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2008 Report

Monitoring Fuel Treatments Across the Continental United States for Overall Effectiveness and Effects on Aquatic and Terrestrial Habitat, Air and Water Quality

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The Wildland Fire Leadership Council

The Wildland Fire Leadership Council was established in April 2002 by the Secretaries of Agriculture and Interior to provide an intergovernmental committee to support the implementation and coordination of Federal Fire Management Policy. The Council, an intergovernmental committee of Federal, State, Tribal, county, and municipal government officials, meets regularly to provide oversight and coordination of the National Fire Plan and the Federal Wildland Fire Management Policy.

The Council also provides strategic oversight to ensure policy coordination, accountability, and effective implementation of Federal Wildland Fire Management Policy—as well as related long-term strategies that address wildfire suppression, assistance to communities, hazardous fuels reduction, habitat restoration, and rehabilitation of our Nation's forests and rangelands.

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Cover Photographs

Top: Prescribed fire treatment on Midewin National Tallgrass Prairie in Illinois.
Bottom Left: Wildland-urban interface area on the Superior National Forest in Minnesota.
Bottom Right: Interdisciplinary monitoring team members on the Apalachicola National Forest in Florida.

All photos in this report provided by this project's interdisciplinary monitoring teams.

Figures

Tables

More detailed information on this report's fuel treatment monitoring project—including a full set of datasheets—is available on the project's Webpage:
http://www.fs.fed.us/adaptivemanagement/wflc/

The relatively tight confidence band indicates that fuel treatment objectives are being met to a high degree in all sections of the country by both the Bureau of Land Management and U.S. Forest Service.

Executive Summary

In 2007, the Wildland Fire Leadership Council (WFLC) organized a task group to:

- Develop a monitoring plan for implementing a directive from the National Fire Plan's *10-Year Implementation Strategy*, and
- Respond to the Healthy Forest Restoration Act requirement of monitoring a representative sample of projects.

This report was completed to fulfill the above directive and requirement.

A broad-based monitoring approach was utilized to qualitatively answer specific monitoring questions about overall fuel treatment objectives and treatment effects on aquatic and terrestrial habitat and air and water quality.

In 2008, the USDA Forest Service and the USDI Bureau of Land Management (BLM) began implementing this approach and conducting joint monitoring of hazardous fuel treatments. To accomplish this task, the continental United States was divided into four quadrants. Thirty sample fuel treatment sites were randomly selected within each quadrant, representing a total of 120 fuel treatment sample sites.

Monitoring was completed on 98 percent of the selected sites. Most of the monitored sites (71 percent) were within the wildland-urban interface. Most of the treatments involved prescribed fire as a stand-alone treatment (42 percent), or were combined with mechanical/manual treatments (28 percent).

Fuel Treatment Objectives Met

Overall, monitoring teams reported that the treatments met the fuel treatment objectives on 92 percent of the sites—attaining the 95 percent "confidence interval" (calculated to determine the reliability of the estimate) of 87.5 to 97.2 percent. The relatively tight confidence band indicates that fuel treatment objectives are being met to a high degree in all sections of the country by both Bureau of Land Management and Forest Service.

When reviewing treatment objectives by vegetation type, the percent of monitored sites meeting fuel treatment objectives exceeded 85 percent for the three broad categories of vegetation types with more than 15 sites sampled (shrub land, 100 percent; woodland, 88 percent; and forested land, 93 percent).

Mitigation measures and project design were successful in limiting unwanted effects on resources. The majority of responses (99 percent of sites) indicated that no adverse effect on other resources had occurred. This finding demonstrates that current mitigations to avoid adverse effects are working. Adverse effects on terrestrial habitat from fuel treatments were reported on only one site (less than 1 percent of the sites). No adverse effects were reported on any treatment sites related to aquatic habitat or air and water quality.

Positive Affect on Environmental Resources

While nearly one-fourth of the responses (24 percent of sites) indicated a positive affect on environmental resources, positive effects varied from 3.3 percent to 72 percent of the monitored sites. Positive environmental effects from fuel treatments were reported on aquatic habitat (7.6 percent of the sites), terrestrial habitat (68 percent of the sites), air quality (11 percent of the sites), and water quality (7.6 percent of sites).

When those sites where environmental categories were reported as "not applicable" were removed, the percent of sites with positive effects increased (aquatic habitat, 21 percent; terrestrial habitat, 74 percent; air quality, 20 percent; and water quality, 17 percent).

Overall, terrestrial habitat appeared to receive positive effects from fuel treatments to a greater extent than aquatic habitat, air quality, or water quality. Air and water quality appeared to have the lowest percentage of positive effects from the fuel treatments.

It should be noted that a "no effect" response on aquatic and terrestrial habitat and air and water quality could be considered encouraging in terms of a lack of negative impacts from fuel treatment implementation.

Fuel Treatments are Meeting Desired Treatment Objectives

In response to the two broad monitoring questions posed by WFLC, results indicate that fuel treatments are broadly effective at meeting desired treatment objectives (over 90 percent of the sites) and rarely (less than 1 percent of the sites) negatively impact aquatic and terrestrial habitat, air and water quality.

It is important to note that in the case of air quality—due to reduced fuel loading and therefore a lesser chance of catastrophic wildland fire which would reduce or eliminate potentially harmful emissions—most positive impacts are actually expected to occur in the future.

I Introduction

In 2008, the USDI Bureau of Land Management (BLM) and USDA Forest Service (FS) completed the first year of monitoring fuel treatments at a national scale. The goal of the monitoring effort was to determine if fuel treatments are effective and if they are affecting any environmental resources. The results of this monitoring:

- Provide information to those developing future fuel treatment strategies,
- Provide input for environmental analysis, and
- Highlight needs for future research.

This and future national monitoring efforts will be used to identify trends over time. This trend analysis may also highlight areas where more intensive monitoring or additional research would be beneficial. This report will also provide information in response to the National Fire Plan *10-Year Comprehensive Strategy* and Congress' requirement in the Healthy Forests Restoration Act (HFRA) to monitor a representative sample of projects.

In 2007, a broad-based monitoring approach was approved by the Wildland Fire Leadership Council (WFLC). This project was designed to qualitatively answer specific monitoring questions about overall fuel treatment objectives and treatment effects on aquatic and terrestrial habitat and air and water quality.

Post-treatment observations and qualitative judgments were made on a randomly selected sample of 120 fuel treatment projects on National Forest System and BLM public lands. This monitoring effort was conducted in a consistent manner to assure that its results could be aggregated nationally.

General Protocol Description

A standardized monitoring protocol was developed to ensure consistency across the nation in reviewing a sample of hazardous fuel treatments and in summarizing results at the geographic and national levels.

Monitoring questions were investigated and results were submitted on standardized worksheets. (See sample worksheets in Appendix A.) Some flexibility was provided, such as allowing individual field offices and local stakeholders to determine the attributes that best addressed aquatic and terrestrial habitat, air and water quality, as well as project objectives to determine fuel treatment effectiveness.

The continental United States was divided into four quadrants: Northeast (NE), Northwest (NW), Southeast (SE), and Southwest (SW). Thirty samples were selected within each quadrant, representing a total sample size of 120 fuel treatment sample sites.

Projects were randomly selected from the National Fire Plan Operations and Reporting System (NFPORS) database from projects completed in 2005 and 2006. (Project locations are depicted by agency in Figure 3.)

Selected fuel treatment sites varied in size from one acre to 10,000 acres, for a total of 62,533 acres. Approximately two percent of the 2005 and 2006 treatment acres were selected for monitoring (out of a total of 3,589,166 acres treated).

Figure 1 – Project site on the Helena National Forest in Montana that featured both mechanical and prescribed fire treatments.

Multi-Party Monitoring Teams

Multi-party teams (including resource specialists) were convened to conduct the fuel treatment monitoring.

The hosting unit invited local stakeholders and non-agency personnel to assist in formulating the specific monitoring questions and to conduct subsequent field monitoring.

To better understand project results,
the multi-party monitoring teams involved people
with a diversity of experience and backgrounds.

To better understand project results, the multi-party monitoring teams involved people with a diversity of experience and backgrounds. Each team was asked to develop a maximum of three objectives for treatment effectiveness, and a maximum of three attributes each for aquatic and terrestrial habitat and air and water quality effects.

The teams qualitatively rated the selected fuel treatment projects to determine their effectiveness in achieving site-specific fuel objectives. The teams also rated site-specific effects (intended or unintended) the treatment had on aquatic and terrestrial habitat, and air and water quality based on the attributes chosen earlier.

The results were documented on the provided monitoring worksheets. A monitoring facilitator assisted each local unit team to ensure that a uniform approach was utilized for all samples.

Monitoring facilitators were provided by the Forest Service Adaptive Management Services Enterprise Team.

Figure 2 – Nighttime prescribed fire on the Stanislaus National Forest in California. The national monitoring project—outlined in this report—was designed to qualitatively answer specific questions about overall fuel treatment objectives and treatment effects on aquatic and terrestrial habitat and air and water quality. Post-treatment observations and qualitative judgments were made on a randomly selected sample of 120 fuel treatment projects on National Forest System and Bureau of Land Management public lands.

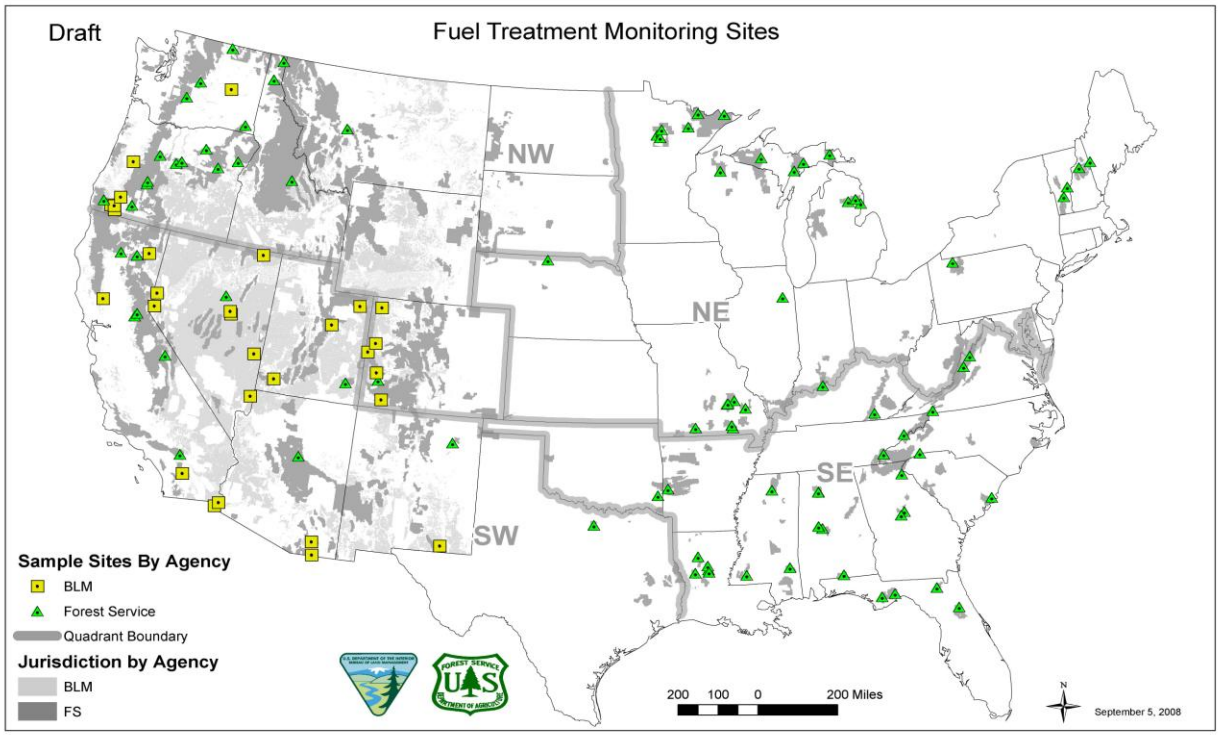

Figure 3 – Map of the 2008 fuel treatment monitoring sites.

Project Site Descriptions

A project was defined as one footprint or contiguous area receiving one or more vegetation treatments designed to achieve an overall fuels objective. Samples were selected from projects where all the specified treatments had been completed. While other treatments—such as chemical or biological—could have occurred on the selected project site, at least one entry must have been prescribed fire or mechanical/manual treatment. To avoid overburdening any individual field office, no more than two sites were selected for monitoring in any one field office.

Prior to initiating project site visits, each unit that had a monitoring project site was contacted to validate that all treatments on that site had, in fact, been completed as well as to collect additional project information.

Substitute projects were selected from a reserve random sample list for the following cases: the specified treatments had not been completed (13); a project site could not be accessed (2); a unit had more than two sites selected (5); or fire activity precluded access (3).

This reserve list consisted of an additional 30 randomly drawn projects from each quadrant. Projects that were represented by one of these criteria for removal: nine sites in the NE quadrant, one site in the SE quadrant, seven sites in the NW quadrant, and six

sites in the SW quadrant. When this occurred in the NE and SE quadrants, the first available randomly selected Forest Service reserve project listed for that quadrant was substituted for the originally selected project. When this occurred in the NW and SW quadrants, the first available BLM project listed on the reserve list was substituted. This was done to more evenly represent the number of projects from each agency in the NW and SW quadrants.

Two Questions Formed Monitoring Effort Basis

Two questions that relate directly to the environmental effects and effectiveness of fuel treatments formed the basis of this monitoring effort:

- What are the environmental effects of fuel treatment on aquatic and terrestrial habitat and air and water quality?
- What are the trends in effectiveness of fuel treatment for achieving desired fire behavior objectives?

First, the monitoring teams identified up to three fuel treatment objectives to monitor. These potential monitoring objectives included:

- Reducing fuel loading per acre,
- Eliminating or reducing ladder fuel,
- Changing future fire behavior, and
- Restoring fire-adapted ecosystems.

In addition, up to three monitoring attributes were evaluated for each resource area (aquatic and terrestrial habitat, air and water quality). In determining attributes for aquatic and terrestrial habitats and air and water quality, the teams:

- Identified any potential effects addressed in the project planning documents.
- Identified any mitigation measures included in the planning documents.
- Identified where no impacts were anticipated to these resources from the project.

Project planning documents and land and resource management plans were referred to in the development of these objectives and attributes. Prior to the field site visit, objectives, attributes, and other basic information about the project were documented on monitoring worksheets. Individual monitoring worksheets were developed to document treatment effectiveness and treatment effects on aquatic and terrestrial habitat and air and water quality. (Evidence of surface erosion is an example of an attribute for water quality and aquatic habitat.)

Field monitoring was conducted on each selected project site. The team qualitatively rated each of the selected objectives for effectiveness and rated each attribute related to environmental effects—recording the ratings and field observations on the monitoring worksheets.

To provide an opportunity to revisit sites, at least one digital photo was taken at a "photo point" established at each project site. This photo point was chosen to show a representative area of the fuel treatment project. The photo points were identified by a GPS (UTM) point and compass direction.

Figure 4 – One of the interdisciplinary monitoring teams on the Deschutes National Forest in Oregon.

II Analysis and Results

Analysis

The completed monitoring worksheets—targeting the effectiveness and treatment effects on aquatic and terrestrial habitat and air and water quality—were compiled and analyzed. This process included:

- A content analysis of the remarks, and
- A statistical analysis based on number of acres treated and sites sampled.

Results were reported for each of the four quadrants in the continental United States (SE, NE, SW, and NW) and combined for national analysis.

Sample Selection Procedure

A total of 120 sites (one percent of the total number of sites available) were randomly selected for fuel treatment environmental effects and effectiveness monitoring. The total number of sites monitored was limited by funding and resources available to accomplish the task.

This random draw was specifically chosen as the sample selection procedure to reduce potential bias and enable inferences to be drawn for the wider set of fuel treatment sites that were not monitored.

While a one percent sample size can result in lower precision estimates than a larger sample size, "confidence intervals" were calculated to determine the reliability of the estimate. The narrower the "confidence interval," the more reliable the estimate for the total population of fuel treatments. For instance, the results indicate that 92 percent of the fuel treatments were effective at meeting the fuel treatment objectives. The 95 percent lower confidence level is 87.5 percent, while the upper confidence level is 97.2 percent.

Thus, if sampling were to be repeated a greater number of times and 120 samples were drawn each time, it is expected that the number of sites reported as being effective at meeting the fuel treatment objectives would still be between 87.5 and 97.2 percent—at least 95 percent of the time.

In this situation, it is highly unlikely that a sample of 120 treatments would result in a considerably lower percentage of the sites (only 75 percent) meeting the fuel treatment objectives.

For the analysis of this 2008 monitoring data, the relatively tight confidence band indicates that fuel treatment objectives are being met to a high degree in all quadrants of the country by both the USDI Bureau of Land Management and USDA Forest Service.

Results

Of the 120 sites selected, teams successfully monitored more than 98 percent (118 sites). Of those sampled, 88 were Forest Service and 30 were Bureau of Land Management projects. While the number of sites selected may seem disproportionate, BLM has very little responsibility for surface land management in the NE and SE quadrants.

Results are presented for all the monitored sites (FS and BLM combined) as a percent of total acres treated and percent of sites sampled. For treatment effectiveness and treatment effects on aquatic and terrestrial habitat and air and water quality, results are displayed both by vegetation category and by quadrant.

National Fire Plan Goals

Each site was provided a list of National Fire Plan goals that best describe what the monitoring project was striving to achieve. Based on planning documents or implied goals, monitoring teams could select one or more of these National Fire Plan goals.

The results of data collected for this element are summarized in Table 1. As expected, the goal of reducing hazardous fuel was most common, and the goal of restoring a fire-adapted ecosystem was also quite widespread.

Table 1 – Summary of Chosen National Fire Plan Goals with BLM and FS Sites Combined.

National Fire Plan Stated Goals	Number of Sites	Percent of Sites
Improve Fire Prevention and Suppression	10	8
Improve Fire Prevention and Suppression, Reduce Hazardous Fuels, and Restore Fire Adapted Ecosystems	1	0.9
Improve Fire Prevention and Suppression, Reduce Hazardous Fuels, and Promote Community Assistance/Protection.	1	0.9
Other	11	9
All Four Above	2	1.8
Promote Community Assistance/Protection	5	4
Promote Community Assistance/Protection and Restore Fire-Adapted Ecosystems	1	0.9
Reduce Hazardous Fuels	59	50
Reduce Hazardous Fuels and Restore Fire-Adapted Ecosystem	6	5
Restore Fire-Adapted Ecosystems	22	19.5
GRAND TOTAL	118	100

Of the 118 sites monitored, 53 sites (45 percent) had local stakeholders or non-agency participants as one or more members of the monitoring team. Of the two sites not visited, one was canceled because of miscommunications about treatment completion. The other non-visited site had scheduling conflicts within the hurricane response season and safe access issues.

Most of the monitored sites (71 percent) were within the wildland-urban interface (WUI). Nearly half of the monitored treatment sites (42 percent; 50 sites) were treated with prescribed fire, 30 percent (35 sites) had mechanical/manual treatments, and 28 percent (33 sites) had a combination of prescribed fire and mechanical/manual treatments. Figure 5 shows the breakdown of treatment types within and outside the WUI.

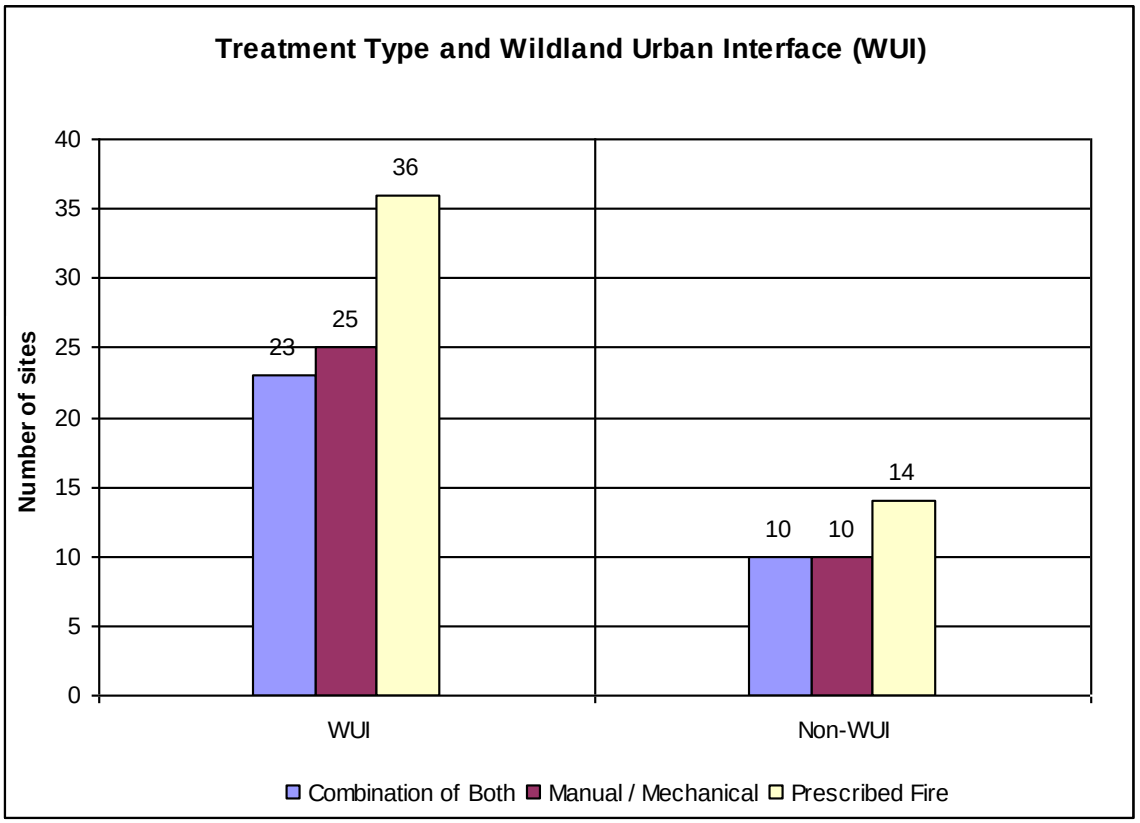

Figure 5 – Treatment types for wildland-urban interface and non-wildland-urban interface sites.

Fuel Treatment Effectiveness

As noted earlier, each monitoring team rated up to three fuel treatment objectives during the field visit. The teams rated each objective as "Totally Met," "Not Met," or "Partially Met."

Overall, monitoring teams reported that 99 percent of the acres monitored (92 percent of the sites) met the fuel treatment objectives. Little variation was seen among the quadrants based on total number of sites. This minimal variation ranged from 83 percent in the NE to 97 percent in the SW (Figure 7), as well as total amount of acres, ranging from 98 percent in the NE to 100 percent in the SE (Figure 8).

Only two sites, both in the NE, reported that their fuel treatment objectives were not met. Reasons given for objectives rated as "Partially Met" or "Not Met" included:

- Conditions during the prescribed fire did not allow for enough fuel consumption,
- Ladder fuels were not removed, or
- The fuelbreak created would not be effective in future large fire events.

Figure 6 – Mechanical treatment on the N.W. Diamond Valley Project, BLM Battle Mountain District in Nevada. Twenty-eight percent of this report's monitored sites involved project areas that featured mechanical/manual treatments.

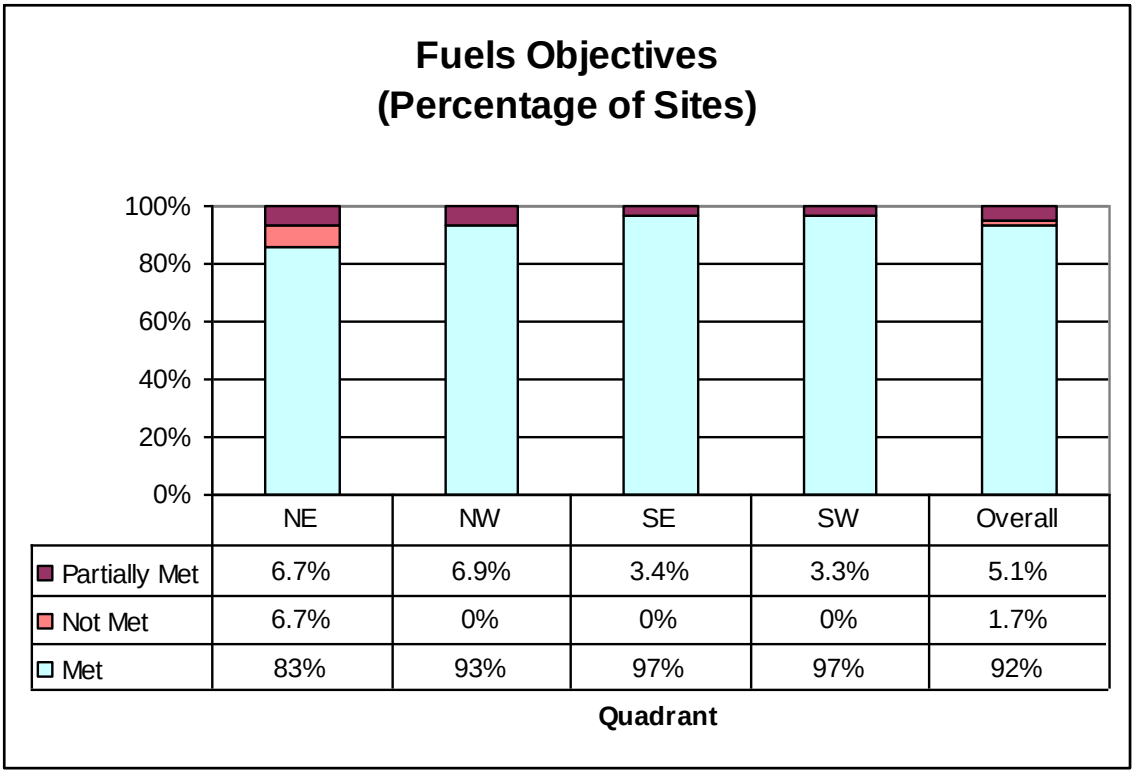

Figure 7 – Fuels objectives based on percent of sites treated.

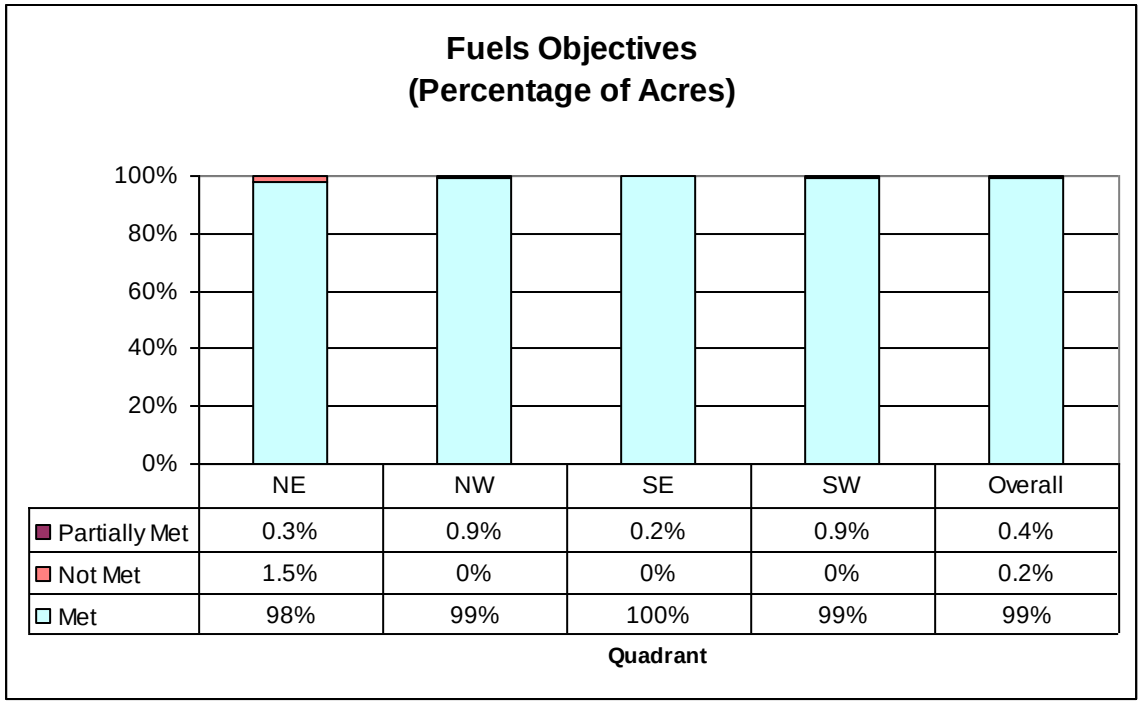

Figure 8 – Fuels objectives based on percent of acres treated.

III Effects on Air and Water Quality, and Terrestrial and Aquatic Habitat

Figure 9 – Implementing a prescribed burn on the Tahoe National Forest in California. This report's monitoring project noted that positive air quality impacts should occur in the future due to reduced fuel loadings that will lessen the chance of catastrophic wildland fire—reducing or eliminating potentially harmful emissions..

Effects on Air Quality

Figure 10 (fuel treatment effects on air quality based on percentage by site) and Figure 11 (fuel treatment effects on air quality based on percentage by acres) provide a summary of the monitoring results related to air quality.

Monitoring teams reported that none of the monitored sites had noteworthy adverse effects on air quality. Some short-term localized air quality changes were noted but were not deemed significant.

Based on responses from all monitoring sites, 11 percent (95 percent confidence bands are 5.3 to 16.7 percent) of the sites (29 percent of acres) reported a positive effect on air quality rating. If only those sites where air quality was reported as an applicable measure were considered separately, positive effects were reported on a greater percentage (20 percent) of those sites.

Considering all sites, the positive effects ranged from 6.7 percent in NE sites to 17 percent in SE sites (2.1 percent of NW acres to 37 percent of SE acres). Positive effect ratings were related to a reduction in the risk of future unwanted wildland fire—which might burn hotter and longer, producing smoke at higher levels than during prescribed fire.

Positive effect ratings
were related to a reduction in risk
of future wildland fire.

It is important to note that in the case of air quality, most positive impacts are actually expected to occur in the future due to reduced fuel loading and therefore a lesser chance of catastrophic wildland fire which would reduce or eliminate potentially harmful emissions.

Considering responses from all sites, 43 percent (47 percent of acres) reported a "no effect on air quality" rating. The "no effect on air quality" ranged from 28 percent of NW sites to 66 percent of SE sites (9.4 percent of NW acres to 52 percent of SW acres). Considering only those sites where air quality was reported as an applicable measure, "no effect on air quality" was reported on a greater percentage, 80 percent of those sites.

Reasons for "no effect on air quality" ratings included:

- Mechanical treatments that did not affect air quality,
- Treatments that met State Environmental Protection Agency standards,
- Effective mitigation measures, and
- Treatment design that minimized air quality effects.

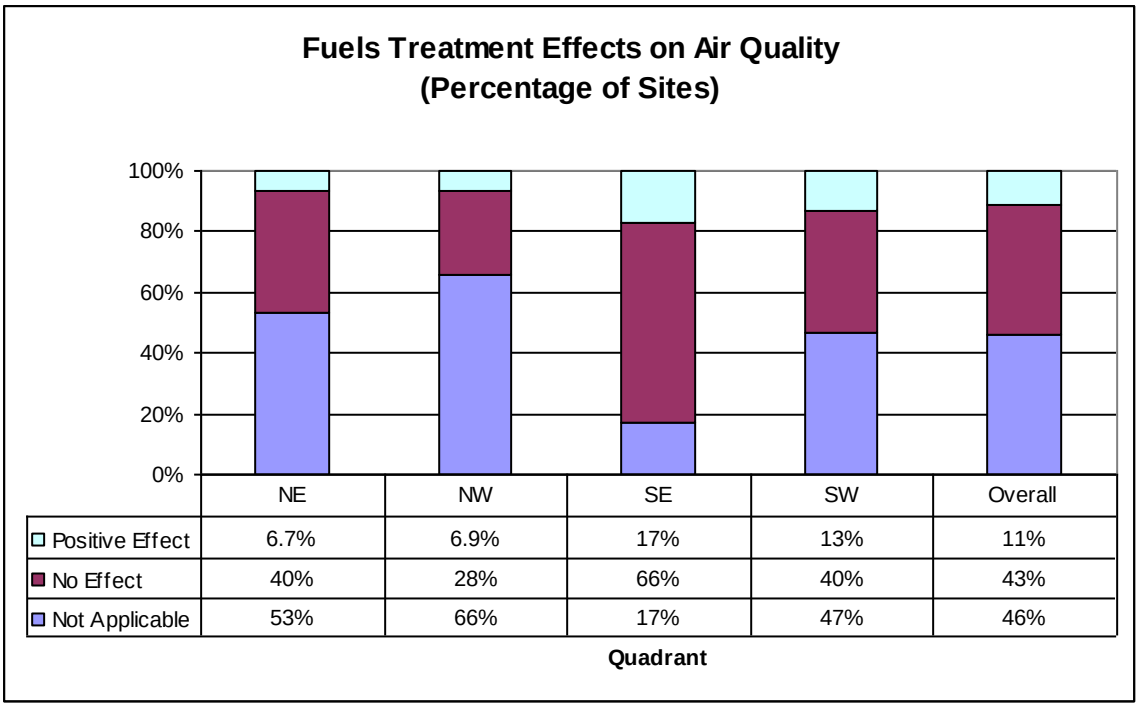

Figure 10 – Fuel treatment effects on air quality based on percent of sites.

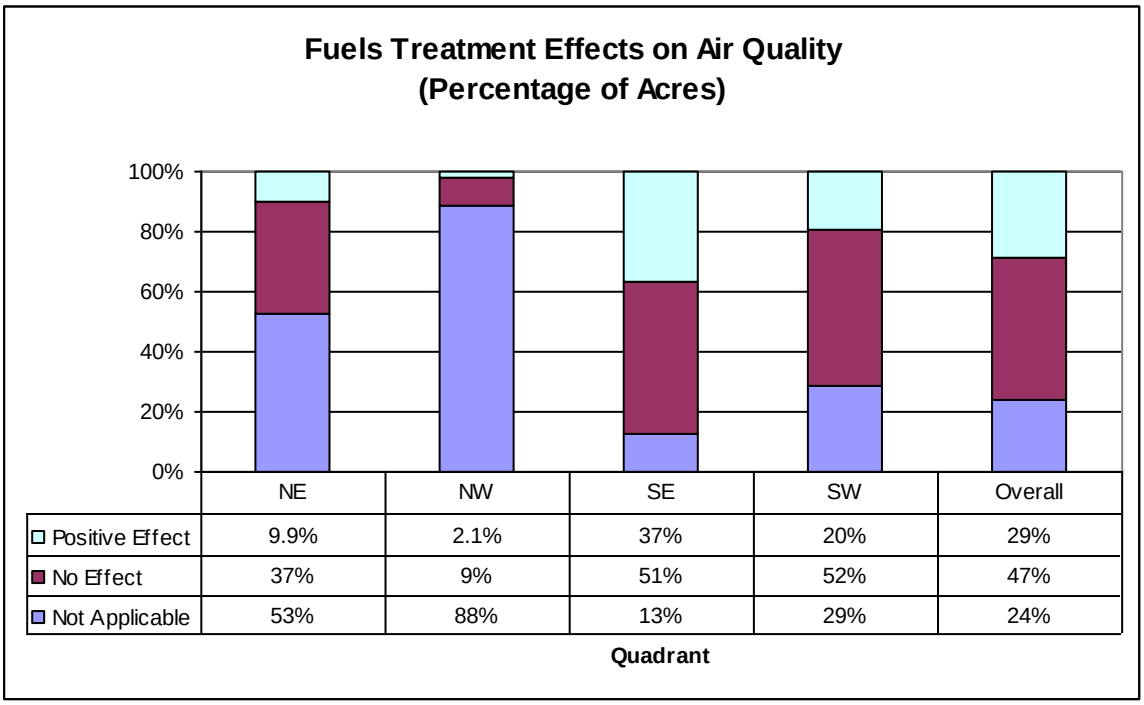

Figure 11 – Fuel treatment effects on air quality based on percent of acres.

Effects on Water Quality

Overall, monitoring teams reported no adverse effect from fuel treatments on water quality (figures 13 and 14). A positive effect was noted on 7.6 percent of the sites (the 95 percent "confidence interval" is 2.8 percent to 12.5 percent) and 8.3 percent of the acres.

Where reported, the positive effect was related to:

- Effective mitigation measures,
- Streamside buffers, and
- Reduction in the risk of future unwanted wildland fire spread.

No effect was reported on 38 percent of the sites (63 percent of the acres). Treatments were reported as having no effect because of effective project mitigation measures and soil type and topography that did not encourage soil movement.

Figure 12 –Treatment area (in background) on the Superior National Forest in Minnesota. Good water quality is crucial for many wildlife species as well as for humans.

If considering only those sites where water quality was reported as an applicable measure, the percentages increased. Seventeen percent of these sites reported positive effects and 83 percent reported no effect.

On 29 percent of the monitored sites, there was no water present on or near the site and the water quality effect was not applicable.

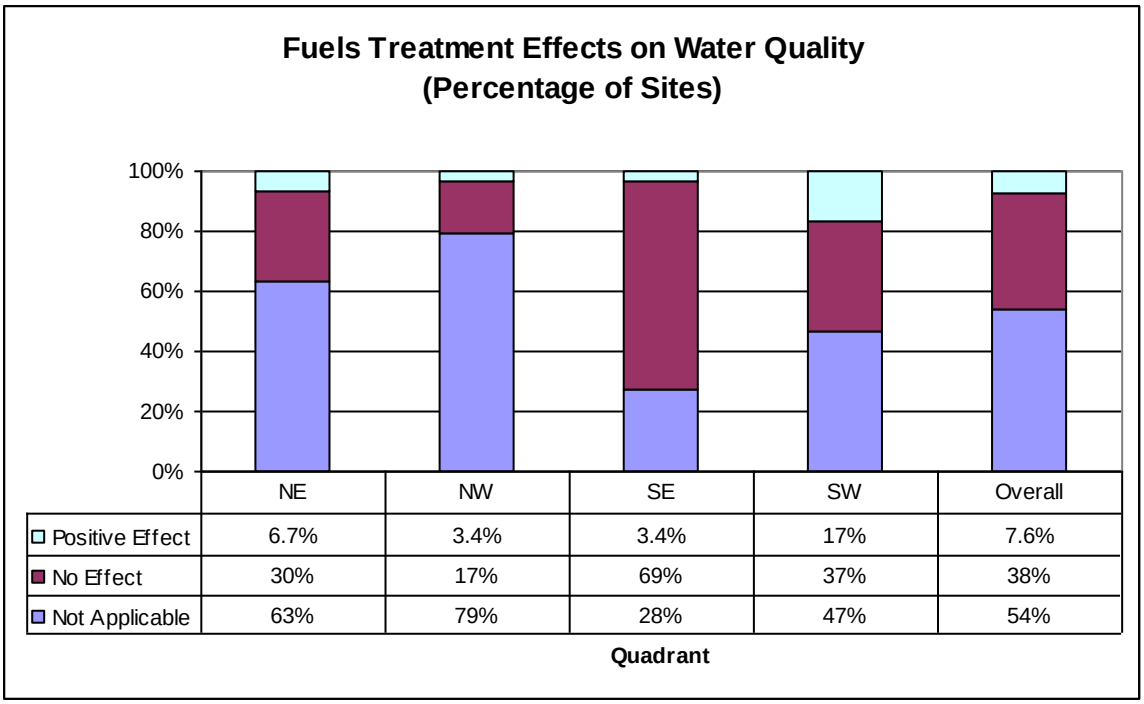

Figure 13 – Fuel treatment effects on water quality based on percent of sites.

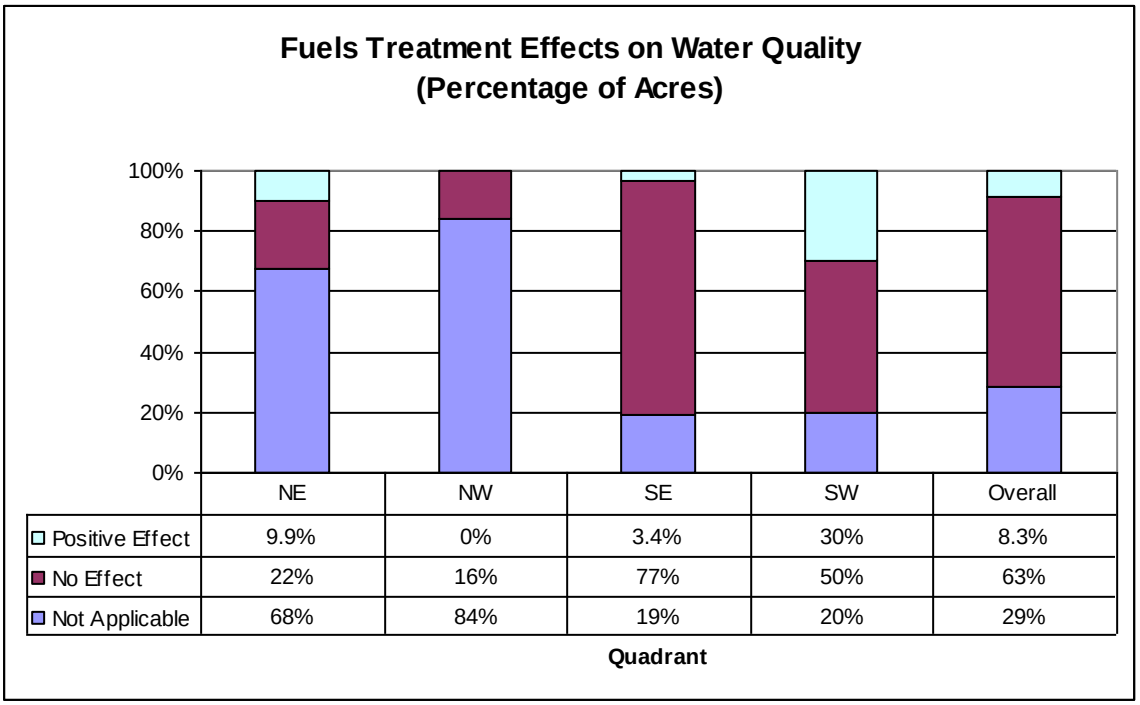

Figure 14 – Fuel treatment effects on water quality based on percent of acres.

Effects on Terrestrial Habitat

Monitoring teams reported a positive effect on terrestrial habitat from fuel treatments on more than two-thirds of the sites monitored (68 percent – the 95 percent "confidence interval" is 59.3 to 76.3 percent) and 84 percent of acres monitored (as shown in figures 15 and 16).

Considering only those sites where terrestrial habitat was reported as an applicable measure, 75 percent reported a positive effect and 25 percent reported no effect.

Considering all sites, more than 90 percent (93) of the sites in the SE received a positive effect rating for terrestrial habitat from fuel treatments.

Reasons for a positive rating in all quadrants included positive changes to forage and habitat, a general positive vegetative change, and creation of snags and downed wood. Less than 1 percent (0.8 percent) of the sites and 0.5 percent of acres received an adverse effect rating based on fuel treatment implementation.

Reasons given for an adverse effect rating in the SE were the creation of too many snags and too great a reduction of crown closure. No adverse effects were reported in the NE, NW, or SW quadrants. Less than one-fourth (23 percent) of the sites stated "no effect" on terrestrial habitat from fuel treatments.

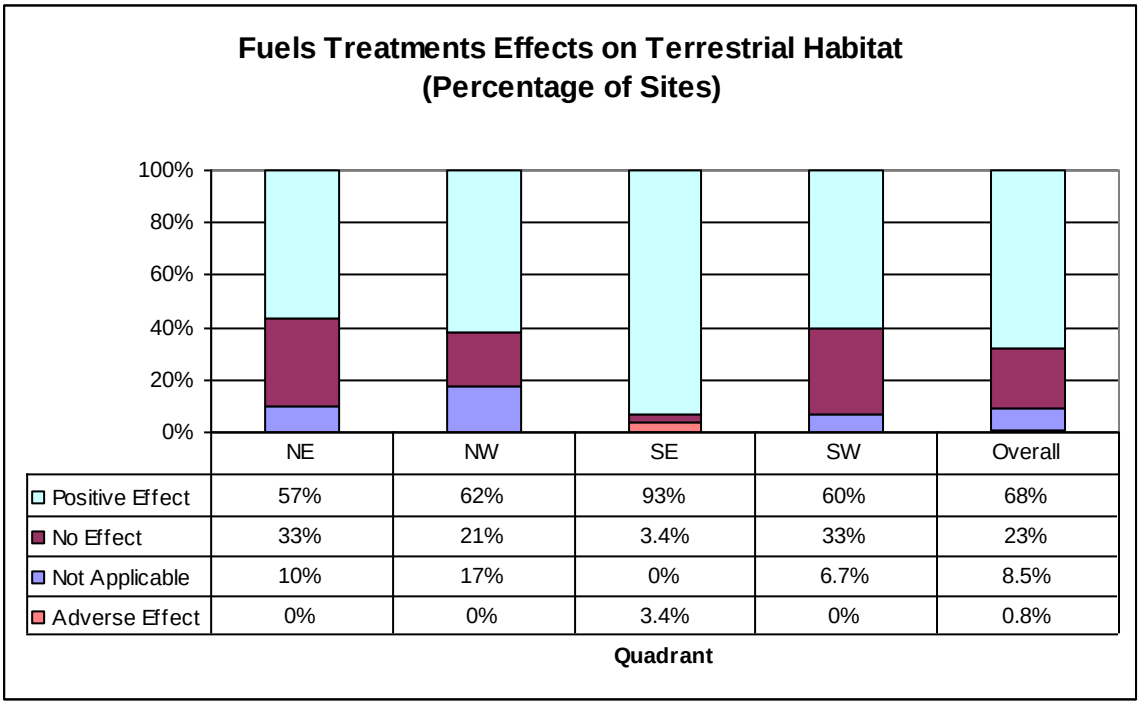

Figure 15 – Fuel treatment effects on terrestrial habitat based on percent of sites.

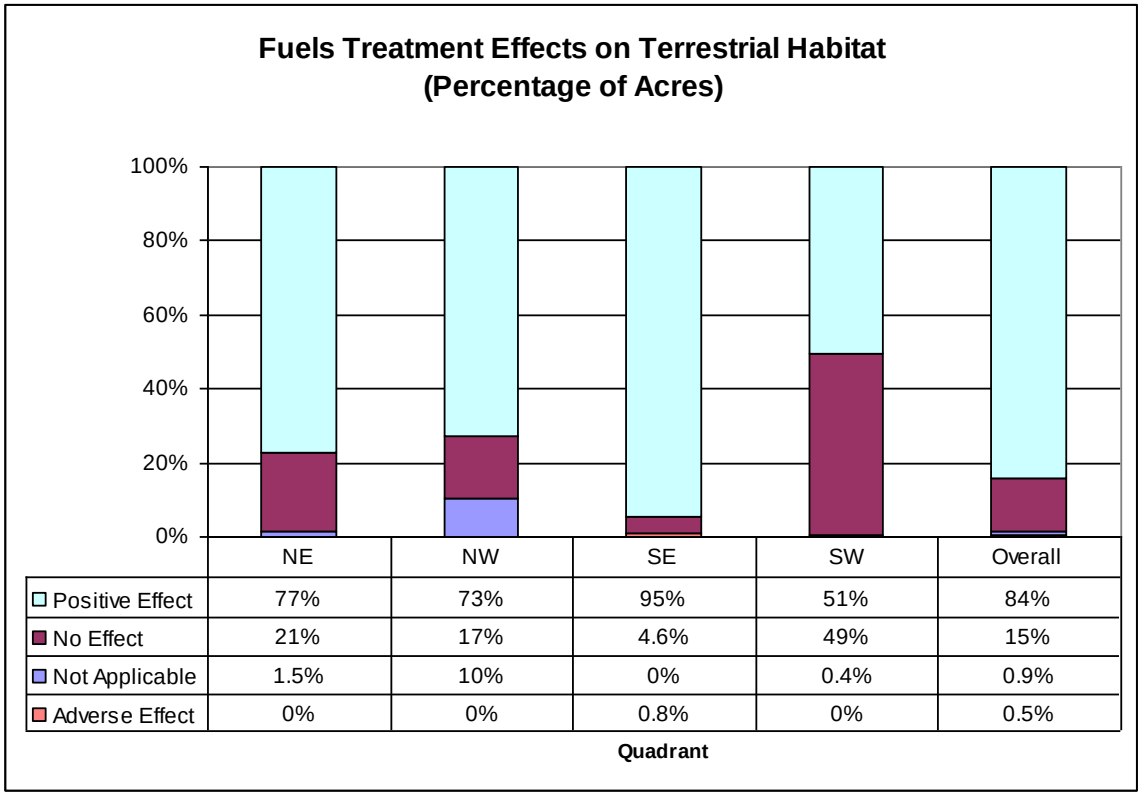

Figure 16 – Fuel treatment effects on terrestrial habitat based on percent of acres.

Effects on Aquatic Habitat

As shown in figures 18 and 19, monitoring teams reported that for nearly two-thirds (64 percent) of the sites and 34 percent of the acres, effects on aquatic habitat were not applicable to the fuel treatments monitored.

The noted exception was in the SE, where only 17 percent of the sites and 7.5 percent of the acres received a "not applicable" rating.

No sites were rated as having an adverse effect on aquatic habitat in any of the quadrants. The ratings of "no effect" and "not applicable" were assigned, generally, because water or aquatic habitat was not present.

Overall, including sites that reported "not applicable," 7.6 percent of the sites (the 95 percent "confidence interval" is 2.8 to 12.5 percent) and 24 percent of the acres received a positive effect rating on aquatic habitat from fuel treatments, varying from 3.4 percent of sites in the NW to 14 percent of sites in the SE.

Positive effects were related to:

- Positive vegetation changes,
- Maintenance of desired vegetation type,
- Increase or maintenance of large woody debris, and
- Effective mitigation measures.

Considering only those sites where aquatic habitat was reported as an applicable measure, 21 percent of those sites reported positive effects and 79 percent reported "no effect."

Figure 17 – California newt on a masticated and burned treatment site on the Tahoe National Forest in California. Many newts and other salamander species require moist habitats for survival and ponds, lakes, or slow flowing streams for breeding.

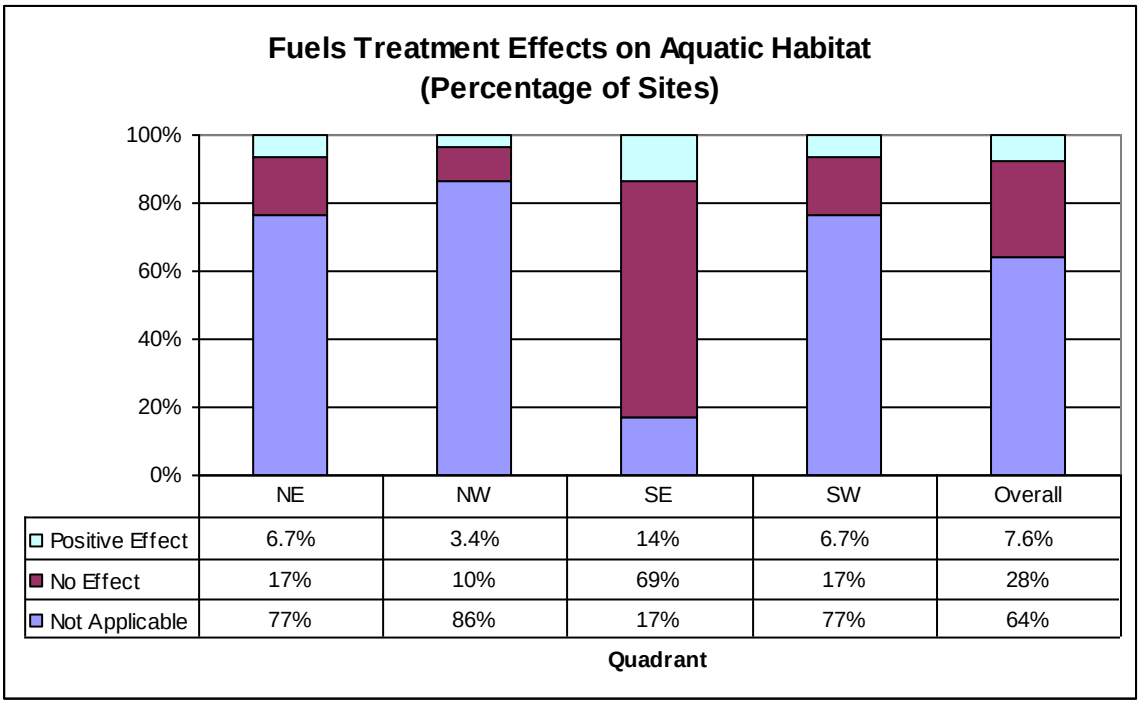

Figure 18 – Fuel treatment effects on aquatic habitat based on percent of sites.

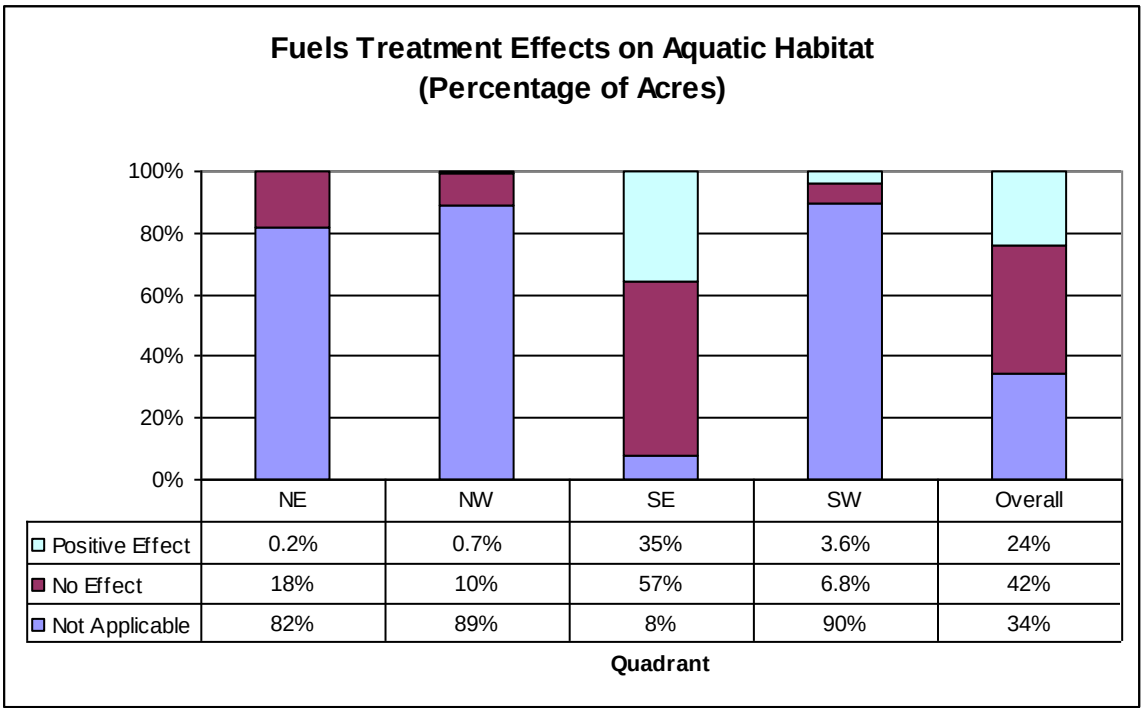

Figure 19 – Fuel treatment effects on aquatic habitat based on percent of acres.

Fuel Treatment Effectiveness and Effects by Vegetation Type

The sampling scheme was not designed to adequately sample all vegetation types. Too few of the randomly drawn treatment sites were in the grassland and riparian/wetland vegetation types to draw inferences beyond the initial sample.

Therefore, to summarize effects for this analysis by vegetation type, at least 15 samples were needed in each vegetation type. Sufficient samples existed for the forested land (57 sites), woodland (22 sites), and shrub land (16 sites) categories.

Fuel treatment objectives were generally met on all vegetation types (92 percent of the sites). The objectives were met on 93 percent of the forested sites, 88 percent of the woodland sites, and 100 percent of the shrub land sites.

Table 2 lists the percent of sites that reported positive effects from fuel treatments in habitat, air, or water quality resources in the three grouped vegetation categories. The 95 percent "confidence interval" is listed for the vegetation categories in each resource monitored. For example, 31 percent of the 61 forest land sites reported positive effects on aquatic habitat. Statistically, if multiple groups of 61 forest land sites were randomly monitored, 95 percent of these forest land sample groups would report positive effects on aquatic habitat approximately 19 to 43 percent of the time.

Figure 20 – Post-Hurricane Katrina manual/mechanical salvage site on the De Soto National Forest in Mississippi two years after treatment.

Table 2 – Percent of Monitored Sites Reporting Positive Environmental Effects from Fuel Treatments in Three Vegetation Categories.

Vegetation Category		Aquatic Habitat	Terrestrial Habitat	Air Quality	Water Quality
Shrub Land (16 sites)	**Percent of Sites**	12.5%	56%	12.5%	6.3%
	95% Confidence Interval* in percent of sites	0 – 30.0%	30.0 – 82.6%	0 – 30.0%	0 – 19.2%
Woodland (25 sites)	**Percent of Sites**	4.0%	68%	8.0%	20%
	95% Confidence Interval* in percent of sites	0 – 12.1%	48.8 – 87.2%	0 – 19.2%	3.5 – 36.5%
Forest Land (61 sites)	**Percent of Sites**	31%	72%	13%	3.3%
	95% Confidence Interval* in percent of sites	19.3 – 43.0%	60.6 – 83.6%	4.5 – 21.7%	0 – 7.9%

[*"Confidence Intervals" were calculated to determine the reliability of the estimate. The narrower the "confidence interval," the more reliable the estimate for the total population of fuel treatments.]

Overall, just one site (in the forested vegetation category) reported adverse effects from the fuel treatments on terrestrial habitat. No adverse effects were reported for any other of the environmental elements monitored independent of vegetation category.

As listed in Table 2, positive environmental effects reported from the monitored sites varied from 3.3 percent to 72 percent of sites in the different resource types.

Overall for the three broad vegetation categories, terrestrial habitat appeared to have positive effects from fuel treatments more than the other environmental elements. Of the four environmental elements monitored, air and water quality appear to have the least amount of positive effect from the fuel treatments—regardless of vegetation category.

If only considering those sites where air and water quality measurements were reported as appropriate, positive effects from fuel treatments were reported for air quality on 20 percent of the sites and for water quality on 17 percent of the sites.

Most responses, 92 percent of the monitored sites, indicate that the treatments were considered successful in changing future fire behavior, a main goal of hazard fuel reduction.

IV Conclusions on Broad-Based Monitoring

Overall, monitoring data indicate that fuel treatments—when reviewed within one to three years after treatment—have fulfilled the preplanned projects' objectives. Most responses, 92 percent of the monitored sites, indicate that the treatments were considered successful in reducing the severity and intensity of future fire behavior—the primary goal of hazard fuel reduction.

When reviewing treatment objectives by vegetation type, the percent of monitored sites meeting treatment objectives exceeded 85 percent for the three broad categories of vegetation types (shrub land 100 percent, woodland 88 percent, and forested land 93 percent) with more than 15 sites sampled in each category.

Virtually all of the responses (99.8 percent of sites) indicated that no adverse effect had occurred on aquatic and terrestrial habitat and air and water quality. The only adverse effect from fuel treatments reported on environmental resources was in the terrestrial habitat category, which was reported on only one site (less than 1 percent of the total amount of sites).

Therefore, no adverse effects were reported on any treatment sites related to aquatic habitat, air quality, or water quality. More specifically, nearly one-fourth of the responses (24 percent of sites), indicated a positive affect on these resource categories. This demonstrates that current mitigations to avoid adverse effects are working for those resources monitored.

Considering all the monitored sites, positive environmental effects from fuel treatments were reported on:

- Air Quality (11 percent of the sites),
- Water Quality (7.6 percent of sites),
- Terrestrial Habitat (68 percent of the sites), and
- Aquatic Habitat (7.6 percent of the sites).

Removing those sites where environmental categories were reported as "not applicable," the percent of sites with positive effects increased (aquatic habitat, 21 percent; terrestrial habitat, 74 percent; air quality, 20 percent; water quality, 17 percent).

Overall, the terrestrial habitat category appeared to have positive effects from fuel treatments to a greater extent than aquatic habitat, air quality, or water quality. Air and

water quality appeared to have the least amount of positive effect from the fuel treatments.

A "no effect" response on aquatic and terrestrial habitat as well as on air and water quality could be considered positive in terms of a lack of negative impacts from fuel treatment implementation.

Overall, fuel treatments are not harming the environment. Furthermore, these treatments include some positive effects on aquatic and terrestrial habitat, and air and water quality.

In response to the two broad monitoring questions posed by the Wildland Fire Leadership Council, results indicate that fuel treatments are broadly effective at meeting desired treatment objectives (over 90 percent of the sites). In addition, fuel treatments rarely (less than 1 percent of the sites) negatively impact aquatic and terrestrial habitat, air, and water quality.

Lessons Learned

This monitoring effort was conducted using protocols that:

- Ensured results could be aggregated nationally, and
- Could be used and easily repeated at low costs by many agencies.

The 2008 data presented here—along with future national monitoring efforts—will be used to identify trends over time. The trend analysis presented in this report highlights areas in which both more- and less-intensive monitoring is needed as well as where additional research would be beneficial.

Considerations for Future Monitoring Efforts

A questionnaire was sent to all the site monitoring participants asking for feedback and suggestions for improvement. This section represents a compilation of ideas from those who responded to the questionnaire as well as from comments submitted on the data sheets.

Timing of Field Site Visits

Recognizing that peak fire activity varies with geographic areas, future monitoring efforts should be scheduled to avoid periods of high fire activity. The initial monitoring effort began later in 2008 than desired and resulted in a number of site visits where some desired monitoring team participants were unavailable due to fire assignments.

Quality Assurance/Quality Control

The use of trained facilitators was instrumental in completing the initial monitoring effort. However, in the future, to ensure consistency and further validate observations made, it would be desirable to have a small oversight team visit 10 percent of the selected sites.

Non-Agency Monitoring Team Members

The protocol established for the initial monitoring effort *suggested,* rather than *required,* that at least one member of the monitoring team for each site be a non-agency person. Protocol for future monitoring efforts should ***require*** that at least one non-agency person be a member of the team.

Include all Department of Interior Agencies

The initial monitoring effort included only Forest Service and Bureau of Land Management fuel treatment projects. In order to accurately establish national trends of effectiveness and effects, future monitoring efforts should include Forest Service, Bureau of Land Management, Park Service, Fish and Wildlife Service, and Bureau of Indian Affairs. Funding for future monitoring should also be shared among these agencies.

National Fire Plan Operations Reporting System (NFPORS)

The random sample drawn for the initial monitoring effort was limited to projects where at least one treatment on the site included the use of prescribed fire or mechanical/manual means, or both. While this requirement was validated during site visits, other data elements entered into NFPORS for specific projects were not always correct. A small number of sites that were selected for monitoring might have been inadvertently entered into NFPORS as a fuel treatment rather than as the "other" category. To ensure the accuracy and adequacy of the data, it would be beneficial to have further training—either online or in a classroom setting—for those making entries into NFPORS.

Clearly Defining Fuel Treatment Objectives

One consistent observation made while reviewing monitoring responses concerned project fuel treatment objectives being incompletely or inaccurately written. For the most part, when an objective of "Reduce Hazardous Fuels" was listed for the project, additional, more specific objectives were actually involved. Ideally, the objectives stated in the environmental analysis or the categorical exclusion should be carried forward and clearly stated as the reason for the fuel treatment project.

Lessons learned suggest the need for further training regarding the development of objectives for fuel treatments and the appropriate classification of treatments. Writing quantifiable fuel treatment objectives is always difficult. It appears that fuel specialists could benefit from training to describe the fuel treatment objectives more clearly.

Purpose and Use of Fuel Treatment Monitoring Data

The reasons for collection and use of data gathered during fuel treatment monitoring need to be more clearly communicated to staff through respective line officers. During the initial monitoring effort, field personnel were often unaware of the reasons for the additional workload. Field staffs were often unaware that the requirement for this monitoring effort was established by the Wildland Fire Leadership Council and directives from the National Fire Plan and Healthy Forest Restoration Act. Although this information was clearly communicated to line officers, oftentimes, the information was not further communicated to field staff.

Random Sampling

In future monitoring efforts, the concept of random sampling should be better explained to field personnel. At many site visits, local staff wondered why a particular site was selected and thought "better" sites existed on their unit. Reasons for questioning the treatment site to be monitored included: the size of the project, the success of the treatment, the difficulty of site access, or the site was not actually a fuel treatment.

Awareness of and Appreciation for National Goals, Priorities, and Policies

In a limited number of cases, field staffs said that Regional or Forest (for Forest Service sites) and State Office (for Bureau of Land Management sites) priorities and policies did not necessarily represent local priorities and policies. This is an issue that needs to be addressed by appropriate line officers.

V Appendices

Appendix A – Sample Worksheets

National BLM/FS Broadbased Monitoring Worksheet

Project Information

Agency:	FS	**Office Name:**	Smokey NF, Dusty RD	**Quadrant:**	SW
Project / Treatment Name:	Happy Camp Mastication				
Date:	7/15/2008			**NFPORS ID:**	3000001
National Fire Plan Goal:	Reduce Hazardous Fuels			**Fire Regime:**	III
Pre-Treatment Condition Class:	3		**Post-Treatment Condition Class:**		2
Area Treated (Acres):	44	**Veg Type:**	Deciduous Woodland		
Project Completion Date:	4/11/2006		**Treatment Method:**		Manual / Mechanical

Remarks: (please explain any "Other" choices below)

Remarks: One person did not show up because they were called to a fire the previous day, so no time to fill her spot. This project is a smaller section of a bigger project that includes rx burn acres. Only the masticated acres were reviewed for these evaluation forms.

MONITORING TEAM MEMBERS

Name	Affiliation	Office	Contact Number / email
Woody Owl	USDAFS	Dusty RD	bdusty@fs.fed.us
Smokey Bear	USDAFS	Smokey SO	nosmokey@fs.fed.us
Elven Elk	USDAFS	Watershed RD	eelk@fs.fed.us
Rusty Rat	DOI BLM	Deer Ck Office	rrat@blm.gov
Leslie Lichen	Fire Safe Council	Forestville, CA	llichen@forest.net
Butch Bear	USDAFS	Dusty RD	bbear@fs.fed.us
Tom Quercus	Environmental Group	Savana, CA	tquercus@eco.net
facilitator : Carol Ewell	USFS	AMS Enterprise Team	cewell@fs.fed.us

Photo Point Photo(s) information in box below:

PHOTO #	.JPG PHOTO FILE NAME	COMPASS DIRECTION TAKEN	GPS (UTM) info
#1	HappyCamp_North	North	708005
			4271040
#2	HappyCamp_East	East	
#3	HappyCamp_South	South	
#4	HappyCamp_West	West	
#5			

Datum:	UTM Zone (10-19):
NAD 83	10

National FS/BLM Broad-Based Monitoring Worksheet

Fuel Treatment Effectiveness

NFPORS ID:	3000001	Project / Treatment Name:	Happy Camp Mastication

Describe Selected Objective	Reduce ladder fuels to decrease probability of crown fires.					
Observed Results:	Ladder fuels reduced. Riparian protection areas required no entry for 30 feet, so no reduction in those areas.	%M	80	Summary Rating:	M	
		%PM	20			
		%NM				
		Total:	100			
Describe Selected Objective	Use mechanical treatment to change site from Condition Class 3 to Condition Class 2, with ultimate goal of Condition Class 1.					
Observed Results:	Observed Condition Class 2. It was an overstocked stand with large brush component; now changed to open stand with forb and hardwood components.	%M	70	Summary Rating:	M	
		%PM	30			
Describe Selected Objective	Reduce vegetation density to improve forest health.					
Observed Results:	Oaks growing due to sun hitting the ground; can see through the stand. No obvious signs of dead or dying trees. Oaks producing lots of acorns. Opened stand to enhance growth.	%M	90	Summary Rating:	M	
		%PM	10			
		%NM				
		Total:	100			

OVERALL Rating of Effectiveness For These 3 Objectives:	M
Additional comments:	

Appendix B – Quadrants

Quadrant: Subdivisions of the continental United States where the fuel treatment monitoring projects are located. Thirty sample sites were randomly selected from each quadrant. Table 3 lists the states that comprise each quadrant.

Table 3 – States that Comprise Each Quadrant.

Northwest	Southwest	Northeast	Southeast
Colorado	Arizona	Connecticut	Alabama
Idaho	California	Delaware	Arkansas
Montana	Nevada	Illinois	Florida
North Dakota	New Mexico	Indiana	Georgia
Oregon	Texas	Iowa	Kentucky
South Dakota	Utah	Kansas	Louisiana
Washington		Maine	Mississippi
Wyoming		Maryland	North Carolina
		Massachusetts	Oklahoma
		Michigan	South Carolina
		Minnesota	Tennessee
		Missouri	Virgina
		Nebraska	
		New Hampshire	
		New Jersey	
		New York	
		Ohio	
		Pennsylvania	
		Rhode Island	
		Vermont	
		West Virginia	
		Wisconsin	