Fire History in Riparian Reserves of the Klamath Mountains

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Abstract

Though riparian areas are recognized as having great importance disproportionate to the area they occupy in landscapes, little information is available concerning their past fire history. As a result, a great deal of uncertainty exists about the role of fire in riparian environments. Considering California's Mediterranean climate and the general pattern of frequent fires in most vegetation types, it is logical to assume that fires regularly affected many riparian areas in the past. A preliminary investigation to develop fire histories from riparian reserves was conducted along the Shasta-Trinity divide in the Klamath Mountains of northern California. Fire return intervals (FRI) were developed from fire scars on stumps in several riparian reserve sites along perennial streams. The FRIs for riparian reserve sites were approximately double the FRIs from nearby upland forest sites, while the ranges of FRIs were very similar. These preliminary data suggest that FRIs in riparian reserves may be more variable than in adjacent uplands and tend to be longer. Riparian areas may have enhanced the spatial and temporal diversity of landscapes by acting as occasional barriers to many low- and moderate-severity fires.

Introduction

Although riparian areas usually occupy a limited proportion of forested landscapes, they have been recognized as having ecological importance disproportionate to the area they occupy (Thomas and others 1979). Yet, Skinner and Chang (1996) were unable to find published fire history studies that would shed light specifically on riparian area fire regimes for the forested landscapes of California.

Riparian reserves have recently been designated in the Klamath Mountains (USDA-USDI 1995). One stated goal is to maintain or restore biological and physical processes of the reserves within their range of natural variability. Accordingly, standards and guidelines have been set for such conditions as coarse woody debris accumulations and shading of streams. However, the standards and guidelines have been set based upon studies of riparian environments that have been under a fire suppression management strategy for much of this century. The conditions displayed by many riparian zones may be, at least partly, an artifact of fire suppression. As a result, the amount of shading and coarse woody debris thought to represent 'natural' conditions may be in excess of amounts provided by a historical fire regime.

A pronounced annual drought is characteristic of California's Mediterranean climate despite total yearly precipitation. This annually contributes to conditions where fire can easily ignite and spread in most forest areas. The predominance of vegetation in California's forested environments is well adapted to recurring fires (Chang 1996). As a result, fire has been recognized as one of the more important processes in most California ecosystems (Blackburn

and Anderson, 1993; Martin and Sapsis, 1992; Pinchot, 1899; Skinner and Chang, 1996). Accordingly, fire was acknowledged as an important ecological process in the Klamath Mountains when the riparian reserves were designated (USDA-USDI 1995).

The strong annual drought ensures that riparian reserves, though somewhat buffered by higher moister conditions, regularly experience conditions where fires can easily burn within them. To provide adequately for the long-term management of riparian reserves within their historical range of variability (Swanson and others 1994), the historical fire regime must be an important and explicit consideration (Skinner 1997).

Considerable uncertainty exists about the role of fire in riparian reserves. Considering California's Mediterranean climate and the general pattern of frequent fires in most forested areas, it is logical to assume that fire regularly affected most forest zone riparian areas before systematic fire suppression. However, lacking empirical data, the potential spatial and temporal variations of fire regime characteristics in riparian areas have mostly been discussed conceptually (Agee 1994). Variation in stream width, seasonal availability of water, and topography would likely lead to considerable variation in the interaction of fire within riparian areas. There exists a great deal of uncertainty regarding the appropriate use and management of fire in riparian reserves largely because of the lack of empirical fire-history data.

This preliminary study assessed the availability of locatable fire scars in riparian reserves for developing fire history and assessed the magnitude of the difference in fire return intervals between riparian reserves and nearby uplands.

Study Area

The study was conducted on the Mt. Shasta Ranger District of the Shasta-Trinity National Forests along the Shasta-Trinity divide in the Klamath Mountains. The terrain in the study area is generally steep and rugged. Elevation of the five sample sites ranges from 1300 m to 1750 m. Four of the five sites were within the Sacramento River watershed with the fifth site in the Trinity River watershed.

The forest type on uplands adjacent to all riparian reserve sites would generally be described as the Klamath enriched mixed conifer type (Sawyer and Thornburgh 1977). Plants common to all riparian reserve sites in the study were western azalea (*Rhododendron occidentale* [Torrey & A. Gray] A. Gray) (nomenclature follows Hickman 1993), Port Orford cedar (*Cupressus lawsoniana* A. Murray), willows (*Salix* spp.), and various grasses, sedges, and forbs associated with wet areas (Skinner and Chang 1996).

Methods

Five sites in riparian reserves were selected. The riparian reserve component for each site was a perennial stream of at least first order. Stream orders were taken from standard 1:24,000 scale, 7.5 minute topographic maps. As each site had been previously logged, stumps were used to identify fire scars.

For two of the sites paired riparian reserve/upland components within 500 m were selected. The riparian reserve component of these two sites were both first order streams (North Fork Shotgun Creek and Root Creek) on south-facing slopes. The paired upland component had

similar elevation, slope steepness, and aspect conditions to those of the riparian reserve component.

Two riparian reserve sites, one a second order (Scott Camp Creek) and the other a third order stream (Soapstone Gulch), were on north trending, gently sloped swales. No nearby comparable, logged, upland component was available for these sites.

The fifth site was an unnamed first order stream on a steep, north-facing slope in the East Fork of the Trinity River watershed. This fifth site had two upland components designated East Fork Trinity A (EFTA) and East Fork Trinity B (EFTB) that were on opposite sides of the stream. Although both sites were considered upland sites, they were partially within the riparian reserve because logging had taken place to within approximately 10 m of the stream channel. No separate riparian reserve component was sampled here. The return intervals for fires shared by the two sites were assumed to approximate the return intervals for fires that would have affected the riparian reserve.

For each site, fire history data were gathered from stumps over approximately a 1-2 hectare area. Fire intervals were identified from scars at stump height by counting exposed annual rings aided by a 10-20X hand lens. A single slab from the stump with the greatest number of scars on each site was cut, sanded, and analyzed under a microscope to develop fire intervals. These intervals were used as references for adjusting fire dates of intervals from fire scars that had been identified in the field using techniques described by Arno and Sneck (1977). Finally, based upon the composite fire history (Dieterich 1980), descriptive fire statistics were developed for each site.

Results and Discussion

Median fire return intervals and other descriptive statistics were developed for each site (Table 1). These data reveal that the riparian reserve sites recorded fire scars less frequently than nearby upland sites.

Table 1. Descriptive statistics for fires recorded in the study.

Site	Median FRI (range)	Period of record	No. of stumps
Root Creek Riparian	33(7-65)	1673-1880	4
Root Creek Upland	7(3-44)	1749-1924	14
N.F. Shotgun Cr. Riparian	16(5-56)	1740-1924	9
N.F. Shotgun Cr. Upland	8(4-64)	1710-1916	16
Scott Camp Creek	21(12-71)	1622-1887	18
Soapstone Gulch	42(9-52)	1688-1933	15
EFTA	13(6-47)	1591-1921	11
EFTB	13(4-47)	1525-1921	14

The two sites on opposite sides of the stream (EFTA, EFTB) show similar FRIs to the other upland sites. The descriptive fire statistics for these sites and the fires they have in common were recorded (Table 2). The fires in common burned uplands on both sides of the riparian zone. Presumably, many of these fires, and at least some of those recorded on only one side, would have burned within the riparian reserve. The median and range of FRIs for the shared fires appear similar to those of the other riparian reserve sites.

Table 2. Medians and ranges of fire return intervals for the two sites (EFTA, EFTB) on opposite sides of the tributary to the East Fork of the Trinity River. Each site is shown individually along with the shared fires.

Variable	EFTA	EFTB	Shared fires
Median Fire Return Interval	13	13	27.5
Range of Fire Return Intervals	6-47	4 – 47	6-47

Overall, the median FRIs for the sites in the riparian reserves was at least twice as long as those of the adjacent uplands. Similarly, the median FRI for the shared fires of EFTA and EFTB was approximately twice the value of each site individually. Interestingly, considerable differences were not found between the ranges of intervals recorded in the riparian reserves and those on the adjacent upland sites. These limited data suggest more variability in the fire intervals (and thus possibly fire behavior) within the riparian reserves than in the adjacent uplands.

That past fires were recorded less often in riparian reserves of perennial streams should not be surprising given the moist (humid) conditions that would often likely reduce fire intensity. A reduction in fire intensity would possibly have affected the recording of the fires in several ways. Fires burning with lower intensity would be less likely to scar trees. Fires entering the more humid riparian reserves may often have burned in a more spotty pattern than in the uplands. A spotty pattern would have caused the fires to miss burning adjacent to many trees. Thus, fires that may have affected the riparian reserves would be less likely to leave a record of fire scars. Additionally, the moist, humid conditions may have just limited the extent of the fires within the riparian reserves so that portions of the reserves would not be burned for periods longer than those of the adjacent uplands.

These limited data suggest that riparian areas with perennial water may serve as effective barriers to many low-severity and some moderate-severity fires, influencing landscape patterns beyond their immediate vicinity. Although riparian areas provide for increased habitat diversity of themselves, by potentially affecting fire spread and intensity, riparian areas may contribute to landscape heterogeneity in the uplands. Providing information regarding the fire/riparian/landscape interactions would potentially be an important component of future landscape-level fire history studies.

Sites with a history of past logging had to be chosen to adequately develop fire history for the riparian reserves. Few trees with open wounds displaying multiple scars were located within the riparian reserves along perennial stream courses. Most of the fire history in these areas was recorded in scars that had healed over. Without stumps to view the entire cross-section of each tree, few of the historical fires would have been detected. Because this method of detection appears necessary, it will be difficult to undertake fire histories in riparian reserves that do not have a history of logging.

However, the lack of external fire scars and less record of fire is not likely to be characteristic of upper reaches of riparian reserves where streams are intermittent. Taylor and Skinner (1998) have recently completed a landscape-level fire history study near Happy Camp in the Klamath Mountains. Their data reveal that fires were frequent (median FRIs: 9.5 - 18 yrs) and readily scarred trees on sites in steep upper reaches of intermittent streams. It is likely the intermittent channels in these upper reaches acted as chutes in which fires spread easily and possibly burned more intensely compared with the landscape overall.

Conclusion

These limited data suggest that fires were frequent in the riparian reserves studied. However, fires appear to have been recorded in riparian reserves of perennial streams less frequently than in the adjacent uplands. Nonetheless, in the upper reaches of watersheds where riparian reserves are associated with intermittent streams, fires appear to have burned with frequency similar to the surrounding uplands. These preliminary results, the ecological importance of riparian areas, and the uncertainty associated with attempting to develop long-term plans for riparian reserves point to the need for more intensive landscape level fire history studies. Landscape level studies that provide data on the long-term influence of fire on pattern and structure in the uplands (Taylor and Skinner 1998) should be combined with a more intensive look at the interactions of fire with riparian reserves. Developing successful, long-term management plans for riparian reserves in California is likely to be problematic without a serious consideration of the physical and biological potential for fire and its ecological function in those environments.

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