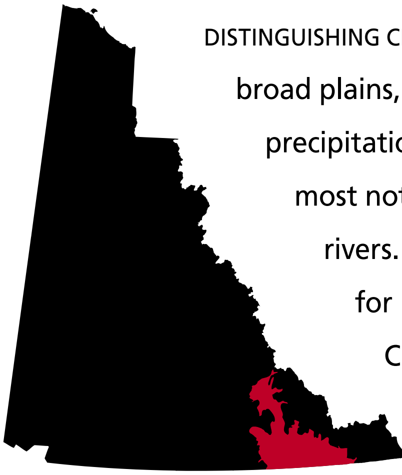
Liard Basin

Boreal Cordillera Ecozone

ECOREGION 181



DISTINGUISHING CHARACTERISTICS: This ecoregion is an area of low hills separated by broad plains, surrounded by mountains and plateaus. The low elevation, moderate precipitation and relatively long, warm summers result in vigorous forest growth, most notably in the floodplains of the Liard, Meister, Frances, Hyland and Coal rivers. The extensive boreal forest of the Liard Basin includes prime habitat for moose, marten, snowshoe hare and lynx. Thousands of Sandhill Cranes migrate through the Liard Basin Ecoregion each spring and fall, following the Frances and Liard valleys.

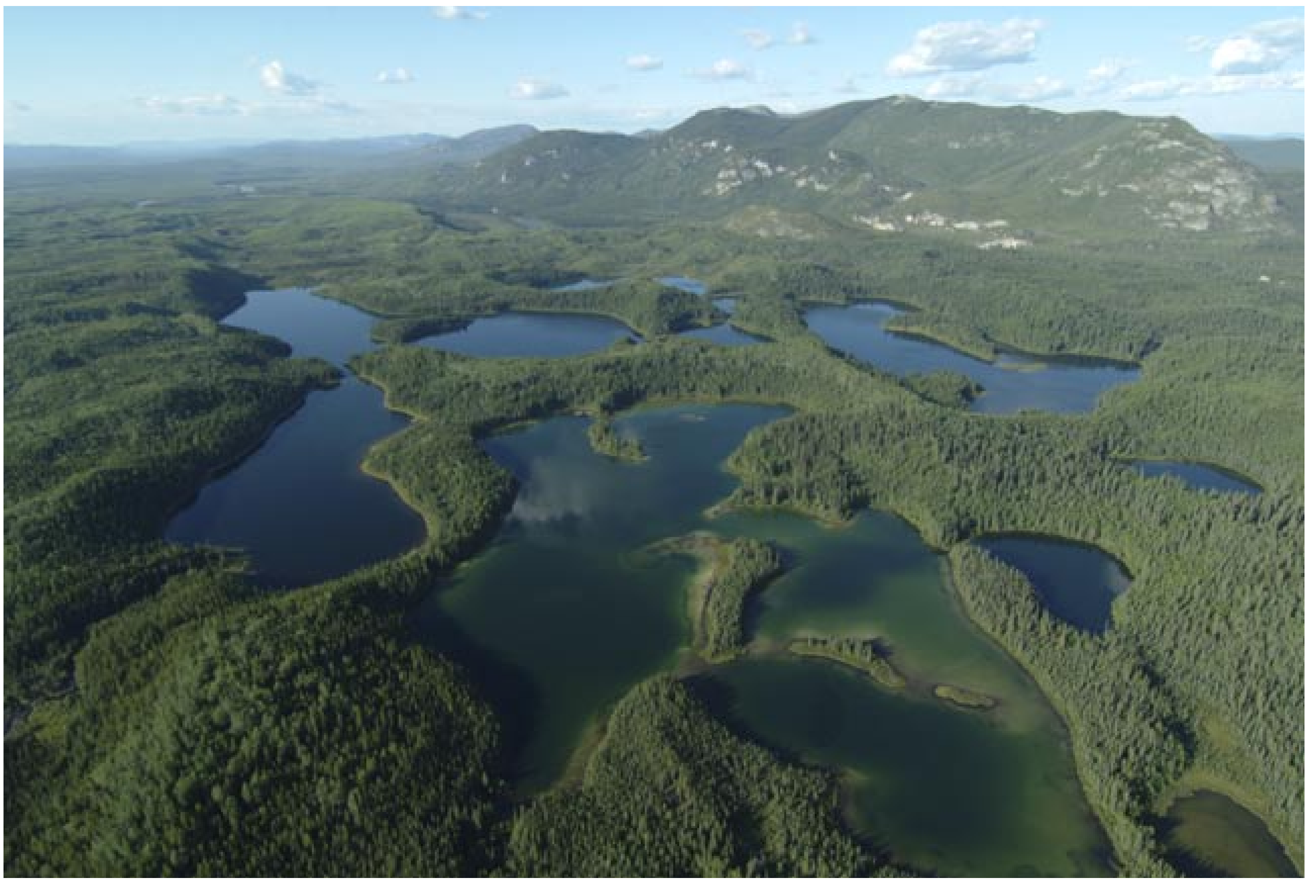


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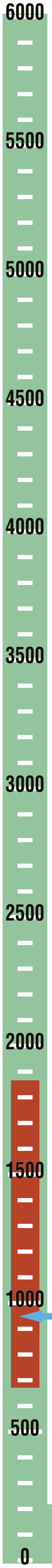
Figure 181-1. Lakes and eskers mark the location where stagnant McConnell glacial ice diverted the Coal River. Numerous uplands, as seen in the distance, occur within the ecoregion with elevations ranging from 1,200 to 1,800 m asl.



Metres above sea level

APPROXIMATE LAND COVER
boreal coniferous and mixed wood forest, 90%
alpine tundra, 5%
lakes and wetlands, 5%

TOTAL AREA OF ECOREGION IN CANADA
34,100 km^2

TOTAL AREA OF ECOREGION IN THE YUKON
21,113 km^2

ECOREGION AREA AS A PROPORTION OF THE YUKON
4%

ELEVATIONAL RANGE
580–1,890 m asl
mean elevation 950 m asl

CORRELATION TO OTHER ECOLOGICAL REGIONS: Equivalent to **Liard River Ecoregion** (Oswald and Senyk, 1977) • Portion of **Cordillera Boreal Region** (CEC, 1997) • Portion of **Northern Cordilleran Forests** (Ricketts et al., 1999)

PHYSIOGRAPHY

The Liard Basin Ecoregion occupies the Liard Lowland (Mathews, 1986), Liard Basin (Hughes, 1987b) or Plain (Bostock, 1948) physiographic units, and the western portion of the Hyland Plateau. About two-fifths of the ecoregion extends south into British Columbia.

This ecoregion is an area of low hills separated by broad flats and surrounded on all sides by mountains and plateaus (Fig. 181-1). More than half of the ecoregion lies below 900 m but rounded hills of 1,200 m are common in the eastern part. Only a few high points in the central part of the ecoregion are over 1,500 m, the highest being 1,887 m.

BEDROCK GEOLOGY

This ecoregion is underlain by a thick mantle of unconsolidated glacial sands and gravel over Early Tertiary fluvial sediments. These sediments have been collectively called the Liard Plain (Klassen, 1987), through which protrudes bedrock on higher ground and in river canyons. Abundant rock is exposed east of the Frances River, west of Simpson Lake, and throughout the ecoregion east of Hyland River.

The geology is unusually complicated because major faults that splay northward juxtapose contrasting rock assemblages within the ecoregion. Areas of bedrock are shown on regional geology maps by Gabrielse (1967, 1968), Gabrielse and Blusson (1969) and Roots (1966). More detailed, though generally unpublished, mapping surrounds the major mineral occurrences, principally the Sa Dena Hes Mine (e.g. Abbott, 1981b), Macmillan, Quartz Lake, and MEL-JERI properties. Stream water characteristics and metal content of silt have been systematically analyzed throughout the western region (Friske *et al.*, 1994).

The Tintina Fault, with about 450 km of dextral offset in the last 100 million years, lies beneath the Liard Plain and trends parallel to the Liard River. Beneath the Frances River lies the Finlayson Lake Fault Zone. The Yukon–Tanana terrane lies between these faults. Across the faults to either side are slivers of Cassiar Platform, consisting of continental margin clastic and carbonate rocks. Further east are fault slices of ocean margin volcanic and ultramafic rocks; the eastern third of the ecoregion contains sedimentary rocks of the miogeocline. Current terrane interpretations are shown on the Yukon geological map compilation (Gordey and Makepeace [compilers], 2001).

General rock types across the ecoregion are described below, beginning in the east. East of Coal River, about 20 km north of the British Columbia–Yukon border and within the dominantly Proterozoic to Carboniferous strata, is an east–west boundary between dominantly shale rocks of the Meilleur embayment to the north and carbonate of the Macdonald Platform to the south. West of Coal River, most of the area is underlain by dark shale, slate, gritty quartzite and conglomerate of the Late Proterozoic to Cambrian Hyland Group. West of Hyland River, a narrow strip extending 40 km southwest from Stewart Lake contains dark-green serpentine, ultramafic and metabasaltic rocks. A distinctive rock (eclogite, composed of garnet–pyroxene–rutile–quartz) originating at great depth, is in two places here (Erdmer, 1987). Where ultramafic rock is incorporated into overlying soil, vegetation will be sickly or stunted by the high magnesium and lack of alkali minerals. Between this strip and Frances River lie reddish weathering chert, rusty black shale and dark-coloured sandstone, with a structural window to underlying argillite and phyllite on Mount Murray and Mount Hundere.

Gravel pits along the Robert Campbell Highway and polymictic conglomerates east of Simpson Lake contain metamorphic clasts and felsic volcanic rock derived from the west (Mortensen, 1997). Between the Frances and Liard rivers, rocks are dominantly schist and phyllite, with 200 m thick Mississippian limestone near Martin and Sambo lakes and in the Middle Canyon of Frances River. Sheared granite is exposed north of Tuchitua River and on Mount Murray. These rocks comprise the Yukon–Tanana Terrane in this area. Grey slate, phyllite, limestone and biotite schist southwest of Liard River comprise the western Cassiar Platform. In the valleys, these rocks are overlain by vesicular olivine basalt flows (about 6 Ma) exposed along and near the Rancheria River, and west of the Upper Canyon of Frances River.

Despite the few areas of exposed bedrock, the region has significant mineral potential. The Sa Dena Hes mine, 45 km north of Watson Lake, yielded zinc, lead and silver from rich deposits between a Cambrian limestone and phyllite. The lead, zinc and barite veins 115 and 75 km northeast of Watson

Lake, respectively, are the most extensively explored of several dozen vein occurrences in the eastern part of the ecoregion. Barite veins cut black shale and chert along the Liard River south of Watson Lake, and lignite to sub-bituminous coal south of Upper Liard, have the potential to be economic deposits.

The Coal River Springs issue along a north-trending fault and precipitate tufa on a ridge of Middle Devonian limestone (Fig. 181-2).

SURFICIAL GEOLOGY AND GEOMORPHOLOGY

Several geological reports and maps on surficial geology of this ecoregion are available: Dyke (1990a,b,c); Jackson (1986; 1993a,b; 1994); Klassen and Morison (1981); and Klassen (1982a). The following comments are derived from these maps and reports.

This part of the Yukon was also subjected to several glaciations since the late Tertiary, but the present surface deposits are from the last glaciation. Ice flow patterns in this region are indicated by the well-defined drumlins on the floor of the Frances, Liard and Hyland River valleys. They show that lobes of McConnell ice, which originated in the Logan Mountains (Dyke, 1990a), moved southwards through the Frances River valley, and from the Pelly and Cassiar mountains flowed east and north-eastwards in the southern part of the ecoregion.

In the alpine areas around Frances Lake, ridge crests and steep walls were modified by large-scale glacial erosion and periglacial and alpine processes. Other bedrock surfaces show little signs of erosion and are probably the remnant of preglacial surfaces.

Further south, high-elevation bedrock slopes and summits are usually covered by a veneer of colluvial moraines, thin moraines over bedrock, and weathered and mass-wasted bedrock. Till on lower slopes can be thicker than 30 m. This is a mixture of cobbly sand, silt and minor clay, which drains well to moderately well. In the Frances River Valley, a dark till results from the incorporation of black Devonian shale (Dyke, 1990a). Geochemically, most till units in the northern part of the ecoregion have a distinctive signature, due to the incorporation of short-travelled bedrock fragments. For example, the clay fraction from the shale-derived till shows a high background level of mercury (up to 100 ppb compared with 200 ppb in other till clay fractions). Tills associated with the Cretaceous monzonite and granodiorite, and with the Precambrian gneiss, have higher background concentrations of uranium than other till bodies (up to 20 ppb compared with 4 ppb in most other tills). Anomalies, usually expressed as high levels of cadmium, molybdenum, silver,

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Figure 181-2. Coal River Springs are cool, tufa-producing springs. Tufa is a whitish precipitate of calcium carbonate forming the "terracettes" visible in this photo. The closed canopy boreal forest growing on the landscape surrounding the springs is typical of the ecoregion.

uranium, zinc, arsenic or lead, are identified in areas of known mineralization, and in the Frances River valley along the Robert Campbell Highway, as well as along the shores of Frances Lake (Dyke, 1991).

Glaciofluvial sand and gravel are found in several of the major valley floors (Fig. 181-1). The Frances and Yusezyu valleys in the north and the Liard, Rancheria, and Hyland river valleys in the south have significant gravelly deposits, in some cases as thick as 30 m (Fig. 181-3). In addition to ice contact and proglacial outwash, several less common features associated with ice margins are present in this area. Ice crevasse fillings are associated with esker ridges in several areas between Nipple Mountain and the east arm of Frances Lake.

As in most mountainous settings, glacial meltwater was dammed at some point during deglaciation and fine-grained glaciolacustrine sediments and beach deposits can be found in a few areas. Slumping of these sediments can be expected as the streams undercut their banks.

The floodplains of most large rivers, particularly the Hyland, Liard and Rancheria, encompass wetlands, many of which have thick peat deposits. Floods related to ice jams, snowmelt and summer rainstorms are possible hazards in lower reaches of most streams in the area (Dougherty *et al.*, 1994)

GLACIAL HISTORY

The surficial geology of the Liard Basin Ecoregion is dominated by till, glaciofluvial gravels and glaciolacustrine clay and silt deposited during the McConnell Glaciation in the Yukon (Bostock, 1966). Deposits from older glaciations are preserved in the subsurface below the Liard Lowland (Klassen, 1987).

During McConnell time, ice flowed into the ecoregion from the Pelly and Selwyn mountains to

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Figure 181-3. Glaciofluvial deposits as deep as 30 m are common in the ecoregion. Stream erosion at the base of these deposits creates steep, unstable bluffs along the Coal River (shown here) and lower Hyland rivers.

the north and the Cassiar Mountains to the west (Dyke, 1990a; Jackson and Mackay, 1991; Jackson *et al.*, 1991). A trunk glacier hundreds of metres thick and the width of Liard Plain flowed down the Liard Valley, where it merged with ice from the northwestern Rocky Mountains. This trunk glacier most likely contacted the retreating Laurentide Ice Sheet in the Mackenzie Valley about 23 ka, and also spilled west into the Coal River basin. The streamlined topography of this region was shaped by this flow. The glacier was probably gone well before 9 ka (Jackson *et al.*, 1991). During the postglacial period, streams incised the glaciated terrain, left flights of stream terraces, and built alluvial fans. Intense mechanical weathering and mass-wasting processes created mantles of colluvium on mountain slopes.

CLIMATE

The ecoregion has a southeast to northwest orientation, which comes under the influence of weather systems from the Pacific Ocean that frequently regenerate over northeastern British Columbia and Alberta. Precipitation is moderate; combined with a relatively extended summer, it results in good vegetative growth.

Mean annual temperatures are near –4°C, ranging from a mean of near –25°C in January to between 10 and 14°C in July. Extremes have been –59 to 34°C. These temperature regimes are modified at higher elevations. Mid-winter thawing temperatures can occur, but are not as common as in the southwestern Yukon. Although midsummer frosts can occur, they are uncommon from early June to late August.

Mean annual amounts of precipitation range from 400 to 600 mm with the heavier amounts over the higher terrain to the north and west. Monthly amounts range from 40 to 70 mm, although February through May receive only 20 to 50 mm. Rain showers and thunderstorms are predominant during the summer.

Winds are generally light, but prolonged periods of moderate easterly winds can occur during the winter. Local strong winds can occur during the summer in association with thunderstorms.

Representative climate stations are Watson Lake and Tungsten.

HYDROLOGY

The Liard Basin ecoregion is situated within the Interior Hydrologic Region (Fig. 8). This hydrologic region encompasses the lower and middle elevations of the Liard River watershed, including the Liard, Frances, Hyland, Coal and Smith River basins within the Yukon, and the Dease and Kechika basins within northern British Columbia. The Liard River is a fifth-order stream, and as such has several large streams within its drainage area. Because the headwaters of many of these streams are located in mountainous regions outside the ecoregion, the hydrologic responses of these streams are not representative of the ecoregion. There are two large lakes, Frances and Simpson, and smaller lakes include Watson, Blind, Stewart, Tillei and McPherson. The coverage by wetlands is also moderately high. Numerous large wetlands are in the many wide river valleys within the lower elevations of the ecoregion.

There are four representative (active, historical continuous, and seasonal) hydrometric stations within the ecoregion: Frances River and Big and Tom creeks within the Yukon portion, and Geddes Creek within the British Columbia portion of the ecoregion. Because of the modest relief of the ecoregion, runoff and peak flow events are relatively low. Annual streamflow is characterized by an increase in discharge in April, due to snowmelt at lower elevations, rising to a peak in May within most of the lower elevation streams. Higher elevation streams such as the Frances River experience their peak flows in June. Summer rain events will produce secondary peaks throughout the summer. Mean annual runoff is moderate but variable, with values ranging from 78 mm at lower elevations to 390 mm at higher elevations with an ecoregion average of 260 mm. Mean seasonal and summer flows are moderately low with values of 15×10^{-3} and 11×10^{-3} $m^3/s/km^2$, respectively. The mean annual flood and mean maximum summer flow are 41×10^{-3} and 33×10^{-3} $m^3/s/km^2$, respectively. The minimum annual and minimum summer flows are relatively high and moderate with values of 1.7×10^{-3} and 4.5×10^{-3} $m^3/s/km^2$, respectively. Minimum streamflow generally occurs during March. Some small streams may experience zero winter flows during cold winters.

PERMAFROST

Permafrost is sporadic throughout this ecoregion, and is rarely encountered during excavations for municipal or highway construction. Permafrost was recorded in less than 5% of holes drilled in the ecoregion in association with the proposed Alaska Highway gas pipeline (Rampton *et al.*, 1983). When permafrost has been identified near Watson Lake, it is "warm," and the base of frozen ground is between 2 and 4 m below the ground surface (EBA, 1982b, 1995). Beneath moist organic soils, the active layer may be less than 1 m, but at dry sites the active layer may be up to 2 m thick (Hoggan, 1991a). Where the upper surface of permafrost has been recorded at depths between 3 and 5 m, the permafrost may be degrading. Winter frost penetration of 2 m is often recorded during drilling in early summer (EBA, 1982b; Hoggan, 1991b).

Thin permafrost is found in peat plateaus at moist sites and beneath organic soils (Dyke, 1990c; Harris *et al.*, 1992; UMA, 1992). Sand and gravel sites, even beneath a dense spruce cover, usually do not support permafrost (Hoggan, 1991b).

SOILS

The soils of the Liard Basin have formed on level to undulating landscapes of primarily morainal, glaciofluvial, and lacustrine parent materials. Much of the landscape adjacent to the Liard River is mantled by up to 50 cm of silty loess. Growing season precipitation is moderate in the ecoregion, leading to the formation of a variety of well-developed soils (Lavkulich, 1973; Rostad *et al.*, 1977). Soils underlain by near-surface permafrost are confined to north-facing slopes and some wetlands.

Brunisolic Gray Luvisols are common on moraine with high clay content. When this moraine is covered by loess, a unique soil morphology results. Weathering in the loess produces often reddish horizons that overlie deeply developed greyish-brown clay-rich B horizons in moraine. Total profile development is often greater than 1 m deep. Where clay contents are less, Eutric Brunisols are common on sandy loam moraine under mixed and coniferous vegetation.

Hummocky and terraced glaciofluvial parent materials underlie much of the landscape where Eutric Brunisols are the dominant soils. Recently deposited alluvial materials along the Meister and Liard rivers have produced some of the most productive forest soils in the Yukon (Fig. 181-4). These deposits are silty to fine sandy, moderately well to imperfectly drained, supporting vigorous stands of white spruce and important wildlife habitat (Zoladeski and Cowell, 1996). The soils show evidence of periodic deposition that has buried organic matter throughout the profile. The soils are classified as Cumulic Regosols (Rostad *et al.*, 1977). These nutrient-rich, neutral-reaction soils have limited distribution, but are an important resource of the ecoregion.

Wetlands are a common, though not extensive, component of the ecoregion. Fen vegetation characterizes the ecoregion's wetlands. Basin fens are a common wetland form; these tend not to be underlain by permafrost. The soils are classified as Typic Mesisols being developed on semi-decomposed sedges and mosses. In areas where permafrost has established within the fens, peat plateau and palsa

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Figure 181-4. The Liard River floodplain upstream from Watson Lake is formed of nutrient-rich, silty alluvium. The resultant soils are termed Cumulic Regosols. Stable surfaces can support very productive forests of balsam poplar and white spruce. More active alluvial surfaces are vegetated by alder–willow shrubs.

bogs are found. Bog soils are Mesic Organic Cryosols of semi-decomposed sphagnum and other mosses.

VEGETATION

Most of the Liard Basin lies below treeline and the vegetation is dominantly boreal forest. The low elevation, moderate precipitation and relatively long, warm summers result in good vegetative growth. Coniferous forests dominate the landscape. The best growth, with tree heights of 30 m or more, occurs along the nutrient rich loamy floodplains of the Liard, Meister, Frances, Hyland and Coal rivers (Applied Ecosystem Management, 1999b).

White spruce is the dominant tree species found on river terraces, where it is underlain by feathermoss and a rich shrub layer including willow, alder, rose, high-bush cranberry and ground shrubs (Zoladeski and Cowell, 1996). Younger stands are often mixed with balsam poplar. On very dry and gravelly fluvial sites, a lichen–kinnikinnick groundcover is found under lodgepole pine or white spruce. Subalpine fir forms extensive open stands in the subalpine between 900 and 1,500 m asl.

On low wooded hills and broad treed uplands, white and black spruce are found with a moss or moss-shrub understory. Where soils are drier and nutrient poor, as on many moraine and glaciofluvial soils, lodgepole pine–black spruce forests are common. Younger stands are often mixed forests of spruce, pine, and trembling aspen, which are found on many sites; paper birch and black spruce are on north aspects, and white spruce and balsam poplar on fluvial sites.

Shrubby–herbaceous fens surrounded by permafrost-induced moss–sphagnum (peat) plateau bogs are typical wetlands in the ecoregion.

WILDLIFE

Mammals

The Liard Basin is one of the most biologically productive ecoregions in Yukon. The northern section is winter range of the Finlayson woodland caribou herd. Intensive management, including harvest restrictions and wolf population reductions in the 1980s, has greatly increased the herd size, which is now about 4,000. High calf recruitment contributed to this population growth. Moose (Fig. 181-5) also increased to high abundance, and wolves have recovered to pre-management levels (Hayes, 1995). The long-term persistence of these population levels is unknown (Hayes, 1995).

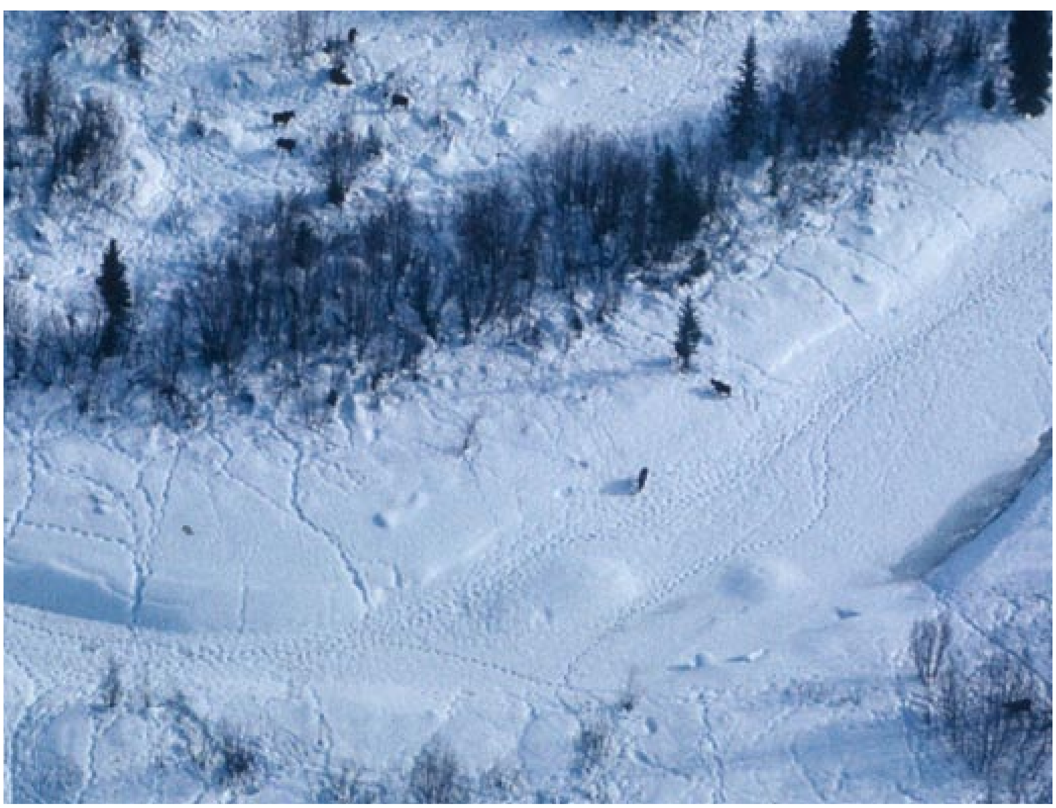

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Figure 181-5. During the winter, moose congregate in the Liard River lowland. Most of these moose disperse into upland habitats during the summer.

The Nahanni Caribou herd to the east estimated at 2,000, the smaller Smith River caribou herd estimated at 200, and the Little Rancheria herd estimated at 700 to the south also inhabit the ecoregion. Moose, black bear, wolverine, marten, and lynx are all common. Grizzly bears are at one of their lowest densities in the Yukon. Alluvial spruce forests are prime marten habitat. Fishers are found in low numbers in the eastern section of the Liard Basin and Hyland Highland ecoregions. Recent burns have enhanced populations of beaver, marten, snowshoe hare and lynx. Alluvial willows and balsam poplar support healthy beaver numbers in the Liard River drainage.

Mule deer and small numbers of white-tailed deer are at their northern limit in the southeast Yukon. Mule deer typically occur in small herds of 12 to 15. About 20 to 30 white-tailed deer reside in the Yukon (M. Hoefs, pers. comm., 2002), mostly in this ecoregion. There are occasional records of cougar from the Liard Basin.

Several bat species, including the western long-eared myotis, northern long-eared myotis, long-legged myotis, big brown bat, and silver-haired bat, have recently been found in this ecoregion in British Columbia (Wilkinson *et al.*, 1995). Bats have received little attention in the Yukon and additional species are expected to occur here. A complete list of mammal species known or expected to occur in this ecoregion is given in Table 4.

Birds

The Liard Valley is part of the southern Tintina Trench and is used by Trumpeter and Tundra Swans, geese, ducks, and Sandhill Crane during migration (Dennington, 1986a). Thousands of Sandhill Cranes migrate through the Liard Valley each spring and fall with some branching off to follow the Frances River Valley and the rest continuing to follow the Liard system into the Pelly Mountains (Dennington, 1986b). The Liard Valley also functions as a migration corridor for many raptors and passerines (McKelvey, 1982), including Northern Harrier, Northern Goshawk, Rough-legged Hawk, American Kestrel, Northern Shrike, American Robin, and Lapland Longspur (McKelvey, 1982).

River and creek banks, as well as lake margins, provide breeding habitat for Osprey, Bald Eagle, Canada Goose, Common Merganser, Spotted Sandpiper, Mew and Herring Gulls, and Northern Rough-winged and Bank Swallows (McKelvey, 1982). Wetlands including oxbows, sloughs, and back-channels of major rivers, support relatively high numbers of breeding and moulting diving ducks in summer (Dennington, 1985; 1988), and provide breeding and fall staging habitat for Trumpeter Swan and dabbling ducks (Theberge *et al.* [editors], 1979; McKelvey and Hawkings, 1990). These wetlands are also important for shorebirds such as Greater and Lesser Yellowlegs, Solitary Sandpiper, and Common Snipe. Songbirds, such as Alder Flycatcher, Yellow Warbler, Northern Waterthrush, Common Yellowthroat, Wilson's Warbler, Savannah, Lincoln's and Swamp Sparrows, and Red-winged and Rusty Blackbirds, inhabit these wetlands (Eckert *et al.*, 1997; Canadian Wildlife Service, unpubl.). Marshes at Blind Lake support the only known breeding population of Black Tern in the Yukon (Eckert, 1996). In spring, migrant American Pipit and Lapland Longspur occur in open wetland areas (McKelvey, 1982).

Riparian forests along larger rivers and creeks are very productive, and support diverse and abundant songbird communities, including several species that are at the northwest edge of their range and others that reach peak densities here (Eckert *et al.*, 1997). Riparian white spruce forests are critical for habitat specialists such as Three-toed Woodpecker, Boreal Chickadee, Red-breasted Nuthatch, Golden-crowned Kinglet, Varied Thrush, and Pine Siskin (Eckert *et al.*, 1997). Other species that occur in these forests include Western Tanager and White-winged Crossbill (Eckert *et al.*, 1997). Species found predominantly in balsam poplar forests are Yellow-bellied Sapsucker, Least and Hammond's Flycatchers, Warbling Vireo, Magnolia Warbler, American Redstart, and Northern Waterthrush, while trembling aspen forests support Yellow-bellied Sapsucker, Warbling Vireo, Bohemian Waxwing, and Chipping Sparrow (Eckert *et al.*, 1997). Species that reach their peak densities in upland lodgepole pine forests are Gray Jay, American Robin, Yellow-rumped Warbler, Dark-eyed Junco and Pine Grosbeak (Eckert *et al.*, 1997). White-throated Sparrow reaches the western limit of its range in this area. This is one of the few Yukon ecoregions in which Pileated Woodpeckers live (Canadian Wildlife Service, unpubl.).