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FLAMBEAU FOREST BLOWDOWN

Windthrow has long been recognized as a significant disturbance factor in the presettlement hemlock hardwood forests of northern Wisconsin (Stearns 1949). Canham (1978) quantified records of large-scale blowdowns in the original land survey records (1834-1873) and agreed with Stearns that canopy windthrow was an important process in the dynamics of the hemlock-hardwood forests.

Disturbance may result in either temporary or permanent change in vegetation. Regeneràtion operates through the ecological process of succession which depends on the characteristics of component species as well as peculiarities of climate, soil and seed availability. Large scale patchy disturbances occur in many forests (Stearns 1949, Curtis 1959, Henry and Swan 1974, Bormann and Likens 1979) and are critical in the determination of forest structure and composition (Henry and Swan 1974).

Spurr (1956) documented regional forest regeneration following the 1938 hurricane in New England. Few studies exist that have provided a detailed chronicle of changes that occur following disturbance. Such evidence is crucial to an understanding of ecosystem structure and dynamics. However, a major problem is finding a recently disturbed site that had a prior record of stand structure and species composition.

On July 4, 1977, the 160 acre Flambeau River Forest Scientific Area was struck by a downburst of hurricane proportions (Fujita 1977) which destroyed most of the preserve. This stand had been one of the few relatively untouched oldgrowth northern hardwood forest stands in the Upper Great Lakes region. Hemlock, yellow birch, and sugar maple are the dominant canopy tree species. The vegetation of this stand had been studied in 1967 (Anderson 1968) and 1973 (Anderson unpublished). Thus, the Flambeau River Forest Scientific Area in northern Wisconsin provides a unique opportunity to examine the changes following large scale disturbance in a stand of known composition.

The purpose of our work was to quantify the extent of destruction from the 1977 blowdown and examine the reestablishment of woody species in a naturally disturbed northern hardwood forest stand.

METHODS

Anderson set out permanent markers in the scientific area in 1963. However, these could not be found in 1979 following the blowdown. Our data were collected along a north-south transect on June 6, 1979, and along an east-west transect on August 30, 1979. Twenty-nine 0.025 ha plots were sampled, giving a total sample of 0.725 ha (1.79A).

A modified line strip sampling scheme was used (Lindsey 1955). The entire 0.025 ha (1/40 ha) plot was sampled for standing live trees (>10cm dbh) and tip-up mounds. Nested plots of 0.0125 ha (1/80 ha), 0.0025 ha (1/400 ha), and 0.00025 ha (1/4000 ha) were used for saplings, shrubs, and herbs (including tree seedlings) respectively. Density (D), frequency (F), and basal area (BA) were noted for trees; D, F, and percent cover (%C) for shrubs and saplings; and D and %C for herbs. These data serve as a basis for comparison with pre-blowdown data.

RESULTS AND DISCUSSION

We have presented only the tree canopy and tree seedling data to document the extent of canopy destruction and the nature of reproduction in the blowdown area (Table 1).

Table 1. Comparison of pre-blowdown and post blowdown basal area (m^2/ha) and seedling density ($individuals/m^2$).

	Tree Basal Area		Seedling Density	
SPECIES	1973*	1979	1973*	1979
Acer saccharum	2.73	0.40	0.56	0.46
Tilia americana	1.77	0.07	0.04	0.17
Fraxinus americana	0.13	–	0.03	0.01
Betula lutea	9.28	1.30	0.06	0.97
Tsuga canadensis	30.66	0.46	0.04	0.03
Acer rubrum	0.16	0.19	0.03	0.14
Ulmus americana	1.11	0.03	0.02	0.06
Prunus serotina	–	–	0.02	–
Acer spicatum	–	–	0.02	–
Ostrya virginiana	0.09	0.03	0.002	–
Abies balsamea	0.03	–	0.006	–
Fraxinus pennsylvanica	–	–	0.003	–
Quercus rubra	0.02	–	0.002	–
Ulmus rubra	0.18	0.01	0.003	–
Fraxinus nigra	–	–	–	0.04
Pinus strobus	1.31	0.29	–	–
Betula papyrifera	0.06	0.03	–	–
Thuja occidentalis	0.03	–	–	–
Total	47.56	2.81	0.83	1.88

*1973 data from Anderson (unpublished).

Total stand basal area has been reduced 94% since the blowdown. Total stand density also decreased dramatically after the blowdown. Yellow birch, which was a distant second in importance to hemlock prior to the blowdown, was least seriously affected and is now the most numerous of the standing trees. With the exception of yellow and white birch, the living tree species occur in about the same order of importance as before the blowdown, however, basal areas are greatly reduced for all species.

In 1973, the density of tree seedlings was 0.83 seedlings/m^2. Sugar maple accounted for 67% of this total followed in importance by yellow birch, basswood, and white ash (each less than 10% of the total). Virtually no hemlock seedlings were present although hemlock was a major dominant. Tree seedlings, after the blowdown, averaged 1.88/m^2. Yellow birch (52%) was the most common followed in importance by sugar maple (25%), basswood (9%), and red maple (7.5%).

Windthrow resulted in the almost complete loss of the tree canopy. Survival of mature canopy species was limited to: predominately isolated yellow birch and white pine, trees located in depressions, and individuals protected from the strong winds by ridges. Clearly, windthrow may have a devastating effect on old growth hemlock-hardwood forests. Conversely, some adjacent areas consisting of young stands were relatively unaffected.

Downed trees and the resulting tip-up mounds have created many microsites suitable for seedling establishment. Yellow birch seedlings were found predominately on the new tip-up mounds. Yellow birch also achieved the greatest percent increase in density from 1973 to 1979 (+162%). Tree recolonization and establishment is occurring. Seedling establishment may result from buried seed, seed from surviving individuals, seed blown in from surrounding undisturbed areas, and survival of seedlings established before the blowdown. Old yellow birch individuals that survived the blowdown may serve as a seed source.

Large scale windthrow can alter the order of importance of tree species in the forest canopy and in the seedling layer. Such changes may affect stand structure and function in a manner unlike that found in forest stands which have only small scale disturbances such as single tree falls. These differences may have important implications in characterizing the regional forest in which large scale disturbance is now absent or where only smaller disturbances occur.

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