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Effect of Overstory Removal on Production of Shrubs and Sedge in a Northern Minnesota Bog

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ABSTRACT — A vegetation survey of a northern Minnesota bog three years after the removal of portions of the overstory showed a decrease in total coverage but an increase in frequency of ericaceous shrubs. Dry weight sedge production was approximately five-fold greater in clearcut areas than under the original black spruce canopy.

Examples of secondary succession after removal of upland forest canopies are numerous. However, little is known of the response of ericaceous shrubs and sedges after overstory removal in bogs. Accordingly, a vegetation survey was conducted in a north-central Minnesota bog three years after the removal of a black spruce (*Picea mariana* (Mill) B. S. P.) overstory.

Site in experimental forest

The study bog, located on the Marcell Experimental Forest (ca. 47° 32′N, 93° 28′W) is about 20 acres in size. It is approximately 1,850 feet long and 450 feet wide, with the long axis oriented north and south. Surface layers of peat consist of sphagnum moss at various stages of decomposition; total peat depths are in excess of 10 feet. Surface water pH is approximately 3.5.

The climate of this region is cool, sub-humid, continental, and has been summarized by Aakre (1966). The growing season is relatively short, averaging 107 days on a fifty-year basis.

In the winter of 1968-69 east-west strips 100 feet wide were cut clear, leaving 150-foot-wide uncut strips of the black spruce stand. This stand was 62 years old, had a stem density of 1,665 trees per acre, and a basal area of 122 square feet per acre. The average tree height was approximately 29 feet, and crown closure was 75 percent. All logging debris was collected and piled. The ground vegetation was undisturbed because logging was done during the winter when snow cover was ample.

Sampling by quadrats

Sample quadrats, one meter square, were established at 25-foot intervals along the length of the bog. Quadrats were also established at 25-foot intervals longitudinally down the middle of two clearcut strips and two forested strips. There were 87 quadrats in the forested strips and 67 in the clearcut strips.

In each quadrat, the percentage of total shrub coverage and the percent contribution of each species was estimated. The percentage of the quadrat occupied by sedges also was estimated and the sedges from one-half of the quadrats were cut at "ground level," immediately sealed in plastic bags, and taken to the laboratory, where fresh weights were obtained. The material was then dried in a forced-draft oven at 105°C for 24 hours and reweighed for dry weights. All sampling was conducted in July of 1971.

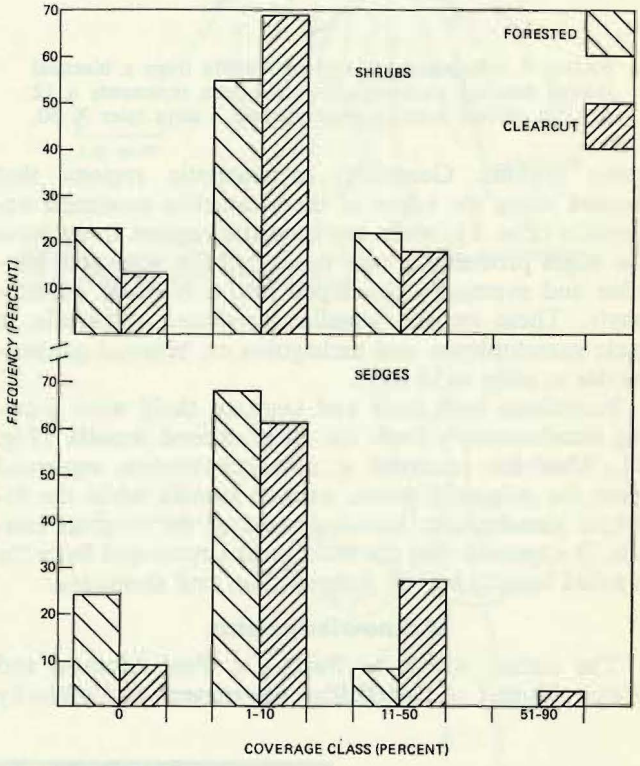

FIGURE 1. Frequency distribution of shrubs and sedges by coverage class.

Coverage/Frequency ratios

Total shrub coverage decreased from 9 percent in the forested strips to 7 percent in the clearcut strips. However, this decrease in coverage was accompanied by an increase in frequency (Fig. 1); shrubs occurred on 87 percent of the sample quadrats in the clearcut strips vs. 77 percent of the quadrats in the forested strips.

This seeming paradox of decreasing total shrub coverage and increasing frequency of occurrence in the clearcut strips can be accounted for by a change in species composition (Table I). *Ledum groenlandicum* Oeder (Labrador tea) occurred on fewer quadrats in the clearcut strip and its percent contribution to total shrub coverage (relative coverage) greatly diminished. Concurrently, there was an increase, both in frequency and

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TABLE I. Frequency of occurrence and relative coverage of shrub species. (In percent)

Species	Forested		Clearcut	
	Frequency	Relative cover	Frequency	Relative cover
Ledum groenlandicum ..	68.0	71.0	54.0	40.0
Chamaedaphne calyculata	21.0	7.0	28.4	12.0
Kalmia polifolia	16.0	3.0	30.0	12.0
Vaccinium angustifolium.	17.0	9.0	25.0	10.0
Andromeda glaucophylla.	1.0	1.0	2.0	1.0
Other	12.0	11.0	37.0	26.0

relative coverage, of *Chamaedaphne calyculata* var. *angustifolia* (Ait.) Rehd. (leatherleaf), *Kalmia Polifolia* Wang (bog laurel) and other shrubs. The greater frequency and coverage of *Ledum groenlandicum* in the forested strip agrees with the observation of Stallard (1929) that it is the most shade tolerant of the bog shrubs, and its classification as a bog forest shrub by Conway (1949). However, the reported restriction of *Chamaedaphne calyculata* to the moss heath, and *Kalmia polifolia* to the bog forest does not appear to apply in this case, because both were found under the spruce canopy and both increased their frequency and coverage in the clearcut strip. *Andromeda glaucophylla* Link (bog rosemary) was found on only one quadrat in both forested and clearcut strips.

The "other shrub" category consisted primarily of *Alnus rugosa* (Du Roi) Spreng. (spreckled alder) which was restricted to the bog margin. Both the coverage and frequency of *Alnus rugosa* increased in the clearcut strips and it appeared to be slowly invading the strips from the bog margins. Reproduction appeared to be by vegetative propagation, rather than by seeding, which agrees with reports by Stallard (1929), Vincent (1964) and others.

The blueberry (*Vaccinium angustifolium* Ait.) was present both under the spruce canopy and in the clearcut areas, which differs with Conway (1949) who restricts its distribution to the young moss heath. Although its frequency increased in the clearcut strip, its relative coverage remained essentially unchanged.

TABLE II. Fresh weight, dry weight, and relative water content of sedge by type of strip.

Strip	Fresh weight	Dry weight	Water content
	gm/m²	gm/m²	percent
Forested	18.70	5.72	226
Clearcut	73.32	27.30	169

The sedges increased in both frequency and coverage in the clearcut strips, occurring on 76 percent of the sample quadrats in the forested strips and in 91 percent of the clearcut quadrats. The area occupied increased from 4 percent in the forested strips to 13 percent in the clearcut. That sedge production increased in the clearcut strips is obvious from the weight measurements (Table II). Their oven-dry weight increased from 51 pounds per acre in the forested strips to 241 pounds per acre in the clearcut strips. However, there did not appear to be a difference in species composition, with *Carex trisperma* Dew. and *Eriophorum tennellum* Nutt. (cotton grass) constituting approximately 50 percent of the samples from both the clearcut and forested strips. *Calamagrostis canadensis* (Michx.) Nutt. (blue joint) was rarely found along the bog margin. It is interesting to note that the relative water content decreased in the clearcut strip (Table II), suggesting an increased water stress in these open sites.

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