Forest Research Notes

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FURTHER OBSERVATIONS OF SNOW AND FROST IN THE ADIRONDACKS

Snow-depth and water-content measurements were made in March and April 1960 in the vicinity of Paul Smiths, New York, to check on procedures developed the previous year for predicting snow accumulation and melt.[1]

Eight 200-foot snow courses were laid out, two each in the four hardwood and conifer cover type conditions previously studied, but in different stands. Snow measurements were taken at 20-foot intervals along the courses at the time of maximum accumulation (March 21) and at the minimum accumulation with complete snow cover (April 18). Canopy closure over each sampling point was measured with a densiometer.

The percentage of canopy closure for each snow course was then used to estimate the snow-water content ratio (depth in forest condition/depth in hardwood saplings) for the time of maximum snow accumulation, employing the regression developed from the 1959 data. The estimated ratio was then multiplied by 8.6 inches, the average snow-water content of the two hardwood-sapling courses, to estimate the snow-water content of the three other forest conditions (table 1). Percentage of canopy closure for each snow course was also used to estimate the snow-melt in inches per degree-day above 32°F.; and the actual and predicted melt during the period March 21 to April 18 were calculated (table 1).

Average maximum snow-water accumulation for the four cover conditions was 8.15 inches; in 1959 it was 7.96 inches. The 1960 melt-season had 137 degree-days between maximum and minimum accumulations; the 1959-season had 118.

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[1]Howard W. Lull and Francis M. Rushmore. Snow accumulation and melt under certain forest conditions in the Adirondacks. U. S. Forest Serv. Northeast. Forest Expt. Sta., Sta. Paper 138. 16 pp., illus., 1960.

Conifer-Branch Interception

For observing comparative snow interception by conifers, 4-foot long branches of balsam fir, red spruce, white pine, and hemlock were nailed to two posts at a height of 5 feet, simulating two stems bearing branches of different species. Observations of snow depth, at three points on each branch, were made during the period December 8, 1959, to March 22, 1960. Miniature depth gages fastened at the measurement points made it possible to measure snow depth without disturbing the snow.

Table 1.--Snow accumulation and melt, based on percentage of canopy closure

Cover type	Canopy closure	Maximum snow-water accumulation		Melt per degree-day above 32° F.	
		Predicted	Actual	Predicted	Actual
	Percent	Inches	Inches	Inches	Inches
Conifer saplings	66	7.5	7.4	0.043	0.036
	60	7.7	7.8	.046	.035
Conifer sawtimber	60	7.7	7.8	.046	.044
	64	7.6	8.0	.044	.044
Hardwood saplings	28	--	8.0	.062	.053
	24	--	9.2	.064	.054
Hardwood sawtimber	23	8.9	8.6	.065	.061
	20	8.9	8.4	.066	.060

Table 2.--Snow accumulation on conifer branches

Species	Post 1				Post 2				Post mean	Frequency of occurrence
	A	B	C	Mean	A	B	C	Mean		
	Inches				Inches					Percent
Balsam fir	2.08	2.28	2.72	2.36	2.22	2.12	1.36	1.90	2.13	84
Red spruce	1.49	1.90	1.82	1.74	1.90	2.36	1.54	1.93	1.84	76
White pine	1.53	2.24	1.97	1.91	1.25	1.96	1.72	1.64	1.78	69
Hemlock	1.30	1.48	1.38	1.39	1.34	.83	.72	.96	1.18	63

Table 3.--Changes in snow depth on branches during periods of snow loss, in inches

Snow-loss periods	Weather during period	White pine	Balsam fir	Hemlock	Red spruce
Dec. 10 - Dec. 14	Sun bright, light wind, followed by rainfall	3.2 .7	3.6 .7	2.4 .8	4.2 .9
Dec. 31 - Jan. 7	Strong and gusty winds	3.9 .4	3.7 1.4	2.7 .3	3.0 .7
Jan. 20 - Jan. 26	Light snow and moderate wind	6.2 3.7	4.2 3.0	4.0 .2	3.7 4.3
Jan. 28 - Jan. 29	Strong wind and snow mixed with rain	5.5 1.1	4.3 1.1	2.1 .6	2.6 1.1

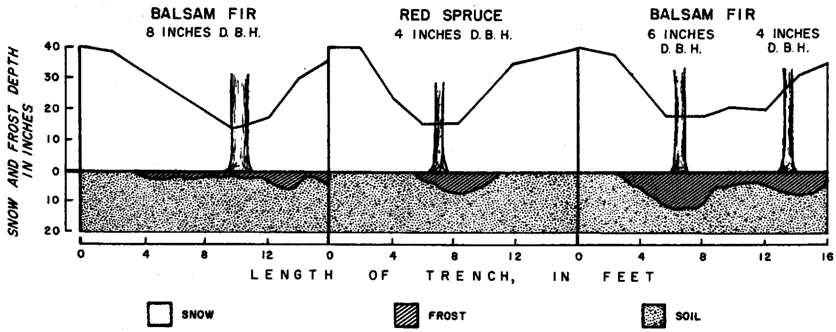

Figure 1.--*Typical snow and frost profiles under conifers.*

Snow was observed on the branches on 51 days. Adding 18 week-end days on which snow was probably present gives a total of 69 snow-days during the 106-day period--or, snow was present on the canopy, in various amounts, for about two-thirds of this period. Needles remained on the cut branches all winter and stayed green.

Maximum accumulations were 4.7 inches on balsam fir, 4.3 inches on red spruce, 6.2 inches on white pine, and 4.5 inches on hemlock. Average snow depth for each position measured, each post-species mean, and frequencies of occurrence are shown in table 2 (positions A, B, and C were approximately $1\frac{1}{2}$, $2\frac{1}{2}$, and $3\frac{1}{2}$ feet, respectively, from the posts).

In an analysis of variance of the snow-depth data for species differences, only between hemlock and other species was snow-depth difference statistically significant. The least significant difference was 0.62. Differences between positions and between posts were not significant.

For the 51 days of observation, frequency of snow occurrence on the branches ranged from 84 percent for balsam fir to 63 percent for hemlock.

Differences in the rate at which snow disappeared from the branches during four snow-loss periods are illustrated in table 3, which gives snow depth at beginning and ending of the period. In three of the four periods, snow disappeared more rapidly from the hemlock and white pine branches than from the balsam fir and spruce. All three periods were marked by moderate to strong winds. During the mid-December period of light winds and bright sunshine, differences in loss rates were not so marked.

The branches of hemlock are feathery and flexible, and they slope downward to form a poor platform for snow accumulation. Balsam fir had the best platform for snow support, apparently because needles persist along branches and there are many stiff branchlets. Spruce was next; and though its needles were small, like those of hemlock, the branchlets were much stiffer and would not dump snow so readily. On a white pine branch, snow was caught within the bare whorls at two of the three positions measured, branches cupping the whorls permitting deepest accumulations of snow; the small stems provided good support for patches of snow when wind or thaws occurred. Time-lapse photographs of interception on white pine showed that snow accumulated on the needles, beginning at the bases of several needle fascicles, and later bending them over to form a platform. Patches of snow persisted longest where several branch tips, bent by snow, combined to form large platforms.

Concrete Frost

On March 21 and 24, 1960, about the time of maximum snow accumulation, observations were made at 160 points along the snow-survey courses to determine the presence and depth of concrete frost. Measurements were taken with a Stoeckeler and Thames frost probe.[2] Frequency of occurrence and average depth of frost were as follows:

	Frequency (percent)	Average depth (inches)
Conifer saplings	30	2.0
Conifer sawtimber	15	1.9
Hardwood saplings	40	1.8
Hardwood sawtimber	15	2.3

On April 18 no concrete frost was found on the courses. These figures substantiate earlier findings that concrete frost in the upland forest is sporadic in occurrence.

Concrete frost tends to concentrate beneath conifer crowns in the snow-interception zone. This tendency, first observed during the 1959 field season, was investigated in 1960 by digging trenches beneath the crowns of isolated conifers (three red spruce and seven balsam fir) in a hardwood stand, and taking snow-depth and frost measurements every 2 or 3 feet along the trench. Typical snow and frost profiles are shown in figure 1.

No relationship between frost and snow depth can be deduced from these limited observations, because the concrete frost observed developed from antecedent, unobserved weather and snow conditions.

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[2] J. H. Stoeckeler and J. L. Thames. The Lake States penetrometer for measuring depth of soil freezing. Soil Sci. 85: 47-50, 1958.

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