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Criticism of established forestry practices has led to the development of alternative silvicultural methods known collectively as "New Forestry." The primary objective of New Forestry is to address concerns about biological diversity, but it is generally acknowledged that controversy will continue until social concerns are also addressed. Consequently, this dissertation examines potential effects of New Forestry on public enjoyment of forests.

A literature review found considerable research on the aesthetic impacts of forest management, and a somewhat smaller body of work on recreational impacts. No prior study has examined Northwest forests, nor New Forestry. In the present study, judgments of scenic, hiking, and camping quality were compared for stands in which New Forestry and traditional prescriptions were employed. Research consisted of two phases, one in which 95 persons judged six stands on-site, and a second in which 117 other subjects rated slides showing 12 silvicultural treatments. Other research questions examined the stand attributes that influence quality judgments, the

particular effects of artificial snag-creation methods, and the ability of information about New Forestry to improve acceptability of non-traditional practices.

New Forestry practices were preferred over traditional methods when judgments were made on-site, but traditional methods were rated more acceptable by slide viewers. Theoretical and methodological reasons for the discrepancy are discussed. Judgments of scenic quality differed slightly from those of hiking quality, and were more divergent from those of camping quality. The contribution of scenic beauty to recreational quality is examined.

Attributes relating to the evidence of human presence were the most influential on both scenic and recreational judgments. Biodiversity also affected scenic beauty, while attraction places enhanced recreational quality. Artificial snag creation reduced the perceived quality of stands where a majority of trees had been harvested, but judgments improved after snag creation in stands where group selection methods were employed. Information about New Forestry had a limited mitigative effect on adverse scenic impacts of non-traditional silviculture.

A concluding section of the dissertation discusses implications of this study on management of forests where the new methods are tested, and suggests directions for future research.

Effects of Traditional and "New Forestry" Practices on Recreational and Scenic Quality of Managed Forests

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EFFECTS OF TRADITIONAL AND "NEW FORESTRY" PRACTICES ON RECREATIONAL AND SCENIC QUALITY OF MANAGED FORESTS

1. INTRODUCTION

Managers of America's forests are increasingly called upon to address public concerns over the impacts of prevailing forest practices. Pressures from within the forestry profession, as well as outside it, have led many to question whether traditional methods constitute proper stewardship of the land. Clark and Stankey (1991) have described the situation this way:

> "[T]he profession finds itself beleaguered, attacked, and criticized by commodity and amenity interests alike. Issues are often cast in good-bad terms, and the stage is filled with villainy -- foresters, loggers, or environmentalists depending on your point of view -- that engenders polarization and conflict while resisting accomodation, compromise, and integration."

Foresters themselves disagree about the effects of traditional methods on biodiversity and longterm site productivity (Heilman, 1990; Salwasser, 1990). The ongoing dialogue among foresters gave impetus to what has come to be known as "New Forestry," an amalgam of traditional and innovative approaches to silviculture based on new scientific information about natural disturbance patterns (Franklin, 1989). One goal of New Forestry is to promote an integrated approach to forest management that encompasses ecosystem components other than dominant tree species and values beyond those associated with commodity extraction.

Yet distrust of scientific solutions is one of the most important factors underlying the growing public skepticism about forestry (Shepard, 1990). Any "new" practices are unlikely to be viewed favorably unless they address social values as well as scientific ones. The USDA Forest Service, recognizing that social and political concerns must be part of any integrated management strategy for public lands, has incorporated social values into its New Perspectives initiative, touted as an "ecological path" to management of the national forests (USDA Forest Service, 1990).

Among the more significant social values from a policy standpoint are those related to public enjoyment of forests, especially scenic viewing and outdoor recreation. If non-traditional New Forestry practices are seen as detracting from public enjoyment, their widespread acceptance is unlikely -- no matter how much they benefit biodiversity or site productivity. It is not clear how the scenic and recreational impacts of the New Forestry practices compare to those of more traditional practices. The Consortium for the Social Values of Natural Resources (Stankey and Clark, 1991) has identified this uncertainty about public acceptance as one of six primary problems associated with integration of social values into New Perspectives.

Study description

This dissertation describes results of a two-phase study using landscape assessment methods to compare recreational and scenic impacts of traditional and non-traditional forest practices. Acceptability judgments were obtained for stands in a managed Douglas-fir forest where a variety of practices are being used. Participants in the study rated stands for their scenic quality and their quality as places to hike and to camp. The stands represented a range of silvicultural systems and age classes, with emphasis placed on recently harvested stands where the impacts of logging and site preparation would be most evident.

In the first phase of the study, tours were conducted in which persons were shown six stands: three experimental New Forestry stands, two stands managed under more traditional methods, and an old-growth stand. Surveys were administered at the western Oregon study site. Respondents rated the stands for their scenic, hiking, and camping quality, and also judged each one in terms of 20 site descriptors. Afterward they rated the importance of each descriptor in making scenic or recreational quality judgments. Three research questions could be addressed using this method:

1. How do judgments of the scenic and recreational quality of New Forestry stands compare to judgments of uncut stands and of stands managed using traditional methods?

2. Do judgments of a stand's scenic quality differ from judgments of the same stand as a recreation setting?

3. What attributes of forest stands are most influential upon judgments of scenic and recreational quality?

In the second phase of the study, participants rated photographic slides of stands, rather than the sites themselves. This method made it possible to obtain more ratings, and to evaluate the effects of traditional practices at different times after harvest. It was also possible to observe the additive effect of creating "snags" (standing dead trees used by wildlife) in stands managed under non-traditional methods. And it was possible to examine whether acceptability judgments can be influenced by information about the justification for forestry practices. However, this method did not allow examination of a wide range of stand attributes, as in the on-site study. Accordingly, the questions addressed in this phase of the study were:

1. How do judgments of the scenic and recreational quality of New Forestry stands compare to judgments of uncut stands and of stands managed using traditional methods?

2. Do judgments of a stand's scenic quality differ from judgments of the same stand as a recreation setting?

3. How does the passage of time after harvest affect judgments of a stand's scenic and recreational quality?

4. How does artificial snag creation affect a stand's scenic and recreational quality?

5. Does information about the purpose of non-traditional forest practices influence perceptions of scenic quality in New Forestry stands?

Finally, by comparing results of the first and second phases of the study, it was possible to evaluate tradeoffs between on- and off-site research methods in measuring scenic and recreational impacts of forestry practices.

Organization of dissertation. Chapter 2 is a broad review of research on landscape assessment and the aesthetic and recreational impacts of forestry practices.

Additional literature relevant to particular questions will be discussed as needed in later chapters. Research methodology is described in Chapter 3. Chapter 4 compares acceptability ratings across treatments (traditional versus New Forestry), uses (recreational versus scenic), and evaluation methods (on-site versus slides). Site attributes that influenced acceptability ratings are discussed in Chapter 5. The effect of snag creation on acceptability ratings is covered in Chapter 6, and Chapter 7 describes how ratings differed for groups that were given different informational messages during Phase 2. In the final chapter, policy and management implications are discussed along with possible directions for future research.

Six appendices are included. Appendix A shows the 36 scenes rated in the slide phase of the study. Appendices B and C are the survey instruments for phases 1 and 2, respectively. The instructions to slide raters are in Appendix D. In Appendix E, responses to the descriptor scales are depicted graphically. Appendix F contains the results of a factor analysis of descriptor ratings (see Chapter 5).

What is New Forestry?

This paper covers an aspect of forestry in rapid transition, and its terminology also is rapidly changing. The **Journal of Forestry** recently lamented that authors proposing to defend or denounce New Forestry practices "had no idea, or rather, so many ideas about what was meant by the term 'New Forestry' as to make all their vehement arguments worthless" (Gregg, 1991). Therefore it may be useful to offer some definitions of forestry terms as they are used in this dissertation.

Franklin (1989), the scientist most closely identified with New Forestry, has called it "a kinder and gentler forestry that better accomodates ecological values, while allowing for the extraction of commodities." It encompasses a collection of silvicultural and landscape management practices which, when applied systematically at varying spatial and temporal scales, are able to imitate patterns of natural disturbance and ecosystem diversity more closely than do traditional high-yield management strategies.

Non-traditional practices under New Forestry emphasize the retention in harvest units of live trees, snags, and woody debris (what Franklin has called "legacy"); greater variation in harvest unit sizes and rotation lengths; and juxtaposition of units so as to minimize fragmentation of landscapes. A holistic New Forestry program may occasionally make use of more traditional practices such as clearcutting, commercial and pre-commercial thinning, or shelterwood systems. In the Douglas-fir region of the Pacific Northwest, where even-age forestry has been practiced almost exclusively for decades, group or single-tree selection methods may be seen as "new" even though uneven-age silviculture has long been common elsewhere. In this paper, uneven-age methods are considered non-traditional.

New Perspectives is another term whose definition is still evolving. In the narrow sense, it refers only to the Forest Service's research program on non-traditional forest management. A more comprehensive approach was taken by Clark and Stankey (1991), who describe an effort to define New Perspectives using a delphi process in which 100 people participated. Their analysis revealed six dimensions within New Perspectives: ecologically based management; greater integration of forest uses and values; reflection of changes in uses and values; new decision-making approaches; incorporation of new high-tech management tools; and questioning of agency and professional motives. The authors suggest it is too soon to standardize a definition of New Perspectives. References in this paper to New Perspectives approaches will imply a synthesis of the first five of Clark and Stankey's dimensions, emphasizing any management strategy that integrates commodity, ecological, and amenity values associated with Northwest forests.

Silviculture is another word having several definitions. Here the term will be used as Smith (1986) suggests, referring to "the various treatments that may be applied to forest stands to maintain and enhance their utility *for any purpose*." The last three words are emphasized because New Perspectives approaches to management may require the manipulation of stands to enhance values other than timber production (the primary goal of silviculture under traditional high-yield forestry).

Silvicultural terms have precise meanings that are often ignored in common practice. For example, the word "clearcutting" properly refers to a method of reproduction by which all trees in a given area are removed in order to provide conditions for regrowth of shade-intolerant tree species, but it is often applied to any operation in which a group of adjacent trees is removed as sawtimber. Similarly, a "shelterwood" is a silvicultural system, or treatment of a stand over an entire rotation, in which some residual trees are left uncut to be removed in a later entry once their sheltering effect on regenerating trees is not needed. However, the word is often used to refer to any stand in which 5-20 mature trees per acre are left behind after a logging operation.

In this paper, the term "treatment" will be used to describe the alternative silvicultural methods whose scenic and recreational effects are examined. Terms used will not be intended to imply any objectives over an entire rotation; on the contrary, a New Perspectives approach should leave room for managers to move in any of several alternative management directions from a single starting point, depending on the dynamic social, ecological, and economic conditions affecting the forest being managed.

2. LITERATURE REVIEW: ASSESSING FORESTS FOR AMENITY VALUES

Humans have sought since the Renaissance to understand and influence natural landscapes (Taylor et al., 1987). However, the empirical and theoretical foundations of this dissertation come from scientific disciplines of much more recent origin: the integrative sciences of environmental psychology and recreation. Both were born in an era of post-war prosperity and pellmell technological growth, as Western society discovered that natural environments could meet an ever-increasing need to escape the pressures of civilization, even as civilization posed an ever-increasing threat to those environments.

Protective laws such as the National Environmental Policy Act provided a mandate throughout the developed world to preserve "amenity values" such as outdoor recreation and scenery. Borrowing heavily from geography, landscape architecture, social psychology, and other established sciences. researchers began seeking the new tools and approaches that might let them fulfill that mandate.

Landscape assessment research

Foundations of landscape assessment. In America, much of the earliest research was by scientists working for federal agencies. Litton (1968) took an orthodox landscape architecture approach to the classification and evaluation of forest landscapes. His system based on formal criteria such as scale. line, form, and edge grew into the Visual Quality Management system (USDA Forest Service, 1974) still used in the agency. Leopold (1969), a hydrologist, took a different sort of expert systems approach to classifying the aesthetic quality of river corridors, assigning points to settings based on levels of a number of physical characteristics. While his system has since been abandoned for both mathematical and theoretical reasons (Hammill, 1985), it was noteworthy in assuming a strong positive correlation between scenic quality and "degree of naturalness." This relationship is still a fundamental tenet of landscape assessment, although the precise nature of "naturalness" has proved difficult to define (Ulrich, 1986).

At about the same time, Forest Service researcher E.L. Shafer and his colleagues began exploring the relationship between aesthetic quality and recreation settings, basing their findings on lay persons' judgments of outdoor scenes. The first article in the first issue of the first U.S. academic journal dedicated solely to recreation research (Shafer et al., 1969) described linear regression models that could predict scenic preferences in terms of formal landscape attributes (e.g., presence of water, percentage of scenes in midground). These were a forerunner of the psychophysical models often used to assess scenic beauty in forest stands (e.g., Brown and Daniel, 1984; Hull et al., 1987).

Shafer also initiated some of the first work done on the effects of silvicultural manipulation on recreation settings, concluding that selective harvest could be used to enhance both scenic and recreational quality (Rutherford and Shafer, 1969). And he examined the effectiveness of photos as proxies for on-site evaluations of landscapes

(Shafer and Richards, 1974), beginning another line of inquiry that has attracted considerable interest in subsequent years (e.g. Shuttleworth, 1980; Brown et al., 1989).

Attempts to build on this foundation came quickly. Carls (1974) applied the new method to a study of developed recreation settings, obtaining models that not only incorporated physical features, but also levels of recreational use and crowding. Calvin et al., (1972) added a psychological dimension to Shafer's method by having evaluators judge each landscape scene in terms of adjective-agreement measures called semantic differential scales.

Similar efforts were under way in Europe. Haakenstad (1972) undertook a large study of the relationship between timber management and recreational use of forests outside Oslo, Norway, examining attitudes toward forestry practices as well as preferences for forest conditions. Jacob (1973) applied semantic differential and factor analytic techniques to recreation settings in Europe just as Calvin et al. (1972) had done in North America.

Landscape assessment paradigms. As the field continued to develop, the approaches to assessing scenic and recreational quality of landscapes began to fall into certain basic categories. Zube et al. (1982) identified four "paradigms" for studying perceived landscape quality: expert, psychophysical, cognitive, and experiential. Daniel and Vining (1983) described five "models" of assessment (ecological, formal aesthetic, psychophysical, psychological, phenomenological), the main difference between the two being that Daniel and Vining broke Zube's expert paradigm into two separate classifications.

The expert paradigm involves evaluations by trained, skilled observers who classify environments by ecological or biophysical characteristics (Leopold, 1969) or formal aesthetic criteria (Litton, 1968). As these approaches do not directly ascertain *public* evaluations of landscapes, they lie largely outside the purview of this dissertation. Also outside the realm of this study are the experiential approaches such as that of Lowenthal (1978), who criticized expert and survey-based studies for smoothing over important nuances and individual variations within landscape experiences. Studies in the experiential paradigm often examine paintings, literary works, or other artistic expressions.

The psychophysical paradigm involves analyzing evaluations by persons chosen to represent the "public" or specific groups. Preferences at either the stand or landscape level are expressed in terms of external properties, which may be formal aesthetic attributes (e.g., Shafer et al., 1969; Arthur, 1977) or biophysical features (e.g., Daniel and Boster, 1976; Brown and Daniel, 1984). Most studies of the scenic quality of forest stands have been done within this paradigm. A typical product of such research is an equation that is expressed, like a growth and yield model, as a function of certain tree measurements; e.g., the model might predict a change in scenic beauty if the number of trees under 10 in. DBH increased by 10/ac., or if shrub cover were 50 percent less. Studies of recreational quality also tend to fall into this paradigm (e.g., Levine and Langenau, 1979; Shelby and Harris, 1985).

The cognitive paradigm focuses on the search for the meanings of scenic preferences. One line of inquiry launched by Stephen and Rachel Kaplan and their colleagues examines landscape features in terms of their effect on the flow of information to an observer (S. Kaplan, 1983). This sort of study might conclude that narrow canyons are disliked because shadows impede information flow (Herzog, 1987), or that "park-like" forests are attractive because thinned stands without a shrub layer are highly legible (Ruddell and Hammitt, 1987). A related line of research seeks to explain scenic preferences in terms of evolutionary theory (e.g., Balling and Falk, 1982; Ulrich, 1986). Such studies often examine the affective benefits of trees in stressful environments (Ulrich, 1986; Sheets and Manzer, 1991).

Taylor et al. (1987) include within the cognitive paradigm semantic differential studies that attempt to associate landscape preferences with adjectives that describe environments. Variants on this method continue to be used, although some cognitive theorists contend this work does a better job of describing language than of describing the psychological abstractions represented by language (R. Kaplan, 1985).

Recent reviews of landscape assessment research have called for an integrative approach that builds on paradigm strengths (Daniel and Vining, 1983; Taylor et al., 1987). In a promising example of cross-paradigm research, Ruddell and his colleagues combined cognitive and psychophysical elements in studies of Texas pine forests by incorporating measurements of visual penetrability along with typical stand-exam data (Rudis et al., 1988; Ruddell et al., 1989).

The aesthetics of forestry

Overview. For decades, foresters believed that high-value scenery came automatically with the practice of high-quality forestry. When a public outcry against clearcutting arose in the late 1960s, a common reaction within the profession was that public concern could be met simply by practicing proper even-aged silviculture and improving public information efforts (McGee, 1970). A few foresters called for silvicultural systems that specifically emphasized aesthetic values (Duffield, 1970), but it was several years before research began to show that significant elements of society were willing to compromise timber production in exchange for production of scenic beauty (e.g., Willhite et al., 1973).

A large body of research has developed that explores public preferences for forest landscapes and the factors that influence those preferences. Ribe (1989) provides a comprehensive literature review. This chapter does not try to duplicate that review, but instead is intended to set the research context by describing the range of studies that have been undertaken. Specific findings relevant to Northwest forests are outlined in subsequent chapters.

Silvicultural practices. Recognition that the public found clearcuts unattractive led researchers to consider practices that might be more aesthetically pleasing. Brush (1976) recommended selective harvests to produce stands having well-lit gaps and airy spaces between trees. Others have examined the effects of thinning (Daniel and Boster, 1976; Vodak et al., 1985), underburning (Taylor and Daniel, 1984), shelterwood systems (Benson and Ullrich, 1981), stand uniformity (Hamilton et al., 1973); slash removal (Schroeder and Daniel, 1981); and pruned boles (Hamilton et al., 1973). Complicating the issue were subsequent findings that public reactions to clearcuts were not always negative (Levine and Langenau, 1979; Becker, 1983). While much of this work has implications for the kinds of non-traditional practices described in this dissertation, no study specifically has examined the effects of New Forestry practices on amenity values.

Stand attributes. A major source of variation in scenic quality of managed forests is the length of time since silvicultural treatments occurred (Hull and Buhyoff, 1986). Assessments of quality vary with the ecological attributes of stands in a given successional stage. Since forest biometricians have long known how to predict attributes of stands at any stage, it made sense to adopt the biometrical framework to predict scenic quality from readily measured stand attributes such as age, stocking density, basal area, etc.

Variation in scenic quality has been associated with variation in tree size (Kellomäki, 1975; Brown and Daniel, 1984, 1986), stand density (Daniel and Boster, 1976; Hull and Buhyoff, 1986), ground vegetation (Hamilton et al., 1973; Arthur, 1977), bare soil (Brown and Daniel, 1984, 1986), insect outbreaks (Buhyoff et al., 1982; Walsh et al., 1989), woody debris (Benson and Ullrich, 1981; Schroeder and Daniel, 1981), hardwood/softwood mixtures (Kellomäki, 1975), and species diversity (Schroeder and Daniel, 1981; Kellomäki and Savolainen, 1984). Findings may also differ between sites of high and low productivity, particularly in the scenic impacts of thinning over time (Hull and Buhyoff, 1986).

Most U.S. forest types have been studied at the stand or landscape level except subtropical forests and the Douglas-fir forests of the Northwest. The most-studied stands are in pine forests of the Rocky Mountains (e.g., Arthur, 1977; Brown and Daniel, 1984, 1986), and the Southeast (e.g., Hull et al., 1987; Rudis et al., 1988). Predictive equations developed in one type of forest have tended not to work in other types, although Ribe (1990) recently has made strides toward developing more generally applicable models.

Characteristics of evaluators. The difficulty of drawing a sample of "typical" forest viewers has led many researchers to consider the effects of inter-rater variation on scenic (and recreational) quality evaluations. Some evidence of bias toward particular attributes of forests has been found among landscape architects (Daniel and Boster, 1976; McCool et al., 1986) and foresters (Hultman, 1981; Vodak et al., 1985). Other characteristics that have influenced scenic quality ratings include participation in certain recreation activities (Nelson et al., 1989), membership in environmental groups (Dearden, 1984), urban residency (Savolainen and Kellomäki, 1981), and gender (Levine and Langenau, 1979).

In general, however, scenic preferences between groups have proved to be more similar than different (Ribe, 1989). For example, Tips and Savasdisara (1986b) showed U.S. forest scenes to people from 13 Asian countries and found no significant influences in ratings when sorted by age, sex, religion, or socio-economic status. Buhyoff et al. (1983), using the same scenes, found only slight evidence of cross-nationality variation among residents of Denmark, Sweden, the Netherlands, and the

United States. Even where cross-cultural variation in preferences have been found (e.g., Eleftheriadis et al., 1990), differences tend to be in the middle range of scenic quality; there is rarely disagreement on whether the scene is attractive or unattractive.

Evaluation methods. Effects of forest attributes on scenic quality have been studied almost exclusively within the psychophysical paradigm. Various measures of scenic quality have been used, including summed rankings (Shafer et al., 1969), adjective scale scores (Savolainen and Kellomäki, 1981), Q-sort rankings (Koch and Jensen, 1988), and simple averages (Brush, 1979), but most commonly researchers employ one of two methods based on Thurstone's laws of judgment (Nunnally, 1967).

The Scenic Beauty Estimation (SBE) method pioneered by Daniel and Boster (1976) transforms ratings to an interval scale based on the Law of Categorical Judgment. Paired comparison studies (e.g., Buhyoff and Wellman, 1980) draw on the Law of Comparative Judgment. Both methods give virtually the same results (Buhyoff et al., 1982), and the SBE gradually has become the preferred technique because it is easier to administer. Recent studies have offered refinements of the SBE with respect to computation methods (Koch and Jensen, 1988), score interpretability (Ribe, 1990), and new functional forms (Hull and Buhyoff, 1983; Hull et al., 1987).

Judging recreational quality

Overview. The study of outdoor recreation, like many interdisciplinary sciences of recent origin, primarily has been a problem-centered endeavor. As a result, most research on recreation quality has focused on the influence of social conditions, rather than site attributes. Often when studies concentrate on site factors to the exclusion of social factors in forested settings, both scenic and recreational quality are considered. One such study by Pukkala et al. (1988) found that a stand attribute's influence on recreational quality was highly correlated (usually around R=.75) with its influence on scenic quality. Yet research also has shown that characteristics other than scenery may be equally important to judgments of a setting's recreational suitability (Brown and Daniel, 1984; Brunson and Shelby, 1991).

Research showing that site attributes and recreational quality were linked led to development of the Recreation Opportunity Spectrum (ROS) planning framework (Clark and Stankey, 1979). This system classifies areas of forests or other outdoor recreation areas based on degrees of primitiveness. A prime example of the expert paradigm as applied to recreation, ROS works best if applied at a regional or national forest scale, and to generic recreation rather than specific activities. The motive-primitiveness link tends to be less clear at other levels of resolution, whether the scale is broader (Williams and Knopf, 1985) or more narrow (Virden and Knopf, 1989).

<u>Activity-specific research</u>. Pukkala et al. (1988) found that their recreational quality model had higher R^2 than their scenic quality model but was less stable. They concluded that activity-specific measurements might be more reliable. Camping is one activity where the influence of site attributes on quality judgments has drawn considerable research attention. A method for classifying attributes by their importance to campsite selection was proposed by Brunson and Shelby (1990) after an extensive review of previous campsite studies. Other activities where attribute/quality

linkages have been studied include hunting (Wilman, 1984; Sanderson et al., 1986); hiking (Haakenstad, 1972; Axelsson-Lindgren and Sorte, 1987); fresh-water fishing (Sanderson et al., 1986); and cross-country skiing (Haakenstad, 1972).

Economic valuation. A new line of inquiry is examining recreational and scenic values of forests using methods first applied to non-market valuation of recreation sites. Methods to incorporate scenic beauty in economic analysis are still in the early development stage (Brown, 1987), but two recent analyses highlight the economic importance of amenity resources.

Walsh et al. (1990) found that Coloradans were willing to pay $47 more per household to protect forest quality. About 27 percent of that total was counted as recreation use value; the rest was existence, option, or bequest values. Daniel et al. (1989) found that willingness to pay for camping trips was highly correlated with campground SBE ratings (R=0.96). Although all campgrounds in the study were considered scenic, estimated trip values for the most scenic and least scenic campgrounds differed by $7/person/day.

3. METHODS

Study setting

Stand descriptions. All stands used in this study are located on Oregon State University's MacDonald-Dunn research forest. This setting, located just 10 miles from the university, offered good examples of New Forestry treatments and was close to a good source of survey respondents.

The terrain and vegetation are typical of forested sites in the rain shadow of the Oregon Coast Range, with Douglas-fir (*Pseudotsuga menziesii*) as the dominant tree species. Treatments were chosen to represent the range of management practices likely to be seen by visitors to the forests of western Oregon and Washington in the near future. One stand has had no logging activity other than individual-tree salvage several decades ago. Five others had been harvested within the previous two years. Two stands, evaluated only during the slide portion (Phase 2) of the study, were chosen to represent traditional treatments (clearcutting and thinning) after stands have had time to recover from initial disturbance impacts.

The six stands visited in Phase 1, the on-site phase, are on generally north-facing slopes drained by Soap Creek, a tributary of the Luckiamute River. These stands were also evaluated in Phase 2, along with the two post-disturbance stands which are on generally east-facing slopes drained by the West Fork of Oak Creek, a tributary of the Marys River.

The previously unharvested <u>old growth</u> stand is dominated by 200-year-old Douglas-fir with a diverse understory characterized by grand fir (*Abies grandis*), bigleaf maple (*Acer macrophylla*), California hazel (*Corylus cornuta*), and associated plants. A marked, well-maintained trail crosses the stand. The evaluation site (i.e., the specific location within the stand where on-site evaluations were made) was about 50 yards downhill from a forest road and a similar distance uphill from a perennial stream course, near a clump of four old-growth Douglas-firs. Standing snags and large logs were visible, including evidence of blowdown from a January 1990 storm.

A traditional <u>clearcut</u> of 45 ac. was logged in winter 1988-89, burned, and replanted with Douglas-fir seedlings as part of a research project to determine the effect of different spacings on wood quality. The stand is in the grass-forb condition. A variety of disturbed-site species have colonized the stand, including domestic garden flowers apparently grown from seeds. Stumps and several large, fire-blackened snags are visible within the stand. The original evaluation site was located on the marked trail that crosses the stand, approximately 120 yards from the trailhead. Non-student participants made their judgments from that location, but the site was later moved to a more accessible location (a former log landing at the southeast corner of the stand) to meet the time constraints of student respondents.

The other traditional treatment was a <u>thinned</u> stand of 30- to 40-year-old trees covering about 8 acres. Thinning was done in spring 1990 using a spacing rule to choose trees for removal. Stumps and scattered slash are evident throughout the thinned portion of the stand, which is crossed by an unmarked trail. The evaluation site was approximately 30 yards up the trail from the main forest road and a similar distance east of a paved county road.

The three remaining stands are being managed using New Forestry-type practices not yet commonly seen in the Douglas-fir region. All three stands were harvested in winter 1989-90 from a tract of 100-year-old trees for a research project examining regeneration and wildlife use in stands managed using alternative silvicultural methods. Although the treatments differed in other respects, all three included the creation of 1.5 artificial snags per acre. This was done in August 1990 by topping live trees with a chain saw at about the 50-foot level. Tops of the trees were left where they fell, except where planting requirements dictated their removal.

One treatment was a <u>patch cut</u> from which one-third of the standing timber volume was removed in harvest units of approximately one-half acre. The patch used as an evaluation site is mildly sloping, and contains an old maple snag and scattered broadleaf slash. It is reached by skid trail about 120 yards from the access road.

The second treatment was a <u>snag-retention clearcut</u>. All trees were removed from this 17-acre stand except for those necessary to retain 1.5 scattered snags per acre throughout the unit. The lowest in elevation of all the study stands, it also is nearest the timbered hill slope across Soap Creek. A narrow buffer strip of trees separates the stand from a county road. The evaluation site was located on a dirt logging road that forms the uphill edge of the roughly rectangular stand about midway along its long side.

Two-thirds of the standing timber volume was cut from the third treatment, a two-story stand, leaving a residual of 8-10 trees scattered over the 21-acre unit. Though similar in appearance to a shelterwood, this silvicultural system envisions retaining the residual trees through the next rotation to create a dual-aged stand. Skid roads cross the stand in several places. This stand is adjacent to the snag retention clearcut, and the same evaluation site was used for both. Participants first evaluated the downhill (snag retention) stand, then turned in the opposite direction to evaluate the uphill two-story stand.

The first of the post-disturbance stands, a 1985 clearcut, covers 53 acres. Replanting was done primarily in December 1985 and February 1986, with a few seedlings added in 1989. Herbicide spraying was done in 1988. Growth rates for the Douglas-fir seedlings appear to have varied considerably within the stand. Grasses are the dominant ground vegetation. The portion of the stand that was photographed was a short, moderate slope alongside a logging road.

The final site was thinned in 1969, 1977, and 1979 to eliminate disease problems, leaving a stand of mostly 70-year-old trees in the 20-, 22-, and 24-inch size classes. Stand density is about 120 trees per acre. Canopy closure is about 90 percent. There is no established shrub understory, but the stand has heavy grass cover. The area had been grazed before being acquired by OSU in the 1930s, and the grasses are almost certainly non-native. This stand is located along the same logging road as the 1985 clearcut. The photographs were taken at a point about 75 yards uphill into the center of the stand.

Selection of study sites. A constrained random selection method was used to choose evaluation sites. Three criteria were used to narrow the range of choices: all six locations had to be accessible within a two-hour period, including round-trip travel from OSU; the full range of relevant features[1] had to be visible in at least one direction; and sites had to be located along a hiking trail, skid trail, or logging road so that stands would be judged from places recreationists were likely to go. Once the stands and associated trails/roads were chosen, specific evaluation sites were selected at random. This method addressed concerns raised by Hull and Revell (1989), who pointed out that while non-random selection can reflect researchers' biases, totally random sampling may not choose views that actually draw visitors' attention.

To maximize correpondence between study phases, the slides presented in Phase 2 had to include scenes photographed from the Phase 1 evaluation sites. In practice, it was easiest to first take photographs at a number of suitable locations, then choose sites for both phases from among those photos. Randomization was achieved by looking at a watch with a second hand and noting the exact time, then walking along the trail or road the same number of steps as the number of seconds past the most recent five-minute interval. This method produced numbers from 1 to 300, essentially at random. For example, if the time were 2:15.32 p.m., the next photo point would be 32 steps away. At 2:18.25 p.m., it would be 205 steps away.

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[1]For example, the relevant features in an old growth Douglas-fir stand would be large trees, standing dead timber, large decaying logs, and a multi-layered canopy.

The watch's second hand was again used to choose the direction for the first photograph taken at each point. Subsequent photographs were taken at 90 degree angles from the previous view, with the camera held level using a tripod set at 5 feet above the ground. There was a maximum of four photos per site, but the actual number was frequently less than four because views were in deep shade, obstructed by branches, or dominated by features outside the stand of interest. Photos were taken on July 15, 1990, and again on Aug. 27 after snags had been created in the New Forestry stands.

The patch cut chosen by this method in July was a site on flat ground with little slash evident. However, when the snags were created in August, the topped portion of one tree fell across the skid trail and blocked easy hiking access to the site. An alternate patch was then chosen on a different branch of the skid trail system. The second patch was used for the on-site study, and both patches were evaluated by participants in the slide study.

The order of stands visited in Phase 1 was fixed: old growth, clearcut, thinned, patch cut, snag-retention, two-story. This sequence may have produced lower acceptability ratings for the managed stands than if a heavily disturbed site had been visited first, as the first stimulus tends to serve as the baseline whenever a series of environmental stimuli is evaluated (Taylor et al., 1987).

In slide experiments, the baseline effect is negated by showing examples of the full range of scenes before any ratings are made (Daniel and Boster, 1976), but that is not feasible in an on-site study. Randomizing the sequence of sites visited could eliminate this source of error, but would also require more time to crisscross the study area from stand to stand. Instead, it was decided to choose a method that was likely to produce the lowest acceptability ratings, but would also let people gradually become acquainted with the evaluation task by first judging stands (old growth and clearcut) with which they were most likely to be already familiar.

Twelve treatments were evaluated in Phase 2. These included the six Phase 1 sites, plus the two post-disturbance stands and the patch that was first chosen in July. The final three treatments were views of the New Forestry stands as they looked in mid-July before snags were created. Three views of each treatment were shown. After eliminating all slides which were of poor quality, were highly similar to other views, or (in the case of the New Forestry treatments) were not available in both pre- and post-snag versions, scenes for the experiment were chosen at random from the remaining slides.

Overall survey design

Phase 1. The first phase of the study took place in September and October 1990. Groups were escorted to the six stands described above, where respondents completed a survey that measured: (a) perceptions of stands' acceptability as places for scenic viewing, hiking, and camping; (b) perceptions of stand attributes; (c) ratings of the importance of stand attributes to making acceptability judgments; and (d) personal characteristics that could influence perceptions of forest environments. Appendix B of this dissertation contains an example of the survey instrument.

Information gathered with this survey was needed to answer three questions. Those questions, and the key variables used to answer them, were:

1. How do judgments of the scenic and recreational quality of New Forestry stands compare to judgments of uncut stands and of stands managed using traditional methods? *KEY VARIABLE: Differences in acceptability ratings between sites within each type of quality.*

2. Do judgments of a stand's scenic quality differ from judgments of the same stand as a recreation setting? *KEY VARIABLE: Differences in ratings between types of quality within each site.*

3. What attributes of forest stands are most influential upon judgments of scenic and recreational quality? *KEY VARIABLES: 18 acceptability ratings; 120 descriptor ratings; 60 descriptor importance scores.*

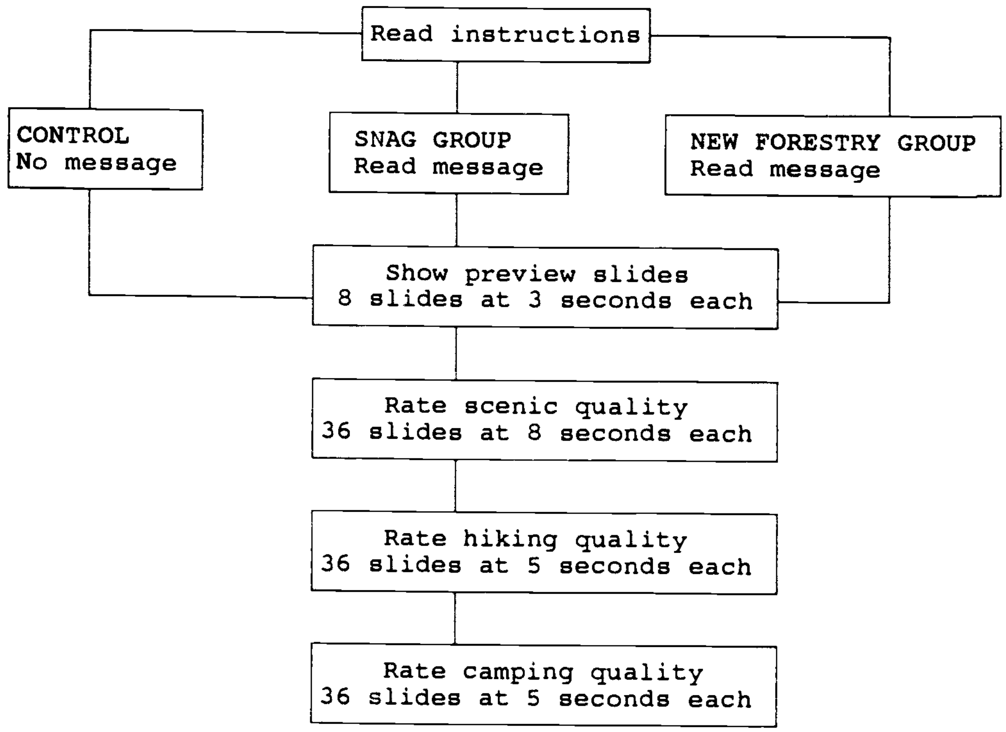
Phase 2. Ratings made during the second phase of research were obtained in April 1991. Three groups of subjects were each shown slides depicting 12 treatments (described in the previous section). A total of 108 ratings were obtained from each group: Three views of each treatment were shown, for a total of 36 slides, and three trays of 36 slides were shown, one for each type of quality rating. Slides were arranged in random order, with the constraint that July and August views of the same New Forestry scenes had to be separated by at least two other slides so that evaluators would be less likely to compare scores and more likely to judge each scene individually. A different random order was used for each tray and each rating session. The survey booklet consisted of nine pages of acceptability scales plus a page of questions asking about personal information relevant to environmental perception. An example of the survey pages is shown in Appendix C.

In most respects the sessions were conducted in as close to an identical fashion as possible. The same instructions, adapted from Daniel and Boster (1976), were read to each group. As Daniel and Boster recommended, preview slides were shown to represent the range of scenes to be evaluated. These were chosen from among the scenes rejected for inclusion in the evaluation set, and were shown in the same order to each group. Time intervals for rating the slides were the same for each group.

The one respect in which sessions differed was that an informational message was read to two of the groups after the initial instructions were read, while the third (control) group began making their ratings as soon as the instructions were finished. This design, patterned after Simpson, Rosenthal, Daniel, and White (1976), made it possible to measure the influence of information about forestry practices on evaluations of recreational and scenic quality. One message described the role played by snags in natural forests. The other, of equal length, described the rationale behind New Forestry. The basic experimental design is depicted in Fig. 1. Appendix D contains the text of both messages and the instructions to raters.

Information gathered during Phase 2 was needed to answer five questions. Questions 1 and 2 are the same as for Phase 1 (see p. 27). The other three are:

3. Are judgments of a stand's scenic and recreational quality likely to change at different time spans after harvest? *KEY VARIABLE: Differences in acceptability ratings between disturbed and post-disturbance versions of traditional treatments.*



TIME REQUIREMENTS (Total 30 mins.)
Initial instructions (5 mins.)
Informational message (6 mins.)
Preview slides (1 min.)
Scenic quality ratings (6 mins.)
Change slide trays (2 mins.)
Hiking quality ratings (4 mins.)
Change slide trays (2 mins.)
Camping quality ratings (4 mins.)

Figure 1. Experimental design of Phase 2

4. What is the effect of snag creation on scenic and recreational quality? *KEY VARIABLE: Differences in acceptability ratings between pre- and post-snag views of the New Forestry stands.*

5. Does information about the purpose of non-traditional forest practices influence their acceptability with respect to scenic and recreational quality?
KEY VARIABLE: Differences in acceptability ratings between viewing sessions.

The acceptability scale

The scale used for measuring respondents' ratings of scenic and recreational quality in individual stands is shown below. This scale is similar in some ways to those used in prior studies, but was devised specifically for this research:

```
-4    -3    -2    -1    0     1     2     3     4
<--unacceptable---------+-----------acceptable-->
```

Likert-type scales such as this are often used in research on recreation preferences, but less often in studies of scenic quality. More commonly, scenic quality is measured using a comparative procedure such as Q-sort (Hultman, 1983b; Koch and Jensen, 1988), in which photos are judged against others rather than individually rated, or the 10-point Scenic Beauty Estimation (SBE) scale devised by Terry Daniel and colleagues (e.g., Arthur, 1977; Brown and Daniel, 1986).

Both methods must be standardized using Z-scores to convert them to interval-type measures. Generally where Likert-type scales are used, results are expressed as simple means (thus assuming that the intervals between scale choices are essentially equal). When Schroeder (1984) compared simple mean ratings of the scenic quality of photographs with results based on SBE and comparative methods, he found that the methods correlated almost perfectly (R > .99). Mean ratings therefore were used in this research, as they are computationally less burdensome and, more importantly, are familiar to managers and therefore much easier to interpret.

The scale addresses other interpretation issues as well. Hull (1989) suggests that while scenic beauty ratings made with either the comparative or SBE methods adhere strictly to statistical and psychophysical theories, they are difficult to interpret because the ratings have an arbitrary sign and magnitude. Scores for randomly chosen "baseline" slides are set at zero, and other scenes are scored either negative or positive depending on how they compare to the baseline scenes. Due to the standardization procedure, the magnitude of scores depends on the amount of total variation in scenes.

The scale used in this study is anchored at zero; i.e., a zero rating means a neutral evaluation, regardless of which scenes are being evaluated. As a result, the sign is interpretable. Positive ratings indicate that a stand is acceptable for the amenity use for which it is being evaluated. Negative ratings indicate that is unacceptable.

The magnitude of ratings and interval between scale values still depends on the range of scenes being evaluated. For example, a difference of two rating points in this study, which examines a wide range of treatments, is likely to be larger in "real" terms than the same difference in a study of variation among stands within a single treatment. It may be best therefore to avoid interpretations based on the magnitude of differences between treatments. As Hull (1989) points out, no mathematical relationship has been established between changes in scenic beauty and changes in visitors' experiences.

Survey samples

Phase 1 respondents. Surveys were completed by 77 student volunteers (forest management, outdoor recreation, and fish and wildlife majors) and 18 non-students. The students were enrolled in two lower-division outdoor recreation management courses. Non-student participants were recruited by an athletic booster club from a Corvallis high school, and the parent-teacher organization of a Lutheran elementary school in Corvallis.

Table 1 shows demographic and other personal data for the Phase 1 respondents. Three-quarters of the sample group were residents of Corvallis or Benton County, and most of the rest were western Oregonians. Nearly half had worked either in forestry or the wood products industry, and 73 percent said they visit forests for recreation at least once a month. As a result, the group is likely to have been more familiar with managed forest environments than the general public. (In fact, nearly half had been to Lewisburg Saddle before.) Persons having this level of familiarity with forests make a useful sample because frequent forest visitors may be more likely than others to be involved in public policy debates over social values in forestry. Participants were well-qualified to evaluate scenic, hiking, and camping quality, as at least half of the sample considered each of those activities as being among their three favorite recreation pursuits.

Phase 2 respondents. All 117 participants in this project were OSU students, including 46 from an introductory outdoor recreation class, 33 from a forestry class for teachers, and 38 from a senior-level anthropology class. Because there were no significant differences in Phase 1 ratings made from the same evaluation sites by students

Table 1
Personal data for Phase 1 participants

Average age = 25.7 years
Average length of residency in area with commercial forests = 18.2 years

Home at the time of the survey:	
Willamette Valley	82%
Metropolitan Portland	9%
Other Western Oregon	2%
Eastern Oregon	4%
California	1%
Washington	1%
Frequency of leisure visits to forests	
Very frequent (≥ 1/wk.)	35%
Somewhat frequent (≥ 1/mo.)	38%
Occasional (several/yr.)	18%
Rare (≤ 2/yr.)	9%
Previous visits to Lewisburg Saddle	
None	55%
At least once	45%
Forest recreation activities (respondents could check more than one)	
Hiking	77%
Camping	67%
Viewing scenery	54%
Picnicking	25%
Hunting	25%
Bicycling	18%
Nature study	14%
Berry picking	8%
Fishing	7%
Birding	6%
Other (boating, running, etc.)	9%
Work experience in forestry or wood products	
No	55%
Yes	45%
Membership in environmental groups	
No	86%
Yes	14%

and non-students (see Chapter 4), it was believed that an all-student sample could reflect the judgments of the general public as long as classes having a majority of non-forestry majors were used.

This group was slightly younger than the Phase 1 sample (Table 2), and contained more people who do not call the Corvallis area home.[2] Two-thirds had never completed a forestry class before participating in the survey, and they were somewhat less likely than the Phase 1 sample to regularly visit forests for work and/or leisure. However, since they were enrolled in an elective course with a natural resource focus, there may be an above-average likelihood that they would participate in policy debates over social values in forestry. This group also included more persons who belong to environmental organizations. The three recreation activities for which the stands were being evaluated were also the three activities that were most likely to be preferred by participants in the study.

Sampling. All but 18 participants in the study were OSU students. The use of student raters is common in research of this type. Student raters have participated in studies of both scenic quality (e.g., Zube, 1973; Brush, 1979; McCool et al., 1986) and recreational quality (e.g., Lane, Byrd, and Brantley, 1975; Kellomäki and Savolainen, 1984). Comparative research has found that when slides are shown to different groups, differences in ratings are small and may be meaningless in terms of "real" variation in

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[2]Questions asked in the Phase 2 survey do not always correspond exactly with those asked in Phase 1; e.g., the on-site survey asked about the town where people live now, while the slide survey asked for the town they consider "home."

Table 2
Personal data for Phase 2 participants

Average age = 24.3 years
Average length of residence in Willamette Valley = 10.0 years

Location of hometown

Willamette Valley	41%	Washington	4%
Metro Portland	22%	California	1%
Other W. Oregon	8%	Other U.S.	11%
Eastern Oregon	10%	Outside U.S.	3%

Location of childhood home

Willamette Valley	31%	Washington	7%
Metro Portland	11%	California	9%
Other W. Oregon	15%	Other U.S.	18%
Eastern Oregon	5%	Outside U.S.	5%

Frequency of visits to forests for leisure

Very frequent (≥ 1/wk.)	17%
Somewhat frequent (≥ 1/mo.)	41%
Occasional (several/yr.)	29%
Rare (≤ 2/yr.)	13%

Frequency of visits to forests for work

Very frequent (≥ 1/wk.)	24%
Somewhat frequent (≥ 1/mo.)	8%
Occasional (several/yr.)	6%
Rare (≤ 2/yr.)	62%

Favorite forest recreation activity

Camping	35%	Horseback riding	2%
Hiking	20%	Photography	2%
Viewing scenery	16%	Backpacking	2%
Fishing	10%	Berry picking	1%
Picnicking	5%	Birdwatching	1%
Hunting	5%	Bicycling	1%
Boating	2%		

Membership in environmental groups

No	79%
Yes	21%

Previous forestry education

Never completed a forestry class	66%
Completed one forestry class	17%
Completed several forestry classes	16%
Completed a forestry degree	1%

experiences even if they are statistically significant. Similarities across disparate groups are sometimes quite striking; e.g., cross-cultural studies in Asia (Tips and Savasdisara, 1986a) and in Europe (Buhyoff et al., 1983) found few differences in ratings of forested scenes.

The sample sizes (95 for Phase 1, 117 for Phase 2) are also typical for landscape assessment research. Obtaining larger samples is problematic because of the logistical difficulties involved in presenting environmental stimuli to evaluators, especially on-site. Where large samples have been obtained, as in a Danish government-sponsored study that obtained more than 2,500 ratings of photographs (Koch and Jensen, 1988), investigators have had advantages not usually available to U.S. researchers, such as legal authority to use voter rolls as a sampling frame and sufficient funds to mail expensively produced brochures to each survey recipient.

Disciplinary and paradigmatic foundations

This project builds upon two decades of research demonstrating that people's perceptions of their environment can be cognitively organized, communicated to others, and quantitatively measured. Sometimes the results of that research have been effectively translated into management strategies; at other times, applications have been slow to appear. Where this project deviates from previous methodology, it is in hopes of obtaining results that could be translated more easily into management applications.

Much of the literature reviewed in Chapter 2 falls into the disciplinary category of environmental psychology. Unlike more established branches of psychology, environmental psychology is defined more by the problems it addresses than by any established set of theories (Darley and Gilbert, 1985). It has diverse disciplinary roots which include social psychology, behavioral geography, human ecology, and the "frontier hypothesis" of historian Frederick Jackson Turner. The research paradigm within environmental psychology entails taking a holistic approach to the study of humans and their environment, stressing a "transactional" view of outdoor experiences in which one's environment and behavior are said to be mutually defined and cannot be explained apart from their context (Ittelson, 1973).

Pitt (1989) has applied the transactional view of environmental perception to an analysis of the quality of recreation places:

> "The nature and quality of the recreational experience [depends] on salient attributes of the environment, characteristics of the recreationists involved, and the psychological, social, physical, and managerial context within which the experience occurs."

Thus an environment's suitability as a recreational or scenic setting may depend upon one's companions, rate of travel through the setting, familiarity with the setting (or similar ones), and preferences for recreation activities, as well as the rules governing activities within the setting.

This dynamic view of environmental experience focuses on what are generally called "events" -- confluences of person, place, and time which are recognized as unique, but have characteristics that can be described, measured, and categorized as long as the meaning of the event to participants is understood (Altman and Rogoff, 1987). In order to understand these meanings, transactional researchers take care to identify what Stokols (1987) calls the "embeddedness" of the target phenomenon, i.e., the variables having an important influence on the target that may be reflected in the results. In this study, some of the potentially embedded variables were accounted for by asking respondents about relevant personal characteristics such as familiarity with the study area, previous education and work experience, or environmental activism.

Pitt (1989) suggests that reactions under experimental conditions may differ from those during actual recreation outings. Therefore the on-site portion of this study was designed to be as similar to a recreation experience as possible. To be considered "recreation," experiences should be self-selected and intrinsically rewarded (Iso-Ahola, 1980). Since broad solicitation of volunteers was likely to attract respondents from poles of the preservation/commodity debate, non-student subjects were recruited through school booster groups, which in turn provided study participants who were known to each other previously and interested in participating. Payments of $5 per subject were made to the clubs; in that way, participation remained discretionary and intrinsically rewarded. Student participants visited during regular class time. Because the study visits were substituted for lectures, the sessions had a quasi-recreational "field trip" flavor.

Generalizability. Results of this pilot study may not be generalizable to all New Forestry stands; however, since so few examples of New Forestry treatments yet exist in the Northwest, there are no "typical" stands to make generalizations about. This study is likely to be most valuable in examining patterns of acceptability judgments and the factors that influence them. The aim is to give forest scientists and managers a way to *pro*actively evaluate the potential recreational and scenic impacts of New Forestry, rather than *re*acting to value conflicts that might arise after the new methods are widely used.

4. COMPARATIVE EVALUATION OF ACCEPTABILITY JUDGMENTS

Traditional forestry practices increasingly have come under fire from both within and outside the forestry profession (Heilman, 1990; Clark and Stankey, 1991). Among foresters, the debate has centered on ecological issues such as biodiversity and longterm site productivity. Advocates of New Forestry argue that traditional practices should be augmented and/or replaced with non-traditional silviculture that is based on new scientific findings about natural disturbance patterns (Franklin, 1989). In this way, they say, concerns about the ecological sustainability of Northwest forests can be eased.

Different issues characterize the debate outside the profession. Ecological concerns share the spotlight with social concerns such as the impact of current practices on scenic beauty, leisure enjoyment, or spiritual rejuvenation. Forest management agencies may be assuming New Forestry can address all concerns equally well. For example, New Forestry projects are featured prominently in the New Perspectives initiative, which professes to embrace ecosystem components other than dominant tree species and values other than commodity extraction. It is worthwhile to examine this assumption more closely. Accordingly, this chapter examines the relative impacts of traditional and New Forestry practices on two important social values: scenic beauty and outdoor recreation.

Individuals' ratings of recreational and scenic quality were examined from two perspectives. First, comparisons were made *among* treatments. The intent was to learn whether New Forestry would produce stands of superior, similar, or inferior quality for a given amenity use when compared to stands where clearcutting or traditional kinds of thinning had been done. If New Forestry does not produce improvement in amenity values, critics of traditional practices may not be mollified by New Forestry despite its apparent scientific benefits. If some New Forestry practices have a beneficial effect on social values while others do not, foresters need to know so they can consider those tradeoffs when choosing among silvicultural and managerial options.

Comparisons were also made *within* treatments to learn whether a stand's scenic quality would differ from its quality as a recreation setting. Forest management agencies do not always distinguish between scenic and recreational resources, sometimes assuming that protecting one resource automatically protects the other. However, it is possible that a silvicultural treatment can produce stands that are visually attractive but unacceptable for many forms of recreation, or vice versa. If so, management decisions should consider those effects as well.

Previous Research

<u>Scenic quality studies</u>. Scenic impacts of forest management have been studied in the U.S. since the 1960s. Lyndon Johnson's "Beautify America" movement awakened an appreciation of the nation's natural assets (Zube et al., 1982). This

renewed attention to scenery, coupled with the era's prevailing spirit of social upheaval, helped to ignite the Monongahela and Bitterroot clearcutting controversies, which in turn shaped the conduct of subsequent management on all federal lands (Dana and Fairfax, 1980).

One line of inquiry, dominated by researchers trained in landscape architecture, has examined scenic quality at the landscape level. A product of this research is the USDA Forest Service's (1974) Visual Management System. Subsequent research on scenic quality in managed forests has often focused on aspects of this system; e.g., research by Benson et al. (1985) on landscape architects' evaluation of harvested stands managed for different visual quality objectives. Landscape-level studies in European even-aged forests have examined the effects of different clearcut shapes (Kardell, 1978) or looked for optimal ratios of forest to cleared land (Hackett, 1978; Gundermann, 1980).

Stand-level studies like the one described in this dissertation have been conducted largely by social scientists interested in features of forests that influence perceived scenic quality. "Near-view" psychophysical studies have been conducted in most major U.S. forest types, including eastern hardwoods (Brush, 1979; Vodak et al., 1985), southern pines (Hull and Buhyoff, 1986; Ruddell et al., 1989), northern hardwoods (Ribe, 1990), and Rocky Mountain ponderosa pines (Arthur, 1978; Brown and Daniel, 1986), as well as in Europe (Savolainen and Kellomäki, 1981; Eleftheriadis et al., 1989) and Asia (Lo et al. 1990). The only economically important U.S. timber-growing region where such research has *not* been done is the Pacific Northwest.

Psychophysical studies look for attributes of managed and unmanaged forests that are linked to scenic quality, often focusing on the same inventory data used in growth and yield models. Considerable work has been done on the scenic effects of timber harvest (Hamilton et al., 1974; Benson and Ullrich 1981) and different silvicultural prescriptions (e.g., Brush, 1979; Brown and Daniel, 1984), but no research has yet examined the recently developed "New Forestry" practices.

Despite the lack of research on Northwest forests and New Forestry, the large body of existing research is useful for predicting scenic impacts of non-traditional practices. The practices themselves may be new, but the forests where they are used have features common to stands in other regions.

Determinants of scenic beauty. High scenic beauty has been associated with large and mature trees, low to moderate stand densities, grass/herb cover, color variation, and multiple species (Ribe, 1989). Many of those variables are highly related; e.g., a mature stand with large-diameter trees and over 90 percent canopy closure is likely to have relatively low densities of dominant trees and a poorly developed shrub layer. An absence of shrubs or small trees is associated with increased visual penetrability (Rudis et al., 1988), which in turn is closely related to scenic beauty judgments. The scenic effects of color may be linked with increased age, as in ponderosa pine stands (Brown and Daniel, 1984), or with hardwood retention, as in some Scandinavian forests (Pukkala, 1988).

Low scenic beauty is associated with small stems, dense shrub cover, bare ground, large amounts of down woody debris, and evidence of mechanical disturbance (logging or road-building). Treatments where slash is removed are preferred over those where it is piled and burned, and thinning from below is preferred over thinning from above (Benson and Ullrich, 1981). Low-intensity fires are associated with increased scenic quality due to their understory thinning effect, but more severe fires detracted severely whether of natural or human origin (Taylor and Daniel, 1984). While most studies have linked woody debris with lower scenic quality, Rudis et al. (1988) found that large down logs were associated with higher ratings in East Texas pine stands.

Clearcuts are generally judged lower in scenic quality than shelterwoods when harvested stands are compared, but small even-aged cutting units may be found compatible with aesthetic quality in some settings (Burde and Lenzini, 1980). Density in partially cut stands appears to have a non-linear relationship with scenic quality. Studies in eastern pine forests (Buhyoff et al., 1986; Hull et al., 1987) suggest that there may be an optimal basal area beyond which a forest may be judged "too dense" or "too sparse." Scenic quality can recover rapidly in the first few years after logging is completed (Hull and Buhyoff, 1986), and in one study more than half of visitors to an area with small clearcuts were unable to recognize them as harvest units five years later (Becker, 1983).

Recreational quality studies. A fundamental tenet of outdoor recreation management is that the quality of recreation experiences is linked to setting attributes.

The Recreation Opportunity Spectrum (Clark and Stankey 1979), a primary tool in recreation planning, stems from landscape-level research showing that recreationists tend to seek settings with attributes that can help them achieve experience goals. ROS classifications are indirectly related to forestry practices (stands are excluded from some ROS classes if there is evidence of logging or roads), but a higher level of resolution is needed to examine effects of specific practices on recreation experiences.

At the stand level, Scandinavian scientists have analyzed forest attributes to predict their quality for generalized recreation (Hultman 1983b; Pukkala et al. 1988). Kellomäki (1975) applied one of the earlier stand-level models to multiple-use forests in Finland, recommending a mosaic of species and rotation lengths, and planting of grasses or low-value hardwoods where necessary to enhance aesthetic aspects. Swedish forester Lars Kardell (1985), arguing for single-objective rather than multiple-use forestry, concluded that the optimal "recreation forest" would use a group selection system with 30 percent hardwood retention and no intermediate treatments. Practices that promote a mosaic of successional types have long been advocated in Germany, but Volk (1985) found that recreational visitors actually preferred landscapes having less open terrain and more forest than landscape planners believed.

The distinction between recreational and scenic quality is not always clear in these generalized studies, and the models seem to work better for some recreation activities than for others (Pukkala et al., 1988). Timber harvest may improve recreational quality in a few cases. The activity cited most often as an example of this is hunting, since clearcutting or shelterwood harvests can improve big game habitat and hunters' sight distances (Levine and Langenau, 1979; Wilman, 1984). A study by Nelson et al. (1989) found that deer hunters opposed clearcutting despite its purported benefits, but Nordic skiers supported clearcutting. Haakenstad (1972) found that cross-country skiers preferred the semi-open terrain produced by shelterwood systems over both uncut forests and the patchy stands where group selection is employed.

Of the activities evaluated in this study, camping has been examined more closely than hiking. Research on campsite preferences has identified features of settings that can enhance or reduce camping quality (Brunson and Shelby 1990). Clark et al. (1984) found that some campers prefer old logging sites because they offer hard-to-find features such as flat ground or roadside pullouts. Rutherford and Shafer (1969) found that selective cutting improved ratings of Adirondack campsites in conifer stands, but not in hardwoods. Foster and Jackson (1979) found that removing trees from campgrounds did not substantially reduce site quality if a modicum of screening remained.

Among the few studies of hiking, Axelsson-Lindgren and Sorte (1987) showed that the quality of hiking trips was increased if trails cross a variety of stand types and ages, but they examined no other stand attributes. Haakenstad (1972) found that hikers, like skiers, preferred shelterwood stands over group selection systems.

Predictions of relative acceptability

Based on previous research outside the Northwest, scenic quality ratings can be expected to be high for mature stands subjected to previous thinning, old growth stands, and group selection stands; moderate for clearcuts in a shrub or open pole condition, recently thinned small sawtimber stands, and shelterwood stands; and low for dense closed pole stands, recent clearcuts, and recent clearcuts with low densities of scattered snags. Applying these to the study stands (see Chapter 3), scenic acceptability ratings were expected to roughly follow this order:

HIGH: Old growth, 1969-79 thinning, patch cuts.

MEDIUM: 1985 clearcut, 1990 thinning, two-story stands.

LOW: 1989 clearcut, snag-retention clearcuts.

Because New Forestry calls for retaining or creating snags and woody debris, those stands were expected to be rated less acceptable than "cleaner"-looking traditionally managed stands having comparable residual volumes.

No attempt was made to predict recreational quality, as prior studies offered little basis for such predictions. However, ratings were expected to be influenced by non-scenic aspects of stands that could affect one's ability to participate in an activity (e.g., flat ground for camping quality, or trail conditions for hiking quality) as well as by scenic quality.

Results

Phase 1. In the on-site phase[3] of the project, acceptability ratings were obtained for six treatments. Mean acceptability for each site is shown in Table 3. A positive rating means that, on average, the site is considered acceptable. The old-growth stand was rated most acceptable for all three uses (scenic viewing, hiking, camping), though the difference in camping quality ratings between the old-growth and patch cut stands was not significant at the .05 level.[4] In general, the New Forestry treatments were judged more favorably than either the thinned stand or traditional clearcut, except that the thinned stand was judged more acceptable for hiking than the snag-retention clearcut.

All ratings of scenic and hiking quality were significantly higher than those of the same sites for camping ($p<.05$, Wilcoxon signed rank test). The old growth, thinned, and patch cut stands were rated more acceptable as places to hike than as places for scenic viewing, while the snag-retention clearcut was rated more acceptable for scenic viewing than for hiking. Hiking and scenic quality ratings were not significantly different for the traditional clearcut and the two-story stand.

Phase 2. Twelve treatments were included in the slide evaluation phase of the project. Results are shown in Table 4. The order of preference was similar for all

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[3]See Chapter 3 for a description of methods for each phase.

[4]Non-parametric significance tests were used in this analysis because, while the Phase 2 results were normally distributed for the most part, Phase 1 responses were not. Frequency distributions for the thinned, two-story, and snag-retention ratings were generally bimodal, with major and minor peaks. The old growth and clearcut stands tended to have modes which were also the most extreme responses possible.

Table 3
Mean acceptability ratings: Phase 1

Scenic quality	Mean	Hiking quality	Mean	Camping quality	Mean
Old growth	3.1[a]	Old growth	3.4[a]	Old growth	0.4[a]
Patch cut	1.4[b]	Patch cut	1.8[b]	Patch cut	-0.0[a]
Two-story	0.6[c]	Two-story	0.5[c]	Two-story	-0.7[b]
Snag retention	0.4[c]	Thinned	0.1[cd]	Snag retention	-1.4[bc]
Thinned	-0.4[d]	Snag retention	-0.1[d]	Thinned	-1.5[c]
Clearcut	-1.2[e]	Clearcut	-1.1[e]	Clearcut	-2.7[d]

[a,b,c,d,e]Ratings with same subscript are not significantly different within uses (Kruskal-Wallis multiple comparison test at .05 level)

Table 4
Mean acceptability ratings: Phase 2

Scenic quality	Mean	Hiking quality	Mean	Camping quality	Mean
Old growth★	3.2[a]	1969-79 thinning	2.7[a]	1969-79 thinning	2.3[a]
1969-79 thinning	2.9[a]	Old growth★	2.2[b]	Old growth★	1.4[b]
Patch 2 (Aug)	2.1[b]	Patch 2 (Aug)	1.8[c]	Patch 2 (Aug)	1.1[bc]
Patch 1★	1.6[c]	Patch 2 (Jul)	1.5[c]	Patch 2 (Jul)	0.8[cd]
1985 clearcut	1.2[d]	Patch 1★	1.5[c]	Patch 1★	0.4[de]
Patch 2 (Aug)	1.1[d]	1985 clearcut	0.7[d]	1985 clearcut	0.1[e]
1990 thinning★	0.9[d]	1990 thinning★	0.5[de]	Two-story (Jul)	-0.0[e]
Two-story (Jul)	-0.1[e]	Two-story (Jul)	0.2[ef]	1990 thinning★	-0.7[f]
Snag ret. (Jul)	-0.7[f]	Clearcut★	-0.1[fg]	Clearcut★	-1.3[g]
Clearcut★	-1.0[f]	Snag ret. (Jul)	-0.5[gh]	Snag ret. (Jul)	-1.3[g]
Two-story (Aug)★	-1.1[f]	Two-story (Aug)★	-0.6[h]	Two-story (Aug)★	-1.5[gh]
Snag ret. (Aug)★	-1.5[g]	Snag ret. (Aug)★	-1.1[i]	Snag ret. (Aug)★	-1.9[h]

[a-i]Ratings with same subscript are not significantly different within uses (Kruskal-Wallis multiple comparison test at .05 level)
★Starred treatments used slides of stands visited in Phase 1

three uses, though not identical. In general, the old growth stand and 1969-79 thinning were rated highest, followed by the patch cuts. The old growth stand was rated highest for scenic quality, but the difference between it and the "recovered" thinned stand was not significant. The 1969-79 thinning was rated significantly higher than any other stand for both types of recreational quality.

Traditional treatments produced significantly higher ratings once a few years had passed since harvest. New Forestry treatments, other than the patch cuts, were rated lower than traditional practices yielding similar timber volumes. The lowest ratings were given to the two-story and snag retention stands as seen after artificial snags had been created. Unlike the on-site evaluations, Phase 2 ratings were distributed normally, but non-parametric significance tests were used for consistency.

Ratings of camping quality were significantly lower than hiking quality ratings for all 12 treatments ($p < .05$, Wilcoxon signed-rank test). Scenic and camping ratings differed for 11 treatments, the sole exception being the two-story stand in July. Ratings of scenic and hiking quality differed for all but the 1969-79 thinning and two of the patch cuts. Scenic quality was higher than hiking quality for the old growth, 1990 thinning, and 1985 clearcut. The traditional clearcut and the New Forestry treatments were rated higher for hiking quality than scenic quality.

Comparison of rating methods. Slides are often used to obtain judgments of scenic and recreational quality for reasons of reduced cost and increased convenience when compared to on-site evaluation methods. However, slide ratings can only be considered as a proxy for on-site ratings if both methods produce the same results.

Table 5 shows a comparison of the ratings obtained for the six stands evaluated by both methods.

On- and off-site methods produced significantly different ratings for scenic quality in three stands, hiking quality in four stands, and camping quality in five stands. Only the patch cut was rated the same by both methods for all uses. The slide method produced significantly lower ratings for all uses in the snag retention and two-story stands, and significantly higher ratings for two uses in the traditional clearcut and thinned stand.

Interpersonal variation in ratings. A transactional research strategy considers the influence of embedded variables that make each measurement a unique event whose meanings must be understood. Under this paradigm, "events" are defined as confluences of person, place, and time. Since the study design held time and place as constant as possible, variation in ratings was most likely to arise from variation in evaluators. The influence of potentially relevant personal characteristics is summarized in tables 6 and 7.

For Phase 1 (Table 6), eight variables were examined for effects on 18 ratings (6 stands x 3 uses). Mann-Whitney-Wilcoxon rank sums were used to test for differences in mean ratings between: environmental group members vs. non-members; students vs. non-students; hunters vs. non-hunters; previous visitors to the study area vs. non-visitors; and persons with forest industry work experience vs. non-experienced persons. Spearman rank correlations were calculated to test for effects of age, length of residency in a timber-growing area, and frequency of forest recreation.

Table 5
Mann-Whitney-Wilcoxon tests comparing mean on-site and slide ratings

		Mean ratings		
Quality type	Treatment	On-site	Slide	Z-score
Scenic	Old growth	2.98	3.18	1.23
	Clearcut	-0.90	-1.04	0.24
	Thinned	-0.20	0.93	3.94***
	Patch cut	1.42	1.65	0.13
	Snag retention	0.62	-1.51	6.78***
	Two-story	0.75	-1.05	7.49***
Hiking	Old growth	3.22	2.21	4.39***
	Clearcut	-1.19	-0.13	3.90***
	Thinned	0.11	0.46	0.55
	Patch cut	1.68	1.51	1.27
	Snag retention	0.06	-1.12	4.05***
	Two-story	0.69	-0.61	5.52***
Camping	Old growth	0.31	1.39	3.56**
	Clearcut	-2.51	-1.31	6.01***
	Thinned	-1.38	-0.72	3.13*
	Patch cut	0.01	0.39	1.18
	Snag retention	-1.20	-1.91	1.96*
	Two-story	-0.57	-1.54	3.40**

* $p < .05$
** $p < .005$
***$p < .0001$

Table 6
Influence of personal characteristics on acceptability ratings (Phase 1)

	TREATMENT[a]					
	OG	CC	TH	PC	SR	TS
Student? (Y or N)						
Scenic	-	Y<N[b]	-	-	-	-
Hiking	-	Y<N	-	-	-	-
Camping	-	-	-	-	-	-
Worked in forest industry? (Y or N)						
Scenic	-	-	-	-	Y<N	-
Hiking	-	-	-	-	-	-
Camping	-	-	-	-	Y<N	-
Environmental group member? (Y or N)						
Scenic	-	-	-	-	-	-
Hiking	-	-	Y<N	-	-	-
Camping	-	-	-	-	-	-
Uses forests for hunting? (Y or N)	NO DIFFERENCES FOUND					
Has visited site previously? (Y or N)						
Scenic	-	-	-	-	-	-
Hiking	-	N<Y	-	-	-	-
Camping	-	-	-	-	-	-
Forest recreation frequency (HI vs. LO)						
Scenic	-	-	-	-	-	LO<HI[c]
Hiking	-	-	-	-	-	LO<HI[c]
Camping	-	-	-	-	-	-
Age	NO CORRELATIONS FOUND					
Years in timber-growing area	NO CORRELATIONS FOUND					

[a]Treatment codes: OG=old growth; CC=traditional clearcut; TH=thinned; PC=patch cut; SR=snag retention clearcut; TS=two-story.
[b]Mean acceptability ratings significantly different at .05 level using the Mann-Whitney-Wilcoxon rank sum test.
[c]Spearman rank correlation significant at .05 level.

Eight of the 144 potential relationships, less than 6 percent of the total possible, were found to be significant ($p < .05$). Differences between student and non-student ratings of the traditional clearcut may be due to the fact that the evaluation site was moved uphill from the trail to a former log landing, rather than to personal characteristics. No systematic pattern of the remaining differences is discernible, so it appears that interpersonal variation had relatively little effect on acceptability as judged on-site.

Tests were performed for 324 potential relationships in Phase 2 ratings (12 treatments x 3 uses x 9 variables). Significant relationships were found in 56 cases, or 17 percent of the total (Table 7). Multiple comparison tests were used to look for differences in all variables except age and Willamette Valley residency, which were tested by correlation analysis.

Two personal characteristics (frequency of forest recreation visits, and membership in environmental groups) yielded more than half of the significant relationships. Persons who rarely visit forests for recreation differed from more frequent visitors on 50 percent of the recreational quality ratings, but none of the scenic quality ratings. The preferred recreation *activity* had no effect. Environmental group members and non-members differed on two-thirds of the scenic quality ratings, and 38 percent of the hiking and camping ratings. Members rated the old growth stand more acceptable for hiking and camping, and the two-story stand higher for scenic viewing, but gave lower ratings to all other stands where significant differences were found.

Table 7
Influence of personal characteristics on acceptability ratings (Phase 2)

	TREATMENT[a]											
	OG	C1	C2	T1	T2	PC	PJ	PA	SJ	SA	TJ	TA
Environmental activism												
Scenic	·	NEG[b]	NEG	NEG	NEG	NEG	·	·	·	NEG	POS	POS
Hiking	POS	·	·	·	·	·	·	·	·	·	NEG	NEG
Camping	POS	NEG	·	·	·	·	·	·	NEG	NEG	·	NEG
Forest recreation visits												
Scenic	·	·	·	·	·	·	·	·	·	·	·	·
Hiking	POS	NEG	·	·	·	·	·	POS	·	NEG	·	NEG
Camping	POS	·	·	·	POS	·	·	POS	NEG	NEG	NEG	NEG
Recreation activity												
Scenic	·	·	·	·	·	·	·	·	·	·	·	·
Hiking	·	·	·	·	·	·	·	·	·	·	·	·
Camping	·	·	·	·	·	·	·	·	·	·	·	·
Forest work experience												
Scenic	·	NEG	·	·	·	·	·	·	·	·	·	·
Hiking	POS	NEG	·	·	POS	·	·	·	·	·	NEG	·
Camping	NEG	·	·	·	POS	POS	·	·	·	·	·	·
Forestry education												
Scenic	·	·	·	NEG	NEG	·	·	·	·	·	·	·
Hiking	·	·	NEG	NEG	·	·	·	·	NEG	·	·	·
Camping	·	·	·	·	·	·	·	·	·	·	·	·
Current hometown												
Scenic	·	·	·	·	·	·	c	·	·	·	·	·
Hiking	·	c	·	·	·	·	c	·	·	·	·	·
Camping	·	·	·	·	·	·	·	·	·	·	·	·
Childhood hometown												
Scenic	·	·	·	·	·	·	·	·	·	·	·	·
Hiking	·	·	·	·	·	·	·	·	·	·	·	·
Camping	·	·	·	·	·	·	·	·	·	·	·	·
Respondent's age												
Scenic	·	·	·	·	·	·	POS	·	·	NEG	·	·
Hiking	·	·	·	·	·	·	·	·	·	·	·	·
Camping	·	·	·	POS	POS	·	POS	·	·	·	·	·
Length of residency												
Scenic	·	·	·	POS	POS	POS	POS	POS	·	·	·	·
Hiking	·	·	·	·	·	·	·	POS	·	·	·	·
Camping	·	·	·	·	·	·	·	·	·	·	·	·

[a]Treatment codes: OG=old growth; C1=1989 clearcut; C2=1985 clearcut; T1=1990 thinning; T2=1969-79 thinning; PC=patch cut; PJ=Patch 2 (July); PA=Patch 2 (August); SJ=snag retention (July); SA=snag retention (August); TJ=two-story (July); TA=two-story (August).
[b]Codes "POS" and "NEG" indicate direction of relationship between variable and acceptability; (e.g., environmental group membership is negatively related to scenic quality of clearcuts).
[c]Persons calling eastern Oregon and Washington home rated these stands less acceptable than residents of other areas.

Respondents who often work in forests differed from others on a third of the recreational quality ratings, but there was no clear response pattern. The effect of forestry education is equally unclear. Persons with no previous forestry coursework gave higher ratings in five cases than persons who had finished one course, but in four of those cases their ratings did not differ from those who had finished *more than one* course. Four measures of landscape familiarity were tested: current hometown, childhood home, age, and length of Willamette Valley residency. Fourteen of 144 possible relationships were significant, half of them showing that patch cuts are found more acceptable by persons who are more familiar with western Oregon forests.

Effects of treatments on scenic quality

This study is the first to assess scenic quality at the stand level in the Pacific Northwest, but the results are consistent with those from the studies that Ribe (1988) reviewed from other regions. The ratings indicate that visitors to Northwest forests prefer mature stands over young ones, "natural-looking" stands over ones where recent timber management impacts were obvious, and partially cut stands over clearcuts. These findings generally fit the predictions of relative acceptability described previously in this chapter, but both phases of the study also yielded some unexpected results.

On-site ratings. When respondents were actually able to visit the stands being evaluated, the old-growth stand was judged most acceptable, the traditional clearcut least acceptable, and partial cutting methods somewhere in-between. Among the latter, the stand with the most residual volume (patch cut) was also the most acceptable.

The relationship of residual volume to scenic quality was not linear, however. The thinned stand, where about half of the volume was removed, was rated lower than two New Forestry stands which had fewer residual trees. In this portion of the study, it appears stand density was less influential on scenic quality than the age and diameter of the residual trees.

The results do not reflect the expected adverse influence of down wood and artificially created snags. Previous studies had found that slash volume is negatively related to aesthetic quality (Arthur 1977; Brown and Daniel 1986), and skeptics often suggest that New Forestry will fail to gain public acceptance because it "looks sloppy" (Brunson, 1990). The scenic impact of slash in the study stands was unclear, however. Large amounts of woody debris existed in the thinned stand, where slash was in small-diameter pieces, and in the two-story and snag-retention stands, where piled and unpiled slash was evident along with the lopped-off tops of created snags and a few trees blown down in a recent windstorm. The snag retention and two-story stands had more woody debris, yet the thinned stand was rated less acceptable.

Due to the exploratory nature of this research, findings were discussed with some participants after the data had undergone preliminary analysis. At a debriefing attended by 38 Phase 1 respondents, low ratings for the thinned stand were attributed partly to slash volumes, but also to a perception that the thinning had been done poorly. The scenic quality of the snag retention clearcut may have been enhanced by the presence of a timbered slope across the narrow Soap Creek valley. Even though respondents were instructed to rate stands without judging their surroundings, participants in the debriefing said they could not entirely separate their judgments from the broader context in which they occur.

Slide ratings. Relative acceptability was somewhat different when the ratings were made from color slides, though the ratings generally followed the predicted order of preference. The highest ratings went to stands that appeared to have been largely untouched by timber harvest. Stands having visible snags or woody debris had significantly lower ratings than stands with similar residual volumes but less dead and down wood (e.g., the traditional clearcut rated higher than either the snag-retention clearcut or the two-story stand in August, even though the latter retained a third of its timber).

As in the on-site phase, scenic quality was associated with increased stand density but the relationship was non-linear. The fully forested old growth and 1969-79 thinned stands were rated highest, followed by the patch cuts and 1990 thinning. However, the traditional clearcut was rated the same for all three uses as the snag retention clearcut *before* artificial snags were created, even though 1.5 live trees per acre remained in the latter stand. Apparently such a residual density is too low to distinguish the stand from a traditional clearcut. Wildlife data from the same location also show no difference in response to the two treatments (McComb, pers. comm.)

Hull and Buhyoff (1986) had found in earlier studies that recently cut stands are seen as having lower scenic quality than stands that have undergone similar treatments several years previously. Here the same result was found even in the patch cuts, where the two August slides were rated higher than the July scene, presumably because there was six weeks' additional growth in the herb layer.

Most Phase 2 respondents took part in debriefings after the data had been compiled and analyzed. Participants indicated that debris left behind by the snag creation process was the most important influence on scenic quality in the New Forestry stands. Not only was debris a detracting influence in itself, but it added shadows and hid some of the herb layer, substantially reducing the amount of green in the slides. In the two-story stand, snag creation also reduced the number of live branches in the scene, lending a more skeletal appearance to residual trees which some people found unappealing. Studies in Spain have suggested that the vegetation features that most closely influence preference for scenic landscapes are fertility (or greenery) and the visibility of plant's internal structure (Gonzalez-Bernáldez et al., 1981; Abelló et al., 1986).

Reaction in the debriefing to the flat, sawed tops of created snags was also negative, but not as strong. Many people said they found the appearance highly unnatural and a definite detractor from scenic beauty, but respondents also said the standing snags were less noticeable than the slash beneath them.

Effects of treatments on recreational quality

Judgments were expected to vary depending on whether the stands were evaluated as scenic backdrops or as places to hike or camp. Previous research has found that favored scenic backdrops are not always valued as recreation sites (Zube et al. 1975; Pukkala et al. 1988). In the present study, the *order* of preference for different stands varied only slightly across uses, but *mean ratings* differed substantially, especially in the on-site phase.

Brown and Daniel have proposed that scenic quality is always a component of recreational quality, but that its influence varies with the extent to which participants can focus attention on their surroundings rather than on the skill demands of their activity.[5] Neither hiking nor camping requires intense concentration on skills for prolonged periods, and previous research has shown that scenic aspects of the recreation setting can be important to both camping (Brunson and Shelby, 1990, 1991) and hiking (Axelsson-Lindgren and Sorte, 1987).

However, scenic quality may be less important than other attributes of the setting that provide basic necessities of the activity, e.g., a place to pitch a tent, or a trail that is relatively free of obstructions. Therefore one would expect ratings of hiking and camping quality to differ from ratings of scenic quality if the "necessity attributes" are not constant across all of the settings being rated.

<u>Camping quality</u>. In both phases of the study, camping quality was consistently rated lower than scenic or hiking quality. This is probably due to topography and lack of clearings. For example, Patch 2, which was basically flat, was rated higher than the more sloping Patch 1. In the on-site study, the patch cut

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[5]For further discussion of the Brown and Daniel model, and of the relationship between scenic and recreational quality, see Chapter 5.

was rated as high as the old growth stand, which had no cleared spaces. Brunson and Shelby (1990) have found that preferences for campsites can also be influenced by non-site characteristics such as the distance to water or to sites for other recreation activities. Participants in the Phase 1 debriefing said they took such factors into account when judging camping quality.

Hiking quality. Where hiking quality differed from scenic quality, the difference often was related to traversability. In the on-site ratings, three stands (old growth, patch cut, thinned) were more acceptable for hiking than for scenic viewing. Each contained a well-defined trail that appeared to have had no recent use by motorized vehicles. The stand judged more acceptable for scenic viewing than for hiking (the snag-retention clearcut) had neither skid trails nor a foot path, but it did have heavy loadings of slash, which appear to have an important effect on both scenic and recreational assessments (Hultman, 1983a). Furthermore, when the evaluation site for the clearcut was moved from the foot trail to a former log deck site at the edge of the stand, subsequent ratings of hiking quality were significantly lower.

Not all slides showed whether a stand was traversable, and this was reflected in the Phase 2 ratings. Mean hiking quality for the old growth stand, where the trail was only visible in one of the three photos, was one full point lower than the stand's rating for scenic quality -- the largest difference between hiking and scenic quality in the entire study. Conversely, the patch cut slides showed that all were traversable; though each was rated differently for scenic quality, they were rated equally for hiking.

Another influence on hiking quality may be the perceived size of stands that have been subjected to a treatment producing low scenic quality. Some Phase 2 participants said they were likely to rate an unattractive stand more acceptable for hiking, because they expected to be able to pass through the area relatively quickly when hiking.

Interpersonal differences. Another important Phase 2 result was that certain groups of respondents rated New Forestry treatments (other than the patch cuts) lower for recreational quality than other respondents. Members of environmental groups tended to give lower ratings of hiking and scenic quality to the two-story and snag retention stands, as did persons who visit forests more frequently for recreation. Hultman (1983b) found similar reactions among environmentalists in Sweden. Environmental and recreational groups tend to be active in debates over timber practices, so their negative reactions may be particularly significant. However, this effect was not seen in Phase 1, and persons in these two groups also are more likely than other segments of the public to encounter New Forestry treatments *in the actual stands*, where their judgments may be quite different (see following section).

On-site vs. off-site evaluation methods

Phase 1 and Phase 2 findings differ from each other in ways that may be important to the course of forest management in the Pacific Northwest. In the on-site phase of this study, New Forestry treatments generally were rated more acceptable than their traditional analogs. The reverse was true when ratings were based on color slides. A question managers and policy-makers may need to consider is: Which method provides a more reliable basis for decisions about the use of New Forestry practices in the Northwest?

From a strictly methodological standpoint, the better choice would be Phase 1. "Real" stands were rated, rather than proxies (color slides) that may not have conveyed all of the information needed to evaluate acceptability of forest stands. However, it is useful to consider how the public will be introduced to the new practices. Some people will be exposed to New Forestry in person, especially those who regularly participate in forest recreation. But many more may be exposed through photographs, or by passing a recently harvested stand at 55 mph. The slide rating method may more accurately reflect how members of the latter group will make their judgments of New Forestry.

Methodological issues. A sizeable body of literature has developed in recent years examining the use of proxies for outdoor scenes in research. Although color slides are used most commonly, other methods that have been evaluated include color prints (Shafer and Richards, 1974; Kellomäki and Savolainen, 1984), black-and-white photos (Shuttleworth, 1980; Hultman, 1983a), illustrations (Martin et al., 1989), computer-generated line drawings (Pukkala et al., 1988), and written descriptions of scenes (Shelby and Harris, 1985). These studies show that photographic methods can approximate outdoor scenes well, while other methods are less reliable. The quest for new methods continues, with research currently under way using video (Hetherington et al., 1990) and various computerized simulation techniques (Daniel, 1990).

The advantage of using photographs is that more people can be exposed to environmental stimuli in less time, without the logistical headaches of transporting people to a site. The chief disadvantage is that photos do not convey all of the information processed in actual visits. They encompass only visual stimuli, yet sound has been shown to influence aesthetic judgments (Anderson et al., 1983), and other senses may also be influential. Distance to landscape features, composition, tonal gradation, time of day, season, and angle of view can all influence ratings made from photographs (Kreimer, 1977). Nonetheless, Shafer and Richards (1974) found that if a photo depicts "most of the variety in a scene," respondents will react to the proxy as they did to the scene itself.

The semi-random photo sampling method used here was intended to capture "typical" views rather than all-encompassing ones. Because ratings are three-slide averages, means for some treatments may be biased by ratings for slides lacking the variety that Shafer and Richards (1974) recommend. If so, this should be more evident in ratings of recreational quality than scenic quality, since attributes needed for camping or hiking (e.g., flat places or passable trails) were not seen in every slide. And in fact, slide and off-site ratings of scenic quality differed for three stands, while ratings of hiking and camping quality differed for four and five stands, respectively.

Brown et al. (1989) observed a similar phenomenon when asking campers to rate a series of photographs, including one of their own campground. On-site ratings not only were substantially higher than the corresponding photo-based ratings, but they were also higher than ratings for the *highest-rated* photo. The authors considered cognitive dissonance a likely cause ("I picked this campground, so it must be scenic"). However, that is a less likely explanation in the present study, since participants didn't choose the site. More pertinent may be another potential cause noted by the authors. The simple fact of participation in an outdoor activity may enhance a setting's aesthetic quality. This explanation fits nicely with Pitt's (1989) transactional view of recreation experiences as being both influenced by and influential upon the perceived character of outdoor settings.

Perceptual issues. Neither the photo-sampling explanation nor the transactional view explains why the slide ratings were consistent with on-site judgments for some treatments but not for others. An answer may be found in the perceptual theories of James Gibson (1966).

Gibson's Theory of Information Pickup states that once an object's constant properties have been perceived (shape, size, color, texture, motion, composition, position relative to other objects), an observer evaluates it for its "affordances," i.e., what the object can furnish to the perceiver. This model of perception implies a learning process. An observer learns to detect the meanings of objects and to perceive their distinctive features -- what they look like, how they work, and so on. Next comes selective attention, as the observer learns to notice only those things that distinguish the object from others of its kind. Nor are all such affordances noticed, but only those that can be identified economically with respect to the task at hand.

Applying the theory to the evaluation of forest environments, visitors can be expected to attend to different features of a forest at different times. On hot days, the key affordance may be canopy cover. At dusk, it may be a flat place to pitch a tent. However, before attending to an object's affordances, one first must learn its constant properties. Thus a scene that is encountered *for the first time* requires more study than a familiar one. An evolutionary view of scenic perception (S. Kaplan, 1983) would suggest that until the meaning of the scene is determined, humans will be predisposed to avoid, and therefore find unattractive, scenes whose dangers are not yet understood.

In this study, most respondents probably were seeing the two-story and snag retention treatments for the first time[6]. When rating them on-site, there was time to look closely at the stands and engage all five senses. This was not possible at the slide sessions. So it should not be surprising that the photographs were less reliable proxies for the snag retention and two-story treatments, and that ratings for photographs of those treatments were generally negative.

Conversely, nearly all Northwesters are familiar with clearcuts and old growth. Ratings of scenic quality in these stands were the same using either method. Fitzgibbon et al. (1985) proposed that environments are perceived through "a filter generated by the interplay of past experience within the memory." That is, when a scene is encountered, it is compared to similar scenes that have been previously

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[6]The other New Forestry treatment, patch cutting, is not a common timber management practice in the Northwest but may be familiar because similar-looking cleared spaces can be seen in campgrounds, picnic areas, and residential lots.

encountered and stored in memory. The slides in Phase 2 may have contained enough information upon which to base accurate judgments of scenic quality only if evaluators had prior cognitive representations of the stands with which to compare them.

Further evidence can be seen in the effect of recreation participation rates on judgments of recreational quality. Frequency of participation was correlated with 67 percent of the ratings in Phase 2, but just 8 percent of the ratings in Phase 1. Persons who rarely visit forests are likely to need more information before discerning the key affordances of a recreation site. Given time to examine stands in person, members of this group drew the same conclusions about hiking and camping as more experienced participants. But their lack of experience was evident when the ratings were made from slides, which offered fewer clues by which to judge recreational quality.

Summary

Judgments of the scenic, hiking, and camping quality of six silvicultural treatments were examined, using evaluations made on-site and from slides. Ratings generally mirrored findings for other forest types: stands with large, old trees were preferred over younger conditions; judgments were positively correlated with the percentage of a stand in mature timber; and acceptability recovered fairly rapidly after harvest. Camping quality ratings were lower than ratings for hiking and scenic quality, and the same general order of preference tended to be found for each type of quality (although lightly manipulated stands can produce superior camping quality).

New Forestry treatments were judged more acceptable than traditional silviculture when ratings were made on-site, but not when they were made from slides. This is believed to be due to the unfamiliarity of the two-story and snag retention treatments for most respondents. This methodological difference may have management and policy implications, since Phase 1 simulated one way in which new silvicultural treatments may be encountered while the briefer photographic exposure of Phase 2 simulated another means of exposure to New Forestry. Environmental activism also had a significant influence on acceptability judgments, and recreational quality ratings were influenced by respondents' depth of experience working and recreating in forests.

5. INFLUENCE OF SITE ATTRIBUTES ON ACCEPTABILITY RATINGS

One way to reduce conflicts between commodity and amenity values in a multi-resource forest is to design extractive activities in such a way that scenic and recreational values are protected as much as possible. Such designs must be based upon knowledge of the features of managed stands that influence their acceptability for amenity uses.

Foresters have long known how to increase production of high-value wood by thinning, fertilization, controlling woody competition, planting genetically superior seedlings, and other means (Smith, 1986). High-value wildlife habitat can also be produced silviculturally using a somewhat different battery of techniques (Brown, 1985; Hunter, 1991). Silviculture should likewise be able to influence the production of high-quality scenic viewing, hiking, or camping. Therefore, one objective of this study was to identify features of the study stands that influenced acceptability ratings and which might be manipulated via silviculture or other forest management options.

Research linking scenic quality with site attributes

Landscape-level approaches. Many studies of forest scenic beauty have sought to identify attributes that influence scenic quality. Landscape-level approaches to the problem have produced several widely applicable management strategies. One example of these is the Forest Service's (1974) Visual Quality Management system.

Under this system, areas are classified by the acceptable level of visual impact, from "preservation" to "maximum modification." Landscape architects can then use formal principles of art and design to judge whether activities proposed within a particular area will meet the appropriate visual quality guidelines.

Site attributes identified in landscape-level research tend to be ones such as contrast, balance, or texture that are not readily apparent to lay observers (nor to most foresters). For example, Arthur (1977) obtained a linear regression model of scenic beauty with $R^2 = .93$ using variables such as lighting direction, contrast, crown canopy prominence, detail, and visual vividness. Many of those are emergent properties, not observable at the stand level. While silviculture can influence those attributes, different treatments may be needed to achieve the same effects at different sites depending on the juxtaposition of stands in a given landscape.

Psychophysical models. Research at the stand level has focused more directly on site attributes that can be manipulated silviculturally, but efforts to translate them into field applications have been less successful. Most studies in forest stands have used the "psychophysical paradigm," in which regression models are developed to measure the effect of different stand attributes on a univariate measure of scenic quality (e.g., Brown and Daniel, 1984; Buhyoff et al., 1986). The resulting models are statistically rigorous, theoretically and empirically sound, resemble growth and yield models, and use many of the same variables.

Yet such models are rarely, if ever, applied in day-to-day management. One reason is that they are highly site-specific; models from a particular forest type in one region might not fit a stand of the same type in a different region (Ribe, 1990). Another is that the dependent variable can be difficult to interpret. Both the sign and magnitude depend on the range of responses to a given set of stimuli (Hull, 1989). And models can be overly sensitive to differences between stands that are meaningless from a practical standpoint.

Cognitive research. A third track of research has been guided by the idea that individuals respond not to features of the landscape, but to internal (cognitive) representations of landscape stimuli which include those features (S. Kaplan, 1983). Because humans communicate via language, psychologists have tried to use language to measure human responses to the environment.

Most commonly the measure is a semantic differential scale, in which pairs of adjectives having polar opposite meanings are arranged at either end of a numerical range. Respondents are asked to indicate where on the scale a setting lies. Multivariate statistical methods such as factor analysis are then used to detect underlying dimensions of environmental perception based on patterns of semantic differential responses. These scales were first used to identify dimensions of language (Mueller, 1986), and some researchers have questioned whether they tell how people perceive environments or how they perceive adjectives (Russell and Ward, 1980; Daniel and Ittelson, 1980; Ward and Russell, 1980).

Integrating paradigms. Recent papers have called for integrative research that builds on the strengths of each approach (Daniel and Vining, 1983; Taylor, Zube and Sell, 1987). Gobster and Chenoweth (1989) compared four domains of scenic beauty predictors and concluded that no single approach is best at explaining aesthetic preferences. In a similar study, Kaplan et al. (1989) observed that "perhaps the most striking finding is the usefulness of predictors of very different kinds [that are] rarely found in the same study."

Research linking recreational quality with site attributes

Clark and Stankey (1986) have proposed that setting attributes affect recreation experiences at three levels: locational (distance, travel time), macrosite (ecotype, land ownership), and microsite (stand, trail segment, campground). Locational attributes form a basis for much work in recreation geography and economics. Work at the macrosite level is exemplified by the Recreation Opportunity Spectrum (Clark and Stankey, 1979), a planning tool based on the idea that recreationists seek settings likely to help them fulfill psychological motives such as escape or self-sufficiency.

Microsite (stand-level) approaches have been slower in coming. Clark (1987) has suggested that the same techniques used to evaluate the structural characteristics of forests for wildlife can be applied to the evaluation of recreation "habitat." Habitat suitability indexes for recreation do not yet exist, however. Finnish researchers have developed models designed to predict the quality of forest stands for outdoor recreation (Kellomäki, 1975; Pukkala, Kellomäki and Mustonen, 1988), but the distinction between scenic and recreational quality in these models is not entirely clear.

Pukkala et al. (1988) found that their generic model did not seem to work for some activities, and recommend activity-specific approaches. Perhaps the activity where the influence of site attributes has been examined most closely is camping. Numerous studies have sought to identify features of developed and dispersed camping areas that attract campers (e.g., Heberlein and Dunwiddie, 1979; Bumgardner et al., 1988). After reviewing this research, Brunson and Shelby (1990) proposed a method for classifying campsite attributes based on their importance in the site selection process. For hiking, the attribute/quality linkage has been examined sporadically, at best. Studies by Gustke and Hodgson (1980) and Axelsson-Lindgren and Sorte (1987) suggest that stand heterogeneity can increase the quality of hiking trips. Haakenstad (1972) found that hikers preferred the sparsely timbered stands found in shelterwood units over the patchy forests created by group selection systems.

Methods

Two findings stand out from the literature review: (1) Investigations of links between stand attributes and scenic quality are most useful if various types of site attributes are included in the analysis; and (2) few studies have examined links between stand attributes and specific recreation activities. Accordingly, this research examined a variety of attribute types and three specific outdoor activities (scenic viewing, camping, hiking).

Data for this portion of the study come from the on-site phase only. At each site, participants indicated whether they agreed or disagreed that the stand could be characterized by each of 20 descriptive words or phrases:

Bright	Foot traffic only	Has distant vistas
Pleasant-smelling	Abundant wildflowers	Natural
Monotonous	Unusual	Steep
Abundant bird life	Damp	Lack of bugs
Colorful	Has flat places	Closed-in
Dead or dying trees	Cool	Good trail/road
Quiet	Good places to stop and rest	

Descriptors were chosen from a variety of sources. They were intended to represent different approaches to the problem, and included attributes that were expected to be important for each use for which acceptability ratings were obtained. The cognitive paradigm is represented by the descriptors monotonous, unusual, bright, natural, colorful, and closed-in, which came from semantic differential scales used by Zube, Pitt, and Anderson (1975). Four other adjectives (quiet, pleasant-smelling, damp, cool) were added to describe non-visual dimensions, since environmental preferences can be influenced by senses other than sight (Anderson et al., 1983).

All but one of the remaining descriptors are psychophysical, i.e., they describe physical conditions that may affect one or more amenity uses. "Foot traffic only" describes management conditions. Flat ground, opportunities to observe nature, lack of bugs, and distant vistas have been linked previously to camping sites (Heberlein and Dunwiddie, 1979; Brunson and Shelby, 1990). Steepness, places to rest, vistas, birds, wildflowers, trail/road quality, and vehicle restrictions were expected to affect hiking quality. Dead or dying trees have been found to negatively influence both scenic and recreational quality (Ribe, 1990; Walsh, Bjonback, Aiken and Rosenthal, 1990). Space was also given for respondents to list any additional words that describe the site.

Instead of a semantic differential, a five-point Likert-type scale was used to measure agreement with descriptors. The scale had five points rather than seven, as in most semantic differential measures, because the precision afforded by additional scale points can be offset by variation in individual styles of response to scale items (Bentler et al., 1971). The nature of some descriptors required using single- rather than dual-anchored items; e.g., the opposite of "pleasant-smelling" can be either "odorless" or "malodorous."

After all six sites had been visited, respondents completed a section of the survey in which they rated how important each descriptive feature was when they judged the stands. Separate scale items were completed for each of the three types of judgments. Importance was rated in a four-point Likert scale ranging from 1 (not at all important) to 4 (very important). Similar importance scales have proved useful in previous recreation studies, including the author's previous work on campsite attributes (Brunson, 1989; Brunson and Shelby, 1990, 1991). Respondents were also asked if any *other* features were important for judging scenic or recreational quality.

Results

Descriptor ratings. The descriptor ratings were shown to be appropriate to the setting and useful for distinguishing between sites. Responses were rarely left blank, which would have indicated that a descriptor was inappropriate to the setting. Fewer than 25 percent of respondents listed any additional descriptors, and no unlisted word or phrase was added to more than three surveys, suggesting that the scale did not omit any obvious descriptive aspects of the stands. The response patterns, including mean ratings for each of the groups visiting each site, are shown in Appendix E.

The full range of responses was used: Mean site descriptor ratings ranged from 1.4 (strong disagreement) for "closed-in" in the traditional clearcut to 4.6 (strong agreement) for "natural" in the old growth stand. The greatest variation for a single descriptor was for "natural," which ranged from 4.6 in old growth to 1.7 in the traditional clearcut. "Lack of bugs" had the least amount of discriminatory power, eliciting responses ranging from 3.3 in the old growth stand to 3.1 in the clearcut, patch cut, and two-story stands. Mean ratings for the clearcut and old growth stands were at opposite extremes for 13 of the 20 descriptors.

Comparison across the four groups showed little visit-to-visit variation. The few cases where group mean responses differed by more than 1.0 were generally due to the timing of a trip; e.g., the student groups visited earlier in the day than the non-student groups, and so were more likely to describe stands as cool or damp.

Importance of descriptors. Importance ratings for the various descriptors are shown in Table 8. For scenic quality, four descriptors fell into the important-to-very important range ($\bar{x} \geq 3.0$): natural, colorful, quiet, and foot traffic only. Of these, naturalness was significantly more important than the others ($p < .05$ using the Least Significant Difference test).

The same four descriptors were rated most important for hiking quality. Two others, "has distant vistas" and "pleasant-smelling," also had mean scores in the important-to-very important range. Descriptors which were rated significantly more important for hiking quality than for scenic quality (Wilcoxen signed rank test, $p < .05$) were foot traffic only, good trail/road, steep, and good places to stop and rest. Mean importance ratings generally were larger for hiking quality than for scenic quality.

Ratings were even higher on average for campsite quality. Seven descriptors were in the important-to-very important range, and all but one was rated at or above the scale midpoint value of 2.5. Flat places, brightness, lack of insects, and enclosure were significantly more important for judging camping quality than for judging hiking or scenic quality.

Relationship of descriptors to acceptability. The most direct way to measure the influence of stand attributes on quality judgments would be to develop regression models with acceptability ratings as dependent variables and the descriptor scores as predictors. However, this approach would have yielded a very unwieldy 20-variable model. Moreover, some of the descriptors were highly correlated (e.g., damp and cool, partial $R = .53$). As an alternative, multivariate analysis was used to reduce the data to a series of subscales which could then be regressed on acceptability ratings.

Table 8
Mean ratings of descriptors' importance to quality judgments

Scenic Quality (N=95)			
Natural	3.7[a]	Unusual	2.5
Colorful	3.3	Places to stop and rest	2.5
Quiet	3.3	Closed-in	2.4
Foot traffic only	3.0	Good trail/road	2.3
Has distant vistas	2.9	Bright	2.3
Monotonous	2.8	Cool	2.2
Pleasant-smelling	2.8	Steep	2.1
Dead or dying trees	2.7	Lack of bugs	2.1
Abundant wildflowers	2.7	Has flat places	2.0
Abundant bird life	2.6	Damp	1.9
Hiking Quality (N=95)			
Natural	3.6	Abundant bird life	2.8
Foot traffic only	3.5	Steep	2.7
Quiet	3.4	Monotonous	2.6
Colorful	3.3	Cool	2.6
Has distant vistas	3.2	Has flat places	2.5
Pleasant-smelling	3.0	Dead or dying trees	2.5
Good trail/road	2.9	Bright	2.4
Places to stop and rest	2.9	Closed-in	2.4
Abundant wildflowers	2.8	Lack of bugs	2.3
Unusual	2.8	Damp	2.3
Camping Quality (N=95)			
Quiet	3.6	Steep	2.9
Has flat places	3.6	Good trail/road	2.8
Natural	3.5	Closed-in	2.8
Pleasant-smelling	3.3	Cool	2.7
Foot traffic only	3.2	Damp	2.6
Colorful	3.1	Abundant bird life	2.6
Places to stop and rest	3.0	Abundant wildflowers	2.6
Bright	2.9	Dead or dying trees	2.6
Lack of bugs	2.9	Unusual	2.5
Has distant vistas	2.9	Monotonous	2.4

[a]Scale: 1=not at all important; 2=slightly important; 3=important; 4=very important.

The method chosen to define the subscales was a factor analysis of the 20x95 matrix of descriptor ratings for each stand. By revealing the covariance structure of multivariate data, factor analysis can be used to develop composite indexes representing psychological constructs. In psychometric research, this method is commonly used to interpret results of semantic differential scales[7] (Nunnally, 1967).

Factor analysis is an appropriate method where the underlying covariance structure can be represented in terms of a hypothetical causal model, and where a sizable portion of the variance in total responses is shared (Johnson and Wichern, 1988). Both conditions apply to this study. One assumption of factor analysis is multivariate normality; while this does not appear to be present in the ratings for many descriptors, the technique is robust to the kinds of non-normal distributions generally exhibited by scores on a constrained psychometric scale (Nunnally, 1967).

The first step in the process was to perform separate factor analyses of the descriptor scale responses for each stand. The number of factors to extract was determined by the number of eigenvalues greater than or equal to 1.00, as suggested by Johnson and Wichern (1988). Eight-factor solutions were indicated for all six stands. Variables were assigned to the factor upon which they loaded highest. These solutions explained 89-91 percent of the total variance in responses. Varimax rotation was used to improve interpretability. A sample solution (for the snag-retention clearcut) is shown in Table 9; Appendix F contains the factor solutions

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[7]See Jacob (1973) for an example of this method applied to scenic/recreation quality research.

Table 9
Factor analysis (varimax rotation): Snag-retention clearcut

Descriptor	FACTORS 1	2	3	4	5	6	7	8
Abundant bird life	.75	.16	-.04	-.02	.00	-.05	.12	.13
Abundant wildflowers	.47	-.11	-.03	-.05	-.02	.00	-.02	-.04
Colorful	.56	.09	-.02	.21	.16	.44	.13	-.13
Monotonous	-.29	.09	-.07	-.08	.00	-.11	.01	.08
Cool	-.02	.77	.00	.18	.08	-.05	.11	-.09
Damp	-.02	.77	-.08	-.04	.01	.05	-.05	.12
Lack of bugs	-.13	.29	.09	.01	-.24	.22	-.02	-.20
Quiet	-.26	.26	.30	.18	.04	.14	.27	.13
Foot traffic only	.19	.07	.75	.03	.07	-.05	-.18	-.05
Good trail/road	.22	.16	-.52	-.10	.10	.08	.02	.08
Natural	.15	-.04	.45	.04	.37	.41	.17	-.18
Has flat places	-.07	-.13	.00	-.62	-.17	.31	.14	.22
Steep	.01	.04	.15	.81	.00	.20	-.00	.17
Closed-in	.18	.10	.12	.10	.71	-.03	.07	.05
Has distant vistas	.22	.02	-.05	.01	-.38	.09	-.00	.02
Unusual	.05	-.05	-.20	.04	.40	.21	-.12	-.05
Places to stop/rest	.09	.03	-.07	-.02	-.05	.69	.02	.03
Bright	.14	-.13	.08	-.03	-.27	.05	.28	.08
Pleasant-smelling	.05	.09	-.18	-.08	.03	.03	.79	-.00
Dead or dying trees	-.07	.02	-.09	.03	-.04	-.01	.04	.81

Eigenvalues: 2.49, 2.11, 1.95, 1.65, 1.44, 1.32, 1.23, 1.05
Total variance explained: 91.0%

for all six stands. For purposes of interpretation, descriptors are grouped together within the factor on which they loaded highest.

Ideally the same covariance structure should have underlain the matrix of responses to each stand. This was not entirely the case, but certain descriptors did tend to load together for a majority of stands. These can be combined to produce six subscales with readily interpretable meanings:

- Attraction places: Has distant vistas, good places to stop and rest.
- Biodiversity: Abundant bird life, abundant wildflowers, colorful.
- Enclosure: Bright, closed-in.
- Lack of human influence: Foot traffic only, natural, pleasant-smelling, quiet.
- Microclimate: Cool, damp.
- Topography: Has flat places, steep.

Four descriptors were excluded from further analysis because they tended to load differently in different stands and their meanings seemed to change from stand to stand. For example, "good trail/road" was positively associated with naturalness in the old growth stand but negatively associated with naturalness in the snag retention and two-story stands.

The 20th descriptor, dead or dying trees, was included as a separate single-variable subscale. This variable loaded by itself in two stands, and in two others it had a loading more than twice that of the descriptor with which it was combined, suggesting that the associated variable made only a minimal contribution to the meaning of the factor.

Next, an index was calculated for each subscale by adding together the descriptor ratings for each variable within it. Two items which were negatively associated with the other descriptor within their respective factors, "bright" and "steep," were reverse-coded for purposes of index construction. No recalculation was necessary for the dead/dying trees subscale.

The resulting indexes were used as independent variables in a series of 18 regression analyses (6 stands X 3 kinds of acceptability judgment). Results of the regression analysis are shown in Tables 10-12. Subscales which have statistically significant coefficients (t-tests, $p < .05$) can be said to influence acceptability judgments for a particular treatment and type of use. (The actual size of regression coefficients has little meaning since it depends on the number of original variables in each subscale.) If a subscale significantly influences the quality of more than half of the treatments, the stand attribute represented by that subscale can be considered of general importance to judgments of scenic or recreational quality. Other attributes may have more specialized influence on evaluations of a particular type of treatment.

Two attributes, biodiversity and lack of human influence, positively influenced scenic quality in five of the six stands (Table 10). The presence of attraction places enhanced scenic quality in the thinned, snag retention, and two-story stands, while dead or dying trees reduced scenic quality in the latter two stands. Microclimate was associated with scenic judgments in the two-story stand only. Scores for the seven subscales explained 29-42 percent of the variance in acceptability, with the highest R^2 values being in the traditional clearcut and two-story stand.

Table 10
Multiple regression of descriptor subscales on scenic acceptability

SUBSCALE	REGRESSION COEFFICIENTS		
	Old growth	Clearcut	Thinned
Attraction places	-0.130	0.211	0.425**
Biodiversity	0.182**	0.459***	0.296**
Enclosure	-0.108	-0.126	-0.134
Dead/dying trees	-0.130	-0.008	-0.235
Lack of human influence	0.190***	0.324***	0.145
Microclimate	0.099	-0.066	0.127
Topography	-0.040	0.085	-0.126
CONSTANT	-0.7	-9.7	-5.3
R^2	29.1%	40.0%	36.1%
	Patch cut	Snag ret.	Two-story
Attraction places	0.159	0.491*	0.330*
Biodiversity	0.269***	0.263*	0.184
Enclosure	-0.029	0.235	0.191
Dead/dying trees	-0.233	-1.038**	-0.450*
Lack of human influence	0.231***	0.332**	0.330***
Microclimate	0.085	-0.169	-0.283**
Topography	-0.108	-0.014	-0.086
CONSTANT	-4.5	-5.2	-4.1
R^2	37.2%	32.4%	42.1%

* $p < .05$, where H_0: $\beta_i = 0$; H_a: $\beta_i \neq 0$
** $p < .01$
*** $p < .001$

Lack of human influences also was associated with hiking quality (Table 11) for every treatment except thinning. Attraction places were the other generally influential attribute, being associated with higher hiking quality in four stands. Biodiversity was a positive influence on hiking quality in the clearcut, thinned, and patch cut stands. Other significant attributes were microclimate in the clearcut and dead/dying trees in the snag retention clearcut. Values for R^2 were slightly lower overall, ranging from 20 percent in the old growth stand to 44 percent in the clearcut.

Fewer subscales were associated with camping quality judgments, and the descriptors explained less of the variance in the stands' acceptability as places to camp (14-30 percent). Attraction places and lack of human influences were significant in four stands each. Biodiversity was a significant influence in the old growth and patch cut stands, microclimate in the snag retention clearcut, and topography in the traditional clearcut.

Growing an "acceptable" forest

Silviculturists cannot protect or enhance amenity values without knowing which features of the stand to manipulate. One objective of this study was to identify those features in Douglas-fir forests. The problem was approached in two ways. First, observers were asked directly to rate the importance of various stand attributes in judging scenic and recreational quality. Second, multivariate statistical methods were used to identify the dimensions of stand descriptions that were most closely associated with acceptability ratings.

Table 11
Multiple regression of descriptor subscales on hiking acceptability

SUBSCALE	REGRESSION COEFFICIENTS		
	Old growth	Clearcut	Thinned
Attraction places	0.097	0.407*	0.516**
Biodiversity	0.070	0.424***	0.233*
Enclosure	0.003	-0.078	-0.137
Dead/dying trees	-0.052	0.131	-0.052
Lack of human influence	0.104**	0.347***	0.162
Microclimate	0.022	-0.302*	0.156
Topography	-0.051	0.059	-0.034
CONSTANT	-0.6	-10.2	-6.7
R^2	20.3%	43.6%	30.2%
	Patch cut	Snag ret.	Two-story
Attraction places	0.208	0.518*	0.320**
Biodiversity	0.205*	0.092	0.059
Enclosure	-0.063	0.116	0.169
Dead/dying trees	-0.024	-0.892*	-0.353
Lack of human influence	0.215**	0.303**	0.327***
Microclimate	0.120	-0.113	-0.132
Topography	0.011	0.093	-0.082
CONSTANT	-5.2	-5.3	-4.2
R^2	31.8%	27.2%	32.7%

* $p < .05$, where H_0: $\beta_i = 0$; H_a: $\beta_i \neq 0$
** $p < .01$
*** $p < .001$

Table 12
Multiple regression of descriptor subscales on camping acceptability

SUBSCALE	REGRESSION COEFFICIENTS		
	Old growth	Clearcut	Thinned
Attraction places	-0.143	0.279*	0.527**
Biodiversity	0.435*	-0.032	0.025
Enclosure	-0.206	0.023	0.073
Dead/dying trees	-0.229	0.036	0.091
Lack of human influence	0.208	0.219**	0.042
Microclimate	-0.162	-0.127	0.149
Topography	0.240	0.429**	-0.085
CONSTANT	-4.6	-8.8	-6.1
R^2	20.7%	26.3%	14.3%
	Patch cut	Snag ret.	Two-story
Attraction places	0.233	0.419*	0.300*
Biodiversity	0.239*	0.060	0.097
Enclosure	-0.082	0.385	0.203
Dead/dying trees	-0.192	-0.630	-0.379
Lack of human influence	0.198*	0.382***	0.369***
Microclimate	-0.160	-0.317*	-0.252
Topography	-0.142	-0.116	0.076
CONSTANT	-4.3	-5.9	-6.6
R^2	17.7%	30.4%	29.1%

* $p<.05$, where H_0: $\beta_i=0$; H_a: $\beta_i \neq 0$
** $p<.01$
*** $p<.001$

Both approaches have advantages. Direct question methods are often better than statistical inferences for accurately measuring preferences and behavioral intentions (Vaske, Donnelly, and Shelby, 1990). But more complex methods may be more useful for identifying the manipulable features of a stand for which changing the level of the attribute will bring about the greatest change in acceptability.

Defining the "natural" forest. Silvicultural protection of scenic and recreational value could be a fairly simple task if the features that were most important to acceptability ratings were also the ones that were most easily manipulated. Unfortunately, this is not the case. The descriptor rated most important for both scenic and hiking quality was "natural," an attribute that can be difficult to achieve in stands managed for high timber yields. Only in the old growth stand was "natural" given a mean descriptor rating in the agreement range (3.0-5.0) by all four groups that visited the study stands (see Appendix E). Three groups agreed that the patch cuts were natural, and one said the two-story stand was natural. The other stands were uniformly judged to be unnatural.

Before trying to make stands more natural-appearing, it is necessary to gain some understanding of what "natural" means. Early research confirmed Leopold's (1969) assumption that naturalness is a key element of scenic quality (e.g., Zube, 1973). Yet a recent review shows that it is not always clear how researchers have defined the term "natural" (Ulrich, 1986). Sometimes the word is used as an antonym for "exotic" or "introduced," implying that management for biodiversity of native species can address the need for natural landscapes. Yet most people may be unable to recognize the natural origin of plant or animal species. Lamb and Purcell (1990), working in Australia, reported wide variation in perceived naturalness even among undisturbed sites (e.g., tall, dense vegetation was judged more "natural" than low, open vegetation).

Another meaning of "natural" is the absence of intervention by modern society. This sort of naturalness is closely related to two other descriptors that were important ($\bar{x} \geq 3.0$) to all three kinds of acceptability: quiet, and foot traffic only. Students at a Phase 1 debriefing said a stand is more natural if it is also quiet, i.e., removed from urban influences and pressures of everyday life. Factor analysis confirms the importance of this aspect of naturalness. The descriptor "natural" loaded most often with attributes such as "foot traffic only," "quiet," and "pleasant-smelling." Together these point toward a factor associated with escape from the mechanized environment and its sights, odors, and sounds. Escape has long been recognized as a primary component of outdoor recreation experiences (Knopf, 1983; Pitt and Zube, 1987). Not surprisingly the subscale based on the escape factor, "lack of human influence," was strongly linked not only with scenic quality but also with both kinds of recreational quality.

For this reason, managing for naturalness will probably require a combination of silvicultural and non-silvicultural strategies that focus on both visual and non-visual impacts of human presence in forests. Visual naturalness may be enhanced by the use of patch cuts (called natural by most respondents) in stands where it is feasible to leave a large proportion of the standing timber volume unharvested. Another silvicultural option might be to seed with annual ground-cover plants that could hide small woody debris while providing forage for wildlife, although this might pose regeneration problems. Non-silvicultural strategies might include a ban on motor vehicle use after harvests in stands having recreation potential. Even the simple act of removing flagging could make recent harvest units look a bit more natural.

Other attribute-acceptability linkages. The only other descriptor having mean importance ratings above 3.0 for all three types of quality judgment was "colorful." Increased color in nature is normally associated with increased structural and species diversity. As those are principal objectives of New Forestry (Franklin, 1989), it is no surprise that the stands considered colorful by survey respondents were the old growth and New Forestry stands. The "biodiversity" subscale (color, wildflowers, birds) was found to enhance scenic quality, and had a more limited effect on recreational quality.

The presence of attraction places was more influential than the importance ratings might have suggested, especially with respect to recreational quality. Previous research has found that visual discontinuities, such as as those afforded by entry into new stands or glimpses of distant scenes, increase the quality of hiking and nature study outings (Gustke and Hodgson, 1980; Axelsson-Lindgren and Sorte, 1987). Strategic positioning of harvest units therefore may enhance the recreational quality of a forest. An ambitious project using this approach is under way in Maine's Acadia National Park, where biologists, landscape architects, and geographic information systems (GIS) specialists are jointly planning the optimal location of small timber removals to open up scenic vistas and wildlife habitat (Steinitz, 1990).

Earlier studies had suggested that scenic quality would be reduced by the presence of snags, stumps, slash, or other evidence of dead and dying trees (Vodak et al, 1985; Ribe, 1990). Yet this factor was not rated especially important using the direct-question method, and was found to have only limited influence in the regression analysis. Scenic quality was negatively influenced by dead/dying trees only in the two New Forestry stands where snag-creation and associated woody debris were most obvious. Hiking quality was negatively influenced only in the snag-retention clearcut, where down wood further decreased the traversability of the only stand that was not crossed by any sort of road or trail. Thus the biodiversity and "legacy" objectives of New Forestry may have countervailing effects, though the evidence from this study seems to suggest that the positive effect outweighs the negative.

Another attribute that had a smaller-than-anticipated influence was topography. Brunson and Shelby (1990, 1991) had found that the presence of flat spaces was perhaps the single most important determinant of campsite quality, and was one of the two most important descriptors for camping quality in the present study (Table 8). Yet respondents' perception of the topography did not influence their camping quality ratings except in the clearcut. People generally agreed that the other four stands had flat places (see Appendix E), so it may not be surprising that topography did not matter there. Perhaps more interesting is the fact that steep topography was not enough to make the old growth stand an unsuitable place for camping.

The relationship between scenic and recreational quality

Recreational and scenic values of forests have been so closely linked in traditional forest management that there may be a tendency to assume that protecting one will automatically protect the other. Yet there is little basis for such a conclusion. Brunson and Shelby (1990, 1991) found that such basic necessities as privacy and a flat place to pitch a tent were more important than natural beauty when selecting a campsite, even for campers who list "being in a natural setting" as the most important reason for making their trip. The current study showed that for most treatments, scenic acceptability ratings differed from ratings of both hiking and camping acceptability.

Brown and Daniel (1984) have suggested that scenic beauty "probably always makes some contribution to visitor satisfaction, and in many cases is the predominant component." They have proposed a continuum describing the influence of scenic quality on recreation experiences based on the extent to which participation in an activity requires participants to focus on the skill demands of the activity instead of on their surroundings:

Kayaking ORV riding	Hunting Fishing	Hiking	Camping	Picnicking	Driving for pleasure

<————————————————————————————————>

LOW INFLUENCE   HIGH INFLUENCE

The basic premise of Brown and Daniel (1984) held true in the present study, but scenic quality seemed to influence hiking more than camping. This is can be seen in the descriptor importance ratings by counting the number of attributes rated above the scale midpoint of 2.5 for each use. Ten attributes had ratings above the scale midpoint for scenic viewing. All ten of those, plus four others, were rated above the midpoint for hiking. Eighteen attributes were important for camping, including all but one of those that were important for scenic viewing.

When acceptability ratings for different uses were compared within stands, scenic and hiking ratings were more similar to each other than to ratings for camping quality. It follows, then, that the stand attributes important to hiking and scenic viewing should be more similar to each other than to the attributes important for camping. That was indeed the case. The same five descriptors were most important to both scenic and hiking quality (natural, foot traffic only, quiet, colorful, has distant vistas), and the order differed only slightly. For camping quality, flat ground and quiet replaced naturalness as the most important attributes.

The regression analyses yielded similar results. Lack of human influence was a significant influence on all three types of ratings, but other subscales were more closely associated with certain kinds of quality than others. Biodiversity was associated most closely with scenic quality, while the presence of attraction spots was more influential on hiking and camping quality. Dead or dying trees influenced scenic quality more than hiking quality, and didn't affect camping quality at all.

Amadeo, Pitt, and Zube (1989) have identified two primary components of perceived scenic value: content and organization. Scenes are judged in terms of two questions: What are the elements of the scene? How are those elements arranged? The latter question defines the difference between scenic and recreational quality.

Scenic judgments consider whether the arrangement of elements is *aesthetically pleasing*. Recreational judgments consider whether the arrangement is *useful*.

It is likely that an important use of forests is to obtain pleasant visual stimulation; if so, pleasing scenery is a key affordance (Gibson, 1966) of the scene. But it is not the only affordance. Other affordances for campers might be ones that address physical requirements of camping (e.g., flat ground; shelter from wind, sun, or rain), or the convenience of sites for other activities that are planned as part of the camping trip (Brunson and Shelby, 1991). For hikers, other affordances might be ones that provide traversability of the landscape, or an occasional change of scene to restore optimal levels of arousal (Berlyne, 1971) or of information flow (Gustke and Hodgson, 1980). The amount of overlap between recreational and scenic quality may be largely dependent on how much attention or effort must be devoted to those other affordances.

Summary

Linkages between stand attributes and acceptability judgments were examined using a direct question method as well as statistical inference. Both methods showed that amenity values are highest for stands where there is the least evidence of human manipulation. Silviculture can be used along with other management strategies to enhance the "naturalness" of a managed forest. Diversity of species and forest structure is also associated with scenic acceptability, suggesting that New Forestry methods can enhance scenic quality, but this effect is offset somewhat by the "legacy" aspects of non-traditional silviculture. The quality of hiking and camping is more closely associated with the presence of attraction places (e.g., scenic vistas), suggesting that the location of a traditional or New Forestry treatment may be as influential as the type of treatment. Scenic quality appears to be an important component of recreational quality. However, the latter hinges not only on whether elements of an environment are arranged in an attractive manner, but also on whether they are arranged in a useful manner.

6. EFFECTS OF SNAG CREATION

The retention of "wildlife trees," or snags, is one of the more visible aspects of New Forestry. Snag preservation and/or creation is often a forest management objective even where non-traditional practices are not considered. Many vertebrate and invertebrate species use snags at some time or other for feeding, roosting, nesting, courtship, escape, etc. The role of snags is especially vital in the Pacific Northwest, where more than 50 species of birds and mammals depend on cavities in snags during all or part of their life cycles (Brown, 1985).

Silvicultural practices such as short rotations, even-aged management, or salvage harvests reduce natural snag densities (Davis et al., 1983). As a result, forest agencies throughout the U.S. have set guidelines for protection of snags in timber-growing areas. Where existing snags cannot be left intact during harvest, these guidelines may call for creating new ones.

While biological effects of artificially created snags have been examined in some detail (e.g., McComb and Rumsey, 1983; Bull and Partridge, 1986), the effects on social values such as recreation or scenery have not. Accordingly, this study examined those effects by comparing acceptability judgments made from photographs taken before and after snags were created in three stands.

Previous research

Scenic quality. Although the scenic impacts of created snags have not yet been studied systematically, previous research does offer insight into the likely impacts of snags. Most evidence suggests that snags will have a detrimental effect on scenic quality, though the impact will almost certainly vary depending upon the ratio of green trees to snags and the relative visibility of trees that have been killed.

Old growth stands in the Northwest generally contain at least 1.5 to 4 snags per acre (depending on the forest type) that are greater than 20 inches in diameter and 15 feet in height (Spies and Franklin, 1988). New Forestry approaches that strive to retain old-growth-like structural diversity are likely to retain similar sizes and densities of snags. Most studies show trees of that size to be associated with increased scenic beauty (Ribe, 1989). The presence of snags in an even-aged stand increase its structural diversity and its visual variety. Both have been linked with increased scenic value (Savolainen and Kellomäki, 1981).

However, Kardell (1978) suggests that visual benefits of tree retention may be diminished if the trees look "out of place." He referred specifically to trees retained in shelterwood harvests, where conifers that have developed in dense stands lack the branching typically seen in lone trees. Visibility of internal vegetation structure is believed to be an important organizing feature in evaluations of the quality of forested landscapes (Abelló et al., 1986). Very low densities of trees, whether large or small, may also be associated with reduced estimates of scenic beauty (Hull et al., 1987).

Created snags also may be regarded as reducing scenic quality if they are perceived to be the result of "unnatural" activities. Snags created by topping, as in the present study, may be especially susceptible to this effect. When human manipulations are obvious, scenic judgments of forests usually are lower (Ribe, 1989). Perceived naturalness is associated with scenic quality even if the human influence is not visible. Hodgson and Thayer (1980) found that settings were rated higher for scenic quality when judged from photos of "forest growth" than when the same photos were labeled "tree farm."

Similarly, perceptions that trees are dead can lead to reduced judgments of scenic beauty whether the cause is natural or not. Buhyoff, Wellman and Daniel (1982) found that ratings of landscape scenes in Colorado were lower if respondents were first told that the stands had been damaged by pine beetle and spruce budworm attacks. Ribe (1990) devised a tree death variable for his SBE models of northern hardwoods that was negatively and significantly correlated with scenic beauty, but added barely 2 percent to the explained variance in the scenes.

Woody debris produced during snag creation can also influence scenic quality. If snags are created by dynamiting or sawing off the foliage-bearing portions of a tree, the tops may be left in the stand to serve as nutrient sources, refugia for small animals, and structures for water storage and erosion control. Yet slash removal is often recommended for enhancing scenic quality (Daniel and Boster, 1976; Vodak, Roberts, Wellman and Buhyoff, 1985). Vodak et al. found down wood to be the most significant contributor to negative scenic evaluations in eastern hardwood stands, especially when more than 18 inches tall and visible above ground vegetation. Schroeder and Daniel (1981) found that the *volume* of debris was less important to scenic beauty than whether the debris was produced naturally or by logging.

Recreational quality. Effects of snag creation on hiking and camping acceptability may be less obvious. The primary impact is less likely to come from the snags themselves than from the resultant debris. Hultman (1983a) suggested that slash is as important to assessments of suitability for outdoor recreation as it is to scenic quality. Down wood may affect hiking quality by limiting the traversability of a stand, as well as by reducing scenic beauty. The effect on camping quality is more ambiguous. A debris-clogged stand may lack cleared areas for setting up a tent. Even if cleared areas exist, slash can increase fire danger, which is an important factor in campsite selection in some settings (Brunson and Shelby, 1990). However, smaller amounts of debris may actually improve camping quality, as the availability of firewood has been identified as a positive influence on campsite choices in areas managed for timber production (Clark et al., 1984).

Results

Two sets of acceptability ratings were obtained for each of the New Forestry stands. One set of slides was taken July 15, 1990, before the snags were created. A second set was taken Aug. 27, 1990, after the trees had been topped, using camera angles and lighting conditions as similar as possible to the July photos. A comparison of ratings is shown in Table 13.

Table 13
Ratings for scenes photographed before and after snag creation

		MEAN RATING		
Quality	Treatment	July	Aug.	Change
Scenic	Patch cut	1.14	2.07	+0.93***
	Snag retention	-0.79	-1.51	–0.72***
	Two-story	-0.07	-1.06	–0.99***
Hiking	Patch cut	1.56	1.80	+0.24*
	Snag retention	-0.52	-1.13	–0.61***
	Two-story	0.21	-0.61	–0.82***
Camping	Patch cut	0.81	1.13	+0.32**
	Snag retention	-1.31	-1.90	–0.59***
	Two-story	-0.01	-1.52	–1.51***

* $p < .05$ (paired t-test)
** $p < .005$
*** $p < .0001$

July and August ratings were significantly different for all three treatments and all three types of quality. For each use, the August rating was higher than the July rating in the patch cut stand, but lower in the snag retention and two-story stands. The greatest amount of change took place in the two-story stand, which was rated essentially neutral for all three uses in July, but fell into the unacceptable range after the snags had been created. The magnitude of change was smallest for recreational quality in the patch cut. Differences ranged in size from .24 for hiking quality in the patch cut to 1.51 for camping quality in the two-story stand.

The effect may be more easily interpreted if the mean differences are converted to a percentage of respondents who rated the stands as acceptable, i.e., assigned ratings greater than zero. In August, the patch cuts were acceptable to 18 percent more people for scenic viewing, 5 percent more for hiking, and 6 percent more for camping. The snag retention clearcut was judged acceptable by 12 percent *fewer* people for scenic viewing, and 8 percent fewer for both hiking and camping. The two-story stand was acceptable to 19 percent fewer people for scenic viewing, 16 percent fewer for hiking, and 25 percent fewer for camping. One pair of slides of the two-story stand (Nos. 27 and 30; see Appendix A) fell from 55 percent acceptable in July to 13 percent acceptable in August.

Scenic and recreational impacts of snag creation

Scenic impacts. Differences between the July and August ratings suggest that snag creation can significantly influence public perceptions of harvested stands.

Although none of the treatments in this study changed from being clearly acceptable to clearly unacceptable, the magnitude of the observed differences suggests such a change could easily happen.

When the ratings were made, respondents were not told they would be comparing two versions of the same scene. To reduce the possibility of direct comparison, slides of the same scene were never shown consecutively. But in debriefings, participants viewed a pair of slides from the two-story stand and were asked what made the scenes different. Several factors were identified that could have influenced reactions to the post-snag slides.

These included: the appearance of the snags themselves, which had been chain-sawed at a uniform height; a skeletal aspect to the remaining trunks as the amount of live foliage was reduced; additional woody debris volume; the unnatural appearance of debris; reduction in greenness as the debris and its associated shadows obscured ground cover seen in July; and flagging used to identify trees for topping and to mark tree-planting rows. Debris and reduced greenness were mentioned most often as scenic quality influences. While some respondents considered the snags unnatural-looking, others said they had barely noticed them. Most people said they had not noticed the flagging.

These results fit well with findings from previous studies. Several researchers have found that debris is among the most significant reducers of scenic quality (e.g., Daniel and Boster, 1976; Brush, 1979). Conversely, green herbage cover is among the most significant positive correlates with scenic beauty estimates (Brown and

Daniel, 1984). Abelló et al. (1986) found that appearance of fertility (greenness) and visibility of plant structure were the primary factors underlying cognitive organization of landscape scenes in a Spanish recreation forest.

Patch cut ratings were higher in August than in July. Almost certainly this is not a function of snag creation, but of the six weeks between photos. The snags are not easy to see in the slides even if one knows what to look for, and are probably invisible to uninformed viewers. Magill (1990) measured detection thresholds among persons viewing slides of forest management activities (most of which were much more obvious than the patch cut snags), and found that a majority of uninformed observers detected just 32 percent of the activities. Topping a few trees reduced the crown canopy, which in turn could have produced more attractive lighting in the August slides. However, the angle and position of the sun would probably influence lighting more than a slight reduction in canopy cover.

The negative "skeletal effect" seen in the two-story stand did not occur in the patch cuts because of the low ratio of snags to retained green trees. However, there was considerably more ground cover in August. As a result, stumps and harvest residues were less visible, and the amount of bare ground was reduced. Stumps, debris, and bare ground are regularly found to reduce scenic quality (Ribe, 1989).

Recreational impacts. Judgments of recreational acceptability changed less than those of scenic acceptability, except for the case of camping in the two-story stand. Since scenic quality is a major component of recreational quality (see Chapter 5), it is not unlikely that scenic impacts were the source of most of the change in recreational quality. An exception appears to be the two-story stand. Most likely this is because additional debris in the stand made camping impractical as well as unattractive. Although debris additions were the same in all stands (since the same number of snags was created in each), the debris seemed most noticeable in the two-story stand.

Snag-creation methods. While many people at the debriefings said the newly created snags were not what drew their attention in the August photos, a significant minority objected to the unnatural appearance of sawed-off boles. The choice of a snag-creation method requires the evaluation of tradeoffs involving cost, the immediacy of the need for snags, wind-throw susceptibility, safety, and effectiveness in creating nest sites, among other things. At settings where recreational or scenic impacts are important, amenity issues could be added to the list of tradeoffs that warrant consideration.

Bull and Partridge (1986) examined cavity use and cost for six different snag-creation methods: topping by chainsaw, topping by explosives, pheromone application (to attract pine beetles), girdling, fungal inoculation, and herbicide injection. They found that topped trees died sooner, were used more often by cavity-nesters, and had lower rates of falling than snags created by the other methods. Despite higher labor and materials costs ($19-34 per tree, compared to $5-15 for the other methods), topping was judged to be more cost-effective in the ponderosa pine forest where the study was conducted.

However, methods that are marginally less effective from the standpoint of cost or nest-site production may be preferable in settings having scenic or recreational importance. Although this study did not examine the effects of other methods, there may be visual benefits to killing trees in a visually unobtrusive manner (e.g., picloram injection). "Naturally killed" trees do reduce scenic beauty, especially if people are told it is occurring (Buhyoff, Wellman and Daniel, 1982), but the visual impacts of human-induced mortality are likely to be greater.

If nest site and wind damage considerations preclude the use of methods other than topping, there may be ways to top trees that are slightly more costly but improve stands' scenic or recreational quality. For example, the higher cost of using explosives may be offset by the fact that dynamited snags look more natural (like a wind-snapped tree) and perhaps are safer to create. Less costly than dynamite, and carrying potential scenic benefits, would be to saw trees off at different heights, e.g. 5-25 m. Although some woodpecker species might not nest in the shortest snags (Bull and Partridge, 1986), this practice could vary the stand's appearance while still providing a diverse sampling of artificial snags.

7. EFFECTS OF INFORMATION ON SCENIC QUALITY JUDGMENTS

New Forestry grew out of scientists' attempts to maintain biological values that previously had been discounted in forest management strategies (Franklin, 1989). Some of the impetus to preserve those values has come from public criticism of current practices. Yet even if the new methods are a response to societal concerns, they may lack societal approval unless the public understands their purpose (Shepard, 1990).

The importance of public education became clear during Phase 1 of this study. To avoid bias due to experimenter influence, respondents' questions about the study stands had been deferred until after all sites were evaluated. At both non-student sessions, post-survey questions led to a discussion of New Forestry. Both times, participants indicated they would have rated the stands higher if they had known more about the purpose of what they'd seen. Phase 2 sought to empirically test this anecdotal finding by comparing ratings by groups of persons who were given differing amounts of information about forestry practices before rating the slides.

Only scenic judgments were analyzed, since a stand's acceptability as a recreation setting was thought to depend largely on the physical requirements of the recreation activity. (For example, if large numbers of down logs make a stand virtually impossible to traverse, knowing *why* the logs were left there won't make the stand any easier to hike across.) Aesthetic judgments are strongly influenced by affective responses to the environment (Craik, 1981; Russell, Ward, and Pratt, 1981), and so might be largely beyond the influence of any cognitive meanings that people assign to silvicultural treatments. But the notion of acceptability also implies a behavioral response -- the act of accepting, or approving, of a treatment -- which is under more direct cognitive control. The question considered in this chapter therefore becomes: Can information about forestry practices be used to influence beliefs about those practices, thereby leading to a subsequent change in the scenic acceptability of forest stands where those practices are used?

Previous research

Information as an influence on scenic judgments. Individuals' beliefs about the nature of forest scenes have been shown to influence scenic quality ratings in several studies. Buhyoff et al. (1982) found that landscape scenes of insect-damaged forests were rated less attractive if viewers were told first about the insect problem. Anderson (1981) found that scenes were rated more attractive when identified as a national park or wilderness than as commercial timberland. Similarly, Hodgson and Thayer (1981) found that photos labeled "tree farm" were judged lower than the same slides labeled "forest growth."

However, Vodak et al. (1985) found that telling respondents which harvest treatments they were evaluating had no effect on Scenic Beauty Estimation (SBE) ratings of eastern hardwood stands. The authors conclude that Anderson's (1981) terms elicited emotional responses, while theirs ("unmanaged," "light thin," "heavy thin," "clearcut") held neutral meanings for the college students and non-industrial forest owners in their sample.

A study by Simpson et al. (1976) showed both cognitive and affective influences on approval/disapproval of forest scenes. Ratings on a 10-point scale were influenced if respondents first read a Forest Service brochure citing the ecological benefits of thinning and slash piling in ponderosa pine stands, and also if they were told the alleged consensus of ratings by knowledgeable graduate students. The cognitive influence (the brochure) improved ratings for clearcut stands but not for natural or thinned stands. The normative influence, which elicited a more affective type of response, improved ratings for all three types of stands.

Simpson et al. believe their results "clearly indicate that aesthetic judgments can be changed by didactic information regarding environmental consequences." However, in a more recent study by Taylor and Daniel (1984), information about the ecological benefits of fire did not increase SBE ratings for forests where prescribed fire was used as a management tool, apparently because the adverse scenic impacts of fire were too strong to be offset by any change in beliefs about fire ecology.

Attitudes toward forestry practices. Attitudes are generally said to have affective, cognitive, and behavioral dimensions (Mueller, 1986). That is, attitudes are a combination of individuals' feelings, beliefs, and behavioral commitment toward an object. The comprehensive study of attitude is said to be the single greatest contribution of U.S. social psychology (Jackson, 1989), yet little of that work examined attitudes toward forests or the outdoors until the recent upsurge in environmental awareness (Weigel, 1983). One conclusion that can be drawn from this rather limited body of research is that aesthetic judgments and attitudes toward forestry are highly interrelated.

Willhite et al. (1973) used factor analysis to show that the greatest influence on attitudes toward forestry practices was agreement or lack of agreement that the timber industry is exploitive and unresponsive to concerns about scenic beauty and wildlife. Levine and Langenau (1979) found aesthetic and gender influences on attitudes toward clearcutting, but argued that these could be overridden by the effects of recreation use patterns. Becker (1983) concluded that visitors to a managed forest in Maryland "experience the forest as a visual, sensual setting and view the idea of clearcutting as a challenge to this value." McCool et al. (1986) administered a six-item attitude scale as part of an SBE study, and found that scenic ratings for managed stands increased with favorable attitudes toward timber harvesting.

Attitudes have also been linked to beliefs about forest biology and forestry practices. Willhite et al. (1973) found that many non-foresters saw clearcuts as "devastated wastelands that have been ecologically destroyed." Becker (1983) discovered that more often than not, opponents of clearcutting did not know they had hiked through small, 5-year-old clearcuts to reach the interview location. Nelson et al. (1989) found that favorable attitudes toward clearcutting in Michigan were linked with a belief that growth exceeds harvest in the state, and that clearcutting would create deer habitat. Manfredo et al. (1990) found a strong link between knowledge of fire ecology and favorable attitudes toward prescribed fire policies.

Changing attitudes and perceptions. All of the authors cited in the previous paragraph urged that public education efforts be increased in order to improve attitudes toward forest management activities. The literature clearly seems to suggest that heightened public awareness can lead to more favorable attitudes, and perhaps also to more favorable judgments of forest aesthetics.

Yet the linkage between the belief and behavior components of attitude can be elusive (Weigel, 1983). Changes in attitude toward an object don't always seem to lead to changes in behavior toward it. Intervening variables, such as the normative influence cited in Simpson et al. (1976), can produce behaviors that don't reflect expressed attitudes. The means chosen to bring about attitude change must be congruent with the attitude or behavior being addressed, and measures of subsequent behavior must be at the same level of specificity as the attitude (Heberlein and Black, 1976). Intervening variables and message specificity are likely to be equally important considerations when attempting to influence judgments of scenic quality in managed forests.

Methods

Phase 2 consisted of three slide-rating sessions, each one part of a regularly scheduled class period. The sessions were conducted identically except that after a set of general instructions were read, members of two groups heard a brief informational talk on "the kinds of forestry practices that are being studied in the Pacific

Northwest" before they began rating the slides. Those in the third (control) group began rating slides immediately after the instructions were given.

The informational segment at one session introduced the concept of New Forestry, based on information from Harris (1984), Franklin (1989), and Hunter (1990). At the other session, the segment covered snags and snag creation only, using information from Brown (1985) and Hunter (1990). All participants were told they would be judging the acceptability of stands managed using different forestry practices. However, they were not specifically told that the slides depicted results of snag creation or New Forestry, nor were the treatments identified in any way during rating sessions. Although texts for each talk were prepared beforehand (see Appendix D), they served mainly as outlines for an informal lecture-style presentation which was thought to be the most effective way to convey the information.

The participating classes were chosen because they were similar in size and consisted mostly of non-forestry majors who were nonetheless likely to be interested in forest issues.[8] To minimize the effect of differing knowledge bases, this part of the analysis was limited to respondents who had not completed any previous forestry courses. Sample sizes were 22 in the control group and 27 in each message group (66 percent of the total sample).

Because the two messages differed in their levels of specificity, they were expected to influence ratings differently. The class that heard the New Forestry

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[8]The classes were: Recreation Resource Management, Forestry for Teachers, and Natural Resource and Community Values.

message was expected to give higher ratings than the control group for all seven New Forestry treatments, but not to the old growth stand or the four traditional treatments. The group that heard the snag message was expected to differ from the control group only on ratings for the four New Forestry treatments that were photographed after snags had been created.

Results

Regression analysis was used to isolate the influence of the messages from that of embedded variables. Five characteristics were associated with significant ($p < .05$) differences in scenic acceptability for at least one treatment: environmental group membership, age, length of Willamette Valley residency, hometown location, and frequency of work in forests (Chapter 4). Regression models were built for each treatment, with scenic quality as the dependent variable and age, area residency, forest work, environmental group membership, hometown, forest work, and message as independent variables. Each of the last five was treated as one or more dummy variables.

Message effects for all treatments are shown in Table 14. Beta coefficients for each message group reflect the difference in ratings (averaged over three slides) between the control group and the indicated message group, after controlling for embedded effects. The New Forestry message was associated with higher ratings for the two-story stand both before and after snags were created, and with lower ratings

Table 14
Variation in scenic acceptability attributable to message group

	-----------Message group------------			
	New Forestry		Snag	
Treatment	Beta	T	Beta	T
Old growth	0.45	1.95	0.22	1.16
1989 clearcut	-0.18	-0.43	0.07	0.19
1985 clearcut	-0.88	-2.18*	0.35	1.01
1990 thinning	0.35	0.95	-0.24	-0.77
1969-79 thinning	-0.55	-2.88**	0.36	2.25*
Patch 1	-0.28	-0.88	0.24	0.89
Patch 2 (July)	0.67	1.93	0.78	2.70*
Patch 2 (Aug.)	0.04	0.14	0.41	1.63
Snag retention (July)	-0.04	0.10	-0.20	-0.56
Snag retention (Aug.)	0.59	1.50	-0.05	-0.17
Two-story (July)	0.89	2.43*	0.51	1.67
Two-story (Aug.)	1.19	3.19**	0.11	0.36

* $p<.05$ (two-tailed)
**$p<.005$

Table 15
Variation in snag creation effect attributable to message

	---------------Message group-----------------		
Treatment	Control	Snags	New Forestry
Patch cut	+1.35[a]	+0.84	+0.75*
Two-story	–0.86	–0.77	–0.28*
Snag retention	–1.02	–1.49	–0.52*

[a]Mean change in ratings of same stands (July→Aug.)
*Significantly different ($p<.05$) from control group

for the 1985 clearcut and 1969-79 thinning. The snag message was associated with higher ratings for the patch cut and 1969-79 thinning.

A non-traditional practice that could be especially influential on scenic quality is artificial snag creation. Table 15 shows how the messages affected the size of differences in ratings for July and August views of the same treatment. The snag-creation effect was significantly smaller for respondents who heard the New Forestry message than for the control group. The effects on the control and snag groups were not significantly different.

Effects of the New Forestry message

The expected effects of information on acceptability ratings were only partially observed, and some effects that were observed had not been expected. Nonetheless, the results do offer limited evidence that the scenic acceptability of some alternative silvicultural methods can be enhanced by providing information about New Forestry.

The New Forestry message was associated with significantly higher ratings for scenic qualtiy in the two-story stand, but not for the patch cuts or snag retention clearcut. This result suggests that, for at least one treatment, information can mitigate negative scenic effects. There was no effect on patch cut ratings, but the impacts of those treatments were mild, and the scenes may not have been recognized as examples of New Forestry. The lack of an effect on ratings for the snag retention clearcut may reflect limits on the severity of impacts for which information can have a softening effect.

Additional evidence of a message effect can be seen by examining the impact of artificial snag-creation on ratings by the New Forestry message group. The snag retention and two-story stands were rated lower in August than July by all groups, but the additive impact of snag creation was less drastic for the New Forestry group. All three groups rated the patch cuts higher in August than July, but the improvement was less dramatic in the New Forestry group.

Examination of the size of regression coefficients (Table 14) shows that the positive change in the patch cuts from July to August was smaller for the New Forestry group because members of that group judged the July views less severely. The detrimental effect in the snag retention clearcut was lessened because post-creation views were not judged as severely. For the two-story stand, both pre- and post-creation views received higher ratings. Thus in all three stands, the New Forestry message were most likely to affect acceptability ratings for the less acceptable version of the treatment, i.e., the version showing greater human-caused disturbance.

Factors limiting message effects

The relatively limited extent of the evidence for an information effect may be attributable to four factors: the experimental design; the strength of affective responses to disturbances; low object-message congruence in the snag talk; and the duration of exposure to messages.

Experimental design. Not only did persons hearing the New Forestry message give higher ratings to the two-story stand, but they also gave *lower* ratings to the two "recovered" stands, the 1985 clearcut and 1969-79 thinning. This result was not predicted. It is conceivable that learning more about the complexity of natural disturbance patterns reduced the acceptability of traditional treatments, which are based on simplified models of disturbance. However, such an explanation assumes respondents could recognize that the stands had been managed in the past using traditional methods, and it fails to explain why the group did not also give lower ratings to the more recently harvested clearcut and thinned stand.

More likely the ratings were influenced by some factor (or factors) besides those included in the regression analysis. Evidently the anthropology students, who heard the New Forestry message, reacted more adversely to previously harvested stands of any age. Failure to control for this tendency is a shortcoming of the experimental design. Students were assigned to control and experimental groups based on their enrollment in pre-existing courses, rather than randomly. Since there was no way to pay people to participate, it was thought necessary to choose a design that could facilitate the study's main purpose (obtaining ratings of recreational and scenic quality from a acceptable-sized sample of non-foresters) without inconveniencing volunteer subjects. In the absence of experimental randomization, only tentative conclusions can be drawn.

Some uncontrolled embedded variable could also have helped bring about the enhanced acceptability of the two-story stand in the New Forestry group. However, the finding about the impact of artificial snag-creation is not affected by the experimental design issue because it describes how messages affect each individual's responses to a pair of related treatments. Any embedded variables, whether on not they were accounted for in the experimental design, should have had similar effects on responses to both treatments.

Affective response. The negative scenic impact of the snag retention treatment was not mitigated by either message, perhaps because the impact was too severe. Simpson et al. (1976) found that clearcuts in ponderosa pine stands received higher approval ratings from persons who had read about forestry practices. But Taylor and Daniel (1984) found that reading a brochure about prescribed fire did not lead to higher SBE ratings for heavily burned pine stands. The affective response to fire may have been too strong to be moderated by one exposure to an information source, while response to the clearcuts may have been weak enough to be susceptible to message effects[9].

Bourassa (1990) has proposed that natural landscapes are experienced primarily at a biological level, and learning therefore is less likely to influence responses to

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[9]Also, Simpson et al.'s approval scale may have drawn responses that reflect all three components of attitude, while scenic beauty lies mainly in the affective domain. Taylor and Daniel found that the fire brochure influenced attitudes and levels of knowledge, but not scenic beauty ratings. The "acceptability" construct of the present study probably lies somewhere between "approval" and "beauty."

natural settings than to built environments. There is evidence linking scenic quality with the biological need for survival (S. Kaplan, 1983). Landscapes having higher survival value tend to be judged as more scenic (Ruddell and Hammitt, 1987). Similarly, scenes showing evidence of life-threatening disturbances such as severe fires may evoke especially strong negative responses. The amount of disturbance visible in the snag retention clearcut may have been severe enough to evoke such a response, while other New Forestry treatments may have had a less visceral impact.

Object-message congruence. The impact of snag creation was not mitigated to a significant extent by the snag message. This result seems contrary to Heberlein and Black's (1976) findings regarding specificity. However, while the snag talk focused on the importance of snags to wildlife, and on how and why snags can be artificially created, the biggest visual impact of artificial snag creation was not the snags themselves but the woody debris produced by the creation process[10]. Debris was not discussed in the snag talk, but only in the New Forestry talk. As a result, there may have been greater object-message congruence in the New Forestry talk even when the visual impact of snag creation was isolated from other New Forestry impacts.

Duration of exposure to messages. Discussions that took place during debriefing sessions for the snag and New Forestry groups suggested that one possible embedded influence was differing levels of general knowledge about natural ecosystems. The education class, which heard the snag message, seemed less knowledgeable about forests than the anthropology class. Such a difference could not

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[10]For a complete discussion of snag-creation effects, see Chapter 6.

be detected by the survey, which asked only about prior coursework in forestry rather than in all biological sciences.

If members of the snag group knew less about ecology in general, a single exposure to didactic information about forestry practices may have been insufficient to influence ratings by that group. At both debriefings, respondents were asked if they felt the message had influenced their ratings. Some in the New Forestry group said it had, but the snag group tended to agree with one student who said the message had had little effect on her ratings because she was hearing about snags for the first time.

Consumer behavior researchers have long known that multiple exposures to information are useful for reinforcing messages and facilitating attitude change (Cacciopo and Petty, 1980). Messages in this study were given only once, but the information they contained would almost surely have greater effect on scenic quality ratings if heard repeatedly. This is likely to be true for any group, but especially for those those segments of the public having less knowledge about forestry in general.

8. CONCLUSIONS

Implications for future forest management

The development of new, innovative forestry practices in the Northwest has been an enterprise of foresters driven by foresters' objectives. That is entirely appropriate and necessary. Yet as Bromley (1981) aptly noted in a post-mortem of one scenic quality controversy:

> "In the ultimate analysis, the diner, not the cook, will be the best judge of the feast."

Ever since the "cut-and-run" era of the 19th century, public displeasure with forestry practices inevitably has led to legal restrictions on forest management (Dana and Fairfax, 1980). Today's forest managers therefore must be keenly aware of public perceptions of management strategies.

This dissertation has offered a preliminary examination of the factors influencing public acceptability of non-traditional forestry practices in the Pacific Northwest. While the findings cannot be used to predict judgments of any stands other than those at McDonald Forest, they clearly show that New Forestry practices are *capable* of producing stands having superior scenic and recreational quality when compared to clearcuts or commercially thinned stands. There is evidence that public acceptance can be increased if people understand the ecological benefits that New Forestry appears to offer. But care is needed when choosing *how* to introduce new practices to the public.

New Forestry as a response to public criticism. To managers concerned about the increasingly adverse public reaction to traditional practices, New Forestry may seem a rational compromise between the status quo and a court-ordered shutdown of timber operations. Yet the complexity and intensity of the current debate makes it clear that the forestry profession is confronting a quintessential "wicked problem" (Allen and Gould, 1986), i.e., one for which there is no rational solution, but merely more or less satisfying ones. Viewed in this light, the key question facing managers might be: Will the public find New Forestry treatments satisfying enough? Re-examination of the Chapter 4 results may point toward an answer.

Fig. 2 shows the percentage of respondents in the on-site study who called each stand acceptable (i.e., chose a rating above the neutral midpoint on the nine-point scale) for each use. A treatment may be defined as meeting public concerns about forestry practices if it is judged acceptable by a given proportion of the public. Choosing that proportion is a political decision; for purposes of discussion, let us suppose a simple majority would be sufficient.

For scenic viewing, the old-growth stand and all three New Forestry treatments met the standard, even though the latter were evaluated within a year after harvest, when scenic quality is typically lowest (Hull and Buhyoff 1986). For hiking, all but the snag-retention and traditional clearcuts met the standard, and simply building a trail across the snag-retention site might be enough to make it acceptable for hiking. Only the old-growth stand was acceptable for camping, and it just barely cleared the standard, but similar treatments on flatter ground might possibly create

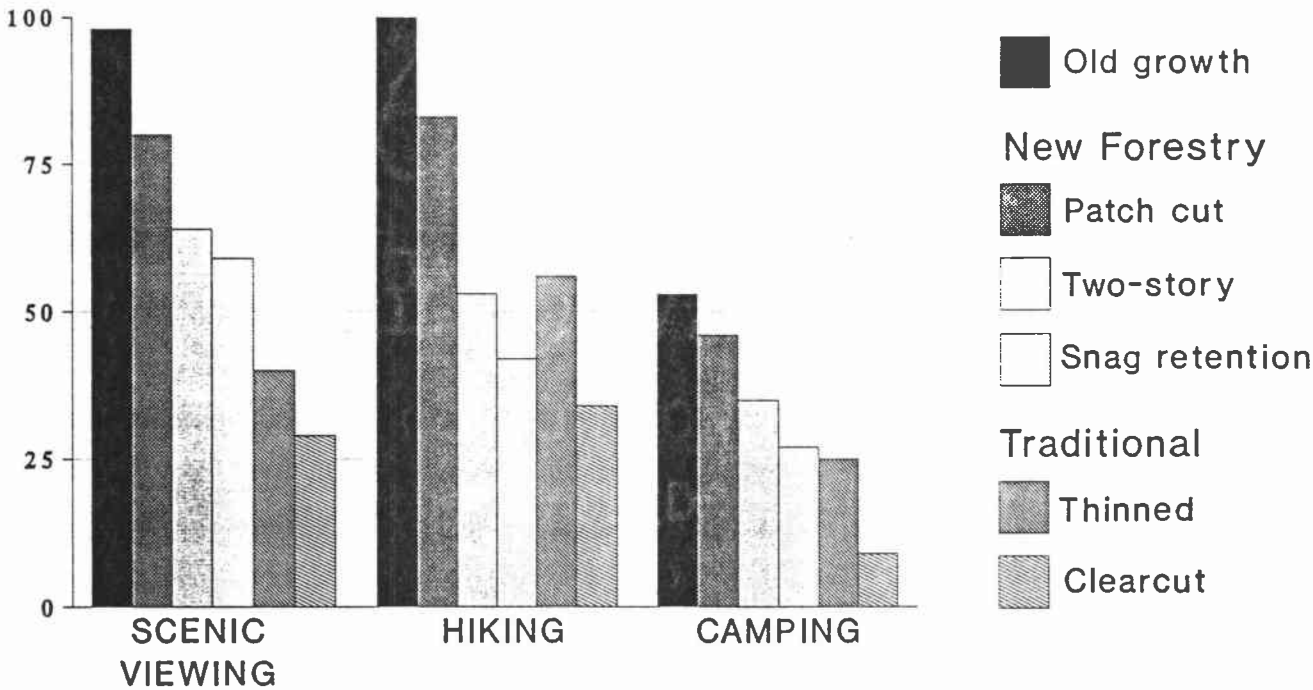

Figure 2. Percentage of sample rating stands as acceptable (Phase 1)

more satisfactory levels of camping quality, especially in the patch cuts, which made natural campsite-sized openings.

Fig. 3 contains the same information for the Phase 2. The old growth and patch cut stands were acceptable to a majority of respondents for all three uses. The only other treatment to meet the 50 percent standard after harvest was thinning, which produced a stand judged acceptable for scenic viewing and hiking. The snag retention and two-story stands were acceptable to only about one-quarter of those who viewed the slides. The traditional clearcut, though clearly unacceptable to most raters, was more likely to be judged acceptable than the snag retention or two-story stands.

The ratings shown in Fig. 3 were made from slides taken *after* artificial snags had been created. Comparison of pre- and post-snag views of the New Forestry stands (Fig. 4) shows that topping live trees with a chain saw and leaving the tops in the stand significantly reduced the percentage of viewers who found the snag retention and two-story stands acceptable, although neither stand had met the 50 percent standard for any use even before the snags were created. However, in the patch cuts, where created snags went largely unnoticed, the passage of just six weeks made them acceptable to a larger proportion of slide viewers. Acceptability invariably increased with time after harvest, although more time may be needed where the initial volume of timber removed is greater.

Further evidence of the effect of time is shown in Fig. 5, which depicts the difference in percentages for ratings of a traditionally managed stand harvested within the previous 18 months and one harvested 5-10 years before. Overall, the previously

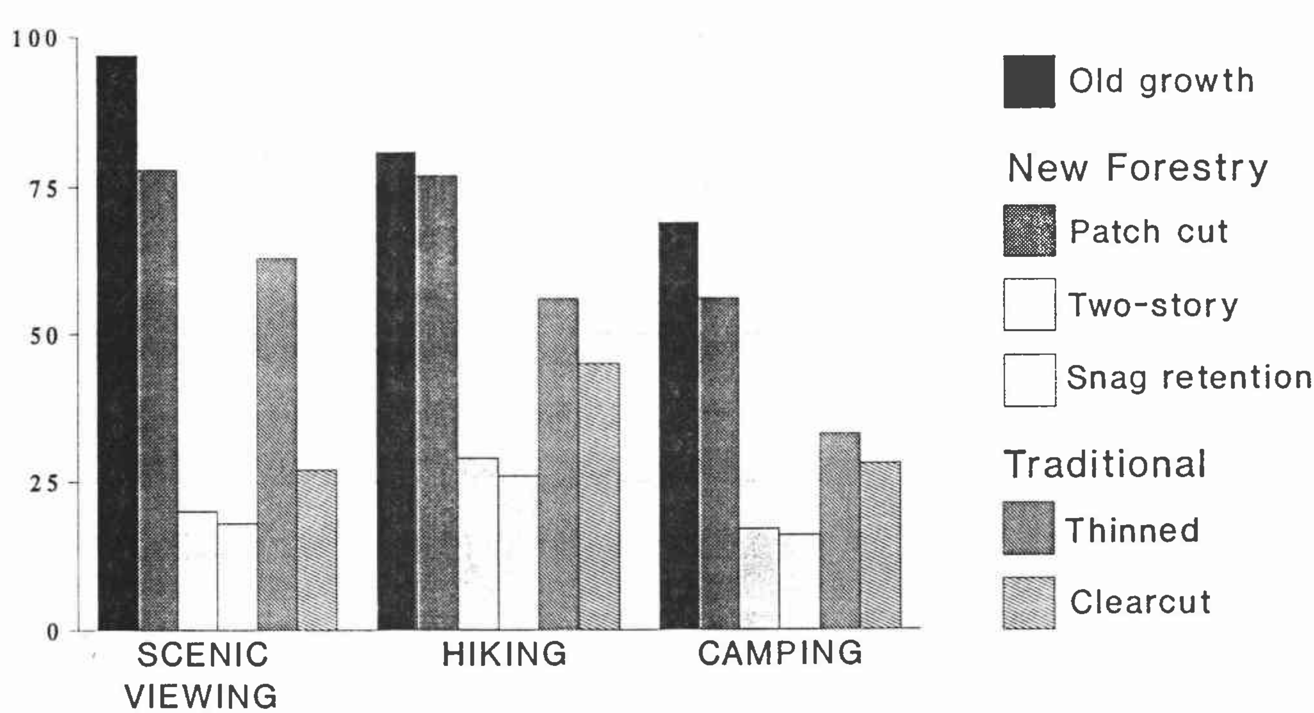

Figure 3. Percentage of sample rating stands as acceptable (Phase 2)

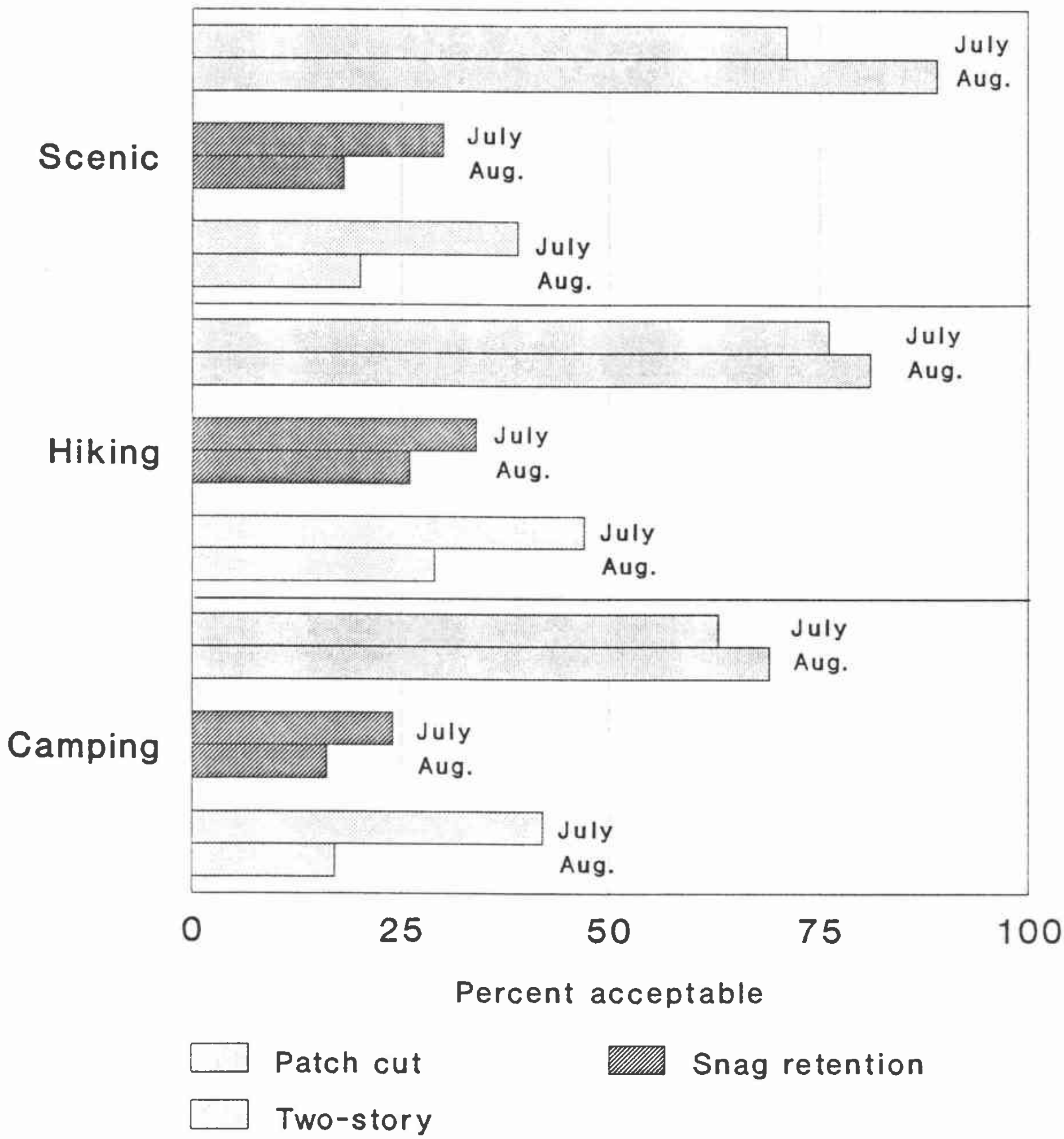

Figure 4. Pre- and post-snag ratings for New Forestry treatments

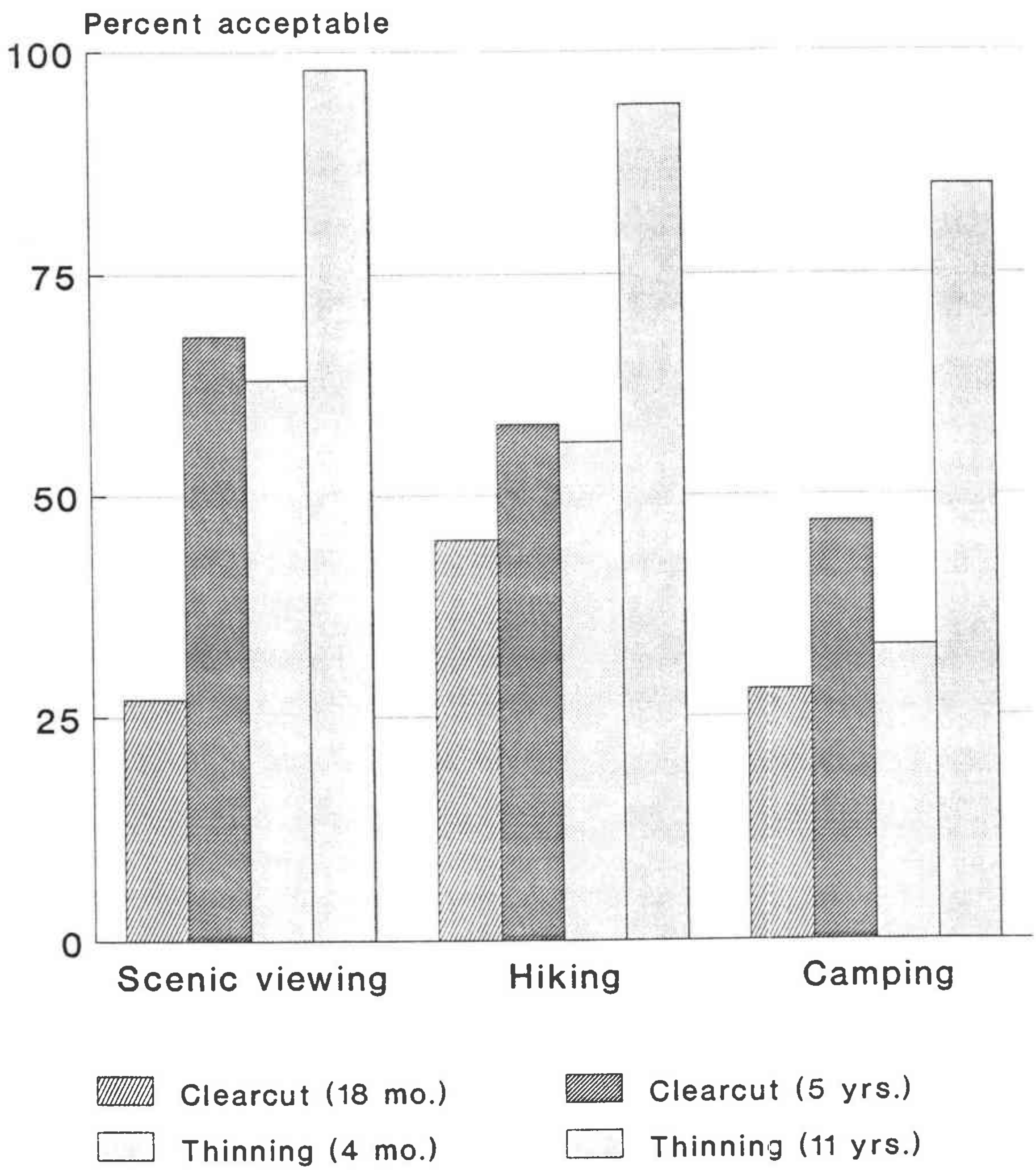

Figure 5. Time effects on traditional treatments

thinned stand was the most acceptable of any in the study. The 5-year-old clearcut was acceptable to a majority of respondents for hiking and scenic viewing, and nearly acceptable to a majority for camping as well.

There is no way to compare recovery rates for traditional and New Forestry treatments, since 5-year-old New Forestry stands do not yet exist. However, there is little reason to expect that recovery would be significantly slower in a two-story stand or snag retention clearcut as long as the stand was being regenerated successfully. While recovery normally may not be as rapid as in the patch cuts, it is likely that both non-traditional and traditional practices can produce stands that will be judged unacceptable for recreation and scenic viewing only during a relatively short "window" of time.

First impressions of New Forestry. Foresters implementing New Forestry practices would be well-advised to consider the disparate effects of on- and off-site evaluations. Persons whose first encounter with a New Forestry partial cut occurs during a recreation visit are likely to react positively. There will be time to learn the constant properties of the new scene, with all five senses engaged. Since recreational visitors are already active in a self-selected pastime, cognitive dissonance may lead them to adjust upward the perceived scenic quality of the setting; i.e., they may find the setting attractive simply because they chose to be there (Brown et al., 1989). Those initial reactions would establish the "cognitive set" -- the memory filter described by Fitzgibbon et al. (1985) -- that would form the basis for subsequent evaluations of other New Forestry stands.

Thus acceptance of New Forestry may come most easily from that portion of the public which makes frequent recreation visits to managed forests. But public reactions may be less positive if based on photos presented by the news media, a management agency, or an interest group that has taken a position regarding the new practices. Similar reactions can be expected from persons whose first impression is based on a fleeting glimpse of a newly harvested stand alongside a highway. Evidence from this study suggests that New Forestry treatments evaluated in this way are judged as negatively as the traditional practices that already are drawing heavy fire from the public.

Due to the differential reaction to non-traditional treatments when experienced directly and through slides, two recommendations can be made to agencies planning to implement New Forestry:

(1) Location of New Forestry demonstration projects should be planned carefully so that the new treatments are presented under circumstances where they are more likely to be viewed favorably.

(2) Agencies implementing New Perspectives projects should try to introduce as many people as possible to the new treatments via field tours or other on-site presentation methods.

Choosing a New Perspectives demonstration site. A key element in the scenic and recreational quality of forests is the perception that a setting is "natural." It may be possible to meet the public's need for naturalness and still extract timber products using New Forestry practices, but planning must account for the elements of New

Forestry that can detract from scenic and recreational quality as well as those that can enhance it.

In locations where public exposure to any single stand is brief, such as along a highway, the most visually acceptable stands are those showing little or no evidence of human manipulation. It may be simplest to leave uncut "buffer strips" along public roadways. If other management objectives make that approach undesirable, the best prescription might be a group selection system with patches of the minimum feasible size for regenerating target species. Forest managers planning a new route to a recreation site should resist the temptation to harvest newly accessed stands during road-building. Unless harvest and the road's opening will be separated by several years, it would be better to develop a route along existing rights-of-way through units that were logged at least five years earlier.

Other New Forestry treatments can be placed where visitors are likely to stay long enough to examine them. Two-story and/or shelterwood stands, even snag retention clearcuts, can be accepted by recreational users. One way to promote acceptance is to place harvest units in the vicinity of existing trails so that trails cross only a small portion of the stand, or skirt one edge, rather than passing directly along its long axis. Where possible, even-age treatments should be located so they open up scenic vistas, or provide a welcome visual discontinuity after a relatively long stretch of trail that passes through a single stand condition.

Decisions on a method of artificial snag creation should also consider the duration of exposure, but for a different reason. Respondents in this survey tended not to notice sawed-off snags during the brief exposures offered by the slide session. More negative reactions to the topped trees were heard from persons who visited the New Forestry stands in person. Therefore it may be advisable for snags in recreation destinations to be created in the least unnatural-looking manner that still meets wildlife and visitor safety objectives. Chainsaw-topped snags may be perfectly acceptable, however, in areas of brief public exposure or wherever selection systems are used.

Trails where such treatments are planned should either be little-used, newly constructed, or already traversing an area with recent timber harvests. Recreationists that repeatedly use certain places tend to develop attachments to those places that can resemble a sense of quasi-ownership (Mitchell, 1989); logging in such a setting may foster ill will even if all sides agree that timber harvest is a legitimate use for the land. However, promoting a "new" trail through a New Perspectives demonstration area -- whether the trail is truly new or simply not well-known -- can offer an opportunity to establish non-traditional silviculture as the status quo.

Protecting scenic quality may sometimes protect recreational quality as well, but silviculturists should consider other stand attributes that may be affordances for recreation experiences. One way to protect both scenic and recreational quality is to promote the "lack of human influence" factor in stands by installing gates or otherwise blocking motorized vehicle access to haul roads after harvest.

Strategic location of harvest units can enhance their later use as recreation sites. Skid trails can become paths for hiking, horseback riding, and mountain biking. Flat patch-cut units containing little debris can become campsites. During long-range planning of a network of recreational trails, the extremely high scenic quality of previously thinned stands can be exploited by locating thinning units in places where it is feasible to delay trail-building until the end of the planning period.

Public information strategies. Wherever practical, active programs of open houses and field tours should accompany implementation of New Forestry treatments. New Perspectives demonstration areas should be just that: areas where new practices are publicly demonstrated. Public information programs about New Forestry should stress on-site introductions to unfamiliar practices. These programs should be active, not passive; interpretive signs in harvest units can be helpful if funds are available, but this should not be the focus of an on-site information program. The Tennessee Valley Authority has placed signs at logging sites in its Land Between The Lakes multiple-use area since the 1970s, but researchers found that the signs and informational displays had done little to educate recreational visitors to the area about forestry practices (Burde and Lenzini, 1980).

Familiarity with a particular practice, setting attribute, or ecosystem type seems likely to produce higher ratings for uncommon or rarely viewed scenes[11]. New Forestry partial cuts would fall into that category. When Dearden (1984) asked people what *they* believed were the most important influences on scenic preferences,

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[11]However, Wellman and Buhyoff (1980) found no regional bias toward generic scenes of the Blue Ridge and Rocky Mountains, and Tips and Savasdisara (1986a) found no familiarity effect when Asians and Western tourists viewed the same slides. Similarly, this study found little connection between acceptability ratings and respondents' overall familiarity with Oregon forests.

past experience was listed most often. A single visit may provide the necessary amount of past experience. In a study of bog environments (which, like non-traditional forestry practices, are unfamiliar to most Americans), Hammitt (1981) found that photos were rated significantly lower in scenic quality by persons who saw them *before* their first visit to a bog than by those who rated the photos after their first visit.

In practical terms, field tours must be supplemented by other means of informing lay persons about New Forestry. It is highly unlikely that on-site opportunities will attract more than a fraction of the public, albeit the fraction that is most likely to take an active position regarding forestry practices. Supplementary efforts can take the form of open houses at agency or company offices, public service announcements, or as part of standard interpretive opportunities. Again, however, active attempts to convey the message are likely to be more effective than passive or reactive efforts. Results of this study clearly suggest there is value in informing people about the reasoning behind New Forestry before enduring negative attitudes toward those practices are formed. The scenic quality of a New Forestry stand is likely to be highest for people who know *why* they're seeing what they're seeing.

Directions for further research

This study has only begun to explore questions that will be increasingly important. We now know it is possible to develop silvicultural prescriptions to achieve biodiversity objectives while meeting visitors' standards for scenic or recreational quality. The differences between ratings of scenic quality and recreational quality underscore the need to consider what kinds of experiences visitors may seek in a stand when developing a prescription for that stand.

Several immediately useful New Forestry research projects are suggested by the findings of this pilot study. Possible research questions include:

1. **How does the size of harvest units influence judgments of scenic and recreational quality?** Harvest units in this study covered one-half, 17, and 45 acres. Limited evidence suggested that scenic quality was inversely related to unit size when evaluators had visited the stands and could assess their extent. It would be useful to know if this relationship holds true over a more complete size range. Is the relationship the same for hiking quality as for scenic quality? Is it linear, or is there an optimal point where reductions in unit size can produce the greatest net gain in acceptability? Addressing this question may be most critical at smaller unit sizes, since regeneration of shade-intolerant tree species may require openings larger than one-half acre.

2. **How does variation in snag creation methods influence judgments of scenic and recreational quality?** As discussed in Chapter 6, topping trees with a saw may produce excellent habitat for cavity nesters while producing poor habitat for campers, hikers, or scenery viewers. In areas of high scenic or recreational value, managers may prefer a snag creation method having less impact on those uses. They cannot choose the proper method without further research on public reactions to different creation methods and snag heights.

3. **How does variation in <u>season</u> influence judgments of recreational and scenic quality?** Attributes of forest stands undergo seasonal change, and it is almost certain that judgments of scenic and recreational quality would change as well. A few researchers have compared judgments of scenic quality over different seasons (Jacob, 1973; Koch and Jensen, 1988; Ruddell et al., 1989), but none has examined Northwest forests nor the range of silvicultural options found in the region. Very little research has been done on seasonal variation in recreation experiences anywhere. Seasonal differences in aerial views are also of interest, since the perceived extent of current timber harvests may be influenced by air passengers' reactions to harvest units visible from above.

4. **What are the scenic and recreational "recovery rates" for different New Forestry practices?** This study confirms previous research showing that scenic and recreational quality of traditionally managed stands improves with time after harvest (Rutherford and Shafer, 1969; Benson and Ullrich, 1981). Similar work is needed in stands where non-traditional practices are used.

5. **What are some of the <u>juxtapositional</u> effects of New Forestry on scenic quality?** Evidence from Phase 1 of this project suggested that the scenic quality of nearby stands influenced the scenic acceptability of non-traditional practices. Minimum fragmentation strategies under New Forestry are likely to produce different juxtapositional patterns than those currently seen in the region. Landscape-level studies of alternative silvicultural methods could help managers understand and predict these scenic impacts.

6. **How does variation in** **<u>viewer distance</u>** **influence judgments of scenic quality?** Hull and Buhyoff (1983) showed there is a non-monotonic relationship between viewer distance and scenic quality. In a mountainous region like the Pacific Northwest, managed forests can be seen from a variety of distances and vantage points. Negative effects of snag creation or woody debris loading may disappear as viewers move farther from a New Forestry stand. Positive benefits of patch-cutting may disappear as well. Knowledge about distance effects would help guide the choice of locations for demonstration sites in potentially sensitive viewsheds.

7. **How do scenic and recreational quality judgments vary for members of different** **<u>interest groups</u>?** Viewer reactions to photos of stands in Phase 2 were influenced by environmental group membership and frequency of forest recreation. Professional norms, belief about foresters' motives, familiarity, and other personal characteristics may influence ratings of scenic and recreational quality. Knowledge about those influences can help managers plan public information and public involvement strategies.

8. **How can** **<u>attitudes</u>** **toward New Forestry be measured?** The success of the New Perspectives program depends on its acceptance by persons having a range of interests, values, and objectives for forests. A well-designed attitude scale could be useful for evaluating the effectiveness of information and involvement strategies, as well as pinpointing aspects of non-traditional forestry that are viewed as especially beneficial or problematic.

9. **What <u>information</u> about New Forestry is most directly connected with judgments of scenic and recreational quality?** This study offers limited evidence that knowledge about New Forestry can enhance public perceptions of alternative silviculture, but the effect was only seen in the moderate (two-story) treatment. Further research on the information-attitude-acceptability linkage is necessary to identify messages that may have broader applicability than the one used here, and to identify the aspects of those messages that most directly influence public reaction to non-traditional practices.

10. **What <u>information strategies</u> can be used to introduce the public to New Forestry so that its affordances can be learned?** Since it is unlikely that most people will first encounter New Forestry through on-site visits, research can be useful in identifying off-site presentation methods that are best able to convey the various dimensions of New Forestry treatments. Such research might also examine the effects of repeated exposure to information about New Forestry on acceptability judgments.

Progress toward truly "integrated" forestry

A guiding premise of this research has been that the multiple-use management of America's forests requires new ways of accomodating a wider range of uses and users. Past multiple-use management followed a dominant-use model, whereby most uses were served only within the constraints imposed by a pre-eminent use (usually timber production). Now that the supply of forests has been outstripped by the demand for forest outputs, a simultaneous-use model is being advanced.

The new byword is "integrated" forestry, as exemplified by the New Perspectives initiative. In the forestry lexicon, this word which originally referred to a pest management strategy is now applied to any management framework that simultaneously addresses multiple uses of forest lands. Forest scientists have moved quickly to tackle integration questions, first looking for ways to produce timber and wildlife habitat (Salwasser and Tappeiner, 1981), but now seeking ways to maintain all ecosystem components ... all ecosystem components, that is, except one: the human presence.

Shepard (1990) notes that one of Gifford Pinchot's legacies to forestry is a preference for scientific solutions over political ones. As a rule, scientists are taught to exclude the human element from their work. This has fostered a tendency to limit the attention given to social values, not only in scientific inquiry about forests but also in management strategies. New Perspectives is a clear acknowledgement of that tendency and its unfortunate side effects. As the public becomes increasingly distrustful of science in general, a scientific solution like New Forestry may be viewed warily despite its best intentions.

Problems of this sort may require what Funtowicz and Ravetz (1990) call "post-normal science." They argue that whenever scientists debate an issue where the decision stakes are high or the systems uncertainties are great, scientific puzzle-solving cannot take place apart from wider societal and ethical issues. Political input cannot dominate the debate, but "outsiders" should be invited to help guide its terms.

The current debate over forest resource allocations in the Northwest has high stakes for both the ecosystem and society. The introduction of New Forestry into that debate adds great systems uncertainties. Political and social aspects of New Forestry should therefore be considered even as the new practices are being developed and tested. Put another way, integration is needed at the *scientific* level as well as the *management* level.

This may be accomplished in two ways. One is through direct public involvement in the scientific process, as Funtowicz and Ravetz (1990) suggest. This will be difficult to accomplish, but may prove especially useful in helping to guide the choice of questions that scientists ask first about New Forestry. Public acceptance of the answers is likely to be easier if the public has a sense of ownership in the questions.

The second way is by incorporating social science more completely into research designs. For example, the first five research questions outlined in the previous section could just as easily be applied to effects on bird habitat, pest management, growth and yield, and many other ecosystem components. An integrated forest science strategy should tackle all of those components simultaneously, with ornithologists, entomologists, biometricians, social scientists, and other specialists working side-by-side in the same stands.

One often hears these days that a scientific revolution is under way in forestry. If so, social concerns did a lot to spark that revolution. Social science can, and must, do a lot to implement it.

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APPENDICES

APPENDIX A: PHOTOGRAPHS USED IN SLIDE RATING STUDY

This appendix contains reproductions of the 36 slides shown during Phase 2 of this study. Three views of each of 12 treatments were chosen for the study, using a constrained random selection process (see Chapter 3). Three sets of the 36 slides were shown, one for each type of amenity use for which ratings were obtained.

Figure 6. Slide #1: Old growth

Figure 7. Slide #2: Old growth

Figure 8. Slide #3: Old growth

Figure 9. Slide #4: Traditional clearcut

Figure 10. Slide #5: Traditional clearcut

Figure 11. Slide #6: Traditional clearcut

Figure 12. Slide #7: 1990 thinning

Figure 13. Slide #8: 1990 thinning

Figure 14. Slide #9: 1990 thinning


Figure 15. Slide #10: Patch 1


Figure 16. Slide #11: Patch 1


Figure 17. Slide #12: Patch 1

Figure 18. Slide #13: Patch 2 (July)

Figure 19. Slide #14: Patch 2 (July)

Figure 20. Slide #15: Patch 2 (July)

Figure 21. Slide #16: Patch 2 (Aug.)

Figure 22. Slide #17: Patch 2 (Aug.)

Figure 23. Slide #18: Patch 2 (Aug.)

Figure 24. Slide #19: Snag retention (July)

Figure 25. Slide #20: Snag retention (July)

Figure 26. Slide #21: Snag retention (July)

Figure 27. Slide #22: Snag retention (Aug.)

Figure 28. Slide #23: Snag retention (Aug.)

Figure 29. Slide #24: Snag retention (Aug.)

Figure 30. Slide #25: Two-story (July)

Figure 31. Slide #26: Two-story (July)

Figure 32. Slide #27: Two-story (July)

Figure 33. Slide #28: Two-story (Aug.)

Figure 34. Slide #29: Two-story (Aug.)

Figure 35. Slide #30: Two-story (Aug.)

Figure 36. Slide #31: 1969-79 thinning

Figure 37. Slide #32: 1969-79 thinning

Figure 38. Slide #33: 1969-79 thinning

Figure 39. Slide #34: 1985 clearcut

Figure 40. Slide #35: 1985 clearcut

Figure 41. Slide #36: 1985 clearcut

APPENDIX B: ON-SITE SURVEY INSTRUMENT

This survey was given in a 12-page, 7 x 8½-inch, staple-bound booklet, with a cover printed on heavy green paper identifying it as part of a study of "Visitor Perceptions of Managed Forests," being conducted by the Department of Forest Resources at Oregon State University. The survey had two parts. Part 1 consisted of six one-page rating sheets, one for each site. Instructions for Part 1 are printed below, and an example of the rating sheets is given on the next page. Part 2, to be completed after the sixth site had been evaluated, asked for ratings of the importance of stand attributes for each kind of quality, as well as some personal data. Instructions, an example of the attribute importance scales, and the personal data page are shown on the final two pages of this appendix.

PART 1

This part of the survey will help us learn more about how people perceive managed forest stands. The questions on each of the following six pages are the same, and one page should be completed at each of the sites we visit.

SITE NO. __

For each of the descriptive words or phrases below, please tell us if you agree or disagree that it describes this particular site.

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
Bright	1	2	3	4	5
Pleasant-smelling	1	2	3	4	5
Monotonous	1	2	3	4	5
Abundant bird life	1	2	3	4	5
Colorful	1	2	3	4	5
Dead or dying trees	1	2	3	4	5
Quiet	1	2	3	4	5
Foot traffic only	1	2	3	4	5
Abundant wildflowers	1	2	3	4	5
Unusual	1	2	3	4	5
Damp	1	2	3	4	5
Has flat places	1	2	3	4	5
Cool	1	2	3	4	5
Good trail/road	1	2	3	4	5
Has distant vistas	1	2	3	4	5
Natural	1	2	3	4	5
Steep	1	2	3	4	5
Lack of bugs	1	2	3	4	5
Closed-in	1	2	3	4	5
Has good places to stop and rest	1	2	3	4	5

Are there any other words or phrases you would use to describe this site? ____

Now we'd like you to rate the quality of this site. As you circle the numbers of your site ratings, think about only the immediate location. Do not consider factors not directly related to the site such as the distance from your home, availability of parking, etc.

How would you rate the scenic quality of this location?

-4 -3 -2 -1 0 1 2 3 4

<--unacceptable---------+-------------acceptable-->

How would you rate this location as a place for you to hike?

-4 -3 -2 -1 0 1 2 3 4

<--unacceptable---------+-------------acceptable-->

How would you rate this location as a place for you to camp?

-4 -3 -2 -1 0 1 2 3 4

<--unacceptable---------+-------------acceptable-->

PART 2

The questions in the rest of this survey will help us learn more about how you use and how you feel about forests. Please try to answer each one. Any unanswered questions can reduce the overall value of your responses.

For each of the descriptive features below, please tell us how important each one was when you rated the scenic quality of the locations we visited.

1 - not at all important
2 - slightly important
3 - important
4 - very important

Brightness	1	2	3	4	Dampness	1	2	3	4
Pleasant odors	1	2	3	4	Having flat places	1	2	3	4
Monotonousness	1	2	3	4	Coolness	1	2	3	4
Abundance of birds	1	2	3	4	Trail/road quality	1	2	3	4
Colorfulness	1	2	3	4	Distant vistas	1	2	3	4
Dead or dying trees	1	2	3	4	Naturalness	1	2	3	4
Quietness	1	2	3	4	Steepness	1	2	3	4
Foot traffic only	1	2	3	4	Lack of bugs	1	2	3	4
Abundance of flowers	1	2	3	4	Enclosedness	1	2	3	4
Unusualness	1	2	3	4	Good places to rest	1	2	3	4

Are there any other features which you believe are important when judging scenic quality?

____

____

We can understand the results of this survey better if we know a little bit about you. Your answers to these questions will be used only for this study, and individual responses will not be revealed.

1. How old are you? _________ years old

2. What is your ZIP code? ____________

3. About how many years of your life have you lived in places where forests are intensively managed to produce timber?
   About ______ years

4. How often do you visit forests during your leisure time?
   ___ Very frequently, at least once a week on average
   ___ Somewhat frequently, at least once a month on average
   ___ Occasionally, several times a year
   ___ Rarely, no more than once or twice a year

5. When you visit forests, what recreation activities do you most like to take part in? (check no more than three)
   ___ Viewing scenery ___ Bicycling ___ Nature study
   ___ Hiking ___ Picnicking ___ Hunting
   ___ Camping ___ Birding ___ Berry picking
   ___ Other (Please specify ________________________________)

6. Have you visited the Lewisburg Saddle area before?
   ___ No -----------> please skip to question #8 below
   ___ Yes

7. If yes, how long have you been visiting Lewisburg Saddle?
   About _______ years

8. Have you ever worked in the wood products industry or the forestry profession?
   ___ No
   ___ Yes (If so, doing what? ______________________________)

9. Do you belong to any environmental organizations?
   ___ No
   ___ Yes (If so, which one(s) ______________________________)

APPENDIX C: SLIDE RATING SURVEY INSTRUMENT

This survey was given in a 10-page, 8½ x 11-inch, staple-bound booklet with a cover printed on heavy yellow paper identifying it as part of the "Visitor Perceptions of Managed Forests" study being conducted by the Department of Forest Resources. Each page had space for rating 12 scenes, so that three pages were used for each tray of slides. The first page is duplicated here as an example. Also shown is page 10, which asked for personal data.

Use this page to rate the **SCENIC QUALITY** of the forest stands shown in these slides. (Circle the number that best fits your judgment.)

SCENE #1 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #2 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #3 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #4 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #5 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #6 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #7 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #8 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #9 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #10 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #11 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

SCENE #12 -4 -3 -2 -1 0 1 2 3 4
<--unacceptable---------+-------------acceptable-->

We can understand the results of this survey better if we know a little bit about you. Your answers to these questions will be used only for this study, and individual responses will not be revealed.

1. How old are you? ____________ years old

2. What town do you consider to be your hometown? (In other words, when you meet someone new, what place are you most likely to say you're from? This may be your current residence, or somewhere you've lived previously.)
   CITY: ________________________________ STATE: __________

3. How long have you lived in the Willamette Valley area?
   About __________ years

4. Where did you spend the greatest portion of your childhood?
   ___ Willamette Valley ___ Eastern Oregon
   ___ Metropolitan Portland ___ Washington state
   ___ Elsewhere in Western Oregon ___ California
   ___ Other state or country (which one? __________________)

5. How often do you visit forests during your <u>leisure time</u>?
   ___ Very frequently, at least once a week on average
   ___ Somewhat frequently, at least once a month on average
   ___ Occasionally, several times a year
   ___ Rarely, no more than once or twice a year

6. How often do you visit forests as part of your <u>work</u>?
   ___ Very frequently, at least once a week on average
   ___ Somewhat frequently, at least once a month on average
   ___ Occasionally, several times a year
   ___ Rarely, no more than once or twice a year

7. When you visit forests, what is the <u>one</u> recreation activity that you <u>most like to</u> take part in?
   ___ Viewing scenery ___ Bicycling ___ Fishing
   ___ Hiking ___ Picnicking ___ Hunting
   ___ Camping ___ Birding ___ Berry picking
   ___ Other (which one? ________________________________)

8. Do you belong to any environmental organizations?
   ___ No
   ___ Yes (which one(s)? ______________________________)

9. Have you ever had any prior education or training in forestry?
   ___ No, I have never completed a class in forestry
   ___ Yes, I have completed <u>one</u> class in forestry
   ___ Yes, I have completed <u>several</u> forestry classes
   ___ Yes, I have a degree in forestry

APPENDIX D: INSTRUCTIONS TO SUBJECTS FOR RATING SLIDES

General instructions

I'm going to read some standardized instructions, so that everyone participating in these experiments will have the same information.

America's forests are the focus of increasing controversy. People attach many different kinds of values to forests, and scientists are looking for ways to manage forests without reducing their quality for all those values. With this research, we want to learn more about how people judge the scenic and recreational quality of forests that are managed in different ways.

I'm going to show you some color slides of forest scenes. I'd like you to rate each scene according to how acceptable or unacceptable you think it is for scenic viewing or recreation. As you make your ratings, please think about the location where the slide was taken, rather than the photographic quality of the slide.

The first few slides will be shown very quickly, just to give you an idea of the kinds of areas you'll be evaluating. Try to imagine how you'd rate them on a scale like the one in your survey booklet. Note that the scale runs from minus-4, meaning the stand is very unacceptable, through 0, neither acceptable nor unacceptable, to plus-4, which is very acceptable.

After the preview slides, I'll announce that you should begin judging the first set of slides. For each slide, we'd like you to judge the scenic quality of the location where the photograph was taken. Some of the scenes may look very similar, but each one is unique in some way. At the end of the set of slides, I'll change slide trays. Then I'll ask you to rate the same scenes again, but this time we want to you to judge how acceptable each one is as a place to hike. Finally, I'll ask you to rate the scenes once more, this time judging each location as a place to camp.

Are there any questions? [Procedural questions should be answered by repeating the instructions. Answers to other questions may be deferred until after the experiment is completed.]

[Insert snag message or New Forestry message here. Control group proceeds directly to the preview slides.]

Now let's look at the preview slides. Do not rate these slides. Just use them to get an idea about the range of scenes. [Show for 3 sec. each.]

Now, we'll begin the ratings. Please judge the following slides for their scenic quality, using the acceptability scale on pages 1-3 of your survey booklet. To help you keep track of which scene you're rating, the number of each scene will be shown before the slide itself. [Show for 8 sec. each.]

That's the end of the first set of slides. Now I'm going to show you the same scenes, but in a different order. This time, please rate each stand for how acceptable it is as a place for you to hike. You should now be on page 4 of your survey booklet. I'll show these slides a little more quickly, so we can finish sooner. [Show at 5 sec. per slide.]

That's the end of the second set of slides. Now I'm going to show the third tray of slides. This time, we'd like you to rate each scene for how acceptable it is as a place for you to camp. [Show at 5 sec. per slide.]

That's all of the slides. Before handing in your survey, we'd like you to answer a few more questions, which you'll find on the last page of the booklet. Thank you very much for your help with this project.

Snag message

Before we look at the preview slides, I'd like to tell you more about the kinds of forestry practices that are being studied in the Pacific Northwest. What I'm going to say may be familiar to some of you, but others of you may be hearing it for the first time.

Death and decay are important natural processes in the forests of the Pacific Northwest. Many trees die because they cannot compete with their neighbors for light, water, or nutrients. Some that are not killed outright are weakened so that they succumb to attacks by insects or disease. Others may be killed by events such as fire, windstorms, landslides, or volcanic eruptions.

Often these trees do not topple when they die, as would happen during a timber harvest. Instead they may remain standing for years, even decades. Such standing dead trees are called "snags." Increasingly foresters are trying to manage forests in ways that acknowledge the vital role snags play in a natural forest ecosystem.

Because snags are almost always present in natural forests, they are important to a wide range of animal species. In the forests of the Pacific Northwest, more than 50 species of birds or mammals <u>depend</u> on cavities in snags during all or part of their life cycles. Tree cavities offer animals a place to sleep, rest, store their food, and rear their young. Cavities are dry, warm in winter, and cool in summer. Some of the animals that use cavities in our forests are woodpeckers, bats, raccoons, bears, and honeybees.

Animals use snags in many other ways, too. Birds that don't nest in <u>cavities</u> may build their nests <u>elsewhere</u> on snags, such as a broken treetop. Hawks often perch near the tops of snags as they search for prey, and snags may be used for roosting, courtship, or escape from predators.

Many smaller creatures live in snags, too. Insects and fungi provide food for larger animals, and at the same time they feed on the snags themselves as part of the natural decay process. When snags decay, they gradually soften until they crumble or fall over. These decayed snags and logs provide nutrients that can be used by growing trees, and so the cycle of life is continued.

Different animals use snags at different stages in the decay process. That means a forest can support more wildlife species if it has a <u>variety</u> of snags at different stages of decay. Modern practices have reduced the quantity of snags in many forests. As a result, these forests may not be able to support as many different kinds of wildlife as they once did. Researchers are now looking for ways to manage forests for wood products while retaining snags to protect biological diversity.

The number of snags in managed forests can be increased by harvesting trees at older ages, leaving portions of stands unharvested, creating snags artificially, or leaving snags behind after harvest. Future foresters will probably use all four methods, often in combination. When harvest is delayed, or if partial cutting is used, nature can be relied upon to create snags over time. But in some cases, more direct action may be needed.

It's best if existing snags are left alone during logging. But that can be dangerous, since softened snags are more likely than live trees to be knocked over unexpectedly during harvest operations. If snags must be removed to protect loggers' safety, or if the supply of existing snags is low, live trees can be turned into snags later on. This may be done by injecting herbicides, girdling bark, or sawing or blasting tops off. A few live trees may also be left behind to provide a source of more snags if needed later on. That way, snags in different stages of decay can be present until the new stand produces enough natural snags of its own.

New Forestry message

Before we look at the preview slides, I'd like to tell you more about the kinds of forestry practices that are being studied in the Pacific Northwest. What I'm going to say may be familiar to some of you, but others of you may be hearing it for the first time.

The forests of the Pacific Northwest are constantly changing. Some of that change is man-made, created by America's increasing demand for lumber, paper, home sites, outdoor recreation, and other products of the forest. But forests change naturally, too. Fires, landslides, wind storms, insect attacks -- all are part of the natural order. Old forests die, and new forests take their place. And at each stage of its life cycle, a forest provides habitat for a different set of animals, plants, and micro-organisms.

Foresters have known for a long time that forests are subject to natural disturbances. Practices such as clearcutting were developed to mimic the natural cycle while taking commodities out of the woods. Logging and controlled burning create excellent conditions for new stands of Douglas-fir, just as lightning-caused fires do. By planting new trees, instead of waiting for them to sprout naturally, foresters try to speed up the natural process while ensuring there will be a future source of wood products.

Practices like clearcutting mimic simple patterns of disturbance. But scientists are discovering that the natural disturbance patterns in Northwest forests are actually quite complex. So while the standard practices are good for growing trees, they may not be so good for growing forests. As a result, foresters are considering new practices that can mimic these more complex disturbance patterns.

To understand the difference, let's use the example of a forest fire. Clearcuts mimic a fire that burns so fiercely it destroys everything in its path. But it turns out most fires don't do that. Fires burn at different intensities. Even the hottest fire leaves behind standing dead trees called "snags." A moderately intense fire may kill some trees, but older or stronger ones survive. The remaining snags and live trees provide shade, shelter, and refuges for small creatures that may not be able to move from the burned areas to nearby areas of mature forest. Fires also leave behind large logs on the forest floor that can store water, provide habitat for animals, reduce erosion, and pump nutrients into the soil as they slowly decompose. These features of natural fires aren't found in traditional clearcut.

Disturbances also come in different sizes, from thousands of acres to a few square feet. Large, hot fires can disturb a lot of area, but they happen only rarely. Cooler fires that spare large trees occur more often. Even more frequent are smaller disturbances, such as winter blow-downs or outbreaks of root rot, that kill a few trees and open up small gaps in the forest for new growth. The most common disturbances of all are the deaths of single trees. These natural, small-scale disturbances aren't simulated by most traditional harvest methods, which typically disturb between 20 and 100 acres at a time.

Soon you may be seeing evidence of <u>new</u> forest practices that mimic a much broader range of natural disturbances. When clearcuts are made, loggers can leave behind a few live trees, dead snags, and fallen logs to lay the foundation for a recovering forest ecosystem. Other timber harvests may leave behind as much as one-third of the mature trees to simulate a cooler kind of fire. Or instead of a single 50-acre clearcut, you might see 25 "patch cuts" of a couple acres each. Helicopters might even be used to lift out individual trees of high value without disturbing the surrounding forest. Practices like these may be able to protect the biological diversity of our forests, while still providing the other products that forests can supply.

APPENDIX E: MEAN DESCRIPTOR RATINGS

This appendix contains graphical representations of the descriptor scale responses given in Phase 1. (See Chapter 5 for a discussion of these ratings). Four different groups of study participants visited the six sites on McDonald Forest: a group organized by the Crescent Valley High School athletic booster club, a group organized by the Zion Lutheran School Parent-Teacher League, a group of students from an introductory outdoor recreation class, and a group of students from a class on social behavior in recreation settings. Ratings are depicted here in the same order in which sites were visited during the study.

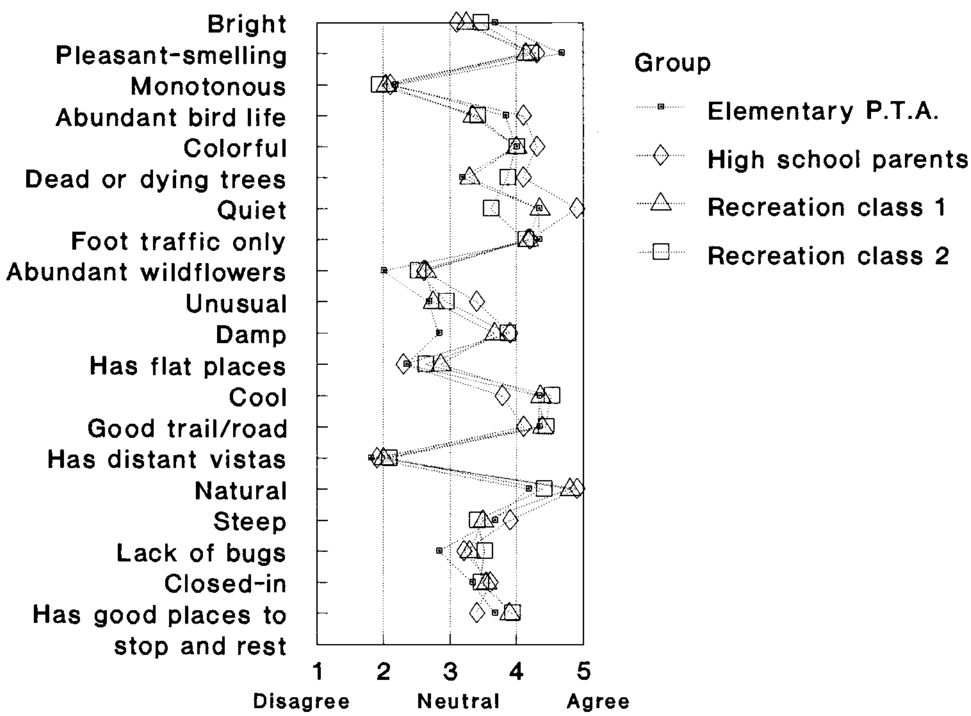

Figure 42. Descriptor ratings for old growth stand

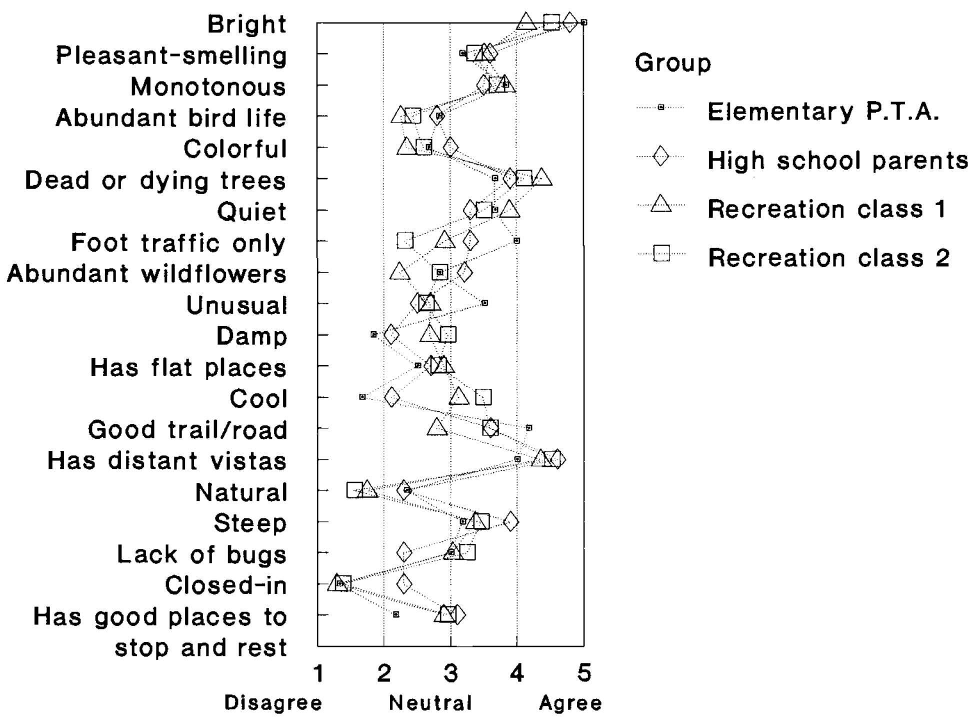

Figure 43. Descriptor ratings for traditional clearcut

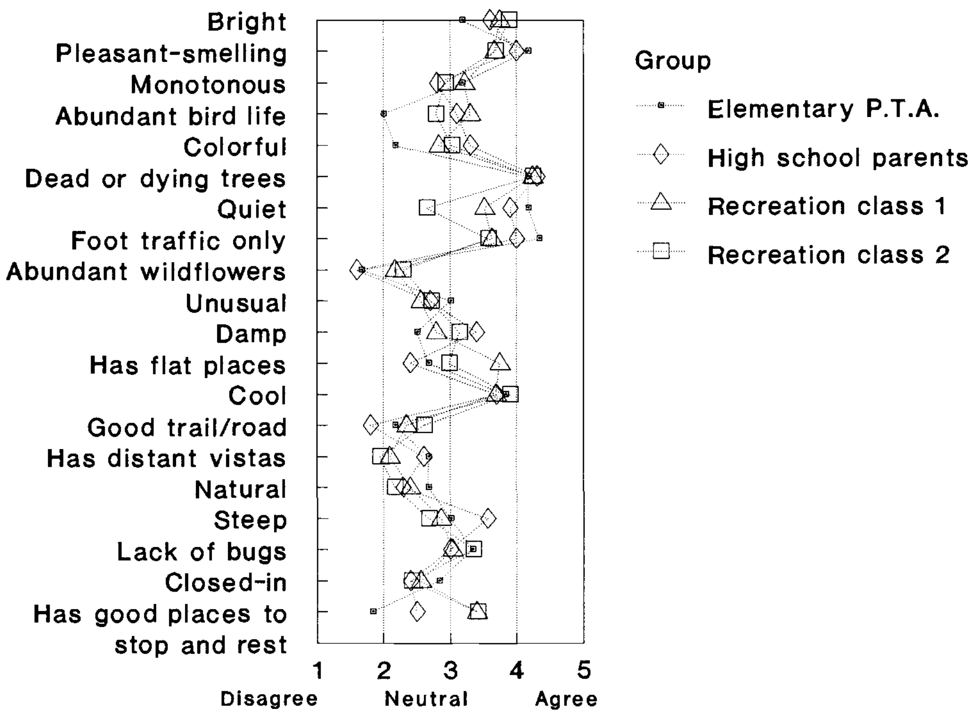

Figure 44. Descriptor ratings for 1990 thinned stand

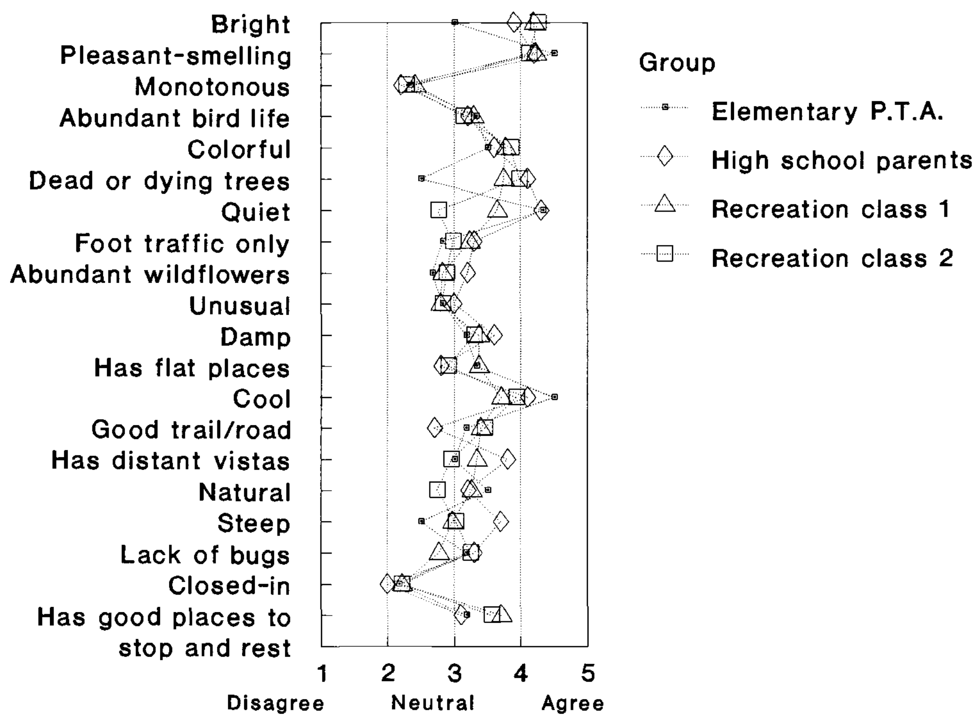

Figure 45. Descriptor ratings for patch cut stand

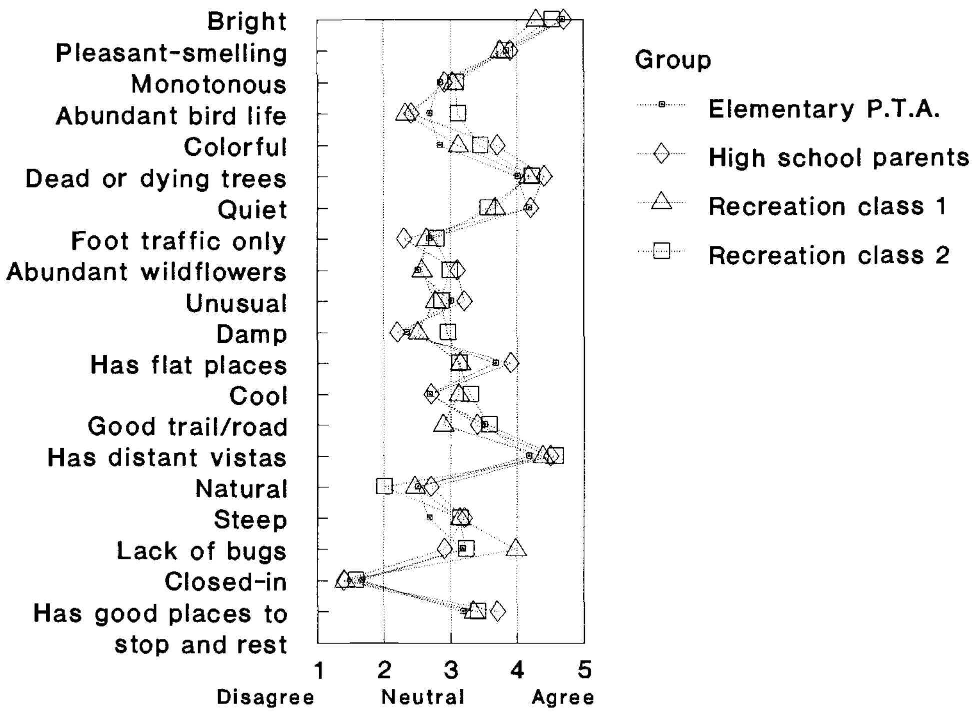

Figure 46. Descriptor ratings for snag retention clearcut

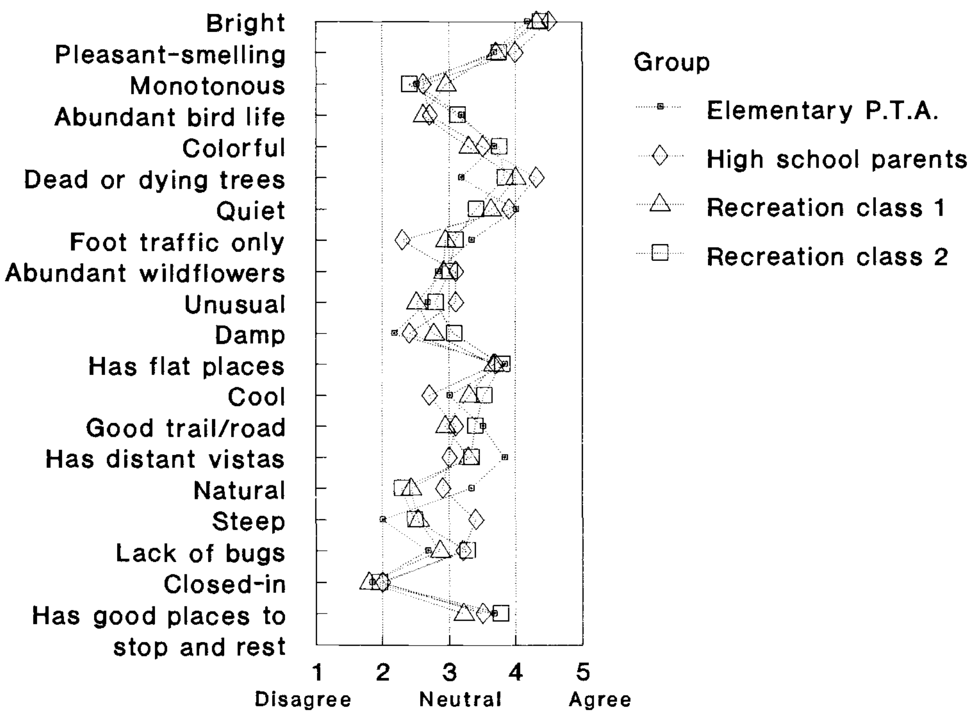

Figure 47. Descriptor ratings for two-story stand

APPENDIX F: FACTOR ANALYSES OF DESCRIPTOR RATINGS

To better understand the linkages between site attributes and acceptability judgments, factor analyses were performed on the matrices of descriptor ratings shown in Appendix E. These analyses were used in creation of empirically based subscales representing the perceived dimensions of forest stands (see Chapter 5 for details). Results of the factor analyses are shown in this appendix.

Table 16
Factor analysis (varimax rotation): Old growth

	FACTORS							
Descriptor	1	2	3	4	5	6	7	8
Colorful	.47	.27	.18	.02	.02	.15	.22	.12
Foot traffic only	.56	-.18	-.08	-.22	-.07	-.17	.04	-.08
Good trail/road	.40	.29	.20	-.05	.36	.11	-.05	.25
Pleasant-smelling	.53	-.01	-.01	.01	.21	.08	.18	-.16
Quiet	.40	-.04	-.08	.04	-.09	.01	-.03	.08
Has flat places	-.10	.72	.08	.07	.06	.11	.04	-.21
Steep	-.02	-.55	.05	.31	.12	.13	.11	-.04
Abundant wildflowers	.01	.06	.59	.02	.07	.15	.07	-.05
Has distant vistas	-.04	-.09	.63	-.12	.03	-.10	-.25	.12
Places to stop/rest	.22	.35	.41	.10	.05	-.06	-.04	.08
Bright	.27	.26	.11	-.43	.16	.11	.16	.08
Closed-in	-.07	-.11	-.23	.63	-.03	-.06	-.04	.09
Damp	-.09	.08	.20	.53	.09	-.04	.28	-.16
Natural	.31	.00	.06	.46	.07	.26	-.17	.00
Cool	-.04	-.04	.07	.04	.90	-.02	-.04	.04
Abundant bird life	.19	.03	.18	.02	-.09	.53	.16	.06
Lack of bugs	.15	.02	.11	.05	-.08	-.63	.02	.24
Dead or dying trees	.12	-.07	-.12	.03	-.05	.08	.74	.00
Monotonous	-.06	-.02	-.01	.01	.06	-.15	-.04	.64
Unusual	.17	-.24	.16	.05	.00	.08	.07	.33

Eigenvalues: 2.90, 1.96, 1.87, 1.75, 1.42, 1.19, 1.15, 1.13
Variance explained: 89.4%

Table 17
Factor analysis (varimax rotation): Traditional clearcut

Descriptor	FACTORS 1	2	3	4	5	6	7	8
Abundant bird life	.54	.12	.09	.20	.06	.15	-.12	.01
Abundant wildflowers	.82	-.05	-.12	-.26	-.14	.04	.05	.06
Colorful	.62	.02	.44	.08	-.11	.00	-.19	.12
Places to stop/rest	.45	.16	.06	.38	.20	-.17	.07	.02
Good trail/road	.36	-.16	-.02	.09	.08	.05	.01	-.23
Cool	-.01	.63	.16	.00	.27	-.12	.15	-.00
Damp	.04	.66	-.00	.08	-.00	.09	-.00	.04
Lack of bugs	-.16	.33	-.15	.16	.29	-.15	-.31	.12
Natural	.05	-.12	.53	.16	.02	.18	-.07	-.13
Pleasant-smelling	.19	.03	.46	-.02	-.17	-.02	.11	-.05
Quiet	-.15	.17	.47	-.02	.11	-.01	.06	-.01
Foot traffic only	.27	-.19	.26	.37	.01	.14	.02	-.07
Has flat places	.01	.02	.03	.60	.03	.01	-.12	-.03
Monotonous	-.19	-.04	-.17	-.39	.15	-.12	-.08	.01
Bright	.00	-.16	.02	.08	-.75	-.01	.01	-.00
Closed-in	.11	-.00	.09	.02	-.03	.87	-.01	-.04
Dead or dying trees	-.26	-.11	.03	.19	.20	-.07	.56	.09
Steep	.03	.17	.03	-.21	-.11	.02	.59	-.00
Has scenic vistas	.20	-.06	-.11	.01	-.07	.01	-.04	.75
Unusual	.15	-.10	.04	.12	-.12	.05	-.08	-.28

Eigenvalues: 2.81, 2.28, 1.72, 1.58, 1.29, 1.25, 1.11, 1.06
Variance explained: 90.2%

Table 18
Factor analysis (varimax rotation): Thinning

Descriptor	FACTORS 1	2	3	4	5	6	7	8
Cool	.63	.21	-.02	.07	.05	-.10	.08	.06
Damp	.77	-.13	.05	.03	-.01	-.00	-.14	.04
Abundant bird life	.04	-.47	.03	.07	.21	.35	.13	.06
Dead and dying trees	.05	.70	-.00	-.11	-.04	.04	-.07	.13
Bright	-.22	.14	.47	.29	.10	.24	.16	-.30
Closed-in	.07	.01	-.47	.00	-.25	.15	.09	.10
Colorful	.18	-.27	.43	.04	.09	.09	.06	.30
Monotonous	-.08	-.01	-.61	.08	.06	-.11	-.12	-.15
Foot traffic only	-.03	.18	.19	-.33	.22	-.13	.17	.17
Good trail/road	.02	-.14	.00	.63	.03	-.12	-.02	-.01
Natural	.23	.31	.06	.45	-.08	.08	.25	.25
Has flat places	.10	-.02	.11	.06	.62	.18	.11	-.04
Places to stop/rest	.31	-.21	.04	.35	.36	.10	.23	.13
Steep	.09	.11	-.02	.10	-.61	.09	.26	-.02
Lack of bugs	.10	.03	-.04	.09	-.05	-.76	.04	.06
Has distant vistas	-.08	-.08	.22	.17	-.19	-.08	.47	.08
Quiet	.08	.08	-.05	-.22	.04	.10	.61	.05
Pleasant-smelling	.00	-.12	.08	.07	.01	-.04	.27	.13
Abundant wildflowers	.11	-.31	.21	.21	.02	.38	-.09	.51
Unusual	.03	.15	.01	-.02	-.01	-.07	.02	.53

Eigenvalues: 2.60, 2.01, 1.76, 1.65, 1.44, 1.36, 1.24, 1.08
Variance explained: 89.2%

Table 19
Factor analysis (varimax rotation): Patch cut

Descriptor	FACTORS 1	2	3	4	5	6	7	8
Good trail/road	.51	.18	.11	-.04	.28	.05	-.16	.05
Has distant vistas	.44	-.02	.00	.29	-.08	-.35	.05	.11
Places to stop/rest	.75	.05	.04	.03	.07	.12	.16	.02
Abundant bird life	.15	.66	.06	-.08	.03	.06	-.01	-.02
Abundant wildflowers	-.06	.66	.16	.00	-.02	-.02	.13	-.01
Colorful	.29	.45	.09	.24	.07	.32	.12	.21
Monotonous	-.02	-.24	-.59	-.25	-.10	-.12	-.18	.09
Natural	.40	-.17	.45	.17	-.11	-.02	.24	-.27
Pleasant-smelling	.05	.11	.64	.13	.08	-.10	.00	.11
Cool	.14	-.16	.11	.58	.01	-.20	-.04	-.17
Damp	.02	.07	.11	.64	.04	.08	.12	.14
Has flat places	.07	-.03	.14	.07	.61	.02	.18	.07
Steep	.00	-.05	-.00	.02	-.72	.15	.07	.18
Closed-in	.06	.11	-.07	-.17	.03	.49	.13	.01
Unusual	.03	-.05	.04	.11	-.22	.48	-.13	.01
Foot traffic only	.23	.03	.09	.03	.12	.18	.56	-.11
Lack of bugs	.25	-.35	-.06	.07	-.03	.24	-.44	-.07
Quiet	-.00	.11	.16	.25	-.04	-.11	.36	-.10
Bright	.15	.07	.22	-.26	.11	-.18	.03	.32
Dead or dying trees	.02	-.03	-.05	.07	-.13	.05	-.12	.68

Eigenvalues: 3.03, 2.01, 1.75, 1.67, 1.48, 1.17, 1.15, 1.08
Variance explained: 89.2%

Table 20
Factor analysis (varimax rotation): Snag retention clearcut

Descriptor	FACTORS 1	2	3	4	5	6	7	8
Abundant bird life	.75	.16	-.04	-.02	.00	-.05	.12	.13
Abundant wildflowers	.47	-.11	-.03	-.05	-.02	.00	-.02	-.04
Colorful	.56	.09	-.02	.21	.16	.44	.13	-.13
Monotonous	-.29	.09	-.07	-.08	.00	-.11	.01	.08
Cool	-.02	.77	.00	.18	.08	-.05	.11	-.09
Damp	-.02	.77	-.08	-.04	.01	.05	-.05	.12
Lack of bugs	-.13	.29	.09	.01	-.24	.22	-.02	-.20
Quiet	-.26	.26	.30	.18	.04	.14	.27	.13
Foot traffic only	.19	.07	.75	.03	.07	-.05	-.18	-.05
Good trail/road	.22	.16	-.52	-.10	.10	.08	.02	.08
Natural	.15	-.04	.45	.04	.37	.41	.17	-.18
Has flat places	-.07	-.13	.00	-.62	-.17	.31	.14	.22
Steep	.01	.04	.15	.81	.00	.20	-.00	.17
Closed-in	.18	.10	.12	.10	.71	-.03	.07	.05
Has distant vistas	.22	.02	-.05	.01	-.38	.09	-.00	.02
Unusual	.05	-.05	-.20	.04	.40	.21	-.12	-.05
Places to stop/rest	.09	.03	-.07	-.02	-.05	.69	.02	.03
Bright	.14	-.13	.08	-.03	-.27	.05	.28	.08
Pleasant-smelling	.05	.09	-.18	-.08	.03	.03	.79	-.00
Dead or dying trees	-.07	.02	-.09	.03	-.04	-.01	.04	.81

Eigenvalues: 2.49, 2.11, 1.95, 1.65, 1.44, 1.32, 1.23, 1.05
Variance explained: 91.0%

Table 21
Factor analysis (varimax rotation): Two-story

Descriptor	FACTORS 1	2	3	4	5	6	7	8
Cool	.88	.15	.02	-.01	-.08	-.05	-.01	.03
Damp	.55	.10	.09	-.02	.23	.07	.16	-.05
Good trail/road	.27	-.19	.21	.02	.08	-.07	.18	.15
Foot traffic only	.01	.55	-.06	.09	.20	-.17	.01	-.09
Natural	.07	.70	.11	.01	-.17	-.16	-.04	-.00
Quiet	.14	.40	-.04	.00	.04	-.03	.18	.06
Abundant bird life	.23	-.09	.40	.30	.29	-.13	-.11	.05
Abundant wildflowers	.02	.05	.68	.23	.02	-.06	-.15	.15
Has distant vistas	.10	-.09	.49	-.12	.09	-.11	.23	-.20
Bright	-.13	.09	.07	.78	-.01	-.10	-.01	-.03
Pleasant-smelling	.21	.03	.12	.47	-.06	.04	-.24	.26
Has flat places	.02	.09	.19	.19	.57	.03	.24	.07
Steep	-.11	.11	-.01	.22	-.71	.12	.07	.15
Monotonous	-.05	-.10	-.07	-.22	-.09	.81	.05	-.05
Dead or dying trees	.09	-.23	-.19	.21	-.05	.47	.13	-.04
Closed-in	-.06	.27	-.10	.08	.03	.37	-.04	.30
Lack of bugs	.10	-.06	-.08	-.10	.02	.13	.67	.04
Places to stop/rest	.07	.22	.37	-.02	.29	-.13	.46	.12
Colorful	.33	.18	.31	.04	.09	-.07	-.22	.47
Unusual	-.03	-.11	.00	.04	-.08	-.02	.15	.64

Eigenvalues: 2.96, 2.11, 1.80, 1.76, 1.41, 1.25, 1.11, 1.01
Variance explained: 90.1%