AESTHETIC JUDGMENTS OF FOREST TREES IN RELATIONSHIP TO TIMBER QUALITY

by

PIETER JAN BEKKER

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Department of Parks & Forest Recreation Resources

The University of British Columbia
2075 Wesbrook Place
Vancouver, Canada
V6T 1W5

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Abstract

This study explores the relationship between timber quality and aesthetic quality of forest trees, in hope of uncovering criteria with which both timber management and forest aesthetics may be realized on the same land base. Findings may also apply to exclusive use recreation forests.

Twenty-four mature trees, growing along a wilderness trail in British Columbia, were selected according to three timber quality classes and paired so that all possible combinations of the quality classes were evenly represented. Wilderness recreation users were asked to judge the attractiveness of the trees, select the one tree of each pair they preferred, and give reasons for their preference.

Study results showed a positive relationship existed between timber quality and aesthetic quality. However, while the timber quality classification did aesthetically differentiate between good and poor timber quality trees, the classification could not, with any consistency, aesthetically differentiate between good and average timber quality trees, or similar timber quality trees. Tree height was also positively related with aesthetic quality, and could distinguish the preferred trees three of the four times that timber quality could not. It therefore was more accurate than timber quality in assessing the aesthetic quality of forest trees.

Reasons for tree preference most often chosen were: more balanced, straighter trunk, fewer dead trunk branches and more attractive background scenery.

Variety both within and between stands, and the retention of some tall trees may, where important to the good husbandry of provincial forest lands, contribute considerably toward increasing the compatability of timber management and forest aesthetics.

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CHAPTER I. INTRODUCTION

The Problem

If timber management and forest recreation trends continue, conflicts between them will also continue to occur. These conflicts arise because in most cases timber management and forest recreation are viewed as being incompatible (Noyes, 1966; Rickard et al., 1967; Rudolf, 1967). The aversion many forest recreationists have of forest stands managed primarily for wood production is indicative of such a view. Instead they seek wild or natural-looking forest land to recreate in, in part because the aesthetically pleasing forest stands found there enhance their recreation experience (Brush, 1978; Cook, 1971; Sieker, 1955).

People demand and receive productive forest land for the exclusive use of recreation (Cook, 1971; Dooling, 1978; Fritz, 1967). History suggests that this is a necessary step in protecting the aesthetic value of forest recreation areas. "Historically, the forest park movement in America originated and derived its strength from the fact that exploitation of forest and range lands commonly -- and indeed typically -- left desolate, unsightly wastes unproductive of commodity or beauty" (Show, 1937, p. 214).

Today, an environmentally aware public sees many forestry practices that detract from the visual quality of the landscape. For example, they see that large tree monocultures diminish the natural diversity of a landscape, and that indiscriminate clearcutting leaves visual scars where none should be (Warden, 1971). Such practices have led to the view that regardless of the economic values, "if high recreation values are present, utilization must be forgone" (Show 1937, p. 215).

There is a real need for forest parks and wilderness areas. However, "it is not enough to identify five or even ten per cent of natural resources as protected park land, for it is our treatment of the ninety or ninety-five per cent of our land and water resources which will largely determine the quality and extent of recreational opportunity and the image of [British Columbia] to the outside world as a desirable place or otherwise to visit and recreate in" (B.C. Ministry of the Environment, 1979, p. 72).

Forest beauty should not stop at the boundary of a forest park, but extend into the forest regions of British Columbia and elsewhere. It should be seen in forests close to public highways, settlements, and tributary to logging road access and water systems opened up by this access (Marshall, 1974). In these areas the forest should be regarded not only as a timber resource, but as part of the human environment, a place (Twiss, 1969).

The appearance of the forests in such places should reflect the desires of the many and increasing number of people visiting them, if only in recognition that by far the greater part of British Columbia's forest lands belongs to the public (Warden, 1971).

Can forest stands be grown and managed so that timber and forest recreational values are concurrently realized? Does economic use necessarily destroy a forest's beauty? These questions point to the basic problem of blending timber management and forest aesthetics. In many publications silviculture, defined as the art of producing and tending a forest (Smith, 1962), is recommended to solve this problem (Cromie, 1937; Koehler, 1922; McDonald and Whiteley, 1972; Neff, 1965; Rudolf, 1967; Rosencrans, 1957; Hough, Stansbury and Associates, Ltd., 1973). However, such publications proclaim the authors' intuitive judgments, personal tastes and subjective standards, and are not based on user preferences (Lime, 1972). As a result, forest managers who either follow the recommended silviculture methods or their own tastes when integrating recreation into the management scheme, may not be pleasing the recreating public to the extent they could. The reason: their taste in forest scenery may differ from that of the recreationists (Buhyoff et al., 1978; Clark et al., 1971; Hendee and Harris, 1970; Kaplan, 1973; Lime, 1972; Peterson, 1974).

More particularly, the educational training most managers receive seems to introduce bias in their perception (Kaplan, 1973). The point is that mangers cannot assume that there is a good fit between their preferences and those of the recreating public. Therefore, if the goal is to create a high quality environment in which to recreate, managers should compare their views with those most affected by their decisions (Buhyoff, 1978; UNESCO, 1973).

To address the problem of blending timber management and forest aesthetics -- aesthetics as judged by on-site users -- perhaps the best place to start looking for answers is at the basic component of forest stands: the trees. It is usually thought that people relate to the stand as a whole and not to the individual trees comprising the stand. However, when using silviculture methods to meet a specific objective, be it timber, water, wildlife, or forest beauty, it is achieved by adding, subtracting, or altering individual trees, either singularly, in groups, or en masse (Cook, 1971).

Forest managers have criteria with which to judge the timber quality of trees. They also know that a stand should ideally consist of tall, straight, clean-boled and healthy trees if their objective is timber production (Cook, 1971). Few criteria exist, however, with which to judge the aesthetic quality of forest trees, and none are particularly applicable to British Columbia's forests. This study's aim is to establish the aesthetic criteria of selected forest trees. Identifying the relationship between timber quality and aesthetic quality of forest trees should help fulfill this aim. Having aesthetic criteria, managers can more confidently manage forest stands for a combination of economic and aesthetic objectives, or for aesthetics alone.

Objectives

To guide the study's aim, the following objectives were proposed:

1. To identify possible relationships between timber quality and aesthetic quality of selected forest trees.

2. To identify which of the visible physical characteristics of forest trees, and the visible physical characteristics of forest stands in the trees' immediate surroundings, have a positive, negative, or neutral effect on stated aesthetic preferences.

3. To determine the consistency with which each participant chose, from selected forest trees of different timber qualities, either higher or lower timber quality trees.

Literature Review

A number of research studies concerning forest aesthetics have been done in the United States where legislation such as the Multiple Use-Sustained Yield Act (1960) and the National Environmental Policy Act (1969) require the consideration of landscape aesthetics in forest management (Arthur, 1977). In Canada such legislation does not exist. It is not surprising then that only one forest aesthetics research study (carried out in Quebec) has been done in Canada.

Three general methods have been used to collect data in forest aesthetics assessment studies. One method, used by Frissell and Duncan (1965), was direct observation of recreationists' reactions to various forest environments. In their study, they observed the intensity of campsite use that various forest types received, and were able to deduce which type was favored. A second method, used by Shafer and Mietz (1969) was to ask recreationists of their scenic preferences. Some studies used both the observation and solicitation methods (Hancock, 1973; James and Cordell, 1970; Klukas and Duncan, 1967). In Klukas and Duncan's (1967) study, for example, visitors to Itasca State Park in Minnesota were observed as they drove around the park. At each of the park's four major forest types it was noted when cars slowed, stopped, or stopped and passengers disembarked. To supplement the observation data, visitors at several of the park's tourist facilities and major attractions were asked of their forest stand preferences. The third method was the use of photographs of natural scenery, instead of the scene itself, to elicit aesthetic responses (Arthur, 1977; d'Amour, 1976; Kaplan, 1977; Rutherford and Shafer, 1969). The use of photographs has been the most popular method because it allows viewing conditions to be controlled, a variety of respondent groups may easily participate, and time, money and effort are saved. Some researchers, by comparing responses to photographs of the scene and the scene itself, have concluded that both can elicit similar responses (Brush, 1978; Daniel et al., 1973).

Recreationists solicited for their aesthetic assessments were generally asked to respond in one of two manners: one, they could compare forest scenes and state which one they preferred (Cook, 1971; d'Amour, 1976; Kaplan, 1977; Shafer and Burke, 1965); or two, they could view scenes individually and use a Likert scale rating to indicate their judgments of each scene's attractiveness (Arthur, 1977; Brush, 1978; Daniel et al., 1973).

Literature Findings

Stands. Recurrent in the research literature is the aesthetic appeal attributed to open, spacious forest stands when compared to dense, less penetrable woods (Brush, 1978; Frissell and Duncan, 1965; Kaplan, 1977; Shafer and Burke, 1965). One reason for this is that in more spacious stands, sunlight can readily penetrate to the forest floor, a condition greatly favored over the dark monotonous stretches closed-in conifers provide (d'Amour, 1976). On the forest floor a medium between full, dense undergrowth and no undergrowth at all is preferred (Hancock, 1973; d'Amour, 1976).

Forest openings varying in size from a tree height in diameter up to four or five acres have also been found aesthetically appealing to many forest visitors (Brush, 1978; Shafer and Mietz, 1969). Such openings provide contrast in lighting, color, temperature and visual access (Shafer and Mietz, 1969).

In several studies, mixed stands were preferred to pure stands, although pure stands of old growth were also favored (Cook, 1971; d'Amour, 1976; Shafer and Mietz, 1969). Cook (1971) noted that forest visitors preferred variety rather than uniformity in tree size. It seems that heterogeneity within and between stands is a sought after quality in aesthetic forests.

Lastly, several studies found that silviculturally treated stands were preferred to untreated, "natural" stands (Arthur, 1977; Daniel et al., 1973; Rutherford and Shafer, 1969). In Rutherford and Shafer's (1969) study for example, a softwood stand, having received selection cutting, was favored 77% of the time over a similar but uncut stand. With hardwoods however, the cut and uncut stands were equally preferred.

The time of the silvicultural treatment is an overriding factor in stand aesthetics. Fresh evidence of tree harvesting has been found to evoke negative aesthetic responses (Brush, 1978), whereas stands thinned, stripcut or selection cut ten or more years ago have been found most aesthetically pleasing by many (Arthur, 1977; Daniel et al., 1973; Rutherford and Shafer, 1969). In the latter case, time will have allowed residual trees to adjust to the removal of adjacent trees, and the groundcover, in response to increased sunlight penetration, will have grown to hide stumps and slash left by logging.

Trees. In his study on hardwoods in the Eastern United States, Cook

(1971) established a positive correlation between timber quality and aesthetic quality of forest trees. However, the relation "was somewhat weak and more than somewhat erratic" (Cook, 1971, p. 142). For deciduous tree species, he found that straight, balanced trees with many crown branches and attractive backgrounds were favored over more subordinate trees.

Cook (1971) also found that in order for trees to be aesthetically pleasing they need to be highly visible. Their crowns, for example, cannot be obscured by the crowns of adjacent trees. In most cases this condition can be met only in more spacious stands, or along a forest edge.

In other studies, people preferred large forest trees over smaller ones (Brush, 1978; Klukas and Duncan, 1967). This preference held even in residential areas. Kalmbach and Kielbaso (1979) found that large street trees were preferred 78% of the time over small ones.

Two Minnesota-based studies by Frissell and Duncan (1965) and Klukas and Duncan (1967) found that pine trees were a favorite specie among forest visitors. In Itasca State Park, interview results showed that visitors preferred red pine, white pine, or a combination of the two 67% of the time over other species such as paper birch, spruce and balsam fir. Also, observation data showed that the red pine stands were the only ones where visitors would stop their vehicles and disembark to take photographs or have a better look. In the Quetico-Superior canoe country in Minnesota, canoeists occupied campsites within pine stands 91% of the time, in hardwood stands 6% of the time, and spruce-fir stands 3% of the time, even though pine stands comprised only a small portion of the shoreline vegetation available. There was a practical explanation for this: besides being aesthetically pleasing, the pine-stands provided ready access due to their brush-free and spacious characteristics.

A more recent study done in Quebec showed that deciduous and coniferous trees were, in general, equally preferred (d'Amour, 1976). Thirty-six per cent of its respondents chose conifers, 42% chose deciduous trees, and 22% liked both. The deciduous trees were seen as providing variety in continuous stretches of coniferous forest.

Other environmental variables which are not necessarily a part of the immediate forest scene but nonetheless have been found to sway preference assessments are clouds, water, landforms such as mountains, and man-made elements (Craik, 1972; Zube et al., 1974; Wohlwill and Harris, 1979).

Viewers. Perceptions and preferences vary not only according to a scene's physical attributes: gender, age, education, place of residence, and familiarity with the environment in question have also explained to some degree variances in personal preferences (Cook, 1971; Kalmbach and Kielbaso, 1979; Klukas and Duncan, 1967; Sonnenfeld, 1966; Zube et al., 1974). Cook (1971) for example, found that men strongly preferred better timber quality trees, whereas women showed no consistent preference for either better or poorer timber quality trees.

In Klukas and Duncan's (1967) Itasca State Park study, vegetative type preferences were partially explained by visitor's place of residence. Minnesotans preferred red pine with greater frequency (51%) than did non-Minnesotans (41%), and non-Minnesotans preferred white birch (7.8%) more often than did Minnesotans (1.3%). Apparently white birch grew state-wide, whereas the red pine found in Itasca were the largest in the state.

Recreation activity also has explained variances in perceptions and preferences. Lucas (1964) found that canoeists in the Boundary Waters Canoe Area perceived the extent of the wilderness to be smaller than did motor-boaters, and Brush (1978) found that activities such as skiing, snowmobiling, horseback riding and trailbike riding explained preference for clearings and spacious, open stands. He reasoned that these activities involved rapid motion through the woods and therefore needed clear views ahead for safety and orientation.

CHAPTER II. STUDY DESCRIPTION

Study Design

Cook's (1971) basic study design was adapted for this study's use. A "viewing course" consisting of twelve pairs of trees was established along a forest trail. The trees were selected so that three timber quality classes (see Table II) were equally represented: eight trees were in timber quality class 1 (good timber quality), eight trees were in timber quality class 2 (average timber quality), and eight were in timber quality class 3 (poor timber quality). All trees were the same species and had a DBH (diameter at breast height) equal to or greater than 30 centimeters (12 inches).

The twelve tree pairs consisted of the six possible combinations of timber quality classes represented twice (i.e. two each of 1-1, 1-2, 1-3, 2-2, 2-3, 3-3). Painted plywood pointers on 2x2 inch wooden stakes pointed to the two trees of each pair, one of which was randomly assigned a brown "A" on a white backboard, the other a "B". The pointers also served to mark and number the locations of 12 viewpoints from which the 12 tree pairs could be seen. Viewpoints were located next to the trail or as close to it as possible.

Forest visitors 15 years and older were asked to participate in the study. If they agreed they were given a questionnaire (see Appendix IV) and a pencil. A demonstration viewpoint (see viewpoint D in figure 2) and pair of trees, along with a "demo" questionnaire sheet, were used to demonstrate how the questionnaire was to be filled out. Participants were instructed to stand directly behind the pointers and observe the two trees marked A and B. Told to go by "feel", they were to rate, using a nine scale rating, the aesthetic quality of each, then indicate their ratings, along with their preference for either tree A or B, and their reasons for preference in the questionnaire provided. If their reasons for preferring a tree were not on the questionnaire list, they were asked to write them in.

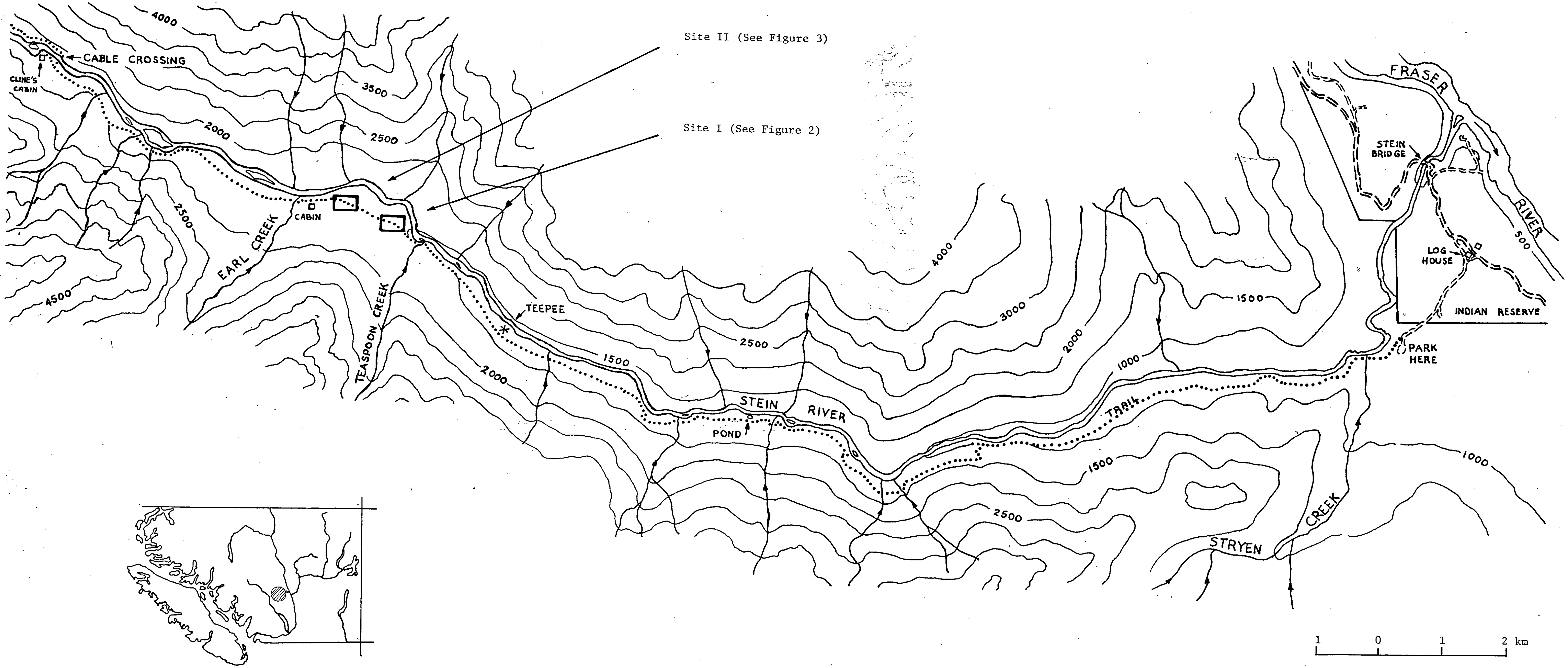
After participants had completed tree pair 1 their questionnaires were checked to see if they were filling them out properly. If so, they were shown the second viewpoint. Since five of the last six viewpoints were off the trail and not readily seen, participants were guided along the viewing course. Any talk regarding the study however was limited to clarifying the instructions already given to them. After completing the viewing course, they were asked in the questionnaire to state their age and gender, and write any comments they had.

The Study Area

A forest ideally suited for this study's purposes had to meet the following requirements: (1) be visited by recreationists, (2) contain merchantable trees, (3) have variety in tree form and tree condition, (4) have uniformity in surroundings and (5) be open enough to see trees in their entirety.

The Stein River watershed was found to contain such forests. An area of 1114 square kilometers (430 mile^2), the "Stein" is located in the southern reach of the Coast Mountains between the Lillooet and Fraser River Valleys (see inset, figure 1). The town of Lytton is due east.

The area consists of a glaciated valley that transects the surrounding mountains in a predominantly easterly direction. The mountain peaks reach elevations up to 2900 meters. The valley floor drops in elevation from 1100 meters in the west to 200 meters in the east. The valley is broad and u-shaped in the west; eastward it narrows and becomes a canyon which after 20 kilometers abuts on the Fraser River Valley. Landforms in



Location of Study Area.

Figure 1. The Stein Main Trail, from Trailhead to River Crossing.

Contours in Feet

Map Adapted from Freeman and Thompson (1979).

the valley consist of outwash terraces that border the Stein River and talus slopes that skirt the valley sides.

The Stein is under the jurisdiction of the B.C. Forest Service and is being increasingly used for wilderness recreation.

Main access to the area is via the eastern end of the valley. A trail follows the river for some 21 kilometers to Ponderosa Creek, located 10 kilometers west of the cable crossing (see figure 1). The trail worsens considerably past Ponderosa Creek, discouraging all but the most ardent hikers.

The lower half of the valley is in Rowe's (1972) Montane forest region and Krajina (1969) classifies it in the Interior Douglas fir biogeoclimatic zone. Douglas fir and ponderosa pine grow in open stands on the valley floor, with Douglas fir dominating north aspects and ponderosa pine dominating south aspects. Western red cedar and black cottonwood line the creeks and river. Trembling aspen grow in clumps at the base of the talus slopes and young stands of lodgepole pine are also seen.

The Sites

Two mature Douglas fir forest sites approximately ½ kilometer apart were used for the viewing course (see figures 2 and 3). Each site contained six tree pairs.

The sites differed in a number of ways, as table I shows. First, site I had by far the larger trees, as can be seen by comparing average DBH and height classes between sites. Secondly, the sites differed in their capability to produce forests. Site[1] index, derived from the mean height and age of sample trees (see Appendix II), indicates that site I had "good" capability and site II had "medium" capability. Third, this difference in

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[1] Site, used as an indicator of an area's capability to produce forests, is determined through tree height-tree age relationships (Soc. Am. For., 1958).

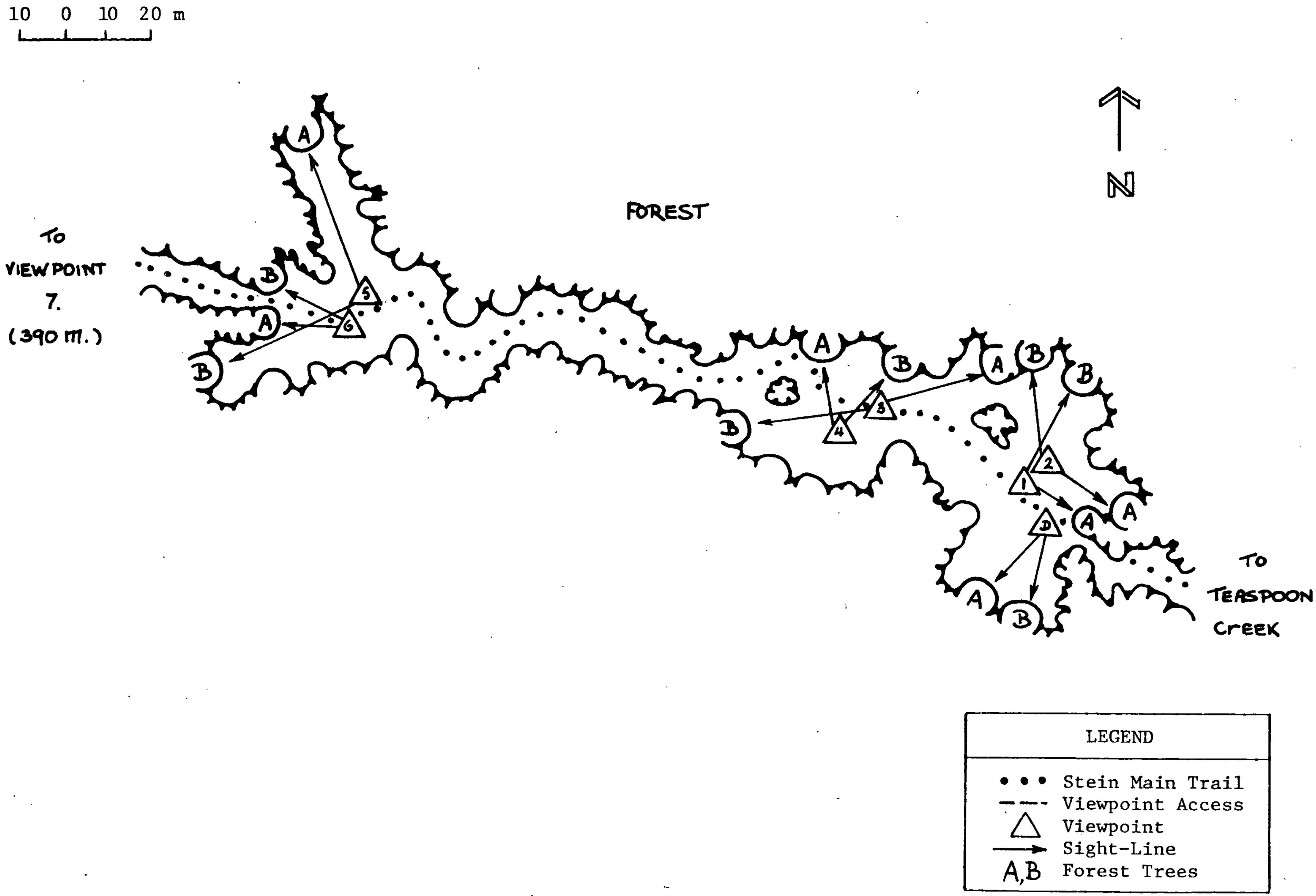

Figure 2. Viewing Course Layout on Site I.

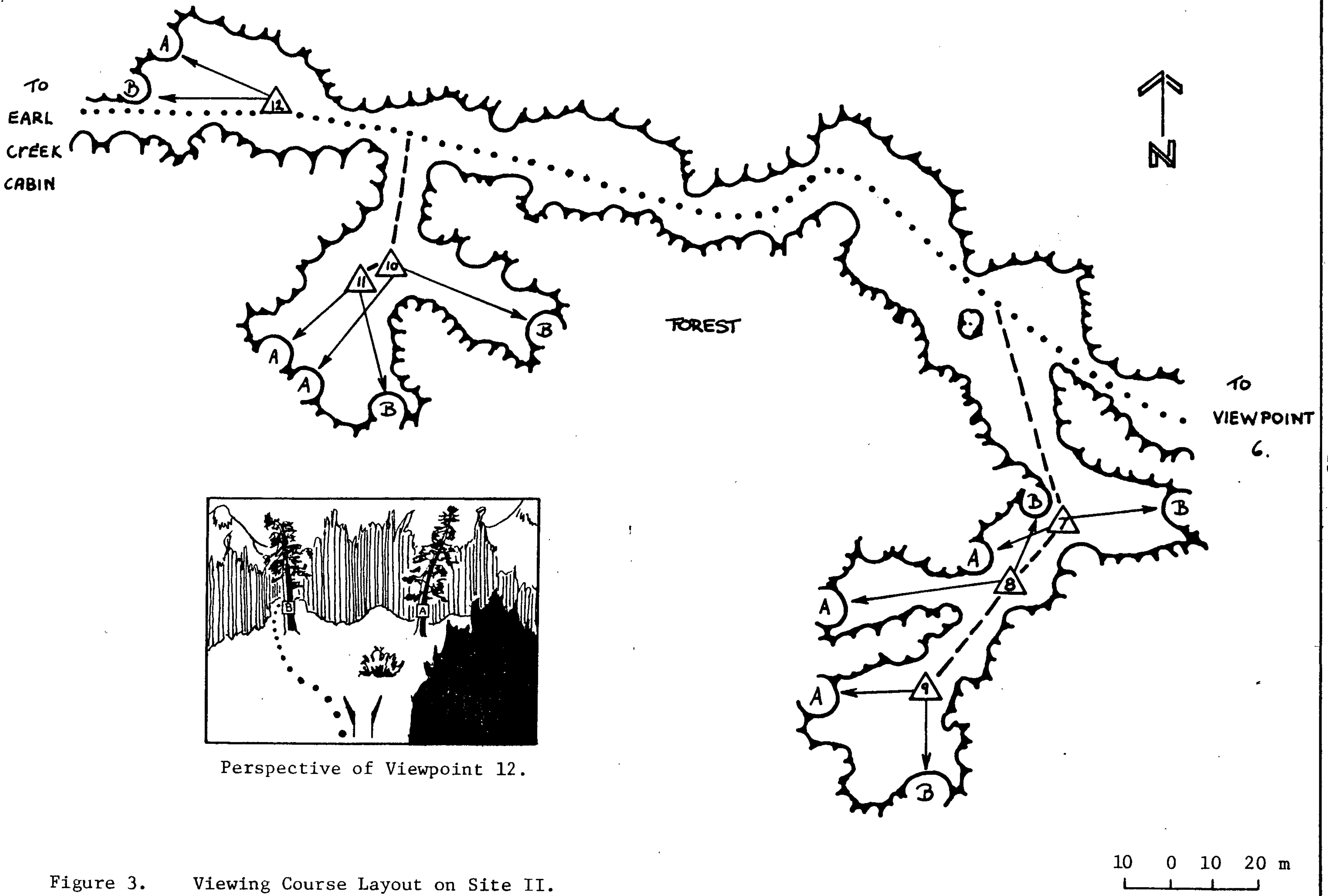

Figure 3. Viewing Course Layout on Site II.

TABLE I. CHARACTERISTICS OF SITES USED IN THE STUDY

CHARACTERISTICS	SITE I	SITE II
Dominant Species:	Douglas fir	Douglas fir
* Average Height Class:	37.5-46.4 m.	19.5-28.4 m.
* Average Age Class:	141-250 years	141-250 years
+ Site Index:	35 m. at reference age 100 years	25 m. at reference age 100 years
Average DBH: (for trees 30 cm. DBH+)	83.5 cm.	54.8 cm.
Average diameter growth in last 10 years:	1.90 cm.	0.64 cm.
* Stocking:	76 or more trees per hectare 27.5 cm. DBH+	76 or more trees per hectare 27.5 cm. DBH+
Crown Closure:	60-80%	40-60%
Understory:	Douglas fir and Paper birch 9-20 m. tall with Western red cedar, Douglas maple, and Alder 5-9 m. tall	Sparsely scattered Paper birch and Douglas maple 3-8 m. tall with Douglas fir seedlings 1 m. tall
Groundcover:	90%	60%
Terrain:	Even ground--flat river terraces with scattered erratics	Uneven ground--bouldered benches

* B.C. Ministry of Forests (1978).

+ B.C. Ministry of Forests (1979).

capability was also reflected in the growth rates: in the last 10 years, site I trees had three times the diameter growth of site II trees (see Appendix 2). The fourth difference between sites was in timber quality: roughly 60 per cent of site I trees were in timber quality class 1, whereas no timber quality class 1 trees existed in site II. Lastly, as indicated by the amount of crown closure, understory and ground cover, site II was more open, allowing better views of the sky, surrounding mountains and tree stands.

The Trees

In order for trees to be selected for the study, they had to meet various requirements. First, they could not have the river in their visible surroundings: it would sway aesthetic preferences. Second, they had to fit one of three timber quality classes (see table II), preferably with trees representing the extreme outside ends of their classes in quality classes 1 and 3, and the middle of quality class 2. Third, they had to be paired so that all possible timber quality combinations were represented twice. Lastly, the trees in each pair were to have similar backgrounds and DBH's, be equally well seen and roughly equidistant from their common viewpoint. In the final viewing course layout, the equidistance condition was met by only half the pairs.

The selected trees were measured and measurements recorded on standard B.C. Forest Service cruise tally sheets (see Appendix II). The trees were also photographed (see Appendix III) using a Mamiya C220 camera with a 6x6 cm. format and 50 mm. lens. All trees were photographed as close to their designated viewpoints as possible. One difficulty in photographing the site I trees arose: if a tree was over 30 m. tall and had to be photographed closer than 30 m. from the tree, its image did not fit entirely inside a single photographic frame. To alleviate this problem the top and bottom halves of such trees were photographed separately and the resulting prints subsequently spliced together. This is not a recommended practice. Future studies should explore the use of a wider angle lens or choose stands more open than site I.

The Timber Quality Classification

The timber quality classification presented in table II was adapted from several under study by Dobie and Middleton (1977). It is applicable to Interior Douglas fir trees 30 cm. DBH or greater only.

Three things should be noted about this classification. One, it uses exterior tree characteristics to estimate interior timber quality. However, there are "no reliable external indicators of interior wood quality" (McIntosh, 1964). Timber degrading conditions such as rot or shake for example, are not manifest externally until well established inside the tree. Therefore, this classification only estimates external timber quality. Two, because trees were to be aesthetically judged from one viewing direction only, they had to be objectively evaluated from that same direction. Therefore the number of trunk branches, stubs, and tree defects were recorded only as seen from the viewpoint. Thirdly, the classification does not account for future tree growth. A timber quality class 2 tree possessing good growth and form could grow into a quality 1 tree, and a quality class 1 tree could grow decadent and become a quality class 2 or 3 tree.

TABLE II. TIMBER QUALITY CLASSIFICATION FOR INTERIOR DOUGLAS FIR TREES 30 CM. DBH AND GREATER

TIMBER QUALITY CLASS 1

1. Tree height should be at least 30.5 meters (100 ft.).
2. Height to the first live limb should be at least 10 meters.
3. It should have a clear bole in the lower 10 meters, but a few epicormic branches are allowed in the top 1/3 of the lower ten meters.
4. It should have no open scars, no conks or blind conks, no fork or crook, no spiral grain, no major sweep ($>$10 cm/5 m) or lean ($>$10° from vertical).
5. It may not have resin exuding from the bole (indicative of shake).
6. It should have a healthy, balanced, and relatively dense crown.
7. No dead or broken tops are allowed.
8. The crown should have a dominant or codominant position in the forest canopy.

TIMBER QUALITY CLASS 2

1. Tree height should be at least 24.4 meters (80 ft.).
2. Height to the first live limb should be at least 5.2 meters (17 ft.).
3. A clear bole in the lower 5.2 meters is desired, but dead trunk branches are o.k.
4. The minimum requirement of this class is that the tree contain one 5-meter sawlog.
5. A lean less than 15° from vertical is o.k., as is sweep, dead or broken top, fork or crook.
6. It may have any one or a combination of defects, but no conks or blind conks.
7. Trunk resinosus is allowed.
8. The crown may have a dominant, codominant, intermediate or suppressed position in the forest canopy.

TIMBER QUALITY CLASS 3

1. The tree must have a DBH of at least 30 cm. (12 in.).
2. A quality class 2 sawlog cannot be taken from it.
3. It must be alive.

CHAPTER III. ANALYSIS OF RESULTS

General

Efficiency of Field Data Collection

In the period from August 1st to September 4th (1979) inclusive, 61 backpackers, all in groups except for one loner, hiked past the portion of trail used for the study (see Table III). Thirteen of them refused to participate and 11 were under the study's minimum age of 15, leaving 37 respondents. On the first sampling day however, two respondents from the same group gave both trees in all pairs the highest rating possible (9), without choosing preferred trees. They thought that trees rated less appealing would be logged--an idea spawned likely from a combination of the controversy surrounding the Stein (logging versus wilderness preservation) and the researcher's unrehearsed procedural explanation on the first sampling day. At any rate, their lack of aesthetic discernment between trees made their responses useless, consequently leaving 35 useable responses in all. This small sample size made the originally planned analysis of socioeconomic variables impossible. However the uniformity of data, as evidenced in Table V, indicates that the small sample size need not detract from any conclusions that have been made.

Most respondents were from British Columbia's lower mainland and on a three to five day wilderness outing. They were comprised of roughly twice as many males as females, and twice as many were under 35 years of age as were 35 or older. Most respondents completed the questionnaire in half an hour and enjoyed the task asked of them. Only two, each from separate groups, said another time would have been better when they were not so tired from backpacking or in such a hurry to get to a certain campsite by nightfall.

All respondents except one viewed the trees in exactly the same order.

TABLE III. SAMPLING PERIOD SUMMARY AND PARTICIPANT NUMBERS.*

DAY	+DATE	GROUPS INTERCEPTED	NO. OF PEOPLE	NO. OF PEOPLE 15 OR OLDER	NO. OF PARTICIPANTS	NO. OF USABLE RESPONSES	WEATHER
Wed.	08/1/79	1	8	4	4	2	sunny, warm
Sat.	4	2	8	8	5	5	cloudy, warm
Tue.	7	2	4	4	2	2	sunny, warm
Sun.	12	2	6	6	0	0	sunny, hot
Sat.	18	1	3	2	2	2	cloudy, warm
Sun.	19	1	2	2	2	2	cloudy, warm
Wed.	22	1	1	1	1	1	fair, warm
Wed.	29	1	4	3	3	3	sunny, warm
Fri.	31	1	2	2	2	2	fair, warm
Sat.	09/1	4	16	13	13	13	rainy, cool
Sun.	2	2	7	5	3	3	rainy, cool
	Totals:	18	61	50	37	35	

*Format adapted from Cook (1971)

+Sampling period consisted of all days from 08/1 to 09/4 1979 inclusive: 35 days in total.

Consequently, it is possible that sequence relevant factors such as practice and fatigue affected the respondent's judgments--and therefore the data--as they progressed along the viewing course. Most respondents, for example, took two to four minutes to assess tree pair 1, but only one to two minutes to assess tree pair 12.

In response to the aforementioned factors, several recommendations for future studies are noted. First, future studies should be conducted in more intensively used recreation forests, ideally near established campgrounds. This would hopefully increase sample size and alleviate the effect of heavy backpacks and hiking fatigue on study results. Secondly, to minimize the effect of sequence relevant factors, the viewing course should be established along a looped trail. The first group encountered could then be sent clockwise around the viewing course, and the second group in a counterclockwise direction. Questionnaires could be assembled to allow for this viewing sequence change.

Aesthetic Preference and Ratings Comparison

At the data compilation stage an infrequent discrepancy was noticed. Since respondents were asked to give both aesthetic ratings and preferences, it was expected that they would prefer, of a pair of trees, the one they had chosen as being the most attractive. Sometimes however, a tree rated as less attractive was preferred. These data discrepancies, in combination with Litton's (1973) doubt-provoking statement that "... preference assessment really has nothing to do with aesthetics," led to the comparison of tree preferences and aesthetic ratings using a fourfold point correlation test. The test's outcome, an r_p value,[2] was found to be 0.95. This is highly signi-

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[2] $$r_p = \frac{BC - AD}{\sqrt{(A+B)(C+D)(A+C)(B+D)}}$$

where A = the number of times tree A was rated higher but tree B was ficant ($P < .05$) and very close to perfect concordance, which would give an $\underline{r}_p$ value of 1. Therefore it can be concluded that the preferences were highly correlated with the attractiveness-unattractiveness tree ratings assigned by the Stein wilderness users.

Aesthetic ratings and preference assessments supplement each other: the aesthetic ratings allow comparisons to be made between any of the 24 trees, but initially have no standard to which each tree can be compared. (A standard is mentally established after a few trees have been judged.) Preference assessment on the other hand always provides a standard--the pair-mate--but does not allow ready comparisons between trees of different pairs.

The Timber Quality - Aesthetic Quality Relationship

The main objective of this study was to determine the relationship, if indeed one existed, between timber quality and aesthetic quality of forest trees. For this purpose, both the aesthetic ratings and the within-pair preferences of the respondents were matched with the appropriate timber quality trees and analyzed.

The Aesthetic Ratings

Mean aesthetic ratings were derived by averaging the Likert scale ratings received per tree. These were matched with their appropriate timber qualities and a correlation coefficient, measuring the degree of association between them, was calculated and found to be r = 0.53 (dF = 22,

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(note 2, cont'd)

preferred;
B = the number of times tree A was rated higher and preferred;
C = the number of times tree B was rated higher and preferred;
D = the number of times tree B was rated higher but tree A was preferred.

P$<$.05). This r value[3] is statistically significant. It was therefore concluded that a positive relationship exists between timber quality and aesthetic quality. Expressed in another way, the r value obtained states that one's accuracy in predicting the aesthetic quality of forest trees will increase by 28% (r^2) once their timber qualities are known.

The next step in the analysis looked closer at the timber quality - aesthetic quality relationship, and consisted of rank-ordering the mean aesthetic ratings and separating them into their respective timber quality classes (table IV). They were then used to calculate an overall mean rating per timber quality class.

First noticed in table IV was that the quality class 3 trees had clustered below the other two quality classes, indicating that in general, poor timber quality trees tended to be rated as less attractive than the good or average timber quality trees. Table IV for example shows that of the seven trees whose means were below 5.0 -- and therefore found generally unattractive -- five belonged to quality class 3. The majority of quality class 3 trees, then, were found to be unattractive. This finding was substantiated by comparing the low overall mean rating of quality class 3 with whose of quality classes 1 and 2. _T_-tests comparing quality classes 1 and 3, and 2 and 3, showed significant differences (t = 3.01 and 4.25 respectively, P$<$.o5). This shows that timber quality class 3 trees, as a group, were rated as less attractive than the trees of either timber quality class 1 or 2. This conclusion implies that if the aesthetic quality of a group of

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[3] $$r = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{(n\Sigma x^2 - (\Sigma x)^2)(n\Sigma y^2 - (\Sigma y)^2)}}$$

where n = the number of trees,
x = the timber quality,
y = the mean aesthetic ratings per tree.

TABLE IV. MEAN AESTHETIC RATINGS RANK ORDERED AND SEPARATED INTO TIMBER QUALITY CLASSES

RANK ORDER POSITION	TREE #	TIMBER QUALITY CLASSES		
		1	2	3
1	5	7.457		
2	23		6.571	
3	2	6.486		
4	12		6.382	
5	18		6.343	
6	20		6.314	
7	9	6.242		
8	19		6.143	
9	6	5.886		
10	10	5.857		
11	24		5.743	
12	4	5.714		
13	16		5.629	
14	14			5.514
15	17			5.171
16	7	5.086		
17	1			5.059
18	22			4.943
19	15			4.886
20	8		4.857	
21	3			4.853
22	21			4.829
23	11	4.676		
24	13			3.829
Overall Mean Ratings Per Timber Quality Class:		5.925	5.998	4.885

individual trees has to be predicted, one step toward greater predictive accuracy would be to attribute most timber quality class 3 trees with low aesthetic quality.

The overall mean ratings for timber quality classes 1 and 2 were also compared. The difference between them however was not statistically significant ($t = 0.02$, $p < .05$). As groups therefore, quality class 1 and 2 trees were attributed almost equal aesthetic quality. This suggests that timber quality cannot accurately predict, when comparing quality class 1 and 2 trees, which ones are more aesthetically pleasing.

Variability in the Aesthetic Ratings

To examine how diverse the opinions of respondents were regarding the aesthetic quality of forest trees, the variances of the mean aesthetic ratings were grouped together into their particular timber quality classes (Table V). Organized in this manner, it could also be seen whether respondents agreed or disagreed more in any particular timber quality class.

Table V shows respondents were in fair agreement over the aesthetic quality of all but two of the trees, the exceptions being trees #12 and #14. Tree #12 had a lower fork and tree #14 had a severe crook (see Appendix 3). As a group then, respondents were unclear as to the aesthetic quality attributable to these uniquely featured trees: some really liked them, others were neutral, and still others did not like them at all.

A comparison of the timber quality class mean variances showed that only those of timber quality classes 1 and 3 were significantly different ($t = 5.104$, $p < .05$). This indicates that respondents as a group agreed less on the aesthetic quality of poor timber quality trees than they did over good timber quality trees.

Both these findings suggest that obvious timber defects such as forks,

TABLE V. MEAN AESTHETIC RATING VARIANCES

PER TREE AND PER TIMBER QUALITY CLASS

TIMBER QUALITY CLASS					
1		2		3	
TREE #	RATING VARIANCE	TREE #	RATING VARIANCE	TREE #	RATING VARIANCE
2	2.081	8	1.891	1	3.390
4	2.210	12	4.122	3	3.402
5	1.432	16	1.770	13	2.676
6	2.692	18	2.173	14	5.022
7	1.316	19	1.303	15	1.869
9	2.877	20	2.281	17	1.617
10	2.538	23	2.017	21	2.911
11	1.741	24	1.903	22	3.467
Mean Variance per Timber Class:					
	2.110		2.182		3.044

crooks, scars and severe sweeps and leans found singularly or in combination on most quality class 3 trees and some quality class 2 trees elicit ambivalent aesthetic responses from forest visitors. Some people find them attractive; others find them aesthetically detracting.

The Tree Preferences

To facilitate the analysis of the preference data, the tree pairs were split into similar and dissimilar timber quality groups (table VI). The number of preferences for a tree in each pair were then compared to see if one tree was preferred a significant number of times over the other.

If, for the similar pairs, the number of preferences for individual trees was statistically different from those of their pair-mates, it could be concluded that timber quality does not differentiate as finely between trees as does aesthetic quality. Table VI shows that the number of preferences in half the similar pairs were statistically different at a probability level of 0.05. These results, in conjunction with an earlier finding, suggest that the timber quality classification is too coarse to predict aesthetic quality accurately, especially when having to discriminate between trees of similar timber quality, or between timber quality class 1 and 2 trees.

Tree pairs 3 and 7 (see Appendix III) illustrate the difference in preference trees of similar timber quality can elicit. In tree pair 3 -- both its trees were superior timber quality class 1 trees -- the difference was especially striking, with tree #5 preferred more than seven times as often as tree #6. Both trees were tall and wide of girth, but tree #5 was the larger of the two. Both trees were straight and leaned slightly, but their crowns differed radically: tree #5 had a sharply conical crown that spanned two-thirds of the tree's height, whereas tree #6 had a crown

TABLE VI. PREFERENCE COUNT COMPARISONS FOR TREES WITHIN EACH PAIR

TREE PAIR	TREE #	TIMBER QUALITY CLASS	NUMBER OF TIMES PREFERRED	Z
		A. SIMILAR PAIRS		
3	5	1	30	4.226*
	6	1	4	
5	9	1	21	1.372
	10	1	13	
10	19	2	15	0.686
	20	2	19	
12	23	2	25	2.535*
	24	2	10	
7	13	3	8	2.959*
	14	3	25	
11	21	3	15	0.353
	22	3	17	
		B. DISSIMILAR PAIRS		
4	7	1	24	2.197*
	8	2	11	
6	11	1	5	4.226*
	12	2	30	
8	15	3	8	3.210*
	16	2	27	
9	17	3	7	3.550*
	18	2	28	
1	1	3	8	3.210*
	2	1	27	
2	3	3	11	2.197*
	4	1	24	

$$Z = \frac{\text{frequency of choice} - N\,(.5)}{\sqrt{N\,(.25)}}$$

*Denotes significance at 0.05 level of probability or better.

rounded on top and concentrated in the top one-third of the tree. The reasons most often chosen for preferring tree #5 were more balanced (12x), straighter trunk (12x), wider trunk (9x), rougher bark (8x) and more attractive background scenery (8x).

The small sizes of trees #13 and #14 in pair 7 were almost identical, and both had fire markings on their lower trunks and a number of dead trunk branches. Tree #14 had a severe crook in its lower trunk where tree #13 had a major sweep. Their small sizes, and their defects, placed both into timber quality class 3, yet tree #14 was aesthetically preferred three times as often as tree #13. Nineteen respondents chose "more crooked trunk" as a reason for preferring #14, and five people chose "straighter trunk" as a reason for preferring #13. In this case it seems that the type of physical defect, or perhaps its degree, played an important role in tree preference.

The two pairs discussed above illustrate that trees similar in timber quality may be assessed differently. It was concluded therefore that the aesthetic quality of forest trees cannot be predicted accurately or consistently by the timber quality criteria as they are. Some modifications or additions would have to be made to increase their accuracy and consistency. That each timber quality class is represented by a differentially preferred pair of trees similar in timber quality shows also that the criteria of all three timber quality classes need modifications.

Of the dissimilar tree pairs, all contained trees that were differentially preferred a significant number of times. Five of the six tree pairs showed that their better timber quality trees were preferred more often, leaving only one tree pair that showed the opposite trend. The exception, pair 6, showed the greatest difference in preference with tree #12 preferred six times as often as tree #11. Tree #11 was an average timber quality class 1 tree whereas tree #12 was slightly taller, had a denser crown and forked one meter up from the ground (see Appendix III). In this case it seems that the fork, in combination with greater tree height and crown density, was more important to tree preference than better timber quality. The attractiveness of the fork was reflected by the number of respondent comments regarding the desirability of forks and other mishapen features. Such variety producing features were favored over stands consisting solely of less interesting, straighter, healthier trees.

The dissimilar pairs were ordered from least dissimilar down to most dissimilar in timber quality. The Z values in table VI show however that increasing dissimilarity is not accompanied by an increasing number of preferences for the better timber quality trees: preferences for the poorer timber quality trees still constitute a sizeable minority in each pair. It is these exceptions, of course, that are hard to predict. A final count of dissimilar pair preferences shows that poorer timber quality trees were preferred 75 times, and the better timber quality trees preferred 135 times. Comparing these counts showed that the better timber quality trees were preferred a significantly greater number of times ($z = 4.14$, $p < .05$). This definite majority substantiates the earlier finding that a positive correlation exists between timber quality and aesthetic quality.

Variability in Preference

To analyze the variability in individual respondents' preferences, the dissimilar tree pairs were grouped according to the timber qualities they harbored (i.e. types 1-2, 2-3, 1-3). It was then noted whether a person who had preferred the better timber quality tree upon seeing the first of each pair type, switched their preference to the poorer timber quality tree upon seeing the second tree pair of that type, and vice-versa. The results are shown in table VII.

TABLE VII. VARIABILITY IN PREFERENCE

	CONSISTENT		VARIABLE	
Type of Pairs	Prefer better tree both times	Prefer poorer tree both times	Prefer better than poorer tree	Prefer poorer than better tree
1 - 2	3	9	21	2
2 - 3	24	4	3	4
1 - 3	20	4	7	4

Table VII shows that more people are consistent in their preference than are not. It also shows that better timber quality trees were consistently preferred more often than the poorer timber quality trees. Comparing timber quality class 2 and 3 trees, and 1 and 3 trees, shows that in both cases the better timber quality trees are consistently preferred at least five times as often. This substantiates an earlier finding that poorer timber quality trees are generally less preferred than better timber quality trees. The exception to this trend is in the type 1-2 pairs where the poorer timber quality trees are consistently preferred more often than the better timber quality trees. This result isolated from the rest seems to indicate that timber quality 2 trees are preferred over timber quality 1 trees. Table VI shows however that the better timber quality tree was preferred significantly more often in the first type 1-2 pair encountered. This reconfirms that aesthetic quality of timber quality 1 and 2 trees are, in general, similar.

Also to be noted is the substantial number of people who switched preferences from the better to the poorer timber quality trees, and vice-versa. By doing so, they indicated a desire for stands to be comprised of an assortment of timber quality trees, rather than of better timber quality trees only.

Reasons for Preference

As in the first objective, so for the second objective, there were two types of data to work with. On the one hand were the reasons given by respondents for their preferences, on the other were the measured tree variables such as height and DBH, which also could aid in identifying reasons for preference.

Given Reasons for Preference

Participants were asked to give from 1 to 4 reasons why at each pair they preferred one tree over the other. The number of reasons they actually gave averaged three per tree and ranged from none to eight. The number of times each characteristic had been used by all respondents was counted and the count converted to a percent of the total number of times all characteristics were used. Also, all characteristics had paired opposites. Each opposite pair described two different degrees of a single attribute (e.g. trunk width, ground evenness). Therefore, to give each attribute relative weight, the percentages of each of the paired opposites were added. Table VIII shows the characteristics, in the same order as respondents saw them, matched with their respective counts and percents, and the attribute percents.

The four characteristics chosen most often by respondents, and listed in order of decreasing importance, were: more balanced, straighter trunk, more attractive background scenery, and fewer dead trunk branches. Straighter trunk and fewer dead trunk branches affect timber quality positively, more balanced may or may not affect timber quality, and more attractive background does not affect timber quality at all. For that matter, all tree characteristics associated with good timber quality were chosen more often than their pair-opposites.

To facilitate the analysis of the given reasons for preference, they

TABLE VIII. GIVEN REASONS FOR PREFERENCE

CHARACTERISTICS OF THE TREE	NO. OF TIMES CHOSEN	% OF TIMES CHOSEN	ATTRIBUTE %
More balanced	128	9.20	12.43
More lopsided	45	3.23	
Wider trunk	47	3.38	3.88
Narrower trunk	7	0.50	
Shorter trunk	2	0.14	2.30
Longer trunk	30	2.16	
More lean	35	2.51	4.74
Less lean	31	2.23	
More crooked trunk	48	3.45	11.64
Straighter trunk	114	8.19	
More dead trunk branches	20	1.44	7.55
Fewer dead trunk branches	85	6.11	
Rougher bark	47	3.38	6.33
Smoother bark	41	2.95	
More scars	27	1.94	5.75
Fewer scars	53	3.81	
More holes	2	0.14	0.93
Fewer holes	11	0.79	
More fungus	30	2.16	3.45
Less fungus	18	1.29	
Denser crown	47	3.38	4.31
Sparser crown	13	0.93	
Broader crown	28	2.01	2.94
Narrower crown	13	0.93	
Longer crown	47	3.38	3.60
Shorter crown	3	0.22	
More dead crown branches	10	0.72	3.74
Fewer dead crown branches	42	3.02	

TABLE VIII (CONT'D)

CHARACTERISTICS OF THE TREE'S SURROUNDINGS	NO. OF TIMES CHOSEN	% OF TIMES CHOSEN	ATTRIBUTE %
Mixed tree species	16	1.15	2.16
Uniform tree species	14	1.01	
Mixed tree sizes	29	2.08	3.23
Uniform tree sizes	16	1.15	
Uneven tree spacing	13	0.93	1.72
Even tree spacing	11	0.79	
Denser undergrowth	22	1.58	3.38
Sparser undergrowth	25	1.80	
Even ground	12	0.86	2.44
Uneven ground	22	1.58	
Flatter ground	8	0.57	1.22
Steeper ground	9	0.65	
More attractive background scenery	109	7.83	8.62
Less attractive background scenery	11	0.79	
Written comments	48	3.66	3.66

were divided under the following headings: the overall tree, the trunk, the crown, the tree's surroundings, and the written comments.

The overall tree. The characteristics pertinent to the overall tree are more balanced/more lopsided and more lean/less lean. More lean and less lean were almost equally favored. Added together they form the attribute of "degree of lean", which was ranked as seventh most used. This relatively high rank is evidence that the degree of lean is important in aesthetic quality. Also, the similar scores for more or less lean indicate that many degrees of lean are welcome. All selected trees leaned somewhat, with tree #2 leaning the least (see Appendix III). Tree #3 leaned the most and, despite its low rating, still received a written comment about its "attractive lean."

More balanced was chosen three times as often as more lopsided; it was also chosen more often than any other characteristic. This suggests that an aesthetically pleasing tree should first of all be well balanced. However, the substantial number of times more lopsided was chosen attests to the fact that lopsided trees are sometimes also favored. Of all the attributes, degree of balance was the most important. That it was listed first in the questionnaire may have elevated the number of times it was chosen; however, other attributes listed later were also used many times.

The trunk. Ten of the 16 characteristics pertaining to the trunk dealt with its surface features. Fewer dead trunk branches, fewer holes, fewer scars, and more fungus were favored at least twice as often as their pair-opposites. Rough and smooth bark were about equally favored. The fungus characteristic produced confusion. Both degrees of fungus together were chosen 48 times as reasons for preference, but there was no sign of fungus, such as brackets, on any of the selected trees. Lichen however grew prolific on many of the trunks and lower branches, especially on site II. The number of times "more fungus" was chosen as a reason for preference in site I was eight; it was chosen 22 times in site II however. Comparing these counts showed that "more fungus" was chosen a significantly greater number of times in site II ($x^2_F = 5.63$, $p < .05$).[4] Also, looking at trees individually showed that tree #16, a site II tree supporting many more lichens than its pair-mate, received "more fungus" more often as a reason for preference than any other tree. No one assigned it "less fungus". Its pair-mate, tree #15, received neither "more fungus" or "less fungus" as preference reasons. Other tree pairs received counts that were less skewed or even contradictory. For example, respondents had chosen "more fungus" four times and "less fungus" three times for tree #18. In cases like this it was debatable which tree of a pair actually had more lichen. The above findings led to the conclusion that respondents had equated lichens with fungus, assuming one was the other.

Also potentially confusing was the difference between a dead trunk branch and a dead crown branch. Longer stubs just below the first live limb could have been thought as belonging to either the trunk or the crown. In the future, perhaps respondents could initially be told that the crown starts at the first live limb and that anything below that belongs to the trunk.

The six remaining trunk characteristics referred to the trunk as a whole. Wider trunk, longer trunk, and straighter trunk were all substantially favored over their pair-opposites. It was noted though that crooked trunk,

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[4] $$x^2_F = \frac{(/F_1 - F_2/ - 1)^2}{F_1 + F_2}$$ where F_1 = frequency of use of characteristic in site I

F_2 = frequency of use of characteristic in site II although subordinate to straighter trunk, was chosen more often than longer trunk and just as often as wider trunk as a reason for preference. Its relative importance, then, shows all the indications of its being one of the overriding characteristics that Cook (1971) refers to. That is, at times a crooked trunk will be preferred, contrary to expectation, over one that is wider, longer, or straighter.

The crown. Of the eight crown characteristics, four were substantially favored over their pair-opposites. Longer crown was favored 15 to 1 to shorter crown; fewer dead crown branches was favored 4 to 1 to more dead crown branches; denser crown was favored 3 to 1 to sparser crown, and broader crown was favored 2 to 1 over narrower crown. The favored characteristics collectively describe a healthier crown, and therefore likely a healthier tree.

The crowns of many of the trees partially produced a differentiation in aesthetic quality. Trees #2 and #4 (see Appendix III) for example, were very similar, especially in height and DBH. Tree #2 was rated considerably higher however. Their greatest difference was in their crowns. Tree #2 had the larger crown whereas tree #4 had a clump of dead branches breaking the continuity of its crown in half. Based on the crown characteristics most often chosen as reasons for preference, tree #2 could have been predicted as having the most aesthetic quality. The high ratings tree #18 received could also have been predicted on this basis. Of the selected trees it was the only one with no dead branches on either its trunk or in its long crown.

The tree's surroundings. More attractive background scenery" was chosen more often as a reason for preference than any other characteristic describing the tree's surroundings. This was to be expected since it alone could refer to all the other "surroundings" characteristics combined. If a respondent liked something about a tree's surroundings, but could not quite figure out what, choosing "more attractive background scenery" would cover it. That less attractive background scenery was chosen at all was surprising. Perhaps those choosing it thought that the less attractive background acted as a contrasting foil that displayed the tree's aesthetic attributes to advantage.

Of the six characteristics pertaining to the surrounding trees, mixed and uniform tree species, and even and uneven tree spacing were chosen an almost equal number of times. This indicates that a variety of tree species and tree spacings likely appeal to most people. That mixed tree sizes were favored more often than uniform tree sizes suggests a tendency for uneven-aged stands to be preferred over even-aged stands.

Mentioned last are the six characteristics dealing with the forest floor. The only one chosen considerably more often than its paired opposite was uneven ground. The unevenness of terrain was due to dry gullies and boulders dispersed over the otherwise flat terraces. Flatter and steeper ground were equally preferred in the trees' surroundings. Denser and sparser undergrowth were also nearly equally preferred, perhaps reflecting that a very noticeable difference in undergrowth density did not exist between trees of any one pair. A variety in undergrowth density then, pleased the respondents. The attribute of undergrowth density, although not chosen many times, was used more often than others such as trunk length or crown width to explain the preference. This, if anything, shows that surroundings also play a decisive role in the overall aesthetic appeal of a tree.

The number of times each characteristic was used was important, but also important was the way in which they were used. Specifically, there was concern that people would find some easy way to use characteristics that they would then repeatedly employ. To examine this aspect, a table was made that showed how many times each respondent had used each characteristic. From it a tally was taken of the number of times characteristics were used once, twice, three times, and so on up to 12 times. Table IX summarizes this tally. It shows that as the frequency of the use of a characteristic goes up, the number of times that frequency occurs goes down.

TABLE IX. THE NUMBER OF TIMES POSSIBLE FREQUENCIES OF A CHARACTERISTIC'S USE PER PERSON OCCURRED

Possible frequency of a characteristic's use per person	1	2	3	4	5	6	7	8	9	10	11	12
Number of times that frequency occurred	301	134	81	43	28	14	17	2	3	1	0	1

Specifically, any one characteristic was used 6 or less times by 4 out of every 5 people. Of course more balanced, straighter trunk and more attractive background scenery were used more often by most persons than any of the other characteristics. This was due to two factors: their applicability in all comparisons, and their ease of application. More attractive background scenery, to illustrate the first factor, could be applied in all cases whereas scarring, found on only a few of the selected trees, applied in those cases only. An example of the second factor would be deciding whether one tree was straighter than the other, this being much easier than deciding which of two trees was surrounded by more tree species.

Nevertheless, only once was the same characteristic (straighter trunk) used to explain preference at all twelve pairs. In all, the figures indicate that specific characteristics were repeatedly used by the same persons, but seldom for all cases, and that other characteristics were used liberally to pinpoint the preference.

The written comments. Respondents wrote 51 comments in the questionnaires to supplement the provided reasons for preference. Twenty-three people had written comments; twelve had not. Trees #12 and #23 (see Appendix III) received the most comments with 10 and 6 comments respectively. Most of the comments for tree #12 referred to its fork, that it gave the tree "character" or was "unusual" or "interesting". The comments for tree #23 referred to its "graceful" lean and branches, and its "nice shape". "Interesting" and "unusual" were the words most often used. Other comments referred to such things as bark color, the foreground, the tree's health, lighting conditions, the presence of lichen.

Ideally the trees and their surroundings would have been scrutinized before completing the list of characteristics supplied in the questionnaire. Perhaps "forking" would then have been on it and morefungus/less fungus would have been replaced by more lichen/less lichen. All listed characteristics were used at least twice, indicating that a preference assessment procedure has room for them all.

Deduced Reasons

Rather than rely solely on the respondents, the measured tree variables were also analyzed in hope of identifying which visible physical characteristics influenced the aesthetic quality of forest trees. If any of the variables did indeed influence aesthetic quality, their ease of measurement would in turn make predictions of tree aesthetic quality easier, and perhaps more accurate.

The measured variables consisted of tree height, DBH, the number of knots in the lower ten meters, and the heights of the first live limb and stub. The values of each variable were matched with the mean aesthetic ratings in order to measure the degree of association between them. The resulting correlation equivalents, or r values, are listed in table X.

TABLE X. CORRELATION COEFFICIENTS FROM COMPARISONS BETWEEN MEAN AESTHETIC RATINGS AND MEASURED TREE VARIABLES

	Tree Height (m.)	DBH (cm.)	Knots First 10 m.	Height of First Live Limb	Height of First Stub
r:	0.68*	0.61*	-0.48*	0.37	0.30

* Significant at 0.05 level of probability.

As the r values show, tree height is the most reliable single indicator of aesthetic quality. The coefficient of determination, r^2, indicates that it alone explains 46% of the variation in the mean aesthetic ratings. Relating this correlation to the timber quality classes, the taller trees within each class generally received the highest ratings. Hence for aesthetic quality predictions, not only can trees be differentiated by timber quality class, but by height within and between timber quality classes as well. The problem then of the timber quality classification being too coarse to predict aesthetic quality accurately, especially between trees of similar timber quality, is in part solved by tree height.

Regarding the list of characteristics, it should be noted that respondents could show their preference for the taller trees either by selecting both longer trunk and longer crown or by writing it on the characteristics lists provided. Only two wrote "taller" as a reason for preference. If future tree aesthetics research is conducted and it uses a characteristics list, both "taller tree" and "shorter tree" should be included characteristics.

The linear relationship between aesthetic quality and tree height is shown in figure 4. The tendency for taller trees to be rated higher can be seen in the plotted data points, but their scattering away from the line indicates that other factors are at play here too.

Diameter at breast height proved also to be positively correlated with aesthetic quality. This was expected however because of its interdependence with tree height: the taller the tree, the wider it usually is. Diameter at breast height then, adds little if any predictive power if tree height is already known.

The number of knots (live and dead branches) seen on the lower ten meters of the tree proved to be negatively correlated with aesthetic quality. That is, as the number of knots increases, aesthetic quality decreases. The negative correlation, however, is caused mainly from the dead branches, and not the live ones. This was concluded for two reasons: first, dead trunk and crown branches usually outnumbered live ones on the lower trunks of selected trees; secondly, longer crowns were preferred, and the more live branches in the lower portion of the tree, the greater the chance of having a long crown.

Height to first live limb was not significantly correlated with aesthetic quality. On the one hand a lower first live limb would likely mean a longer crown; on the other hand, a higher first live limb would mean a longer trunk. As both conditions were aesthetically pleasing, no direct correlation could exist.

Height to first stub was likewise not significantly correlated with aesthetic quality. It had been expected, since dead trunk branches were generally disfavored, that a low stub would mean low aesthetic quality. However, irregularities such as the very low stub found on tree #12, which nonetheless received a high rating, are a probable cause of the

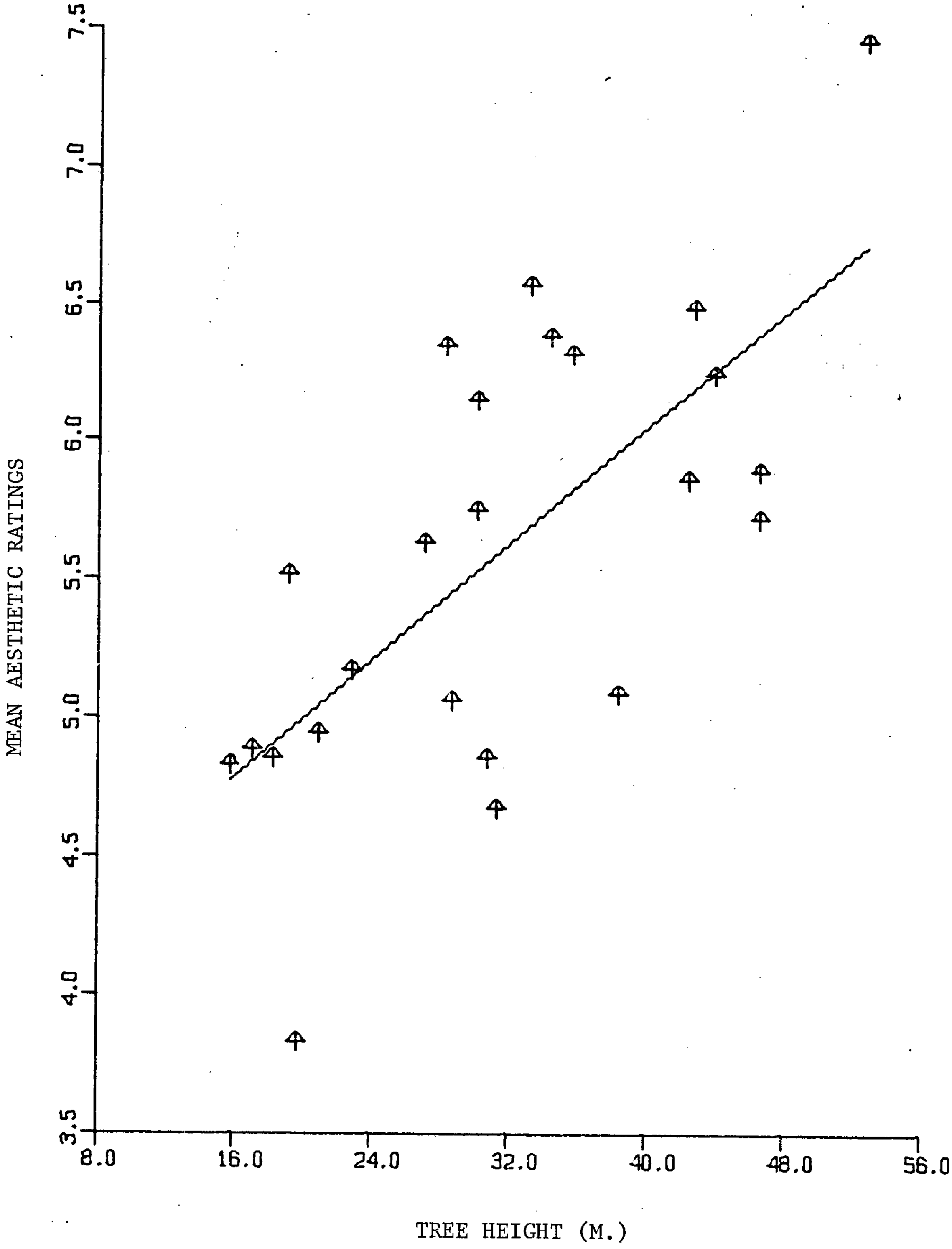

Figure 4. Mean aesthetic ratings versus tree height.

non-significance.

After examining the accuracy with which the variables individually predicted aesthetic quality of forest trees, it was desirable to know if more precise predictions could be made when they worked in combination with each other. (Tree aesthetics is, after all, a result of many interdependent factors.) For this purpose a step-wise multiple regression analysis was used. Simply speaking, this form of regression analysis chooses various combinations of the independent variables (tree variables), multiplies each variable within each combination by an appropriately weighted value, and then estimates how accurately each combination predicts the dependent variable (mean aesthetic ratings). The end product is a set of regression equations constituting various predictive accuracies. The most accurate regression equation[5] explained 69% of the variance in the mean aesthetic ratings. The limited number of trees and participants sampled though, restrict its application in forest management. However, its general finding that the aesthetic quality of forest trees can be predicted agrees with Cook's (1971) findings.

A Within Site Comparison

The two study sites were separately scrutinized to see what effect each had on tree aesthetics. Although this was outside of the proposed research objectives, it was felt it would lend a valuable perspective to this study.

To scrutinize the sites separately, the trees on each were rank or-

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[5] Mean aesthetic rating = 5.769 + 0.080 (tree height in meters) - 0.045 (number of knots in lower 10 m.) - 0.142 (height to first live limb in m.) - 0.139 (height of first stub in m.)

dered according to their aesthetic quality. As table XI illustrates, the timber quality class 2 and 3 trees on site II separated well on the basis of aesthetic quality. This exemplifies the earlier finding that a good distinction exists between quality class 2 and 3 trees. Site I shows a more irregular pattern however, with a highly rated class 2 tree and a short class 1 tree dispersing the timber quality class 1 tree ratings.

These results can be discussed best by regarding the relationships between timber qualities. The timber quality class 2 trees on site II for example, were the tallest that site had to offer, or possessed the best possible growth form. Placed amongst the quality class 3 trees, they cut a fine figure indeed. There was good contrast, both in height and form, between the two timber quality classes. This in turn led to the ready aesthetic distinction between them. On the other hand, the timber quality class 1 trees on site I did not dominate as conspicuously as did the timber quality class 2 trees on site II. They stood amongst many other tall, well-formed trees that were just as suitable for quality class 1 trees except that their crowns were not in full view. Within such a matrix, the selected class 1 trees generally did not stand out well. The highly rated quality class 2 tree on site I is another case in point. It was not competing with the quality class 1 trees on the dimensions of height or good form as much as on the dimension of uniqueness. Its fork provided pleasing contrast among the single stemmed trees and because of that was rated highly.

The quality class 1 tree with the lowest mean aesthetic rating well exemplifies the above discussion: it was shortest of the class 1 trees; it was shortest of the selected trees on site I, and it was not unique in any way. Consequently, it received low aesthetic ratings.

Timber quality class 2 trees were the dominants on site II, and timber

TABLE XI. A WITHIN SITE TREE AESTHETICS RANKING

RANK ORDER POSITION WITHIN STAND	TREE #	MEAN AESTHETIC RATING	TIMBER QUALITY CLASS
	A. SITE I		
1	5	7.457	1
2	2	6.486	1
3	12	6.382	2
4	9	6.242	1
5	6	5.886	1
6	10	5.857	1
7	4	5.714	1
8	7	5.086	1
9	1	5.059	3
10	8	4.857	2
11	3	4.853	3
12	11	4.676	1
	B. SITE II		
1	23	6.571	2
2	18	6.343	2
3	20	6.314	2
4	19	6.143	2
5	24	5.743	2
6	16	5.629	2
7	14	5.514	3
8	17	5.171	3
9	22	4.943	3
10	15	4.886	3
11	21	4.829	3
12	13	3.829	3

quality class 1 trees were generally dominant on site I. Their equal dominance roles resulted in their receiving near equal overall aesthetic ratings and preference counts. The relationship of the timber quality classes within each site then, helped to explain their general aesthetic relationships.

CHAPTER IV. SUMMARY AND CONCLUSIONS

This study investigated three things: (1) the relationships between timber quality and aesthetic quality of forest trees; (2) the effect visible physical characteristics of forest trees and their surroundings have on forest tree aesthetic preferences; (3) the consistency in preference for either better or poorer timber quality trees. Study trees were interior Douglas fir, 30 cm. DBH or greater, growing in the Stein River valley. Twenty-four were chosen according to three timber quality classes, and paired so that all possible combinations of the quality classes were evenly represented. The resulting pairs in turn were evenly divided between two sites ½ kilometer apart. Wilderness backpackers were asked to rate the attractiveness of the trees, to compare the two trees of each pair and select the one they preferred, then check reasons for their preference.

In interpreting the study findings it should be noted that statistical testing necessitated the pooling of responses; the results therefore represent the judgements of a group and tend to mask individual responses. That the individual responses were relatively uniform, however, as shown by the minimal variance in the mean aesthetic ratings, offers some assurance of their representativeness.

Another form of assurance, and an interesting one at that, was found when comparing study findings with those of Cook (1971). He performed his study nine years ago, on the other side of the continent on deciduous trees; yet many of both studies' findings were similar. Witness especially the reasons given for preference. Both studies found that trees were preferred if they were balanced, had a straight trunk, and attractive background scenery. A difference between the studies however was in the fourth most listed reason for preference: Cook found it to be many crown branches; in this study it was few dead trunk branches.

This study's chief finding was that a positive relationship exists between timber quality and a preference assessment of forest trees, directly viewed. More specifically, people found timber quality class 3 (poor) trees overall less attractive than timber quality class 1 and 2 (good and average) trees, and timber quality class 1 and 2 trees of generally equal attractiveness. Timber quality in other words, could not with any consistency, aesthetically differentiate between timber quality class 1 and 2 trees. It also could not, with any consistency, aesthetically differentiate between trees of similar timber quality. That is, when comparing two trees of similar timber quality, be they both in class 1, 2, or 3, half the time they were judged as aesthetically quite dissimilar. It was found that tree height and diameter at breast height could however differentiate more accurately between these trees. Specifically, large trees were preferred over smaller ones. Tree size was found then to aesthetically differentiate where timber quality could not. It therefore was more accurate than timber quality in predicting the aesthetic quality of forest trees.

Knowing the effect tree size had on aesthetic quality, the reason for timber quality class 1 and 2 trees being judged equal in aesthetic quality became clear. On site I, timber quality class 1 trees were the dominants; on site II, timber quality class 2 trees were the dominants. The dominant trees on both sites were found aesthetically pleasing, resulting therefore in their aesthetic equality. The timber quality class 3 trees however, were the subordinates on both sites, and therefore received generally low aesthetic ratings.

Other characteristics people preferred were long, broad, dense and healthy (few dead crown branches) crowns . Based on them, it could have been predicted that some trees, indistinguishable from others otherwise, would be preferred.

In analyzing the consistency of people's preferences, it was found that more people were consistent in their preference for either better or poorer timber quality trees than were not. Also found was that the better timber quality trees were consistently preferred more than twice as often as the poorer timber quality trees. Those inconsistent in their preference constituted a sizeable minority, however, indicating a desire for a variety of timber quality trees. Analyzing the variance in aesthetic ratings revealed that people agreed less on the aesthetic quality of poor timber quality trees than they did for good timber quality trees. This could be seen especially with a forked tree and a tree with a severe crook: both showed a greater variance in aesthetic ratings than the other trees.

As stated in the introduction, this study's aim was to establish aesthetic quality criteria for forest trees. Also, the relationship between timber quality and aesthetic quality was to reveal possible compatibilities between timber production and recreation, and give the criteria their needed objectivity for application in exclusive use recreation forests. The nature of the data does not allow the establishment of a definitive aesthetic hierarchy among countless forest trees -- an impossibility at any rate -- but does allow aesthetic distinctions to be made, with some confidence, between interior Douglas fir trees of the same stand. To illustrate the application of the study findings, some aspects of aesthetic stand management in forest recreation areas are discussed.

Tree cutting is the most prevalent form of stand management. It can maintain or enhance a stand's aesthetics if tree selection is guided by aesthetic criteria. One criterion, for example, is that big trees are attractive, and should therefore be retained whenever possible or feasible.

If the recreation site is within a timber production forest, this could mean the retention of a percentage of trees past their economic maturity, allowing them to reach full size. When such trees present a safety hazard due to decadence, they can be selection cut and replaced by new growth, or be removed all at once and the recreation site located elsewhere. Straight, well balanced trees with long, broad, dense and healthy crowns should also be retained, hopefully to comprise the larger part of the stand's overstory. When necessary, they could also be selection cut.

Cutting trees to manipulate stand density is called thinning. A stand is thinned for many reasons, some of which may be to increase ease of access, to harden the stand for intensive recreation use, to give residual trees room to grow, or to encourage regeneration and herbaceous growth. In thinning, many poor timber quality trees can be removed from the stand without aesthetic detriment, as long as they do not constitute a major part of the stand. Those exhibiting unique characteristics should however be retained to provide contrast in the stand. Trees that shelter specimen trees by maintaining the stand's windfirmness should also be retained, but allow good views of the dominants and other specimen trees.

When stands are thinned, the change in stand lighting should be noted, and perhaps contrasted with prevailing forest conditions. Contrasting light intensities can also be provided by forest openings of varied size. Views to the scenery outside of the stand can be emphasized. An enclosed view of alpine peaks, a lake, or other features may be exposed by the removal of specific trees.

Tree cutting should encourage regeneration. Since Douglas fir is commonly a pioneer species, its regeneration necessitates clearcuttings of various sizes, large group selection cuts, or planting under more closed-in conditions. In later years, the resulting immature stand can be thinned to favor potential timber quality class 1 and 2 trees, and uniquely formed trees.

Respondents indicated by their "additional comments" and preference reasons that they preferred variety in the stand. Specifically, they desired uneven aged, mixed specie stands with variety in tree lean, tree density and undergrowth density. Although skewed toward the healthy end, a range of tree conditions was also desired.

This preference for within stand variety can likely be translated to a preference for between stand variety as well. Uneven-aged and immature stands mixed with even-aged and mature stands would, for example, likely provide variety appreciated by many.

A suggestion for future study is the aspect of preferred tree species. For example, are a ponderosa pine and Douglas fir of similar timber quality equal in aesthetic quality? Are preferences similar province-wide?

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APPENDIX I.

SCIENTIFIC NAMES OF SPECIES

MENTIONED IN THE TEXT AND TABLES

SCIENTIFIC NAMES OF SPECIES MENTIONED IN THE TEXT AND TABLES

	Scientific Name	Common Name
1.	Abies balsamea (L.) Mill.	Balsam fir
2.	Acer glabrum Torr. var. douglasii (Hook.) Dipp.	Douglas maple
3.	Alnus tenuifolia Nutt.	Mountain alder
4.	Betula papyrifera Marsh.	Paper birch
5.	Picea spp. A. Dietr.	Spruce
6.	Pinus contorta Dougl.	Lodgepole pine
7.	Pinus ponderosa Laws.	Ponderosa pine
8.	Pinus resinosa Ait.	Red pine
9.	Pinus strobus L.	White pine
10.	Populus trichocarpa Torr. & Gray	Black cottonwood
11.	Populus tremuloides Michx.	Trembling aspen
12.	Pseudotsuga menziesii var. glauca (Biessn.) Franco	Douglas fir
13.	Thuja plicata Donn	Western red cedar

APPENDIX II

RECORDED TREE DATA

B.C. FOREST SERVICE CRUISE TALLY SHEET

PAGE 1 OF 2

CT	LICENCE NO.	C.P. NO.	BLOCK	STRIP	PLOT	%C	TYPE NO.	AGE 10'S	HT. m
9			SITE		I				

MAIN PLOT SIZE (HECTARES or B A F, F/H, D B H LIMIT) — SUB-PLOT SIZE (HECTARES or B A F, F/H, D B H LIMIT)

Live limb / Stub: HEIGHT (METRES)

Card	Tree No.	Total Height (Metres)	Species	D.B.H. (Centimetres)	Tree Class	Conk	Blind Conk	Scar	Fork or Crook	Frost Crack	Mistletoe	Rotten Br.	D or B Top	Spiral Grain	Sweep	Lean	Live Limb	Stub	Knots 1st 5m	Knots 2nd 5m
2	01	28.7	F	72.2	3			4	2							0	8.2	6.1	0	12
	02	42.7	F	82.0	1												10.1	8.5	0	3
	03	18.3	F	67.5	3								3			2	8.2	8.2	0	10
	04	46.6	F	84.2	1												5.2	8.5	0	2
	05	52.7	F	133.6	1												10.1	9.1	0	1
	06	46.6	F	100.3	1												12.8	11.0	0	4
	07	38.4	F	75.1	1										1		11.3	11.3	0	0
	08	30.8	F	58.8	2	RESINOSUS											6.1	1.5	18	29
	09	43.9	F	89.1	1												17.4	6.1	0	3
	10	42.4	F	125.4	1												10.4	7.6	0	7
	11	31.4	F	59.0	1										0		15.5	7.0	0	3
	12	34.4	F	55.0	2				1								13.1	2.1	3	1

55.0
98.3 AT DBH

Card	Sample Tree Details: Tree No.	Height	Species	D.B.H.	C/C	Total Age	Counted Age	C&R	B.H.	Height Calculations: Top	Bot.	Total	S.D.	S	H.D.	HT.	COR.
3	02	42.7	F	82.0	1	250	240	10									
	07	38.4	F	75.1	2	204	194	10									
	11	31.4	F	59.0	2	156	146	10									

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B.C. FOREST SERVICE CRUISE TALLY SHEET

PAGE 2 OF 2

CT	LICENCE NO.	C.P. NO.	BLOCK	STRIP	PLOT	%C	TYPE NO.	AGE 10'S	HT. m
9			SITE		II				

MAIN PLOT SIZE (HECTARES or B A F, F/H, D B H LIMIT) — SUB-PLOT SIZE (HECTARES or B A F, F/H, D B H LIMIT)

Live limb / Stub: HEIGHT (METRES)

Card	Tree No.	Total Height (Metres)	Species	D.B.H. (Centimetres)	Tree Class	Conk	Blind Conk	Scar	Fork or Crook	Frost Crack	Mistletoe	Rotten Br.	D or B Top	Spiral Grain	Sweep	Lean	Live Limb	Stub	Knots 1st 5m	Knots 2nd 5m
2	13	19.8	F	32.5	3			1							2	2	4.6	4.3	2	22
	14	19.2	F	34.8	3				1								3.4	0.3	20	17
	15	17.1	F	56.0	3			1					3			1	4.3	2.1	12	26
	16	27.1	F	52.0	2												10.4	7.0	0	8
	17	22.9	F	53.0	3			1								2	6.5	3.0	10	25
	18	28.3	F	55.5	2												5.8	*	0	5
	19	30.2	F	71.3	2												7.3	7.3	0	6
	20	35.7	F	75.2	2												8.8	1.2	6	14
	21	15.8	F	41.6	3				3							2	6.1	1.8	5	9
	22	21.0	F	49.5	3				7						2	1	8.8	2.7	7	8
	23	33.2	F	64.7	2										2	1	9.4	9.4	0	3
	24	30.2	F	71.7	2				3						0	0	6.7	4.6	1	18

* NOTE NO STUBS

Card	Sample Tree Details: Tree No.	Height	Species	D.B.H.	C/C	Total Age	Counted Age	C&R	B.H.	Height Calculations: Top	Bot.	Total	S.D.	S	H.D.	HT.	COR.
3	16	27.1	F	52.0	2	195	180	15									
	17	22.9	F	53.0	3	190	175	15									
	23	33.2	F	64.7	2	280	265	15									

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TREE CLASS		PATH. CODE	QUALITY CODE				KNOT CODE (QUARTERS (Q) WITH KNOTS)				CROWN CLASS (C/C)	
1	Residual	1	Spiral Grain	0 = Absent	LEAN	0 = 0°-4.9°	0	NONE	3	THREE Q	1	DOMINANT
2	Suspect	2		1 = Present		1 = 5°-9.9°	1	ONE Q	4	FOUR Q	2	CO-DOMINANT
3	Dead Potential	3	Sweep	0 = None		2 = 10° +	2	TWO Q	5	Any Branch Over 10 cm.	3	INTERMEDIATE
4	Dead Useless	4		1 = Minor							4	SUPPRESSED
5	Veteran	5		2 = Major								
		6										

CONDITIONS AFFECTING APPRAISALS FOR THIS PLOT

CARD TYPE	SLOPE (Percent)		TERRAIN	ROUGHNESS: PLOT QUARTERS	ROUGHNESS NUMBER: .25 to .5 m	.5 to 1.0 m	1.0 m & over	DEPTH TO MINERAL SOIL (metres)		SOIL DEPTH (metres)		SOIL MATERIAL		SOIL MOISTURE	EXPOSED ROCK		DEFOLIATOR	BARK BEETLE	BRANCH MISTLETOE	VIGOUR	UNDERSTORY		WINDFALL		UNDERGROWTH
1	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39		48	49	50	51	52	53	54	55	56
4									•		•					SITE I									

SLOPE – record average percent slope for plot.

TERRAIN – record as coded 1 – Even 2 – Rolling 3 – Gullied 4 – Broken

ROUGHNESS – -Number of Plot Quarters with obstacles over .25 metres
-Number of obstacles by classes (record nine or more obstacles as 9)
-.004 hectares subplot

DEPTH TO MINERAL SOIL – record the depth of organic material in 0.1 metres

SOIL DEPTH – Depth to bedrock or hardpan in metres – tenths of metre required for first metre only.

SOIL MATERIAL – CODE AS
combinations are acceptable
(eg. 63 – gravel - silt)
10 – Organic Soil > .5 m deep.
20 – Clay 60 – Gravel
30 – Silt 70 – Cobble
40 – Loam 80 – Boulder
50 – Sand 90 – Exposed Bedrock

SOIL MOISTURE – CODE AS
1 – Dry 3 – Wet
2 – Moist 4 – Swampy

DEFOLIATORS / BARK BEETLE / BRANCH MISTLETOE – CODE AS 0 – None 1 – Light 2 – Moderate 3 – Heavy 4 – Past Occurance

VIGOUR – CODE AS 1 – Thrifty 2 – Average 3 – Decadent

UNDERSTORY – number of stems of commercial species below the minimum d.b.h. on a .004 ha subplot 3.60 m radius)

WINDFALL – number over 50% sound originating on a .004 ha subplot

UNDERGROWTH – CODE AS
1 – light – does not affect walking
2 – medium – affects walking
3 – heavy – difficult walking & influences work
4 – very heavy – very difficult walking & influences work greatly.

EXPOSED ROCK – CODE AS
0 – none
1 – light - 1-10% area affected
2 – moderate - 11 - 30% area affected
3 – heavy - 31% & over area affected
4 – rock bluffs or cliffs

REMARKS – other defects & quality, factors affecting logging.

VEGETATION (MAIN HERBACIOUS AND SHRUB SPECIES)

GROWTH RATES – (complete only when directed)

CARD	TREE NO.		RINGS LAST 2.5 cm			TEN YEAR GROWTH cm.			TREE NO.		RINGS LAST 2.5 cm			TEN YEAR GROWTH			TREE NO.		RINGS LAST 2.5 cm			TEN YEAR GROWTH		
1	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
5	0	2		2	9	0	•9	5	1	1		3	3	0	•9	5							•	
5	0	7		2	7	0	•9	5							•								•	

SNOW DEPTH ______ metres

CERTIFIED THAT THIS IS A TRUE STATEMENT OF SAMPLING DONE BY ME AT THE PLACE SHOWN.

DATE 08 79
MONTH YEAR

TREE CLASS		PATH. CODE	QUALITY CODE				KNOT CODE (QUARTERS (Q) WITH KNOTS)				CROWN CLASS (C/C)	
1	Residual	1	Spiral Grain	0 = Absent	LEAN	0 = 0°-4.9°	0	NONE	3	THREE Q	1	DOMINANT
2	Suspect	2		1 = Present		1 = 5°-9.9°	1	ONE Q	4	FOUR Q	2	CO-DOMINANT
3	Dead Potential	3	Sweep	0 = None		2 = 10° +	2	TWO Q	5	Any Branch Over 10 cm	3	INTERMEDIATE
4	Dead Useless	4		1 = Minor							4	SUPPRESSED
5	Veteran	5		2 = Major								
		6										
		7										

CONDITIONS AFFECTING APPRAISALS FOR THIS PLOT

CARD TYPE	SLOPE (Percent)		TERRAIN	ROUGHNESS: PLOT QUARTERS	ROUGHNESS NUMBER: .25 to .5 m	.5 to 1.0 m	1.0 m & over	DEPTH TO MINERAL SOIL (metres)		SOIL DEPTH (metres)		SOIL MATERIAL		SOIL MOISTURE	EXPOSED ROCK		DEFOLIATOR	BARK BEETLE	BRANCH MISTLETOE	VIGOUR	UNDERSTORY		WINDFALL		UNDERGROWTH
1	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39		48	49	50	51	52	53	54	55	56
4									•		•					SITE II									

SLOPE – record average percent slope for plot.

TERRAIN – record as coded 1 – Even 2 – Rolling 3 – Gullied 4 – Broken

ROUGHNESS – -Number of Plot Quarters with obstacles over .25 metres
-Number of obstacles by classes (record nine or more obstacles as 9)
-.004 hectares subplot

DEPTH TO MINERAL SOIL – record the depth of organic material in 0.1 metres

SOIL DEPTH – Depth to bedrock or hardpan in metres – tenths of metre required for first metre only.

SOIL MATERIAL – CODE AS
combinations are acceptable
(eg. 63 – gravel - silt)
10 – Organic Soil > .5 m deep
20 – Clay 60 – Gravel
30 – Silt 70 – Cobble
40 – Loam 80 – Boulder
50 – Sand 90 – Exposed Bedrock

SOIL MOISTURE – CODE AS
1 – Dry 3 – Wet
2 – Moist 4 – Swampy

DEFOLIATORS / BARK BEETLE / BRANCH MISTLETOE – CODE AS 0 – None 1 – Light 2 – Moderate 3 – Heavy 4 – Past Occurance

VIGOUR – CODE AS 1 – Thrifty 2 – Average 3 – Decadent

UNDERSTORY – number of stems of commercial species below the minimum d.b.h. on a .004 ha subplot 3.60 m radius)

WINDFALL – number over 50% sound originating on a .004 ha subplot

UNDERGROWTH – CODE AS
1 – light – does not affect walking
2 – medium – affects walking
3 – heavy – difficult walking & influences work
4 – very heavy – very difficult walking & influences work greatly

EXPOSED ROCK – CODE AS
0 – none
1 – light - 1-10% area affected
2 – moderate - 11 - 30% area affected
3 – heavy - 31% & over area affected
4 – rock bluffs or cliffs

REMARKS – other defects & quality, factors affecting logging.

VEGETATION (MAIN HERBACIOUS AND SHRUB SPECIES)

GROWTH RATES – (complete only when directed)

CARD	TREE NO.		RINGS LAST 2.5 cm			TEN YEAR GROWTH cm.			TREE NO.		RINGS LAST 2.5 cm			TEN YEAR GROWTH			TREE NO.		RINGS LAST 2.5 cm			TEN YEAR GROWTH		
1	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
5	1	6		3	9	0	•3	2	2	3		5	7	0	•4	8							•	
5	1	7		5	2	0	•1	6							•								•	

SNOW DEPTH ______ metres

CERTIFIED THAT THIS IS A TRUE STATEMENT OF SAMPLING DONE BY ME AT THE PLACE SHOWN.

DATE 08 79
MONTH YEAR

APPENDIX III

PHOTOGRAPHIC RECORD OF STUDY TREES

TREE PAIR 1

TREE A OR # 1

MEAN AESTHETIC RATING: 5.059

DESCRIPTION

Total Height: 28.7 m.

DBH: 72.2 cm.

Timber Quality Class: 3

Pathological Remarks: Scars on lower 2/3 of tree; fork in middle 1/3.

Quality Remarks: None

Height to first live limb: 8.2 m.

Height to first stub: 6.1 m.

Knots in first 5 meters: 0

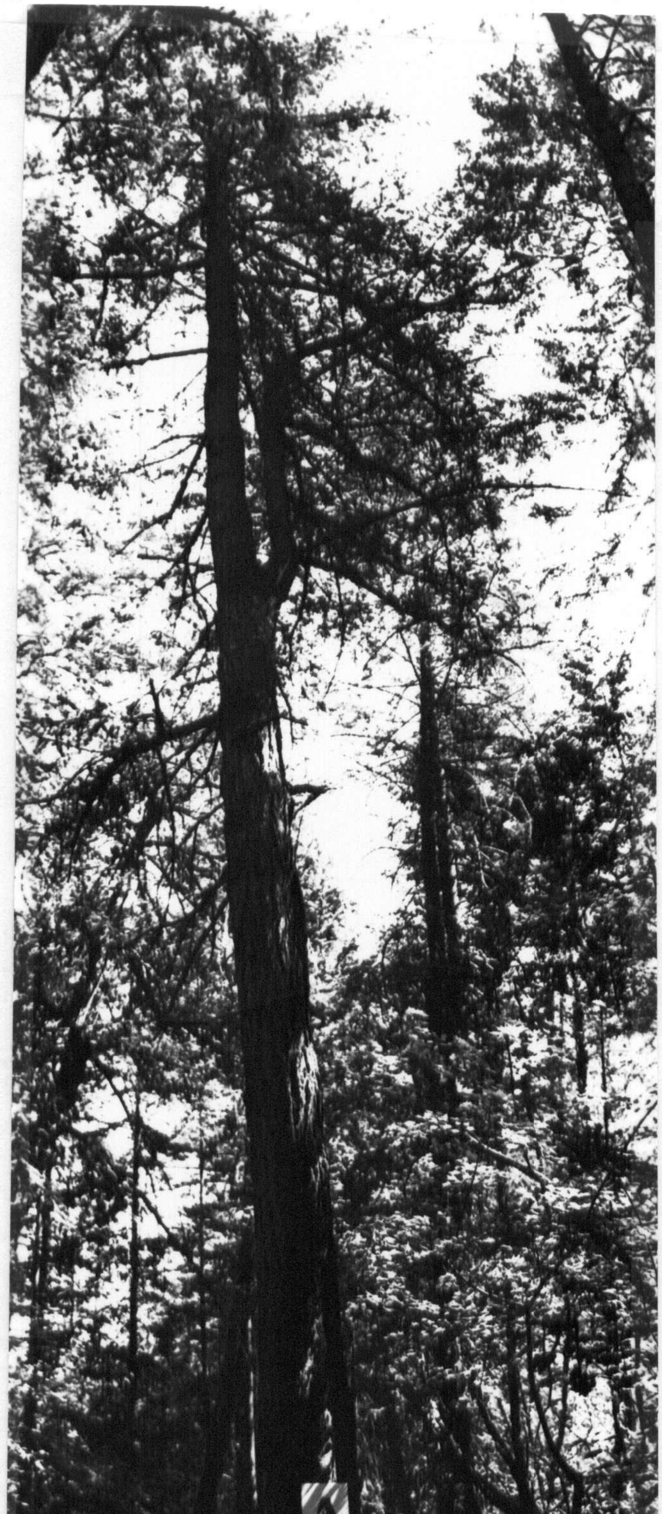
Knots in second 5 meters: 12

Distance from viewpoint: 7.6 m.

Azimuth from viewpoint: 130°

COMMENTS

A deep 2 meter long fire scar could be seen on the lower 1/3 of the bole. This tree was the closest of all selected trees to its viewpoint.


A

TREE PAIR 1

TREE B OR # 2

MEAN AESTHETIC RATING: 6.486

DESCRIPTION

Total Height: 42.7 m.

DBH: 82.0 cm.

Timber Quality Class: 1

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 10.1 m.

Height to first stub: 8.5 m.

Knots in first 5 meters: 0

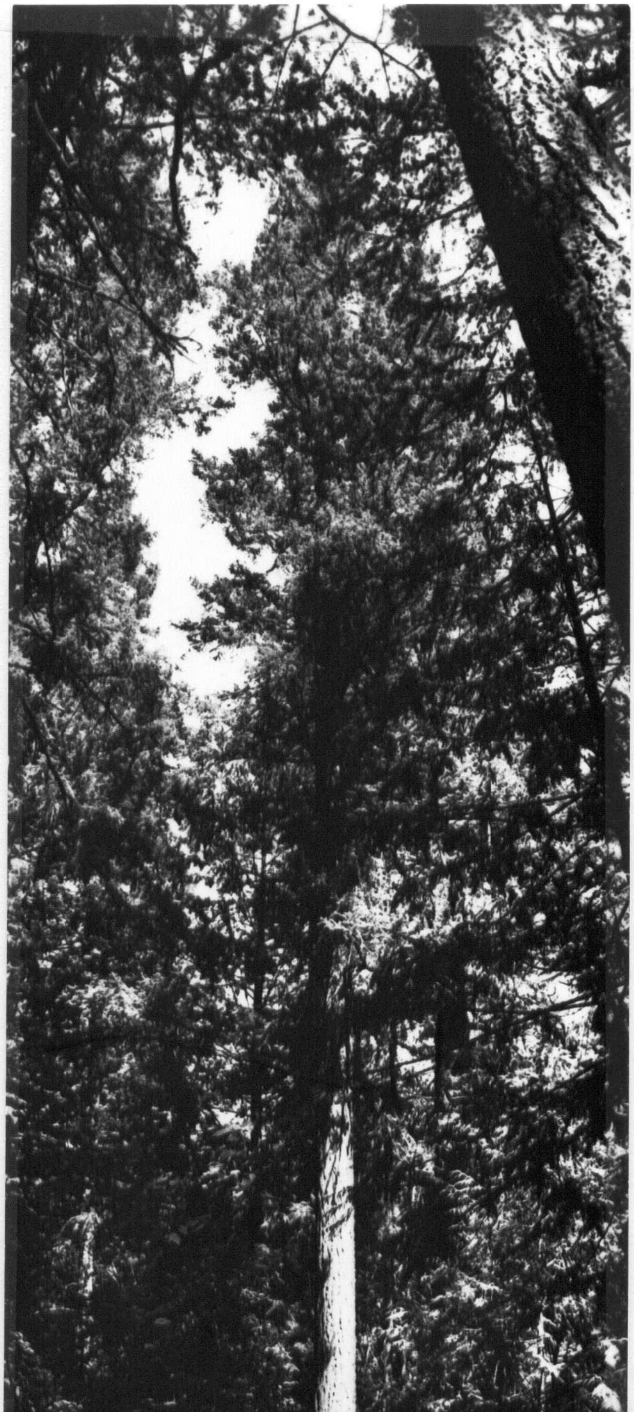
Knots in second 5 meters: 3

Distance from viewpoint: 18.9 m.

Azimuth from viewpoint: 22°

COMMENTS

This tree leaned the least of all selected trees. It had a long, full crown and was surrounded by dense undergrowth.



TREE PAIR 2

TREE A OR # 3

MEAN AESTHETIC RATING: 4.853

DESCRIPTION

Total Height: 18.3 m.

DBH: 67.5 cm.

Timber Quality Class: 3

Pathological Remarks: Broken top.

Quality Remarks: Lean (> 10° from vertical)

Height to first live limb: 8.2 m.

Height to first stub: 8.2 m.

Knots in first 5 meters: 0

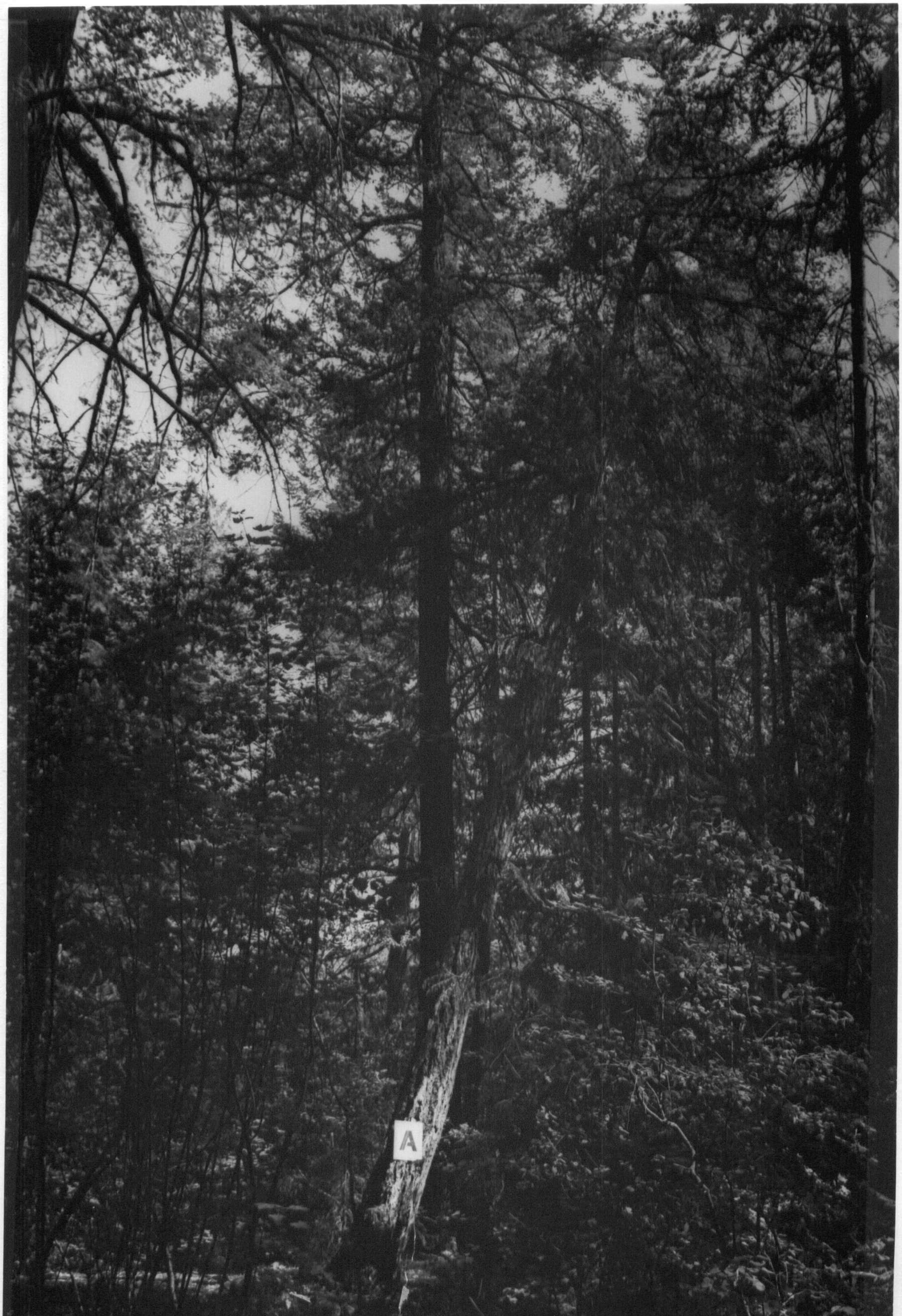
Knots in second 5 meters: 10

Distance from viewpoint: 18.0 m.

Azimuth from viewpoint: 125°

COMMENTS

This tree received flecked sunlight only. Its extreme lean provided contrast in the stand.


A

TREE PAIR 2

TREE B OR # 4

MEAN AESTHETIC RATING: 5.714

DESCRIPTION

Total height: 46.6 m.

DBH: 84.2 cm.

Timber Quality Class: 1

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 15.2 m.

Height to first stub: 8.5 m.

Knots in first 5 meters: 0

Knots in second 5 meters: 2

Distance from viewpoint: 20.1 m.

Azimuth from viewpoint: 354°

COMMENTS

This tree looked like tree #2 except for a clump of dead branches that disrupted the continuity of its crown. Dense undergrowth surrounded it.

TREE PAIR 3

TREE A OR # 5

MEAN AESTHETIC RATING: 7.457

DESCRIPTION

Total Height: 52.7 m.

DBH: 133.6 cm.

Timber Quality Class: 1

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 10.1 m.

Height to first stub: 9.1 m.

Knots in first 5 meters: 0

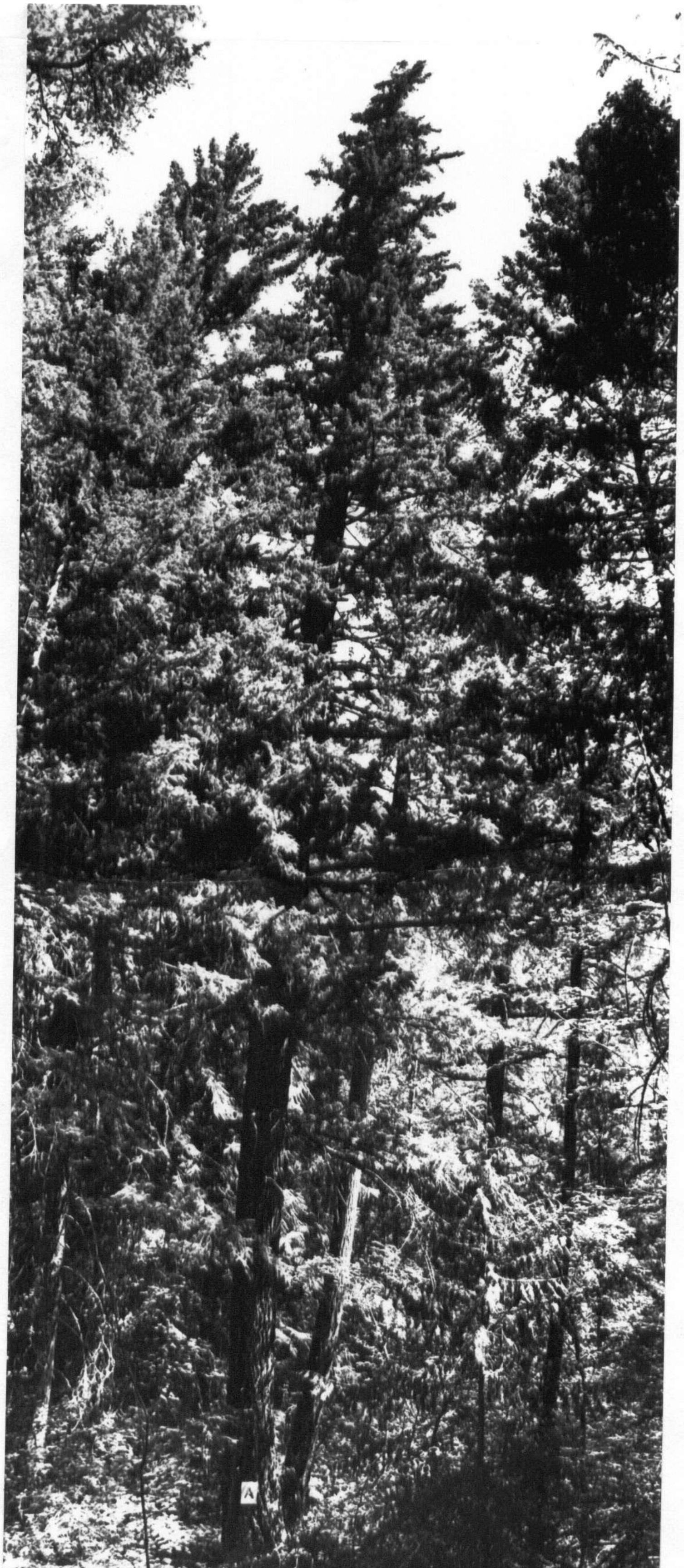
Knots in second 5 meters: 1

Distance from viewpoint: 27.7 m.

Azimuth from viewpoint: 76°

COMMENTS

This was the largest of the selected trees. It had a long, full and tapered crown. Black streaks were on its base, evidence of long past groundfires.



TREE PAIR 3

TREE B OR # 6

MEAN AESTHETIC RATING: 5.886

DESCRIPTION

Total Height: 46.6 m.

DBH: 100.3 cm.

Timber Quality Class; 1

Pathological Renarks: None

Quailty Remarks: None

Height to first live limb: 12.8 m.

Height to first stub: 11.0 m.

Knots in first 5 meters: 0

Knots in second 5 meters: 4

Distance from viewpoint: 27.7 m.

Azimuth from viewpont: 268°

COMMENTS

This tree was on the edge of a forest opening and was either front or sidelit. An old creekbed could be seen in the foreground. Other tree species surrounded it.


B

TREE PAIR 4

TREE A OR # 7

MEAN AESTHETIC RATING: 5.086

DESCRIPTION

Total Height: 38.4 m.

DBH: 75.1 cm.

Timber Quality Class: 1

Pathological Remarks; None.

Quality Remarks: Minor sweep ($<$10 cm./5 m.)

Height to first live limb: 11.3 m.

Height to first stub: 11.3 m.

Knots in first 5 meters: 0

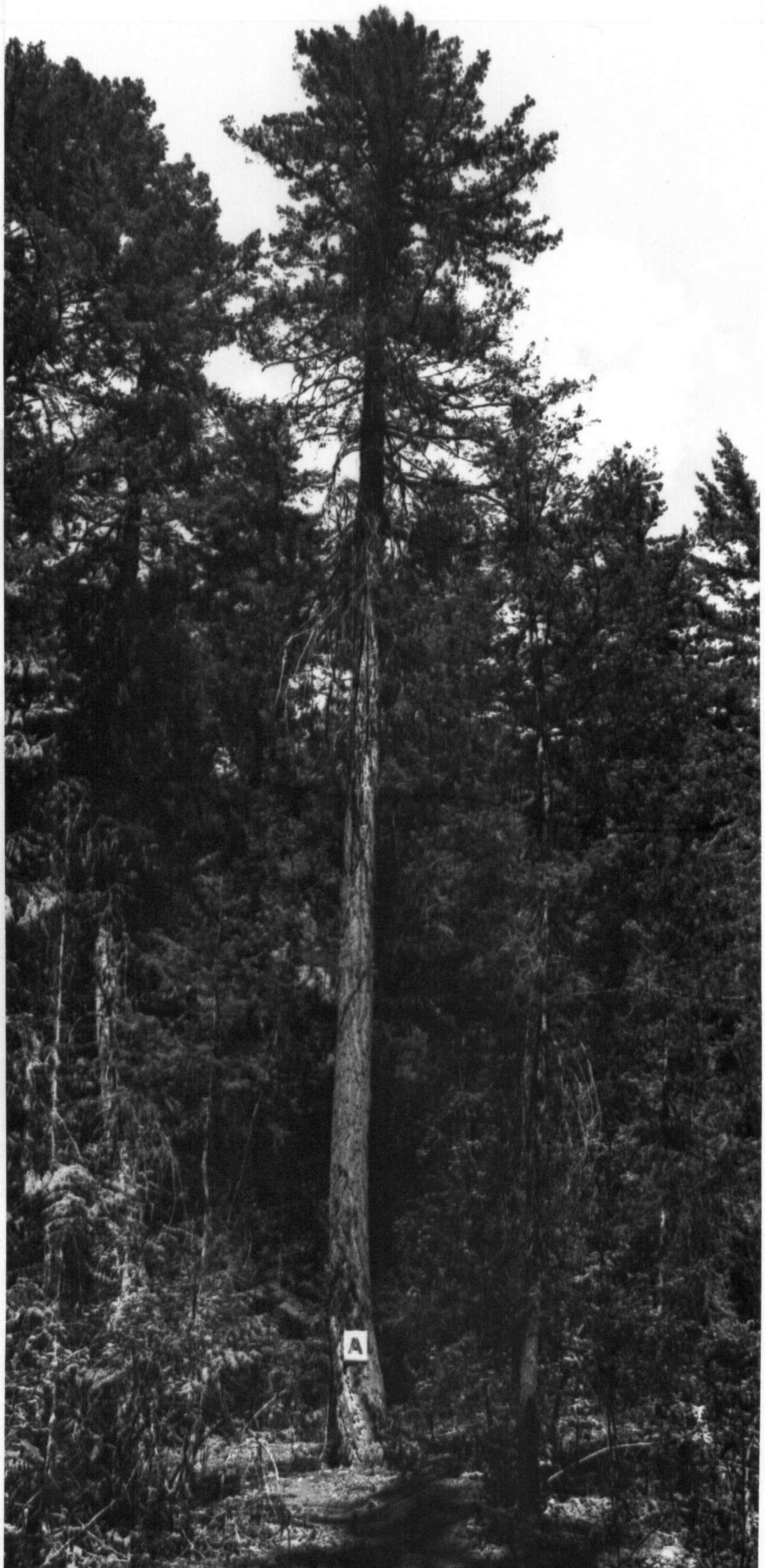
Knots in second 5 meters: 0

Distance from viewpoint: 14.6 m.

Azimuth from viewpoint: 347°

COMMENTS

This tree bordered the same forest opening as tree #6, and stood next to the trail.


A

TREE PAIR 4

TREE B OR # 8

MEAN AESTHETIC RATING: 4.857

DESCRIPTION

Total Height: 30.8 m.

DBH: 58.8 cm.

Timber Quality Class: 2

Pathological Remarks: Resinosus on lower portion of bole.

Quality Remarks: None

Height to first live limb: 6.1 m.

Height to first stub: 1.5 m.

Knots in first 5 meters: 18

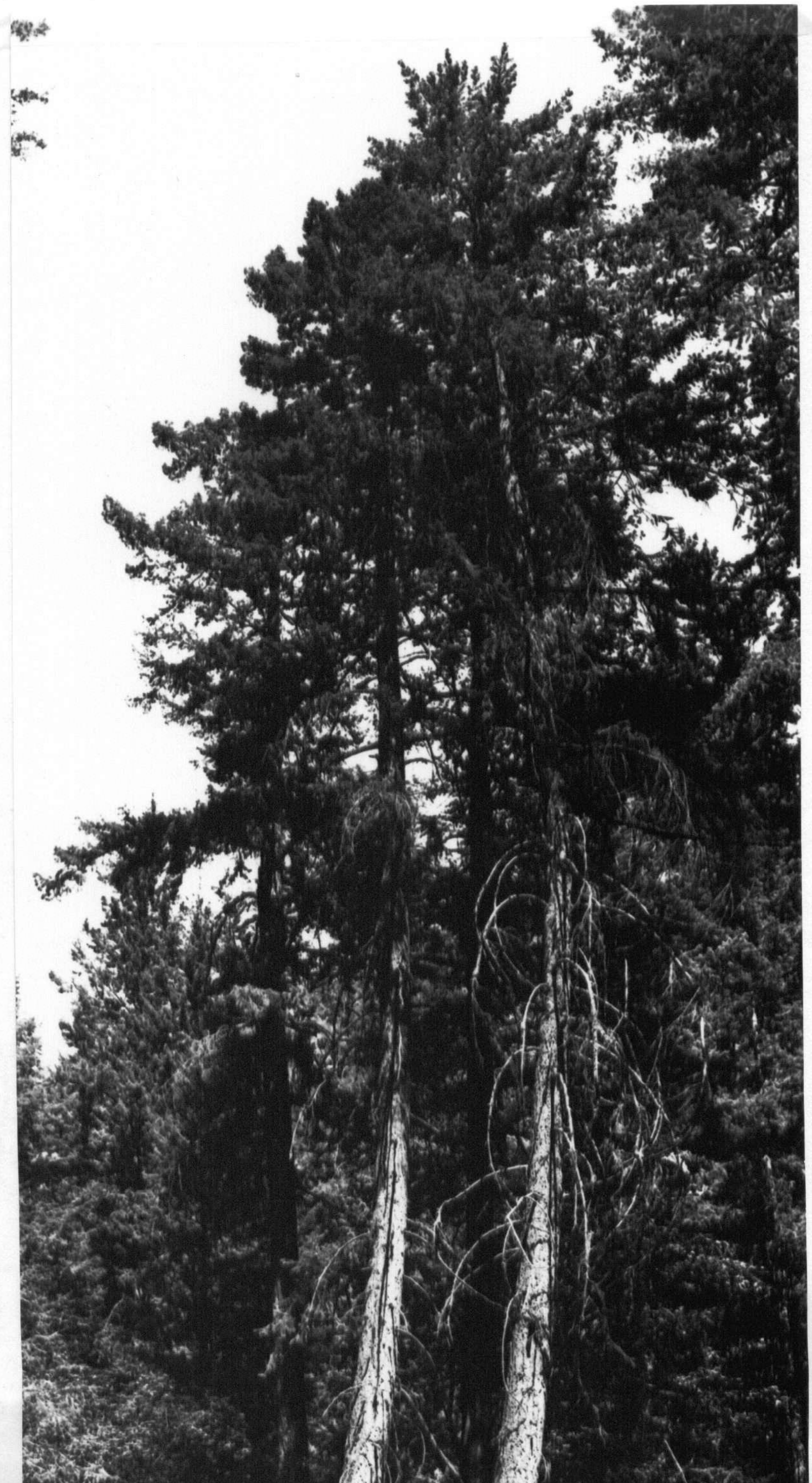
Knots in second 5 meters: 29

Distance from viewpoint: 14.6 m.

Azimuth from viewpoint: 40°

COMMENTS

Compared to tree #7, this tree was rougher barked at its base, and its background was more open and varied in tree size. Its crown melded with two others.


B

TREE PAIR 5

TREE A OR # 9

MEAN AESTHETIC RATING: 6.242

DESCRIPTION

Total Height: 43.9 m.

DBH: 89.1 cm.

Timber Quality Class: 1

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 17.4 m.

Height to first stub: 6.1 m.

Knots in first 5 meters: 0

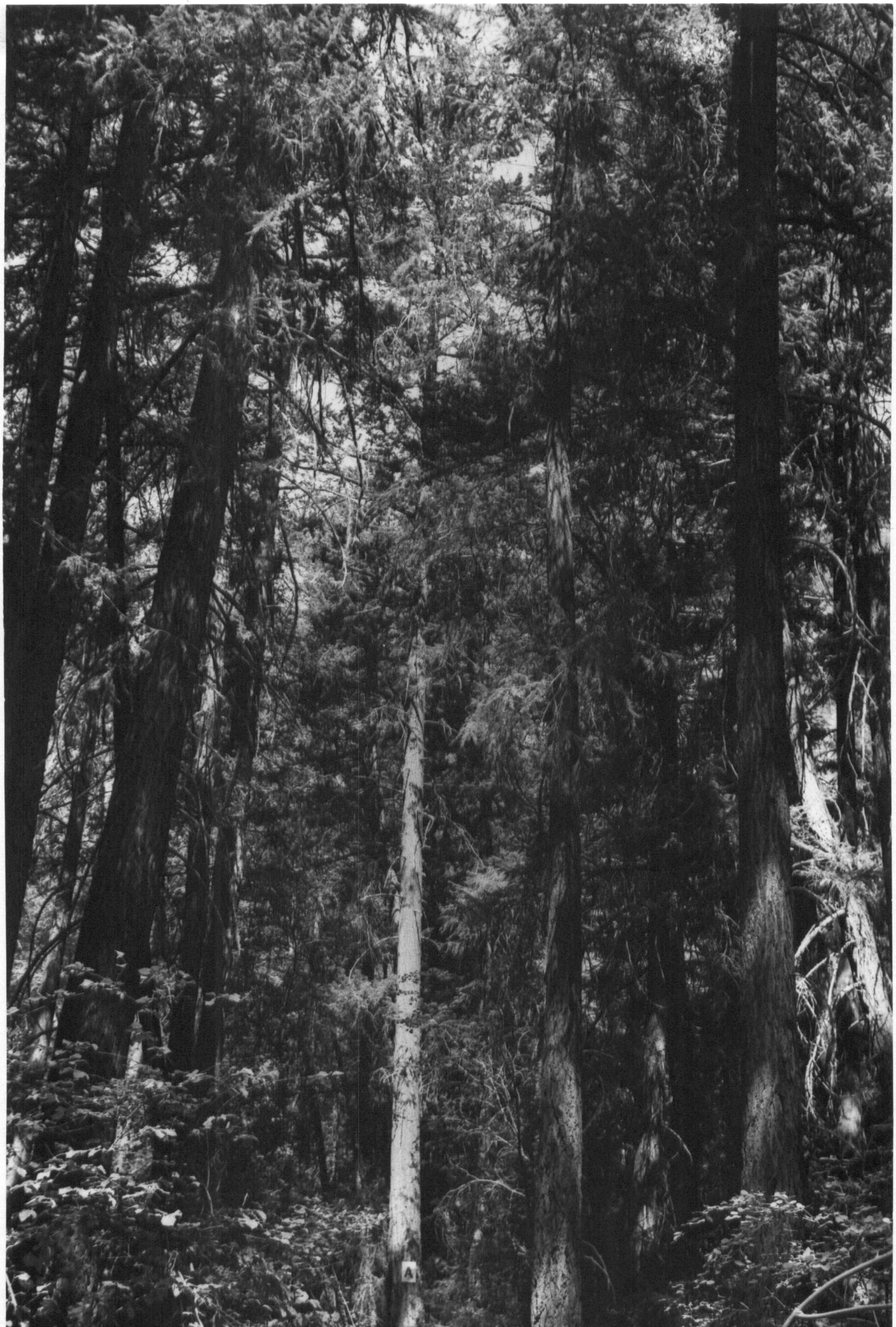
Knots in second 5 meters: 3

Distance from viewpoint: 33.5 m.

Azimuth from viewpoint: 338°

COMMENTS

This tree had a sparse crown. It could be more readily seen in situ than this photo depicts.



TREE PAIR 5

TREE B OR # 10

MEAN AESTHETIC RATING: 5.857

DESCRIPTION

Total Height: 42.4 m.

DBH: 125.4 cm.

Timber Quality Class: 1

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 10.4 m.

Height to first stub: 7.6 m.

Knots in first 5 meters: 0

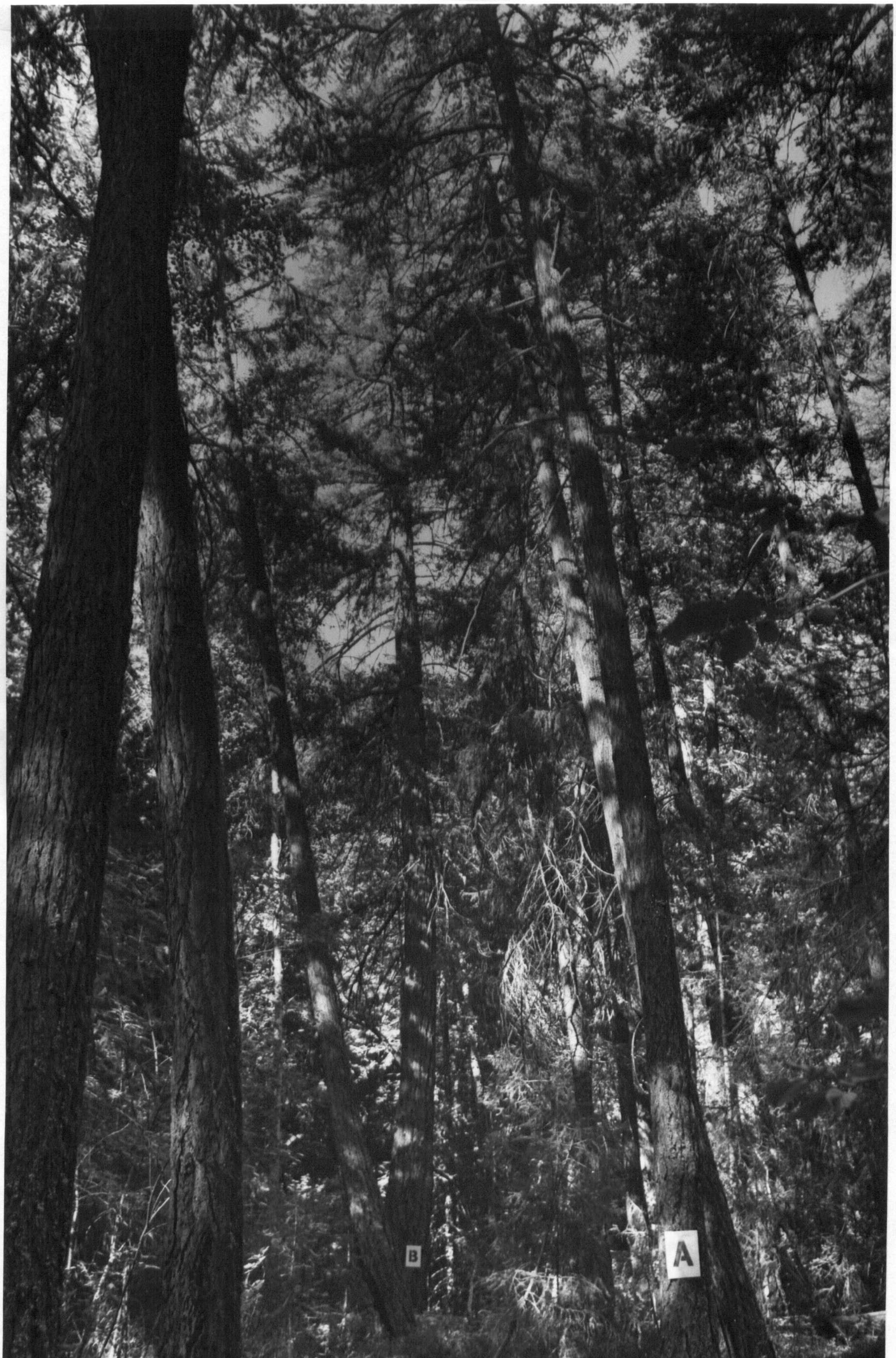
Knots in second 5 meters: 7

Distance from viewpoint: 35.1 m.

Azimuth from viewpoint: 245°

COMMENTS

The lower half of this tree was normally in shade, and its crown was normally in full sunlight. Its bark was deeply furrowed. A smaller stand of trees could be seen behind it. This tree could be more readily seen in situ than this photo illustrates.


B
A

TREE PAIR 6

TREE A OR # 11

MEAN AESTHETIC RATING: 4.676

DESCRIPTION

Total Height: 31.4 m.

DBH: 59.0 cm.

Timber Quality Class: 1

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 15.5 m.

Height to first stub: 7.0 m.

Knots on first 5 meters: 0

Knots in second 5 meters: 3

Distance from viewpoint: 13.7 m.

Azimuth from viewpoint: 266°

COMMENTS

This was the smallest of the timber quality class 1 trees. It had a short, sparse crown and grew next to the trail.


A

TREE PAIR 6

TREE B OR # 12

MEAN AESTHETIC RATING: 6.382

DESCRIPTION

Total Height: 34.4 m.

DBH: 55.0 cm.

Timber Quality Class: 2

Pathological Remarks: Fork in lower 1/3

Quality Remarks: None

Height to first live limb: 13.1 m.

Height to first stub: 2.1 m.

Knots in first 5 meters: 3

Knots in second 5 meters: 1

Distance from viewpoint: 16.2 m.

Azimuth from viewpoint: 297°

COMMENTS

This tree had the unique feature of a lower fork. Both stems had full but short crowns. A younger tree stand could be seen behind it.


3

TREE PAIR 7

TREE A OR # 13

MEAN EASTHETIC RATING: 3.829

DESCRIPTION

Total Height: 19.8 m.

DBH: 32.5 cm.

Timber Quality Class: 3

Pathological Remarks: Scar in lower 1/3

Quality Remarks: Major sweep (> 10 cm./5 m.);
Lean (> 10° from vertical)

Height to first live limb: 4.6 m.

Height to first stub: 4.3 m.

Knots in first 5 meters: 2

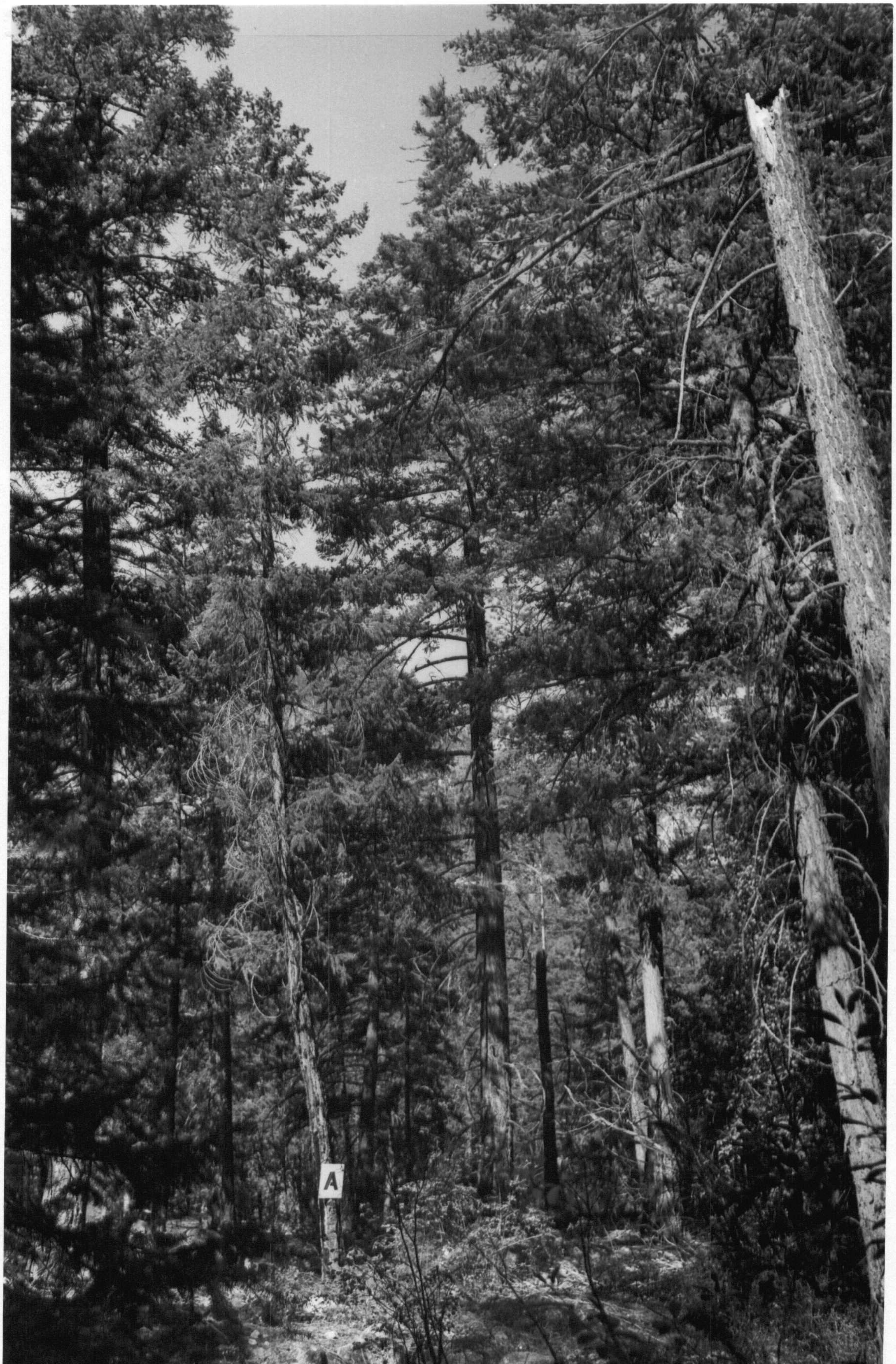
Knots in second 5 meters: 22

Distance from viewpoint: 15.5 m.

Azimuth from viewpoint: 247°

COMMENTS

This was the smallest of all the selected trees. It had a fire scar running 3 meters up its base and numerous dead lower branches.


A

TREE PAIR 7

TREE B OR # 14

MEAN AESTHETIC RATING: 5.514

DESCRIPTION

Total Height: 19.2 m.

DBH: 34.8 cm.

Timber Quality Class: 3

Pathological Remarks: Crook in lower 1/3

Quality Remarks: None

Height to first live limb: 3.4 m.

Height to first stub: 0.3 m.

Knots in first 5 meters: 20

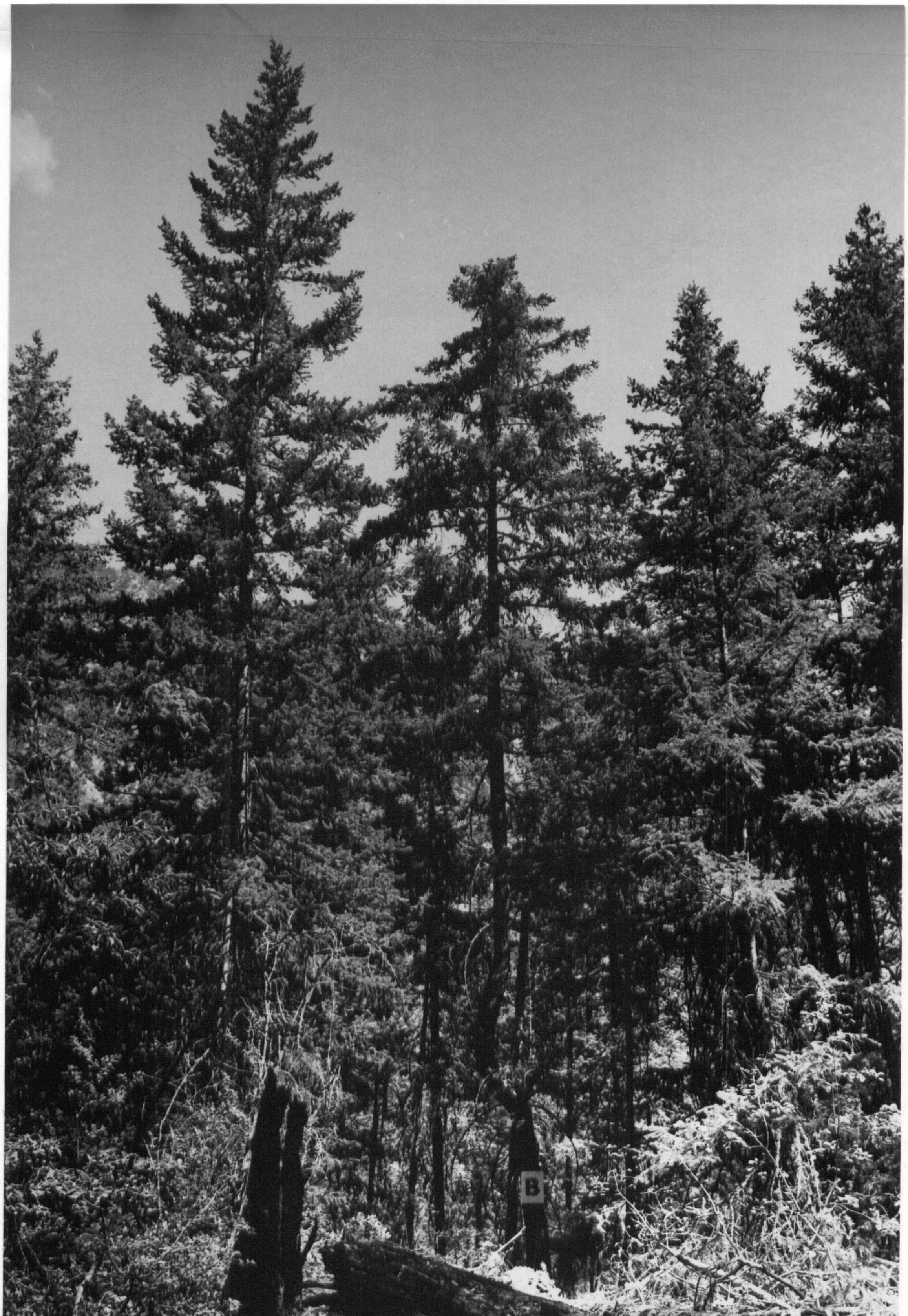
Knots in second 5 meters: 17

Distance from viewpoint: 21.0 m.

Azimuth from viewpoint: 82°

COMMENTS

This tree had a unique crook and numerous dead lower branches. It received side an backlighting only. Charred tree trunks were in the foreground and an expanse of sky could be seen in the background.


B

TREE PAIR 8

TREE A OR # 15

MEAN AESTHETIC RATING: 4.886

DESCRIPTION

Total Height: 17.1 m.

DBH: 56.0 cm.

Timber Quality Class: 3

Pathological Remarks: Scar in lower 1/3; dead top.

Quality Remarks: Lean (0°-4.9° from vertical)

Height to first live limb: 4.3 m.

Height to first stub: 2.1 m.

Knots in first 5 meters: 12

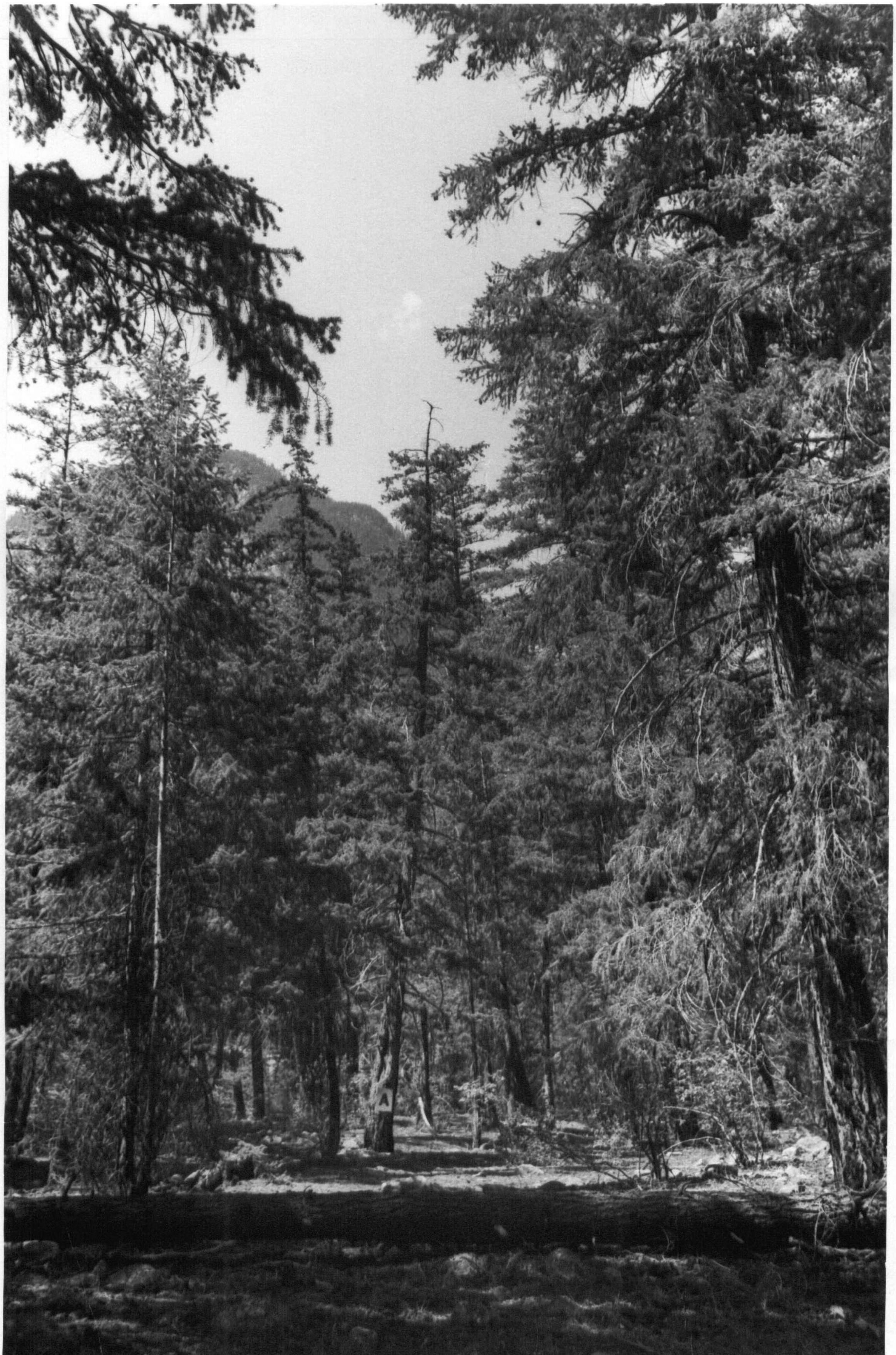
Knots in second 5 meters: 26

Distance from viewpoint: 36.6 m.

Azimuth from viewpoint: 262°

COMMENTS

This tree had a prominent fire scar on its lower trunk. Trees of similar height surrounded it. It was furthest, of all selected trees, from the viewpoint.



TREE PAIR 8

TREE B OR # 16

MEAN AESTHETIC RATING: 5.629

DESCRIPTION

Total Height: 27.1 m.

DBH: 52.0 cm.

Timber Quality Class: 2

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 10.4 m.

Height to first stub: 7.0 m.

Knots in first 5 meters: 0

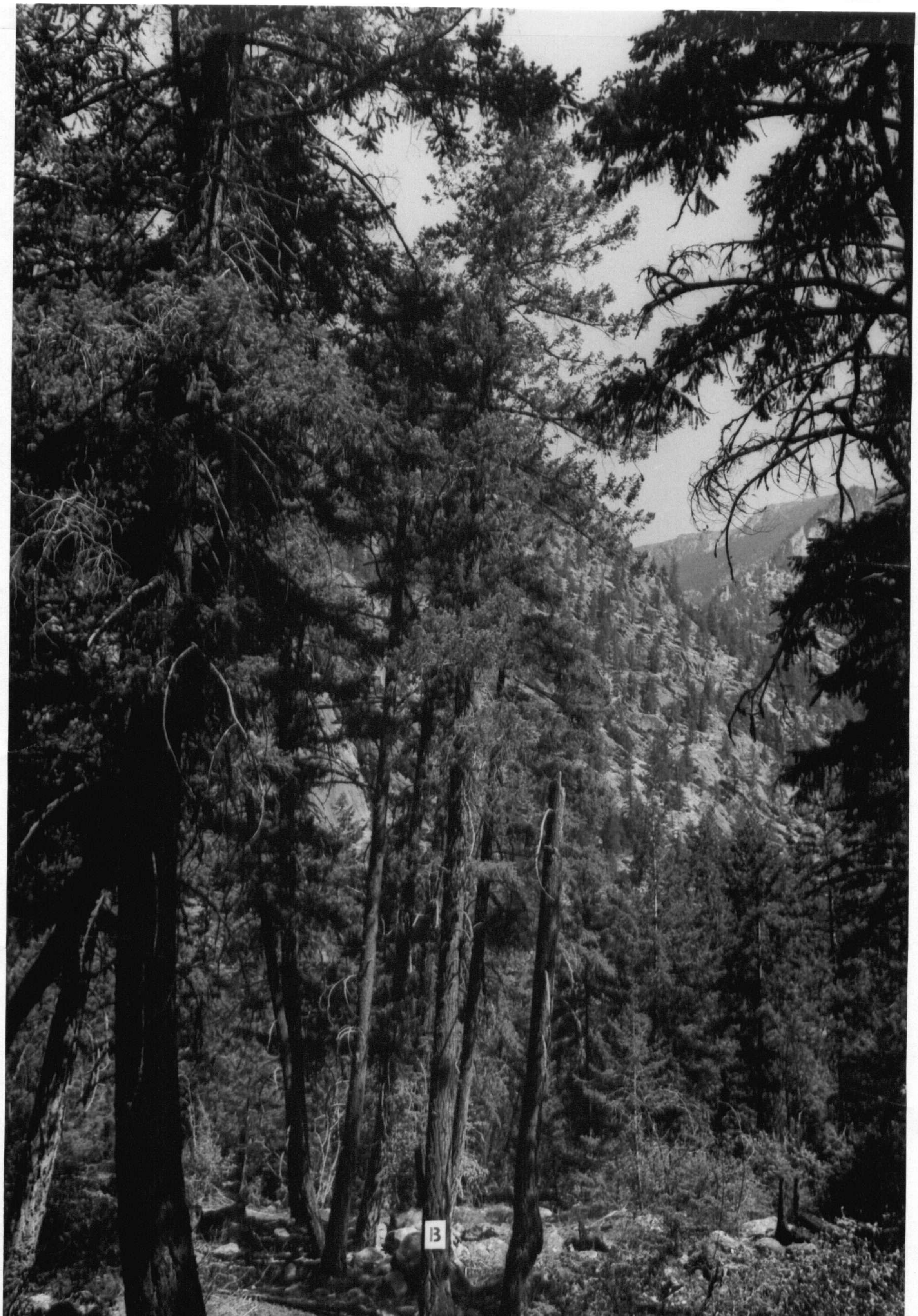
Knots in second 5 meters: 8

Distance from viewpoint: 16.8 m.

Azimuth from viewpoint: 30°

COMMENTS

This tree had good growth form. Mountain slopes and ridges could be readily seen in the background.


B

TREE PAIR 9

TREE A OR # 17

MEAN AESTHETIC RATING: 5.171

DESCRIPTION

Total Height: 22.9 m.

DBH: 53.0 cm.

Timber Quality Class: 3

Pathological Remarks: Scar in lower 1/3

Quality Remarks: Lean ($>10°$ from vertical)

Height to first live limb: 5.5 m.

Height to first stub: 3.0 m.

Knots in first 5 meters: 10

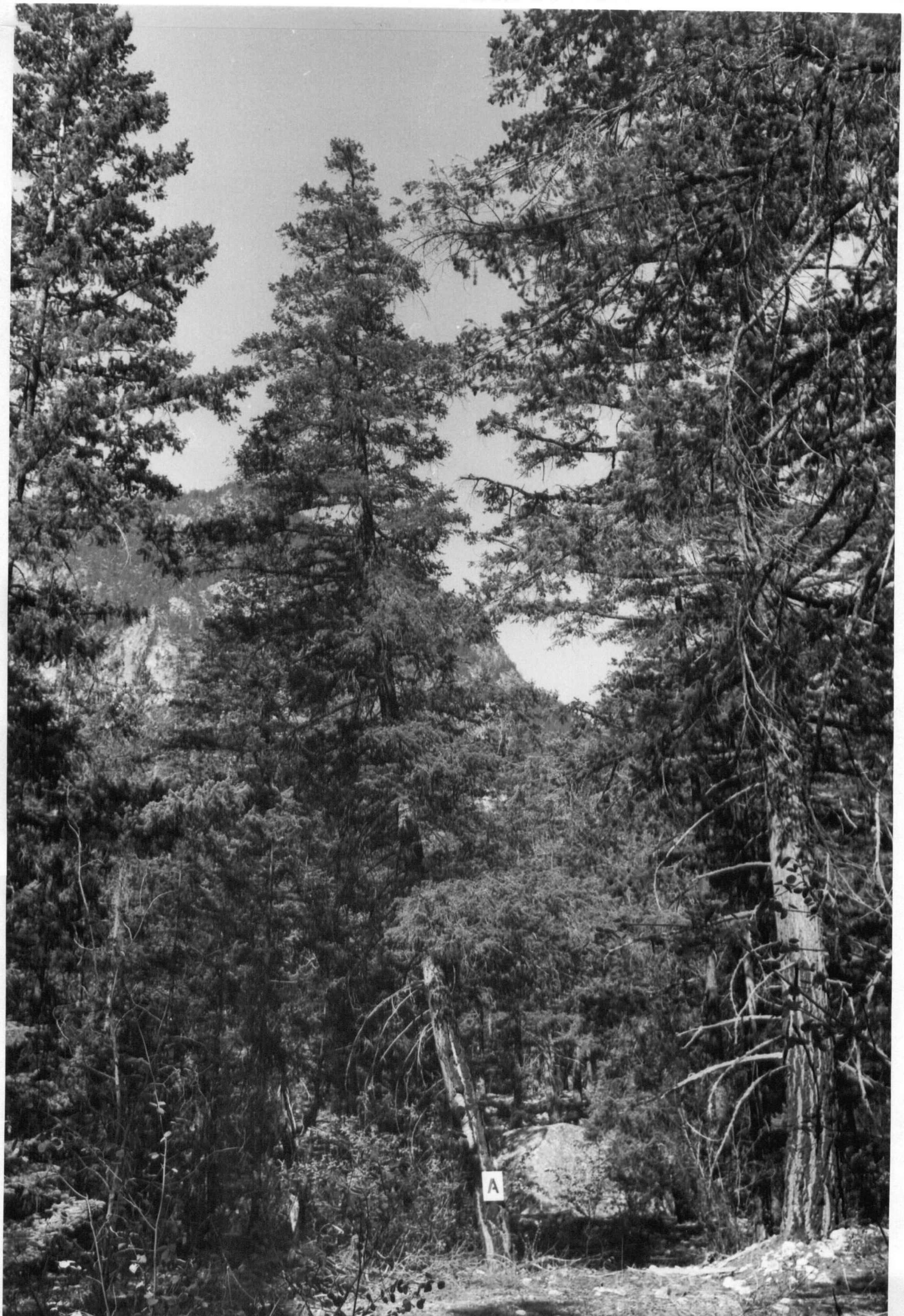
Knots in second 5 meters: 25

Distance from viewpoint: 19.2 m.

Azimuth from viewpoint: 267°

COMMENTS

This tree grew on the edge of a swale. A huge boulder added interest to its background.


A

TREE PAIR 9

TREE B OR # 18

MEAN AESTHETIC RATING: 6.343

DESCRIPTION

Total Height: 28.3 m.

DBH: 55.5 cm.

Timber Quality Class: 2

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 5.8 m.

Height to first stub: no stubs present

Knots in first 5 meters: 0

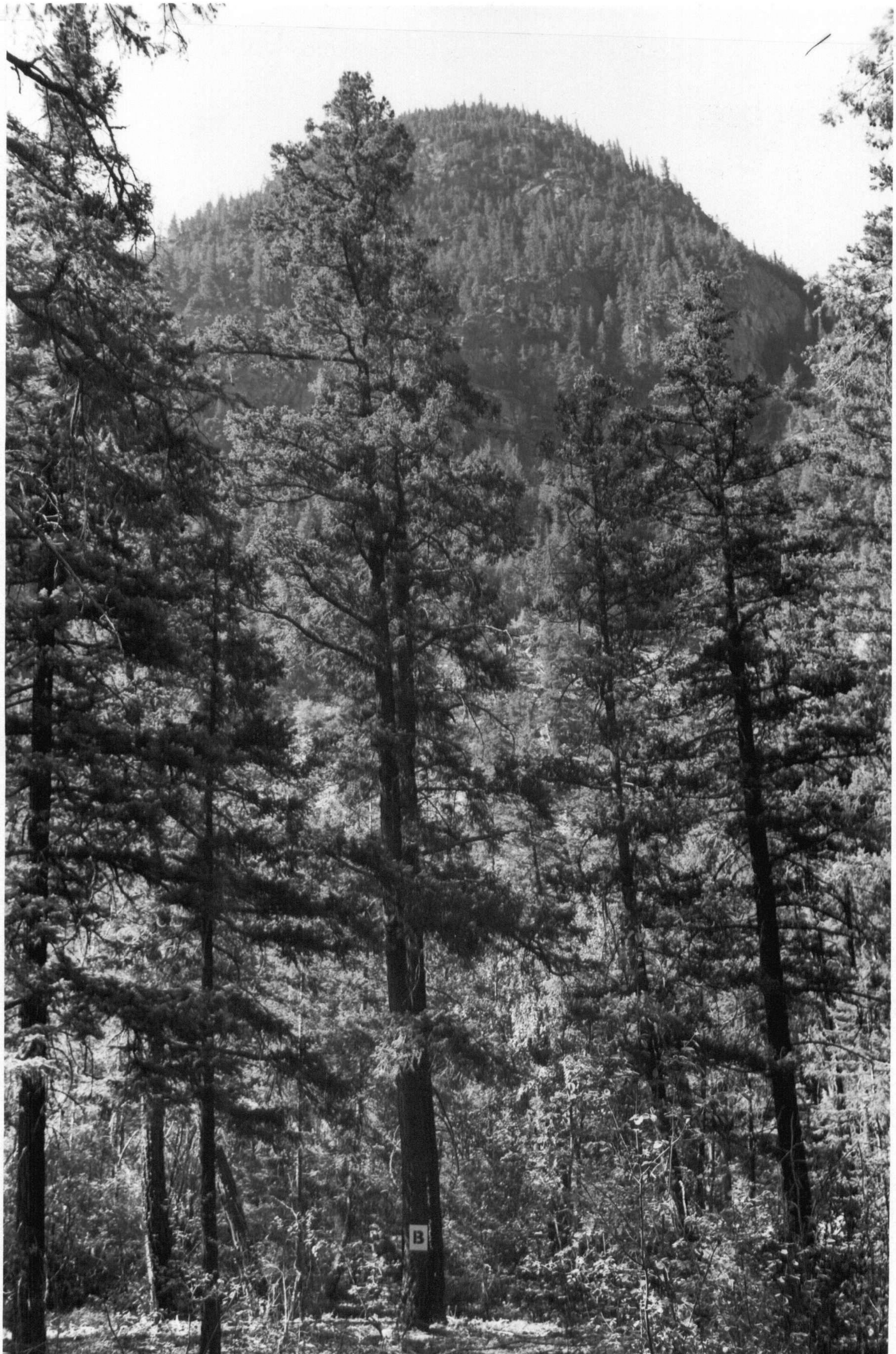
Knots in second 5 meters: 5

Distance from viewpoint: 17.7 m.

Azimuth from viewpoint: 180°

COMMENTS

This tree had good growth form and no dead branches. A mountain top and younger stand could be seen in the background.


B

TREE PAIR 10

TREE A OR # 19

MEAN AESTHETIC RATING: 6.143

DESCRIPTION

Total Height: 30.2 m.

DBH: 71.3 cm.

Timber Quality Class: 2

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 7.3 m.

Height to first stub: 7.3 m.

Knots in first 5 meters: 0

Knots in second 5 meters: 6

Distance from viewpoint: 29.3 m.

Azimuth from viewpoint: 217°

COMMENTS

This tree had good growth form. It received only side and backlighting. It had a light background.


A

TREE PAIR 10

TREE B OR # 20

MEAN AESTHETIC RATING: 6.314

DESCRIPTION

Total Height: 35.7 m.

DBH: 75.2 cm.

Timber Quality Class: 2

Pathological Remarks: None

Quality Remarks: None

Height to first live limb: 8.8 m.

Height to first stub: 1.2 m.

Knots in first 5 meters: 6

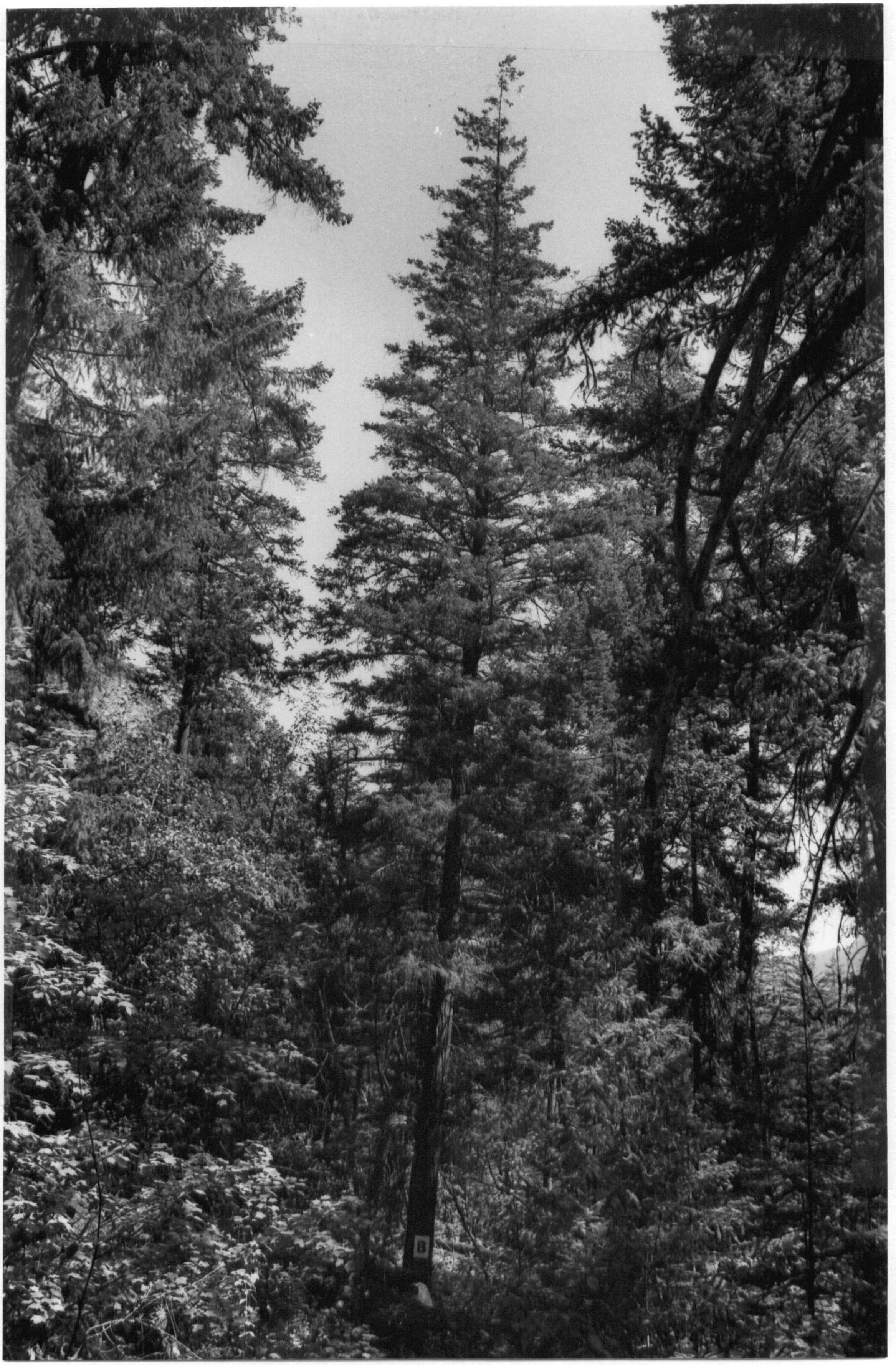
Knots in second 5 meters: 14

Distance from viewpoint: 33.5 m.

Azimuth from viewpoint: 112°

COMMENTS

This tree grew in a small depression. It had a symmetrical crown and was the tallest of the site II trees.



TREE PAIR 11

TREE A OR # 21

MEAN AESTHETIC RATING: 4.829

DESCRIPTION

Total Height: 15.8 m.

DBJ: 41.6 cm.

Timber Quality Class: 3

Pathological Remarks: Crook at top

Quality Remarks: Lean (> 10° from vertical)

Height to first live limb: 6.1 m.

Height to first stub: 1.8 m.

Knots in first 5 meters: 5

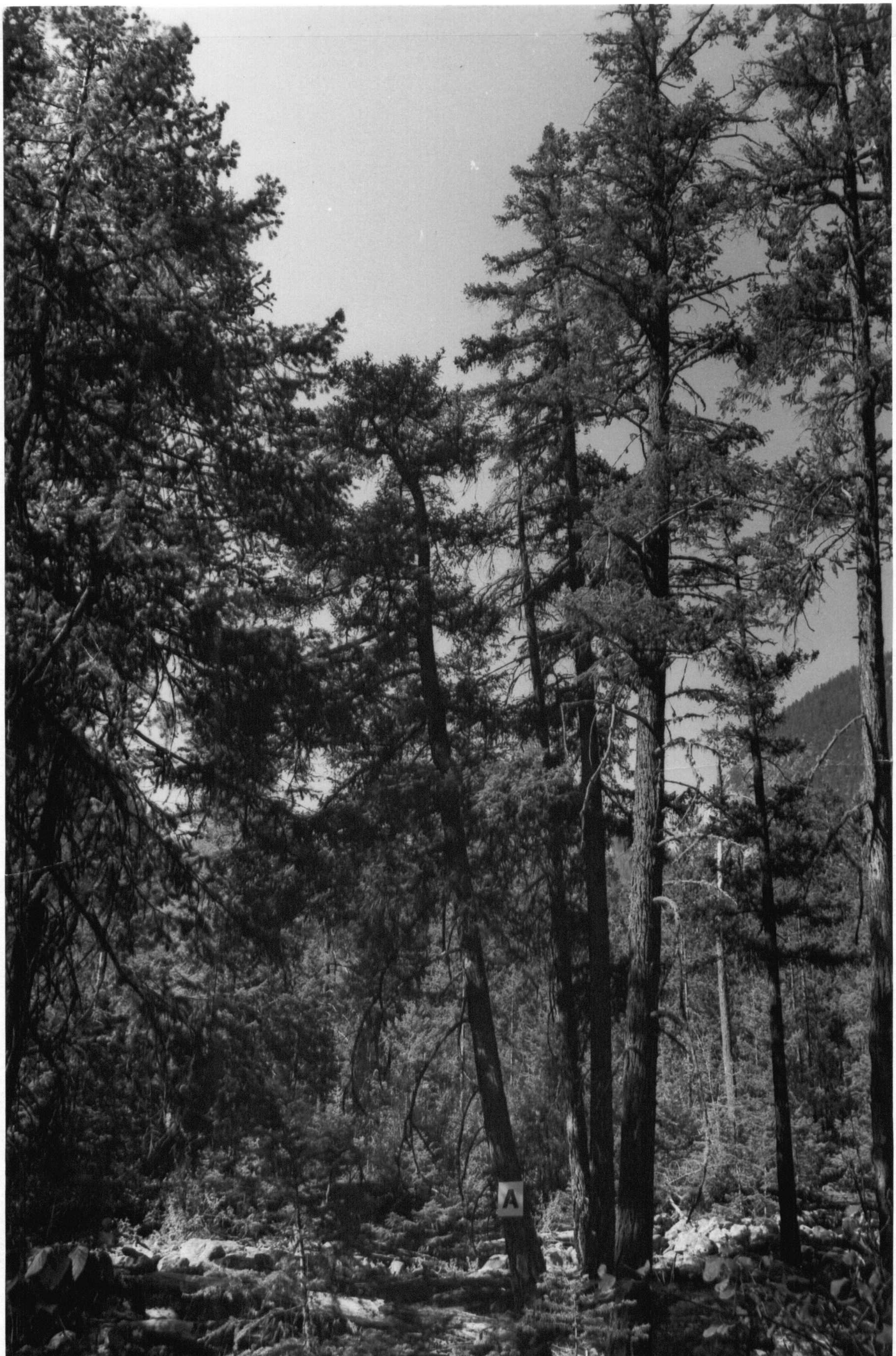
Knots in second 5 meters: 9

Distance from viewpoint: 20.1 m.

Azimuth from viewpoint: 232°

COMMENTS

This tree had a denser crown than tree #22. It had a light background in which a young tree stand and mountain ridge could be seen.


A

TREE PAIR 11

TREE B OR # 22

MEAN AESTHETIC RATING: 4.943

DESCRIPTION

Total Height: 21.0 m.

DBH: 49.5 cm.

Timber Quality Class: 3

Pathological Remarks: Crooks in all 3 thirds of tree

Quality Remarks: Sweep ($<$10 cm./5 m.);

Lean (5°-9.9° from vertical)

Height to first live limb: 8.8 m.

Height to first stub: 2.7 m.

Knots in first 5 meters: 7

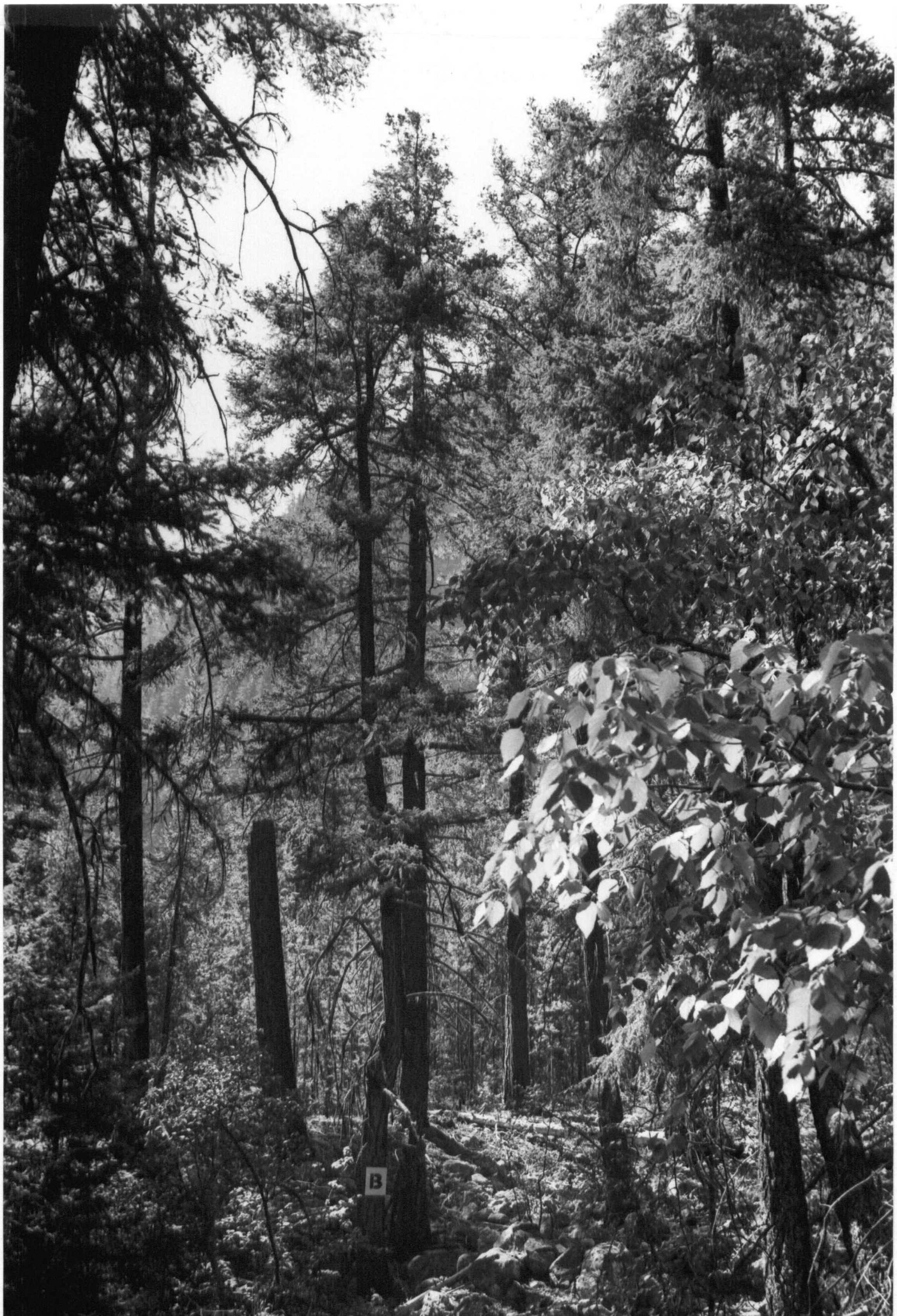
Knots in second 5 meters: 8

Distance from viewpoint: 25.6 m.

Azimuth from viewpoint: 166°

COMMENTS

This tree received only side and backlighting. A mountainside, high stump and young tree stand could be seen in the background.


B

TREE PAIR 12

TREE A OR # 23

MEAN AESTHETIC RATING: 6.571

DESCRIPTION

Total Height: 33.2 m.

DBH: 64.7 cm.

Timber Quality Class: 2

Pathological Remarks: None

Quality Remarks: Sweep ($<$ 10 cm./5 m.)

Lean (5° - 9.9° from vertical)

Height to first live limb: 9.4 m.

Height to first stub: 9.4 m.

Knots in first 5 meters: 0

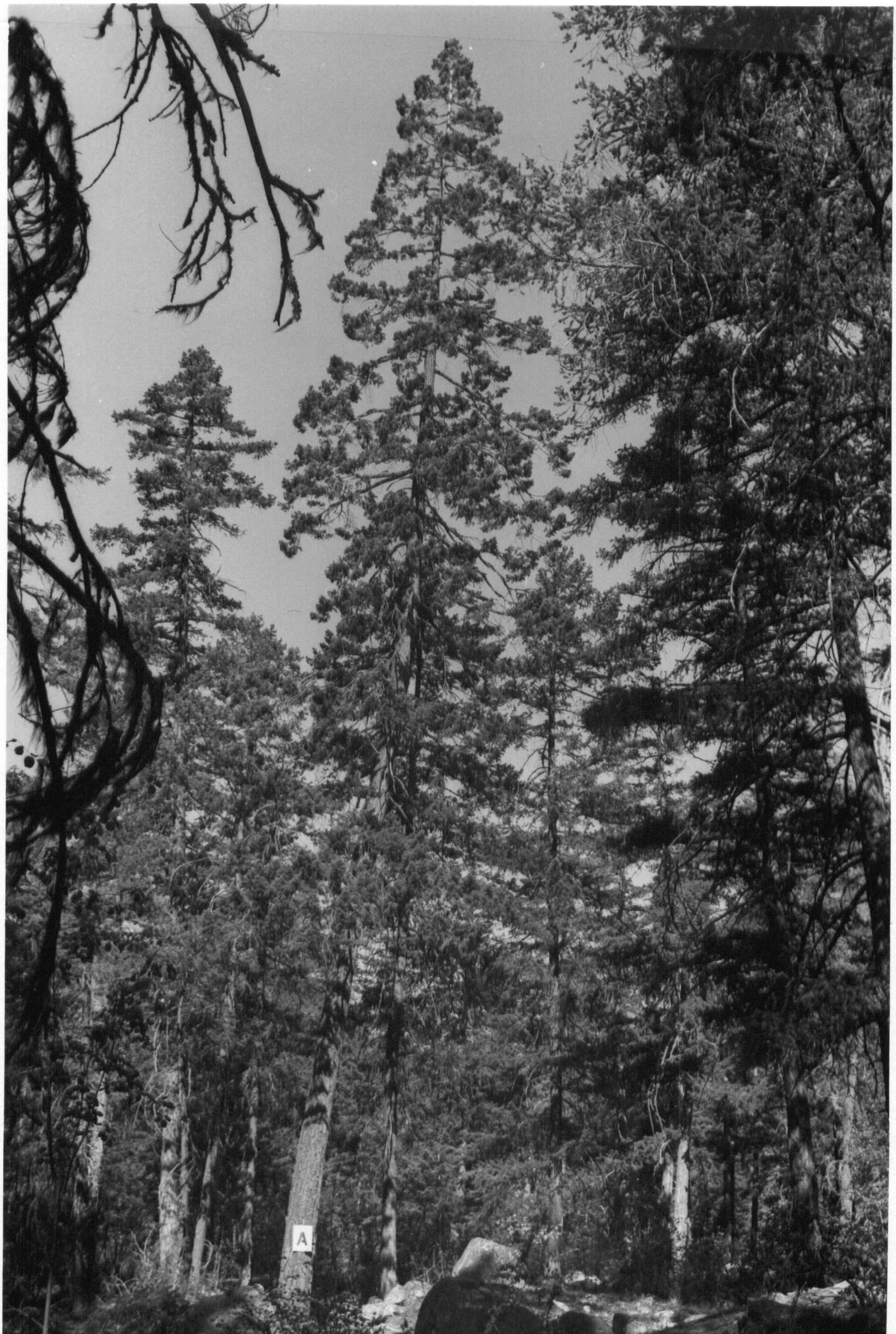
Knots in second 5 meters: 3

Distance from viewpoint: 22.9 m.

Azimuth from viewpoint: 293°

COMMENTS

This tree had a uniquely sweeping trunk and a symmetrical, sparse but healthy crown. It received front and sidelighting only.


A

TREE PAIR 12

TREE B OR # 24

MEAN AESTHETIC RATING: 5.743

DESCRIPTION

Total Height: 30.2 m.

DBH: 71.7 cm.

Timber Quality Class: 2

Pathological Remarks: Crook in top 1/3 of tree.

Quality Remarks: Lean (0°-4.9° from vertical)

Height to first live limb: 6.7 m.

Height to first stub: 4.6 m.

Knots in first 5 meters: 1

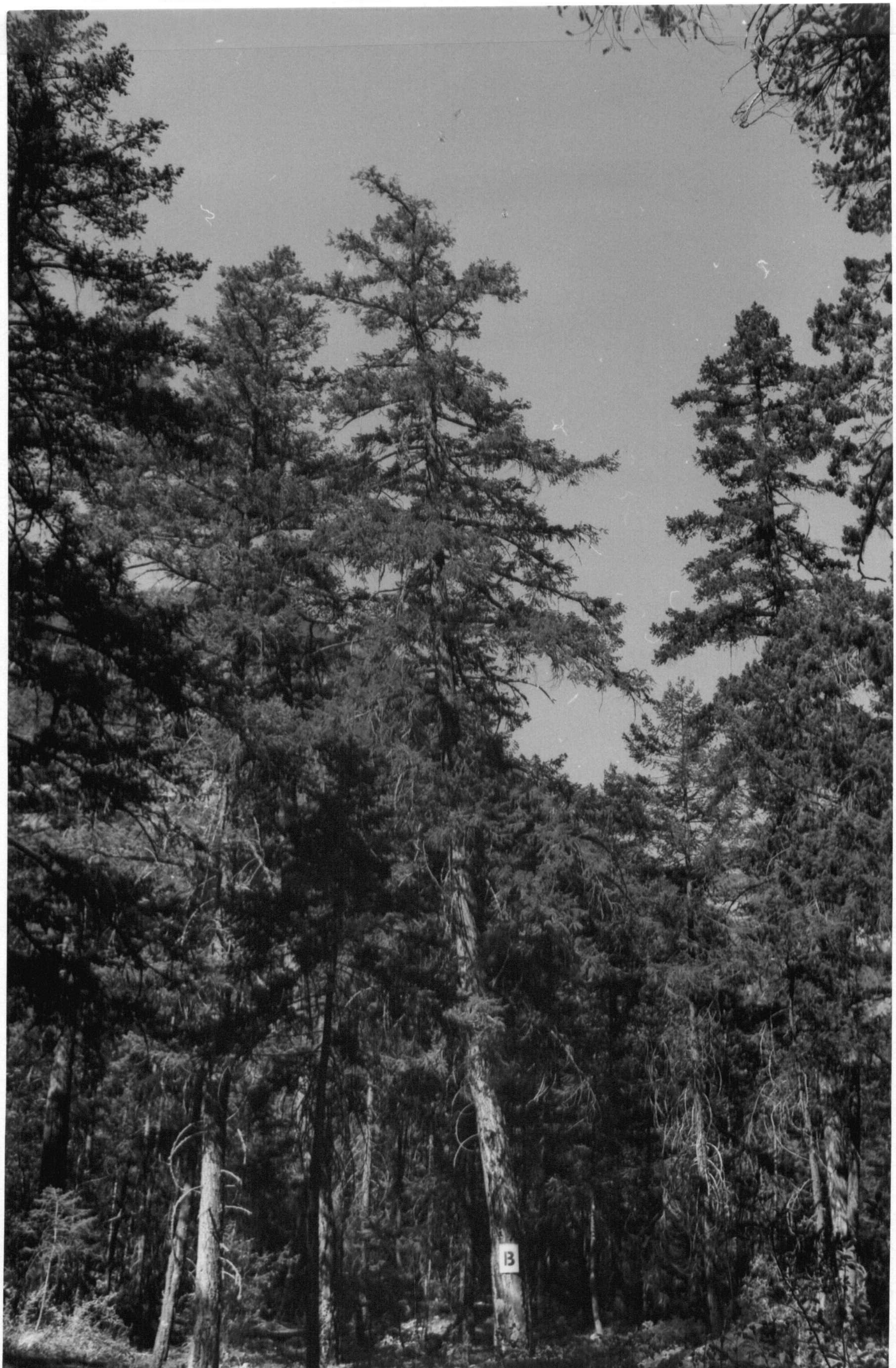
Knots in second 5 meters: 18

Distance from viewpoint: 25.6 m.

Azimuth from viewpoint: 270°

COMMENTS

This tree had a wide lower bole that tapered quickly to a twisted top. It had scorched bark at its base, and stood beside the trail.


B

APPENDIX IV

THE QUESTIONNAIRE

RECREATION RESOURCES MANAGEMENT

FACULTY OF FORESTRY

UNIVERSITY OF BRITISH COLUMBIA

BALLOT FOR YOUR PREFERENCES ON THE
AESTHETIC QUALITY OF FOREST TREES

INSTRUCTIONS

1. Your preferences must be yours alone. There are no right or wrong answers here.

2. Stand directly behind the numbered stake and, using the 9-point rating scale, rate both tree A and tree B.

3. Now compare tree A with tree B. Circle the one you aesthetically prefer. Also give reasons for your preference.

4. Upon completion, please return this ballot to the researcher.

VIEWING STATION #	**DEMO**
1. HOW DO YOU RATE EACH TREE?	**A__________ B__________**
2. CIRCLE YOUR PREFERRED TREE.	**A B**
3. WHY DID YOU PREFER IT?	
(CIRCLE UP TO 4 OF YOUR MOST IMPORTANT REASONS.)	

CHARACTERISTICS OF THE TREE

MORE BALANCED	MORE SCARS
MORE LOPSIDED	FEWER SCARS
WIDER TRUNK	MORE HOLES
NARROWER TRUNK	FEWER HOLES
SHORTER TRUNK	MORE FUNGUS
LONGER TRUNK	LESS FUNGUS
MORE LEAN	DENSER CROWN
LESS LEAN	SPARSER CROWN
MORE CROOKED TRUNK	BROADER CROWN
STRAIGHTER TRUNK	NARROWER CROWN
MORE DEAD TRUNK BRANCHES	LONGER CROWN
FEWER DEAD TRUNK BRANCHES	SHORTER CROWN
ROUGHER BARK	MORE DEAD CROWN BRANCHES
SMOOTHER BARK	FEWER DEAD CROWN BRANCHES

CHARACTERISTICS OF THE TREE'S SURROUNDINGS

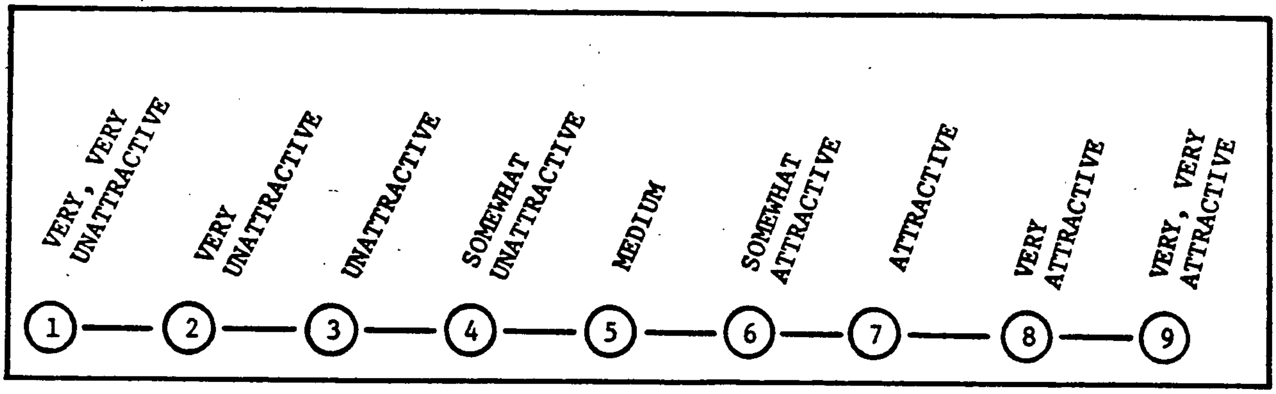
MIXED TREE SPECIES	DENSER UNDERGROWTH
UNIFORM TREE SPECIES	SPARSER UNDERGROWTH
MIXED TREE SIZES	EVEN GROUND
UNIFORM TREE SIZES	UNEVEN GROUND
UNEVEN TREE SPACING	FLATTER GROUND
EVEN TREE SPACING	STEEPER GROUND

MORE ATTRACTIVE BACKGROUND SCENERY

LESS ATTRACTIVE BACKGROUND SCENERY

Stacked on top of the "Demo" half of this page were 12 numbered sheets just like it, one for each of the 12 tree pairs.

RATING SCALE



ANY ADDITIONAL COMMENTS?

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PERSONAL CHARACTERISTICS

Name: ____

Sex: ☐ **Female** ☐ **Male**

Age: ☐ 15-24 ☐ 35-44 ☐ 55-64
☐ 25-34 ☐ 45-54 ☐ 65 and over

THANK YOU FOR PARTICIPATING!