

## T4.2 POST-GLACIAL COLONIZATION BY PLANTS

### PRE-GLACIAL VEGETATION IN EASTERN CANADA

Roland and Smith<sup>1</sup> suggest that “there is no reason to think that the vegetation [of Nova Scotia] just before the last glaciation was substantially different from that existing at the present time.” The pre-glacial vegetation of the region had evolved in a number of major centres over millions of years. Plants of our shade-tolerant deciduous forests, for example, show closer relationships with those of eastern Asia than they do with western Europe, indicating that a long period of separation had existed between the North American and European landmasses. It is thought that a mild climate led to the existence of a wide deciduous-vegetation belt ranging from the eastern United States and Canada to Alaska and down the eastern Asia coast until late in the Tertiary. A number of our present herbaceous species, e.g., Mayflower, Clintonia, Blue Cohosh and Northern Bedstraw, either exhibit disjunct distributions encompassing eastern North America, western North America and eastern Asia, or have closely related species which together exhibit such a disjunct distribution. During the recent period of glaciation in North America, the species of our present flora remained in refugia south of the glacial margin.

The other major group of plants which existed in the region prior to glaciation were those typical of our present coniferous forests. There is, however, no evidence to indicate that a wide band of coniferous forest, similar to our present boreal forest, existed prior to the Pleistocene. Some of the evergreen species existed in more northerly latitudes, some occurred along the windswept coast, and others existed in alpine areas and in refugia on mountain tops further south.

### GLACIATION

During the Pleistocene, glaciers completely eradicated all pre-glacial vegetation from the landmass that is now Nova Scotia. During interglacial periods, the nature of the vegetation recolonizing the exposed landmass has been documented through pollen-profile studies conducted on organic sediments in Cape Breton<sup>2</sup> and mainland Nova Scotia.<sup>3,4</sup> However, all such vegetation was eradicated by subsequent ice advances.

### POST-GLACIAL FLORAL ELEMENT IMMIGRATION

The general trends in post-glacial vegetation change in Nova Scotia have been documented through pollen-profile studies. Generally, from about 10,000 years ago until about 7300 years ago, tundra vegetation gave way to boreal vegetation, where fir, birch and spruce predominated. Pine and oak became more important in the forest vegetation of much of the province until about 6000 years ago. Following the pine maximum, pollen of hemlock, beech and other deciduous species became more significant in the pollen profiles over much of the province.

Roland describes the flora of Nova Scotia in the following manner: “The plants of Nova Scotia may be divided into a number of groups called floral elements, with each floral element composed of those plants which have more or less the same distribution outside the area and therefore somewhat the same phytogeographic history. All of our floral elements may be considered extraneous as they have migrated into the area from outside the Province, although their earlier evolution undoubtedly occurred in a northern climate before glaciation occurred.”

The main centres from which plants radiated into newly exposed areas are those immediately outside of the glacial front, either from reservoirs of plants south of the terminal limits of the ice advance, from plants pushed southward by the advancing glaciers or from the exposed areas on the outer limits of the coastal plain.

## FLORAL ELEMENTS

Roland identified six floral elements: Arctic-Alpine and Boreal Disjunct, Boreal, Canadian, Alleghanian, Southwestern and Plants of the Seashore.

**Arctic-Alpine and Boreal Disjunct**

The sixty-one plant species of these elements were the first to migrate into the area under the cool climatic conditions following glaciation. They have a scattered distribution, often only being known from one or two locations. This suggests that they are relic elements of a flora which was widespread immediately following glaciation but which is now better represented further north. The presence of many of the plants at high elevations further south indicates that they moved northwards into Nova Scotia following the retreat of the ice. Some of them may have survived on the exposed coastal plain.

In the early stages of colonization, soils would have been more alkaline before extensive leaching had taken place, competition would have been less on the newly exposed areas, and the climate would have been more severe. As these conditions changed, the plants of these elements survived only in locations favourable to them: cool areas, headlands around the coast, the Cape Breton Plateau (Region 100), deep ravines or shaded cliffs.

Some of the plants are found at sea level around the coast (Region 800). These include

*Sedum rosea* —Rose-root  
*Claytonia fontana*  
*Lycopodium selago* —Fir Club-moss  
*Betula michauxii*  
*Geum peckii*

Over twenty species are found in the Bay of Fundy–Cobequid area (District 310), including five unusual ferns. Examples of this group include

*Woodsia ilvensis* —Rusty Woodsia  
*Woodsia glabella* —Smooth Woodsia  
*Asplenium trichomanes* —Maidenhair Spleenwort  
*Asplenium viride* —Green Spleenwort  
*Dryopteris fragrans* —Fragrant Fern  
*Arabis hirsuta*, *A. drummondii* —rock cress

These and additional species also occur in the highlands of northern Cape Breton, usually along moist, steep-walled river gorges (District 220). Four species are plants of the high barrens and bogs in Region 100 and District 210:

*Betula glandulosa*, *B. borealis*, *B. michauxii* —birch  
*Vaccinium uliginosum* —Alpine Whortleberry  
Other species, relatively rare and only found in northern Cape Breton (District 210), include  
*Saxifraga aizoides* —Saxifrage  
*Diapensia lapponica*  
*Pinguicula vulgaris* —Butterwort

Another group of plants appears to be characteristic of boreal deciduous woods rather than coniferous woods. Part of this group may be called the Cordilleran element because the plants are common in similar cool, moist habitats on the Pacific coast or in the Rocky Mountains. Examples of this group are the two ferns: *Dryopteris filix-mas* (Male Fern), and *Polystichum braunii*.

**Boreal**

The boreal forest is the most extensive forest type in Canada. The typical plants of the boreal element are found in coniferous woods, swamps, swales and bogs. Their distribution is more uniform than that of more southern plants, sometimes occurring around the northern hemisphere. Common examples include

*Typha latifolia* —Broad-leaved Cat-tail  
*Habenaria hyperborea* —Green Habenaria  
*Myrica gale* —Sweet Gale  
*Alnus crispa* —Downy Alder  
*Moneses uniflora* —One-flowered Shinleaf  
*Chamaedaphne calyculata* —Leather-leaf  
*Linnaea borealis* —Twinflower

Plants of this element with a more northern or Hudsonian range are found chiefly on headlands and barren areas in cooler parts of the province (Regions 100, 200 and 800). Examples include the junipers and the Bakeapple.

**Canadian**

The plants of this element are widely distributed and can be said to form the background flora of north-eastern North America. They range from Nova Scotia and Newfoundland to Manitoba, south to Pennsylvania, and in the mountains in North Carolina and Tennessee. They are commonly found in open woods, pastures, barrens or old fields. The element includes a range of shrubs, such as Wire Birch, Chokecherry, Mountain Maple, Witherod and Meadowsweet (Hardhack, *Spiraea latifolia*); also a number of ericaceous or heath plants, such as Rhodora, Lambkill, and various blueberries. Other common examples include

*Onoclea sensibilis* —Sensitive Fern  
*Pontederia cordata* —Pickerel-weed  
*Maianthemum canadense* —Wild Lily-of-the-valley

*Clintonia borealis* —Blue-bead Lily  
*Habenaria psychodes* —Purple-fringed Orchid  
*Epigaea repens* —Trailing Arbutus (Mayflower)  
*Gaultheria procumbens* —Teaberry (Wintergreen)

### **Alleghanian**

The plants of the Alleghanian element are mainly associated with the deciduous forests far to the south. The range is from Nova Scotia to Minnesota and south to the Gulf States. In Nova Scotia, they are usually found growing in rich soils in the best deciduous woods or along river intervals in the northern part of the province from Annapolis County to Cape Breton (Regions 500, 600). Some of the species are widespread, but many are rare. These plants presumably migrated along the Chignecto Isthmus (Unit 523) when this area was at a higher elevation above sea level than it is now. Examples include

*Athyrium thelypteroides* —Silvery Spleenwort  
*Allium tricoccum* —Wild Leek  
*Erythronium americanum* —Dog's-tooth Violet  
*Trillium erectum* —Purple Trillium  
*Ostrya virginiana* —Hop-hornbeam  
*Sanguinaria canadensis* —Bloodroot

### **Southwestern**

The southwestern part of the province, south of a line from Digby Neck to Musquodoboit Harbour, has a distinctive flora. The plants typical of this region are usually absent from other quartzite and granitic regions. A characteristic feature is the mingling of northern and southern plants.

The plants of the southwestern flora are believed to have survived during the last glaciation in a refugium off the Atlantic coast or to have moved northward over the exposed coastal plain while the glacier was retreating. The exposed land, with its ponds, sandy or peaty soils, and stream edges, presented a suitable area for colonization by more southern plants. As the sea level rose, these plants gradually became isolated from their range further south, and they are not found today in New Brunswick, Maine or Massachusetts.

The following are examples from the group of plants now found from Florida to Louisiana or Texas (some even to Mexico or the West Indies) and north along the coast to New England, before jumping to southwestern Nova Scotia. These plants represent the coastal-plain element of our flora:

*Woodwardia areolata* —Dwarf Chain Fern  
*Lachnanthes tinctoria* —Redroot  
*Smilax rotundifolia* —Green Brier  
*Hydrocotyle umbellata* —Water-pennywort

Other plants which are distinctly coastal plain in nature and are very common in southwestern Nova Scotia have developed a wider distribution and also occur inland, in Cape Breton, and often in southern Newfoundland. These include

*Juncus militaris* —rush  
*Calopogon pulchellus* —Grass-pink  
*Drosera intermedia* —Narrow-leaved Sundew  
*Viola lanceolata* —Lance-leaved Violet  
*Gaylussacia dumosa* —Bog Huckleberry

### **Plants of the Seashore**

About fifty species are restricted to beaches, cliffs and salt marshes along the seashore. A few of these plants have a more southern origin and range, analogous to the coastal-plain flora. Examples include

*Spartina patens* —Saltmarsh Cord-grass  
*Limonium nashii* —Sea-lavender  
*Solidago sempervirens* —Seaside Goldenrod

Many of the most common seaside plants have a northerly distribution similar to plants of the boreal floral element. This group includes

*Hierochloa odorata* —Sweet-grass  
*Juncus balticus* —rush  
*Juncus gerardii* —rush  
*Mertensia maritima* —Sea-lungwort  
*Plantago maritima* —Seaside Plantain

A smaller number of species— American Beach-grass *Ammophila breviligulata*, Sea-rocket *Cakile edentula* and Scotch Lovage *Ligusticum scoticum*— are found only in eastern North America and in Europe. Their range is somewhat less northern, extending southward from the warmer areas around the Gulf of St. Lawrence.

### **INTRODUCTIONS**

The contemporary flora also includes an introduced component. The direct or indirect importation of species may go back as far as 1000 years. Introduced species may be commonly found in native, as well as anthropogenic, habitats (see T12.2 Cultural Landscapes).

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**Associated Topics**

T3.3 Glaciation, Deglaciation and Sea-level Changes, T4.1 Post-glacial Climatic Change, T4.3 Post-glacial Colonization by Animals, T9.3 Biological Environment, T10.1–T10.12 Plants, T12.10 Plants and Resources

**Associated Habitats**

H2.1–H2.6 Coastal, H3.1–H3.6 Freshwater, H4.1–H4.4 Freshwater Wetlands, H5.1–H5.5 Terrestrial Unforested, H6.1–H6.3 Forests

**References**

- 1 Roland, A.E., and E.C. Smith (1969) "The Flora of Nova Scotia." *Proc. N.S. Inst. Sci.* 26.
- 2 Livingstone, D.A. (1968) Some Interstadial and Postglacial Pollen Diagrams from Eastern Canada. (*Ecological Monographs* no. 38).
- 3 Mott, R.J., and D.R.G. Grant (1985) "Pre-Lake Wisconsinan paleoenvironments in Atlantic Canada." *Geographie Physique et Quaternaire* 39: 239–254.
- 4 Vernal, (de) A., C. Causse, C. Hillaire-Marcel, C.R.J. Mott and S. Occhietti (1986) Palynostratigraphy and Th/V ages of upper Pleistocene interglacial and interstadial deposits on Cape Breton Island, eastern Canada," *Geology* 14: 554–7.

**Additional Reading**

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- Pielou, E.C. (1991) *After The Ice Age: The Return of Life to Glaciated North America*. University of Chicago Press, Chicago.