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Effects of the Hatchery Complex Fires on Northern Spotted Owls in the Eastern Washington Cascades

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Abstract. During the summer of 1994 the Hatchery Complex fires burned 17,603 ha in the east Cascades of Washington. These fires affected three habitat reserves and six activity centers for the northern spotted owl (*Strix occidentalis* caurina). The availability of spotted owl habitat within a 2.9 km radius of these activity centers was reduced by the direct effects of the fire, (average habitat loss=31%, range 8%-45%) but was also significantly reduced by delayed tree mortality and insect caused mortality (average habitat loss=55%, range 10%-85%). Fewer spotted owls occuppied and reproduced at these sites than in previous years. Spotted owl habitat located in riparian areas or on a bench was somewhat more likely to remain as fire refugia than habitat located on mid-upper slopes. This was especially true on south aspects. The availability of spotted owl habitat under current and inherent fire regimes was very dynamic across the east Cascades landscape. Appropriate management strategies may include strategically located low density fuel areas created to protect adjacent spotted owl habitat.

Introduction

Fires are a natural event within the eastside Cascades ecosystems (Agee 1994), however, fire suppression and logging have contributed to higher fuel loadings that can lead to higher fire intensity than would have inherently occurred (Agee and Edmunds 1992). The fires of 1994 were a dramatic example of this. Areas in which the inherent disturbance regime would have been low to moderate intensity and high frequency fires, burned as moderate to high intensity stand replacement fires. Several of these fires were part of the Hatchery Complex that included the Rat, Hatchery, Eightmile, Blackjack I and Blackjack II fires. In total these fires burned about 17,603 ha.

These fires burned within three areas that have been identified as Late-Succesional Reserves (USFS 1994 and 1995). These areas have management objectives to provide habitat for late- successional associated species, including the Threatened northern spotted owl (*Strix occidentalis* caurina). Agee and Edmunds (1992) stated that: "There is a very low probability that any (spotted owl habitat reserve) created in the East Cascades subregion will avoid catastrophic wildfire over a significant portion of its landscape over the next century." Thus the management dilema, while fire suppression may have increased the amount of suitable spotted owl habitat across the lanscape, it has also resulted in a greater risk of habitat loss due to catastrophic fires (Agee and Edmunds 1992, Buchanan et al. 1995). Management of these landscapes must consider the short-term habitat needs of the spotted owl and the risk associated with stand replacement fires.

Important in the management of these landscapes is understanding how fire affects spotted owls and their habitat. Our objectives were to quantify, as much as possible, the effects of the Hatchery Complex fires on spotted owl habitat, occupancy rates, and reproduction. In addition, the future risk to additional owl sites and possible management strategies will be presented.

Study Area

This study was conducted on the Leavenworth Ranger District, Wenatchee National Forest, located on the east side of the Cascades of Washington state (Figure 1). Elevations range from 650 meters to 1300 meters. The study area is composed of ponderosa pine (*Pinus ponderosa*) plant associations at lower elevations, and Douglas-fir (*Pseudotsuga menziesii*) and grand fir (*Abies grandis*) plant associations at the mid-elevations.

Disturbances, such as fire, have been shown to have a significant influence on the vegetation patterns and processes of east Cascade landscapes (Gast et al. 1991, Agee 1994, Johnson et al. 1994, Harrod et al. 1996). Prior to fire suppression, fire occurred at relatively frequent intervals within east Cascade forests (Agee and Edmunds 1992). For example, within the ponderosa pine and dry Douglas fir plant series fire occurred at intervals of 10 to 25 years resulting in a forest structure largely composed of open park-like ponderosa pine forests (Agee 1991 and 1994). Fires in these forests were usually of low to moderate intensity.

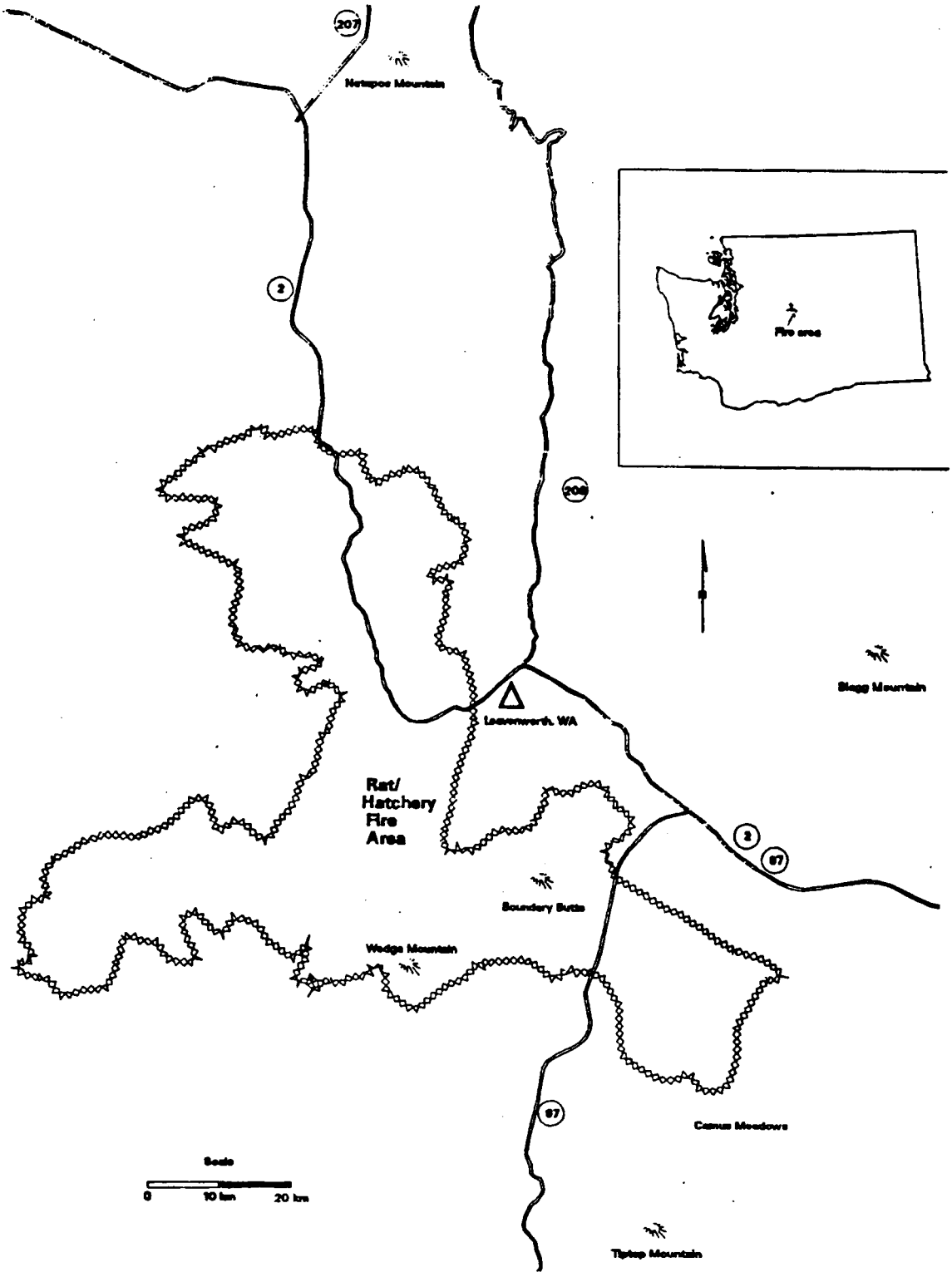

Figure 1. Vicinity map of the Rat and Hatchery Fires.

Fire suppression and logging have signficantly altered these forests. With the advent of effective fire supression technologies, fire frequency within these forests was significantly reduced (Agee and Edmunds 1992). In addition, logging practices until about 1950 often focused on removing the most fire tolerant species, the large ponderosa pine (Wellner 1984). The end result is that eastside forests are now composed of more shade tolerant tree species, are less fire tolerant, are at higher densities, and are more prone to large scale high intensity fires (Agee and Edmunds 1992, Camp 1995).

Methods

Habitat Inventory

Inventories of spotted owl habitat were completed from aerial photo-interpretation followed by field verification. These data were then loaded into MOSS geographic information system for habitat analyses. Habitat inventories were completed prior to the fire, immediately post-fire, and one year after the fires occurred in order to measure habitat changes over time. Suitable habitat was defined as having at least a 60% canopy closure presence of numerous snags and several down logs, and two or more canopy layers. The habitat mapping resolution was 0.8 ha.

Once habitat maps were developed an additional analysis was conducted to describe landscape features for habitat that was within the fire perimeter but remained suitable following the fire. This analysis was completed for all habitat within a 2.9 km radius around three of the six fire affected activity centers. A spotted owl activity center is the location in which there was a resident single, pair or nest site (USFS 1991). These three spotted owl activity centers were selected because they were distributed across the burned landscape, they were the most extensively affected, and there was no overlap in habitat within the 2.9 km radius. This information was developed to determine if habitat at particular landscape locations burned at proportions equal to, greater than or less than was available within the three activity centers. Habitat was classified into one of the following categories: north aspect (>270 to 89 degrees), south aspect (>90 to 270 degrees), riparian, valley (>300m wide), bench (<10% slope and >6 ha), and mid-upper slope.

Spotted Owl Inventories

The Region 6 spotted owl survey protocol was followed (USFS 1991). During 1995, spotted owl activity centers were surveyed regardless of how extensive the habitat was changed as a result of the fires. Sites were monitored to determine if spotted owls were present, and if so, their status: single, pair, or reproductive pair. If spotted owls were determined to be reproductive, additional monitoring was conducted to determine the number of young. Surveys and site monitoring were accomplished through a cooperative effort between the U.S. Forest Service, National Council on Air and Stream Improvement, and Natapoc Resources.

Data Analysis

A linear correlation analysis (Zar 1984) was completed to determine if there was a relationship between site status and the degree to which habitat was affected by the fires within a 0.8 km and 2.9 km radius. A Chi-Square Goodness of Fit test (Zar 1984) was used to determine if there was a significant difference between habitat burned vs habitat available at several locations on the burned landscape.

Persistence of Spotted Owl Nest Sites

Camp (1995) presents a probability model for the development of late-successional fire refugia under an inherent disturbance regime for the eastern Cascade mountains. Because spotted owl nesting habitat has been shown to be associated with these late- successional conditions (Buchanan et al. 1993, Buchanan et al. 1995) this model was used to show the potential for a fire under an inherent disturbance regime, at the 28 known nest sites on the Leavenworth Ranger District.

Results and Discussion

Habitat Availability

The availability of suitable spotted owl habitat within a 2.9 km radius of the six affected activity centers prior to the fire, immediately following the fire and one year post-fire are shown in Table 1. The average amount of habitat loss that occurred within a 2.9 km radius was 31% and ranged from 8% to 45%. The average amount of habitat lost within a 2.9 km radius as of one year after the fire was 55% and ranged from 10% to 85%.

These data show that a considerable reduction in habitat occurred as a result of the direct effects of the fire, however, additional habitat reductions occurred well after the fires were out. This occurred because trees damaged but not directly killed by the fires eventually died.

Table 1. Habitat availability pre-fire, post-fire, and one year post-fire within a 2.9 km radius of spotted owl activity centers (n=6), Hatchery Complex Fires.

Site No.	Pre-fire (ha)	Post-fire (ha)	1 Yr Post-fire (ha)
1	691	463	342
2	493	454	446
3	512	399	114
4	604	344	92
5	618	420	324
6	377	208	171

In addition, some trees that survived the fires have been killed by increased insect activity. It is expected that this trend will continue as insect populations increase, however the extent is not yet known.

The results of the analysis to determine if suitable habitat at various locations on the landscape burned in proportion to its availability are shown in Figures 2 and 3. Habitat located on north aspects and within riparian areas burned less than available, though not statistically different ($p>0.05$). Habitat on north slopes located on a bench burned at proportions equal to it's availability. Habitat on north slopes on the mid-upper part of the slope burned at levels slightly greater than available, but not statistically different than expected ($p>0.05$). On south slopes habitat located on a bench burned at levels that were significantly less than expected ($p<0.05$). Habitat located on south slopes and on the mid-upper portion of the slope burned at proportions greater than available, but not at levels significantly different than expected ($p>0.05$).

Site Status

The results of the spotted owl surveys at the six fire affected activity centers are shown in Table 2. Four of the six sites were not occupied during 1995. At one of these sites the fire overtook the activity center very rapidly and at extremely high intensity. It is likely that these owls did not survive the fire, and their activity center is likely no longer capable of supporting an owl pair. Habitat at an additional site was reduced to levels that make it unlikely that it could support spotted owls. This site was not occupied in 1995. Fewer of these activity centers were occupied in 1995 than at any time during the previous four years. In addition, only one site was reproductive, also the lowest level compared to the previous four years.

Site Status and Habitat Availability

There was no correlation between the habitat available within a 2.9 km radius one year post-fire and the site status (alpha=0.05, $p>0.05$). There was, however, a cor-

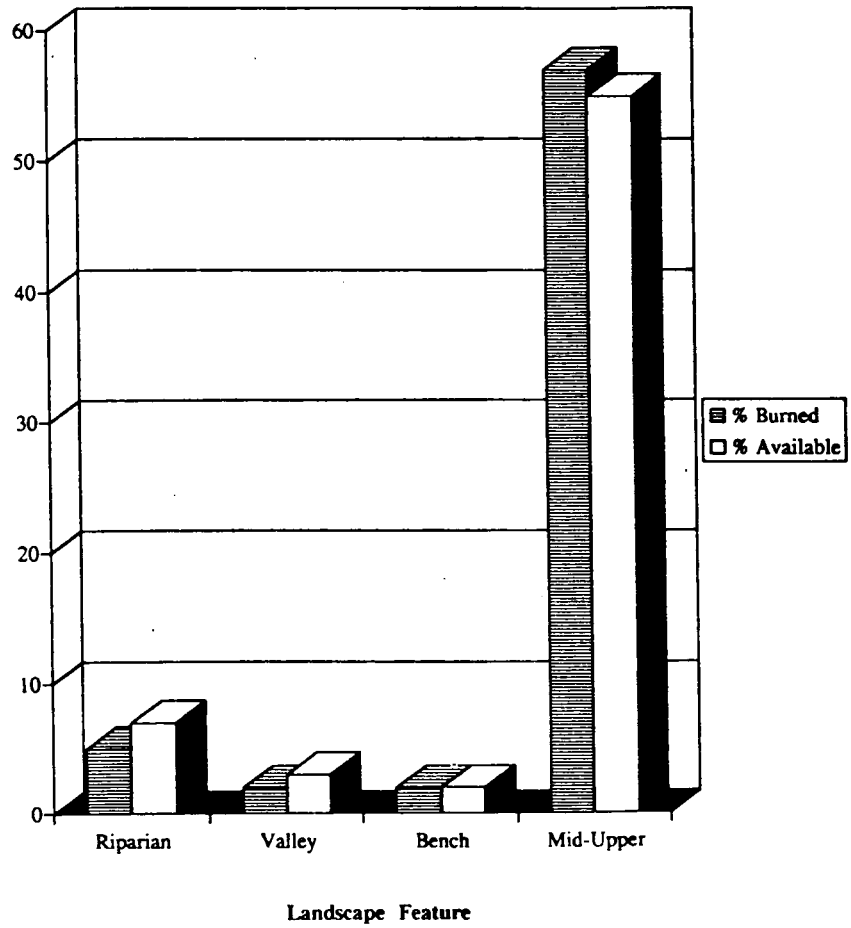

Figure 2. Proportion of spotted owl habitat that burned vs that available at various locations on north aspects, Hatchery Complex fires.

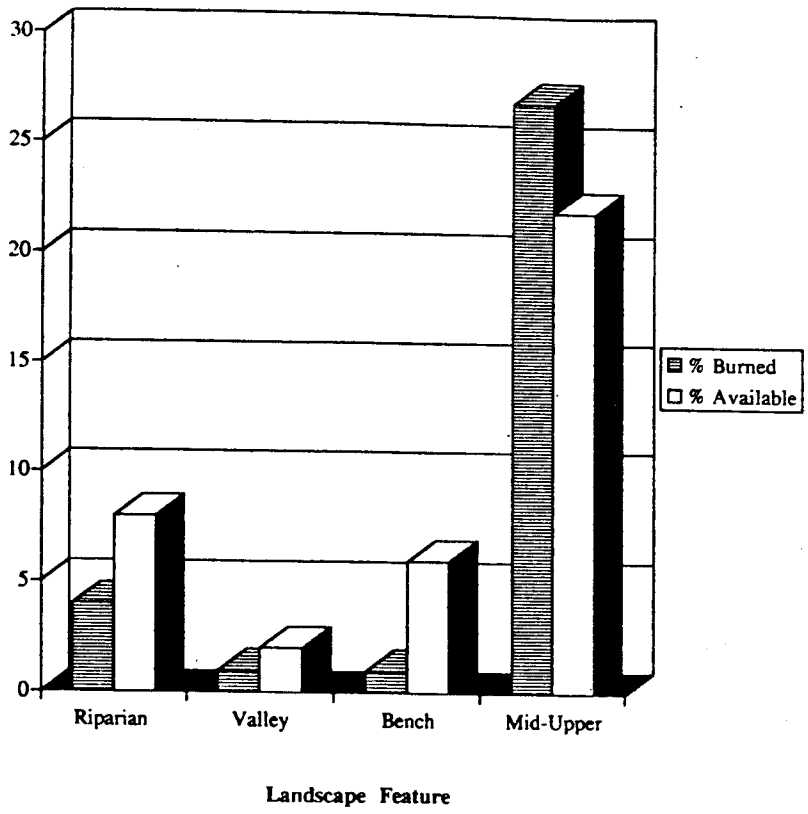

Figure 3. Proportion of spotted owl habitat that burned vs that available at various locations on south aspects, Hatchery Complex fires.

Table 2. Status of spotted owl activity centers for four years prior to the Hatchery Complex fires and one year following.

Status	1991	1992	1993	1994	1995
No Present	50%	25%	20%	17%	66%
Single		25%		33%	
Pair			20%	17%	17%
Reproductive	50%	50%	60%	33%	17%
No. sites	4	4	5	6	6

relation between site status and the amount of habitat remaining after the fire within a 0.8 mile radius (alpha=0.05, $p<0.05$). As the availability of habitat increased so did the site status (no presence being low status and reproductive pair being the highest status).

Reproduction

Data from all owl sites on the Leavenworth Ranger District were used to compare reproduction at burned vs unburned sites. These data are shown in Table 3. The 1995 season (one year post burn) was lower than any of the previous four years at the sites affected by the fires. However, reproduction during 1994 was also quite low, and as shown in Table 3, 1995 was overall a low year for reproduction. Reproduction, at least one year post-fire was not reduced much below previously reported low years.

Spotted Owl Nest Sites and Inherent Fire Regime

A total of 28 nest sites on the Leavenworth Ranger District were evaluated using the fire refugia model developed by Camp (1995). The results of this evaluation are shown in Figure 4. Two (7%) of the nest sites were in

Table 3. Comparison of # young/site at spotted owl activity centers affacted and not by the Hatchery Complex fires.

Site Data	1991	1992	1993	1994	1995
Affected by fires (# young/site)	0.6	1	0.8	0.3	0.2
No. sites	5	5	6	6	6
Not affected fy fires (# young/site)	0.9	1.3	.03	1.8	0.3
No. sites	13	15	15	14	17

locations where there was only a 2% probability of them remaining as fire refugia under an inherent fire regime. Fourteen (50%) of the sites occurred at a position on the landscape in which there was a 10% probability of them remaining as fire refugia under an inherent disturbance regime. Eleven (39%) of the nest sites occurred at locations in which there was a 19% probability, and 1 (4%) was at a location in which there was a 51% probability of them remaining as fire refugia. This assessment examplifies the dynamic nature of spotted owl habitat across a landscape in which fire played its inherent role. This is especially true on forests on the east side of the Cascades where relatively dry conditions resulted in frequent fires (Agee 1994).

Conclusions

Because data from only one season has been collected up to this point, conclusions must be mae very cautiously. Additional monitoring of these sites will occur in succeeding years and data may support the findings made in this initial evaluation or it may provide new insights. However, at this point the following observations about the effects of the Hatchery Complex fires on spotted owls and their habitat have been made.

The fires reduced the availability of spotted owl habitat around six activity centers. The initial direct reduction caused by the fire was not an accurate reflection of the total affects on habitat availability. Fire damaged trees continued to die, and increased insect activity contributed to the total reduction in spotted owl habitat within the burned landscape.

Habitat located within riparian areas and on a bench is somewhat more likely to remain as suitable following a fire vs habitat located on the mid-upper slopes, especially on south slopes. This information should be useful in the development of management plans for habitat reserves.

In the six fire affected activity centers there was a decrease in the number of reproductive pairs and an increase in the number of sites not occupied. Direct mortality likely occurred at one of the sites as a result of rapid and intense fire.

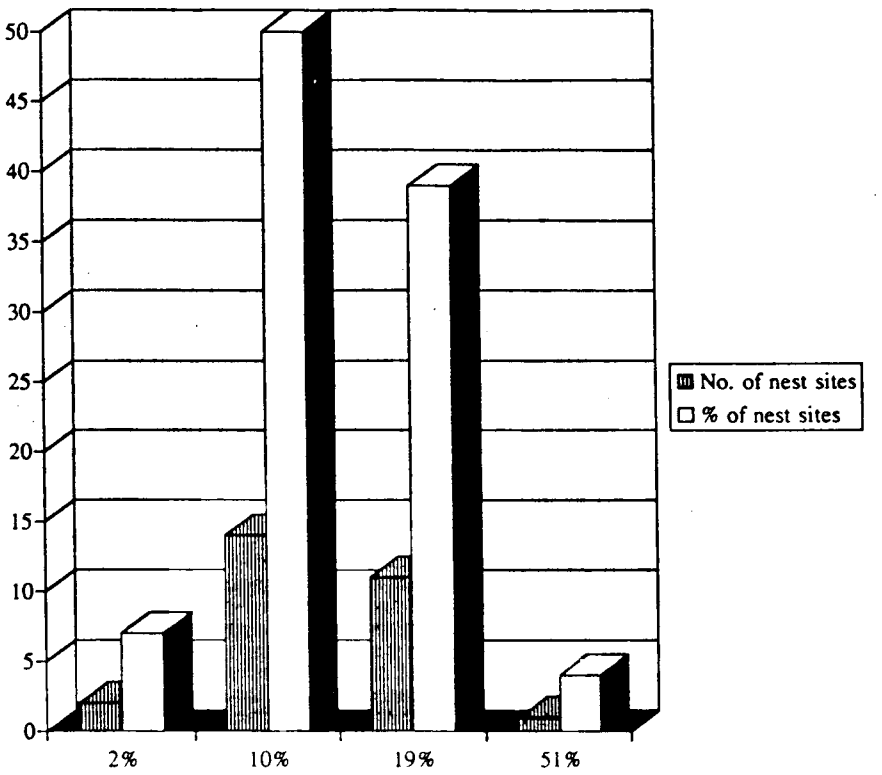

Figure 4. Persistence of spotted owl nest sites (n=28) using the Fire Refugia model (Camp 1995), Hatchery Complex fires.

The availability of spotted owl habitat across the eastern Cascades landscape appears to have been very dynamic under inherent disturbances (Camp 1995). This is an important consideration when developing management strategies for habitat reserves. The fire refugia model developed by Camp (1995) and information from this study should be useful in developing strategies that result in the highest probability of sustaining spotted owl habitat.

Management of fuel loading and tree density within habitat reserves may be neccessary to protect activity centers (Agee and Edmunds 1992). Strategically located low fuel density areas could accomplish dual objectives: protection of adjacent spotted owl habitat and restoration of fire climax ponderosa pine.

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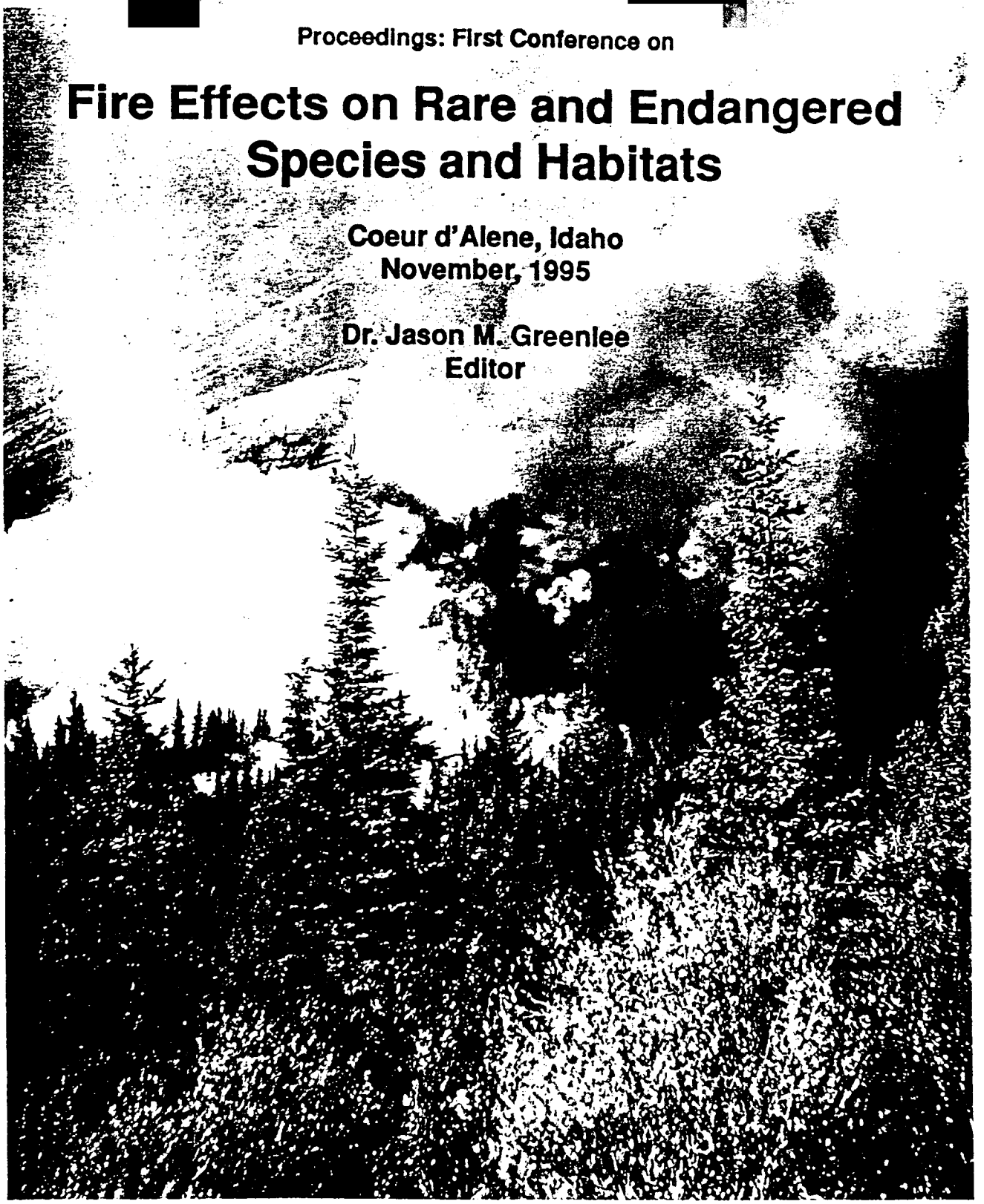

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