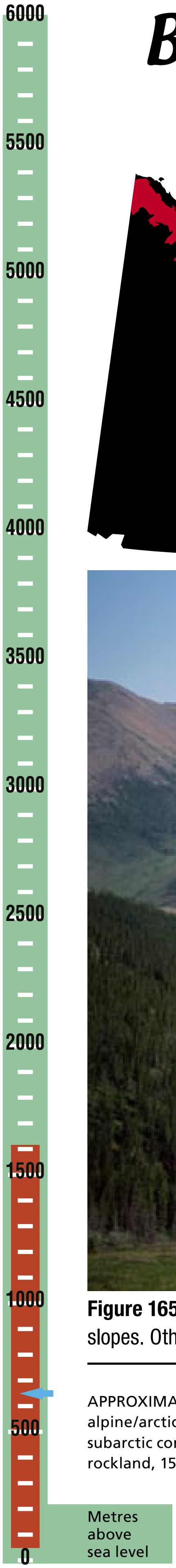
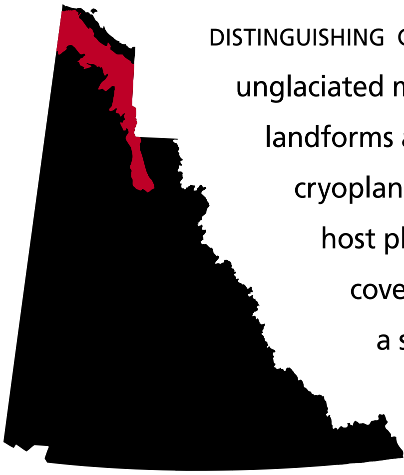


British-Richardson Mountains

Taiga Cordillera Ecozone

ECOREGION 165



DISTINGUISHING CHARACTERISTICS: The ecoregion contains the largest extent of unglaciated mountain ranges in Canada. Some excellent examples of periglacial landforms are found within the ecoregion, including solifluction lobes and cryoplanation summits and terraces. The northernmost Richardson Mountains host phosphate minerals, including lazulite, the Yukon gemstone. Vegetation cover, strongly influenced by aspect and elevation (Fig. 165-1), produces a surprising diversity of ecosystems and habitats. This mountainous ecoregion contains the Yukon portion of calving habitat along with important migration routes of the Porcupine caribou herd.

J. Hawkings, Canadian Wildlife Service

Figure 165-1. View looking eastward in the Richardson Mountains showing spruce forest growing on lower elevation, south-facing slopes. Other slope aspects and elevations above 600 m asl support only shrub and/or tundra vegetation.

APPROXIMATE LAND COVER
alpine/arctic tundra, 65%
subarctic coniferous forest, 20%
rockland, 15%

TOTAL AREA OF ECOREGION IN CANADA
26,690km^2

TOTAL AREA OF ECOREGION IN THE YUKON
22,900 km^2

ECOREGION AREA AS A PROPORTION OF THE YUKON
5%

ELEVATIONAL RANGE
40–1,610 m asl
mean elevation 640 m asl

CORRELATION TO OTHER ECOLOGICAL REGIONS: Mountainous portion of **Northern Mountains and Coastal Plain Ecoregion** (Oswald and Senyk, 1977) • Equivalent to **Northern Mountain Ecoregion** (Wiken et al., 1981) • Yukon portion of **Brooks Range Tundra Region** (CEC, 1997) • Yukon portion of **Brooks/British Range Tundra Ecoregion** (Ricketts et al., 1999). Contiguous with the **Brooks Range Ecoregion of Alaska** (Nowacki *et al.*, 2001)

PHYSIOGRAPHY

The British, Barn and Richardson mountains and intervening valleys compose the British–Richardson Mountains Ecoregion (Rampton, 1982) (Fig. 2). They have been sometimes known collectively as the Arctic Mountains or Ranges (Bostock, 1948; Hughes, 1987b). The British Mountains comprise the eastern extension of the Alaskan Brooks Range, including the Buckland Hills and the northern foothills of the British Mountains (Rampton, 1982). The British and Barn mountains run parallel to the north coast of the Yukon. The Richardson Mountains trend north–south from east of the Barn Mountains south to the Peel River.

The mountains have remained largely unglaciated except for minor alpine glaciation in the British Mountains and the eastern flank of the Richardson Mountains (Fig. 165-2). The ecoregion is characterized by steep, V-shaped valleys in the higher ranges and gently sloping pediments where the valleys are broader.

The relief in the mountains ranges from 450 to 900 m. The highest elevations are associated with the western British Mountains and the southern Richardson Mountains where there are unnamed peaks over 1,600 m asl. In the northern Richardson and Barn mountains, the topography is more subdued.

The British, Barn and Richardson mountains are cut by large rivers flowing north to the Beaufort Sea. From the west, the most significant are the Malcolm, Firth, Babbage, Blow and Big Fish rivers. The southern slopes of the mountain ranges are drained by small tributaries to the Porcupine River. Most of the Richardson Mountains also drain to the Porcupine via the Bell and tributaries of the Eagle River. The south and east slopes of the Richardsons are part of the Peel watershed.

J. Meikle, Yukon Government

Figure 165-2. A view of the Richardson Mountains showing Laurentide glacial drift in valley bottoms and unglaciated upper slopes and ridgetops. Note the contrast between light coloured, lichen-dominated colluvial slopes and valley-bottom drift surfaces that are vegetated by darker coloured sedge tussock/moss communities.

BEDROCK GEOLOGY

This ecoregion contains well-exposed sedimentary rocks of Proterozoic to Cretaceous age and small Devonian granite intrusions, and spans three separate geological structures. The British and Barn mountains, an eastern continuation of the Alaskan Brooks Range, are part of the Arctic–Alaska Terrane, consisting of continental margin sediments (Wheeler and McFeely, 1991). The topographically subdued region east of the mountains is the Blow Trough, a mid-Cretaceous extension basin. The south-trending Richardson Mountains resulted from Paleozoic deep-water clastic sediments being uplifted by outward-verging thrust faults located at an interpreted westward-dipping crustal ramp (Lane, 1996) in latest Cretaceous or early Tertiary time.

Bedrock geology of the entire ecoregion is shown on regional maps by Norris (1981a,b,f,g) and described by various authors in his report (Norris [editor], 1997). Many regional aspects of the stratigraphy and structure have been studied in detail.

The British and Barn mountains comprise folded and faulted structural blocks, uplifted in early Tertiary time, separated by a structural depression along the Babbage River. The Romanzov Uplift, traversed by the Firth River, exposes a thick structural succession consisting of the following units: Proterozoic mixed carbonate and fine clastic rocks; latest Proterozoic to Cambrian sandstone — the Neruokpuk Formation, 600–1000 m thick; Cambrian and Ordovician volcanic and volcanic-clastic rocks with limestone and argillite — the Whale Mountain succession; and Ordovician to Devonian black argillite and siltstone — equivalent to Road River Formation. Most of the succession is directly correlated with the Proterozoic to mid-Paleozoic Selwyn Basin of the central Yukon (Lane and Cecile, 1989; Lane, 1991). Mount Sedgewick in the British Mountains is cored by a biotite quartz monzonite pluton (370 Ma; Mortensen and Bell, 1991). The Barn Range is a tectonic uplift of a structurally thickened succession of dark grey to black, red, and green shale, ridge-forming grey quartzite and siltstone, and light grey limestone (Cecile, 1988; Cecile and Lane, 1991) equivalent to the upper Hyland group and overlying Road River Formation. Two hornblende–biotite granites, Mount Fitton and Hoidahl Dome, have prominent orange-weathering pyrite haloes. The flanks of these two uplifts constitute the Endicott and Lisburne groups of Carboniferous age overlain by Kingak Formation from the Jurassic–Cretaceous. Blow River Trough contains 4 to 10 km of Albian flysch, in part the Rapid Creek Formation (Young, 1975).

The Richardson Mountains are divided by a structural and topographic depression at the head of the Vittrekwa River at the continental divide on the Dempster Highway with different structural styles to north and south. To the north, ridges formed by differential erosion of more resistant units are short and offset by faults. The White Mountains are an uplifted block of light-grey Paleozoic limestone, which produces extremely rugged topography, surrounded by dark brown clastic sediments of Ordovician to Devonian age. In contrast, the southern Richardson Mountains are a breached anticlinorium with sandstone and limestone of the Slats Creek and Illtyd formations, being Lower and Middle Cambrian respectively (Fritz, 1996) in the hinges, flanked by more resistant chert and limestone of the Road River Formation of Ordovician to Middle Devonian age. Throughout the Richardson Mountains are long, curved and near-vertical faults of the Richardson Fault Array. The southern Richardson Mountains remain seismically active (Forsyth *et al.*, 1996).

In general the oldest succession of mixed carbonate and clastic rocks underlies subdued topography and produces calcareous soil with common caliche surfaces (L. Lane, pers. comm., 1997). The blocky talus below thick limestone units, as well as from Precambrian sandstone units, provides denning sites for foxes, wolf and bear. Slopes underlain by the sandstone, as well as Cambro–Ordovician volcanic and volcaniclastic rocks are characteristically unstable and lightly vegetated with blocky talus cones. Cambro–Ordovician argillite and chert underlies subdued topography with fine, granular talus that is well vegetated and suitable habitat for burrowers. Steeply dipping chert layers locally produce jagged, razor-like ridge crests. The Carboniferous dark shale of the Kayak Formation and sandstone locally harbour evaporite minerals, used as salt licks by caribou, while the tilted limestone strata erode into rugged topography.

A variety of mineral types are known, although much of the northern part of the ecoregion was withdrawn from claim staking in 1978, limiting further investigations. The Blow River, Rapid Creek and Big Fish River area contain new phosphate minerals (Robinson *et al.*, 1992), including lazulite, the Yukon gemstone. This area also contains very large phosphatic iron manganese reserves. The Barn Mountains hold uranium in conglomerate of Carboniferous and Cretaceous Age as well as in skarns with molybdenum, tungsten and copper near the Fitton and Sedgewick granitic intrusions. Minor gold occurs at Mount Sedgewick and at Whale Mountain. The erosion of Devonian granite in nearby Alaska has produced the placer deposit in Sheep Creek, near the Firth River. A magnetite iron formation occurs locally in the Cambrian to Devonian units of the Romanzov Uplift near the Alaska–Yukon border (Lane *et al.*, 1995). Seams of anthracite are common in the Mississippian Kayak and Cretaceous Kamik formations throughout the ecoregion. The Richardson Mountains contain several galena and sphalerite occurrences, typically in breccia zones within the Illtyd (Pilon showing) and Road River (Vittrekwa showing) limestones. Magnetite, minor chalcopyrite and brannerite occur in a diatreme breccia within Proterozoic lime siltstone. Large gypsum lenses in the Richardson Fault Array straddle the Yukon–Northwest Territories border.

A spectacular exposure of Road River sedimentary rocks occurs at Canyon Creek, and quartzite of the Jurassic Bug Creek Group provides impressive cryoplanation terraces in the northern Richardson Mountains (Fig. 27 *in* Norris [editor], 1997).

SURFICIAL GEOLOGY AND GEOMORPHOLOGY

This high relief, largely unglaciated terrain has been affected mostly by mass wasting and weathering. Rock outcrops are common, being mostly composed of friable sedimentary rocks such as sandstone, limestone and shale. At high elevations, tors, pinnacles and dyke-like ridges stand out at or near summits. The summits, as well as the uppermost slopes of mountains, are usually blanketed by unvegetated rock fragments either as felsenmeer or colluvium veneer, interspersed with frost-shattered crags.

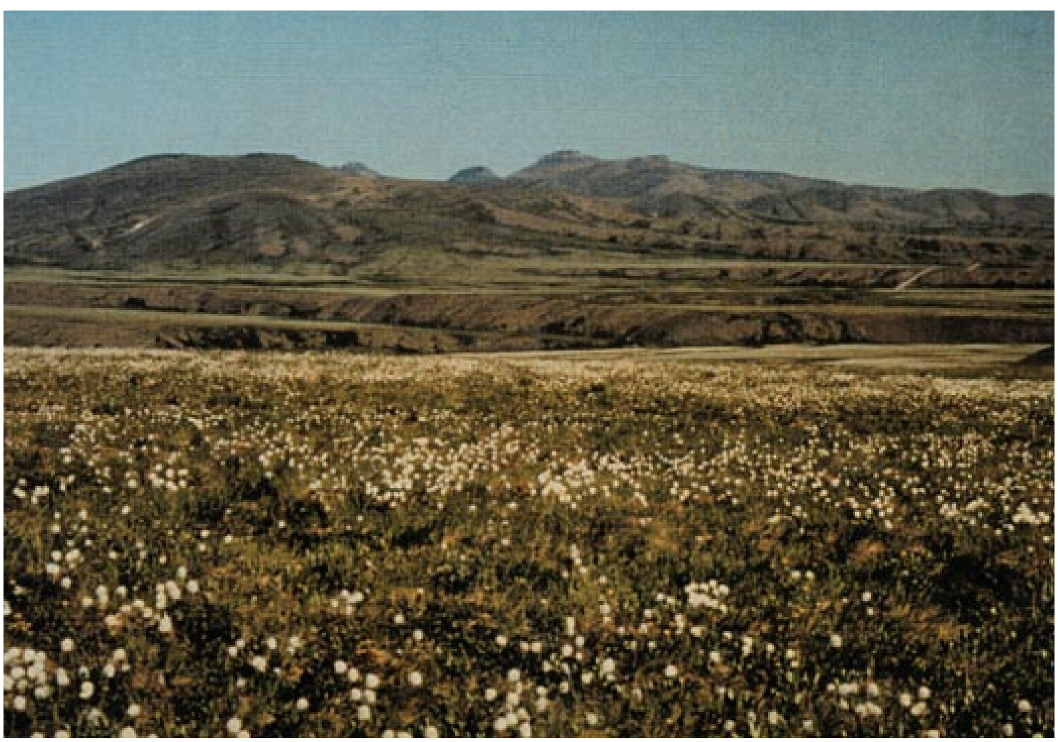
Middle and low elevations are covered by residual or weathered rock, or soliflucted and colluvial materials, which form fans or long, gentle pediment slopes. Pediments are extensively developed in this mountainous ecoregion, with three levels identified in the Richardson Mountains and at least six in the British Mountains (L. Lane, pers. comm., 1997) (Fig. 165-3). Stone circles and other patterned grounds are occasionally present.

Most small streams have coarse gravel beds. The streams are often entrenched in pediment surfaces. Upper slopes have developed intricate, feather-like drainage patterns. Thin loess deposits are common throughout the ecoregion.

Modern processes relate dominantly to colluvium deposits, including a variety of materials transported by solifluction and sheetwash (Fig. 165-4). Periglacial features include cryoplanation terraces found all along the northern Cordillera, with the highest concentration along the southern slopes of the British Mountains north of the Old Crow Basin (Lauriol and Godbout, 1988; Lauriol, 1990).

GLACIAL HISTORY

Localized alpine glaciers affected the highest mountains during Pleistocene glacial periods of undetermined ages. There are two restricted areas where local glaciers developed: at the headwater of Malcolm River in the British Mountains (Duk-Rodkin, in press) and east of Bell River in an unnamed peak in the Richardson Mountains (Duk-Rodkin and Hughes, 1992a). Cirque scars are found in both these areas, but no glacial deposits have been recognized in the valleys of the Richardson Mountains. Malcolm Valley has glacial features that could relate to three glacial periods, including the Late Wisconsinan. The identification of these three glacial periods is based on the degree of preservation of glacial features on these valleys.



A. Duk-Rodkin, Geological Survey of Canada

Figure 165-3. Pediment terraces on the eastern slope of the Richardson Mountains have been partly glaciated by the Laurentide ice sheet. The tundra vegetation in the foreground is dominated by cotton grass *(Eriophorum vaginatum)*.

Figure 165-4. The mottled texture of this slope results from solifluction, the sliding of the active layer over the underlying permafrost. The solifluction lobes, like rolls, are several metres across and up to 2 m high. They are composed of a mix of mineral soil, organic matter and rock fragments.

During its maximum extent, the Laurentide Ice Sheet extended up to 970 m asl in the southern Richardson Mountains, descending to 880 m asl in McDougall Pass. This Late Wisconsinan limit 30,000 years ago (Hughes *et al.*, 1981; Schweger and Matthews, 1991) is the only glacial limit represented in this ecoregion. Though the ice sheet crossed the continental divide in this ecoregion only at McDougall Pass, meltwater drained to the western side of the mountains at several sites, including the headwaters of the Road and Vittrekwa rivers. This resulted in several changes to pre-existing drainages, most importantly the westward diversion of the Porcupine River (Duk-Rodkin and Hughes, 1994) that caused the inundation of the Bell–Old Crow–Bluefish basins. The outlet of this proglacial lake cut a canyon to the west, establishing the Porcupine River as a tributary to the Yukon River. Today, the former thalweg of the paleo-Porcupine River in McDougall Pass is buried under 150 m of glacial drift. Terraces related to the preglacial drainage are found along both sides of the valley in McDougall Pass, some of which have been partially glaciated by the Laurentide Ice Sheet (Duk-Rodkin and Hughes, 1992a, 1994). The paleo-Porcupine River was one of the many drainage systems that were changed by the Laurentide Ice Sheet.

Pediment development has been ongoing since at least the late Miocene (McNeil *et al.*, 1993; Duk-Rodkin and Hughes, 1994). Lower pediment surfaces grade into alluvial fans towards the interior basins. Pediment surfaces commonly have a veneer of colluvium derived from local bedrock. Extensive pediment areas are found along the eastern and western slopes of Richardson Mountains (Duk-Rodkin and Hughes, 1992a,b). However, pediments along the eastern side of the mountains were covered by the Laurentide Ice Sheet (Fig. 165-3). On the deep glacial drift in McDougall Pass, the dominant surface units are morainal blankets, hummocky moraine and lacustrine deposits.

CLIMATE

Mountains in this ecoregion are oriented southeastward through the northern Yukon and then southward to the Peel River valley. Although not massive, with elevations from 500 to 1,600 m asl, these mountains are rugged and have significant climatic effects. The higher elevations have less extreme temperatures, but greater precipitation and wind velocity, than in surrounding terrain. Winds are stronger over higher elevations, but particularly significant is the funneling effect of the valleys. There are frequent occurrences of strong to gale-force winds that can develop through depressions when masses of cold Arctic air either spill into or out of the Yukon's interior during the winter. Due to the latitude, the sun remains above the horizon from early June to mid-July, and below the horizon from early December to early January.

Mean annual temperatures are near –7.5°C. Mean January temperatures are –20 to –25°C, but near –5°C temperatures are not uncommon. Equally frequent are temperatures near –40°C, particularly in the lower valley floors. Spring or summer conditions are generally delayed until early June. Mean temperatures are near 10°C in July, but again with variations from near freezing to 25°C.

Precipitation is relatively moderate ranging from 250 to 400 mm annually with the heaviest precipitation from June through August over the Richardson Mountains. Precipitation remains moderate through to December, primarily as snow from September onwards.

Winds are believed to be moderate, but during the winter can often be strong to gale force. The prime directions are west and east, but these can be strongly influenced by local topography. Active systems moving over the Beaufort Sea can result in strong outflows of cold Arctic air spilling through depressions such as the Blow and Babbage rivers. These winds can result in extensive snow redistribution.

Little long-term weather data are available from within the mountains but inferences can be made from such stations as Old Crow, Eagle Plains, Fort McPherson, Shingle Point and Komakuk Beach. Interesting data are becoming available from an automatic weather station at Rock Creek, near Wright Pass north of Eagle Plains. The wind data may be indicative of conditions in other passes.

HYDROLOGY

The northern watersheds of the ecoregion fall largely within the Arctic Hydrologic Region, while the southern Richardson Mountains watersheds extend down into the Northern Hydrologic Region. The area of waterbodies is relatively small; there are few large lakes within the ecoregion and wetland coverage is limited in this unglaciated landscape.

Because of the elongated nature of the ecoregion, hydrologic response is somewhat variable. The majority of the ecoregion is located north of 68°N and exhibits a relatively uniform response. The Richardson "panhandle," which extends to below 66°N, extends into a region of higher precipitation. There are two representative hydrometric stations within the Yukon portion of the ecoregion: Firth and Babbage rivers, though the Eagle River is on the periphery and is somewhat representative of the southern portion of the ecoregion. In addition, three hydrometric stations are adjacent to the ecoregion in Alaska: Kaparuk and Sagavanirktok rivers and the Sagavanirktok River tributary. Annual streamflow is generally characterized by a gradual increase in discharge in the spring, rising to a peak in May or June due to snowmelt inputs. Peak flows tend to be consistently earlier within the southern portion, and later with a more variable timing in the north. This ecoregion has among the highest peak flows and lowest winter low flows in the Yukon. Many of the first- and second-order headwater streams are steep and relatively short; therefore, streamflow response tends to be rapid and flashy. On these smaller streams, approximately 40% of the annual maximum flows are due to intense summer rainstorm events. Some small steep streams are susceptible to mud flows triggered by these summer rainstorms. Mean annual runoff is moderate ranging from 150 to 280 mm, with an ecosystem average of 208 mm. Mean seasonal and summer flows are likewise moderate with values of 15.8 X 10^{-3} and 11.4 X 10^{-3} $m^3/s/km^2$, respectively. The mean annual flood is relatively high with a value of 128 X 10^{-3} $m^3/s/km^2$, while the mean maximum summer flow is more moderate with a value of 35 X 10^{-3} $m^3/s/km^2$. Minimum streamflow generally occurs during January or February in the southern portion of the ecoregion and earlier in the northern portion. The mean annual minimum flow ranges from zero in the northern portion to 0.04 X 10^{-3} $m^3/s/km^2$ in the southern portion. Mean summer minimum flow within the ecoregion is 1.9 X 10^{-3} $m^3/s/km^2$. Most streams experience zero winter flow.

PERMAFROST

Permafrost is continuous in the British–Richardson Mountains Ecoregion of the northern Yukon (Harris, 1986) (Fig. 21). Most of the ecoregion was not glaciated during the Quaternary period, so there are terrain features produced by over 2 million years of frost action. The ecoregion is accessible along the Dempster Highway, from which aprons of frost-shattered debris, extensive networks of patterned ground, and numerous solifluction lobes are visible on the mountainsides (Fig. 165-4). The land grading down from the Barn Mountains towards the Yukon Coastal Plain Ecoregion forms extensive pediments of gentle gradient (French and Harry, 1992). Similarly, high elevations within the Richardson Mountains have well-developed sequences of up to 15 cryoplanation terraces (Lauriol, 1990) — flat surfaces separated by short, steep rock walls, which have formed after long-term frost weathering of host material (Rampton, 1982).

The near-surface permafrost layers are often ice-rich, even in bedrock (EBA, 1985). Ice-rich ground has been detected at depths over 5 m by ground-probing radar along the Dempster Highway near the Yukon–Northwest Territories border (EBA, 1987a). Many features characteristic of continuous permafrost, such as ice wedges, may be found beneath the regolith, but soil movement down slope may mask their surface expression. Thaw slumps are occasionally seen in riverbanks where recent erosion has exposed ground ice.

Several of the rivers and creeks draining the ecoregion are fed by perennial springs, and extensive ice develops in the channel beds each winter. The largest aufeis, in the Firth River, is visible on satellite images taken well into summer (Lauriol *et al.*, 1991). This ice may be several metres thick and extend over 25 km^2.

There are no published determinations of permafrost thickness in this ecoregion, but data from neighbouring areas suggest depths of 200 to 300 m (Burgess *et al.*, 1982). The active layer is usually less than 0.5 m deep on pediments and lower slopes, but Rampton (1982) reports a thickness of 2.5 m at favourable well-drained upland sites.

SOILS

Soils in this ecoregion have formed under the influence of a subarctic climate, strong local relief and varied geologic parent materials. They are formed on mountainside colluvium slope deposits or on the large pediment surfaces of broad valleys. The near-surface permafrost is nearly continuous, except for localized occurrences of unfrozen ground along alluvial systems, glacio-fluvial terraces and some well-drained south-facing slope deposits. The soil–landscape relationships in this ecoregion have been described by Wiken *et al.* (1981) and more recently by Welch and Smith (1990) and are summarized in Figure 165-5. Well-developed periglacial landforms exist, including cryoplanation terraces and cryopediment slopes (French and Harry, 1992). Soils have formed in nonglacial parent materials except for those on the eastern flank of the Richardson Mountains, which were subjected to Laurentide glaciations during the Pleistocene.

All gently sloping surfaces tend to have soil development strongly influenced by cryoturbation. These Cryosols are often silty or clay-textured, saturated for most of the growing season, and classified as Gleysolic Turbic Cryosols. These soils tend to be acidic, particularly in association with shale bedrock; are high in organic matter and silt, and have active layers of less than 50 cm (see site 9, Tarnocai *et al.*, 1993). On pediment surfaces, these soils are associated with tussock tundra vegetation. Shallow soils over bedrock on upland surfaces above treeline exhibit a variety of patterned ground formations, mostly sorted and non-sorted nets and stripes, tend to be less saturated, and are classified as Orthic Turbic Cryosols. On mountain slopes below treeline where there is no near-surface permafrost, soils are most often classified as Eutric Brunisols, or occasionally as Melanic Brunisols if they have thick surface A horizons. Soils are classified as Orthic Turbic Cryosols wherever permafrost occurs on steep slopes (Fig. 165-6). Alluvial sands and gravels tend to lack strong cryoturbation features or a near-surface permafrost table, and are classified as Orthic or Humic Regosols. On older, more stable alluvial surfaces where permafrost is established, soils are typically classified as Regosolic Static Cryosols. On well-drained fluvial terraces, near-surface permafrost may be lacking and soils are classified as Orthic Eutric Brunisols.

One of the unique soil features of the ecoregion is the humus-rich, rendzina-like soil of the limestone areas of the British Mountains (Welch and Smith, 1990; Smith *et al.*, 1990,). Others are the cryoplanation terraces and summits of the Richardson Mountains with their associated patterned ground formations, unique soil fauna populations (Tynen *et al.*, 1991), and solifluction lobes (see site 7 in Tarnocai *et al.*, 1993).

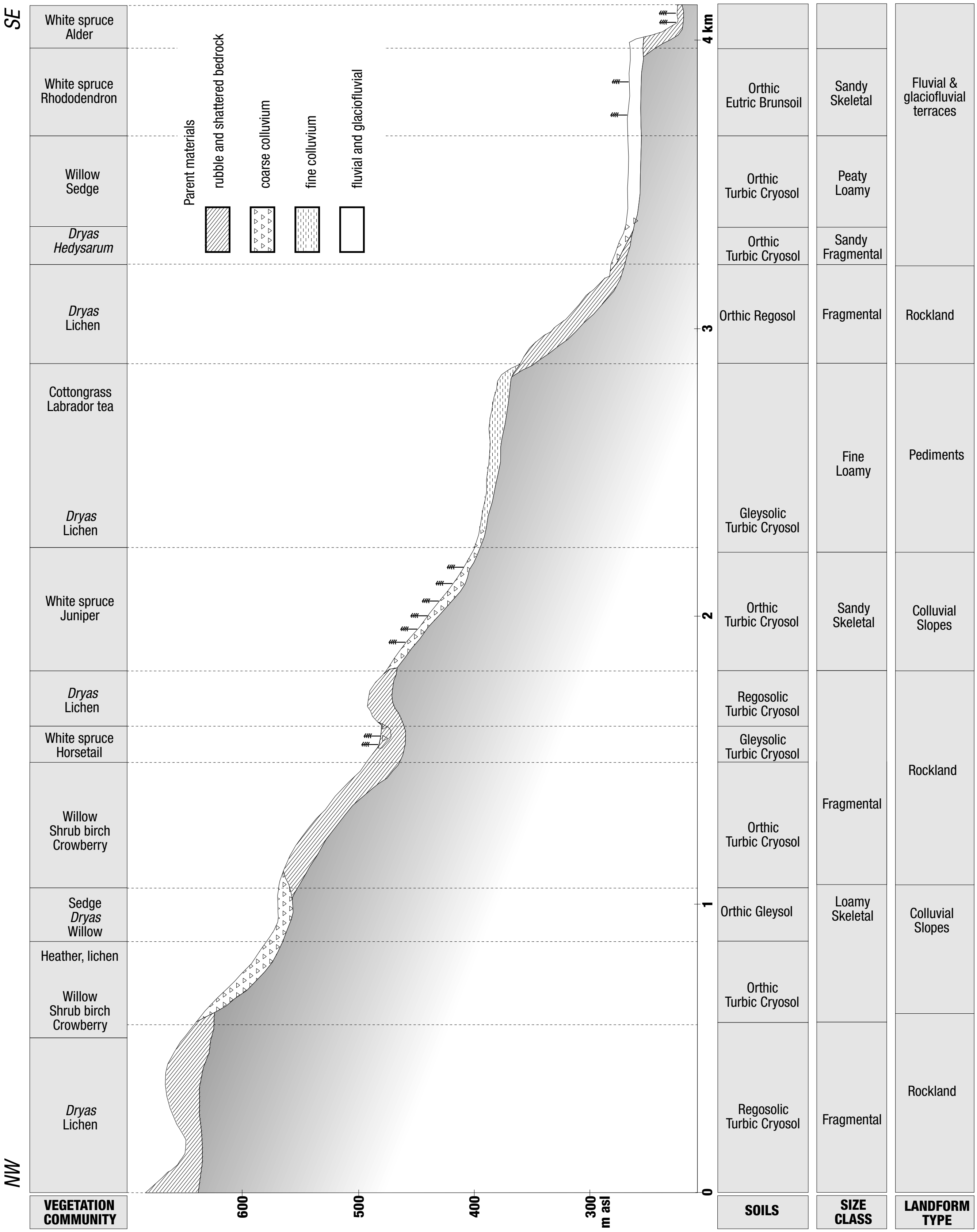


Figure 165-5. Cross-section of soil and vegetation relationships in the Firth River valley in the British Mountains portion of the ecoregion.

VEGETATION

The vegetation of the British–Richardson Mountains Ecoregion is dominated by shrub tundra. Treeline ranges from around 600 m asl in the south to 300 m asl in the north (Zoltai and Pettapiece, 1973; Ritchie, 1984; Loewen and Staniforth, 1997b). Ridge crests support dwarf willow or dryas–lichen tundra, often with sparse vegetation cover. Upper and middle slopes are covered by dry to moist, low shrub and heath tundra, while on lower slopes sedge tussock communities predominate. Shrub thickets are typical along creeks and drainage channels. Trees are limited to river valleys such as the Firth, Big Fish, Bell, and lower slopes with favourable aspects (Fig. 165-1).

On mountain and ridge crests, ranging from 330 to 1,600 m asl, the vegetation is dependent on the parent material. Because most of the area was not glaciated, the soil and vegetation communities reflect the underlying bedrock. Shrub willow (*Salix phlebophylla)* is the dominant cover on shale and sandstone. A sparse cover of *S. phlebophylla*, arctic bearberry, dryas, locoweed, and shrub birch often occurs on only 10 to 20% of the ground surface (Ritchie, 1984; Loewen and Staniforth, 1997b). On calcareous parent material (more extensive to the west in the British Mountains), a floristically rich, although very sparse, dryas–sedge alpine community with numerous forbs, including moss campion, northern sweet-vetch and anemone, and ground shrubs is more typical (Ritchie, 1984).

Slopes contain a mix of shrub and heath tundra. On moister snow accumulation sites and solifluction slopes, willow and ericaceous shrubs including mountain heather, blueberry, lingonberry, mosses and forbs are common. Slopes are often unstable in permafrost areas and many are characterized by scattered flows or slides. These create numerous microsites and intricate complexes of dry to moist vegetation communities. The scarps usually have dry, low shrubs, while the depressions below are wet, colonized first by moss, and then quite rapidly by shrubs. Earth hummocks also create diverse microsites. In the numerous drainages that transect the slopes, tall to medium willow grows with some shrub birch and alder, commonly with an understory of stepmoss, horsetail, forbs and grass (Kennedy, 1990).

On the gentle pediment surfaces of lower slopes, sedge tussock communities predominate. Cottongrass (*Eriophorum vaginatum)* is the major tussock-forming species associated with sedge (*Carex lugens)*, shrub birch, Labrador tea, blueberry, lingonberry and mosses dominated by *Aulacomnium*, *Tomenthypnum* and *Hylocomium*.

Major river valleys provide lower elevation sheltered environments and deeper active layers, which can support open stands of white spruce on inactive

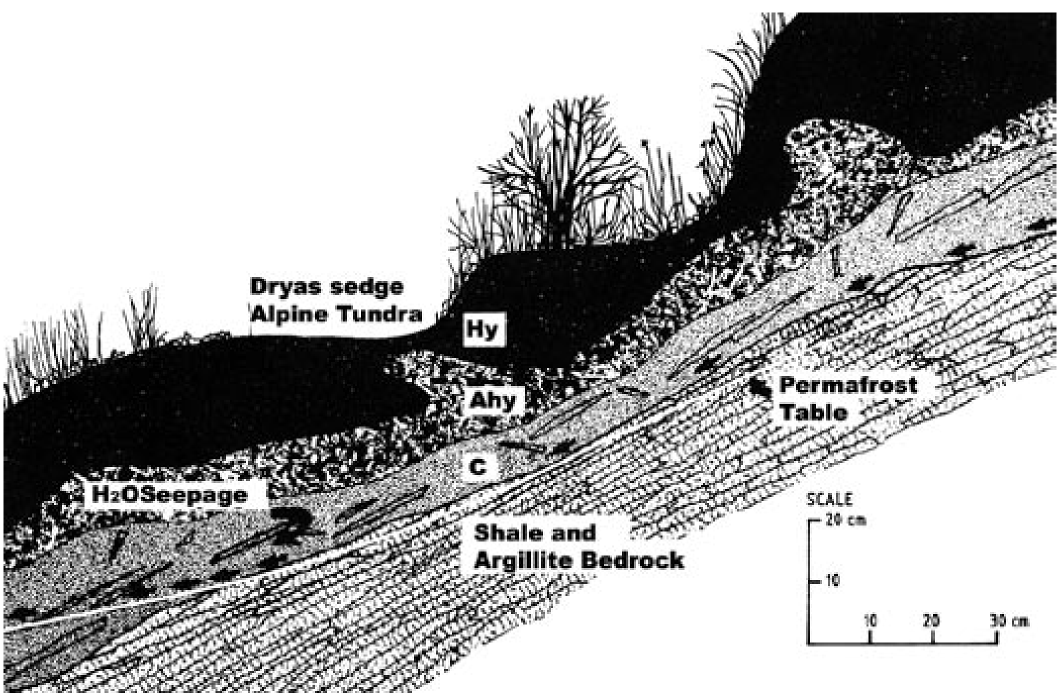


Figure 165-6. Cross-section of typical soil formation on steep slopes, Richardson Mountains. Soils typically have dark-coloured, humus-rich surface horizons (Hy and Ahy). These horizons are mixed with rock fragments as a result of solifluction and cryoturbation. These overlie a mineral horizon (C) of weathered bedrock (from Smith *et al.*, 1990).

river terraces and on well-drained slopes above the streams (Kennedy, 1990). Tamarack is found at treeline in the Richardson Mountains with white spruce on moist calcareous substrate. Balsam poplar is found along recent floodplains and is probably successional to white spruce if left undisturbed. Willow, and sometimes alder, thickets are associated with permafrost-free Regosolic soils on recent floodplains. Horsetails and annual herbs are found on the most frequently flooded sites beside the rivers (Welch and Smith 1990).

WILDLIFE

Mammals

This mountainous region is the primary Canadian calving area of the Porcupine barren-ground caribou herd (Fancy *et al.*, 1994). Caribou use the mountain ridges to maximize wind exposure and gain relief from biting insects in summer. The ecoregion is also used for spring and fall migrations and winter range by the herd. Dall sheep reach their northern limit of distribution in the British Mountains near the Alaska border and in the Richardson Mountains near the Northwest Territories border (Barichello *et al.*, 1989a). Most moose are seasonal residents of riparian habitats, migrating below treeline on the south slope of the mountains in winter (Smits, 1991).

Grizzly bears reach their highest density north of the Mackenzie Mountains here. Wolverines are abundant and heavily dependent on caribou, which they opportunistically cache for future use. River otters are present along fish-bearing streams. Singing Vole colonies and Varying Lemming are common. A list of mammal species known or expected to occur in this ecoregion is given in Table 4.

Birds

The Surfbird is a significant breeder in these rocky slopes and ridges, as its Canadian distribution is limited to these mountains and the Ogilvie Mountains (Frisch, 1987). The mostly barren uplands are utilized in summer by nesting Baird's Sandpipers, Hoary Redpolls, Horned Larks, Northern Wheatears and Gray-crowned Rosy Finch (Frisch, 1975, 1987; Godfrey, 1986).

Sedge tussock tundra provides habitat for many species such as Rock Ptarmigan, American Golden-Plover, Whimbrel, Long-tailed Jaeger and American Pipit (Frisch, 1975, 1987; Weerstra, 1997). Shrubby tundra at these and lower elevations is inhabited by Willow Ptarmigan, Northern Shrike, American Tree, Savannah and White-crowned Sparrows, Smith's Longspur and Common Redpoll (Godfrey, 1986; Frisch, 1987; Weerstra, 1997). Upland Sandpipers breed in sparsely treed, subalpine bogs (Frisch, 1987).

Scattered forests provide breeding habitat for Gray Jay, Townsend's Solitaire, Gray-cheeked Thrush, American Robin, Yellow-rumped Warbler and Fox Sparrow (Frisch, 1987; Weerstra, 1997). The rare Gray-headed Chickadee is occasionally found in this sparsely treed habitat, while the omnipresent Common Raven occurs throughout (Frisch, 1987; Sinclair *et al.* [editors], 2003).

Cliffs, banks, and canyon walls of the Firth River provide breeding sites for Rough-legged Hawk, Golden Eagle, Peregrine Falcon, Gyrfalcon and Say's Phoebe (Theberge *et al.* [editors], 1979; CWS, Birds of the Yukon Database). Harlequin Ducks occur in summer on swift flowing streams and smaller rivers (Frisch, 1987). Wandering Tattlers nest along gravel bars of mountain streams (Godfrey, 1986). Dense willow and alder along many of these watercourses provide habitat for breeding Yellow and Wilson's Warblers (Frisch, 1987). Tundra ponds provide breeding habitat for Red-throated Loon, Tundra Swan, Northern Pintail, Long-tailed Duck and Red-necked Phalarope (Frisch, 1987). Ferns and shallow water ponds provide breeding habitat for Northern Harrier, Least Sandpiper and Common Snipe (Frisch, 1987).