

12.2 Hierarchical Frameworks in Pedology and Ecology

A hierarchy is a grouping of items in successive orders or levels of organization. The essence of hierarchical organization is a vagueness and loss of detail in proceeding from one level to a higher level. Hierarchical frameworks (Fig. 11.2) have been used in pedology (Heil and Anderson, 1980) and Ecology (Rowe, 1961). In pedology, the levels of hierarchy from higher levels to lower levels are: soil zone, land system, toposequence, polypedon, pedon, horizon and aggregate. The aggregate, consisting of a cohesive unit of mineral colloids, microorganisms and organic colloids, is the fundamental unit in pedology. In ecology, levels of hierarchy from higher levels to lower levels are: ecosphere, regional ecosystem, local ecosystem, ecosystem - single organism - habitat, organism, organ and cell. The cell is the fundamental unit in ecology.

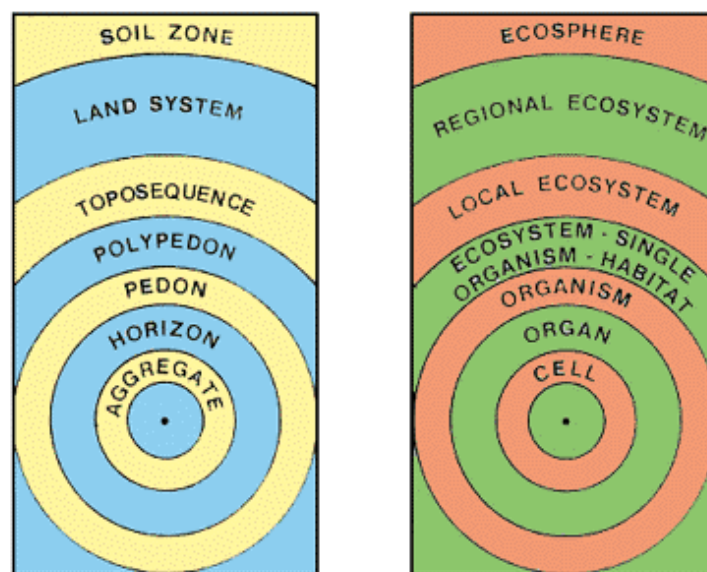


Fig 12.2. Integrative levels of organization in pedology and ecology (after Anderson (1987) and Rowe (1961)).

Scientists at the Centre for Land and Biological Resources Research, Research Branch of Agriculture and Agri-Food Canada and the State of the Environment Directorate Environmental Conservation Service, Environment Canada, have developed “A National Ecological Framework for Canada” (Ecological Stratification Working Group, 1996). Information about ecosystems is organized hierarchically into three levels of generalization.

Ecozones: Ecozones are areas of the Earth’s surface representative of large and very generalized units which are formed through the interaction of biotic and abiotic factors. Therefore, the ecozone defines, on a subcontinental scale, the broad mosaics formed by the interaction of the macroscale climate, human activity, vegetation, soils, geological, and physiographic features of the country. In the national ecological framework of Canada, the country is grouped according to very broad physiographic and ecological similarities into 15 ecozones (Ecological Stratification Working Group, 1996). Ecozones are designed for use at a map scale of 1:7.5 million (Fig. 12.3).

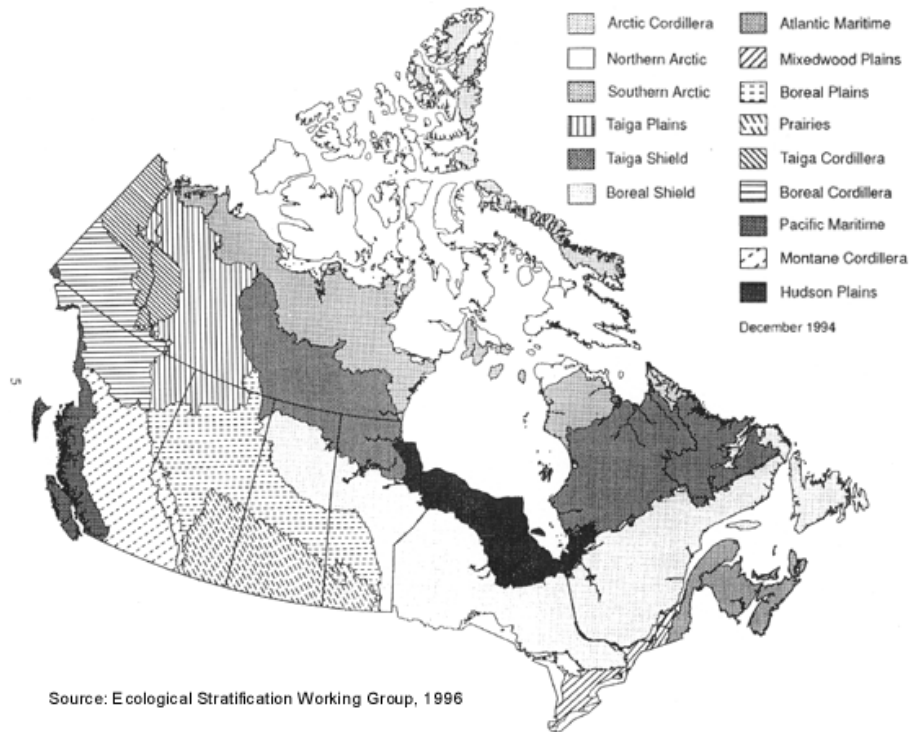


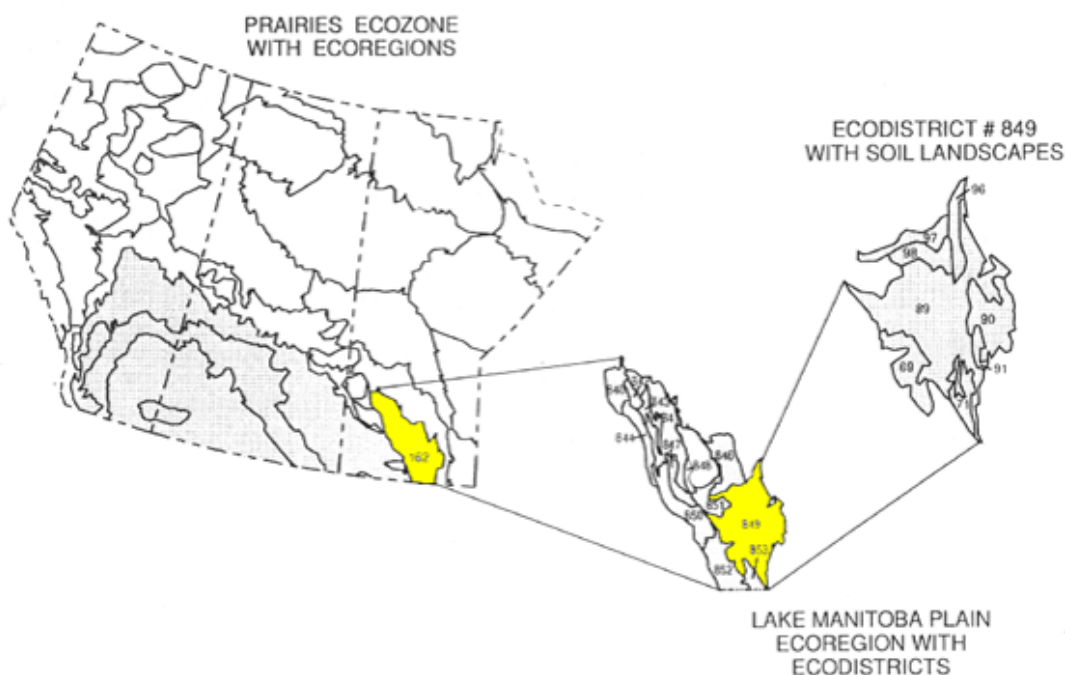
Fig. 12.3. Terrestrial ecozones of Canada (Ecological Stratification Working Group, 1996).
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Ecoregions: Ecoregions are subdivisions of the ecozones characterized by distinctive large order landforms or assemblages of regional landforms, small order macro- or mesoclimates, vegetation, soils, water, and regional human activity patterns/uses. The ecoregions constitute the major bridge between the sub-continental scale ecozones and the more localized ecodistricts. The Canadian ecozone framework is further divided into a total of 194 ecoregions. Each ecoregion has a name, which is normally based on a prominent biophysical or physiographic feature within the ecoregion. Ecoregions are designed for use at a map scale of 1:5 million to 1:2 million (Fig. 12.4).

Ecodistricts: Ecodistricts are subdivisions of ecoregions and are characterized by distinctive assemblages of landforms, reliefs, surficial geologic materials, soils, water bodies, vegetation, and land uses. Each ecodistrict is characterized by relatively homogeneous biophysical and climatic conditions. The differentiating characteristics of ecodistricts are: regional landform, local surface form, permafrost distribution, soil development, textural group, vegetation cover/land use classes, range of annual precipitation, and mean temperature. Ecodistrict size is a function of the regional variability of these defining attributes, and minimum size is approximately 100,000 ha. Ecodistricts are designed for use at a map scale of 1:3 million to 1:1 million (Fig. 12.4).

Soil Landscapes of Canada: Soil landscapes of Canada are subdivisions of ecodistricts and are organized according to a uniform national set of soil and landscape criteria based on permanent natural attributes. The soil landscapes are based on existing soil survey maps which have been recompiled at 1:1 million scale. Each area on the map is described by a standard set of attributes. The full array of attributes includes surface form, slope, water table depth, permafrost and lakes.

Soil landscapes may contain one or more distinct soil landscape components and may also contain small but highly contrasting inclusion components. The location of these components within the a specified area (polygon) is not defined.



Source: Ecological Stratification Working Group, 1996

Fig. 12.4. Ecoregions in the Prairie ecozone of Canada (Ecological Stratification Working Group, 1996). Reproduced with permission from Canadian Government Publishing, Ottawa.

The national ecological framework for Canada recognizes that soils are integral part of each of the terrestrial ecozones (Table 12.1). The pattern of distribution of soils is intimately linked to the geomorphology, climate and vegetation in different terrestrial ecozones. The soil classification system emphasizes the soil component of ecosystems and is presented in Section 5.3.

Table 12.1. Examples of geomorphology, soils, vegetation and climate encountered at three levels of generalization used in the Canadian Ecological Land Classification system (adapted from Ironside, 1991).

Level of Generalization and map scale	Geomorphology	Soils	Vegetation	Climate
Ecozone 1: 7.5 million	Macro-landforms	Soil order group(s)	Broad physiognomic types	Macro
Ecoregion 1: 5 to 1: 2 million	Large-order landforms or assemblages of regional landforms	Great groups or associations thereof	Plant regions or assemblages thereof	Meso or small order macro
Ecodistrict 1:3 to 1:1 million	Regional landforms or assemblages thereof	Subgroups or associations thereof	Plant districts or assemblages thereof	Meso or large order micro