T9.3 BIOLOGICAL ENVIRONMENT

Soils are the foundation of terrestrial ecosystems. They support plants, shelter a variety of animals and micro-organisms, regulate the movement of water, and are where most organic material is decomposed. The greatest amount of biological activity occurs in the A horizon, or "topsoil." The abundance and diversity of living things in the soil are influenced by factors including acidity, type of leaf or needle litter, soil texture and soil moisture. Soil offers a relatively constant environment; it lacks the wide daily or seasonal temperature fluctuations of the atmosphere.

> *Most plants prefer soil that contains about 5 per cent organic matter, 25 per cent water, 25 per cent air, and 45 per cent soil mineral particles by volume.*

SOIL CLIMATE

Soil climate is the integration of those aspects of atmospheric climate which most affect the environment of soil flora and fauna. One soil-climate classification (Figure T9.3.1) is based on soil-temperature and soil-moisture regimes during the year.[1]

The sheltered Annapolis Valley (District 610) has a Mesic temperature regime, while the rest of southern Nova Scotia is moderately cool Boreal to mild Mesic. The northern part of the province is moderately cool Boreal, with the exception of the Northumberland Shore and southern Cape Breton, which are cool Boreal. The rest of Cape Breton is moderately cold Cryoboreal.

Most of the province is Perhumid, meaning that the soils are moist all year. The Annapolis Valley and parts of the central lowlands are humid and experience slight moisture deficits in the growing season.

FOREST HUMUS FORMS[2,3]

Coniferous trees drop a needle litter that is not readily digested by most micro-organisms, so it decomposes slowly and accumulates on the soil surface. The primary decomposers of coniferous forest litter are fungal organisms. Their decomposition by-products are strongly acid and usually create an environment adverse to earthworms. Thus, little of this raw humus, or mor as it is called, is mixed with the mineral soil. Infiltrating water is made more acidic by its reaction with the by-products of fungal decomposition. The resultant soil solution readily leaches out plant nutrients and other bases.

The litter from hardwood trees is more readily digested by soil micro-organisms and is usually higher in nutrients than conifer litter. As a result, hardwood litter is more easily decomposed and incorporated into the mineral soil, forming partly decomposed humus called moder. Bacteria tend to replace fungi as decomposers, and there tends to be

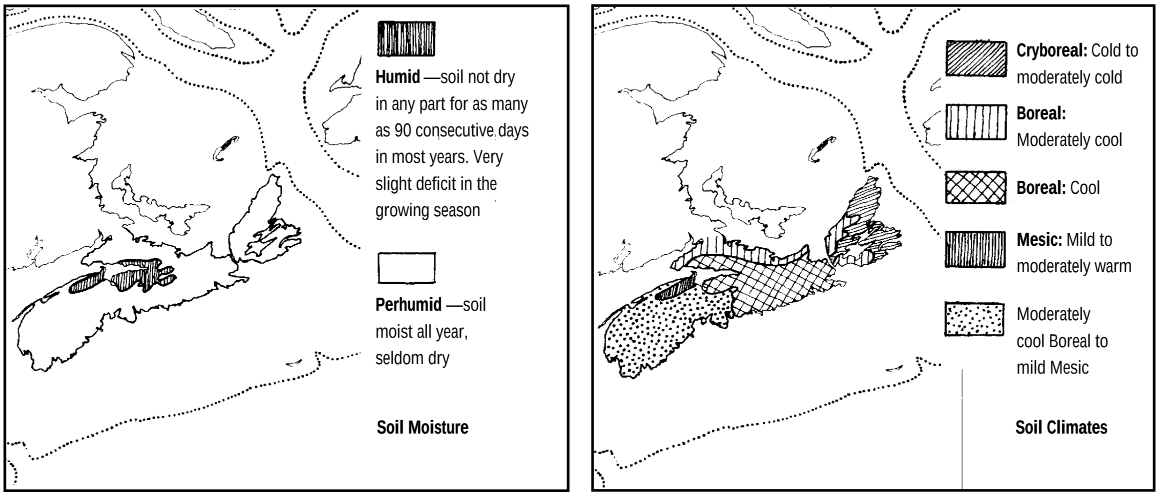

Figure T9.3.1: Classification of soil climate based on soil-temperature and -moisture regimes.

T9.3 Biological Environment

a larger diversity of soil fauna. Under less-acid, more nutrient-rich soil conditions, hardwood litter is consumed and incorporated into the mineral soil very quickly by earthworms, producing intimately mixed, humified humus called mull. In Nova Scotia, true mull is not common and is mainly found on the North Mountain (District 720) or on the Cobequids (Unit 311), where the bedrock is more basic.

Mor, moder and mull are terrestrial humus forms, found on rapidly to imperfectly drained sites. Humus forms developed on poorly drained sites are divided into two classes. Organic horizons are called peaty mors and are transitional to soils of the Organic Order. Anmoors are associated with soils of the Gleysolic Order, where the humus has been incorporated into the mineral soil.

Soil organic matter helps to strengthen soil structure, holds moisture (2.5 times its weight in water) and is a source of plant nutrients.

RESTRICTING LAYERS

Most Nova Scotia soils have a layer that restricts rooting depth, water movement or both. In addition to bedrock (see T2), some restricting features are ortstein layers, fragipans and basal till.

Ortstein Layer

An ortstein layer consists of organic matter cemented with illuviated iron, aluminium oxides and organic matter. Ortsteins are permeable to water but not to plant roots. It has been suggested that ortsteins are associated with change from a wet to a drier soil moisture regime. The cementing may be caused by desiccation and resultant oxidation. Ortsteins are most commonly found in coarse-textured upland and highland soils, particularly the Ferro-Humic Podzols, which feature substantial leaching of organic matter to the B horizon. Ortsteins are found extensively in the barrens of southwestern Nova Scotia (District 440) and on the Cape Breton plateau (Districts 210 and Region 100). A typical ortstein is often found in soils of the Lydgate series—a Gleyed Ferro-Humic Podzol common in Shelburne County (Unit 841). The surface drainage is fairly rapid, but the fine, thick organic surface layer retains moisture over long periods. The dark-brown, strongly mottled ortstein layer is found at a depth of about 30 cm. Where forested, Lydgate soils usually support only spruce. Large areas are covered with heath vegetation. Other soils which often develop ortstein layers are Nictaux, Cornwallis, Somerset, Hebert, Bayswater and Gibraltar.

Fragipan Layer

A fragipan is a layer of silt and sand cemented by clay and low in organic matter. It has a platy structure and is brittle when moist and extremely hard when dry. A well-developed fragipan cannot be penetrated by roots and is only slightly permeable to water. Fragipans are particularly associated with lowland soils on glacial tills of medium to coarse texture, e.g., the Debert series in Unit 521. The fragipan usually begins between 30 and 60 cm from the surface and is 5–15 cm thick. Drainage is restricted and tree throw is frequent because of shallow rooting.

Basal-till Layer

Compact till, with or without an overlying fragipan, is a common feature of the lowland regions of Nova Scotia. From a plant growth point of view, the characteristics of basal tills are similar to fragipans: high bulk density, and low permeability to roots, water and air. Queens and Debert soils have developed on material overlying compact till. There are several reasons offered to explain the compacted nature of the till.[4] One theory is that the bottom part of the glacial debris, the basal till, was compacted by the weight of the glacier and present-day soils developed in the overlying ablation till that melted out of the glacier. Another explanation is that the low calcium content of the parent material, coupled with a moist climate, led to poor soil structural development, which, in turn, led to restricted drainage, further inhibiting structural development, and so on, in cyclical fashion.

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Associated Topics
T5 Climate, T9.1 Soil-forming Factors, T9.2 Soil Classification, T10.9 Algae, T10.10 Fungi, T11.16 Land and Freshwater Invertebrates

Associated Habitats
H6 Forests

References
1 Clayton, J.S., W.A. Ehrlich, D.B. Cann, J.H. Day, and I.B. Marshall (1977) *Soils of Canada*. Agriculture Canada, Research Branch, Ottawa.
2 Webb, K.T. (1990) Soils of Pictou County, Nova Scotia. Research Branch, Agriculture Canada, Ottawa. (*Nova Scotia Soil Survey Report* No. 18).
3 Bernier, B. (1983) "Descriptive outline of forest humus form classification." In *The Canada Soil Information System (CanSIS) Manual for Describing Soils in the Field*, edited by J.H. Day. Research Branch, Agriculture Canada, Ottawa. (*Land Resource Research Institute Contrib*. No. 82-52).
4 Smeck, N.E., and E.J. Ciolkosz, eds. (1989) "Fragipans: Their occurrence, classification and genesis." *Soil Sci. Soc. Amer.* (24).