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A decade of recreation ratings for six silviculture treatments in Western Oregon

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Abstract

Managed forests are increasingly being used for recreation. As a result, foresters may be expected to tailor silvicultural treatments to accommodate specific recreation preferences. To better understand changes in hiking and camping quality in the years following a harvest, six sites on the Oregon State University's research forest were evaluated annually for 11 years. Multiple comparison and regression analyses were used to describe the data. Results show that recreation ratings generally improved over time; recreation ratings were related to but different from scenic ratings; and there were differences among recreation activities. Although several studies have previously examined recreation quality after harvest, we know of no other study that has tracked the ratings of individual harvest units through the early stages of stand regeneration.

Keywords: Recreation; Silviculture; Esthetics; Managed forests; Camping; Hiking

1. Introduction

The multiple-use paradigm has dominated public forest management for more than a century, but the relative importance of different uses has shifted considerably (Brunson and Kennedy, 1995; Giltmeier, 1998). In North America and much of Europe, the primary role of forests has been gradually moving from wood production towards providing a largely urban public with recreation and environmental amenities (Mather, 2001; Spiecker, 2003). However, the value of forests as a source of wood products is still an important driver of forest policy and management (Caneday and Kuzmic, 1997; Mather, 2001). As a result, foresters increasingly are expected to tailor silvicultural prescriptions to accommodate multiple uses simultaneously, with particular attention to recreation (Brunson and Shelby, 1992; Spiecker, 2003).

In 1990, a baseline study on the Oregon State University research forest assessed camping and hiking quality for six silviculture treatments within two years of harvest (Brunson and Shelby, 1992). Comparisons were made for unharvested old-growth and five stands, where logging had recently taken place using different silvicultural prescriptions (clearcut, thinning, snag retention, two-story, and patch cut; see Table 1). Site evaluations have continued through the following 10 years; the present article describes these findings.

Our research addresses two primary questions.

How do hiking and camping ratings for the silvicultural treatments compare over more than a decade of stand development? Foresters, more than most land managers, must consider effects of their activities over long periods of time. Because timber harvest entries occur decades- or sometimes even centuries—apart, foresters can make better decisions about how to accommodate multiple values in their management strategies if they know how recreation qualities change with regrowth of harvested sites.

How do recreation ratings compare to scenic quality ratings made for the same sites? For as long as authors have

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Table 1
Comparison of harvesting treatments in an Oregon State University research forest

Harvest type	Stand type	Stand description*[a]
None	Old-Growth	Dominated by Douglas-fir approximately 250–300 years old, with diverse maple, grand fir and Pacific yew understory
Non-traditional	Patch cut	Half-acre cuts with all trees removed, scattered throughout a 20 acre unit of mature Douglas-fir forest (age 100) with about one-third of the total volume removed
	Two-story	Twenty-one acres, Douglas-fir dominated, about two-thirds of volume removed, 8–10 scattered overstory trees per acre retained (age 100). Similar to shelterwood in appearance,but prescription does not call for removing overstory after regeneration establishment.
	Snag retention	Seventeen acre clearcut with 1.5 large (>30″dbh) Douglas-fir snags (saw-toped at ~70 feet) retained per acre as wildlife trees. Tree tops were left where they fell for habitat
Traditional	Thinning	Eight acres, Douglas-fir dominated plantation, thinned to approximately 100 trees per acre. Residual trees are 30–40 years old with understory of sparse herbs and shrubs
	Clearcut	Forty-five acres, all trees removed from matrix of mature (age 100) and old growth trees

All harvested sites except thinning received herbicide site-prep and were replanted to approximately 200 trees per acre. The clearcut, snag retention, and two-story sites have denser stocking due to natural regeneration.

[a] All harvested sites were cut between the winter of 1989 to the winter of 1990.

been commenting on the impacts of timber harvest on non-commodity values, the conceptual boundaries between recreational impacts and scenic impacts have been blurred (e.g. Caneday and Kuzmic, 1997; Lindhagen, 1996; Marshall, 1925). Some have assumed (either implicitly or explicitly) that addressing scenic quality would take care of recreation, but research has shown that some forms of recreation are more compatible with timber harvest than others (Brown and Daniel, 1984; Findley, 2001; Hunt et al., 2000). Shelby et al. (2003) described 10 years of changes in ratings of the scenic quality of the same stands described in the present paper. Thus our research offers an opportunity to compare the magnitude of ratings for different uses and the relative variability in ratings. This information allows foresters to predict and plan for impacts of harvests and amenity uses that occur in, or near, a forest stand. For social scientists such information adds to our understanding of the complexity of factors that influence judgments about forest practices and conditions.

Underlying this research is a fundamental assumption that environmental perception is cognitively organized and can be quantitatively measured. The 'full ecology' perspective in environmental psychology (Bonnes, 1998; Bonnes and Bonaiuto, 2002) argues that people and places are reciprocally interdependent, and thus people evaluate environments in terms of how they meet psychological, social, and/or physical needs. Contemporary environmental psychologists (e.g. Stokols, 1987; Wapner and Demick, 2002) also argue that environmental perception is highly dependent upon the experiential context of the place being evaluated. Therefore we measured people's responses to forest stands in their entirety, rather than linking judgments to specific elements of the environment as in many earlier studies of silvicultural impacts (e.g. Brown and Daniel, 1984; Ribe, 1991).

2. Methods

Following the same protocols developed for the 1990 study (Brunson and Shelby, 1992), site quality data for hiking and camping were obtained at six sites in the McDonald Research Forest near Corvallis, OR. The harvest treatments were originally developed for the College of Forestry Integrated Research Project, a long-term study of forest management practices. This interdisciplinary effort has resulted in over thirty publications on diverse topics such as wildlife biology, stand development, harvest operations and costs, and scenic and recreation value (Chambers et al., 1999).

The sites consisted of one old growth Douglas-fir (*Pseudotsuga menziesii*) stand (age 250–300), and five other stands that had been harvested in 1989 and 1990. The treatments included: a 45-acre clearcut, a thinned stand with 30–40 year old residual trees at a density of approximately 100 trees per acre, a half-acre patch cut in a 20 acre matrix of mature Douglas-fir (age ~100) with approximately one-third of the volume removed, a snag retention cut with 1.5 large saw-topped snags per acre, and a two-story stand with 8–10 overstory trees left per acre. Logging debris was left except, where replanting required its removal. Hiking trails or skid trails crossed all sites except the snag-retention cut. All sites were replanted within 18-months of harvest. Table 1 describes the sites in more detail.

Each October from 1990 to 2000, a group of students enrolled in a junior-level wildland recreation class at Oregon State University were taken to the Research Forest to conduct evaluations. Enrollment ranged from 37 to 67 students. Previous research at these specific sites found that scenic and recreation evaluations by college students were similar to those by non-students (Brunson, 1991; Brunson and Shelby, 1992). Other research has found that scenic ratings by students were similar to those of the public

(Daniel and Boster, 1976; Brunson and Reiter, 1996). Instructions were given to the respondents explaining the purpose of the study and directing them to respond only for the stand of interest. If they had additional questions about the sites, they were asked to wait until after the surveys for all sites were completed. Because the first stimulus tends to serve as the baseline whenever a series of environmental stimuli is evaluated (Taylor et al., 1987), the order in which the stands were visited was held constant throughout the study. The old growth stand was rated first, followed by the clearcut, thinned stand, patch cut, snag-retention, and two-story. Logistical difficulties beyond our control prevented us from obtaining ratings on the patch cut treatment in 1998.

On the self-administered questionnaire, students were asked: 'How would you rate this location as a place for you to hike?' and 'How would you rate this location as a place for you to camp?' Responses were on a 9-point acceptability scale, with −4 being the most unacceptable, zero being 'neutral,' and +4 being the most acceptable. Silviculture treatments and past evaluations were discussed in a follow-up class session.

Annual mean ratings were used to compare treatments within and between years. This method is consistent with other studies that address environmental perception through ratings (Palmer et al., 1995; Schroeder, 1984) and has been shown to produce results similar to more complicated scaling methods (Schroeder, 1984). A Bonferroni multiple comparison procedure was used to compare mean ratings within each year. A linear regression model, with time as the independent variable and mean site ratings as the dependent variable was done for on all sites that exhibited a significant change in mean ratings between 1990 and 2000. The patch cut showed no such change; however, a visual examination of these data displayed an apparent curvilinear trend, which led us to a multiple regression procedure that included a quadratic term as an explanatory variable. The percentage of respondents who gave each site a positive rating was calculated for years 1990 and 2000. Finally, a correlation coefficient was obtained to compare the scenic ratings reported in Shelby et al. (2003) with the recreation ratings reported here.

The analysis provides a straight-forward presentation of a valuable yet unusual data-set, where ratings were carried out on the same sites for more than a decade. For several reasons we urge caution when interpreting the results. First, this analysis is based on one site per silvicultural treatment—so no extrapolation beyond these sites is justified. Second, survey respondents within each year rated all six sites in question—so ratings are not independent within years. Third, respondents were an 'opportunity sample' of college students. Finally, the sites were chosen as part of a much broader study and factors that affect site ratings were not controlled (e.g. size of harvest, aspect, slope etc.). Despite these limitations, the data are compelling and we know of no other study that has followed the recreation ratings of individual harvest units through the first decade of regeneration.

2.1. Findings

Tables 2 and 3 show the mean hiking and camping ratings for each site from 1990 to 2000. Positive ratings indicate that, on average, the site was rated acceptable; negative scores indicate an unacceptable rating. Multiple comparison and regression analysis were Fig. 1 used to explore the differences between sites and the changes within sites over time (Figs. 2 and 3).

2.2. Hiking

For all years the old growth site received the highest rating for hiking quality and there was no significant change in average ratings between 1990 and 2000 (one-sided p-value >

Table 2
Mean hiking quality ratings for different stands

Year	n	Unmanaged Old growth	Traditional Clearcut	Thinning	Non-traditional Patch-cut	Snag retention	Two-story
1990	42	$+3.12^{a}$	-1.45^{b}	$+0.05^{c}$	$+1.50^{d}$	-0.14^{c}	$+0.69^{c}$
1991	49	$+3.02^{a}$	-2.00^{b}	-0.02^{c}	$+2.04^{d}$	-1.10^{e}	-0.27^{c}
1992	67	$+3.26^{a}$	-1.13^{b}	$+0.62^{c}$	$+1.32^{c}$	-1.11^{b}	-0.22^{d}
1993	62	$+3.05^{a}$	-1.46^{b}	$+1.52^{c}$	$+1.68^{c}$	-0.51^{d}	$+0.34^{e}$
1994	43	$+3.21^{a}$	-1.05^{b}	$+1.26^{c}$	$+2.54^{a}$	-1.49^{b}	-0.19^{d}
1995	53	$+3.12^{a}$	-0.46^{b}	$+1.23^{c}$	$+2.45^{a}$	$+1.08^{c}$	$+0.74^{c}$
1996	48	$+3.13^{a}$	-0.88^{b}	$+1.48^{c}$	$+1.68^{c}$	-0.72^{b}	$+0.54^{d}$
1997	54	$+3.00^{a}$	-0.98^{b}	$+1.51^{c}$	$+1.68^{c}$	$+0.23^{d}$	$+0.65^{c,d}$
1998	37	$+3.14^{a}$	$+0.51^{b}$	$+2.30^{a}$	N/A	$+0.51^{b}$	$+0.95^{b}$
1999	41	$+3.30^{a}$	-0.66^{b}	$+1.37^{c}$	$+1.27^{c}$	$+0.10^{b,d}$	$+0.63^{c,d}$
2000	41	$+3.20^{a}$	-0.86^{b}	$+1.85^{c}$	$+0.80^{d}$	$+0.40^{d}$	$+1.31^{c,d}$
Slope			0.13	0.18	0.46(−0.04)	0.13	0.11
Intercept			−1.73	0.12	0.98	−1.05	−0.16
r^2			46%	70%	59%	30%	47%
p-value			0.022	0.001	0.045	0.079	0.02

Ratings with different superscripts are significantly different within rows, using the Bonferroni multiple comparison test. Slope is equal to the annual rate of change in the evaluation. The value given in parentheses for the patch cut is the parameter estimate for the quadratic term.

Table 3
Mean camping quality ratings for different stands

		Unmanaged	Traditional		Non-Traditional		
Year	*n*	Old growth	Clearcut	Thinning	Patch-cut	Snag retention	Two-story
1990	42	-0.07^{a}	-3.10^{b}	-1.76^{c}	$-0.57^{a,d}$	-1.81^{c}	$-1.02^{c,d}$
1991	49	-1.06^{a}	-2.51^{b}	-1.04^{a}	$+0.45^{c}$	$-2.27^{b,d}$	$-1.55^{a,d}$
1992	67	$+0.85^{a}$	-2.25^{b}	-0.09^{c}	-0.11^{c}	$-1.88^{b,d}$	-1.09^{d}
1993	62	$+0.53^{a}$	-2.28^{b}	$+0.31^{a}$	$+0.18^{a,c}$	-1.15^{d}	$-0.63^{c,d}$
1994	43	-0.28^{a}	-1.98^{b}	-0.16^{a}	$+1.60^{c}$	-2.07^{b}	-0.88^{a}
1995	53	$+0.39^{a}$	-1.20^{b}	$+0.13^{a}$	$+1.28^{c}$	$+0.02^{a}$	-0.08^{a}
1996	48	-0.13^{a}	$-0.98^{a,b}$	$+0.06^{a}$	$+0.38^{a}$	-1.34^{b}	-0.27^{a}
1997	54	$+0.02^{a}$	-1.30^{b}	$+0.34^{a}$	$+0.04^{a}$	$-0.40^{a,b}$	$-0.29^{a,b}$
1998	37	-0.19^{a}	$+0.14^{a}$	$+0.39^{a}$	N/A	0.03^{a}	$+0.19^{a}$
1999	41	$+0.25^{a}$	-1.66^{b}	-0.17^{a}	$+0.24^{a}$	$-0.88^{a,b}$	-0.59^{a}
2000	41	-0.20^{a}	-1.53^{b}	-0.10^{a}	$-0.97^{a,b}$	$-0.73^{a,b}$	-0.18^{a}
Slope			0.19	0.12	0.50(−0.03)	0.17	0.12
Intercept			−2.86	−0.92	−0.83	−2.17	−1.29
r^2			54%	39%	59%	49%	60%
p-value			0.009	0.039	0.043	0.017	0.006

Ratings with different superscripts are significantly different within rows, using the Bonferroni multiple comparison test. Slope is equal to the annual rate of change in the evaluation. The value given in parentheses for the patch cut is the parameter estimate for the quadratic term.

0.10). The regression lines for the clearcut (slope = 0.13, $r^2 = 46\%$), snag retention (slope = 0.13, $r^2 = 30\%$) and two-story (slope = 0.10, $r^2 = 47\%$) sites were similar; these sites showed significant improvement between 1990 and 2000 (one-sided *p*-values all below 0.05). The clearcut was the lowest rated site in 1990 (one-sided *p*-value < 0.05) and in 2000 (one-sided *p*-value < 0.05). The thinned site showed the highest rate of improvement over time (slope = 0.18, $r^2 = 70\%$) and the greatest increase in ratings between 1990 and 2000 (one-sided *p*-value < 0.05). Ratings for the patch cut were unique in that they generally increased over the first five years and decreased over the latter six; overall, the average rating decreased significantly over the length of the study (one sided *p*-value < 0.05). These ratings could not be reasonably represented by a simple linear equation, but a quadratic equation describes the trend ($r^2 = 59\%$).

2.3. Camping

Camping ratings were highest in the old growth site, and there was no significant change between 1990 and 2000 (one-sided *p*-value > 0.10). Simple linear regression models show the thinning (slope = 0.12, $r^2 = 39\%$) and the two-story stand (slope = 0.12, $r^2 = 60\%$) had similar rates of improvement, though the goodness of fit was higher in the two-story stand. Both sites improved significantly between

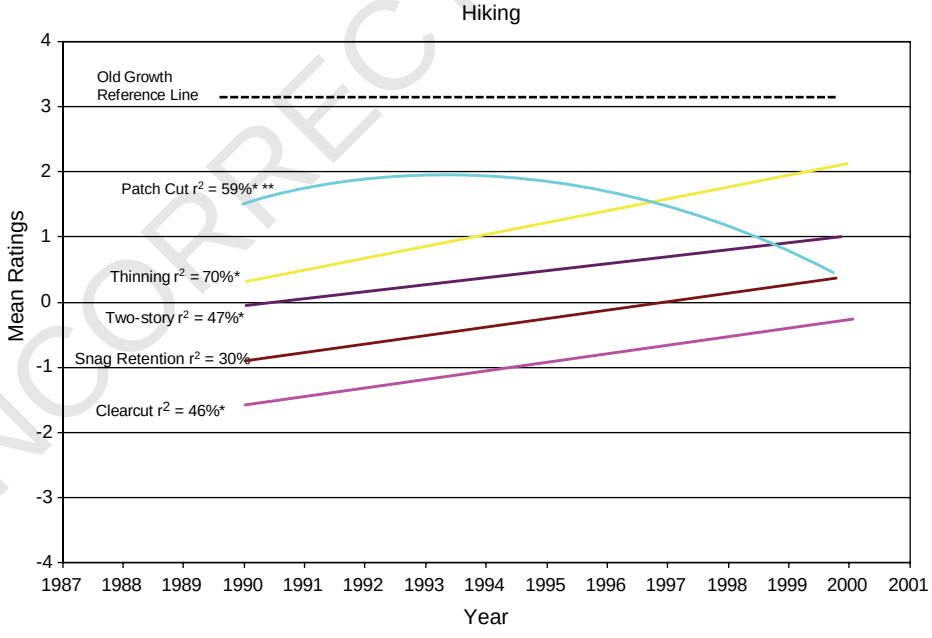

Fig. 1. Regression lines fit to the average hiking rating for each site from 1990 to 2000. *, *p*-value < 0.05; □, includes quadratic term.

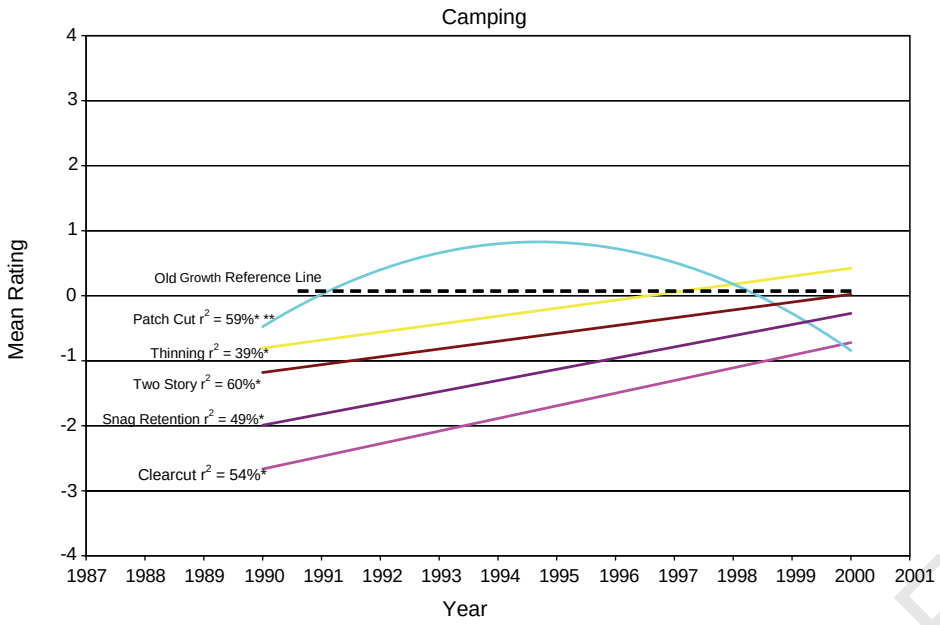

Fig. 2. Regression lines fit to the average camping rating for each site from 1990 to 2000. *, p-value <0.05; □, includes quadratic term.

1990 and 2000 (one-sided p-values both below 0.05). Rates of improvement were also similar for the clearcut (slope $=0.19$, $r^2=54\%$) and snag retention (slope $=0.17$, $r^2=49\%$) sites. Both sites improved significantly between 1990 and 2000 (one-sided p-values both below 0.05), though the clearcut site showed a larger increase in average rating. The patch cut received generally increasing ratings in the early years of the study followed by decreasing scores in the latter years, and there was no significant difference in ratings between 1990 and 2000 (one-sided p-value >0.10). A quadratic equation was used to describe this trend ($r^2=64\%$).

2.4. Changes in acceptability

Fig. 3 shows the percentage of respondents who rated each stand 'acceptable' (+1 or higher) in 1990 and 2000. This may be of interest from a policy point of view. A harvest method may be defined as meeting the public's standards if judged acceptable by some proportion of

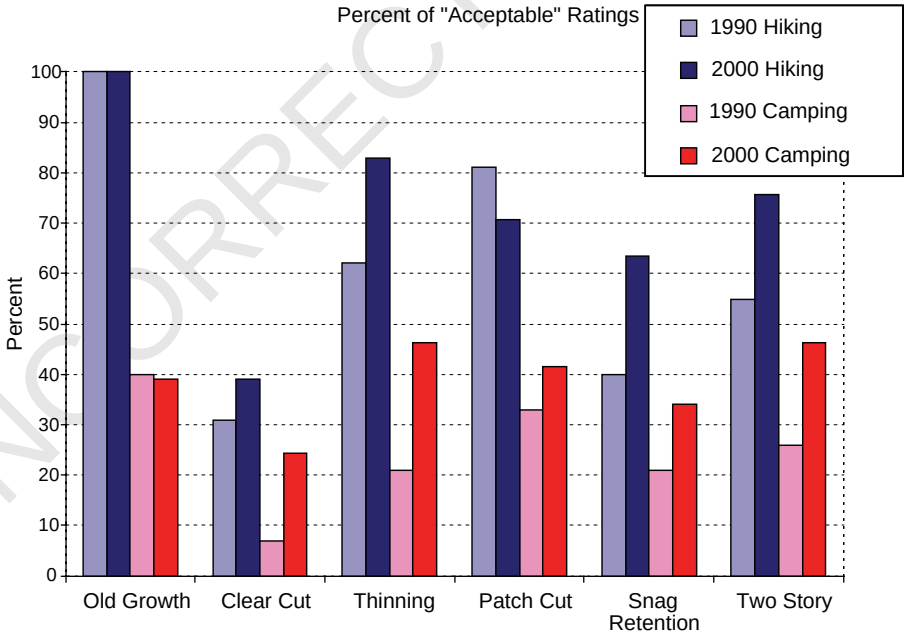

Fig. 3. Percentage of respondents who rated a site 'acceptable' for hiking and camping in 1990 and 2000.

Table 4
Pearson's correlations between mean scenic ratings (Shelby et al., 2003) and mean recreation ratings

SITE	SCENIC–HIKING	SCENIC–CAMPING
OLD GROWTH	0.68	0.57
CLEARCUT	0.80	0.84
THINNING	0.98	0.84
PATCH CUT	0.86	0.93
SNAG RETENTION	0.95	0.83
TWO-STORY	0.95	0.73

the public; for the purpose of this discussion a simple majority (>50 percent) is used.

For hiking quality, the old growth site is in a class by itself, with 100% acceptability ratings in 1990 and 2000. In 1990, the thinning, patch cut, and two-story sites received acceptable ratings for hiking quality from the majority of respondents. By 2000, the snag retention had also met this standard, leaving only the clearcut site below fifty percent. All sites except the patch cut showed improvement.

Camping acceptability levels were universally lower than those for hiking, and no sites received a majority of 'acceptable' votes. Even the untreated old growth site, a consistently highly rated site for scenic quality and hiking, falls below an acceptable rating for camping. However, all treated sites show an improvement over the duration of the study, and the thinned and two-story sites are within 4% below a majority by 2000.

2.5. Scenic and recreation quality

Relationships between scenic and recreation quality, shown in Table 4, are based on data from the present study and from Shelby et al. (2003). Results show that on some sites (e.g. thinning, snag retention and two-story) scenic quality explains most of the variation in hiking quality. On most other sites, however, scenic quality explains some but not all of the variation in recreation quality and that the effect varies across sites. Generally, correlations between hiking and scenic ratings were higher than correlations between camping and scenic ratings.

3. Discussion

3.1. Improvements in ratings

From a management standpoint, one of the most important findings of this study is that ratings of both hiking and camping quality improved over the study period for most treatments. The two exceptions were the old growth stand, where hiking quality ratings were already very high, and the patch cut stand, where ratings increased and then decreased over the life of the study (discussed below).

For hiking quality, by the end of the study period a majority of respondents found all but the clearcut stand acceptable. Our findings suggest that negative effects on hiking quality that are associated with a partial harvest can be a relatively short-term phenomenon as long as trails are maintained, although the excellent growing conditions of western Oregon may also have contributed to the rapid recovery.

Camping quality also improved over the period of the study, but none of the stands is yet judged acceptable by a majority of visitors. Given this circumstance also holds true for the old growth stand, it may be unrealistic to expect camping quality in these particular stands to be judged positively by most people. Although the direction of improvement suggests that in different locations camping quality might be acceptable a decade after harvest, but this study is inconclusive.

The patch cut ratings, regardless of use, generally showed increased ratings in the early years of the study, followed by decreases in the latter years. We think the initial increases were due to reduction in evidence of logging, and the subsequent decreases due to understory brush accumulation and a 'messy' appearance (Shelby et al., 2003). Ribe (1991) has shown that the character of understory vegetation may complicate a simple linear relationship. Because campsites in forested areas are essentially made by creating a patch cut and then maintaining part of the area free of undergrowth, it is not surprising that a patch, where that maintenance does not take place would be rated gradually lower in terms of camping quality. In this particular stand, heavy growth of understory vegetation also began to cover the trail leading to the site, further illustrating the negative impacts of understory vegetation on hiking and camping.

3.2. Differences among recreation activities

If one compares the camping and hiking ratings reported here to scenic beauty ratings reported by Shelby et al. (2003), it is striking that camping quality was consistently lower than scenic and hiking quality. Even the old growth site, which tops the scenic and hiking ratings in all years, received a relatively low score. This is likely due to the high number of additional attributes considered when choosing a campsite (Brunson and Shelby, 1990). Flat ground, for example, may be seen as a requirement for a campsite, yet this attribute is in short supply in all of the study sites. In his analysis of site attributes, Brunson (1996) found that topography affected camping evaluations but not others. Similarly, Brunson and Shelby (1990) hypothesized that off-site factors (such as distance to water and other recreation opportunities) also influence campsite evaluations.

In two surveys of recreation and nature-based tourism visitors to northern Ontario, Hunt et al. (2000) found that consumptive and motorized activities are well suited to areas

with multiple use management while many non-consumptive activities, including hiking, are better suited to areas spatially segregated from logging. Brown and Daniel (1984), after examining the relative importance of scenic beauty to recreation quality, proposed a continuum of influence based on the extent to which participation in an activity requires one to focus on the skill demands of the activity, as in many physically demanding or machine-based activities, instead of one's surroundings. Our study adds further evidence that effects of forest management on recreation quality depend on the particular recreation activity for which the evaluation is made.

3.3. Differences between scenic quality and recreation quality

It is important to review the question of whether scenic quality judgments can be used as proxies for judgments of recreation quality. Research on the amenity impacts of silviculture has concentrated on scenic quality (see Ribe, 1989 for an extensive review). This research has influenced harvest plans that consider the scenic impacts of intensive forestry, identified silvicultural techniques that can preserve or even enhance scenic beauty (e.g. Brown and Daniel, 1984; Johnson et al., 1994). However, little effort has gone into designing silvicultural techniques to enhance recreation quality.

Results from the first year of this study (Brunson and Shelby, 1992) showed that ratings for scenic quality were related to but different from those for hiking and camping. Though this seemed obvious after the data drew attention to it, the issue has not received much attention in the literature, and it has often been assumed in forest management that managing for scenic quality will take care of recreation attributes. Researchers have found that ratings of forests for generic 'recreational quality' are highly correlated with scenic quality (Pukkala et al., 1988; Hollenhorst et al., 1991), but the relationship does not hold for ratings of individual recreation activities are examined (Hunt et al., 2000). When viewed in light of environmental perception, theory suggests a place is evaluated based on its ability to meet psychological, social, or physical needs; this finding makes sense - judgments of a forest stand depend upon the needs it is being asked to meet. Thus a stand may have attributes that support one activity - what the psychologist J.J. Gibson (1966) called 'affordances'—more than they support another. Scenic beauty is one such affordances—an important one, but not the only one. Further analysis of relationships between scenic and recreation ratings (Table 4) suggests that scenic quality is a stronger influence on hiking quality than camping quality for three of the five harvested sites in the present study.

Brunson and Shelby (1992) point out that hiking and camping require site attributes such as trails (hiking) and flat areas (camping), so judging a site for these activities includes additional considerations beyond scenic quality. This suggests that evaluations of sites for specific recreation activities (like hiking and camping) may be more complex than evaluations for scenic quality alone; scenic quality may be a necessary component of recreation ratings, but is not entirely sufficient to characterize the quality of a site for specific uses. Brunson (1996) analyzed the relative contribution of various environmental attributes to quality judgments. He found that hiking, camping, and scenic quality ratings all associated with site characteristics, such as attraction sites, biological diversity, and lack of obvious human influence, but the relative importance of those attributes differed. In addition, microclimatic factors such as shade influenced hiking and camping ratings but not scenic ratings, while presence of dead trees affected scenic ratings.

4. Conclusion

We tracked the changes in perceived recreation quality of an old growth and five silvicultural treatments for over a decade using unique longitudinal data. The study showed improvements in ratings for most sites and no change in the ratings for the old growth site. It also suggested that recreation quality is related to, but different from, scenic quality, and different recreation activities can have different requirements. This means, when designing silvicultural prescriptions in areas managed for recreation, scenic quality can be an important and perhaps the dominant consideration. However, it is not the whole picture. Recreationists have several additional attributes that are incorporated into their judgments, which vary across activities; therefore, foresters should consider the specific type of experience that visitors seek (or managers are trying to provide) when evaluating effects of harvesting on recreation quality.

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