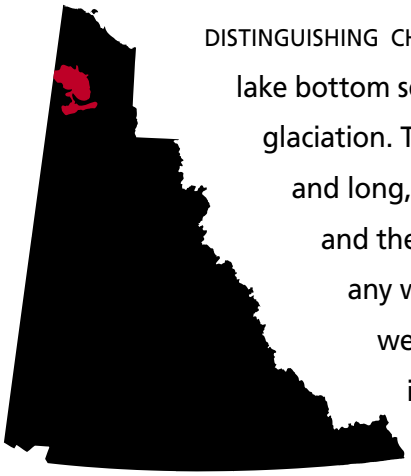
Old Crow Flats

Taiga Cordillera Ecozone

ECOREGION 167



DISTINGUISHING CHARACTERISTICS: The extent of this eroregion is defined by the area of lake bottom sediments deposited by a glacial lake that formed at the end of the last glaciation. The climate of the ecoregion is strongly continental with warm summers and long, cold winters. The difference between the mean July temperature and the mean January temperature at Old Crow village is the greatest of any weather station in the Yukon. The ecoregion is composed of lakes and wetlands occupying a large topographic basin that forms an extremely important wildlife habitat. The ecoregion supports the most abundant waterfowl population within the Taiga Cordillera Ecozone in Canada.

J. Hawkings, Canadian Wildlife Service

Figure 167-1. The level landscape of the Old Crow Flats Ecoregion is covered by small lakes, wetlands and meandering streams. The outline of lakes changes over time through a cycle of erosion and permafrost decay, potential lake drainage, revegetation and re-establishment of permafrost.

APPROXIMATE LAND COVER
subarctic coniferous forest, 55%
lakes and wetlands, 35%
tussock tundra, 10%

TOTAL AREA OF ECOREGION IN CANADA
5,970 km^2

TOTAL AREA OF ECOREGION IN THE YUKON
5,970 km^2

ECOREGION AREA AS A PROPORTION OF THE YUKON
1%

ELEVATIONAL RANGE
325–610 m asl
mean elevation 327 m asl

CORRELATION TO OTHER ECOLOGICAL REGIONS: Equivalent to Old Crow Flats portion of **Old Crow Basin Ecoregion** (Oswald and Senyk, 1977) • Equivalent to Old Crow Flats portion of **Old Crow Basin Ecoregion** (Wiken et al., 1981) • Portion of **Alaskan Boreal Interior Region** (CEC, 1997) • Portion of the **Interior Alaska/Yukon Lowland Ecoregion** (Ricketts et al., 1999) • Portion of **Yukon Old Crow Basin** (Nowacki *et al.*, 2001)

PHYSIOGRAPHY

The Old Crow Flats Ecoregion includes two parts joined along the Old Crow River: the Old Crow Flats or Basin, and the lowlands along the Porcupine River, from the mouth of the Driftwood River to the Bluefish River. This second part is a portion of the Old Crow Pediplain (Matthews, 1986), the Bluefish Basin (Hughes, 1987b), or the Porcupine Plain (Bostock, 1948).

This is a lowland area in which most of the elevation is less than 600 m asl. The basins, the result of downwarping or downfaulting, are sites of deposition. Local relief is about a few metres. Lakes are numerous, covering about 35% of the land surface. Many lakes are rectangular (Fig. 167-2) and oriented northwest–southeast, perpendicular to the prevailing wind.

The Old Crow River and its tributaries flow southward through the Old Crow Flats to the Porcupine River, which heads west into Alaska.

BEDROCK GEOLOGY

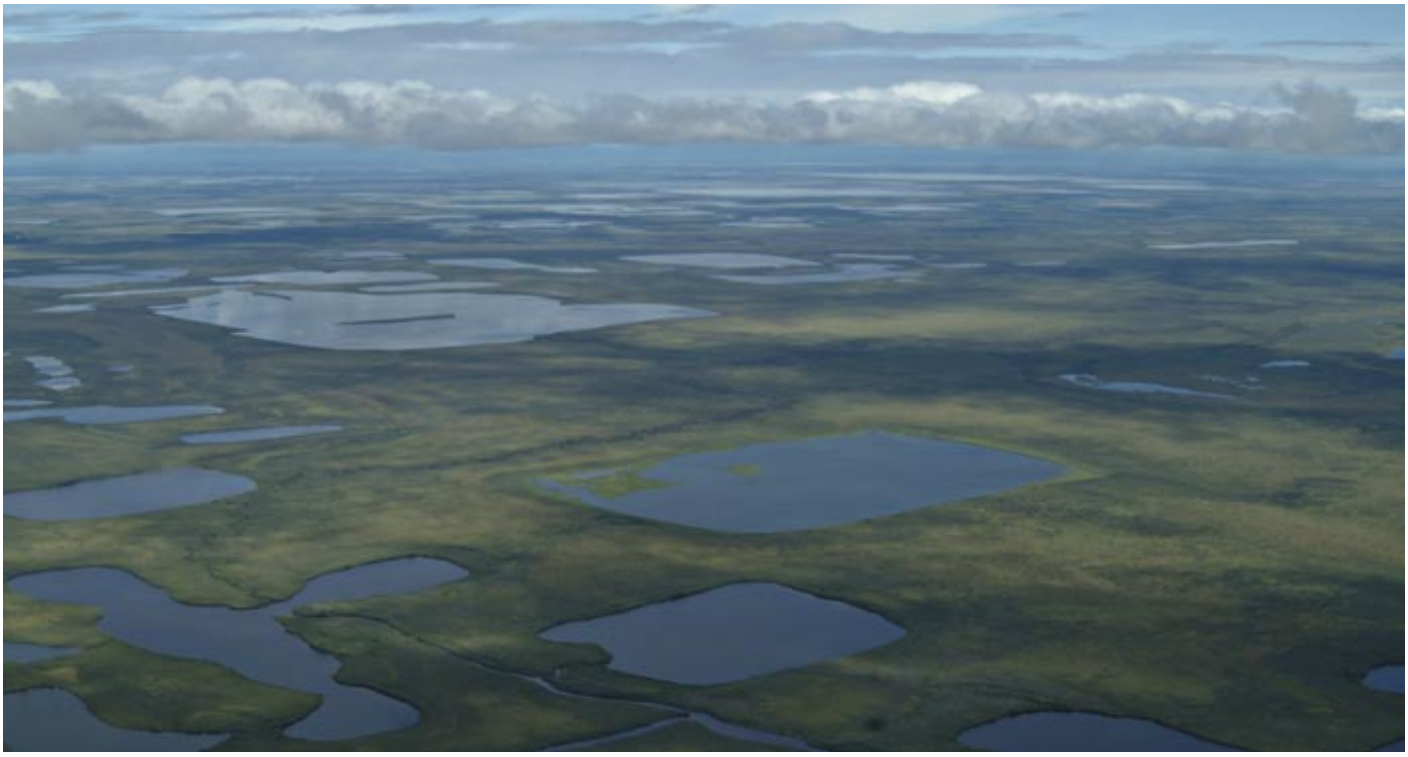
Thick Tertiary and Quaternary glaciolacustrine and fluvial sediments up to 1,200 m thick underlie all of the Old Crow Flats Ecoregion except a single exposure of Carboniferous shale near the mouth of Timber Creek (Morrell and Dietrich, 1993). The surrounding Flats contain several elevated areas that are structural uplifts or resistant granite; some rivers have incised to bedrock. Large areas of outcrops are shown on regional geological maps (Norris, 1981b,c).

Few mineral occurrences are present. The potential for oil and gas has been tested near Whitefish Lake in the Bell Basin (Lane, 1996) and shale-like lignite is exposed nine kilometres east of Old Crow Village.

SURFICIAL GEOLOGY AND GEOMORPHOLOGY

Most of the surface deposits in this ecoregion are composed of nearly flat, thick glaciolacustrine sediments overlain by frozen peats, often several metres thick. The entire area appears as a maze of small, shallow angular lakes, ponds and wetlands crossed by the Old Crow River and Johnson Creek with their broad meanders and oxbow lakes.

Ice-wedge polygons and oriented rectangular thermokarst lakes, as well as active layer detachment slides, retrogressive thaw flow slides, debris flows and rotational slumping, are all



J. Meikle, Yukon Government

Figure 167-2. Rectangular lake in the Old Crow Flats. Rectangular lakes are typically oriented with the prevailing wind. Vegetation debris blown across the surface tends to accumulate uniformly at the ends of long reaches.

indicative of ice-rich permafrost present in the fine-grained sediments.

The remainder of the area is covered by alluvium deposited by the Old Crow River or one of its tributaries. The alluvium tends to lack near-surface permafrost.

GLACIAL HISTORY

This ecoregion is located on flat terrain comprising the Old Crow and Bluefish Basin physiographic units. These basins were part of an extensive proglacial lake during the Late Wisconsinan; Glacial Lake Old Crow formed when the Laurentide Ice Sheet stood along the eastern slopes of the Richardson Mountains and Bonnet Plume Depression, blocking drainage of the Porcupine and Peel rivers. It thereby diverted all drainage from the Mackenzie Mountains region across the continental divide, causing inundation of the Bell–Bluefish–Old Crow Basins about 30 ka ago (Lemmen *et al.*, 1994; Duk-Rodkin and Hughes, 1995). This vast lake discharged westward through the present-day Ramparts of the Porcupine River. By the time McDougall Pass was free of ice, the outlet at The Ramparts had incised below the elevation of the pass, and the present westward drainage for the Porcupine River was established. Glacial Lake Old Crow shorelines are traceable discontinuously around the basins, reaching 366 m asl (Hughes *et al.*, 1973; Matthews *et al.*, 1987). Repeated catastrophic flooding related to fluctuations of the Laurentide Ice Sheet are recorded in the Porcupine River sediments west of The Ramparts into Alaska (Thorson, 1989), as well as in McDougall Pass (Catto, 1986) and Rock River (Schweger and Matthews, 1991). Over 70 m of unconsolidated sediments lie below the village of Old Crow, recording lacustrine, glaciolacustrine, delta, and fluvial sedimentation (Hughes, 1969b; Matthews *et al.*, 1987). The lacustrine sediments likely are related to tectonic activity on the Old Crow Basin and late Tertiary uplift of the Richardson Mountains which affected the Porcupine River in pre-glacial time (Duk-Rodkin and Hughes, 1994).

CLIMATE

The climate of the Old Crow Flats Ecoregion is very similar to that of the Old Crow Basin Ecoregion. However, some areas with higher elevation in the Old Crow Basin may have slightly higher precipitation, and temperatures may be slightly more moderate. When relatively calm and very cold air masses persist, the Old Crow Flats may experience colder temperatures than the surrounding upland areas.

During the winter, the area is dominated by an Arctic high-pressure system. Infrequently, a strong low-pressure system moving through the Beaufort Sea can result in short, windy, mild spells. During the short summer, the area is under a weak low-pressure system with relatively mild moist air. Spring and summer are delayed by almost a month compared with the southern Yukon.

Mean annual temperatures are among the lowest in the Yukon, approximately –8 to –10°C with a strong seasonal variation. Mean January temperatures are –30 to –35°C; the mean July temperature ranges from 12 to 15°C. Extreme winter minimums are –55 to –60°C, but above freezing temperatures have briefly occurred. Extreme summer maximums are 33 to 35°C, but frosts can occur at any time of the year. Winters are prolonged, and generally extend from October to mid-May. The North Ogilvie Mountains to the south are enough of a barrier to retard southerly winds eroding the cold air from the lower elevations. The transition from winter to summer conditions is rapid. The prolonged low angle of the sun above the horizon during winter also reduces the daily cycle of temperatures during those periods.

Precipitation is relatively light, amounting only to 200 to 300 mm annually. The wettest period is June through August, with monthly amounts of 30 to 45 mm. This summer precipitation is in the form of rain, primarily showers or thunderstorms. There have been some summer months with precipitation amounts of 100 to 150 mm. The driest period is January to April, averaging 10 to 15 mm of snow monthly.

Wind data are limited, although some data are available from the Old Crow village site. Winds are generally light at less than 15 km/hr, particularly during the winter. Periods of moderate winds of 15 to 30 km/hr occur less than one quarter of the time, primarily from the northeast, and less frequently from the southwest. Winds greater than 40 km/hr are common.

Representative climate information is available from Old Crow.

HYDROLOGY

The Old Crow Flats Ecoregion is level, encompassing the middle and lower reaches of the Old Crow River basin, an area known as the Old Crow Flats. The Old Crow River flows southward into the Porcupine River, of which a 120 km long, low-lying reach is included within the ecosystem. In addition to the Porcupine and Old Crow rivers, intermediate streams include the very lowest reaches of the Bluefish and Driftwood rivers, north- and south-flowing, respectively. Smaller streams include Johnson and Schaeffer creeks, and the lower reaches of Timber, Thomas, and Black Fox creeks. The coverage by waterbodies and wetlands is the highest of all Yukon ecoregions, estimated at about one third of the total area. The ecoregion contains hundreds of interconnected lakes, including many that are large and unnamed.

There is only one representative historical hydrometric station record for the ecoregion: Old Crow River. Though it is a relatively large watershed, the nature and consistency of the ecoregion's topography allows for the transfer of its hydrologic characteristics throughout the ecosystem. The hydrologic characteristics are completely dominated by the waterbody and wetland storage features of the ecosystem, such that these characteristics can be scaled down to smaller basins with little loss in accuracy. Because of the extremely low relief, runoff and peak flow events are likewise low. Annual streamflow is estimated to have an increase in discharge in April due to snowmelt, rising to a peak in May or June. Because of the significant storage throughout the ecosystem, summer rain events do not produce significant secondary peaks as in most other ecoregions.

Mean annual runoff, the lowest of all ecoregions, is 98 mm, while mean seasonal and summer flows are likewise relatively low with values of 7.1×10^{-3} and 3.5×10^{-3} $m^3/s/km^2$ respectively. The mean annual flood and mean maximum summer flow are moderate to low with values of 56×10^{-3} and 12×10^{-3} $m^3/s/km^2$, respectively. The minimum annual and summer flows are both near the lowest of all ecoregions with values of 0.03×10^{-3} and 0.3×10^{-3} $m^3/s/km^2$, respectively. Minimum streamflow generally occurs during March or earlier with the relative magnitude among the lowest of all Yukon ecoregions, due to the increasing role of winter temperatures and permafrost on streamflow. Unlike other ecoregions at this high latitude, winter flows are higher due to storage contributions. All streams, other than the Porcupine River, occasionally experience zero winter flows.

PERMAFROST

The Old Crow Flats Ecoregion lies in the continuous permafrost zone. Old Crow Flats were covered by Glacial Lake Old Crow during the Late Wisconsinan. Permafrost was likely eradicated from beneath the lake at that time. The base of permafrost was encountered at 63 m depth in two holes drilled to provide a water supply for the community of Old Crow (EBA, 1982a). All holes drilled for construction in the community have encountered frozen ground within 2 m of the surface. Annual mean near-surface ground temperatures are about –4°C (Stanley Associates, 1979), and the active layer depth in the peatlands of the basin is usually more than 40 cm and occasionally greater than 60 cm (Ovenden and Brassard, 1989).

Shallow lakes within the ecoregion are warm in summer, and sufficiently deep to prevent freezing of lake-bottom sediments in winter. As a result, a talik persists beneath the lakes, many of which are sufficiently wide for the talik to penetrate through permafrost, theoretically. The lakes are oddly rectangular and oriented northeast–southwest or northwest–southeast (Fig. 167-2). Their surface expression is likely unassociated with permafrost conditions, but may be a product of wind-generated currents (Mackay, 1956).

The low-lying terrain and pediment surfaces have a hummocky microtopography typical of moist taiga regions and near-surface permafrost is usually ice-rich. Ice-wedge polygons occur throughout the region, but they have not developed into the extensive networks characteristic of the Yukon Coastal Plain Ecoregion. There are well-developed, active ice wedges along the Porcupine River, growing syngenetically with floodplain deposits (Lauriol *et al.*, 1995).

Sedimentary sequences exposed in bluffs cut by the Porcupine River have been used to trace environmental conditions back to the late Tertiary (Pearce *et al.*, 1982). Ice-wedge casts in the sediments provide early evidence of permafrost in the Yukon (Burn, 1994).

SOILS

The soils in this ecoregion have formed within the extensive wetlands of the Old Crow Flats. Soil parent materials found throughout the ecoregion include lacustrine silts and clays, alluvial deposits, accumulated peat and thermokarst sediments, and slumps. The fine-textured soil parent materials of the Old Crow Flats are usually ice-rich and have experienced cryoturbation during their formation. As all of the ecoregion existed as a lake basin during the Late Pleistocene, the soil parent materials are younger here than in the surrounding pediments and mountain ranges. Soils are often high in incorporated organic matter resulting from the formation and cycling of organic debris in earth hummocks that underlie the open, black spruce forest. Wetlands have considerable peat accumulations in some locations. Wetland forms include peat plateau bogs and ribbed fens (Fig. 167-3). These soils are mostly classified as Mesic Organic Cryosols. The only portions of the landscape without near-surface permafrost are the active alluvial landforms associated with the major rivers of the ecoregion, the Old Crow and Porcupine, and recently drained lake basins. These soils are classified as Regosols, or as Regosolic Static Cryosols if permafrost has re-established in these materials.

As with other lowland regions of the Low Arctic and Subarctic, there exists a cycle of lake formation through thermokarst, lake drainage by stream capture, and wetland establishment with peat accumulation leading ultimately to a subsequent round of thermokarst and lake formation (Fig. 167-4). There are distinctive soil and vegetation features associated with each stage within the “thaw-lake” cycle (MacKay, 1997; Eisner and Peterson, 1998). As ground ice is exposed through erosion, tremendous melting occurs, often with considerable disruption to the surrounding landscape. This process of thermokarst can generate fresh surfaces on which soil development begins. Recently disrupted materials will not have evidence of active cryoturbation for some years. These soils

J. Hawkings, Canadian Wildlife Service

Figure 167-3. The Old Crow Flats Ecoregion is characterized by extensive sedge fens surrounding irregular lakes with emergent vegetation, including horsetail, bur-reed, yellow pond lily and buckbean. Slightly higher elevation peat plateaus support open stands of stunted black spruce in the distance.

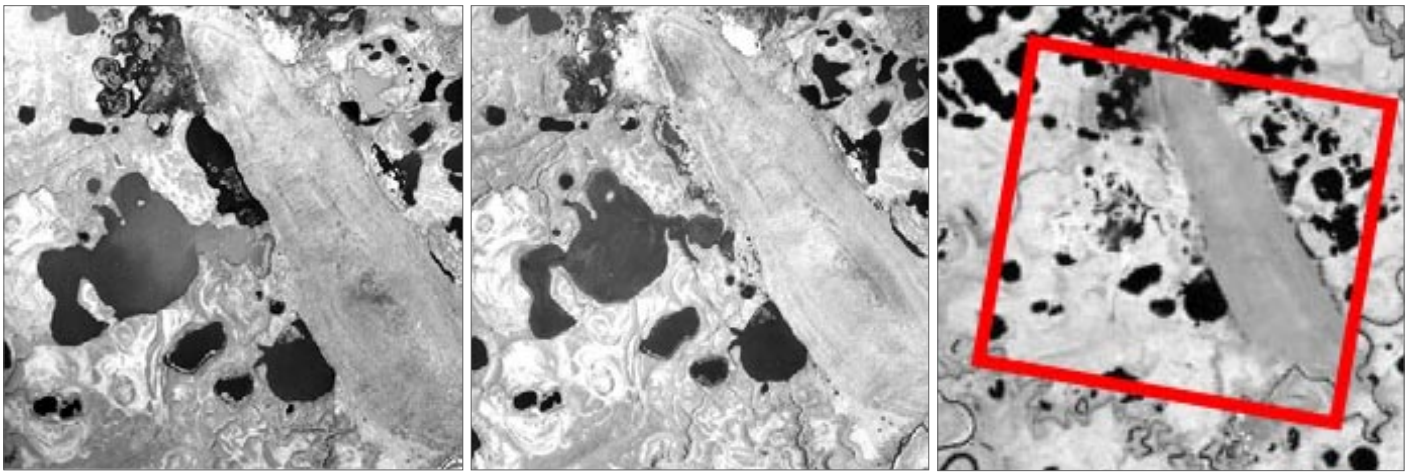


Figure 167-4. The highly dynamic nature of shallow thaw lakes adjacent to Timber Hill in the Old Crow Flats Ecoregion is illustrated in this series of aerial photographs (1951, 1972) and a satellite image (1999 Landsat 7 ETM, band 4). Drainage of the lakes is related to change in the drainage pattern controlled by local degradation and aggradation of near-surface permafrost (adapted from Labreque *et al.*, 2001). The red box on the right-hand photo corresponds to the area of the 1951 and 1972 photos.

may be classified as Static Cryosols if permafrost has re-established.

VEGETATION

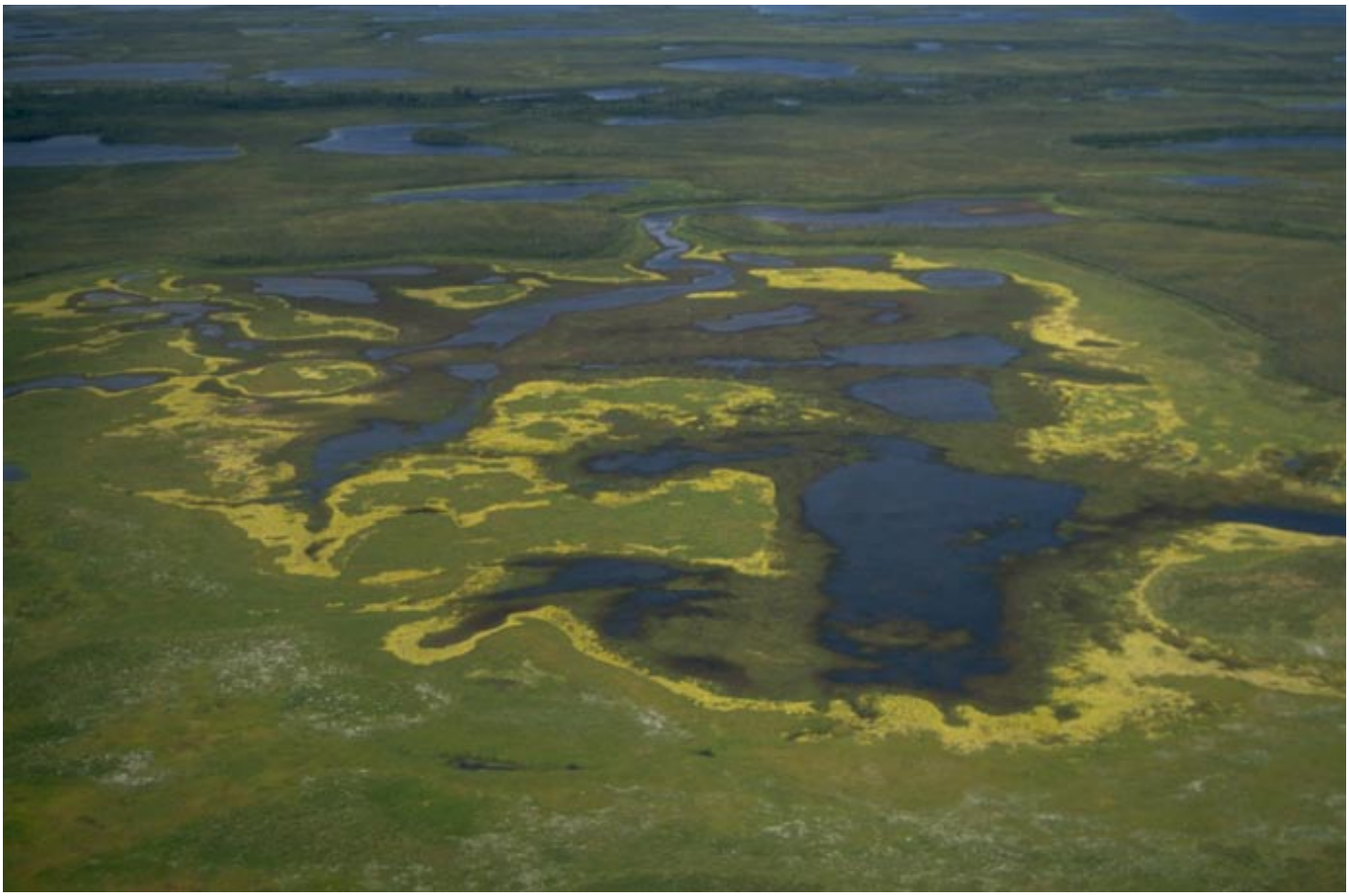
The vegetation of the Old Crow Flats Ecoregion reflects the distribution pattern of cyclical formation and draining of lakes and wetlands, and intervening sparsely treed uplands. The vegetation ranges from shallow-water emergent wetland types to graminoid meadows, sphagnum blankets, shrub thickets, and sparsely treed heath and tussock tundra. The Porcupine and Old Crow rivers and their tributaries have cut deep channels dissecting the wetland surface.

There is a complex "thaw-lake" cycle of thermokarst lakes forming and growing larger by thermokarst erosion of the banks, and then draining as outlets are eroded. Because of this ongoing cycle, there is a complex pattern of vegetation found at all stages of the process (National Wetlands Working Group, 1988). Much of the Flats are underlain by thick peat. Shallow-water wetlands supports dense communities of bur-reed and yellow pond lily (Fig. 167-3). Shore marshes and fens on the lake margins consist of *Carex aquatilis*, *Arctophila fulva*, horsetail, and buckbean. Moist parts of drained lakebeds support sedges, grasses and water-tolerant forbs (Fig. 167-5), succeeded by tall willows. Gradually, as the permafrost table re-establishes within the rooting zone, the willows die from lack of moisture. *Arctophila fulva*, or *Calamagrostis* grasslands with scattered willow and alder, dominate other drained lakebeds. Low-centre polygons, an early stage of lowland polygon development (National Wetland Working Group, 1988), are also found in old drained basins. The vegetation of the low-centre polygons consists of sphagnum mats with sedges and some dwarf shrubs (Ovenden and Brassard, 1989; J. Hawkings unpubl. data)

Much of the "upland" area is also wetland. Polygonal peat plateau bogs are dominated by lichen heath (Ovenden and Brassard, 1989; Eamer *et al.*, 1996). Sparse, scraggly black spruce, and low shrubs are underlain by sphagnum moss in moister parts, and by reindeer lichen on drier parts of peat plateaus (Murray, 1997).

On the drier mineral "upland" soils between the lakes, cottongrass tussock and open spruce/shrub/lichen communities are typical. On the best-drained sites, sparse black and white spruce, shrub birch, Labrador tea, blueberry and other ericaceous shrubs and lichen predominate. On imperfectly drained soils, extensive areas of sedge tussocks with sparse white and black spruce and Labrador tea are found (Zoltai and Pettapiece, 1973; Eamer *et al.*, 1996; J. Hawkings, unpubl. data).

Where rivers have cut up to 20 m below the surface of the flats, white spruce with some black spruce, paper birch and aspen occupy favourable warm



J. Hawkings, Canadian Wildlife Service

Figure 167-5. A recently drained lake in Old Crow Flats Ecoregion supports lush growth of colonizing sedges, grasses and yellow Mastadon flower *(Senecio congestus)*.

slopes with deeper active layers. The deciduous trees usually follow some disturbance, such as fire. Alder, shrub birch and soapberry, with ground shrubs and herbs, dominate the understory. Balsam poplar is found on the active floodplains.

WILDLIFE

Mammals

The Old Crow Flats possess some of the most abundant wildlife populations of the Taiga Cordillera, with many species reaching densities typical of the Boreal Cordillera of the southern Yukon. However, the diversity of rodents and ungulates is low by comparison.

This is both a unique and highly productive ecoregion of the Yukon. The vast wetlands are home to moose, grizzly bear, muskrat and mink. Moose are present only during summer, migrating to the head of drainages in the British Mountains in the fall. The most abundant muskrat populations in the Yukon, numbering in the hundreds of thousands, are near the northern edge of their range and experience slow growth and low productivity (Simpson *et al.*, 1989). The Flats are on the annual spring and fall migration routes of the Porcupine Caribou, which numbers about 150,000 individuals. The mammals of this ecoregion have received little attention other than opportunistic observation during caribou and waterfowl studies. Mammal species known or expected to occur in this ecoregion are listed in Table 4.

Birds

The interconnected lakes and marshes dominating this landscape are the single most important waterfowl area in the Yukon, providing over 500,000 waterbirds with breeding, moulting, and staging habitat (Yukon Waterfowl Technical Committee, 1995). More than 100 bird species have been

recorded on the Flats, including at least 21 species of waterfowl (Hawkings, 1996).

According to aerial surveys conducted each June by the U.S. Fish and Wildlife Service, breeding populations over the past 30 years have included 20,000-100,000 American Widgeon, 10,000 to 100,000 Northern Pintail, 5,000 to 40,000 Canvasback, 50,000 to 100,000 scaup, 20,000 to 80,000 White to winged and Surf Scoters, and 10,000 to 30,000 Long-tailed Duck (Hawkings, 1996). The Old Crow Flats also support three species of loons, Tundra Swan, White-fronted Goose, and a variety of other waterbirds. Banding studies have shown these birds to be associated with all four North American flyways. Waterfowl are more concentrated here than at other locations in the north. For example, densities of ducks on the Flats are usually about 80 ducks/km^2, two to three times higher than in any of the 11 primary waterfowl breeding grounds surveyed annually in Alaska by the U.S. Fish and Wildlife Service. Some of these birds breed and moult on the Flats, while others, such as Barrow's Goldeneye, do not breed there, but come in midsummer from further south to undergo their annual moult (Hawkings, 1996).

Other waterbirds occurring in these wetlands include Lesser Yellowlegs, Solitary, Spotted, and Least Sandpipers, Common Snipe, Red-necked Phalarope, and Herring, Mew, and Bonaparte's Gulls (CWS, Birds of the Yukon Database). Common songbirds associated with wetlands include Yellow Warbler, Northern Waterthrush, and Rusty Blackbird (Canadian Wildlife Service, unpubl.).

Peregrine Falcon are known to nest along cliffs and cutbanks of the Porcupine and Old Crow drainage (Hayes and Mossop, 1978) and Golden Eagle and Gyrfalcon nest on cliffs and rock ledges in tundra areas. Other raptors include Osprey, Bald Eagle, and Northern Harrier (Sinclair *et al.* [editors], 2003).

Species common in shrub tundra include Willow Ptarmigan, American Robin, American Tree, Savannah, Fox, and White-crowned Sparrows, and Common Redpoll (CWS, Birds of the Yukon Database). Gray-headed Chickadee, a rare resident of these subarctic forests, has been observed on a few occasions and likely breeds in shrubby riparian habitats (Murie, 1928; Eckert, 1994; Sinclair *et al.* [editors], 2003).

Subarctic forests provide breeding habitat for Merlin, Three-toed Woodpecker, Gray-cheeked and Varied Thrushes, Blackpoll Warbler, and Dark-eyed Junco (Sinclair *et al.* [editors] 2003). Year-round residents of these subarctic forests probably include Gray Jay and Common Raven (Godfrey, 1986).