 | 65.2 |
| Yosemite NP | Mosquito Creek | 29-Jul | 5-Aug | 0.0141 | 0.0146 | 44.7 |
| Yosemite NP | Mosquito Creek | 5-Aug | 12-Aug | 0.0122 | 0.0134 | 39.9 |
| Yosemite NP | Mosquito Creek | 12-Aug | 19-Aug | 0.0171 | 0.0173 | 53.6 |
| Yosemite NP | Mosquito Creek | 19-Aug | 26-Aug | 0.0184 | 0.0175 | 56.0 |
| Yosemite NP | Mosquito Creek | 26-Aug | 2-Sep | 0.0153 | 0.0154 | 47.9 |
| Yosemite NP | Mosquito Creek | 2-Sep | 9-Sep | 0.0191 | 0.0228 | 65.3 |
| Yosemite NP | Mosquito Creek | 9-Sep | 16-Sep | 0.0192 | 0.0203 | 61.6 |
| Yosemite NP | Mosquito Creek | 16-Sep | 23-Sep | 0.0170 | 0.0179 | 54.4 |
| Yosemite NP | Mosquito Creek | 23-Sep | 30-Sep | 0.0179 | 0.0175 | 55.2 |
| Yosemite NP | El Portal | 12-May | 28-May | 0.0108 | 0.0109 | 33.8 |
| Yosemite NP | El Portal | 3-Jun | 10-Jun | 0.0087 | 0.0086 | 27.0 |
| Yosemite NP | El Portal | 10-Jun | 17-Jun | 0.0140 | 0.0128 | 41.8 |
| Yosemite NP | El Portal | 17-Jun | 24-Jun | 0.0153 | 0.0145 | 46.5 |
| Yosemite NP | El Portal | 24-Jun | 1-Jul | 0.0141 | 0.0149 | 45.2 |
| Yosemite NP | El Portal | 1-Jul | 8-Jul | 0.0143 | 0.0143 | 44.6 |
| Yosemite NP | El Portal | 8-Jul | 15-Jul | 0.0171 | 0.0181 | 54.9 |
| Yosemite NP | El Portal | 15-Jul | 22-Jul | 0.0159 | 0.0127 | 44.6 |
| Yosemite NP | El Portal | 22-Jul | 29-Jul | 0.0160 | 0.0175 | 52.2 |
| Yosemite NP | El Portal | 29-Jul | 5-Aug | 0.0126 | 0.0118 | 38.0 |
| Yosemite NP | El Portal | 5-Aug | 12-Aug | 0.0116 | 0.0119 | 36.6 |
| Yosemite NP | El Portal | 12-Aug | 19-Aug | 0.0156 | 0.0153 | 48.2 |
| Yosemite NP | El Portal | 19-Aug | 26-Aug | 0.0146 | 0.0146 | 45.5 |
| Yosemite NP | El Portal | 26-Aug | 2-Sep | 0.0113 | 0.0131 | 38.0 |
| Yosemite NP | El Portal | 2-Sep | 9-Sep | 0.0169 | 0.0166 | 52.2 |
| Yosemite NP | El Portal | 9-Sep | 16-Sep | 0.0170 | 0.0168 | 52.7 |
| Yosemite NP | El Portal | 16-Sep | 23-Sep | 0.0152 | 0.0145 | 46.3 |
| Yosemite NP | El Portal | 23-Sep | 30-Sep | 0.0137 | 0.0164 | 46.9 |
| Eldorado NF | Placerville Jail | 13-May | 26-May | 0.0151 | 0.0156 | 47.9 |
| Eldorado NF | Placerville Jail | 26-May | 9-Jun | 0.0145 | 0.0138 | 44.1 |
| Eldorado NF | Placerville Jail | 9-Jun | 23-Jun | 0.0174 | 0.0185 | 56.0 |
| Eldorado NF | Placerville Jail | 23-Jun | 7-Jul | 0.0183 | 0.0178 | 56.3 |
| Eldorado NF | Placerville Jail | 7-Jul | 21-Jul | 0.0215 | 0.0225 | 68.6 |
| Eldorado NF | Placerville Jail | 21-Jul | 4-Aug | 0.0167 | 0.0170 | 52.5 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Eldorado NF | Placerville Jail | 4-Aug | 18-Aug | 0.0145 | 0.0146 | 45.4 |
| Eldorado NF | Placerville Jail | 18-Aug | 1-Sep | 0.0217 | 0.0201 | 65.2 |
| Eldorado NF | Placerville Jail | 1-Sep | 15-Sep | 0.0216 | 0.0211 | 66.6 |
| Eldorado NF | Placerville Jail | 15-Sep | 29-Sep | 0.0203 | 0.0199 | 62.7 |
| Eldorado NF | Sly Park | 13-May | 26-May | 0.0118 | 0.0119 | 36.9 |
| Eldorado NF | Sly Park | 26-May | 9-Jun | 0.0114 | 0.0115 | 35.7 |
| Eldorado NF | Sly Park | 9-Jun | 23-Jun | 0.0137 | 0.0129 | 41.5 |
| Eldorado NF | Sly Park | 23-Jun | 7-Jul | 0.0121 | 0.0126 | 38.5 |
| Eldorado NF | Sly Park | 7-Jul | 21-Jul | 0.0200 | 0.0190 | 60.8 |
| Eldorado NF | Sly Park | 21-Jul | 4-Aug | 0.0123 | 0.0119 | 37.7 |
| Eldorado NF | Sly Park | 4-Aug | 18-Aug | 0.0118 | 0.0118 | 36.8 |
| Eldorado NF | Sly Park | 18-Aug | 1-Sep | 0.0161 | 0.0166 | 51.0 |
| Eldorado NF | Sly Park | 1-Sep | 15-Sep | 0.0169 | 0.0170 | 52.9 |
| Eldorado NF | Sly Park | 15-Sep | 29-Sep | 0.0163 | 0.0168 | 51.6 |
| Eldorado NF | Peavine/RivertonRidge | 13-May | 26-May | 0.0159 | 0.0159 | 49.6 |
| Eldorado NF | Peavine/RivertonRidge | 26-May | 9-Jun | 0.0144 | 0.0146 | 45.2 |
| Eldorado NF | Peavine/RivertonRidge | 9-Jun | 23-Jun | 0.0171 | 0.0183 | 55.2 |
| Eldorado NF | Peavine/RivertonRidge | 23-Jun | 7-Jul | 0.0185 | 0.0179 | 56.7 |
| Eldorado NF | Peavine/RivertonRidge | 7-Jul | 21-Jul | 0.0200 | 0.0204 | 63.0 |
| Eldorado NF | Peavine/RivertonRidge | 21-Jul | 4-Aug | 0.0154 | 0.0166 | 49.9 |
| Eldorado NF | Peavine/RivertonRidge | 4-Aug | 18-Aug | 0.0153 | 0.0154 | 47.9 |
| Eldorado NF | Peavine/RivertonRidge | 18-Aug | 1-Sep | 0.0191 | 0.0187 | 58.9 |
| Eldorado NF | Peavine/RivertonRidge | 1-Sep | 15-Sep | 0.0198 | 0.0196 | 61.4 |
| Eldorado NF | Peavine/RivertonRidge | 15-Sep | 29-Sep | 0.0181 | 0.0188 | 57.5 |
| Eldorado NF | Loon | 26-May | 9-Jun | 0.0167 | 0.0162 | 51.3 |
| Eldorado NF | Loon | 9-Jun | 23-Jun | 0.0192 | 0.0252 | 69.2 |
| Eldorado NF | Loon | 23-Jun | 7-Jul | 0.0169 | 0.0179 | 54.3 |
| Eldorado NF | Loon | 7-Jul | 21-Jul | 0.0230 | 0.0237 | 72.8 |
| Eldorado NF | Loon | 21-Jul | 4-Aug | 0.0205 | 0.0194 | 62.2 |
| Eldorado NF | Loon | 4-Aug | 18-Aug | 0.0175 | 0.0162 | 52.5 |
| Eldorado NF | Loon | 18-Aug | 1-Sep | 0.0188 | 0.0183 | 57.8 |
| Eldorado NF | Loon | 1-Sep | 15-Sep | 0.0193 | 0.0203 | 61.7 |
| Eldorado NF | Loon | 15-Sep | 29-Sep | 0.0177 | 0.0172 | 54.4 |
| Eldorado NF | Huckleberry | 13-May | 26-May | 0.0137 | 0.0138 | 42.9 |
| Eldorado NF | Huckleberry | 26-May | 9-Jun | 0.0120 | 0.0129 | 38.8 |
| Eldorado NF | Huckleberry | 9-Jun | 23-Jun | 0.0121 | 0.0124 | 38.2 |
| Eldorado NF | Huckleberry | 23-Jun | 7-Jul | 0.0132 | 0.0137 | 41.9 |
| Eldorado NF | Huckleberry | 7-Jul | 21-Jul | 0.0139 | 0.0137 | 43.0 |
| Eldorado NF | Huckleberry | 21-Jul | 4-Aug | 0.0118 | 0.0120 | 37.1 |
| Eldorado NF | Huckleberry | 4-Aug | 18-Aug | 0.0095 | 0.0094 | 29.5 |
| Eldorado NF | Huckleberry | 18-Aug | 1-Sep | 0.0107 | 0.0108 | 33.5 |
| Eldorado NF | Huckleberry | 1-Sep | 15-Sep | 0.0116 | 0.0115 | 36.0 |
| Eldorado NF | Huckleberry | 15-Sep | 29-Sep | 0.0109 | 0.0107 | 33.7 |
| Eldorado NF | Woodsford | 13-May | 26-May | 0.0172 | 0.0197 | 57.5 |
| Eldorado NF | Woodsford | 26-May | 9-Jun | 0.0183 | 0.0173 | 55.5 |
| Eldorado NF | Woodsford | 9-Jun | 23-Jun | 0.0185 | 0.0188 | 58.2 |
| Eldorado NF | Woodsford | 23-Jun | 7-Jul | 0.0179 | 0.0233 | 64.2 |
| Eldorado NF | Woodsford | 7-Jul | 21-Jul | 0.0181 | 0.0188 | 57.5 |
| Eldorado NF | Woodsford | 21-Jul | 4-Aug | 0.0176 | 0.0167 | 53.5 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Eldorado NF | Woodsford | 4-Aug | 18-Aug | 0.0165 | 0.0145 | 48.3 |
| Eldorado NF | Woodsford | 18-Aug | 1-Sep | 0.0180 | 0.0188 | 57.4 |
| Eldorado NF | Woodsford | 1-Sep | 15-Sep | 0.0164 | 0.0170 | 52.1 |
| Eldorado NF | Woodsford | 15-Sep | 29-Sep | 0.0154 | 0.0148 | 47.1 |
| Eldorado NF | Amador | 13-May | 26-May | 0.0165 | 0.0162 | 51.0 |
| Eldorado NF | Amador | 26-May | 9-Jun | 0.0151 | 0.0149 | 46.8 |
| Eldorado NF | Amador | 9-Jun | 23-Jun | 0.0177 | 0.0180 | 55.7 |
| Eldorado NF | Amador | 23-Jun | 7-Jul | 0.0190 | 0.0179 | 57.5 |
| Eldorado NF | Amador | 7-Jul | 21-Jul | 0.0215 | 0.0223 | 68.3 |
| Eldorado NF | Amador | 21-Jul | 4-Aug | 0.0186 | 0.0177 | 56.6 |
| Eldorado NF | Amador | 4-Aug | 18-Aug | 0.0155 | 0.0153 | 48.0 |
| Eldorado NF | Amador | 18-Aug | 1-Sep | 0.0200 | 0.0196 | 61.7 |
| Eldorado NF | Amador | 1-Sep | 15-Sep | 0.0230 | 0.0206 | 68.0 |
| Eldorado NF | Amador | 15-Sep | 29-Sep | 0.0201 | 0.0203 | 63.0 |
| Eldorado NF | Bear/Lumberyard | 13-May | 26-May | 0.0173 | 0.0172 | 53.8 |
| Eldorado NF | Bear/Lumberyard | 26-May | 9-Jun | 0.0168 | 0.0164 | 51.8 |
| Eldorado NF | Bear/Lumberyard | 9-Jun | 23-Jun | 0.0186 | 0.0198 | 59.9 |
| Eldorado NF | Bear/Lumberyard | 23-Jun | 7-Jul | 0.0193 | 0.0195 | 60.5 |
| Eldorado NF | Bear/Lumberyard | 7-Jul | 21-Jul | 0.0211 | 0.0214 | 66.3 |
| Eldorado NF | Bear/Lumberyard | 21-Jul | 4-Aug | 0.0184 | 0.0186 | 57.7 |
| Eldorado NF | Bear/Lumberyard | 4-Aug | 18-Aug | 0.0162 | 0.0165 | 51.0 |
| Eldorado NF | Bear/Lumberyard | 18-Aug | 1-Sep | 0.0200 | 0.0196 | 61.7 |
| Eldorado NF | Bear/Lumberyard | 1-Sep | 15-Sep | 0.0213 | 0.0207 | 65.5 |
| Eldorado NF | Bear/Lumberyard | 15-Sep | 29-Sep | 0.0196 | 0.0199 | 61.6 |
| Eldorado NF | Blodgett | 13-May | 27-May | 0.0157 | 0.0156 | 48.8 |
| Eldorado NF | Blodgett | 27-May | 9-Jun | 0.0145 | 0.0146 | 45.4 |
| Eldorado NF | Blodgett | 10-Jun | 24-Jun | 0.0219 | 0.0186 | 63.1 |
| Eldorado NF | Blodgett | 24-Jun | 8-Jul | 0.0162 | 0.0141 | 47.2 |
| Eldorado NF | Blodgett | 8-Jul | 22-Jul | 0.0198 | 0.0202 | 62.4 |
| Eldorado NF | Blodgett | 22-Jul | 4-Aug | 0.0176 | 0.0174 | 54.6 |
| Eldorado NF | Blodgett | 4-Aug | 19-Aug | 0.0154 | 0.0150 | 47.4 |
| Eldorado NF | Blodgett | 19-Aug | 2-Sep | 0.0188 | 0.0231 | 65.3 |
| Eldorado NF | Blodgett | 2-Sep | 16-Sep | 0.0268 | 0.0208 | 74.2 |
| Eldorado NF | Blodgett | 16-Sep | 29-Sep | 0.0188 | 0.0183 | 57.8 |
| Inyo NF | Grant Lake | 26-May | 10-Jun | 0.0159 | 0.0150 | 48.2 |
| Inyo NF | Grant Lake | 10-Jun | 23-Jun | 0.0169 | 0.0177 | 53.9 |
| Inyo NF | Grant Lake | 23-Jun | 7-Jul | 0.0198 | 0.0230 | 66.7 |
| Inyo NF | Grant Lake | 7-Jul | 22-Jul | 0.0254 | 0.0188 | 68.9 |
| Inyo NF | Grant Lake | 22-Jul | 4-Aug | 0.0173 | 0.0166 | 52.9 |
| Inyo NF | Grant Lake | 4-Aug | 18-Aug | 0.0156 | 0.0156 | 48.6 |
| Inyo NF | Grant Lake | 18-Aug | 1-Sep | 0.0001 | 0.0000 | NA |
| Inyo NF | Grant Lake | 1-Sep | 15-Sep | 0.0355 | 0.0357 | 111.0 |
| Inyo NF | Grant Lake | 15-Sep | 29-Sep | 0.0129 | 0.0130 | 40.4 |
| Inyo NF | Deadman Summit | 26-May | 10-Jun | 0.0149 | 0.0155 | 47.4 |
| Inyo NF | Deadman Summit | 10-Jun | 23-Jun | 0.0175 | 0.0171 | 53.9 |
| Inyo NF | Deadman Summit | 23-Jun | 7-Jul | 0.0216 | 0.0204 | 65.5 |
| Inyo NF | Deadman Summit | 7-Jul | 22-Jul | 0.0189 | 0.0181 | 57.7 |
| Inyo NF | Deadman Summit | 22-Jul | 4-Aug | 0.0148 | 0.0142 | 45.2 |
| Inyo NF | Deadman Summit | 4-Aug | 18-Aug | 0.0137 | 0.0137 | 42.7 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Inyo NF | Deadman Summit | 18-Aug | 1-Sep | 0.0141 | 0.0151 | 45.5 |
| Inyo NF | Deadman Summit | 1-Sep | 15-Sep | 0.0138 | 0.0135 | 42.6 |
| Inyo NF | Deadman Summit | 15-Sep | 29-Sep | 0.0103 | 0.0101 | 31.8 |
| Inyo NF | Minaret Vista | 26-May | 10-Jun | 0.0177 | 0.0339 | 80.4 |
| Inyo NF | Minaret Vista | 10-Jun | 23-Jun | 0.0229 | 0.0249 | 74.5 |
| Inyo NF | Minaret Vista | 23-Jun | 7-Jul | 0.0266 | 0.0189 | 70.9 |
| Inyo NF | Minaret Vista | 7-Jul | 22-Jul | 0.0279 | 0.0296 | 89.6 |
| Inyo NF | Minaret Vista | 22-Jul | 4-Aug | 0.0204 | 0.0221 | 66.3 |
| Inyo NF | Minaret Vista | 4-Aug | 18-Aug | 0.0189 | 0.0180 | 57.5 |
| Inyo NF | Minaret Vista | 18-Aug | 1-Sep | 0.0209 | 0.0206 | 64.7 |
| Inyo NF | Minaret Vista | 1-Sep | 15-Sep | 0.0195 | 0.0204 | 62.2 |
| Inyo NF | Minaret Vista | 15-Sep | 29-Sep | 0.0183 | 0.0177 | 56.1 |
| Inyo NF | Sherwin | 26-May | 10-Jun | 0.0191 | 0.0165 | 55.5 |
| Inyo NF | Sherwin | 10-Jun | 23-Jun | 0.0210 | 0.0220 | 67.0 |
| Inyo NF | Sherwin | 23-Jun | 7-Jul | 0.0130 | 0.0252 | 59.6 |
| Inyo NF | Sherwin | 7-Jul | 22-Jul | 0.0285 | 0.0348 | 98.7 |
| Inyo NF | Sherwin | 22-Jul | 4-Aug | 0.0039 | 0.0214 | 39.4 |
| Inyo NF | Sherwin | 4-Aug | 18-Aug | 0.0168 | 0.0212 | 59.2 |
| Inyo NF | Sherwin | 18-Aug | 1-Sep | 0.0199 | 0.0195 | 61.4 |
| Inyo NF | Sherwin | 1-Sep | 15-Sep | 0.0179 | 0.0184 | 56.6 |
| Inyo NF | Sherwin | 15-Sep | 29-Sep | 0.0140 | 0.0144 | 44.3 |
| Inyo NF | Rovana | 26-May | 10-Jun | 0.0164 | 0.0153 | 49.4 |
| Inyo NF | Rovana | 10-Jun | 23-Jun | 0.0227 | 0.0198 | 66.3 |
| Inyo NF | Rovana | 23-Jun | 7-Jul | 0.0122 | 0.0161 | 44.1 |
| Inyo NF | Rovana | 7-Jul | 22-Jul | 0.0247 | 0.0201 | 69.8 |
| Inyo NF | Rovana | 22-Jul | 4-Aug | 0.0184 | 0.0199 | 59.7 |
| Inyo NF | Rovana | 4-Aug | 18-Aug | 0.0161 | 0.0158 | 49.7 |
| Inyo NF | Rovana | 18-Aug | 1-Sep | 0.0186 | 0.0203 | 60.6 |
| Inyo NF | Rovana | 1-Sep | 15-Sep | 0.0166 | 0.0164 | 51.4 |
| Inyo NF | Rovana | 15-Sep | 29-Sep | 0.0148 | 0.0147 | 46.0 |
| Inyo NF | Sage Flat | 30-Jul | 18-Aug | 0.0187 | 0.0188 | 58.5 |
| Inyo NF | Sage Flat | 18-Aug | 1-Sep | 0.0205 | 0.0198 | 62.8 |
| Inyo NF | Sage Flat | 1-Sep | 15-Sep | 0.0184 | 0.0182 | 57.1 |
| Inyo NF | Sage Flat | 15-Sep | 29-Sep | 0.0167 | 0.0162 | 51.3 |
| Inyo NF | Sage Flat | 29-Sep | 13-Oct | 0.0150 | 0.0173 | 50.4 |
| Lassen NP | Manzanita Lake | 10-Jun | 23-Jun | 0.0147 | 0.0146 | 45.7 |
| Lassen NP | Manzanita Lake | 23-Jun | 7-Jul | 0.0134 | 0.0132 | 41.5 |
| Lassen NP | Manzanita Lake | 7-Jul | 21-Jul | 0.0154 | 0.0151 | 47.5 |
| Lassen NP | Manzanita Lake | 21-Jul | 4-Aug | 0.0137 | 0.0133 | 42.1 |
| Lassen NP | Manzanita Lake | 4-Aug | 19-Aug | 0.0113 | 0.0109 | 34.6 |
| Lassen NP | Manzanita Lake | 19-Aug | 1-Sep | 0.0137 | 0.0136 | 42.6 |
| Lassen NP | Manzanita Lake | 1-Sep | 16-Sep | 0.0127 | 0.0131 | 40.2 |
| Lassen NP | Manzanita Lake | 16-Sep | 30-Sep | 0.0150 | 0.0152 | 47.1 |
| Lassen NP | Summit Lake | 23-Jun | 7-Jul | 0.0103 | 0.0105 | 32.4 |
| Lassen NP | Summit Lake | 7-Jul | 21-Jul | 0.0109 | 0.0112 | 34.5 |
| Lassen NP | Summit Lake | 21-Jul | 4-Aug | 0.0108 | 0.0113 | 34.5 |
| Lassen NP | Summit Lake | 4-Aug | 19-Aug | 0.0084 | 0.0087 | 26.7 |
| Lassen NP | Summit Lake | 19-Aug | 1-Sep | 0.0097 | 0.0099 | 30.6 |
| Lassen NP | Summit Lake | 1-Sep | 16-Sep | 0.0095 | 0.0092 | 29.2 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Lassen NP | Summit Lake | 16-Sep | 30-Sep | 0.0112 | 0.0116 | 35.5 |
| Lassen NP | Diamond Peak | 10-Jun | 23-Jun | 0.0185 | 0.0195 | 59.2 |
| Lassen NP | Diamond Peak | 23-Jun | 7-Jul | 0.0149 | 0.0151 | 46.8 |
| Lassen NP | Diamond Peak | 7-Jul | 21-Jul | 0.0168 | 0.0172 | 53.0 |
| Lassen NP | Diamond Peak | 21-Jul | 4-Aug | 0.0168 | 0.0157 | 50.7 |
| Lassen NP | Diamond Peak | 4-Aug | 19-Aug | 0.0143 | 0.0145 | 44.9 |
| Lassen NP | Diamond Peak | 19-Aug | 1-Sep | 0.0173 | 0.0180 | 55.0 |
| Lassen NP | Diamond Peak | 1-Sep | 16-Sep | 0.0160 | 0.0166 | 50.8 |
| Lassen NP | Diamond Peak | 16-Sep | 30-Sep | 0.0182 | 0.0180 | 56.4 |
| Lassen NF | Hatchet Mountain | 12-May | 27-May | 0.0157 | 0.0160 | 49.4 |
| Lassen NF | Hatchet Mountain | 27-May | 10-Jun | 0.0146 | 0.0137 | 44.1 |
| Lassen NF | Hatchet Mountain | 10-Jun | 24-Jun | 0.0158 | 0.0151 | 48.2 |
| Lassen NF | Hatchet Mountain | 24-Jun | 8-Jul | 0.0131 | 0.0130 | 40.7 |
| Lassen NF | Hatchet Mountain | 8-Jul | 22-Jul | 0.0178 | 0.0186 | 56.7 |
| Lassen NF | Hatchet Mountain | 22-Jul | 5-Aug | 0.0172 | 0.0166 | 52.7 |
| Lassen NF | Hatchet Mountain | 5-Aug | 19-Aug | 0.0137 | 0.0147 | 44.3 |
| Lassen NF | Hatchet Mountain | 19-Aug | 2-Sep | 0.0161 | 0.0161 | 50.2 |
| Lassen NF | Hatchet Mountain | 2-Sep | 16-Sep | 0.0163 | 0.0156 | 49.7 |
| Lassen NF | Hatchet Mountain | 16-Sep | 30-Sep | 0.0172 | 0.0160 | 51.8 |
| Lassen NF | Hat Creek | 12-May | 27-May | 0.0153 | 0.0150 | 47.2 |
| Lassen NF | Hat Creek | 27-May | 10-Jun | 0.0134 | 0.0137 | 42.2 |
| Lassen NF | Hat Creek | 10-Jun | 24-Jun | 0.0156 | 0.0143 | 46.6 |
| Lassen NF | Hat Creek | 24-Jun | 8-Jul | 0.0129 | 0.0128 | 40.1 |
| Lassen NF | Hat Creek | 8-Jul | 22-Jul | 0.0159 | 0.0159 | 49.6 |
| Lassen NF | Hat Creek | 22-Jul | 5-Aug | 0.0161 | 0.0149 | 48.3 |
| Lassen NF | Hat Creek | 5-Aug | 19-Aug | 0.0134 | 0.0138 | 42.4 |
| Lassen NF | Hat Creek | 19-Aug | 2-Sep | 0.0158 | 0.0159 | 49.4 |
| Lassen NF | Hat Creek | 2-Sep | 16-Sep | 0.0155 | 0.0152 | 47.9 |
| Lassen NF | Hat Creek | 16-Sep | 30-Sep | 0.0150 | 0.0156 | 47.7 |
| Lassen NF | Harvey Mountain | 12-May | 27-May | 0.0160 | 0.0167 | 51.0 |
| Lassen NF | Harvey Mountain | 27-May | 10-Jun | 0.0141 | 0.0140 | 43.8 |
| Lassen NF | Harvey Mountain | 10-Jun | 24-Jun | 0.0159 | 0.0165 | 50.5 |
| Lassen NF | Harvey Mountain | 24-Jun | 8-Jul | 0.0131 | 0.0139 | 42.1 |
| Lassen NF | Harvey Mountain | 8-Jul | 22-Jul | 0.0175 | 0.0179 | 55.2 |
| Lassen NF | Harvey Mountain | 22-Jul | 5-Aug | 0.0164 | 0.0160 | 50.5 |
| Lassen NF | Harvey Mountain | 5-Aug | 19-Aug | 0.0147 | 0.0151 | 46.5 |
| Lassen NF | Harvey Mountain | 19-Aug | 2-Sep | 0.0159 | 0.0162 | 50.0 |
| Lassen NF | Harvey Mountain | 2-Sep | 16-Sep | 0.0160 | 0.0158 | 49.6 |
| Lassen NF | Harvey Mountain | 16-Sep | 30-Sep | 0.0159 | 0.0161 | 49.9 |
| Lassen NF | Pine Creek Valley | 12-May | 27-May | 0.0120 | 0.0131 | 39.1 |
| Lassen NF | Pine Creek Valley | 27-May | 10-Jun | 0.0117 | 0.0128 | 38.2 |
| Lassen NF | Pine Creek Valley | 10-Jun | 24-Jun | 0.0121 | 0.0118 | 37.3 |
| Lassen NF | Pine Creek Valley | 24-Jun | 8-Jul | 0.0110 | 0.0104 | 33.4 |
| Lassen NF | Pine Creek Valley | 8-Jul | 22-Jul | 0.0114 | 0.0122 | 36.8 |
| Lassen NF | Pine Creek Valley | 22-Jul | 5-Aug | 0.0115 | 0.0113 | 35.5 |
| Lassen NF | Pine Creek Valley | 5-Aug | 19-Aug | 0.0103 | 0.0096 | 31.0 |
| Lassen NF | Pine Creek Valley | 19-Aug | 2-Sep | 0.0111 | 0.0119 | 35.9 |
| Lassen NF | Pine Creek Valley | 2-Sep | 16-Sep | 0.0101 | 0.0104 | 32.0 |
| Lassen NF | Pine Creek Valley | 16-Sep | 30-Sep | 0.0109 | 0.0113 | 34.6 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Lassen NF | Little Fredonyer | 12-May | 26-May | 0.0191 | 0.0167 | 55.8 |
| Lassen NF | Little Fredonyer | 27-May | 10-Jun | 0.0172 | 0.0159 | 51.6 |
| Lassen NF | Little Fredonyer | 10-Jun | 23-Jun | 0.0166 | 0.0183 | 54.4 |
| Lassen NF | Little Fredonyer | 23-Jun | 7-Jul | 0.0161 | 0.0144 | 47.5 |
| Lassen NF | Little Fredonyer | 7-Jul | 21-Jul | 0.0176 | 0.0189 | 56.9 |
| Lassen NF | Little Fredonyer | 21-Jul | 4-Aug | 0.0168 | 0.0177 | 53.8 |
| Lassen NF | Little Fredonyer | 4-Aug | 18-Aug | 0.0149 | 0.0155 | 47.4 |
| Lassen NF | Little Fredonyer | 18-Aug | 1-Sep | 0.0174 | 0.0174 | 54.3 |
| Lassen NF | Little Fredonyer | 1-Sep | 15-Sep | 0.0166 | 0.0167 | 51.9 |
| Lassen NF | Little Fredonyer | 15-Sep | 29-Sep | 0.0162 | 0.0156 | 49.6 |
| Lassen NF | Paynes Creek | 13-May | 26-May | 0.0170 | 0.0175 | 53.8 |
| Lassen NF | Paynes Creek | 26-May | 9-Jun | 0.0158 | 0.0165 | 50.4 |
| Lassen NF | Paynes Creek | 9-Jun | 23-Jun | 0.0181 | 0.0171 | 54.9 |
| Lassen NF | Paynes Creek | 23-Jun | 7-Jul | 0.0164 | 0.0148 | 48.6 |
| Lassen NF | Paynes Creek | 7-Jul | 21-Jul | 0.0203 | 0.0207 | 63.9 |
| Lassen NF | Paynes Creek | 21-Jul | 4-Aug | 0.0190 | 0.0187 | 58.8 |
| Lassen NF | Paynes Creek | 4-Aug | 18-Aug | 0.0162 | 0.0167 | 51.3 |
| Lassen NF | Paynes Creek | 18-Aug | 1-Sep | 0.0208 | 0.0215 | 65.9 |
| Lassen NF | Paynes Creek | 1-Sep | 15-Sep | 0.0213 | 0.0201 | 64.5 |
| Lassen NF | Paynes Creek | 15-Sep | 29-Sep | 0.0171 | 0.0184 | 55.3 |
| Lassen NF | Mineral | 13-May | 26-May | 0.0143 | 0.0145 | 44.9 |
| Lassen NF | Mineral | 26-May | 9-Jun | 0.0133 | 0.0128 | 40.7 |
| Lassen NF | Mineral | 9-Jun | 23-Jun | 0.0146 | 0.0148 | 45.8 |
| Lassen NF | Mineral | 23-Jun | 7-Jul | 0.0135 | 0.0135 | 42.1 |
| Lassen NF | Mineral | 7-Jul | 21-Jul | 0.0163 | 0.0165 | 51.1 |
| Lassen NF | Mineral | 21-Jul | 4-Aug | 0.0152 | 0.0178 | 51.4 |
| Lassen NF | Mineral | 4-Aug | 18-Aug | 0.0129 | 0.0133 | 40.8 |
| Lassen NF | Mineral | 18-Aug | 1-Sep | 0.0168 | 0.0167 | 52.2 |
| Lassen NF | Mineral | 1-Sep | 15-Sep | 0.0160 | 0.0160 | 49.9 |
| Lassen NF | Mineral | 15-Sep | 29-Sep | 0.0151 | 0.0139 | 45.2 |
| Lassen NF | Butte Meadows | 13-May | 26-May | 0.0148 | 0.0157 | 47.5 |
| Lassen NF | Butte Meadows | 26-May | 9-Jun | 0.0138 | 0.0142 | 43.7 |
| Lassen NF | Butte Meadows | 9-Jun | 23-Jun | 0.0159 | 0.0140 | 46.6 |
| Lassen NF | Butte Meadows | 23-Jun | 7-Jul | 0.0135 | 0.0110 | 38.2 |
| Lassen NF | Butte Meadows | 7-Jul | 21-Jul | 0.0180 | 0.0175 | 55.3 |
| Lassen NF | Butte Meadows | 21-Jul | 4-Aug | 0.0160 | 0.0152 | 48.6 |
| Lassen NF | Butte Meadows | 4-Aug | 18-Aug | 0.0129 | 0.0138 | 41.6 |
| Lassen NF | Butte Meadows | 18-Aug | 1-Sep | 0.0174 | 0.0171 | 53.8 |
| Lassen NF | Butte Meadows | 1-Sep | 15-Sep | 0.0167 | 0.0167 | 52.1 |
| Lassen NF | Butte Meadows | 15-Sep | 29-Sep | 0.0160 | 0.0149 | 48.2 |
| Lassen NF | Canyon Dam | 13-May | 26-May | 0.0166 | 0.0158 | 50.5 |
| Lassen NF | Canyon Dam | 26-May | 9-Jun | 0.0146 | 0.0147 | 45.7 |
| Lassen NF | Canyon Dam | 9-Jun | 23-Jun | 0.0148 | 0.0150 | 46.5 |
| Lassen NF | Canyon Dam | 23-Jun | 7-Jul | 0.0137 | 0.0143 | 43.7 |
| Lassen NF | Canyon Dam | 7-Jul | 21-Jul | 0.0170 | 0.0175 | 53.8 |
| Lassen NF | Canyon Dam | 21-Jul | 4-Aug | 0.0147 | 0.0166 | 48.8 |
| Lassen NF | Canyon Dam | 4-Aug | 18-Aug | 0.0145 | 0.0142 | 44.7 |
| Lassen NF | Canyon Dam | 18-Aug | 1-Sep | 0.0166 | 0.0173 | 52.9 |
| Lassen NF | Canyon Dam | 1-Sep | 15-Sep | 0.0169 | 0.0174 | 53.5 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Lassen NF | Canyon Dam | 15-Sep | 29-Sep | 0.0168 | 0.0166 | 52.1 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 12-May | 26-May | 0.0190 | 0.0174 | 56.7 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 26-May | 9-Jun | 0.0197 | 0.0224 | 65.6 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 9-Jun | 23-Jun | 0.0188 | 0.0182 | 57.7 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 23-Jun | 7-Jul | 0.0164 | 0.0164 | 51.1 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 7-Jul | 21-Jul | 0.0268 | 0.0216 | 75.5 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 21-Jul | 4-Aug | 0.0187 | 0.0192 | 59.1 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 4-Aug | 18-Aug | 0.0144 | 0.0150 | 45.8 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 18-Aug | 1-Sep | 0.0172 | 0.0177 | 54.4 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 1-Sep | 15-Sep | 0.0164 | 0.0162 | 50.8 |
| Plumas NF | Jarbo Gap/Flea Mtn. | 15-Sep | 29-Sep | 0.0172 | 0.0169 | 53.2 |
| Plumas NF | Bucks Lake | 26-May | 9-Jun | 0.0140 | 0.0139 | 43.5 |
| Plumas NF | Bucks Lake | 9-Jun | 23-Jun | 0.0150 | 0.0147 | 46.3 |
| Plumas NF | Bucks Lake | 23-Jun | 7-Jul | 0.0151 | 0.0145 | 46.1 |
| Plumas NF | Bucks Lake | 7-Jul | 21-Jul | 0.0170 | 0.0173 | 53.5 |
| Plumas NF | Bucks Lake | 21-Jul | 4-Aug | 0.0169 | 0.0168 | 52.5 |
| Plumas NF | Bucks Lake | 4-Aug | 18-Aug | 0.0132 | 0.0137 | 41.9 |
| Plumas NF | Bucks Lake | 18-Aug | 1-Sep | 0.0142 | 0.0138 | 43.7 |
| Plumas NF | Bucks Lake | 1-Sep | 15-Sep | 0.0122 | 0.0121 | 37.9 |
| Plumas NF | Bucks Lake | 15-Sep | 29-Sep | 0.0145 | 0.0147 | 45.5 |
| Plumas NF | Quincy | 12-May | 26-May | 0.0162 | 0.0168 | 51.4 |
| Plumas NF | Quincy | 26-May | 9-Jun | 0.0134 | 0.0139 | 42.6 |
| Plumas NF | Quincy | 9-Jun | 23-Jun | 0.0152 | 0.0167 | 49.7 |
| Plumas NF | Quincy | 23-Jun | 7-Jul | 0.0155 | 0.0150 | 47.5 |
| Plumas NF | Quincy | 7-Jul | 21-Jul | 0.0179 | 0.0170 | 54.4 |
| Plumas NF | Quincy | 21-Jul | 4-Aug | 0.0162 | 0.0163 | 50.7 |
| Plumas NF | Quincy | 4-Aug | 18-Aug | 0.0136 | 0.0142 | 43.3 |
| Plumas NF | Quincy | 18-Aug | 1-Sep | 0.0170 | 0.0168 | 52.7 |
| Plumas NF | Quincy | 1-Sep | 15-Sep | 0.0172 | 0.0169 | 53.2 |
| Plumas NF | Quincy | 15-Sep | 29-Sep | 0.0144 | 0.0139 | 44.1 |
| Plumas NF | Antelope Lake | 12-May | 26-May | 0.0120 | 0.0131 | 39.1 |
| Plumas NF | Antelope Lake | 26-May | 9-Jun | 0.0119 | 0.0128 | 38.5 |
| Plumas NF | Antelope Lake | 9-Jun | 23-Jun | 0.0120 | 0.0121 | 37.6 |
| Plumas NF | Antelope Lake | 23-Jun | 7-Jul | 0.0121 | 0.0121 | 37.7 |
| Plumas NF | Antelope Lake | 7-Jul | 21-Jul | 0.0114 | 0.0121 | 36.6 |
| Plumas NF | Antelope Lake | 21-Jul | 4-Aug | 0.0123 | 0.0120 | 37.9 |
| Plumas NF | Antelope Lake | 4-Aug | 18-Aug | 0.0101 | 0.0103 | 31.8 |
| Plumas NF | Antelope Lake | 18-Aug | 2-Sep | 0.0129 | 0.0125 | 39.6 |
| Plumas NF | Antelope Lake | 2-Sep | 15-Sep | 0.0126 | 0.0118 | 38.0 |
| Plumas NF | Antelope Lake | 15-Sep | 29-Sep | 0.0115 | 0.0105 | 34.3 |
| Plumas NF | Pike County Peak Lookout | 12-May | 26-May | 0.0181 | 0.0176 | 55.7 |
| Plumas NF | Pike County Peak Lookout | 26-May | 9-Jun | 0.0164 | 0.0156 | 49.9 |
| Plumas NF | Pike County Peak Lookout | 9-Jun | 23-Jun | 0.0186 | 0.0178 | 56.7 |
| Plumas NF | Pike County Peak Lookout | 23-Jun | 7-Jul | 0.0173 | 0.0177 | 54.6 |
| Plumas NF | Pike County Peak Lookout | 7-Jul | 21-Jul | 0.0201 | 0.0203 | 63.0 |
| Plumas NF | Pike County Peak Lookout | 21-Jul | 4-Aug | 0.0191 | 0.0196 | 60.3 |
| Plumas NF | Pike County Peak Lookout | 4-Aug | 18-Aug | 0.0159 | 0.0155 | 49.0 |
| Plumas NF | Pike County Peak Lookout | 18-Aug | 1-Sep | 0.0197 | 0.0200 | 61.9 |
| Plumas NF | Pike County Peak Lookout | 1-Sep | 15-Sep | 0.0197 | 0.0200 | 61.9 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Plumas NF | Pike County Peak Lookout | 15-Sep | 29-Sep | 0.0195 | 0.0197 | 61.1 |
| Plumas NF | Little Grass Vally Reservoir | 26-May | 9-Jun | 0.0147 | 0.0136 | 44.1 |
| Plumas NF | Little Grass Vally Reservoir | 9-Jun | 23-Jun | 0.0155 | 0.0147 | 47.1 |
| Plumas NF | Little Grass Vally Reservoir | 23-Jun | 7-Jul | 0.0155 | 0.0145 | 46.8 |
| Plumas NF | Little Grass Vally Reservoir | 7-Jul | 21-Jul | 0.0174 | 0.0172 | 53.9 |
| Plumas NF | Little Grass Vally Reservoir | 21-Jul | 4-Aug | 0.0157 | 0.0166 | 50.4 |
| Plumas NF | Little Grass Vally Reservoir | 4-Aug | 18-Aug | 0.0135 | 0.0136 | 42.2 |
| Plumas NF | Little Grass Vally Reservoir | 18-Aug | 1-Sep | 0.0153 | 0.0145 | 46.5 |
| Plumas NF | Little Grass Vally Reservoir | 1-Sep | 15-Sep | 0.0155 | 0.0154 | 48.2 |
| Plumas NF | Little Grass Vally Reservoir | 15-Sep | 29-Sep | 0.0156 | 0.0156 | 48.6 |
| Plumas NF | Clover Valley | 12-May | 26-May | 0.0124 | 0.0140 | 41.2 |
| Plumas NF | Clover Valley | 26-May | 9-Jun | 0.0130 | 0.0144 | 42.7 |
| Plumas NF | Clover Valley | 9-Jun | 23-Jun | 0.0143 | 0.0134 | 43.2 |
| Plumas NF | Clover Valley | 23-Jun | 7-Jul | 0.0141 | 0.0137 | 43.3 |
| Plumas NF | Clover Valley | 7-Jul | 21-Jul | 0.0146 | 0.0145 | 45.4 |
| Plumas NF | Clover Valley | 21-Jul | 4-Aug | 0.0136 | 0.0134 | 42.1 |
| Plumas NF | Clover Valley | 4-Aug | 18-Aug | 0.0114 | 0.0116 | 35.9 |
| Plumas NF | Clover Valley | 18-Aug | 2-Sep | 0.0136 | 0.0133 | 41.9 |
| Plumas NF | Clover Valley | 2-Sep | 15-Sep | 0.0131 | 0.0131 | 40.8 |
| Plumas NF | Clover Valley | 15-Sep | 29-Sep | 0.0117 | 0.0114 | 36.0 |
| Sequoia NF | Scicon | 12-May | 26-May | 0.0185 | 0.0177 | 56.4 |
| Sequoia NF | Scicon | 26-May | 9-Jun | 0.0005 | 0.0004 | NA |
| Sequoia NF | Scicon | 9-Jun | 24-Jun | 0.0262 | 0.0246 | 79.2 |
| Sequoia NF | Scicon | 24-Jun | 7-Jul | 0.0271 | 0.0265 | 83.6 |
| Sequoia NF | Scicon | 7-Jul | 21-Jul | 0.0238 | 0.0218 | 71.1 |
| Sequoia NF | Scicon | 21-Jul | 4-Aug | 0.0255 | 0.0251 | 78.9 |
| Sequoia NF | Scicon | 4-Aug | 18-Aug | 0.0201 | 0.0201 | 62.7 |
| Sequoia NF | Scicon | 18-Aug | 1-Sep | 0.0231 | 0.0233 | 72.3 |
| Sequoia NF | Scicon | 1-Sep | 15-Sep | 0.0259 | 0.0264 | 81.5 |
| Sequoia NF | Scicon | 15-Sep | 29-Sep | 0.0242 | 0.0252 | 77.0 |
| Sequoia NF | Mountain Home | 9-Jun | 24-Jun | 0.0400 | NA | 124.7 |
| Sequoia NF | Mountain Home | 24-Jun | 7-Jul | 0.0257 | 0.0224 | 75.0 |
| Sequoia NF | Mountain Home | 7-Jul | 21-Jul | 0.0183 | 0.0186 | 57.5 |
| Sequoia NF | Mountain Home | 21-Jul | 4-Aug | 0.0216 | 0.0221 | 68.1 |
| Sequoia NF | Mountain Home | 4-Aug | 18-Aug | 0.0154 | 0.0161 | 49.1 |
| Sequoia NF | Mountain Home | 18-Aug | 1-Sep | 0.0179 | 0.0192 | 57.8 |
| Sequoia NF | Mountain Home | 1-Sep | 15-Sep | 0.0207 | 0.0199 | 63.3 |
| Sequoia NF | Mountain Home | 15-Sep | 29-Sep | 0.0178 | 0.0181 | 56.0 |
| Sequoia NF | North Road | 10-Jun | 24-Jun | 0.0232 | 0.0210 | 68.9 |
| Sequoia NF | North Road | 24-Jun | 8-Jul | 0.0230 | 0.0212 | 68.9 |
| Sequoia NF | North Road | 8-Jul | 21-Jul | 0.0156 | 0.0145 | 46.9 |
| Sequoia NF | North Road | 21-Jul | 4-Aug | 0.0203 | 0.0203 | 63.3 |
| Sequoia NF | North Road | 4-Aug | 19-Aug | 0.0167 | 0.0167 | 52.1 |
| Sequoia NF | North Road | 18-Aug | 1-Sep | 0.0167 | 0.0149 | 49.3 |
| Sequoia NF | North Road | 1-Sep | 17-Sep | 0.0197 | 0.0201 | 62.0 |
| Sequoia NF | North Road | 17-Sep | 29-Sep | 0.0154 | 0.0164 | 49.6 |
| Sequoia NF | Parker Pass | 12-May | 26-May | 0.0176 | 0.0168 | 53.6 |
| Sequoia NF | Parker Pass | 26-May | 9-Jun | 0.0185 | 0.0188 | 58.2 |
| Sequoia NF | Parker Pass | 9-Jun | 24-Jun | 0.0205 | 0.0212 | 65.0 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Sequoia NF | Parker Pass | 24-Jun | 8-Jul | 0.0219 | 0.0204 | 65.9 |
| Sequoia NF | Parker Pass | 8-Jul | 21-Jul | 0.0150 | 0.0154 | 47.4 |
| Sequoia NF | Parker Pass | 21-Jul | 4-Aug | 0.0202 | 0.0202 | 63.0 |
| Sequoia NF | Parker Pass | 4-Aug | 19-Aug | 0.0151 | 0.0145 | 46.1 |
| Sequoia NF | Parker Pass | 18-Aug | 1-Sep | 0.0141 | 0.0144 | 44.4 |
| Sequoia NF | Parker Pass | 1-Sep | 16-Sep | 0.0184 | 0.0186 | 57.7 |
| Sequoia NF | Parker Pass | 16-Sep | 29-Sep | 0.0158 | 0.0159 | 49.4 |
| Sequoia NF | Uhl Hill | 12-May | 26-May | 0.0191 | 0.0184 | 58.5 |
| Sequoia NF | Uhl Hill | 26-May | 9-Jun | 0.0185 | 0.0170 | 55.3 |
| Sequoia NF | Uhl Hill | 9-Jun | 24-Jun | 0.0238 | 0.0266 | 78.6 |
| Sequoia NF | Uhl Hill | 24-Jun | 8-Jul | 0.0199 | 0.0237 | 68.0 |
| Sequoia NF | Uhl Hill | 8-Jul | 21-Jul | 0.0227 | 0.0223 | 70.2 |
| Sequoia NF | Uhl Hill | 21-Jul | 4-Aug | 0.0244 | 0.0251 | 77.2 |
| Sequoia NF | Uhl Hill | 4-Aug | 19-Aug | 0.0209 | 0.0196 | 63.1 |
| Sequoia NF | Uhl Hill | 18-Aug | 1-Sep | 0.0213 | 0.0205 | 65.2 |
| Sequoia NF | Uhl Hill | 1-Sep | 16-Sep | 0.0284 | 0.0290 | 89.5 |
| Sequoia NF | Uhl Hill | 16-Sep | 29-Sep | 0.0242 | 0.0243 | 75.6 |
| Sequoia NF | Sherman | 9-Jun | 23-Jun | 0.0234 | 0.0230 | 72.3 |
| Sequoia NF | Sherman | 23-Jun | 7-Jul | 0.0213 | 0.0209 | 65.8 |
| Sequoia NF | Sherman | 7-Jul | 22-Jul | 0.0167 | 0.0178 | 53.8 |
| Sequoia NF | Sherman | 22-Jul | 4-Aug | 0.0193 | 0.0177 | 57.7 |
| Sequoia NF | Sherman | 4-Aug | 19-Aug | 0.0156 | 0.0149 | 47.5 |
| Sequoia NF | Sherman | 1-Sep | 16-Sep | 0.0178 | 0.0190 | 57.4 |
| Sequoia NF | Sherman | 15-Sep | 29-Sep | 0.0146 | 0.0148 | 45.8 |
| Sequoia NF | Blackrock | 13-May | 26-May | 0.0193 | 0.0205 | 62.0 |
| Sequoia NF | Blackrock | 26-May | 9-Jun | 0.0165 | 0.0191 | 55.5 |
| Sequoia NF | Blackrock | 9-Jun | 23-Jun | 0.0229 | 0.0214 | 69.1 |
| Sequoia NF | Blackrock | 23-Jun | 7-Jul | 0.0205 | 0.0196 | 62.5 |
| Sequoia NF | Blackrock | 7-Jul | 22-Jul | 0.0168 | 0.0175 | 53.5 |
| Sequoia NF | Blackrock | 22-Jul | 4-Aug | 0.0175 | 0.0173 | 54.3 |
| Sequoia NF | Blackrock | 4-Aug | 19-Aug | 0.0148 | 0.0144 | 45.5 |
| Sequoia NF | Blackrock | 19-Aug | 1-Sep | 0.0195 | 0.0190 | 60.0 |
| Sequoia NF | Blackrock | 1-Sep | 16-Sep | 0.0191 | 0.0177 | 57.4 |
| Sequoia NF | Blackrock | 16-Sep | 29-Sep | 0.0146 | 0.0138 | 44.3 |
| Sequoia NF | Fulton | 13-May | 26-May | 0.0159 | 0.0172 | 51.6 |
| Sequoia NF | Fulton | 26-May | 9-Jun | 0.0151 | 0.0130 | 43.8 |
| Sequoia NF | Fulton | 9-Jun | 23-Jun | 0.0191 | 0.0190 | 59.4 |
| Sequoia NF | Fulton | 23-Jun | 7-Jul | 0.0212 | 0.0214 | 66.4 |
| Sequoia NF | Fulton | 7-Jul | 21-Jul | 0.0177 | 0.0187 | 56.7 |
| Sequoia NF | Fulton | 21-Jul | 4-Aug | 0.0191 | 0.0180 | 57.8 |
| Sequoia NF | Fulton | 4-Aug | 19-Aug | 0.0142 | 0.0142 | 44.3 |
| Sequoia NF | Fulton | 19-Aug | 2-Sep | 0.0200 | NA | 62.4 |
| Sequoia NF | Fulton | 2-Sep | 15-Sep | 0.0206 | 0.0207 | 64.4 |
| Sequoia NF | Fulton | 15-Sep | 29-Sep | 0.0187 | 0.0182 | 57.5 |
| Sequoia NF | Greenhorn Summit | 13-May | 26-May | 0.0169 | 0.0200 | 57.5 |
| Sequoia NF | Greenhorn Summit | 26-May | 9-Jun | 0.0209 | 0.0223 | 67.3 |
| Sequoia NF | Greenhorn Summit | 9-Jun | 23-Jun | 0.0488 | 0.0291 | 121.4 |
| Sequoia NF | Greenhorn Summit | 23-Jun | 7-Jul | 0.0293 | 0.0280 | 89.3 |
| Sequoia NF | Greenhorn Summit | 7-Jul | 21-Jul | 0.0239 | 0.0244 | 75.3 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Sequoia NF | Greenhorn Summit | 21-Jul | 4-Aug | 0.0247 | 0.0259 | 78.9 |
| Sequoia NF | Greenhorn Summit | 4-Aug | 19-Aug | 0.0198 | 0.0198 | 61.7 |
| Sequoia NF | Greenhorn Summit | 19-Aug | 2-Sep | 0.0246 | 0.0242 | 76.1 |
| Sequoia NF | Greenhorn Summit | 2-Sep | 15-Sep | 0.0254 | 0.0253 | 79.0 |
| Sequoia NF | Greenhorn Summit | 15-Sep | 29-Sep | 0.0210 | NA | 65.5 |
| Sequoia NF | Grouse Springs/Breckenridge | 13-May | 26-May | 0.0230 | 0.0235 | 72.5 |
| Sequoia NF | Grouse Springs/Breckenridge | 26-May | 10-Jun | 0.0184 | 0.0187 | 57.8 |
| Sequoia NF | Grouse Springs/Breckenridge | 10-Jun | 23-Jun | 0.0257 | 0.0254 | 79.7 |
| Sequoia NF | Grouse Springs/Breckenridge | 23-Jun | 7-Jul | 0.0244 | 0.0250 | 77.0 |
| Sequoia NF | Grouse Springs/Breckenridge | 7-Jul | 21-Jul | 0.0216 | 0.0212 | 66.7 |
| Sequoia NF | Grouse Springs/Breckenridge | 21-Jul | 4-Aug | 0.0225 | 0.0227 | 70.5 |
| Sequoia NF | Grouse Springs/Breckenridge | 4-Aug | 19-Aug | 0.0186 | 0.0182 | 57.4 |
| Sequoia NF | Grouse Springs/Breckenridge | 19-Aug | 1-Sep | 0.0234 | 0.0232 | 72.6 |
| Sequoia NF | Grouse Springs/Breckenridge | 1-Sep | 15-Sep | 0.0235 | 0.0235 | 73.3 |
| Sequoia NF | Grouse Springs/Breckenridge | 15-Sep | 30-Sep | 0.0198 | 0.0195 | 61.3 |
| Sequoia NF | Havilah/Lightner | 13-May | 26-May | 0.0235 | 0.0258 | 76.9 |
| Sequoia NF | Havilah/Lightner | 26-May | 10-Jun | 0.0206 | 0.0222 | 66.7 |
| Sequoia NF | Havilah/Lightner | 10-Jun | 23-Jun | 0.0277 | 0.0292 | 88.7 |
| Sequoia NF | Havilah/Lightner | 23-Jun | 7-Jul | 0.0264 | 0.0281 | 85.0 |
| Sequoia NF | Havilah/Lightner | 7-Jul | 21-Jul | 0.0225 | 0.0238 | 72.2 |
| Sequoia NF | Havilah/Lightner | 21-Jul | 4-Aug | 0.0244 | 0.0251 | 77.2 |
| Sequoia NF | Havilah/Lightner | 4-Aug | 19-Aug | 0.0200 | 0.0212 | 64.2 |
| Sequoia NF | Havilah/Lightner | 19-Aug | 1-Sep | 0.0269 | NA | 83.9 |
| Sequoia NF | Havilah/Lightner | 1-Sep | 15-Sep | 0.0257 | 0.0251 | 79.2 |
| Sequoia NF | Havilah/Lightner | 15-Sep | 30-Sep | 0.0210 | NA | 65.5 |
| Sequoia NF | Liebel/Piutes | 13-May | 26-May | 0.0274 | 0.0331 | 94.3 |
| Sequoia NF | Liebel/Piutes | 26-May | 10-Jun | 0.0195 | 0.0188 | 59.7 |
| Sequoia NF | Liebel/Piutes | 10-Jun | 23-Jun | 0.0223 | 0.0220 | 69.1 |
| Sequoia NF | Liebel/Piutes | 23-Jun | 7-Jul | 0.0232 | 0.0219 | 70.3 |
| Sequoia NF | Liebel/Piutes | 7-Jul | 21-Jul | 0.0167 | 0.0200 | 57.2 |
| Sequoia NF | Liebel/Piutes | 21-Jul | 4-Aug | 0.0200 | 0.0202 | 62.7 |
| Sequoia NF | Liebel/Piutes | 4-Aug | 19-Aug | 0.0157 | 0.0155 | 48.6 |
| Sequoia NF | Liebel/Piutes | 19-Aug | 1-Sep | 0.0224 | 0.0227 | 70.3 |
| Sequoia NF | Liebel/Piutes | 1-Sep | 15-Sep | 0.0200 | 0.0185 | 60.0 |
| Sequoia NF | Liebel/Piutes | 15-Sep | 30-Sep | 0.0163 | NA | 50.8 |
| Sierra NF | Usona | 26-May | 10-Jun | 0.0051 | 0.0112 | 25.4 |
| Sierra NF | Usona | 10-Jun | 23-Jun | 0.0080 | 0.0096 | 27.4 |
| Sierra NF | Usona | 23-Jun | 7-Jul | 0.0104 | 0.0104 | 32.4 |
| Sierra NF | Usona | 7-Jul | 22-Jul | 0.0181 | 0.0172 | 55.0 |
| Sierra NF | Usona | 22-Jul | 4-Aug | 0.0170 | 0.0176 | 53.9 |
| Sierra NF | Usona | 4-Aug | 18-Aug | 0.0127 | 0.0116 | 37.9 |
| Sierra NF | Usona | 18-Aug | 1-Sep | 0.0002 | 0.0197 | 31.0 |
| Sierra NF | Usona | 1-Sep | 15-Sep | 0.0221 | 0.0208 | 66.9 |
| Sierra NF | Usona | 15-Sep | 30-Sep | 0.0213 | 0.0223 | 68.0 |
| Sierra NF | Poison Meadow | 26-May | 9-Jun | 0.0073 | 0.0114 | 29.2 |
| Sierra NF | Poison Meadow | 9-Jun | 23-Jun | 0.0149 | 0.0173 | 50.2 |
| Sierra NF | Poison Meadow | 23-Jun | 7-Jul | 0.0106 | 0.0110 | 33.7 |
| Sierra NF | Poison Meadow | 7-Jul | 22-Jul | 0.0186 | 0.0183 | 57.5 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Sierra NF | Poison Meadow | 22-Jul | 4-Aug | 0.0172 | 0.0184 | 55.5 |
| Sierra NF | Poison Meadow | 4-Aug | 18-Aug | 0.0150 | 0.0149 | 46.6 |
| Sierra NF | Poison Meadow | 18-Aug | 1-Sep | 0.0003 | 0.0229 | 36.2 |
| Sierra NF | Poison Meadow | 1-Sep | 15-Sep | 0.0418 | 0.0418 | 130.3 |
| Sierra NF | Poison Meadow | 15-Sep | 30-Sep | 0.0201 | 0.0203 | 63.0 |
| Sierra NF | Granite | 12-May | 26-May | 0.0063 | 0.0046 | 17.0 |
| Sierra NF | Granite | 9-Jun | 23-Jun | 0.0058 | 0.0099 | 24.5 |
| Sierra NF | Granite | 23-Jun | 7-Jul | 0.0049 | 0.0088 | 21.4 |
| Sierra NF | Granite | 7-Jul | 22-Jul | 0.0104 | 0.0105 | 32.6 |
| Sierra NF | Granite | 22-Jul | 4-Aug | 0.0121 | 0.0110 | 36.0 |
| Sierra NF | Granite | 4-Aug | 18-Aug | 0.0101 | 0.0082 | 28.5 |
| Sierra NF | Granite | 18-Aug | 1-Sep | 0.0135 | 0.0130 | 41.3 |
| Sierra NF | Granite | 1-Sep | 15-Sep | 0.0132 | 0.0139 | 42.2 |
| Sierra NF | Granite | 15-Sep | 30-Sep | 0.0114 | 0.0114 | 35.5 |
| Sierra NF | Auberry | 12-May | 26-May | 0.0185 | 0.0188 | 58.2 |
| Sierra NF | Auberry | 26-May | 9-Jun | 0.0146 | 0.0152 | 46.5 |
| Sierra NF | Auberry | 9-Jun | 23-Jun | 0.0207 | 0.0194 | 62.5 |
| Sierra NF | Auberry | 23-Jun | 7-Jul | 0.0212 | 0.0210 | 65.8 |
| Sierra NF | Auberry | 7-Jul | 21-Jul | 0.0225 | 0.0246 | 73.4 |
| Sierra NF | Auberry | 21-Jul | 4-Aug | 0.0213 | 0.0211 | 66.1 |
| Sierra NF | Auberry | 4-Aug | 18-Aug | 0.0168 | 0.0166 | 52.1 |
| Sierra NF | Auberry | 18-Aug | 1-Sep | 0.0204 | 0.0206 | 63.9 |
| Sierra NF | Auberry | 1-Sep | 15-Sep | 0.0230 | 0.0221 | 70.3 |
| Sierra NF | Auberry | 15-Sep | 29-Sep | 0.0224 | 0.0225 | 70.0 |
| Sierra NF | Shaver Lake | 12-May | 26-May | 0.0181 | 0.0180 | 56.3 |
| Sierra NF | Shaver Lake | 26-May | 9-Jun | 0.0155 | 0.0158 | 48.8 |
| Sierra NF | Shaver Lake | 9-Jun | 23-Jun | 0.0174 | 0.0173 | 54.1 |
| Sierra NF | Shaver Lake | 23-Jun | 7-Jul | 0.0207 | 0.0209 | 64.9 |
| Sierra NF | Shaver Lake | 7-Jul | 21-Jul | 0.0197 | 0.0201 | 62.0 |
| Sierra NF | Shaver Lake | 21-Jul | 4-Aug | 0.0198 | 0.0200 | 62.0 |
| Sierra NF | Shaver Lake | 4-Aug | 18-Aug | 0.0168 | 0.0177 | 53.8 |
| Sierra NF | Shaver Lake | 18-Aug | 1-Sep | 0.0178 | 0.0178 | 55.5 |
| Sierra NF | Shaver Lake | 1-Sep | 15-Sep | 0.0199 | 0.0200 | 62.2 |
| Sierra NF | Shaver Lake | 15-Sep | 29-Sep | 0.0183 | 0.0188 | 57.8 |
| Sierra NF | Kaiser | 9-Jun | 23-Jun | 0.0181 | 0.0177 | 55.8 |
| Sierra NF | Kaiser | 23-Jun | 7-Jul | 0.0157 | 0.0158 | 49.1 |
| Sierra NF | Kaiser | 7-Jul | 21-Jul | 0.0152 | 0.0155 | 47.9 |
| Sierra NF | Kaiser | 21-Jul | 4-Aug | 0.0155 | 0.0149 | 47.4 |
| Sierra NF | Kaiser | 4-Aug | 18-Aug | 0.0146 | 0.0146 | 45.5 |
| Sierra NF | Kaiser | 18-Aug | 1-Sep | 0.0154 | 0.0150 | 47.4 |
| Sierra NF | Kaiser | 1-Sep | 16-Sep | 0.0162 | 0.0157 | 49.7 |
| Sierra NF | Kaiser | 16-Sep | 29-Sep | 0.0126 | 0.0122 | 38.7 |
| Sierra NF | Trimmer | 12-May | 26-May | 0.0175 | 0.0177 | 54.9 |
| Sierra NF | Trimmer | 26-May | 9-Jun | 0.0152 | 0.0151 | 47.2 |
| Sierra NF | Trimmer | 9-Jun | 23-Jun | 0.0198 | 0.0193 | 61.0 |
| Sierra NF | Trimmer | 23-Jun | 7-Jul | 0.0183 | 0.0223 | 63.3 |
| Sierra NF | Trimmer | 7-Jul | 21-Jul | 0.0205 | 0.0202 | 63.5 |
| Sierra NF | Trimmer | 21-Jul | 4-Aug | 0.0205 | 0.0203 | 63.6 |
| Sierra NF | Trimmer | 4-Aug | 18-Aug | 0.0165 | 0.0174 | 52.9 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Sierra NF | Trimmer | 18-Aug | 1-Sep | 0.0206 | 0.0205 | 64.1 |
| Sierra NF | Trimmer | 1-Sep | 16-Sep | 0.0242 | 0.0236 | 74.5 |
| Sierra NF | Trimmer | 16-Sep | 29-Sep | 0.0220 | 0.0226 | 69.5 |
| Sierra NF | Teakettle | 9-Jun | 23-Jun | 0.0178 | 0.0172 | 54.6 |
| Sierra NF | Teakettle | 23-Jun | 7-Jul | 0.0152 | 0.0156 | 48.0 |
| Sierra NF | Teakettle | 7-Jul | 21-Jul | 0.0147 | 0.0146 | 45.7 |
| Sierra NF | Teakettle | 21-Jul | 4-Aug | 0.0155 | 0.0153 | 48.0 |
| Sierra NF | Teakettle | 4-Aug | 18-Aug | 0.0132 | 0.0128 | 40.5 |
| Sierra NF | Teakettle | 18-Aug | 1-Sep | 0.0167 | 0.0153 | 49.9 |
| Sierra NF | Teakettle | 1-Sep | 16-Sep | 0.0157 | 0.0160 | 49.4 |
| Sierra NF | Teakettle | 16-Sep | 29-Sep | 0.0134 | 0.0132 | 41.5 |
| Sierra NF | Courtright | 9-Jun | 23-Jun | 0.0196 | 0.0209 | 63.1 |
| Sierra NF | Courtright | 23-Jun | 7-Jul | 0.0193 | 0.0208 | 62.5 |
| Sierra NF | Courtright | 7-Jul | 21-Jul | 0.0174 | 0.0186 | 56.1 |
| Sierra NF | Courtright | 21-Jul | 4-Aug | 0.0193 | 0.0188 | 59.4 |
| Sierra NF | Courtright | 4-Aug | 18-Aug | 0.0155 | 0.0154 | 48.2 |
| Sierra NF | Courtright | 18-Aug | 1-Sep | 0.0180 | 0.0180 | 56.1 |
| Sierra NF | Courtright | 1-Sep | 16-Sep | 0.0176 | 0.0175 | 54.7 |
| Sierra NF | Courtright | 16-Sep | 29-Sep | 0.0144 | 0.0149 | 45.7 |
| Stanislaus NF | Avery | 12-May | 27-May | 0.0179 | 0.0191 | 57.7 |
| Stanislaus NF | Avery | 27-May | 9-Jun | 0.0152 | 0.0162 | 49.0 |
| Stanislaus NF | Avery | 9-Jun | 24-Jun | 0.0168 | 0.0167 | 52.2 |
| Stanislaus NF | Avery | 24-Jun | 7-Jul | 0.0176 | 0.0193 | 57.5 |
| Stanislaus NF | Avery | 7-Jul | 21-Jul | NA | 0.0306 | 95.4 |
| Stanislaus NF | Avery | 21-Jul | 4-Aug | 0.0193 | 0.0210 | 62.8 |
| Stanislaus NF | Avery | 4-Aug | 18-Aug | 0.0293 | 0.0165 | 71.4 |
| Stanislaus NF | Avery | 18-Aug | 1-Sep | 0.0211 | 0.0216 | 66.6 |
| Stanislaus NF | Avery | 1-Sep | 15-Sep | 0.0231 | 0.0427 | 102.6 |
| Stanislaus NF | Avery | 15-Sep | 29-Sep | 0.0203 | 0.0196 | 62.2 |
| Stanislaus NF | Hells Kitchen | 12-May | 27-May | 0.0154 | 0.0153 | 47.9 |
| Stanislaus NF | Hells Kitchen | 27-May | 9-Jun | 0.0154 | 0.0143 | 46.3 |
| Stanislaus NF | Hells Kitchen | 9-Jun | 24-Jun | 0.0194 | 0.0204 | 62.0 |
| Stanislaus NF | Hells Kitchen | 24-Jun | 7-Jul | 0.0161 | 0.0168 | 51.3 |
| Stanislaus NF | Hells Kitchen | 7-Jul | 21-Jul | 0.0178 | 0.0179 | 55.7 |
| Stanislaus NF | Hells Kitchen | 21-Jul | 4-Aug | 0.0165 | 0.0162 | 51.0 |
| Stanislaus NF | Hells Kitchen | 4-Aug | 18-Aug | 0.0126 | 0.0134 | 40.5 |
| Stanislaus NF | Hells Kitchen | 18-Aug | 1-Sep | 0.0172 | 0.0171 | 53.5 |
| Stanislaus NF | Hells Kitchen | 1-Sep | 15-Sep | 0.0182 | 0.0174 | 55.5 |
| Stanislaus NF | Hells Kitchen | 15-Sep | 29-Sep | 0.0156 | 0.0155 | 48.5 |
| Stanislaus NF | Ebbett's Pass | 27-May | 9-Jun | 0.0189 | 0.0207 | 61.7 |
| Stanislaus NF | Ebbett's Pass | 9-Jun | 24-Jun | 0.0206 | 0.0207 | 64.4 |
| Stanislaus NF | Ebbett's Pass | 24-Jun | 7-Jul | 0.0214 | 0.0194 | 63.6 |
| Stanislaus NF | Ebbett's Pass | 7-Jul | 21-Jul | 0.0236 | 0.0246 | 75.1 |
| Stanislaus NF | Ebbett's Pass | 21-Jul | 4-Aug | 0.0229 | 0.0183 | 64.2 |
| Stanislaus NF | Ebbett's Pass | 4-Aug | 18-Aug | 0.0148 | 0.0152 | 46.8 |
| Stanislaus NF | Ebbett's Pass | 18-Aug | 1-Sep | 0.0189 | 0.0209 | 62.0 |
| Stanislaus NF | Ebbett's Pass | 1-Sep | 15-Sep | 0.0192 | 0.0198 | 60.8 |
| Stanislaus NF | Ebbett's Pass | 15-Sep | 29-Sep | 0.0168 | 0.0175 | 53.5 |
| Stanislaus NF | Five Mile | 12-May | 27-May | 0.0178 | 0.0178 | 55.5 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Stanislaus NF | Five Mile | 27-May | 9-Jun | 0.0152 | 0.0151 | 47.2 |
| Stanislaus NF | Five Mile | 9-Jun | 23-Jun | 0.0189 | 0.0180 | 57.5 |
| Stanislaus NF | Five Mile | 23-Jun | 7-Jul | 0.0185 | 0.0189 | 58.3 |
| Stanislaus NF | Five Mile | 7-Jul | 21-Jul | 0.0207 | 0.0231 | 68.3 |
| Stanislaus NF | Five Mile | 21-Jul | 4-Aug | 0.0193 | 0.0190 | 59.7 |
| Stanislaus NF | Five Mile | 4-Aug | 18-Aug | 0.0158 | 0.0156 | 49.0 |
| Stanislaus NF | Five Mile | 18-Aug | 1-Sep | 0.0195 | 0.0199 | 61.4 |
| Stanislaus NF | Five Mile | 1-Sep | 15-Sep | NA | 0.0221 | 68.9 |
| Stanislaus NF | Five Mile | 15-Sep | 29-Sep | 0.0206 | 0.0217 | 65.9 |
| Stanislaus NF | Pinecrest | 26-May | 9-Jun | 0.0122 | 0.0144 | 41.5 |
| Stanislaus NF | Pinecrest | 9-Jun | 23-Jun | 0.0212 | 0.0195 | 63.5 |
| Stanislaus NF | Pinecrest | 23-Jun | 7-Jul | 0.0184 | 0.0197 | 59.4 |
| Stanislaus NF | Pinecrest | 7-Jul | 21-Jul | 0.0183 | 0.0188 | 57.8 |
| Stanislaus NF | Pinecrest | 21-Jul | 4-Aug | 0.0154 | 0.0168 | 50.2 |
| Stanislaus NF | Pinecrest | 4-Aug | 18-Aug | 0.0161 | 0.0180 | 53.2 |
| Stanislaus NF | Pinecrest | 18-Aug | 2-Sep | 0.0166 | 0.0170 | 52.4 |
| Stanislaus NF | Pinecrest | 2-Sep | 16-Sep | 0.0214 | 0.0239 | 70.6 |
| Stanislaus NF | Pinecrest | 16-Sep | 29-Sep | 0.0187 | 0.0214 | 62.5 |
| Stanislaus NF | Clark Fork | 26-May | 9-Jun | 0.0105 | 0.0081 | 29.0 |
| Stanislaus NF | Clark Fork | 9-Jun | 23-Jun | 0.0131 | 0.0135 | 41.5 |
| Stanislaus NF | Clark Fork | 23-Jun | 7-Jul | 0.0124 | 0.0133 | 40.1 |
| Stanislaus NF | Clark Fork | 7-Jul | 21-Jul | 0.0135 | 0.0105 | 37.4 |
| Stanislaus NF | Clark Fork | 21-Jul | 4-Aug | 0.0121 | 0.0132 | 39.4 |
| Stanislaus NF | Clark Fork | 4-Aug | 18-Aug | 0.0089 | 0.0105 | 30.2 |
| Stanislaus NF | Clark Fork | 18-Aug | 2-Sep | 0.0100 | 0.0106 | 32.1 |
| Stanislaus NF | Clark Fork | 2-Sep | 16-Sep | 0.0175 | 0.0145 | 49.9 |
| Stanislaus NF | Clark Fork | 16-Sep | 29-Sep | 0.0125 | 0.0111 | 36.8 |
| Stanislaus NF | Buck Meadow | 12-May | 26-May | 0.0114 | 0.0102 | 33.7 |
| Stanislaus NF | Buck Meadow | 26-May | 9-Jun | 0.0143 | 0.0148 | 45.4 |
| Stanislaus NF | Buck Meadow | 9-Jun | 23-Jun | 0.0187 | 0.0180 | 57.2 |
| Stanislaus NF | Buck Meadow | 23-Jun | 7-Jul | 0.0178 | 0.0177 | 55.3 |
| Stanislaus NF | Buck Meadow | 7-Jul | 21-Jul | 0.0201 | 0.0190 | 61.0 |
| Stanislaus NF | Buck Meadow | 21-Jul | 4-Aug | 0.0143 | 0.0155 | 46.5 |
| Stanislaus NF | Buck Meadow | 4-Aug | 18-Aug | 0.0166 | 0.0100 | 41.5 |
| Stanislaus NF | Buck Meadow | 18-Aug | 2-Sep | 0.0137 | 0.0185 | 50.2 |
| Stanislaus NF | Buck Meadow | 2-Sep | 16-Sep | 0.0211 | 0.0216 | 66.6 |
| Stanislaus NF | Buck Meadow | 16-Sep | 29-Sep | 0.0183 | 0.0180 | 56.6 |
| Stanislaus NF | Reed Creek | 12-May | 26-May | 0.0110 | 0.0132 | 37.7 |
| Stanislaus NF | Reed Creek | 26-May | 9-Jun | 0.0111 | 0.0096 | 32.3 |
| Stanislaus NF | Reed Creek | 9-Jun | 23-Jun | 0.0130 | 0.0130 | 40.5 |
| Stanislaus NF | Reed Creek | 23-Jun | 7-Jul | 0.0132 | 0.0134 | 41.5 |
| Stanislaus NF | Reed Creek | 7-Jul | 21-Jul | 0.0152 | 0.0160 | 48.6 |
| Stanislaus NF | Reed Creek | 21-Jul | 4-Aug | 0.0111 | 0.0112 | 34.8 |
| Stanislaus NF | Reed Creek | 4-Aug | 18-Aug | 0.0109 | 0.0062 | 26.7 |
| Stanislaus NF | Reed Creek | 18-Aug | 2-Sep | 0.0126 | 0.0127 | 39.4 |
| Stanislaus NF | Reed Creek | 2-Sep | 16-Sep | 0.0096 | 0.0143 | 37.3 |
| Stanislaus NF | Reed Creek | 16-Sep | 29-Sep | 0.0141 | 0.0149 | 45.2 |
| Stanislaus NF | Sonora Pass | 26-May | 9-Jun | 0.0095 | 0.0098 | 30.1 |
| Stanislaus NF | Sonora Pass | 9-Jun | 23-Jun | 0.0040 | 0.0109 | 23.2 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Stanislaus NF | Sonora Pass | 23-Jun | 7-Jul | 0.0102 | 0.0089 | 29.8 |
| Stanislaus NF | Sonora Pass | 7-Jul | 21-Jul | 0.0104 | 0.0106 | 32.7 |
| Stanislaus NF | Sonora Pass | 21-Jul | 4-Aug | 0.0102 | 0.0090 | 29.9 |
| Stanislaus NF | Sonora Pass | 4-Aug | 18-Aug | 0.0067 | 0.0073 | 21.8 |
| Stanislaus NF | Sonora Pass | 18-Aug | 2-Sep | 0.0066 | 0.0074 | 21.8 |
| Stanislaus NF | Sonora Pass | 2-Sep | 16-Sep | 0.0115 | 0.0114 | 35.7 |
| Stanislaus NF | Sonora Pass | 16-Sep | 29-Sep | 0.0086 | 0.0086 | 26.8 |
| Tahoe NF | North Yuba/Marysville | 13-May | 27-May | 0.0139 | 0.0148 | 44.7 |
| Tahoe NF | North Yuba/Marysville | 27-May | 9-Jun | 0.0125 | 0.0117 | 37.7 |
| Tahoe NF | North Yuba/Marysville | 9-Jun | 24-Jun | 0.0127 | 0.0133 | 40.5 |
| Tahoe NF | North Yuba/Marysville | 24-Jun | 8-Jul | 0.0126 | 0.0120 | 38.4 |
| Tahoe NF | North Yuba/Marysville | 8-Jul | 22-Jul | 0.0153 | 0.0015 | 26.2 |
| Tahoe NF | North Yuba/Marysville | 22-Jul | 5-Aug | 0.0146 | 0.0159 | 47.5 |
| Tahoe NF | North Yuba/Marysville | 5-Aug | 19-Aug | 0.0127 | 0.0126 | 39.4 |
| Tahoe NF | North Yuba/Marysville | 19-Aug | 2-Sep | 0.0145 | 0.0139 | 44.3 |
| Tahoe NF | North Yuba/Marysville | 2-Sep | 16-Sep | 0.0163 | 0.0170 | 51.9 |
| Tahoe NF | North Yuba/Marysville | 16-Sep | 30-Sep | 0.0149 | 0.0148 | 46.3 |
| Tahoe NF | Downieville | 13-May | 27-May | 0.0112 | 0.0117 | 35.7 |
| Tahoe NF | Downieville | 27-May | 9-Jun | 0.0094 | 0.0075 | 26.3 |
| Tahoe NF | Downieville | 9-Jun | 24-Jun | 0.0114 | 0.0123 | 36.9 |
| Tahoe NF | Downieville | 24-Jun | 8-Jul | 0.0101 | 0.0106 | 32.3 |
| Tahoe NF | Downieville | 8-Jul | 22-Jul | 0.0086 | 0.0118 | 31.8 |
| Tahoe NF | Downieville | 22-Jul | 5-Aug | 0.0116 | 0.0126 | 37.7 |
| Tahoe NF | Downieville | 5-Aug | 19-Aug | 0.0110 | 0.0127 | 36.9 |
| Tahoe NF | Downieville | 19-Aug | 2-Sep | 0.0126 | 0.0134 | 40.5 |
| Tahoe NF | Downieville | 2-Sep | 16-Sep | 0.0149 | 0.0136 | 44.4 |
| Tahoe NF | Downieville | 16-Sep | 30-Sep | 0.0132 | 0.0124 | 39.9 |
| Tahoe NF | Yuba Pass | 9-Jun | 24-Jun | 0.0154 | 0.0158 | 48.6 |
| Tahoe NF | Yuba Pass | 24-Jun | 8-Jul | 0.0213 | 0.0167 | 59.2 |
| Tahoe NF | Yuba Pass | 8-Jul | 22-Jul | 0.0162 | 0.0174 | 52.4 |
| Tahoe NF | Yuba Pass | 22-Jul | 5-Aug | 0.0159 | 0.0158 | 49.4 |
| Tahoe NF | Yuba Pass | 5-Aug | 19-Aug | 0.0133 | 0.0137 | 42.1 |
| Tahoe NF | Yuba Pass | 19-Aug | 2-Sep | 0.0161 | 0.0164 | 50.7 |
| Tahoe NF | Yuba Pass | 2-Sep | 16-Sep | 0.0147 | 0.0161 | 48.0 |
| Tahoe NF | Yuba Pass | 16-Sep | 30-Sep | 0.0160 | 0.0164 | 50.5 |
| Tahoe NF | Nevada City | 13-May | 27-May | 0.0164 | 0.0162 | 50.8 |
| Tahoe NF | Nevada City | 27-May | 9-Jun | 0.0138 | 0.0134 | 42.4 |
| Tahoe NF | Nevada City | 9-Jun | 24-Jun | 0.0114 | 0.0115 | 35.7 |
| Tahoe NF | Nevada City | 24-Jun | 8-Jul | 0.0142 | 0.0142 | 44.3 |
| Tahoe NF | Nevada City | 8-Jul | 22-Jul | 0.0176 | 0.0177 | 55.0 |
| Tahoe NF | Nevada City | 22-Jul | 4-Aug | 0.0168 | 0.0168 | 52.4 |
| Tahoe NF | Nevada City | 19-Aug | 2-Sep | 0.0193 | 0.0178 | 57.8 |
| Tahoe NF | Nevada City | 2-Sep | 16-Sep | 0.0201 | 0.0207 | 63.6 |
| Tahoe NF | Nevada City | 16-Sep | 29-Sep | 0.0171 | 0.0174 | 53.8 |
| Tahoe NF | White Cloud | 13-May | 27-May | 0.0162 | 0.0163 | 50.7 |
| Tahoe NF | White Cloud | 27-May | 9-Jun | 0.0142 | 0.0143 | 44.4 |
| Tahoe NF | White Cloud | 9-Jun | 24-Jun | 0.0135 | 0.0167 | 47.1 |
| Tahoe NF | White Cloud | 24-Jun | 8-Jul | 0.0159 | 0.0135 | 45.8 |
| Tahoe NF | White Cloud | 8-Jul | 22-Jul | 0.0222 | 0.0201 | 65.9 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Tahoe NF | White Cloud | 22-Jul | 4-Aug | 0.0182 | 0.0171 | 55.0 |
| Tahoe NF | White Cloud | 4-Aug | 19-Aug | 0.0165 | 0.0157 | 50.2 |
| Tahoe NF | White Cloud | 19-Aug | 1-Sep | 0.0182 | 0.0189 | 57.8 |
| Tahoe NF | White Cloud | 1-Sep | 15-Sep | 0.0198 | 0.0200 | 62.0 |
| Tahoe NF | White Cloud | 15-Sep | 29-Sep | 0.0185 | 0.0184 | 57.5 |
| Tahoe NF | Cisco Grove/Kelly Lake | 9-Jun | 24-Jun | 0.0122 | 0.0141 | 41.0 |
| Tahoe NF | Cisco Grove/Kelly Lake | 24-Jun | 8-Jul | 0.0137 | 0.0145 | 44.0 |
| Tahoe NF | Cisco Grove/Kelly Lake | 8-Jul | 22-Jul | 0.0149 | 0.0151 | 46.8 |
| Tahoe NF | Cisco Grove/Kelly Lake | 22-Jul | 5-Aug | 0.0144 | 0.0146 | 45.2 |
| Tahoe NF | Cisco Grove/Kelly Lake | 5-Aug | 19-Aug | 0.0125 | 0.0139 | 41.2 |
| Tahoe NF | Cisco Grove/Kelly Lake | 19-Aug | 2-Sep | 0.0147 | 0.0145 | 45.5 |
| Tahoe NF | Cisco Grove/Kelly Lake | 2-Sep | 16-Sep | 0.0163 | 0.0154 | 49.4 |
| Tahoe NF | Cisco Grove/Kelly Lake | 16-Sep | 30-Sep | 0.0146 | 0.0141 | 44.7 |
| Tahoe NF | Serene | 9-Jun | 24-Jun | 0.0179 | 0.0157 | 52.4 |
| Tahoe NF | Serene | 24-Jun | 8-Jul | 0.0184 | 0.0332 | 80.4 |
| Tahoe NF | Serene | 8-Jul | 22-Jul | 0.0190 | 0.0213 | 62.8 |
| Tahoe NF | Serene | 22-Jul | 5-Aug | 0.0191 | 0.0175 | 57.1 |
| Tahoe NF | Serene | 5-Aug | 19-Aug | 0.0153 | 0.0190 | 53.5 |
| Tahoe NF | Serene | 19-Aug | 2-Sep | 0.0253 | 0.0192 | 69.4 |
| Tahoe NF | Serene | 2-Sep | 16-Sep | 0.0184 | 0.0184 | 57.4 |
| Tahoe NF | Serene | 16-Sep | 30-Sep | 0.0183 | 0.0193 | 58.6 |
| Tahoe NF | Hobart | 13-May | 27-May | 0.0109 | 0.0109 | 34.0 |
| Tahoe NF | Hobart | 27-May | 9-Jun | 0.0110 | 0.0108 | 34.0 |
| Tahoe NF | Hobart | 9-Jun | 24-Jun | 0.0117 | 0.0129 | 38.4 |
| Tahoe NF | Hobart | 24-Jun | 8-Jul | 0.0124 | 0.0095 | 34.1 |
| Tahoe NF | Hobart | 8-Jul | 22-Jul | 0.0122 | 0.0119 | 37.6 |
| Tahoe NF | Hobart | 22-Jul | 5-Aug | 0.0112 | 0.0105 | 33.8 |
| Tahoe NF | Hobart | 5-Aug | 19-Aug | 0.0115 | 0.0104 | 34.1 |
| Tahoe NF | Hobart | 19-Aug | 2-Sep | 0.0114 | 0.0116 | 35.9 |
| Tahoe NF | Hobart | 2-Sep | 16-Sep | 0.0119 | 0.0121 | 37.4 |
| Tahoe NF | Hobart | 16-Sep | 30-Sep | 0.0124 | 0.0134 | 40.2 |
| Tahoe NF | Foresthill Road | 13-May | 27-May | 0.0161 | 0.0184 | 53.8 |
| Tahoe NF | Foresthill Road | 27-May | 10-Jun | 0.0148 | 0.0135 | 44.1 |
| Tahoe NF | Foresthill Road | 10-Jun | 24-Jun | 0.0171 | 0.0203 | 58.3 |
| Tahoe NF | Foresthill Road | 24-Jun | 8-Jul | 0.0163 | 0.0165 | 51.1 |
| Tahoe NF | Foresthill Road | 8-Jul | 22-Jul | 0.0208 | 0.0192 | 62.4 |
| Tahoe NF | Foresthill Road | 22-Jul | 4-Aug | 0.0174 | 0.0209 | 59.7 |
| Tahoe NF | Foresthill Road | 4-Aug | 19-Aug | 0.0168 | 0.0155 | 50.4 |
| Tahoe NF | Foresthill Road | 19-Aug | 2-Sep | 0.0394 | 0.0202 | 92.9 |
| Tahoe NF | Foresthill Road | 2-Sep | 16-Sep | 0.0246 | 0.0219 | 72.5 |
| Tahoe NF | Foresthill Road | 16-Sep | 29-Sep | 0.0166 | 0.0175 | 53.2 |
| Tahoe NF | Foresthill Seed Orchard | 13-May | 27-May | 0.0132 | 0.0173 | 47.5 |
| Tahoe NF | Foresthill Seed Orchard | 27-May | 10-Jun | 0.0157 | 0.0136 | 45.7 |
| Tahoe NF | Foresthill Seed Orchard | 10-Jun | 24-Jun | 0.0181 | 0.0183 | 56.7 |
| Tahoe NF | Foresthill Seed Orchard | 24-Jun | 8-Jul | 0.0160 | 0.0166 | 50.8 |
| Tahoe NF | Foresthill Seed Orchard | 8-Jul | 22-Jul | 0.0213 | 0.0201 | 64.5 |
| Tahoe NF | Foresthill Seed Orchard | 22-Jul | 4-Aug | 0.0196 | 0.0191 | 60.3 |
| Tahoe NF | Foresthill Seed Orchard | 4-Aug | 19-Aug | 0.0171 | 0.0160 | 51.6 |
| Tahoe NF | Foresthill Seed Orchard | 19-Aug | 2-Sep | 0.0207 | 0.0204 | 64.1 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|
| Tahoe NF | Foresthill Seed Orchard | 2-Sep | 16-Sep | 0.0032 | 0.0200 | 36.2 |
| Tahoe NF | Foresthill Seed Orchard | 16-Sep | 29-Sep | 0.0193 | 0.0177 | 57.7 |
| Sequoia NP | Three Pole Corner | 26-May | 9-Jun | 0.0168 | 0.0184 | 54.9 |
| Sequoia NP | Three Pole Corner | 9-Jun | 24-Jun | 0.0266 | 0.0266 | 82.9 |
| Sequoia NP | Three Pole Corner | 24-Jun | 8-Jul | 0.0268 | 0.0276 | 84.8 |
| Sequoia NP | Three Pole Corner | 8-Jul | 21-Jul | 0.0212 | 0.0219 | 67.2 |
| Sequoia NP | Three Pole Corner | 21-Jui | 3-Aug | 0.0254 | 0.0251 | 78.7 |
| Sequoia NP | Three Pole Corner | 3-Aug | 17-Aug | 0.0193 | 0.0192 | 60.0 |
| Sequoia NP | Three Pole Corner | 17-Aug | 1-Sep | 0.0232 | 0.0237 | 73.1 |
| Sequoia NP | Three Pole Corner | 1-Sep | 14-Sep | 0.0249 | 0.0241 | 76.4 |
| Sequoia NP | Three Pole Corner | 14-Sep | 30-Sep | 0.0240 | 0.0229 | 73.1 |
| Sequoia NP | Three Pole Corner | 30-Sep | 14-Oct | 0.0203 | 0.0203 | 63.3 |
| Sequoia NP | Little Baldy Saddle | 13-May | 26-May | 0.0175 | 0.0172 | 54.1 |
| Sequoia NP | Little Baldy Saddle | 26-May | 9-Jun | 0.0165 | 0.0159 | 50.5 |
| Sequoia NP | Little Baldy Saddle | 9-Jun | 24-Jun | 0.0252 | 0.0252 | 78.6 |
| Sequoia NP | Little Baldy Saddle | 24-Jun | 7-Jul | 0.0228 | 0.0228 | 71.1 |
| Sequoia NP | Little Baldy Saddle | 7-Jul | 21-Jul | 0.0211 | 0.0202 | 64.4 |
| Sequoia NP | Little Baldy Saddle | 21-Jul | 4-Aug | 0.0224 | 0.0229 | 70.6 |
| Sequoia NP | Little Baldy Saddle | 4-Aug | 18-Aug | 0.0174 | 0.0174 | 54.3 |
| Sequoia NP | Little Baldy Saddle | 18-Aug | 2-Sep | 0.0212 | 0.0219 | 67.2 |
| Sequoia NP | Little Baldy Saddle | 2-Sep | 15-Sep | 0.0203 | 0.0209 | 64.2 |
| Sequoia NP | Little Baldy Saddle | 15-Sep | 29-Sep | 0.0192 | 0.0197 | 60.6 |
| Sequoia NP | Little Baldy Saddle | 29-Sep | 13-Oct | 0.0181 | 0.0181 | 56.4 |
| Sequoia NP | Pinehurst Work Center | 12-May | 26-May | 0.0174 | 0.0170 | 53.6 |
| Sequoia NP | Pinehurst Work Center | 26-May | 9-Jun | 0.0164 | 0.0166 | 51.4 |
| Sequoia NP | Pinehurst Work Center | 9-Jun | 23-Jun | 0.0259 | 0.0278 | 83.7 |
| Sequoia NP | Pinehurst Work Center | 24-Jun | 7-Jul | 0.0231 | 0.0241 | 73.6 |
| Sequoia NP | Pinehurst Work Center | 7-Jul | 21-Jul | 0.0261 | 0.0238 | 77.8 |
| Sequoia NP | Pinehurst Work Center | 21-Jul | 4-Aug | 0.0187 | 0.0190 | 58.8 |
| Sequoia NP | Pinehurst Work Center | 4-Aug | 19-Aug | 0.0215 | 0.0202 | 65.0 |
| Sequoia NP | Pinehurst Work Center | 19-Aug | 1-Sep | 0.0229 | 0.0239 | 73.0 |
| Sequoia NP | Pinehurst Work Center | 2-Sep | 16-Sep | 0.0289 | 0.0266 | 86.5 |
| Sequoia NP | Pinehurst Work Center | 16-Sep | 30-Sep | 0.0218 | 0.0222 | 68.6 |
| Sequoia NP | Swale Work Center | 27-May | 9-Jun | 0.0142 | 0.0132 | 42.7 |
| Sequoia NP | Swale Work Center | 9-Jun | 23-Jun | 0.0231 | 0.0225 | 71.1 |
| Sequoia NP | Swale Work Center | 26-Jun | 7-Jul | 0.0280 | 0.0260 | 84.2 |
| Sequoia NP | Swale Work Center | 7-Jul | 21-Jul | 0.0196 | 0.0191 | 60.3 |
| Sequoia NP | Swale Work Center | 22-Jul | 4-Aug | 0.0197 | 0.0175 | 58.0 |
| Sequoia NP | Swale Work Center | 4-Aug | 19-Aug | 0.0166 | 0.0167 | 51.9 |
| Sequoia NP | Swale Work Center | 19-Aug | 1-Sep | 0.0191 | 0.0195 | 60.2 |
| Sequoia NP | Swale Work Center | 1-Sep | 16-Sep | 0.0208 | 0.0216 | 66.1 |
| Sequoia NP | Swale Work Center | 16-Sep | 30-Sep | 0.0170 | 0.0168 | 52.7 |

Table A-2. Ambient ozone sites, beginning and ending exposure dates, oxidation rates and corresponding estimate ambient ozone for several additional sites in Sequoia National Park that were jointly funded with another project. These sites had 4 samplers per time period rather than 2 samplers per time period used for this study, and were located within a smaller area relative to other sampler sites used for this study.

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Sampler 3 Oxidation Rate | Sampler 4 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|---|---|
| Sequoia NP | Lower Kaweah | 12-May | 27-May | 0.0179 | 0.0170 | 0.0171 | 0.0173 | 54.0 |
| Sequoia NP | Lower Kaweah | 27-May | 9-Jun | 0.0168 | 0.0167 | 0.0156 | 0.0151 | 50.0 |
| Sequoia NP | Lower Kaweah | 9-Jun | 24-Jun | 0.0252 | 0.0247 | 0.0249 | 0.0239 | 76.9 |
| Sequoia NP | Lower Kaweah | 24-Jun | 8-Jul | 0.0244 | 0.0241 | 0.0229 | 0.0251 | 75.2 |
| Sequoia NP | Lower Kaweah | 8-Jul | 21-Jul | 0.0208 | 0.0204 | 0.0207 | 0.0203 | 64.1 |
| Sequoia NP | Lower Kaweah | 21-Jul | 3-Aug | 0.0203 | 0.0214 | 0.0201 | 0.0206 | 64.2 |
| Sequoia NP | Lower Kaweah | 3-Aug | 18-Aug | 0.0142 | 0.0144 | 0.0137 | 0.0146 | 44.4 |
| Sequoia NP | Lower Kaweah | 18-Aug | 1-Sep | 0.0200 | 0.0201 | 0.0196 | 0.0188 | 61.2 |
| Sequoia NP | Lower Kaweah | 1-Sep | 14-Sep | 0.0196 | 0.0201 | 0.0187 | 0.0197 | 60.9 |
| Sequoia NP | Lower Kaweah | 14-Sep | 29-Sep | 0.0179 | 0.0176 | 0.0180 | 0.0175 | 55.3 |
| Sequoia NP | Lower Kaweah | 29-Sep | 14-Oct | 0.0175 | 0.0173 | 0.0166 | 0.0180 | 54.1 |
| Sequoia NP | Crystal Cave | 12-May | 27-May | 0.0161 | 0.0158 | 0.0162 | 0.0158 | 49.8 |
| Sequoia NP | Crystal Cave | 27-May | 9-Jun | 0.0140 | 0.0128 | 0.0141 | 0.0135 | 42.4 |
| Sequoia NP | Crystal Cave | 9-Jun | 24-Jun | 0.0151 | 0.0142 | 0.0136 | 0.0155 | 45.5 |
| Sequoia NP | Crystal Cave | 8-Jul | 21-Jul | 0.0168 | 0.0176 | 0.0174 | 0.0174 | 53.9 |
| Sequoia NP | Crystal Cave | 21-Jul | 4-Aug | 0.0205 | 0.0206 | 0.0216 | 0.0218 | 65.9 |
| Sequoia NP | Crystal Cave | 4-Aug | 17-Aug | 0.0142 | 0.0149 | 0.0146 | 0.0141 | 45.1 |
| Sequoia NP | Crystal Cave | 17-Aug | 1-Sep | 0.0165 | 0.0172 | 0.0178 | 0.0171 | 53.5 |
| Sequoia NP | Crystal Cave | 1-Sep | 14-Sep | 0.0194 | 0.0190 | 0.0191 | 0.0199 | 60.3 |
| Sequoia NP | Crystal Cave | 14-Sep | 30-Sep | 0.0174 | 0.0175 | 0.0173 | 0.0174 | 54.3 |
| Sequoia NP | Crystal Cave | 30-Sep | 14-Oct | 0.0163 | 0.0162 | 0.0159 | 0.0161 | 50.3 |
| Sequoia NP | Stony Creek | 13-May | 26-May | 0.0135 | 0.0130 | 0.0136 | 0.0134 | 41.7 |
| Sequoia NP | Stony Creek | 26-May | 9-Jun | 0.0125 | 0.0118 | 0.0131 | 0.0132 | 39.4 |
| Sequoia NP | Stony Creek | 9-Jun | 24-Jun | 0.0177 | 0.0186 | 0.0181 | 0.0183 | 56.7 |
| Sequoia NP | Stony Creek | 24-Jun | 7-Jul | 0.0173 | 0.0180 | 0.0178 | 0.0174 | 55.0 |
| Sequoia NP | Stony Creek | 7-Jul | 21-Jul | 0.0142 | 0.0148 | 0.0145 | 0.0147 | 45.4 |
| Sequoia NP | Stony Creek | 21-Jul | 4-Aug | 0.0170 | 0.0165 | 0.0166 | 0.0162 | 51.7 |
| Sequoia NP | Stony Creek | 4-Aug | 18-Aug | 0.0135 | 0.0132 | 0.0131 | 0.0137 | 41.7 |
| Sequoia NP | Stony Creek | 18-Aug | 2-Sep | 0.0155 | 0.0165 | 0.0161 | 0.0159 | 49.9 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Sampler 3 Oxidation Rate | Sampler 4 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|---|---|
| Sequoia NP | Stony Creek | 2-Sep | 15-Sep | NA | 0.0196 | 0.0184 | 0.0192 | 59.4 |
| Sequoia NP | Stony Creek | 15-Sep | 29-Sep | 0.0136 | 0.0150 | 0.0138 | 0.0141 | 44.0 |
| Sequoia NP | Stony Creek | 29-Sep | 13-Oct | 0.0153 | 0.0150 | 0.0153 | 0.0155 | 47.6 |
| Sequoia NP | Wolverton | 12-May | 26-May | 0.0124 | 0.0139 | 0.0136 | 0.0138 | 41.9 |
| Sequoia NP | Wolverton | 26-May | 9-Jun | 0.0127 | 0.0133 | 0.0116 | 0.0103 | 37.3 |
| Sequoia NP | Wolverton | 9-Jun | 24-Jun | 0.0190 | 0.0190 | 0.0186 | 0.0190 | 58.9 |
| Sequoia NP | Wolverton | 24-Jun | 8-Jul | 0.0140 | 0.0138 | 0.0143 | 0.0139 | 43.7 |
| Sequoia NP | Wolverton | 8-Jul | 21-Jul | 0.0123 | 0.0125 | 0.0126 | 0.0123 | 38.7 |
| Sequoia NP | Wolverton | 21-Jul | 3-Aug | 0.0134 | 0.0136 | 0.0142 | 0.0139 | 43.0 |
| Sequoia NP | Wolverton | 3-Aug | 18-Aug | 0.0114 | 0.0110 | 0.0112 | 0.0119 | 35.5 |
| Sequoia NP | Wolverton | 18-Aug | 1-Sep | 0.0134 | 0.0130 | 0.0132 | 0.0135 | 41.4 |
| Sequoia NP | Wolverton | 1-Sep | 14-Sep | 0.0144 | 0.0138 | 0.0140 | 0.0144 | 44.1 |
| Sequoia NP | Wolverton | 14-Sep | 29-Sep | 0.0104 | 0.0103 | 0.0103 | 0.0119 | 33.4 |
| Sequoia NP | Wolverton | 29-Sep | 13-Oct | 0.0111 | 0.0114 | 0.0113 | 0.0115 | 35.3 |
| Sequoia NP | Ash Mountain | 12-May | 26-May | 0.0167 | 0.0164 | 0.0168 | 0.0176 | 52.6 |
| Sequoia NP | Ash Mountain | 26-May | 9-Jun | 0.0176 | 0.0167 | 0.0171 | 0.0169 | 53.2 |
| Sequoia NP | Ash Mountain | 9-Jun | 24-Jun | 0.0241 | 0.0245 | 0.0233 | 0.0240 | 74.8 |
| Sequoia NP | Ash Mountain | 24-Jun | 8-Jul | 0.0238 | 0.0241 | 0.0211 | 0.0233 | 71.9 |
| Sequoia NP | Ash Mountain | 8-Jul | 21-Jul | 0.0189 | 0.0202 | 0.0207 | 0.0207 | 62.7 |
| Sequoia NP | Ash Mountain | 21-Jul | 3-Aug | 0.0211 | 0.0205 | 0.0220 | 0.0235 | 67.9 |
| Sequoia NP | Ash Mountain | 3-Aug | 17-Aug | 0.0200 | 0.0195 | 0.0190 | 0.0191 | 60.5 |
| Sequoia NP | Ash Mountain | 17-Aug | 1-Sep | 0.0226 | 0.0226 | 0.0224 | 0.0221 | 69.9 |
| Sequoia NP | Ash Mountain | 1-Sep | 14-Sep | 0.0229 | 0.0224 | 0.0226 | 0.0226 | 70.5 |
| Sequoia NP | Ash Mountain | 14-Sep | 30-Sep | 0.0216 | 0.0207 | 0.0211 | 0.0228 | 67.2 |
| Sequoia NP | Ash Mountain | 30-Sep | 14-Oct | 0.0191 | 0.0174 | 0.0185 | 0.0178 | 56.7 |
| Sequoia NP | Marble Fork | 12-May | 26-May | 0.0141 | 0.0136 | 0.0125 | 0.0136 | 41.9 |
| Sequoia NP | Marble Fork | 26-May | 9-Jun | 0.0130 | 0.0122 | 0.0123 | 0.0125 | 39.0 |
| Sequoia NP | Marble Fork | 9-Jun | 24-Jun | 0.0189 | 0.0186 | 0.0182 | 0.0184 | 57.8 |
| Sequoia NP | Marble Fork | 24-Jun | 7-Jul | 0.0180 | 0.0179 | 0.0171 | 0.0179 | 55.3 |
| Sequoia NP | Marble Fork | 7-Jul | 21-Jul | 0.0132 | 0.0141 | 0.0136 | 0.0138 | 42.6 |
| Sequoia NP | Marble Fork | 21-Jul | 4-Aug | 0.0169 | 0.0167 | 0.0171 | 0.0172 | 52.9 |
| Sequoia NP | Marble Fork | 4-Aug | 18-Aug | 0.0125 | 0.0129 | 0.0126 | 0.0128 | 39.6 |
| Sequoia NP | Marble Fork | 18-Aug | 2-Sep | 0.0164 | 0.0161 | 0.0160 | 0.0168 | 50.9 |
| Sequoia NP | Marble Fork | 2-Sep | 15-Sep | 0.0154 | 0.0158 | 0.0154 | 0.0155 | 48.4 |
| Sequoia NP | Marble Fork | 15-Sep | 29-Sep | 0.0122 | 0.0125 | 0.0125 | 0.0123 | 38.6 |
| Sequoia NP | Marble Fork | 29-Sep | 13-Oct | 0.0124 | 0.0130 | 0.0126 | 0.0130 | 39.8 |
| Sequoia NP | Huckleberry Meadow | 13-May | 27-May | 0.0156 | 0.0161 | 0.0160 | 0.0162 | 49.8 |
| Sequoia NP | Huckleberry Meadow | 27-May | 9-Jun | 0.0142 | 0.0139 | 0.0146 | 0.0168 | 46.4 |

| Forest | Site Name | Date On | Date Off | Sampler 1 Oxidation Rate | Sampler 2 Oxidation Rate | Sampler 3 Oxidation Rate | Sampler 4 Oxidation Rate | Ozone (ppb-hr) |
|---|---|---|---|---|---|---|---|---|
| Sequoia NP | Huckleberry Meadow | 9-Jun | 24-Jun | 0.0228 | 0.0225 | 0.0226 | 0.0228 | 70.7 |
| Sequoia NP | Huckleberry Meadow | 24-Jun | 8-Jul | 0.0232 | 0.0224 | 0.0225 | 0.0231 | 71.1 |
| Sequoia NP | Huckleberry Meadow | 8-Jul | 21-Jul | 0.0183 | 0.0184 | 0.0193 | 0.0189 | 58.4 |
| Sequoia NP | Huckleberry Meadow | 21-Jul | 3-Aug | 0.0191 | 0.0189 | 0.0186 | 0.0183 | 58.4 |
| Sequoia NP | Huckleberry Meadow | 3-Aug | 18-Aug | NA | 0.0155 | 0.0163 | 0.0145 | 48.1 |
| Sequoia NP | Huckleberry Meadow | 18-Aug | 1-Sep | 0.0198 | 0.0187 | 0.0210 | 0.0186 | 60.9 |
| Sequoia NP | Huckleberry Meadow | 1-Sep | 14-Sep | 0.0182 | 0.0198 | 0.0204 | 0.0200 | 61.1 |
| Sequoia NP | Huckleberry Meadow | 14-Sep | 30-Sep | 0.0178 | 0.0193 | 0.0173 | 0.0174 | 56.0 |
| Sequoia NP | Huckleberry Meadow | 30-Sep | 13-Oct | 0.0181 | 0.0178 | 0.0183 | 0.0173 | 55.7 |