



# Minnesota Forestry Research Notes

No. 202  
April 15, 1969

THE CONDITION OF WILDERNESS CAMPSITES IN THE BOUNDARY WATERS CANOE AREA<sup>1/</sup>

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## Introduction

The Boundary Waters Canoe Area (BWCA), located on the Superior National Forest in northern Minnesota and covering approximately 1,000,000 acres, is one of the most heavily used wilderness areas in the United States. Over 820,000 visitor-days use were recorded in 1968. The BWCA is not only the largest wilderness area east of the Rocky Mountains, but is the only wilderness canoe area in the United States.

In order to increase its information base for management, the U. S. Forest Service has inventoried all existing campsites within the BWCA. These now total over 1600. Many of the existing campsites were selected and established by canoeists and may indicate their preferences for campsite location. Other sites were selected and developed by the Forest Service. This study was initiated to determine the physical condition of campsites within the BWCA and to provide information to help in the selection of future sites.

## Past Research

Previous research on visitor impact on campsites has been conducted primarily in developed recreation areas. Some of the results which are of major interest to this study follow:

1. Bulk density and soil compaction increased with intensity of use (1, 2).
2. Increasing use was accompanied by a decreased tree diameter growth (2).
3. Fertile sites were better able to withstand use than less fertile sites (3).
4. Use of campsites was inversely related to duff depth and proportion of area covered by forbs and shrubs (4).

<sup>1/</sup> This study was financed through a Cooperative-Aid grant to the University of Minnesota, School of Forestry from the U. S. Forest Service, U. S. Department of Agriculture, North Central Forest Experiment Station. The authors wish to extend their appreciation to the personnel of the Superior National Forest for their assistance in conducting this study.

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Research conducted by Frissell and Duncan (5) in the BWCA indicated that litter and humus depths on campsites in the BWCA and Quetico Provincial Park in Canada were reduced an average of 65 percent below control plots. Trees with exposed roots were found to occur on 60 percent of the examined campsites.

### Methods

One hundred nineteen sites were randomly selected and studied during the summers of 1966 and 1967. After sampling, the selected campsites were separated into the following four classes depending on position: (1) on small island, less than three acres; (2) on medium sized island, three to ten acres; (3) on large island, over ten acres; and (4) on mainland. They were also separated according to location, on or off a major canoe route. The total sample was probably adequate and representative of the population as indicated by data on campsite position:

	Mainland	Island	Total
Sample	54%	46%	100%
Population	56%	44%	100%

The reader should recognize, however, that additional stratification of the sample, such as separating islands by size, may weaken the representativeness of the sample.

Measurements taken at each site included soil compaction, duff depth, proportion of area covered by bare soil and duff, site area, forest cover type, slope, aspect and presence of mechanical damage and trash. Soil compaction was measured at ten systematically determined points both on and immediately adjacent to the campsite using a soil penetrometer which measured resistance to penetration. The average on-site reading was divided by the average off-site reading and multiplied by 100% to compute the percentage change in resistance to penetration (compaction). Duff depth readings were also taken at some points.

### Results

Island campsites had larger increases in soil compaction, greater reduction in duff depth, a larger proportion of the site without vegetation and were larger in size than those located on the mainland (Table 1).

Table 1. Average physical characteristics of 119 campsites in the BWCA by selected locational classes

Position	Percent increase compaction	Percent decrease duff depth	Percent duff area	Percent bare soil area	Size of site (acres)
Island	241.6	68.0	40.9	16.5	.072
Small	247.8	68.7	49.2	17.8	.059
Medium	256.5	72.5	46.7	12.7	.091
Large	214.2	62.4	18.5	17.8	.079
Mainland	201.6	53.9	34.9	10.1	.059
<b>Total</b>	<b>220.4</b>	<b>60.6</b>	<b>37.7</b>	<b>13.1</b>	<b>.065</b>

Campsites located on major canoe routes had larger proportionate increases in soil compaction, greater reductions in duff depth and were larger in size than campsites located off major canoe routes. Little difference was recorded in proportionate area covered by bare soil and duff (Table 2).

Table 2. Average physical characteristics of campsites by canoe route location (BWCA 1966-67)

Location	Percent increase compaction	Percent decrease duff depth	Percent duff area	Percent bare soil area	Size of site (acres)
On canoe route	226.1	62.8	37.4	13.4	.070
Off canoe route	199.1	52.1	38.9	12.0	.047
Total	220.4	60.6	37.7	13.1	.065

Proportionately more island campsites were located in the red pine cover type than were mainland campsites. Whether this is a function of the distribution of cover types or visitor preferences cannot be fully determined. The study by Frissell and Duncan (5) indicated a preference for pine types. Jack pine has a higher proportionate representation on mainland sites (Table 3). In terms of location on or off route, differences were negligible (Table 4).

Table 3. The percentage of the 119 campsites on islands and mainland in various forest cover types (BWCA 1966-67)

Position	Red pine	White pine	Jack pine	Nonpine	Total
	-Percentage-				
Island	30.4	8.8	30.4	30.4	100.0
Small	21.5	17.8	35.7	25.0	100.0
Medium	57.2	0.0	21.4	21.4	100.0
Large	21.4	0.0	28.6	50.0	100.0
Mainland	17.5	9.5	41.3	31.7	100.0
Average	23.5	9.2	36.1	31.2	100.0

Table 4. Distribution of cover types by location in percent BWCA Study Campsites (1966-1967)

Location	Red pine	White pine	Jack pine	Nonpine	Total
On route	24.5	9.6	35.1	30.8	100.0
Off route	20.0	8.0	40.0	32.0	100.0
Total	23.5	9.2	36.1	31.2	100.0

Trash left by campers was found more frequently on campsites located off routes than on routes. Mechanical damage (hacking of trees, nails in trees, etc.) was present on 64 percent of the on route sites and 60 percent of the off route sites.

Trash and mechanical damage seemed to be more prevalent on island sites, although no consistent relationship appeared:

Campsite Position	Mechanical Damage	Trash
Island	67%	77%
small	68%	75%
medium	72%	86%
large	64%	72%
Mainland	51%	72%

#### Summary

This study attempted to describe the present condition of wilderness campsites within the BWCA. In general, island campsites appear to have sustained a greater degree of deterioration than those located on the mainland. Campsites located on major canoe routes also appear to have sustained a higher degree of deterioration than those located off routes. However, the absence of large differences in the variables may mean that management techniques and priorities may be quite flexible in application. Causes of these differences may be related more to use intensities than to actual site conditions although no definite statement can be made because of the nature of the study design.

#### Future plans:

This study was the second in a series of three studies designed to determine the condition and rate of deterioration of campsites in the BWCA. The third study will concern the rate of deterioration on thirty-three newly established campsites in the BWCA under known levels of use during the period from establishment in 1968 through 1973.

#### Literature Cited

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