Occurrence and distribution of sugar maple in northern Cape Breton Island

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Présence et distribution de l'érable à sucre dans la partie septentrionale de l'île du Cap Breton. On a cherché les relations station-distribution de l'érable à sucre au moyen de superficies échantillonnées et situées à proximité ou à la limite de la distribution de l'espèce dans la partie septentrionale de l'île du Cap Breton.

Les données ainsi recueillies des places-échantillons et des transsects montrent que l'espèce se rencontre sur les stations variées. Sa plus grande abondance se produit cependant sur des sols humides, quoique bien drainés. Une forte densité se rencontre également sur les terrains frais caractérisés par des eaux de ruissellement et d'infiltration disparaissant plus lentement. A l'opposé, les endroits à drainage rapide permettent peu à l'érable à sucre de s'implanter.

L'influence du milieu semble être un trait caractéristique de cette espèce en cette région. Cette influence est marquée si on garde à l'esprit le fait que l'espèce en est à sa limite dans le nord-est de l'Amérique du Nord.

Les facteurs responsables de la distribution de l'érable à sucre en cette région définie ne sont pas établis; le climat, la compétition et certains points de vue historiques peuvent présenter une influence vis-à-vis l'actuelle distribution de cette espèce en ces endroits.

Sugar maple, [*Acer saccharum* Marsh.]¹, reaches the northeastern limits of its natural range in northern Cape Breton Island (Fernald 1911 and 1950, Nichols 1918, Rouleau 1956). Nevertheless, the species is abundant and widely distributed in the region. My study was initiated to obtain detailed information on distribution-site relations in sugar maple in northern Cape Breton Island, with specific reference to patterns in the valleys of the Northeast Margaree, North Aspy and Grande Anse Rivers (Figure 1).

Regional physiography and soils

Northern Cape Breton Island is dominated by a massive, mainly granitic plateau, rising in elevation from 1000 ft at its southern limits to 1700 ft in the north. Except in the south, the flanks of the plateau either border the ocean or descend to a narrow coastal plain (Figure 1).

Numerous short, swiftly-flowing rivers and streams dissect the plateau. Steep, mainly tree-covered slopes form the approaches to the plateau surface, both from seaward and along the river courses. Instability is a common feature of many hillslopes, and evidence of mass-wasting is widespread. Both upland and lowland areas have been glaciated.

¹Nomenclature follows Fernald (1950).

Fig. 1. Map of Cape Breton Island.

Cann and MacDougall (1963) have typed northern Cape Breton Island as rough mountain land characterized by steep slopes with excessively-shallow, stony, weakly-developed soils. They considered the mapping of these soils impractical. The bottom-land soils of the sample areas have been classified as deriving from fine-textured, glacial till, from medium-textured glacial till with admixtures of alluvium and from coarse-textured, water-deposited materials.

Forests

The forests of the region comprise a mosaic of cover types. Bottom lands, foot-slopes² and stabilized mid-slopes support undisturbed or variously-disturbed, hardwood or mixedwood forests varying widely in age, structure and history. Stable crest-slopes and the gentle, peripheral slopes of the plateau are characterized by a structurally-variable, transitional forest comprising softwoods and hardwoods in varying mixtures, with a slight tendency toward regional differentiation. In the Aspy and Grande Anse watersheds these upper mid-slope and crest-slope forests comprise mixedwoods and mixedwood-softwood transitions, whereas in the Northeast Margaree the percentage of deciduous elements is higher.

On occasion, mid-slope and crest-slope segments of a particular hillslope may support an irregular, unthrifty forest composed of white spruce [*Picea glauca* (Moench) Voss], and balsam fir [*Abies balsamea* (L.) Mill.]. Pronounced steepness, outcrops of bedrock and a coarse, surficial rubble commonly are associated with this cover type.

²Slope terminology follows Leopold et al. (1964).

The surface of the plateau supports a coniferous forest composed predominantly of balsam fir, with lesser amounts of white spruce, black spruce [*Picea mariana* (Mill.) BSP], larch [*Larix laricina* (Du Roi) K. Koch] and white birch [*Betula papyrifera* Marsh.]. The continuity of this upland forest is broken by extensive areas of windthrow, by bogs and barrens of wide occurrence and considerable extent, and, in the south-central section, by recent, clear-cutting operations.

Methods

Sample plots and line-plot cruises were utilized to obtain occurrence and abundance estimates. Site and stand characteristics were described, and all trees in excess of 3 inches d.b.h. were tallied by diameter and species. Height measurements were made of canopy trees, and the kind and amount of regeneration noted.

Observations

Bottom lands and foot-slopes. High densities (trees per acre) and basal areas per acre of sugar maple occur in the bottom-land forests of the sample areas. Relative densities of sugar maple vary from 44 to 69%, with the species distributed over virtually the entire range of diameters included in the stands. Sugar maple regeneration varies from good to excellent.

Diameters of sugar maples in the canopy of old-growth, bottom-land stands in the sample areas range from 14 to 34 inches at breast height. Heights vary from 74 to 100 ft. Ages in excess of 200 years have been noted. Other species represented in the overstory of these stands include yellow birch [*Betula lutea* Michx. f.], red maple [*Acer rubrum* L.], red oak [*Quercus rubra* L. var. *borealis* (Michx. f.) Farw.], white ash [*Fraxinus americana* L.], balsam poplar [*Populus balsamifera* L.], white birch, white spruce and balsam fir.

Mid-slopes, crest-slopes and plateau surface. The abundance of sugar maple on hillslopes fluctuates widely. On stabilized mid-slopes and crest-slopes in the Northeast Margaree area, the density of the species ranges from a few stems to a modest percentage representation per acre. However, in this region, the abundance of sugar maple increases sharply immediately above the break in slope separating steep valley-sides from the gently-rising plateau surface. Relative densities of sugar maple exceeding 50% are common in peripheral upland stands, the species occurring over a large segment of the total range of diameters represented.

On the plateau surface in the Margaree region, the density of sugar maple declines markedly on approaching the limit of the range of the species. This decrease in sugar maple is accompanied by a pronounced increase in the percentage of balsam fir. The actual limit comprises a zone of scattered trees, with individual sugar maples occurring as codominants in the overstory.

Through a large percentage of the Grande Anse and North Aspy watersheds undisturbed forests

extend from valley bottoms to the plateau surface. On mid-slope segments of these hillslopes the density of sugar maple varies from low to moderately high. Alternatively, in crest-slope forests the density of the species is uniformly low. In these watersheds, in contrast to the situation prevailing in the Margaree, the altitudinal limit of the range of sugar maple usually is reached on hillslopes prior to attaining the plateau surface.

Regeneration of sugar maple is poor on the limit of its range. Where the limit occurs on the plateau surface, sugar maple seedlings and saplings are concentrated in the immediate vicinity of seed-bearing, overstory trees. Alternatively, where the limit is reached on uppermost mid-slopes and crest-slopes, occasional seedlings and saplings are found also in openings at elevations slightly exceeding those of nearby canopy trees. However, such regeneration commonly is unthrifty, with pronounced die-back in aerial portions of the stems.

Spurs, stream hollows and valley heads. The relative density of sugar maple in stream hollows and valley heads commonly is high. Alternatively, on spurs the density of the species varies widely. On spurs of considerable lateral extent, bordered on either side-slope by sub-parallel drainage channels, relative densities of sugar maple reach moderate levels. In contrast, on steep, narrow features lying between intersecting streams the species may be virtually absent.

To illustrate variability in stocking in sugar maple with change in topographic setting, data from a cruise line crossing several terrain types are included in Table 1. This transect was directed upward parallel to, but slightly downslope from the axis of a steep, narrow spur, across a shoulder, thence into a stream hollow, crossing this feature diagonally. Quitting the hollow the traverse passed upward across a short, steep, straight slope, ultimately reaching the gentle, peripheral slopes of the tableland. Attention is invited to the small percentage of sugar maple on the axis of the spur, to the sudden rise in the abundance of the species in the stream hollow, and to the subsequent decline in the percentage representation of sugar maple toward the plateau surface.

Higher terraces and benches. Moderate to high densities of sugar maple occur on the bed-rock terraces and benches in the middle reaches of the Grande Anse and North Aspy Rivers. On strath terraces³ in the North Aspy, relative densities of sugar maples on these terraces reach heights of 90 of the species on nearby bottom lands. Individual sugar maple on these terraces reach heights of 90 ft, with the species distributed throughout the entire range of diameters included in the plot tally. Regeneration of sugar maple is good.

Alternatively, softwoods and mixedwoods prevail on coarse-textured fans and alluvial terraces, particularly in the middle reaches of the Northeast Margaree. On these sites the density of sugar maple is variable but commonly low.

³Terrace terminology follows Leopold et al. (1964).

TABLE 1. Variation in stocking in sugar maple with change in topographic setting

Plot No.	Distance from starting point (chains)	Land form	All species	Trees per acre Sugar maple	% Sugar maple	Basal area (sq. ft per acre)		
						All species	Sugar maple	% Sugar maple
1	2	Spur	290	40	14	80	15	19
2	6	Spur	230	0	—	26	—	—
3	10	Spur	210	0	—	30	—	—
4	14	Spur	230	30	13	44	4	9
5	18	Spur	280	0	—	33	—	—
6	22	Spur	390	30	8	62	5	8
7	26	Spur	470	0	—	62	—	—
8	30	Shoulder	340	30	9	82	14	17
9	34	Stream hollow	230	40	17	76	10	13
10	36	Stream hollow	180	110	61	70	48	69
11	40	Straight slope	370	30	8	95	7	7
12	44	Upland Sfc.	110	10	9	103	8	8
13	48	Upland Sfc.	350	0	—	129	—	—
14	52	Upland Sfc.	450	0	—	112	—	—

Discussion

Field studies indicate sugar maple is distributed over diverse sites in northern Cape Breton Island. Broad habitat-tolerance appears to be a feature of the species in this region. This wide tolerance is notable considering the close proximity to the limit of the species in northeastern North America.

Fowells (1965) has summarized the habitat preferences of sugar maple, and comments that the species flourishes on moist, well-drained sites. Fowells concludes also that "yield and quality increase as soil moisture conditions improve." Site-density relations in northern Cape Breton Island support the suggestion of a coincidence between the abundance of sugar maple and soil moisture regimes. In northern Cape Breton Island maximum abundance of the species is reached on moist, well-drained, bottom lands. Moderately-high relative densities occur on fresh sites where run-off and seepage water are concentrated or less quickly dispersed—e.g. stream hollows and strath terraces. Alternatively, low densities of sugar maple are found on sites marked by rapid drainage—coarse-textured fans and alluvial terraces, narrow spurs and steep mid-slopes and crest-slopes.

The factors controlling the range of sugar maple in northern Cape Breton Island are not well defined. The present limit apparently is not linked to edaphic or topographic changes or discontinuities. Possible climatic effects are suggested by pronounced unthriftiness in sugar maple regeneration at elevations slightly exceeding the altitudinal limit of nearby canopy trees, and by differences in the altitudinal limit

on seaward-facing versus inland sites (Greenidge 1961). Competition also may be involved in restricting the dispersal of sugar maple in the region. Alternatively, historical factors, notably Pleistocene and post-Pleistocene events, may be of significance to the present patterns of distribution of sugar maple in northern Cape Breton Island.

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Literature Cited

- CANN, D. B. and J. I. MacDOUGALL. 1963. Soil survey of Cape Breton Island, Nova Scotia. Rep. No. 12. Nova Scotia Soil Survey. Truro, Nova Scotia.
- FERNALD, M. L. 1911. A botanical expedition to Newfoundland and southern Labrador. *Rhodora* 13: 109-162.
- . 1950. *Gray's manual of botany*. Eighth edition. American Book Company, New York.
- FOWELLS, H. A. 1965. *Silvics of forest trees of the United States*. USDA, Agr. Handb. 271.
- GREENIDGE, K. N. H. 1961. Patterns of distribution of sugar maple, *Acer saccharum* Marsh., in northern Cape Breton Island. *Amer. Mid. Nat.* 66: 138-151.
- LEOPOLD, L. B., M. G. WOLMAN, and J. P. MILLER. 1964. *Fluvial processes in geomorphology*. W. H. Freeman and Co., San Francisco and London.
- NICHOLS, G. E. 1918. The vegetation of northern Cape Breton Island, Nova Scotia. *Trans. Conn. Acad. Arts and Sci.* 22: 249-467.
- ROULEAU, E. 1956. A check list of the vascular plants of the Province of Newfoundland. *Contrib. Inst. Bot. Univ. Montréal* 69: 41-103.