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RESEARCH

Fuel Reduction Management Practices in Riparian Areas of the Western USA

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Abstract Two decades of uncharacteristically severe wildfires have caused government and private land managers to actively reduce hazardous fuels to lessen wildfire severity in western forests, including riparian areas. Because riparian fuel treatments are a fairly new management strategy, we set out to document their frequency and extent on federal lands in the western U.S. Seventy-four USDA Forest Service Fire Management Officers (FMOs) in 11 states were interviewed to collect information on the number and characteristics of riparian fuel reduction treatments in their management district. Just under half of the FMOs surveyed (43%) indicated that they were conducting fuel reduction treatments in riparian areas. The primary management objective listed for these projects was either fuel reduction (81%) or ecological restoration and habitat improvement (41%), though multiple management goals were common (56%). Most projects were of small extent (93% < 300 acres), occurred in the wildland-urban interface (75%), and were conducted in ways to minimize negative impacts on species and habitats. The results of this survey suggest that managers are proceeding cautiously with treatments. To facilitate project planning and implementation, managers recommended early coordination with resource specialists, such as hydrologists and fish and wildlife biologists. Well-designed monitoring of the consequences of riparian fuel treatments on fuel loads, fire risk, and ecological effects is needed to provide a scientifically-defensible basis for the continued and growing implementation of these treatments.

Keywords Wildfire · Fuel reduction · Prescribed fire · Thinning · Riparian

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Fire and Fuels in Forested Riparian Areas

Riparian areas are widely recognized and managed as critical habitats that contribute to the diversity and function of both terrestrial and aquatic ecosystems (Gregory and others 1991; Acker and others 2003). Stream riparian areas occur as linear features within the matrix of many vegetation types. Frequent natural disturbance, moisture gradients, and spatial heterogeneity of riparian areas interact to create conditions that support a variety of species, life-history strategies, habitats, and physical and biotic processes across a number of spatial and temporal scales (Naiman and Décamps 1997).

Wildfire is a widespread natural disturbance throughout the western USA and has likely exerted a strong influence on riparian and aquatic habitat complexity and species evolution (Gresswell 1999; Reeves and others 2006; Pettit and Naiman 2007; Jackson and Sullivan 2009; Arkle and others 2010). Fire history analyses indicate that fires were once fairly common in some forested riparian areas, occurring only slightly less frequently than upland fires (Table 1). However, fire-return intervals have been shown to be more variable in riparian areas relative to adjacent upland sites (Skinner 2002; Skinner and others 2006). Riparian forests generally burn when fires in upland forests are carried into ravines and gullies, riparian vegetation is dry enough to ignite, and weather is conducive to fire spread.

Following two decades of large, severe wildfires, the extent of active fuel reduction treatments on public lands has grown in response to policy (USDA Forest Service and USDA Forest Service and USDI 2001) and legislation (Healthy Forests Restoration Act 2003) intended to reduce the risk of hazardous wildfires, modify fire behavior, and restore more fire-resilient forests (Agee and Skinner 2005). Fuel reduction treatments, including prescribed fire and thinning, were initially focused on drier forest types, such as ponderosa pine (*Pinus ponderosa*), mixed conifer, and Douglas-fir (*Pseudotsuga menziesii*) forests (Brown and others 2004), but have extended to other forest and vegetation types, especially where perceived risks are high (e.g., near communities or in areas with high levels of canopy mortality from insects or disease). The extent to which fuel treatments are directly applied in riparian areas is unclear, but some resource managers are beginning to incorporate active manipulation of riparian vegetation into management strategy and long-term planning.

As in uplands, the primary justification given by public land managers for conducting treatments in riparian areas is to reduce current fuel levels and thus the probability of severe wildfire, both in ecosystems and human communities. Riparian vegetation is characterized by higher plant diversity, biomass, basal area, stand density, and rates of production than adjacent upland vegetation (Naiman and Décamps 1997; Naiman and others 1998). Current fuel quantities and distribution in some riparian areas are perceived to be hazardous, thus constituting a higher probability of severe fire in the event of ignition. Avoidance of fuel treatments in riparian forests, while surrounding uplands are treated, may allow the perpetuation of hazardous fuels that could act as corridors for severe wildfire in the future (Agee 1998; Williamson 1999).

Over the past several decades, management of riparian areas has progressed towards sustaining or restoring natural disturbance regimes and their influence on instream and riparian functions and characteristics (Dwire and Kauffman 2003; Naiman and others 2005; Pettit and Naiman 2007). More recently, fire management, including fuel reduction treatments, has been recognized as a potentially important component of riparian management (Olson 2000; Andison and McCleary 2002; Everett and others 2003; Hessburg and Agee 2003; Rieman and others 2003; Bury 2004). However, because relatively few studies have investigated fuel treatment and fire in riparian forests, the ecological consequences of riparian fuel treatments remain largely unknown.

The potential negative impacts of conducting fuel reduction or fire surrogate treatments in streamside areas generate concern, particularly in watersheds that support sensitive vertebrate species, serve as the source of municipal water supplies, or provide valued fisheries. Fuels management may lead to decreased streambank stability and water quality, reduced stream shading, increased sediment delivery to streams (McLaughlin 2005), and altered patterns of large wood recruitment, which could negatively affect sensitive aquatic and riparian species (Rhodes 2007). Activities associated with mechanical treatments, such as road building and mineral soil exposure and compaction, could also affect water quality, biogeochemical functioning

Table 1 Historic fire regimes in riparian and adjacent upland forests organized by forest type

Location	Forest type	Riparian fire return interval (years)	Sideslope fire return interval (years)	Citation
Elkhorn Mountains, OR	Dry, Douglas-fir and Grand Fir	15	11	Olson (2000)[a]
Southern Blue Mountains, OR	Dry, Ponderosa Pine, Douglas-fir	14	12	Olson (2000)[a]
Salmon River Mountains, ID	Dry, Ponderosa Pine and Douglas-fir	11–19	9–29	Barrett (2000)[b]
Cascade Range, WA	Dry, Ponderosa Pine and Douglas-fir	19	14	Everett and others (2003)[c]
Cascade Range, OR	Mesic, Douglas-fir	38	29	Olson and Agee (2005)[a]
Klamath Mountains, CA	Mesic, Mixed Conifer	16–42	7–13	Skinner (2002)[b]

[a] Weibull median probability fire return interval (WMPI)

[b] Mean or median fire return interval (MFI)

[c] Mean fire-free interval (FFI)

of riparian areas, and stream channel geometry and substrates. On public lands, many riparian areas have been severely altered by flow regulation, livestock grazing, logging, mining, and presumably fire suppression and severe wildfires, making it difficult to define the natural range of variability and thus to set targets or goals for fuel reduction projects. The success of fuel reduction treatments in reducing the probability of severe fire in uplands depends on a variety of factors (Agee and Skinner 2005), and there is considerable debate about the overall effectiveness of these treatments (Rhodes and Baker 2008). Furthermore, few studies have examined effects of fuel reduction treatments on streams and riparian areas (but see Bêche and others 2005; Arkle and Pilliod 2010).

The arguments for and against performing fuel reduction treatments in riparian forests reflect the range of values associated with managing public lands. Inconsistent administrative policies complicate the issue; some are aimed at protecting riparian areas by limiting management activities such as fuel reduction (see FEMAT 1993; PACFISH, USDA/DOI 1995; INFISH, USDA 1995), while others—although targeted for forested uplands—expedite fuel reduction projects by reducing environmental impact analysis and public involvement (USDA Forest Service and USDI 2001; Franklin and Agee 2003; Healthy Forest Restoration Act 2003; Dombeck and others 2004).

Fuels Management in Riparian Areas of the Western USA

Survey of Active Riparian Management for Fuels on US Forest Service Lands

While the discussion surrounding the use and ecological impacts of fuel reduction treatments in riparian areas continues, the extent to which these projects are being implemented in western states is unknown. To examine this issue, we conducted phone interviews with District-level USDA Forest Service Fire Management Officers (FMOs). In some instances, we were referred to Assistant FMOs, Fuels Planners, or Fuels Specialists. The survey was confined to 11 western states and 55 different National Forests, encompassing a wide range of vegetation types and fire regimes (Table 2). Over a one month survey period, attempts were made to contact one FMO from each National Forest within this region. Once this initial criterion was satisfied, additional FMOs were contacted until the end of the defined survey period. FMOs were randomly selected from a list organized by National Forest. FMOs who could not be reached after two attempts were not contacted again. District representation was limited by both FMO availability and unfilled positions. Seventy-four interviews, each representing a different District, were conducted between 17 December 2007 and 17 January 2008. Fifty-five National Forests were represented.

Table 2 Summary of riparian fuels survey effort, showing geographical extent and the number of USDA Forest Service Districts that are or are not conducting fuel reduction treatments in riparian areas as of January 2008

State	Number of National Forests Surveyed	Number of Districts within National Forests Surveyed	Number of National Forest Districts with/without riparian treatments
Arizona	6	10	2/8
California	11	12	7/5
Colorado	5	7	3/4
Idaho	4	5	0/5
Montana	7	16	5/11
Nevada	1	1	1/0
New Mexico	4	4	0/4
Oregon	7	9	7/2
Utah	4	4	3/1
Washington	3	3	2/1
Wyoming	3	3	2/1
Total	55	74	32/42

FMOs were asked about the number, type, size, monitoring efforts, and management goals of riparian fuel reduction projects that are currently proposed or have been completed in their District in the past 10 years. FMOs were also asked about factors that influence the planning and implementation of treatments in riparian areas (see Appendix 1). Riparian areas were defined as the interface between terrestrial and aquatic ecosystems (Gregory and others 1991), including streams, lakes, bays and their adjacent side channels, floodplains, and wetlands. Only those proposed projects that had completed the National Environmental Policy Act (NEPA) review process were considered in this analysis. This filter was used to identify proposed projects with a high likelihood of implementation.

A total of 32 Districts in 27 National Forests have completed or were proposing fuel reduction treatments in riparian areas (Table 2, Fig. 1). A total of 42 Districts in 31 National Forests had not conducted fuel reduction treatments in riparian areas, though 14% (6 Districts) of these Districts indicated that they would like to implement such projects in the future. Most Districts (78%) currently doing treatments indicated the desire to do more or different types of fuel reduction treatments in riparian areas. Three Districts indicated that only a limited number of project areas were available for treatment due to concerns over sensitive species, particularly in areas associated with large streams.

Fig. 1 Geographic distribution of US Forest Service Districts surveyed with (*filled circle*, 32 Districts) and without (*open circle*, 42 Districts) riparian fuel treatments

Characteristics of Riparian Fuel Reduction Treatments

Prescribed fire and mechanical thinning were the most common types of fuel reduction treatments, though a combination of techniques was frequently used (Table 3). For those Districts doing treatments that involved fire, the majority (92%) indicated that they were likely to perform such treatments outside of their District's normal fire season, the season of which varied by geographic region.

The size of treatments varied widely, particularly because some treatments were conducted across landscapes that encompassed both riparian and upland areas, and it was difficult for fire managers to estimate the riparian acreage affected. While some small projects were centered on protecting specific man-made structures near riparian areas, the majority of treatments included riparian areas as part of larger upland projects, and in many cases, treatment size was more a function of the size of the upland area to be treated than the riparian area. For the majority of these upland projects, which ranged anywhere from 1 to 8,100 ha (2–20,000 acre), riparian areas were considered a minor component of the treated landscape, reflecting their actual spatial extent. For the 15 Districts that targeted riparian areas specifically, the majority of projects were less than 120 ha (300 acre) in size (Table 3).

Treatments were conducted in a wide range of vegetation types. While forest type varied considerably, values for Fire Regime Condition Class (FRCC; Table 3, Hann and others 2003) were similar, with all Districts reporting FRCC values of 2 or 3 before treatment, indicating a moderate to high departure from reference conditions (Hann and Bunnell 2001; Hardy and others 2001; Schmidt and others 2002). Most projects (75%) were in the Wildland-Urban Interface (WUI), as defined by the FMO. The majority (81%) of Districts that had conducted or were planning riparian treatments had more than one project underway in a riparian area.

Riparian fuel reduction projects implemented at the District level had a number of objectives. Over half of the Districts (56%) reported that projects were considered multi-objective. Fuel reduction was the most common primary treatment objective, followed by ecological restoration and/or habitat improvement (Table 3). Although ecological restoration and habitat improvement were not explicitly defined, we assume respondents were referring to restoring the structure, function, or habitat conditions of the stream-riparian corridor. Other primary objectives of projects included structure protection, flood damage mitigation, cattle forage improvement, noxious weed control, and removal of encroaching vegetation.

During the survey, managers were also asked if they allowed prescribed fire to back or creep into riparian areas as part of a larger upland project. Of the 32 Districts doing riparian-specific treatments, 97% indicated that in some or all cases they allowed prescribed fire to move into riparian areas. Of the 42 Districts not specifically doing riparian treatments, 88% allow prescribed fire to back into riparian areas. In these Districts, some managers indicated that this allowance was used to reduce fuels in riparian areas adjacent to treated uplands. Prescribed fires that were allowed to move into riparian areas were described as having generally low intensity and severity. Some managers indicated that equipment use and fireline construction to suppress prescribed fire around riparian areas would have had more negative effects than the treatment itself.

Post-Treatment Effectiveness Monitoring

The majority of Districts (88%) reported that monitoring of some kind took place to evaluate the effectiveness or ecological effects of the fuel reduction treatments on riparian areas. However, monitoring efforts were frequently qualitative, or not collected with sufficient spatial and temporal replication for quantitative summaries. Similarly, a lack of standardization in monitoring methods and approaches was evident, greatly limiting the inferences that

Table 3 Summary of characteristics of fuel reduction projects conducted in riparian areas as reported by Fire Management Officers from 55 National Forests

Characteristics of riparian fuel reduction projects	Percent of Districts reporting (number of Districts reporting)
Treatment type	
Prescribed fire	75% (24)
Mechanical thinning	69% (22)
Lopping/pruning	19% (6)
Pile burning after thinning or lopping/pruning	31% (10)
Mastication	13% (4)
Combination of techniques	75% (24)
Treatment Size (15 Districts targeting riparian areas)	
<100 acres	53% (8)
100–300 acres	40% (6)
>300 acres	20% (3)
Number of treatments	
Single treatment in District	19% (6)
Multiple treatments in District	81% (26)
Treatment location	
In wildland-urban interface (WUI)	75% (24)
Not in wildland-urban interface (WUI)	22% (7)
Target of treatment	
Riparian areas targeted	47% (15)
Riparian areas included as part of larger project	59% (19)
Management objectives	
Single objective	44% (14)
Multiple objective	56% (18)
Primary objective = Fuel reduction	81% (26)
Primary objective = Ecological restoration/ habitat improvement	41% (13)
Fire Regime Condition Class (18 Districts reporting)	
1 = ecosystems that are within or close to historical range of variability during a specifically defined reference period	0%
2 = ecosystems with moderate departure from historic range of variability	50% (9)
3 = ecosystems with high departure from historic range of variability	72% (13)
Other	5% (1)
Monitoring	
Did monitoring take place?	
Yes	88% (28)
No	9% (3)
Monitored features (29 Districts reporting)	
Riparian vegetation	72% (21)
Hydrologic variables (e.g., water quality, temperature)	38% (11)
Habitat variables for species of concern	38% (11)
Soils	24% (7)

Unless specified, data are from all 32 Districts performing treatments in riparian areas. Percentages may add up to more or less than 100% depending on whether Districts used a combination of methods, had multiple projects, or there was no information available

could be made from monitoring information. The type of monitoring varied widely, ranging from fuel and vegetation monitoring to examining water quality or wildlife habitat. Of the Districts that monitored, 72% examined aspects of riparian vegetation, such as fuel loading, stem density, regeneration, plant species composition, canopy closure, and presence of weeds. Water monitoring took place in 38% of the Districts conducting post-treatment monitoring, and included measures of water quality, streamflow, shallow groundwater levels, and stream temperature. In many cases, especially where water quality, soils, or fish and wildlife habitat were of concern, resource specialists in the District were responsible for monitoring.

Twenty-four Districts (75%) indicated that they had some sort of framework in place for evaluating the effectiveness of their fuels reduction treatments, though not all Districts reported their exact methodology (6 Districts, 19%). Ten Districts (31%) looked directly at the objectives specified in written management plans to assess treatment effectiveness. Treatment success was often based on specific targets such as the reduction of ladder fuels, number of acres affected, elimination of a weedy species, amount of aspen regeneration, or quality of elk browse. Five Districts (15%) indicated that they installed pre- and post-treatment observation plots for monitoring and evaluation purposes. Three Districts (9%) visually inspected their project areas to assess effectiveness, but did not collect data. Five Districts (15%) indicated that they had no framework for evaluating the effectiveness of their treatments.

Project Implementation

Fire managers listed a number of factors that influence their ability to conduct fuel reduction treatments in riparian areas (Table 4), and offered strategies to facilitate project planning and implementation. The major recommendation was to work closely with resource specialists, including hydrologists and fish and wildlife biologists, throughout the project. Managers from 14 Districts (44%) conducting treatments noted that collaborating with resource specialists and providing ecological justification for riparian fuel treatments were crucial for successful project implementation. Five Districts (16%) doing treatments indicated that communicating with the general public early in the process was also important, especially if the District anticipated the potential for litigation. Other recommendations included fostering interagency cooperation, beginning with small projects, conducting initial projects in safe areas where few problems are anticipated, trying multiple types of projects, and adapting techniques over time.

Discussion

Survey results revealed that US Forest Service fire managers are proceeding cautiously with fuels reduction treatments in riparian areas on National Forests in the western USA. Most prescribed fires were implemented in the fall or spring when fire control can be maximized. Though there is some concern about the adverse effects of out-of-season treatments on vegetation, it has been suggested that native plants in fire-adapted ecosystems are

Table 4 Considerations influencing the use of fuel reduction treatments in riparian areas as reported by Fire Management Officers from 55 National Forests

(1) Presence of Threatened, Endangered or sensitive species (including plants, fish, amphibian, birds, and mammals) and associated administrative policies
(2) Administrative policies addressing multiple environmental impacts (including conservation of rare species); for example,
Local—Community Water Boards;
National Forest level—Forest Management Plans;
Regional level—PACFISH/INFISH;
National level—National Environmental Policy Act, Endangered Species Act, Roadless Area Conservation Rule
(3) Lack of agreement, support, and/or collaboration among resource specialists and Fire Management Officers on a National Forest District
(4) Lack of information and/or understanding regarding historical and ecological role of fire in riparian areas. Potential concerns among co-workers or stakeholders include the presence of untreated, 'fuel-heavy' riparian areas in a matrix of treated uplands with the possibility of uncontrolled fire and an upslope 'wick-effect'
(5) Ecological concerns and unknowns (short and long-term effects of treatments in riparian areas); for example;
Grazing interests and issues;
Impacts of mechanical equipment (especially in steep topography);
Potential reduction in stream shading;
Reduction in potential for large wood recruitment to adjacent streams;
Protection of streamside old growth habitat;
Potential for increased cover of noxious weeds or nonnative plant species;
Concern over immediate impacts, such as sedimentation or ash pollution
(6) Potential for litigation over ecological and environmental concerns; negative perceptions by the general public and environmental community regarding treatments in riparian areas

resilient to one or a few prescribed fire treatments outside of the normal fire season (Knapp and others 2009).

In the Districts surveyed, prescribed fire treatments are often conducted to reduce fuels in upland areas; riparian areas are affected because they either occur within the treatment area or because prescribed fire is allowed to move into adjacent streamside areas during upland project implementation. Projects that directly target riparian areas tend to be small, with over 90% being less than 120 ha (300 acres). This pattern may reflect the relatively small proportion of the landscape that riparian areas occupy. It is important to note that this study did not investigate the shape or spatial arrangement of treatments, making it difficult to assess the actual amount of riparian area treated. A 120 ha (300 acres) linear treatment along a stream would not only result in more riparian area treated, it would also likely have different ecological impacts than a 120 ha (300 acres) treatment spanning upland and riparian areas.

As in uplands, the primary objective for treatments is reduction of different types of fuels to decrease the probability of severe wildfire. However, especially in riparian areas, secondary objectives and benefits are common and tend to be focused on wildlife habitat improvements and restoration through purposeful manipulation of streamside vegetation. Although there is definite and widespread interest in treating riparian areas, administrative constraints, as well as pervasive caution regarding active manipulation of streamside areas, have influenced the number and extent of projects conducted in riparian areas.

The ecological impacts of different treatment techniques and combinations, as well as expected reductions in fuels hazards, are known to differ in upland forests (Hunter and others 2007). For treatment of riparian vegetation, managers appear to be selecting techniques that are most likely to achieve objectives for fuel reduction, habitat improvement, and restoration, while minimizing physical effects. Mechanical treatments are most often used in areas where managers are unable, for various reasons, to treat with fire. For example, risk to property in the wildland-urban interface often precludes the use of burning treatments. Similarly, concern over unknown or unwanted effects of burning on endangered species may limit the use of fire. As in upland projects, treatment combinations are used to target different fuelbed strata and thus achieve multiple objectives. Information and guidance on the selection of treatment options is becoming available (Johnson and others 2009); however, additional attention needs to be focused on the consequences of using specific practices in streamside areas.

The predominance of treatments at the wildland-urban interface is notable. These are special treatments, driven by socioeconomic concerns and community responsibility in addition to advancing more fire-resilient wildlands nearby (Dombeck and others 2004). Many campgrounds, picnic areas, roads, structures, and private in-holdings are located in riparian floodplains, and fuel reduction treatments are one mechanism to protect them, thus reducing human safety risks and the potential for property damage. In spite of growing support for this work, active management of National Forests remains controversial (Winter and others 2004) and public scrutiny for work conducted within the wildland-urban interface is high.

Regardless of the impetus for active management of riparian fuel profiles, ecological justification for these treatments has yet to be supported by empirical evidence. Although vegetation metrics have been shown to be strong indicators of riparian burn severity (Halofsky and Hibbs 2008), there is limited published information available to managers on the necessity or ecological effects of fuel reduction treatments in riparian ecosystems. Both concerns and justifications for conducting treatments are largely derived from anecdotal experience or studies that have investigated the effects of forest harvest or wildland fire (Dwire and others 2010). Because riparian plant communities may differ considerably from upland vegetation (Dwire and Kauffman 2003), the application of FRCC ratings, derived for dominant upland vegetation types, is questionable for some riparian areas. In addition, riparian fuel conditions can be difficult to define for many reaches due to impacts of grazing, flow alteration, logging, mining, fire suppression, and other disturbances (Wohl 2000; Dwire and others 2010).

The positive and negative impacts of riparian fuel treatments remain largely undocumented in the literature. The few studies directly addressing the ecological impacts of prescribed fire on riparian systems in the western United States found minimal or short-duration changes in biotic and abiotic parameters (Bêche and others 2005; Arkle and Pilliod 2010). Bêche and others (2005) concluded that fire-induced changes in small mountain stream and riparian environments may be minimal when prescribed fires have small extent, are of low severity, and in moderate topography. Arkle and Pilliod (2010) reached similar conclusions and noted that the extent and severity of riparian vegetation burned during typical prescribed fires in ponderosa pine forests may be too low to generate the fire-induced changes that have been observed after low-severity wildfires. Additional experimental studies of fuel treatment effects on aquatic and riparian ecosystems are needed before generalizations can be made across different forest types and local conditions.

In addition to the parameters currently monitored, improved assessment of pre-and-post treatment fuel characteristics and levels is needed. Well-replicated monitoring using statistically defensible analyses will generate robust inferences regarding the effectiveness and ecological consequences of fuel reduction activities that can be used to inform treatments in other areas. Guidelines for assisting managers in conducting riparian fuel treatments and designing monitoring approaches are needed (Dwire and others 2010). Dissemination of monitoring results, collected to assess the effectiveness of riparian-specific burn plans, would advance discussions regarding the benefits, risks, and challenges of conducting treatments in riparian areas.

To increase understanding of the ecological role of fuel reduction treatments, assessment of effects need to be considered at a landscape or watershed-scale that incorporates fire history, past fire suppression, and current wildfire behavior and burn patterns for riparian and adjacent upland areas. Survey results reported here are limited to lands administered by the US Forest Service; similar information for tribal lands and public lands administered by the Bureau of Land Management, National Park Service, and US Fish and Wildlife Service would increase appreciation for the extent of riparian treatments and possibly allow larger-scale assessments of treatment effectiveness for some stream and riparian networks. Other research needs include: determination of historical fuel conditions for a range of riparian forests and plant associations, effectiveness comparisons of different treatment types (e.g. prescribed fire, thinning, combinations), evaluation of using mechanical fuel treatments as surrogates for low-intensity wildland fire in riparian areas, risk assessment of 'no action' options for cases in which riparian fuel loads are perceived as hazardous, and rigorous examination of treatment effects on water quality, aquatic and riparian biota, and habitat.

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Appendix

See Table 5

Table 5 Fuel reduction in riparian forest survey questions

Questions for FMOs
1. In the past ten years, have you proposed, completed, or are you in the midst of completing fuel reduction treatments in riparian areas?
If YES,
2a. What are the management goals of the treatment (primary, secondary)?
3a. What type of treatment are you doing (prescribed fire, thinning, combination)? What time of year is the treatment (spring, fall)?
4a. What is the approximate size of your treatment?
5a. What are the forest types and condition class (FRCC) for the riparian area and adjacent upland forests, and is this area considered to be in the wildland-urban interface?
5a. Forest type?
5a. Condition class?
5a. Located in the wildland-urban interface?
6a. What, if any, characteristics (water quality, stream biota, vegetation, fuel) are you monitoring in the riparian area before and after treatment?
7a. Do you have a framework for evaluating the effectiveness of this treatment?
8a. Do you have any recommendations for techniques that were highly successful or not successful at all?
9a. Would you like to do more or different treatments in riparian areas? If so, what constrains you?
10a. Are management plans (burn plans, NEPA documents) available for your project?
Comments (challenges, successes, etc.):
If NO,
2b. Do you have plans to do fuel reduction treatments in riparian areas?
3b. Are there constraints in place that prevent you from conducting treatments in riparian areas (potential for litigation, threatened and endangered species, administrative policies for riparian areas)?
Follow up:
Under your forest management plan, do you allow prescribed fires to creep into riparian areas?

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