ECOLOGICAL REGIONS OF THE NORTHWEST TERRITORIES

SOUTHERN ARCTIC

ECOSYSTEM CLASSIFICATION GROUP

Department of Environment and Natural Resources
Government of the Northwest Territories

2012

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This report may be cited as:

Ecosystem Classification Group. 2012. Ecological Regions of the Northwest Territories – Southern Arctic. Department of Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT, Canada. x + 170 pp. + insert map.

Library and Archives Canada Cataloguing in Publication

Northwest Territories. Ecosystem Classification Group
Ecological regions of the Northwest Territories, southern Arctic /
Ecosystem Classification Group.

ISBN 978-0-7708-0199-1

1. Ecological regions--Northwest Territories. 2. Biotic communities--Arctic regions. 3. Tundra ecology--Northwest Territories. 4. Taiga ecology--Northwest Territories. I. Northwest Territories. Dept. of Environment and Natural Resources II. Title.

QH106.2 N55 N67 2012 577.3'7097193 C2012-980098-8

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About the cover: The small digital images in the inset boxes are enlarged with captions on pages 28 (*Tundra Plains Low Arctic (north) Ecoregion*) and 82 (*Tundra Shield Low Arctic (south) Ecoregion*). Aerial images: Dave Downing. Main cover image, ground images and plant images: Bob Decker, Government of the Northwest Territories.

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Acknowledgements

The authors acknowledge the contribution of the following Environment and Natural Resources (ENR) staff to the Southern Arctic mapping revisions and report: Kim Ullyot and Aingeal Stone (ENR library – reference documents); Ainsley Zock (ENR Information Services – photographs); Kathleen Groenewegen (ENR Forest Management – ongoing GIS support and revisions to final coverages and NWT boundaries); Norm Mair (GNWT Geomatics Centre – imagery); Steve Matthews and Chandra Venables (ENR Daring Lake Research Station – accommodation and fuel logistics). The Forest Management Division and Wildlife Division of ENR provided the primary funding for the Southern Arctic Ecosystem Classification Project. Tom Lakusta, Susan Corey, Nicole McCutchen and Susan Fleck provided management and administrative support.

Chris Hunter (Manager, Tuktut Nogait National Park (TNNP), Paulatuk) loaned materials from Parks Canada's Paulatuk library and Joachim Obst (private contractor) provided useful reports from TNNP.

David Kroetsch (Agriculture and Agri-Food Canada) provided the initial classification upon which the 1996 Northwest Territories version was built. John Downing provided assistance in obtaining and interpreting bedrock geology information. Wayne Pettapiece compiled most of the glossary of terms in Appendix 5. Members of the 1995 Ecological Stratification Working Group, members of the 1989 Ecoclimatic Regions Working Group and all researchers who compiled various geologic and natural resource assessments for the area are also acknowledged for their contribution.

Field support and accommodation throughout the Southern Arctic was courteously provided by: Margaret and Amanda Peterson (Owners, Point Lake Lodge, NWT); Shane Jonker (Camp Manager, Plummer's Great Bear Lake Lodge, NWT); Bob Huitikka (Owner, Tukto Lodge, NWT); and staff of the Paulatuk Visitor Centre.

Safe and reliable helicopter transportation was provided by Great Slave Helicopters (pilot Chuck Burcke).

Dave Taylor (GIS consultant) provided support services for navigation equipment. Susanne Downing provided data entry services for the Southern Arctic photo themes and for approximately 50,000 previous thematic records for the Taiga Plains, Taiga Shield and Cordillera ecosystem classifications.

Preface

A vast circumpolar complex of tundra and polar deserts lies north of the tree line in Canada, Alaska, Russia and Europe. In Canada, the Southern Arctic includes the southern part of this complex, forming a wide belt with the southern boundary defined broadly by tree line, extending north within the Northwest Territories to the Arctic coast. It is home to herds of barren-ground caribou and muskox that range across sparse to continuous shrub, herb and lichen tundra on permanently frozen soils, to barren-ground grizzlies, wolves and other carnivores and to upland birds and waterfowl. Coniferous trees are restricted to locally warm, dry places on slopes and along rivers where they usually occur as stunted individuals or groves, twisted and sheared by cold winter winds bearing sharp ice crystals that cut needles and branchlets. Low-elevation wet coastal plains, glacial till blankets, glacial outwash features, weather-worn plateaus that have been ice-free for hundreds of thousands of years, rocky barrens and river valleys add physical, biological and visual diversity to this unique northern landscape.

The Southern Arctic is the collective term for a region within the Northwest Territories that includes two extensive tundra landscapes differentiated by climate, geology and topography. The *Tundra Plains* lies north and west of Great Bear Lake. It is a cold mostly treeless northern extension of the Taiga Plains that is affected by both coastal and continental climates and that includes coastal and upland plains, plateaus and hill systems. It is generally covered by glacial till and wetlands are common and locally extensive. The *Tundra Shield* lies east of Great Bear Lake at lower latitudes than the Tundra Plains. Extending from tree line to the Northwest Territories – Nunavut border and beyond, it is a cold, mostly treeless northern extension of the Taiga Shield. Continental climates influence the Tundra Shield and its level to hilly landscapes include Precambrian rocklands, ice-modified till deposits a few centimetres to several metres deep that blanket the bedrock, extensive outwash deposits and thousands of lakes and ponds.

Climate, geology and topography affect ecosystem development in the Southern Arctic in the same way as they do in boreal ecosystems to the south. *Abiotic factors* such as latitude, elevation, slope and parent materials control temperature, moisture, light and nutrient levels, all of which determine the type of plant communities and soils that can develop. *Biotic factors* such as competition between plant species or the influence of grazing animals on plant communities also play a role. In tundra environments where plant community development is strongly controlled by regional climate and microsite conditions and where growth is restricted to a few weeks in July and early August, competition is usually a less significant influence than it is in Taiga and Boreal ecosystems. The influence of biotic and abiotic factors is determined by the interplay of atmospheric and terrain elements – climate, topography, parent materials and biotic elements – acting over short to very long periods, as described by Major (1951) and Jenny (1941) for vegetation and soils, respectively.

Vegetation and terrain patterns can be delineated and represented as abstract ecological map units and described at various scales. At the global scale, the *Biome* or *Vegetation Zone* is recognized (Walter 1979, Scott 1995, Commission for Environmental Cooperation 1997). At the national scale in Canada, *Ecozones*, *Ecoregions* and *Ecodistricts* are described (Ecological Stratification Working Group 1995). The Northwest Territories has modified the Canadian national scale and classification framework to match the multi-level continental ecosystem classification framework – *Ecological Regions of North America* – developed by the Commission for Environmental Cooperation in 1997. The Canadian and continental systems are outlined in Section 1 of this report.

The value of regional ecosystem classification systems as a foundation for sustainable resource management has been recognized since the 1960s in Canada. Ecosystem classifications provide a means of presenting and understanding biophysical patterns and processes in a geographic context. They also provide a common basis for communication. The Government of the Northwest Territories has used the national ecosystem classification framework since 1996 as the basis for identifying candidate protected areas, forest management planning, wildlife habitat management and environmental impact assessment and mitigation. In 2004, in response to increasing development pressures in the Mackenzie River Corridor, the delineation and description of the 1996 Taiga Plains Ecozone was examined by an external reviewer to assess its utility. Subsequently, a series of workshops in 2004 – 2006 and an intensive survey of the entire Taiga Plains in 2005 led to significant changes to the 1996 map and a revised map and report were produced in early 2007 (Ecosystem Classification Group 2007 [revised 2009]).

Similar revisions were undertaken in 2006 through 2008 for the 1996 Taiga Shield Ecozone bordering the Taiga Plains to the east (Ecosystem Classification Group 2008) and again in 2007 through 2010 for the 1996 Taiga Cordillera and Boreal Cordillera Ecozones bordering the Taiga Plains to the west (Ecosystem Classification Group 2010). Initial planning for the Southern Arctic survey involved a geographic information system-based review of several spatial data sources including Landsat(tm) imagery, digital elevation models, hydrology, permafrost, bedrock and surficial geology, soils and interpolated climate models. The Circumpolar Arctic Vegetation Map (CAVM Team 2003) provided a broad-scale and comprehensive overview of Southern Arctic biophysical characteristics and a conceptual framework for understanding its relationship to Arctic ecosystems in Canada and elsewhere; published and unpublished ecological and geological maps and documents for the area were reviewed and integrated. All of this information facilitated the review of landscapes and existing mapped ecosystem units from a number of different perspectives and from this review, provisional ecosystem units were developed.

Air and ground assessment of the provisional units was an integral part of the revision process. In the summer of 2009, a helicopter survey traversed the entire area, covering a linear distance of about 10,500 km. A detailed record of landscape and ground features was captured in approximately 9,500 geographically referenced digital images accompanied by text comments. Site, vegetation and soil information was also collected from detailed and reconnaissance ground plots. All of the digital images were reviewed following the survey and more detailed comments were added. Both the images and themes derived from the comments were indispensable for the revision process that involved ecosystem classification experts from the Northwest Territories Government (Bob Decker, Bas Oosenbrug), Agriculture and Agri-Foods Canada (Charles Tarnocai) and private industry (Dave Downing, Tom Chowns).

This report and the accompanying map (Appendix 3 and back pocket in published hardcopy version) provide ecological descriptions and spatial representations of ecoregions within the Southern Arctic. Better spatial information and an understanding of climate and landscape patterns and processes gained through intensive aerial surveys have resulted in the recognition of 35 Level IV[1] ecoregions within the Southern Arctic, compared to 10 described by the Ecological Stratification Working Group in 1995 for the Southern Arctic and three others that were assigned to the 1996 Taiga Shield, Taiga Plains and Northern Arctic Ecozones.

The report integrates currently available information about climatic, physiographic, vegetation, soil and wildlife attributes to characterize each of the ecoregions within the Southern Arctic in a format that is suited to both technical and non-technical users. For this purpose, it has been organized into four sections.

- Section 1 defines the *Ecological Regions of North America* ecosystem classification framework as applied to the Southern Arctic and its relationship to the national classification system that is applied across much of Canada. The climatic and physiographic factors that exert major influences on Arctic landscapes are also discussed.
- Section 2 provides further details on the methods employed in the review and refinement of the 1996 Canadian Ecological Framework to better represent landscape patterns and to describe these patterns within the continental framework.
- Section 3 describes the Southern Arctic. Within this section:
    - Section 3.1 provides an overview of Section 3 contents.
    - Section 3.2 provides an overview of the Southern Arctic and its two main landscapes, the Level II Tundra Plains and Tundra Shield Ecoregions.
    - Section 3.3 explains how Level III and Level IV ecoregions are described.
    - Section 3.4 describes the Level III Tundra Plains (Low Arctic north) Ecoregion and 26 Level IV Ecoregions within it.
    - Section 3.5 describes the Level III Tundra Shield (Low Arctic south) Ecoregion and 9 Level IV Ecoregions within it.
- Section 4 describes the mammals and birds found throughout the Southern Arctic.

The report concludes with: a list of cited references; common and scientific names of vascular plants mentioned in the text or commonly occurring in the Southern Arctic along with images of some representative and special plants (Appendix 1); a summary of changes from the 1996 published version of Ecozones and Ecoregions for the Southern Arctic to the current version (Appendix 2); a page-size map and legend for the Southern Arctic (Appendix 3); a discussion of suggested future revisions to the Taiga Plains – Tundra Plains boundary based on 2009 tree distribution observations (Appendix 4); and a glossary of useful terms (Appendix 5). A foldout map of the Southern Arctic Ecosystem Classification is provided in a map pocket at the back of printed copies of this report.

[1] Level I, Level II, Level III and Level IV ecoregion definitions are provided in Section 1.

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Section 1: Concepts, Climates, and Landscapes

1.1 Introduction

This section explains the system that classifies the Northwest Territories into ecologically meaningful units based on climate, physiography and vegetation patterns. Section 1.2 provides an overview of the North American continental ecosystem classification system, a comparison to the related Canadian framework and its application to the Northwest Territories. Section 1.3 reviews mapping concepts and definitions, including the practical aspects of applying the ecosystem classification scheme to the Northwest Territories. Section 1.4 explains how climatically distinct regional land areas are delineated (Level III ecoregions, defined in Section 1.3.3). Section 1.5 explains how these regional areas are divided into units characterized by vegetation and physiography (Level IV ecoregions, defined in Section 1.3.4), how units are named and how they are described.

1.2 Classification Framework

The recognition that climate and landforms influence biotic processes differently from place to place and at all scales encouraged the development of an integrated climate and landform-based ecosystem classification approach in Canada; this system has been under development since the 1960s. The Subcommittee on Biophysical Land Classification (Lacate 1969) developed the first nationally applied multi-level definition of landscapes using these criteria. The Canada Committee on Ecological Land Classification (CCELC) was formed in 1976; the Ecoregions Working Group was established shortly afterwards with a mandate to develop the concept and hierarchy for the *Ecoclimatic Regions of Canada* (Ecoregions Working Group, 1989). The CCELC further defined classification elements and the methods for mapping them (Wiken and Ironside 1977); CCELC developed a multi-level classification framework, shown in Table 1 (Marshall *et al.* 1996; Commission for Environmental Cooperation 1997).

From 1996 to early 2006, this national scheme was used to delineate and describe ecosystem units within the Northwest Territories (Ecological Stratification Working Group 1995; Downing *et al.* 2006). Discussions with other experts in Canada and the United States in 2006 indicated the value of integrating the Northwest Territories ecosystem classification framework with the continental *Ecological Regions of North America*[2] and ecosystems of the Taiga Plains, Taiga Shield and Cordillera were subsequently described as units within that classification.

Like the Canadian system, the North American continental framework is a multilevel, nested system for delineating and describing ecosystems; the Government of the Northwest Territories uses this information for planning and reporting purposes. Currently, the top four levels of the continental framework as applied to the Southern Arctic are Level I ecoregions, Level II ecoregions, Level III ecoregions and Level IV ecoregions.

1.3 Mapping Concepts and Landscape Descriptions

The classification scheme adopted for the Northwest Territories supports the logical division of landscapes into units that reflect the ecological relationships between climate, topography, parent materials and biota. The approach starts with the largest landscape complex (Level I global to continental scale). Level II, III and IV ecoregions are nested within these and are recognized as discrete units by vegetation and landform patterns at increasingly large scales. Level III and Level IV ecoregions cover areas of hundreds to thousands of square kilometres and encompass considerable complexity. At each level and associated scale of the ecoregion hierarchy, the smallest mapping unit is about two square centimetres; this is usually the smallest area that reasonably represents a significant difference between adjacent mapped polygons.

The spatial delineation and description of any of these units depends on the mapper's concept of what constitutes an ecologically meaningful pattern and the information available to support this conclusion. The mapping process is therefore inherently subjective and mapped units and their descriptions are based on the best empirical information available at the time, a reasonable compromise between differing viewpoints and the acknowledgement that map units are abstract representations of real-world landscapes. For example, boundaries between Level I, II and III ecoregions are shown as sharp lines on a map or in a GIS database, but are not always so well defined in nature. Clearly visible features such as the topographic differences between the generally level landscapes of the Taiga Plains and the elevated plateaus and ridges of the adjacent Cordillera are readily observed and mapped. Where regional climatic differences are the boundary criterion, as they are along most of the Southern Arctic – Taiga Shield and Southern Arctic – Taiga Plains interface, boundaries between map units are more usefully viewed as broad transition zones perhaps tens of kilometres in width.

[2] Further information available at the Commission for Environmental Cooperation website: http://www.cec.org/files/pdf/BIODIVERSITY/eco-eng_EN.pdf and http://www.epa.gov/wed/pages/ecoregions/ecoregions.htm

Table 1. Northwest Territories ecosystem classification framework as applied to the Southern Arctic, compared to Canada's National Ecosystem Classification.

Northwest Territories/Continental Ecosystem Classification	National Ecosystem Classification Equivalent	Description
Level I Ecoregion *(Tundra)*	**Ecoclimatic Province** (Ecoregions Working Group 1989)[1]	*Global – Continental:* Scale 1:50,000,000. Equivalent to global biomes. Used as the first level of stratification for international planning and management initiatives.
Level II Ecoregion *(Southern Arctic, referring collectively to its two level II components, the Tundra Plains, a northern extension of the Taiga Plains and the Tundra Shield, a northern extension of the Taiga Shield).*	**Ecozone**	*Territorial – National*: Scale 1:30,000,000. Subdivision of global biomes. Used for national state-of-environment tracking.
Level III Ecoregion *(Low Arctic component of the Tundra Plains, Low Arctic component of the Tundra Shield)*	**Ecoprovince** (Canada Committee on Ecological Land Classification) or **Ecoclimatic Region** (Ecoregions Working Group 1989)	*Regional*: For the Northwest Territories (Southern Arctic), Level III ecoregions are defined by regional climatic differences within Level II ecoregions and approximate Ecoclimatic Regions defined in *Ecoclimatic Regions of Canada* (Ecoregions Working Group 1989). Scale 1:2,000,000 – 1:10,000,000.
Level IV Ecoregion *(35 in Southern Arctic, nested within two Level II ecoregions and two Level III ecoregions specifically associated with Level II).*	**Ecoregion**	*Regional*: Broad recurring vegetation and landform patterns within a regional climatic framework. For the Northwest Territories, physiographic characteristics (e.g., plains, hill systems) and geographic features (e.g., major rivers and valleys) are employed to subdivide Level III ecoregions into Level IV ecoregions. Scale 1:250,000 – 1:1,500,000.
No current equivalent in North American continental system	**Ecodistrict**	*Subregional:* Subdivisions of an ecoregion based on distinctive landform differences. Ecodistricts, ecoregions and ecozones are defined for all provinces and territories in Canada in the national system. For the Northwest Territories, the ecodistrict might be equivalent to one or more Soil Landscape (SLC) polygons (refer to Section 1.3.5 for discussion). Scale 1:50,000 – 1:250,000.
	Ecosection	*Subregional:* More specific delineation of recurring landform and vegetation patterns, usually with reference to major community type groups or soil subgroups. They are typically represented as complexes and may be used for regional and subregional integrated resource planning. An SLC polygon with vegetation attributes linked to physical characteristics could be regarded as an ecosection. Scale 1:20,000 – 1:50,000.
	Ecosite	*Local:* Scale 1:20,000 – 1:50,000. May be mapped at the operational level ("ecosites", "site series") for example, forest resources inventory.
	Ecoelement	*Local:* Scale <1:10,000. Usually a single vegetation type on a single soil type and site, but could be complexed in boreal landscapes. They are delineated where very detailed information is required (e.g., detailed pre-harvest assessments, special features delineation, detailed habitat mapping).

1. The term tundra for the Southern Arctic was not used in the 1989 publication. The Southern Arctic and all of the Arctic Islands fall within the Arctic Ecoprovince of that publication.

These ecosystem classification concepts provide the basis for an explicit, structured approach involving the application of consistent rules for mapping, naming and describing units. The criteria for mapping discrete units are provided in Sections 1.4 and 1.5 and are further explained in Section 3.

1.3.1 Level I Ecoregions

North America includes 15 broad, Level I ecological regions (ecoregions) that provide the backdrop to the ecological mosaic of the continent and provide context at global or intercontinental scales (Commission for Environmental Cooperation 1997). These ecoregions are similar in scale and scope to the global *biomes* (e.g., Walter 1979) and are mapped at a scale of about 1: 50,000,000.

Three Level I ecoregions span the Northwest Territories. The *Tundra* occurs north of tree line and includes the Southern Arctic, a collective term that encompasses the Level II Tundra Plains and Tundra Shield Ecoregions discussed below. The *Taiga* includes most of the area between tree line and the 60th parallel. The *Northwestern Forested Mountains* extend from Alaska to New Mexico; in the Northwest Territories it includes the southernmost quarter of the main mountain ranges with its northern limits at at about 63º N along the Yukon- Northwest Territories border and in the Nahanni Range west of Fort Simpson.

1.3.2 Level II Ecoregions

Level II ecoregions are useful for national and sub-continental overviews of physiography, wildlife and land use (Commission for Environmental Cooperation 1997). They are more or less equivalent to the Canadian *ecozone*, defined as "areas of the earth's surface representative of large and very generalized ecological units characterized by interactive and adjusting abiotic and biotic factors … the ecozone defines, on a sub-continental scale, the broad mosaics formed by the interaction of macro-scale climate, human activity, vegetation, soils, geological and physiographic features of the country." (Ecological Stratification Working Group 1995). They are nested within Level I ecoregions and are represented at a scale of 1:5,000,000 to 1:10,000,000. There are currently 20 Level II ecoregions within Canada, nine of which are in the Northwest Territories.

Level II ecoregions of the Northwest Territories include a broad range of climatic and physiographic conditions. Boundaries are recognized by major changes in physiography (e.g., the well-defined bedrock boundary between the Taiga Plains and the Taiga Shield or the transition to mountainous terrain that marks the boundary between the Taiga Plains and Cordillera). Boundaries are also recognized by regional climate changes (e.g., the change from cold continental climates in the Taiga Plains to very cold continental climates in the Tundra Plains that are indicated by a change from forest-tundra complexes to tundra).

The Level II Tundra Plains and Tundra Shield Ecoregions, collectively termed the Southern Arctic, are part of the Level I Tundra Ecoregion. The Tundra Plains are a cold northern extension of the Taiga Plains, with dominantly calcareous till deposits, a relatively high proportion of organic veneers and blankets and landscapes that range from coastal plains to high-elevation hills. The Tundra Shield is a cold northern extension of the Taiga Shield, with a mix of rocklands, till veneers and till blankets, outwash deposits and a lower proportion of organic deposits than the Tundra Plains has. Figure 1 shows the mainland Level II Tundra Plains and Tundra Shield Ecoregions and the neighbouring Level II Taiga Plains, Taiga Shield and Cordillera ecoregions. Section 3.2 provides an overview of the Level II Tundra Plains and Tundra Shield Ecoregions.

1.3.3 Level III Ecoregions

Level III ecoregions are approximately equivalent to the Canadian *ecoprovince* (Ecological Stratification Working Group 1995) or *ecoclimatic region* (Ecoregions Working Group 1989). In this document, Level III ecoregions are characterized by regional climatic differences, approximately as defined at the ecoclimatic region level in *Ecoclimatic Regions of Canada* (Ecoregions Working Group 1989). The criteria for recognizing Level III ecoregions are provided in Section 1.4. Figure 2 shows how Level III ecoregions are distributed across the mainland Northwest Territories.

Level III ecoregions provide a logical framework within which Level IV ecoregions having similar physiographic characteristics and climatic regimes can be discussed. They are represented at map scales of 1:2,000,000 to 1:5,000,000; there are currently 73 Level III ecoregions in Canada and 19 Level III ecoregions in the Northwest Territories. The climatic, vegetation and landscape features that are used to delineate and define the Northwest Territories Level III ecoregions are discussed in Section 1.4.

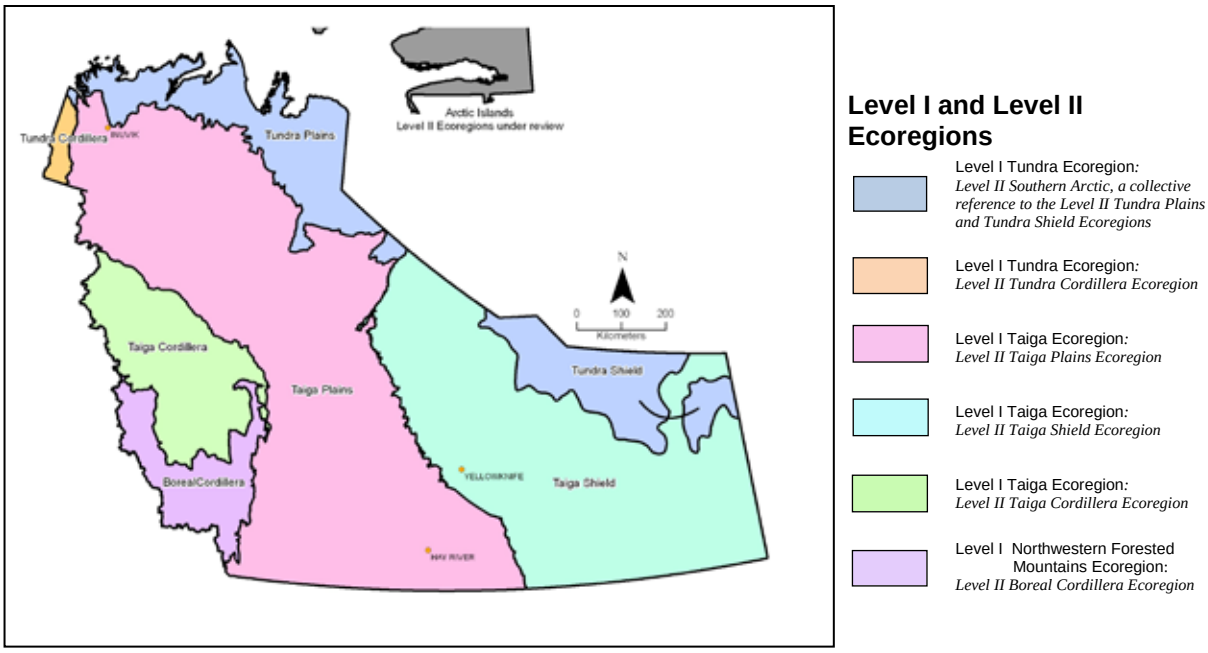


Figure 1. Level I and Level II ecoregions define broad regional landscapes of the mainland Northwest Territories within the Southern Arctic and the adjacent Level II Taiga Plains, Taiga Shield and Cordillera Ecoregions. Level II Ecoregions are discussed in Section 3.2 of this report.

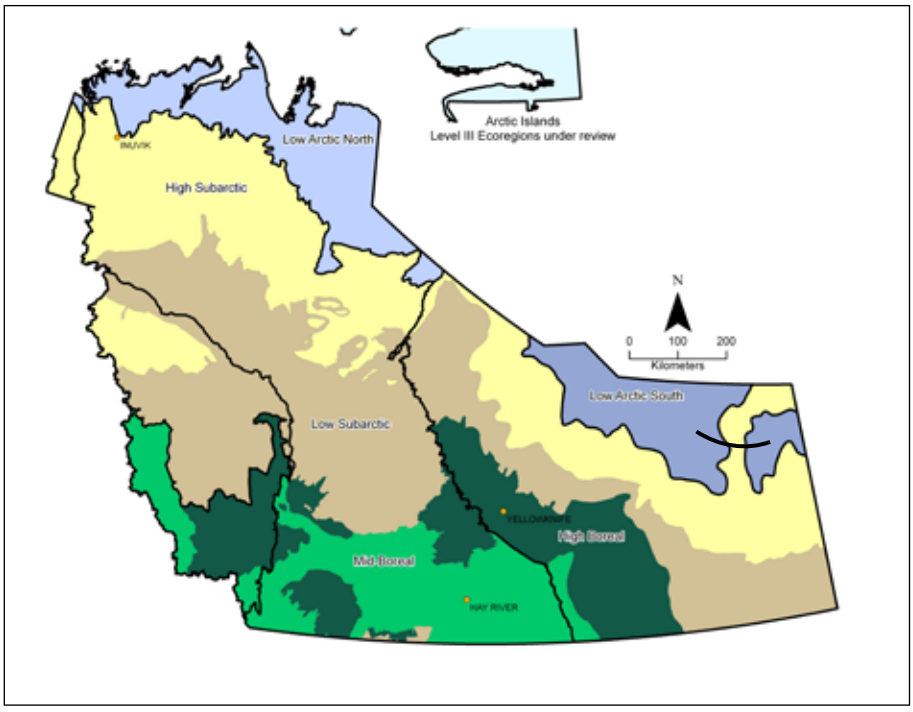


Figure 2. Level III ecoregions show the distribution of regional climates and are nested within the Level II ecoregions (delineated by heavy black lines). Details about the mapping criteria used to define the Level III Tundra Plains Low Arctic (north) and Tundra Shield Low Arctic (south) Ecoregions are presented in Section 1.4 of this report; a description of these Ecoregions is provided at the beginning of Sections 3.4 and 3.5, respectively.

1.3.4 Level IV Ecoregions

Level IV ecoregions are subdivisions of, and are nested within, the Level II and Level III ecoregions. They are characterized by distinctive regional ecological factors, including climate, physiography, vegetation, soil, water and fauna (Marshall *et al.* 1996). Level IV ecoregions have been variously defined, depending on the landscape and the classification objectives, as "total landscape ecoregions" (physiography–vegetation), "habitat ecoregions" (wildlife habitat–vegetation–physiography), "soil ecoregions" (soil–vegetation) or "ecoclimatic ecoregions" (ecologically effective macroclimate as expressed by vegetation) (Ecoregions Working Group 1989).

Climate, physiography, vegetation and soils all define Level III and Level IV ecoregions to the extent that available information allows. Long-term annual climate data records are very sparse from the Southern Arctic, but there is sufficient climate-related terrain and vegetation information to reasonably delineate and describe Level III and Level IV ecoregions.

Information sources include: existing surficial and bedrock geology maps; good-quality satellite imagery; terrain models; geo-referenced digital photographs; observed relationships between climate and climate surrogates such as permafrost-affected upland and wetland features, forest cover density and composition, and plant species distribution. Level IV ecoregions are usually represented at a scale of 1:250,000 to 1:1,500,000.

The Southern Arctic includes 35 Level IV Ecoregions. Twenty-six ecoregions occur within the Level II Tundra Plains Ecoregion and nine occur within the Level II Tundra Shield Ecoregion. Figure 3 shows the currently mapped Level IV ecoregions within the Tundra Plains as an example; the inset box shows the level of detail displayed at this level of classification for part of the Southern Arctic.

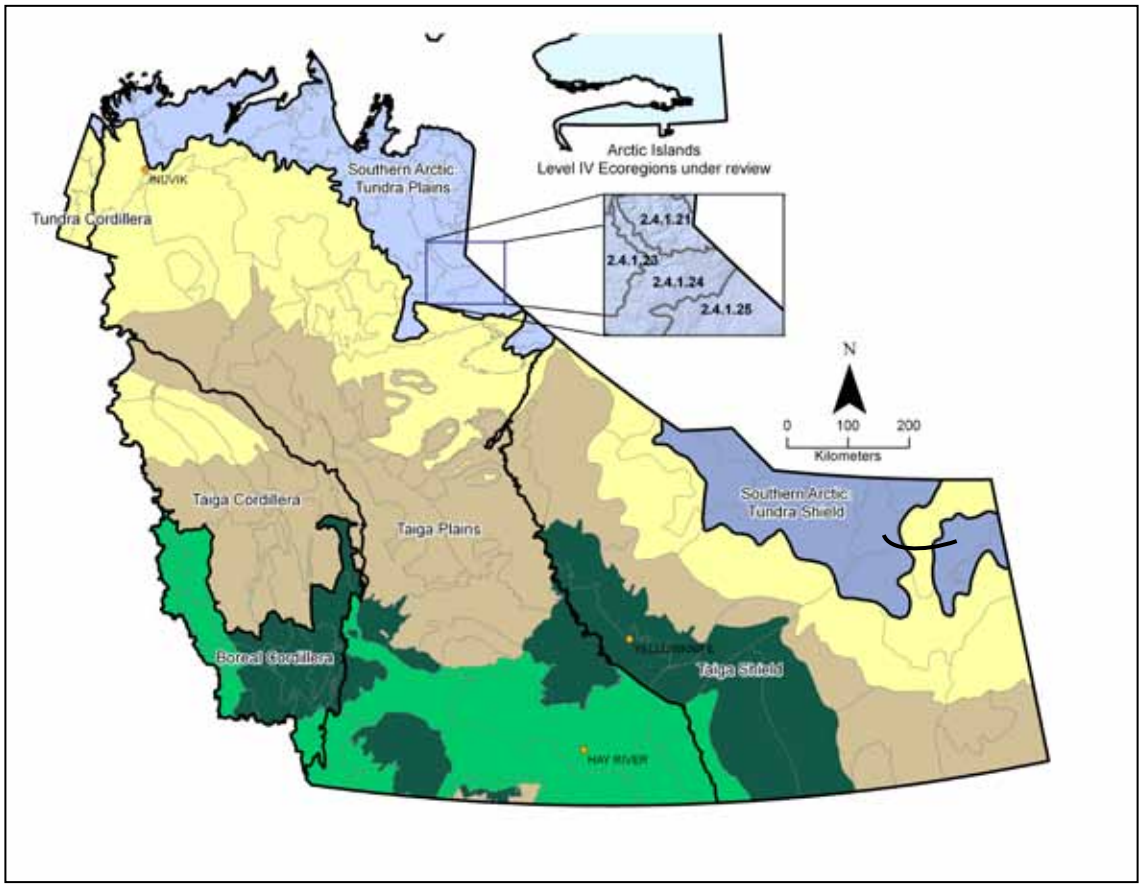


Figure 3. Level IV ecoregions (light gray lines) are nested within Level II and Level III ecoregions and are differentiated on the basis of bedrock geology, landform, hydrology and vegetation. The inset box shows part of four Level IV ecoregions within the Level II Tundra Plains Ecoregion. Details about the mapping criteria used to define Southern Arctic Level IV ecoregions are presented in Section 1.5; descriptions of individual Level IV ecoregions are provided in Sections 3.4 and 3.5. A map of Southern Arctic Level III and Level IV ecoregions is presented in Appendix 3.

1.3.5 Further Divisions of Level IV Ecoregions

Two additional classification levels form part of the 1996 ecosystem classification framework of the Northwest Territories. The *ecodistrict* is a finer physiographic subdivision of the Level IV ecoregion. Ecodistricts may also include one or more smaller units. "*Soil Landscapes of Canada (SLC) polygons*" are described by a standard set of attributes such as surface form, slope class, general texture and soil type, water table depth, permafrost and lake area. SLC polygons 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 polygon is not defined.

The ecodistrict and the SLC level of classification are neither detailed in this report nor presented on the map because ecoregions are only mapped to a regional Level IV scale. The 1996 ecodistrict units delineated by the Ecological Stratification Working Group (1995) are useful because they reveal general climatic trends through interpolated models developed by Agriculture and Agri-Foods Canada (1997), discussed further in Section 1.4. The 1996 SLC map units delineated and described by the Ecological Stratification Working Group (1995) as the largest-scale classification levels also provide information that is used to augment the description of parent geologic materials, soils and wetland/upland proportions within each Level IV ecoregion. The ecodistrict and SLC levels of classification are usually represented at scales of about 1:50,000 to 1:250,000.

1.3.6 Long-term Value of the Southern Arctic Ecosystem Classification

The 2010 Southern Arctic ecosystem classification is a reasonable approximation of Northwest Territories biophysical patterns north of tree line on the mainland given the climatic and biophysical information currently available. It is based partly on present-day evidence of past climatic trends that are not necessarily representative of future trends (refer to Section 1.4.1). It is likely that current ecological classification concepts will change in response to new information, climate change, improved analytical techniques and revised viewpoints on how national and global classifications ought to be presented. This document and the accompanying map will serve both as a framework for current resource management and as a benchmark against which future ecosystem changes can be assessed.

1.4 How Level III Low Arctic Ecoregions are Defined

Ecoclimatic Regions of Canada (Ecoregions Working Group 1989) has provided the initial concept for Level III ecoregion delineations in the Northwest Territories and has been used in modified form to date for the Taiga Plains, Taiga Shield and Cordillera. Modifications have been necessary in all three of these classifications to adjust boundaries based upon better information, to refine definitions of the ecoclimatic regions and to integrate ecoclimatic regions across the subarctic and boreal Northwest Territories. Similarly, modifications are necessary for the Southern Arctic classification.

Ecoclimatic Regions of Canada includes all of the Southern Arctic within the Low Arctic Ecoclimatic Region, the largest in Canada, extending across the country in a wide belt between boreal-subarctic ecoclimatic regions to the south and the Mid to High Arctic ecoclimatic regions to the north. Its extent means that there are east to west and north to south variations and one was formally recognized by the Ecoregions Working Group (1989) as the relatively wet Low Arctic (moist) ecoclimatic region on the east coast of Labrador.

The available information suggests that the Northwest Territories Southern Arctic includes two Level III ecoregions, each included within and having exactly the same boundaries of its respective Level II ecoregion. The reasons for defining two Level III ecoregions are based primarily on latitudinal differences and there are also clear geological and topographic differences. The Level II Tundra Shield Ecoregion occurs at more southerly latitudes than the Level II Tundra Plains Ecoregion and this latitudinal difference appears sufficient to create climatic differences in solar energy inputs, temperature and precipitation based on climate models produced by Agriculture and Agri-Food Canada (1997). These climatic differences are reflected by the Level III Low Arctic subscripts *n* (north) and *s* (south). The principal climatic and geographic factors that define the Low Arctic generally and the two Level III Low Arctic Ecoregions more specifically are summarized in Section 1.4.1. Vegetation and landform features used to delineate and differentiate Level III ecoregions are discussed in Section 1.4.2.

When the northern boundaries of the Taiga Plains and the Taiga Shield were established in 2005 and 2006, the landscape and vegetation features considered as useful indicators of regional climatic patterns were the absence of trees and the presence of certain permafrost features and tundra types (Ecosystem Classification Group 2007 [revised 2009], 2008). Field observations in 2009 along the southern boundary of the Southern Arctic mostly supported the original concept, but indicated areas where boundary placement could have been improved had more transect information and high-resolution satellite imagery been available when the Taiga Plains map was prepared. These areas are discussed within specific Level IV ecoregion descriptions in Section 3.4 and are discussed more generally in Appendix 4.

1.4.1 Climatic Factors Influencing Level III Ecoregions

Climate can be defined as the cumulative long-term effects of weather, involving the processes of heat and moisture exchange between the earth and atmosphere. Regional climates are defined by the interaction of several interacting factors that in the Southern Arctic are indicated by the distribution of permafrost and vegetation features. A summary of these features and of climate data for each of the Level III ecoregions is provided in Table 2.

Low Arctic climates are determined by both regional factors (Section 1.4.1.1) and by local factors (Section 1.4.1.2) that significantly modify regional climatic influences. Climate change over time has been and will continue to be a controlling influence on regional to local ecosystems (Section 1.4.1.3).

1.4.1.1 Factors influencing regional climate

Latitude

As latitude decreases, the incident angle of the sun's rays increase. At mid-day on December 21 at Tuktoyaktuk (69°29'N) in the Tundra Plains, the sun does not rise at all. On the same day at Point Lake in the Tundra Shield (65°15'N) the sun is above the horizon for about 4.5 hours, reaching a maximum angular elevation of about 1.5 degrees. Figure 4 illustrates this relationship at these two locations on June 21 and December 21. A decrease in sun angle produces a corresponding decrease in the amount of solar energy, which is further reduced by the longer passage the sun's rays must take through the atmosphere at higher (more northerly) latitudes. Slope and aspect variations can strongly influence solar energy (Section 1.4.1.2). Generally, reduced solar energy is accompanied by lower summer and annual average temperatures and less precipitation (Bliss 1999).

Figure 5 shows the increase in average daily global solar radiation (the amount of radiation incident at the top of the atmosphere[3]) with decreasing latitude, modeled from Ecodistrict Climate Normals provided by Agriculture and Agri-Food Canada (1997). The amount of incident solar radiation also influences the annual temperature of an area; Figure 6 shows how average annual temperature also decreases from south to north. Because warm air holds more moisture, average annual precipitation increases toward the south (Figure 7 and Section 1.4.1.2).

Latitudinal effects can be modified significantly by elevation, slope, slope aspect and parent material. Growing season conditions are a function of many interacting factors which determine the overall regional and local climatic regime.

[3] This amount exceeds the solar radiation incident at the ground surface for various reasons, including particulate matter and clouds in the atmosphere and the albedo of incident surfaces.

Regional and global circulation patterns

General north-to-south circulation patterns in the atmosphere redistribute heat, without which arctic and subarctic regions would experience a net annual energy loss. They also redistribute moisture. Upper air flow is determined by two features: an upper low that is usually over the central Arctic Islands during the summer and that intensifies and moves to the northern Foxe Basin during the winter; and the Aleutian Low/Pacific High (Klock *et al.* 2002).

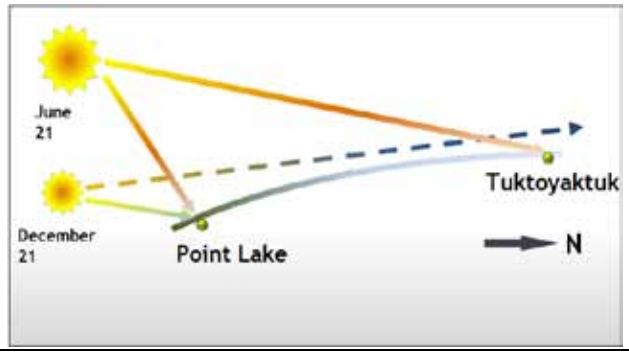


Figure 4. Schematic portrayal of summer and winter solstice sun angles in the Tundra Shield (Point Lake) and the higher-latitude Tundra Plains (Tuktoyaktuk).

<u>*Winter patterns*</u>: A north-westerly upper air flow holds cold Arctic high pressure systems across the Northwest Territories and often drives these systems south into the Prairies (Klock *et al.* 2002). Cold, generally dry air masses persist, but low pressure systems to the east and west create strong northerly winds and blowing snow, unimpeded by trees; wind patterns are strongly influenced by local topography.

<u>*Summer patterns*</u>: The summer upper flow pattern is weaker than the winter pattern and averages west-northwest. Temperature contrasts between warm air from the south and the cold air over the Arctic Basin produce low pressure systems and cold fronts (Klock *et al.* 2002). Melting sea ice provides surface moisture and low cloud and fog persist over the ocean, drifting onto the coast or farther inland if the terrain is flat and the wind is strong. Convective activity strong enough to produce thunderstorms occurs occasionally throughout the Southern Arctic; it appears to be less common in the more northerly Tundra Plains than in the Tundra Shield, where lightning-caused tundra fires were noted during field surveys in 2009.

<u>*Proximity to oceans:*</u> The Tundra Plains climate is different than that of the Tundra Shield because of oceanic influences in the former. Coastal weather patterns in the Tundra Plains are influenced by sea ice and local terrain. Sea ice along the coast from the Mackenzie Delta to Amundsen Gulf breaks up by mid-July and reforms in October; polynyas (year-round open water areas) occur in places, the Cape Bathurst polynya being one of the largest. Abrupt rises in terrain from the coastal plains to elevated plateaus occur from Cape Bathurst east to the Northwest

Territories – Nunavut border and beyond, and can trap low cloud and fog seaward (Klock *et al.* 2002). The "burst of Beaufort" is a common phenomenon along the western coast of the Tundra Plains, where low cloud and fog blanket coastal areas, induced by a low pressure centre in the nearshore Beaufort Sea. Strong winds can develop over the Melville Hills and on the Mackenzie Delta, causing extensive blowing snow in winter and also storm surges on the Mackenzie Delta during open-water periods. The area between Paulatuk and the Melville Hills is well known for winds that are strong enough to erode boulders through wind-borne ice and sand scouring and that severely limit plant growth on windward slopes (Mackay 1958).

1.4.1.2 Factors influencing local climate

Topography

Climate models (Agriculture and Agri-Food Canada 1997) show a general decrease in average annual precipitation towards the north (Figure 7). Within this general pattern, topography can significantly affect precipitation distribution, most notably snow accumulation. Windward slopes and open areas may be blown free of snow, whereas lee slopes, gullies and valleys collect more snow that melts later in the growing season and provides a source of moisture for snowpatch tundra communities. Different parent materials also contribute to the effectiveness of precipitation; coarse-textured deposits and bouldery terrain usually store less moisture within the rooting zone of plants than medium- to fine-textured materials.

As elevations increase, average temperatures fall and average wind speeds rise. These trends are reflected by landscape characteristics typical of more northerly climates at regionally high elevations; the Melville Hills are 800 metres higher than the coastal plains to the north and have permafrost features and tundra communities that are more typical of Mid-Arctic than Low Arctic environments. North-facing slopes receive less direct sun exposure than south-facing slopes and this tendency increases with latitude.

Albedo

Albedo is the ratio of the amount of solar radiation reflected by a body to the amount incident on it, commonly expressed as a percentage (Klock *et al.* 2002). Coniferous forest cover has a low albedo and reflects about nine percent of incident sunlight (Eugster *et al.* 2000) and high lake densities decrease albedo (CAVM Team 2003). Snow and ice cover reflect considerably more incident sunlight; extensive ice-covered areas (e.g., sea ice along coastlines in the Tundra Plains) increase albedo. Cloud and fog which are usually present when winds are light during the open water season along the coast (Klock *et al.* 2002) also increase albedo. Southerly slopes intercept more solar radiation than northerly slopes that consequently retain reflective snow cover for longer periods in the spring and early summer.

1.4.1.3 Climate change

Northern environments are highly sensitive to climate change (Eugster *et al.* 2000). Duk-Rodkin *et al.* (2004) provide extensive evidence for markedly different climates in the Northwest Territories and Yukon over the last three million years. Zoltai (1995) presents evidence indicating that permafrost zones were considerably further north 6,000 years ago in the Holocene Warm Period than they are at the present time. Woo *et al.* (1992) suggest that average annual surface temperatures may increase by 4^{o}C in Northern Canada in future; Tarnocai *et al.* (2004) indicate that the depth of thaw penetration into permafrost is sensitive to past temperature change and has responded measurably to recent major climatic events. Eight to ten thousand years ago, tree line was north of its present location; pollen records indicate that black and white spruce grew on the Tuktoyaktuk Peninsula, about 50 to 100 km north of the current distributional limit (Spear 1982, Hare and Ritchie (1971).[4]

Change has been and will continue to be a characteristic of planetary climates and ecosystems. This ecosystem classification should be viewed as the present-day representation of a dynamic Arctic climatic-geologic-biotic system and a useful benchmark against which to compare future environmental states.

1.4.2. Landscape and Vegetation Features That Define Level III Ecoregions

The methods used to delineate and define Level III and Level IV ecoregions in the Southern Arctic and in the preceding Taiga Plains, Taiga Shield and Cordillera classifications (Ecosystem Classification Group 2007 (revised 2009), 2008, 2010) employ characteristics that can be assessed using broad-scale information and a combination of extensive aerial surveys and focused ground stops. These methods, described in Section 2, were developed as an efficient and practical means of collecting and collating information across very large sampling areas within the time frame and budget available. Observations of features that produce characteristic signatures on satellite images coupled with oblique aerial digital images collected along flight transects are of central importance to Level III ecoregion delineation, as are topographic features from digital elevation models and National Topographic Series maps, regional surficial and bedrock geology maps, peatland distribution maps and hydrology.

[4] Note that current tree line mapping interpretations and the inherent variability associated with pollen-based studies (tree pollen can be blown some distance from its source) might influence the accuracy of this estimate. Tree line issues related to the current Southern Arctic–Taiga Plains boundary are discussed further in Appendix 4.

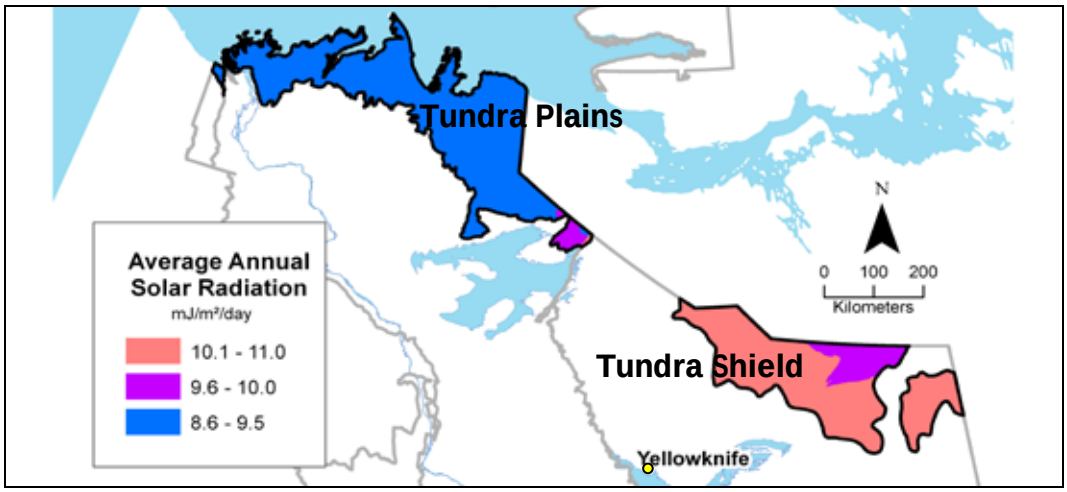


Figure 5. Increasing average annual solar radiation with decreasing latitude (southward) in the Tundra Shield and Tundra Plains (units are $mJ/m^2/day$). Source data: Agriculture and Agri-Food Canada (1997). The Tundra Shield is at a lower latitude and modelled annual solar radiation is higher than the Tundra Plains.

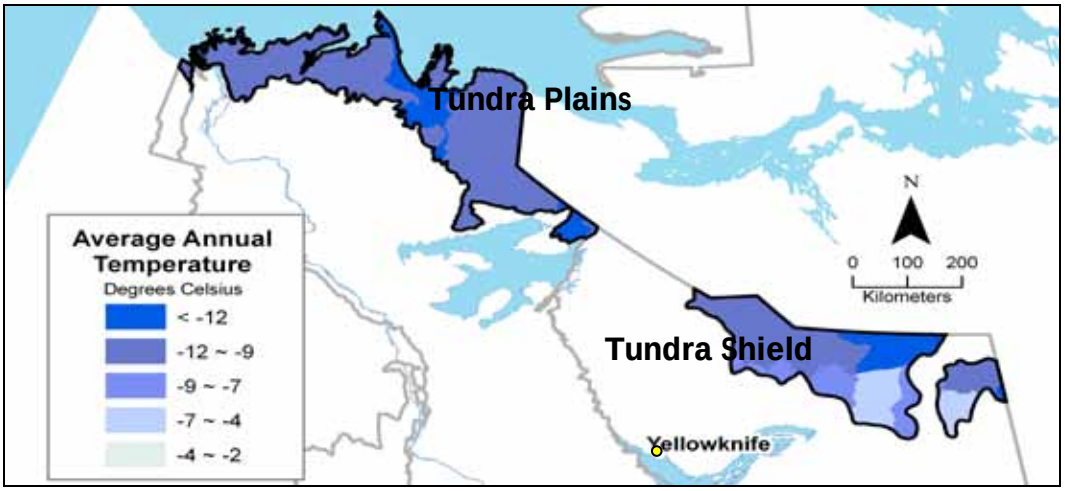


Figure 6. Increasing average annual temperature with decreasing latitude (southward) in the in the Tundra Shield and Tundra Plains (units are degrees Celsius). Source data: Agriculture and Agri-Food Canada (1997). The modelled average annual temperatures for the northern part of the Tundra Shield and all of the Tundra Plains are below $-10^{o}C$; the modelled temperatures for the southern Tundra Shield are between $-6^{o}C$ and $-9^{o}C$.

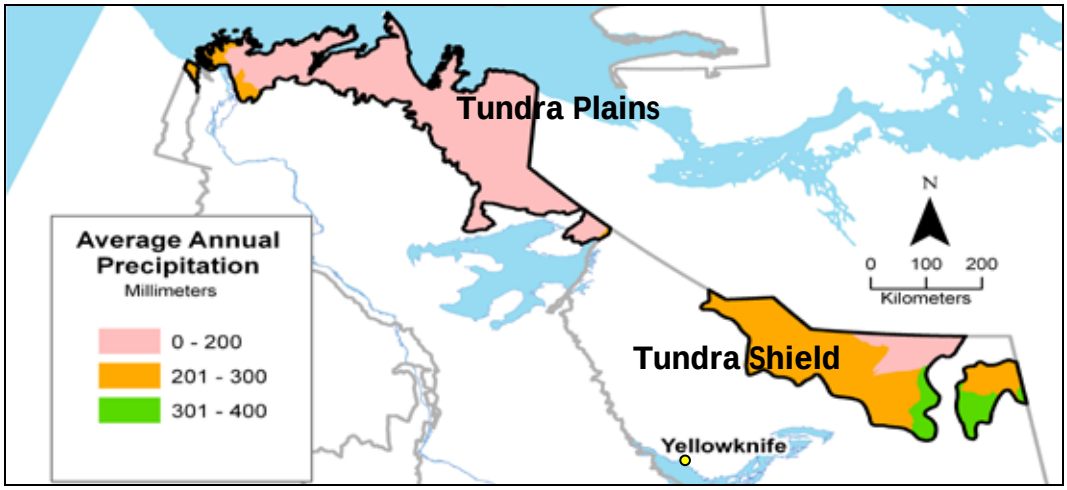


Figure 7. Increasing average annual precipitation with decreasing latitude (southward) in the Tundra Shield and Tundra Plains (units are mm of precipitation). Modelled precipitation for the Tundra Plains is less than 200 mm annually. Modelled precipitation for most of the Tundra Shield is between about 200 to 300 mm annually: Source data: Agriculture and Agri-Food Canada (1997).

In the Taiga Plains, Taiga Shield and Cordillera, readily visible permafrost and vegetation characteristics were used to indicate climatic influences and arrive at a reasonable approximation of Level III ecoregion boundaries. Forest characteristics, such as the presence or absence of indicator tree species (jack pine, lodgepole pine, deciduous trees) and the vigour and density of forest growth were easily seen on oblique aerial digital images and their distribution was mapped to aid in Level III ecoregion delineation.

Permafrost and vegetation characteristics are also useful in the Arctic, but vegetation trends are more subtle. It is the distribution of tundra (e.g., continuous vs. patchy, slope position and aspect, parent material relationships) and the presence or absence of broad species groups (tall shrubs, dwarf shrubs, herbaceous communities, lichen-moss communities) that indicate regional trends in the colder and drier treeless Arctic. Permafrost and vegetation characteristics together with available climate data and models and the previously established northern limits of the Level II Taiga Plains and Taiga Shield Ecoregions were used to arrive at a reasonable approximation of Level III ecoregion boundaries.

1.4.2.1 Permafrost features

Permafrost features typical of the Low Arctic include pingos, earth hummocks, high-centre polygons, low-centre polygons, ice-wedge polygons, solifluction features and sorted and non-sorted circles, stripes and nets. These features occur throughout the Southern Arctic within the Northwest Territories; some features, such as earth hummocks and pingos, are uncommon in the colder climates of the Arctic Islands while others such as sorted circles and nets and ice-wedge polygons become more common to the north. Many of these features are illustrated and explained in Figures 8 through 15[5] and are summarized in Table 2.

1.4.2.2 Vegetation features

The term tundra is derived from the Finnish word *tunturi*, meaning "completely treeless heights" (Chernov 1985, cited in Scott 1995 p. 32). The name reflects the fact that Arctic climates are too harsh for trees to establish and grow except in sheltered locales along the southern transition area between Subarctic and Arctic climates. Tundra communities in the Southern Arctic include tall shrub types (2-5 m high) to dwarf-shrub heath (5-40 cm high) and graminoid-moss types, generally with a plant cover of 80 to 100 percent. To the north, at higher elevations and on dry exposed sites, plant cover becomes discontinuous, shrubs are shorter and sub-erect to prostrate and herbaceous or cryptogamic communities dominate in the High Arctic (Scott 1995, Bliss 1999, CAVM Team 2003).

Plants and plant communities of the tundra and the polar deserts and semideserts further to the north have adapted to a very short growing season and a number of controlling factors (Walter 1979, Zoltai *et al.* 1992, Scott 1995, Bliss 1999, CAVM Team 2003) that include:

- *Temperature.* Average daily air temperatures are above 0^{o}C for three to four months in the Low Arctic, where temperatures in the warmest month (July) do not exceed 10^{o}C. Temperatures are above 0^{o}C for less than two months in the High Arctic. Increasing elevation is equivalent to a northward latitudinal shift and influences both plant development and the expression of permafrost features, so that tundra communities atop the Melville Hills at over 800 mASL are more typical of a mid-Arctic climate than they are of the regional Low Arctic climate. Microsite variations have a major influence on surface temperatures, which are of more importance to plant growth and south-facing slopes have longer growing seasons and are warmer and drier than northerly slopes as discussed above in Section 1.4.1.2. Parent materials also influence temperatures in the rooting zone; coarse-textured well-drained soils warm up more quickly and have a deeper active layer than water-saturated soils.
- *Wind.* Wind redistributes snowfall, exposing some areas and depositing snow on lee slopes and in depressions, gullies and valleys. In areas blown free of snow, exposed plant parts are subject to dessication and physical damage from windblown ice crystals or sand particles. Exposed areas are often colonized by lichen communities with a few scattered dwarf shrubs and herbs.
- *Water.* Water availability affects the type of community development that occurs and is determined by regional climate modified by local terrain conditions including slope, aspect, slope position and soil texture. Rapidly drained sands and exposed rock may be non-vegetated or support only lichen communities. As soil moisture increases, dwarf-shrub communities establish. In wet areas on lower slopes, level plains and seepage tracks, shrub-graminoid communities grow on poorly-drained wet soils. Areas of snow accumulation have better moisture supplies; in the Southern Arctic, snow usually melts by June but above 74^{o} N latitude, snow patches may persist throughout the short summer because of low sun angles and low air temperatures. Tall shrub communities are often correlated with snow deposition areas and occur more frequently in river valley bottoms, steep banks and upland drainages where snow collects.
- *Nutrients.* Low temperatures affect the rate at which plants can take up nutrients. Many Arctic soils are nitrogen-deficient and seepage areas or places where birds or grazing animals congregate are often comparatively species-rich because of increased nitrogen levels in those locales. Insufficient or excessive calcium and other macronutrients can affect the growth of plants and the composition of plant communities; an excess of calcium carbonate (or chloride salts in tidal flat areas along the coast) can make water uptake more difficult for many Arctic plants. This can affect the extent of tundra development; for example, highly calcareous substrates on the Parry Peninsula near Paulatuk in the Low Arctic create patterns in tundra distribution and

[5] Appendix 5 contains a glossary of terms.

type similar to those seen in higher-latitude mid-Arctic climatic regions.

- *Mechanical factors.* Frost action (cryoturbation) is the most common form of mechanical disturbance. It produces sorted and non-sorted circles, stripes and nets, earth hummocks, or patterned ground. Saturated active layers can flow downslope slowly or rapidly (solifluction, retrogressive flow slides). These events affect the development of plant communities through disturbance of the rooting zone, exposure of new soils for colonization and modifications to the water regime[6]. The type of frost action changes from south to north as the dominant types of permafrost features change.

These factors interact to provide plant community types that recur under similar environmental conditions regionally and globally and that have recently been presented in a comprehensive mapped framework of circumpolar Arctic plant community types with supporting data (CAVM Team 2003). Because these community types correspond reasonably well to the 2009 ground stop and aerial information collected across the Southern Arctic and to other regional vegetation studies (Zoltai *et al.* 1979, Zoltai *et al.* 1992, Fehr *et al.* 2006) and because they are part of an explicitly defined and internationally accepted framework, they are referenced in this report both as indicators of a range of Low Arctic conditions for Level III ecoregions and as descriptors of major vegetation cover trends for Level IV ecoregions. The major community types are summarized in Section 1.5.2 (Table 3).[7]

1.5 How Level IV Ecoregions are Defined

Level IV ecoregions are the most detailed mapped units presented in this report. They are recognized and named according to a combination of features, discussed in Section 1.5.1. Section 1.5.2 provides an overview of vegetation patterns that are common to many of the Southern Arctic Level IV ecoregions.

1.5.1 Landscape and Climate Features That Define Level IV Ecoregions

Level IV ecoregions are consistently named with reference to three descriptive components: geographic location; dominant landscape feature; and ecoclimate.

Geographic location

The ecoregion's name is defined by a feature of local or regional significance and in the Southern Arctic generally by a named feature on National Topographic Series maps (Melville Hills), a major water feature (Horton Plateau, traversed by the Horton River), or a place name (Tuktoyaktuk Peninsula).

Dominant landscape feature

Nine major landscape elements constitute the second component of ecoregion names in the Southern Arctic and these are defined by their form, position relative to other elements, topographic variability, parent materials and hydrologic processes, all of which modify the effects of regional climates. Landscape elements are described in alphabetical order below.

- *Coastlands* are narrow linear areas parallel to the seacoast that are influenced by both oceanic and terrestrial processes and that include a variety of landforms.
- A *delta* is an alluvial sediment deposit at the mouth of a river, often somewhat triangular in form, frequently flooded and nearly level. High water tables, abandoned channels and oxbow lakes and periodic nutrient-rich sediment deposition are important ecological factors.
- *Hills* are prominences rising generally no more than about 500 m above the surrounding areas, although there are notable exceptions such as the Melville Hills that are more than 800 m above the coastal lowlands to the north. They may have gentle to abrupt slopes; slope steepness and aspect along with bedrock substrates near or at the mineral soil surface can strongly influence vegetation development. Drainage patterns are well developed relative to those of the surrounding lower-lying areas. In the Southern Arctic, this term is used to name ecoregions with variable topography that are markedly higher than the surrounding terrain and that often have distinctive bedrock and surficial geology features.
- A *lowland* is an area of low relief at the lower ranges of regional elevation; it receives water inputs from adjacent higher terrain. It is typically imperfectly- to poorly-drained, has a higher proportion of wetlands than other landscape types and is nearly level. Drainage patterns are poorly defined.
- A *peninsula* is a land mass surrounded on three sides by water.
- A *plain* is an extensive, typically level, gently sloping or hummocky area that can occur at low to high elevations, the latter often as part of high elevation plateaus. It is referred to as a *coastal plain* when it borders the coastline and is influenced by oceanic and terrestrial factors.
- A *plateau* is an extensive level to gently sloping upland area at a higher elevation than its surroundings, often underlain by horizontally-oriented bedrock strata. They can be deeply eroded by streams.
- *Upland* is a general term for an area that is higher than the surrounding area, sometimes several hundred metres higher, that are not plateaus or hills. Uplands usually have undulating to hummocky terrain, a higher proportion of moderately well- to well-drained sites than lowlands or plains and a lower proportion of wetlands. Drainage patterns tend to be dendritic (resembling tree roots).
- A *valley* includes any lower-elevation area bounded by plateaus, mountains, hill systems or plains, typically including a creek or river its lowest point.

[6] For example, localized soil moisture gradients in cryoturbated earth hummock terrain at tree line near Inuvik are severe enough to cause black spruce seedling mortality (Black, 1977, cited in Pettapiece, 1984).

[7] The Canadian National Vegetation Classification working group is currently developing a comprehensive classification of subarctic and arctic plant communities.

Figure 8. Non-sorted circles are common over continuous permafrost throughout the Southern Arctic. Freezing of the soil forces a mixture of boulders, gravels, sand, silt and clay upward and outward from the centre, creating a raised dome. Soil movement limits vegetation development in the centre, but the slightly lower circle rims are more stable and have enough moisture to support plant growth. *Location:* Horton Upland LA*n* Ecoregion.

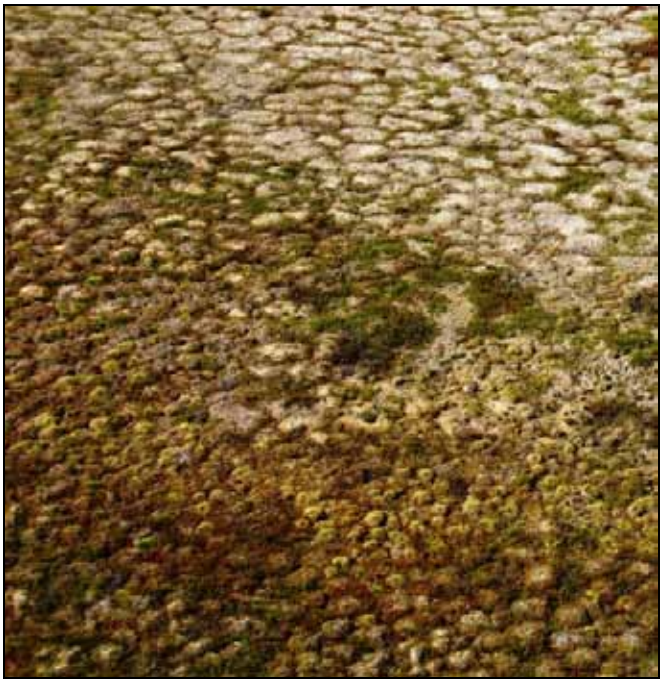


Figure 9. Earth hummocks are a type of non-sorted circle that develop in silty and clayey soils, most commonly at or near tree line along the southern boundary of the Tundra Plains. In this image, the earth hummocks are light-coloured with pronounced dome shapes; the hummock tops are mostly nonvegetated and clumps of dwarf birch and sedge and cotton grass tussocks grow around the perimeter. *Location*: Bathurst Peninsula Upland LA*n* Ecoregion.

Figure 10. Sorted circles are similar to non-sorted circles but develop in colder environments. The centres are fine-textured materials pushed up by frost heaving and support patches of tundra. The outer parts of the circle are coarser-textured than the centres, often consisting of frost-heaved boulders with little or no tundra development. *Location:* Point Upland LA*s* Ecoregion.

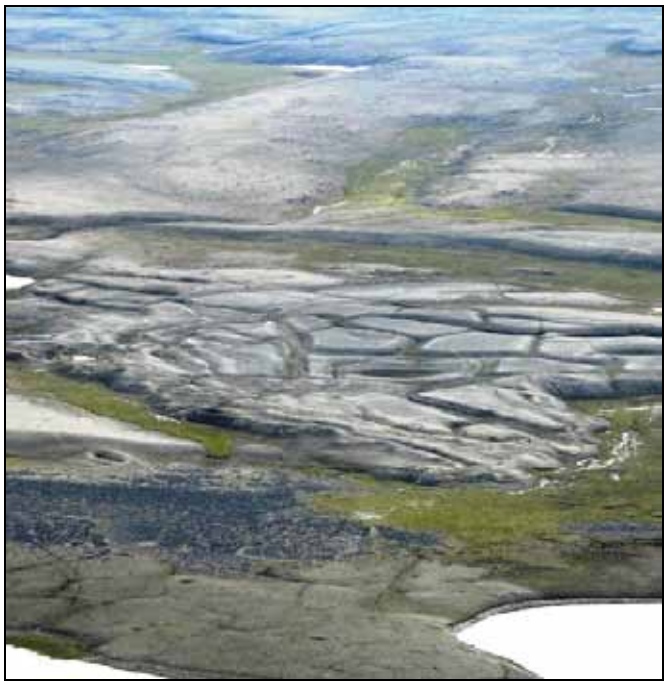


Figure 11. Ice-wedge polygons form in cold climates on dry to moist parent materials that shrink and crack when they cool quickly at the onset of winter. In the summer, meltwaters flow into the cracks and freeze when they contact permafrost at the bottom. An ice wedge forms and grows over time and the initial crack will broaden over time to several metres in width as the edges erode. *Location*: East Melville Slopes LA*n* Ecoregion.

Figure 12. Low-centre polygons are indicative of continuous permafrost in wet terrain (e.g., drained lakes). Ice wedges develop in cracks, pushing up soil ridges adjacent to the wedges and creating dams that trap water inside the resulting polygons. High-rimmed ridges surrounding wet shallow central pools of water are distinguishing features. *Location*: Bathurst Peninsula Upland LA*n* Ecoregion.

Figure 13. High-centre polygons are the long-term result of the same processes that produce low-centre polygons. The dome-shaped peat surface can take hundreds or thousands of years to develop because plant growth and peat accumulation are very slow. Unlike low-centre polygons, these polygons are relatively dry in the centre which is above the local water table. *Location:* Tuktoyaktuk Peninsula Coastal Lowland LA*n* Ecoregion.

Figure 14. Ice exerts great force when it expands and can fracture bedrock from both the upward force of permafrost and the expansion of freezing water in cracks. The mound of boulders in the centre of this image has been pushed up by frost and is flanked by fractured bedrock that has been polished by glacial ice. *Location*: Melville Plateau LA*n* Ecoregion.

Figure 15. Pingos are an interesting permafrost feature produced when water freezes in the beds of drained lakes, pushing the overlying soil up which eventually cracks. The pingo grows until all of the water has frozen. Pingos are common on the coastal plain near Tuktoyaktuk and occasional to rare elsewhere. *Location:* Horton Upland LA*n* Ecoregion.

Table 2. Climate and landscape characteristics of Level III Ecoregions within the Level II Tundra Plains and Tundra Shield Ecoregions, Northwest Territories

Distinguishing Characteristic	**Level III Ecoregion**	
	Tundra Plains Low Arctic north (LAn) Ecoregion	*Tundra Shield Low Arctic south (LAs) Ecoregion*
Temperature regime [1,2]	Very short, cold summers; extremely cold and long winters; frost occurs in every month; average annual temperature –11°C; average July temperature (warmest month) +6 to +7°C in north, somewhat warmer in south; average January temperature (coldest month) –28°C.	Short, cold summers, very cold winters, frost occurs in every month; extremely cold and long winters; average annual temperature –9 °C; average July temperature (warmest month) +10 to +12°C; average January temperature (coldest month) –30°C.
Precipitation patterns [1,2]	Average annual precipitation 130-190 mm, about 50 percent as rain and 50 percent as snow.	Average annual precipitation 200-300 mm; about 60 percent as rain and 40 percent as snow.
Relative insolation [1]	8.5 to 9 mJ/m^2/day (average annual value)	9 to 10 mJ/m^2/day (average annual value)
Characteristic permafrost features, peatlands and soils[3]	Continuous permafrost. Common patterned ground features include non-sorted circles, stripes and nets, low- and high-centre polygons, ice-wedge polygons and pingos, the latter in high concentrations along the coast but uncommon in the uplands. Retrogressive flow slides and solifluction are common in saturated fine-textured materials. Earth hummocks are common in the Inuvik area. Sorted circles, stripes and nets occur at high elevations in the Melville Hills; there are extensive peatlands in the Tuktoyaktuk area and near the Horton River. Cryosols are the dominant soils, with Brunisols on coarse-textured materials and Regosols or non-soils (bedrock) in rockland areas.	Continuous permafrost Extensive rocklands in the west and central portions control permafrost terrain expressions, most permafrost-related features are non-sorted circles, sorted circles, ice-wedge polygons and high-centre polygons. Cryosols are the dominant soils, with Brunisols on coarse-textured materials and Regosols or non-soils (bedrock) in rockland areas. Pingos are rare.
Characteristic tundra cover[3]	*Coastal areas*: Nearly continuous erect dwarf-shrub tundra, nontussock sedge – dwarf-shrub – moss tundra, low-shrub tundra, sedge – moss – dwarf-shrub wetland; discontinuous graminoid – prostrate dwarf-shrub – forb tundra. *Plateaus, high hills, highly calcareous soils:* discontinuous graminoid – prostrate dwarf-shrub – forb tundra, prostrate dwarf-shrub – herb tundra.	Complex of low-shrub tundra (continuous to discontinuous depending on proportion of exposed bedrock), erect dwarf-shrub tundra (continuous to discontinuous), with nontussock sedge – dwarf-shrub – moss tundra adjacent to the Thelon River valley (Taiga Shield Level IV Thelon Valley HS Ecoregion, described in *Ecological Regions of the Northwest Territories – Taiga Shield* [Ecosystem Classification Group 2008]).
Differences from Ecoclimatic Regions of Canada (1989)	The 1989 Low Arctic Ecoregion matches well with the west half of the Level III Tundra Plains LA*n* Ecoregion but is slightly further north than the current ecoregion boundary south of the Parry Peninsula and the Melville Hills. Refer to Appendix 4 for a discussion of tree line anomalies along the Taiga Plains – Tundra Plains boundary.	The 1989 Low Arctic Ecoregion boundary line lies mainly north of the tree line – the southern boundary of the current Level III Tundra Shield LA*s* ecoregion, which was based on tree line analyses by Timoney *et al.* (1992) supplemented by field observations (Ecosystem Classification Group 2008).
Bioclimate[4]	Mainly Subzone E (9-12°C July temperature, moss layer 5-10 cm thick, herbaceous and dwarf-shrub layer 20-50cm tall or low-shrub layer to 80 cm, 80-100% cover of vascular plants, closed canopy, net primary production 3.3-4.3 t ha^{-1} yr^{-1}). Subzone D on coastal peninsulas and Melville Hills (7-9°C July temperature, herbaceous dwarf-shrub cover 10-40 cm tall, 50-80% cover of vascular plants, interrupted closed vegetation, net primary production 2.7-3.9 t ha^{-1} yr^{-1}).	Subzone E (9-12°C July temperature, moss layer 5-10 cm thick, herbaceous and dwarf-shrub layer 20-50cm tall, 80-100% cover of vascular plants, closed canopy, net primary production 3.3-4.3 t ha^{-1} yr^{-1}).

[1] Data generalized from *Canadian Ecodistrict Climate Normals* (Agriculture and Agri-Food Canada 1997).

[2] Descriptive climatic information obtained from *Ecoclimatic Regions of Canada* (Ecoregions Working Group 1989) augmented by long-term climate records from Tuktoyaktuk, Clinton Point and the Parry Peninsula (Environment Canada Climate Normals 1971-2000, Zoltai *et al.* 1992).

[3] Site and general geomorphic information were obtained from the 2009 field program ground and aerial observations. Reports by Mackay (1958), Rampton (1988), Zoltai *et al*. (1992), Veillette (2004) and regional soil surveys were consulted for the Tundra Plains. Vegetation types are named and classified following the Circumpolar Arctic Vegetation Map system (CAVM Team 2003) (refer to Section 1.5.1 and Section 2 of this report).

[4] Source: *Circumpolar Arctic Vegetation Map* (CAVM Team 2003)

Ecoclimate

The ecoregion name includes the ecoclimate, expressed as a two-letter code (Low Arctic, LA) following the naming conventions outlined in *Ecoclimatic Regions of Canada* (Ecoregions Working Group 1989) with a lowercase modifier (LA*n*, LA*s*) that indicates subregional climate variations as explained in Section 1.4 and as shown above in Figures 5 through 7 and discussed in Table 2. This modifier indicates the Level III ecoregion within which the Level IV ecoregion occurs.

Level IV ecoregions are defined by vegetation, soil and landform characteristics that together differentiate one ecoregion from another. The *reference site* is the vegetation – landform – soil combination that succinctly describes the central concept of a Level IV ecoregion. It is conventionally regarded as a site with "deep, well- to moderately well-drained, medium-textured soils, with neither a lack nor an excess of soil nutrients or moisture and neither exposed nor protected from climatic extremes" (Strong and Leggat 1992; Ecoregions Working Group 1989). Sites meeting these criteria are considered to reflect the regional climate. However, in the Arctic, deep, well- to moderately well-drained soils are the exception rather than the rule, because permafrost is continuous, the active layer is generally less than a metre thick for a few weeks during the growing season and bedrock is close to or at the surface in places. Reference conditions therefore vary for every Level IV ecoregion and are defined by the most commonly occurring combination of landform, soil and vegetation. For example, the Tuktoyaktuk Peninsula Lowlands LA*n* Ecoregion occurs on the low-elevation peninsular complex of marine, glaciofluvial and till deposits adjacent to the Beaufort Sea and is one of 26 Level IV ecoregions that are part of the Level III Tundra Plains LA*n* Ecoregion. In contrast, the Point Upland LA*s* Ecoregion is characterized by extensive rocklands with till veneers and blankets and is one of nine Level IV ecoregions that are part of the Level III Tundra Shield LA*s* Ecoregion. The conventional reference site definition is applicable to neither Ecoregion.

1.5.1 Recurring Vegetation Patterns in Level IV Ecoregions

The *Circumpolar Arctic Vegetation Map* (CAVM Team 2003) describes 15 vegetation units that are associated with circumpolar environments. The map shows that eight of these units occur within the Southern Arctic; they are listed in Table 3 along with the major species that characterize them and their general distribution within the Tundra Shield and Tundra Plains. Figures 16 through 19 provide representative images of four of the units.

The distribution of these units within Level IV ecoregions is provided in the individual ecoregion descriptions in Sections 3.4 and 3.5. Local landform characteristics can be as influential as regional climate on smaller-scale distribution patterns that cannot be represented on the CAVM map. Exposed bedrock, parent material depth and texture, permafrost, soil chemistry (particularly high calcium carbonate levels), seepage, slope and aspect all play a role as outlined in Section 1.4.2.2.

Table 3. Circumpolar vegetation units that occur within the Southern Arctic[1]

Unit name and CAVM map code	Description, major species	General Distribution
Erect dwarf-shrub tundra (S1)	Moist to dry tundra, 80-100% plant cover on zonal sites to sparse on dry ridges; *Betula glandulosa, Vaccinium uliginosum, V. vitis-idaea, Ledum palustre, Salix glauca, Empetrum nigrum*, mosses, lichens.	Extensive (Tundra Plains, Tundra Shield)
Low-shrub tundra (S2)	Moist tundra, low shrubs >40cm tall dominate. Similar shrubs as S1, low and tall *Salix, Alnus*, some trees along southern river valleys, thick moss carpets.	Extensive (Tundra Plains, Tundra Shield)
Nontussock sedge – dwarf-shrub – moss tundra (G3)	Moist tundra, peaty nonacidic soils, plant cover 50-100%, some semi-prostrate and erect shrubs (*Salix* spp., *Rhododendron lapponicum* but mainly sedges (*Carex scirpoidea, Carex misandra, Carex* spp., *Eriophorum* spp., well developed moss layers, relatively diverse herbaceous layer).	Minor (Tundra Shield, Tundra Plains)
Tussock-sedge – dwarf-shrub – moss tundra (G4)	Moist tundra, cold acidic soils, plant cover 80-100%, height 20-40 cm, tussock-forming *Carex* spp., *Eriophorum vaginatum*, prostrate and erect dwarf shrubs (*Ledum palustre, Vaccinium uliginosum, V. vitis-idaea*), mosses, lichens, herbs.	Minor, locally extensive (Tundra Plains)
Graminoid – prostrate dwarf-shrub – forb tundra (G2)	Moist to dry tundra, nonacidic soils, plant cover 40-80%, height 5-15cm, *Carex* spp., *Eriophorum* sp, prostrate dwarf-shrubs (*Salix* spp., *Dryas* spp.), herbs, mosses, lichens.	Extensive (eastern Tundra Plains)
Prostrate dwarf-shrub – herb tundra (P1)	Dry tundra, 20-80% plant cover, 5-10cm tall, dominantly prostrate dwarf-shrubs (*Dryas* spp., *Salix arctica*, other *Salix* spp.). Other common plants are various sedges, grasses, mosses, lichens.	Limited (Tundra Plains, high elevation or calcareous soils)
Sedge – moss – low-shrub wetland (W3)	Bog-fen complexes, deep organic deposits, dominantly *Carex* spp, *Eriophorum* spp, mosses, some dwarf-shrubs (*Ledum* spp., *Vaccinium* spp., *Empetrum nigrum* etc.).	Minor (Tundra Plains, Tundra Shield)
Sedge – moss – dwarf-shrub wetland (W2)	Mainly fens, slightly acid to neutral, nontussock *Carex* spp., *Eriophorum* spp., mosses, scattered dwarf shrubs (e.g. *Ledum palustre, Empetrum nigrum, Vaccinium spp*.) on more acidic sites.	Tundra Plains, minor (Tundra Shield)

[1] Source: *Circumpolar Arctic Vegetation Map* (CAVM Team 2003)

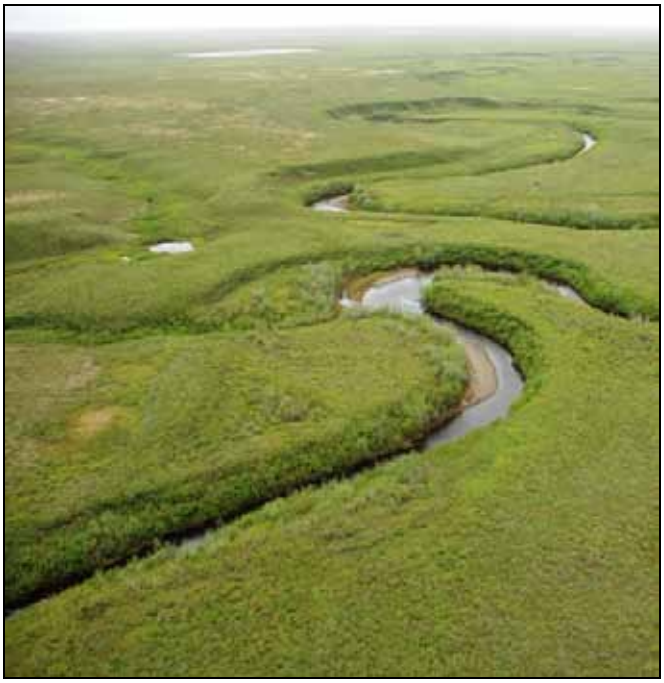


Figure 16. *Low-shrub tundra*, characteristic of the southern part of the Tundra Plains and Tundra Shield, appears from the air as a nearly continuous cover of light-green shrubs. On the uplands, dwarf birch taller than about 40cm is the dominant shrub. Taller willows and alders grow along streambanks in this image. *Location:* Bathurst Peninsula Upland LA*n* Ecoregion.

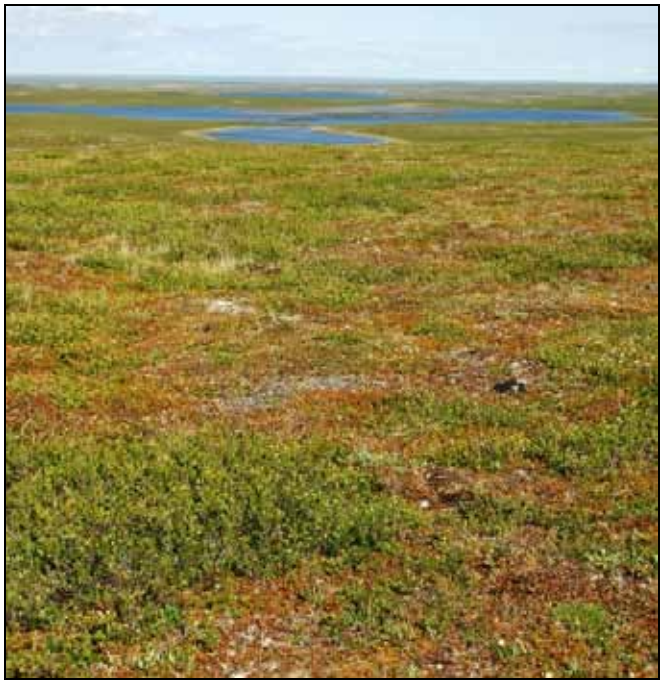


Figure 17. *Erect dwarf-shrub tundra* is shown in this image. Silty tills in this area support a low cover of dwarf birch, mountain avens, mountain heather, crowberry, arctic bearberry, arctic lupine and lichens. The taller shrubs are less than 40 cm high. *Location:* Contwoyto Upland LA*s* Ecoregion.

Figure 18. *Prostrate dwarf-shrub – herb tundra* occurs at higher elevations in the Melville Hills and on exposed coastal areas along the Amundsen Gulf. The low-growing dry tundra community in this image is associated with calcareous soils and exposure to cold, dry winds on the Parry Peninsula. *Location:* Parry Peninsula Coastal Plain LA*n* Ecoregion.

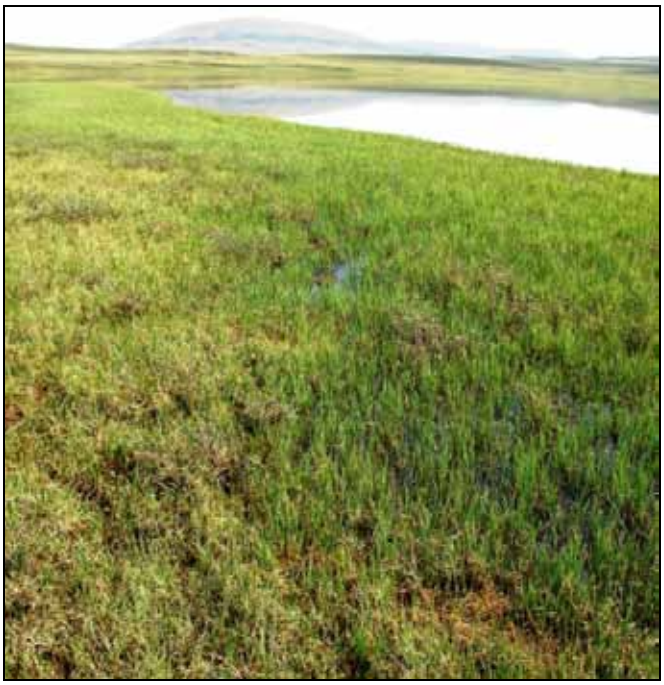


Figure 19. *Sedge – moss – low-shrub wetland* occurs in seepage areas and lower slope terrain such as this pond margin east of the Melville Hills. Note the surface water between the plants in the foreground. The main sedge species in this image is water sedge (*Carex aquatilis*). *Location:* Hornaday Valley LA*n* Ecoregion.

Section 2: Methods

2.1 Introduction

The 2012 Southern Arctic ecosystem classification was developed through a consultative process that involved representatives from the Government of the Northwest Territories, Environment and Natural Resources (ENR), the Government of Canada (Agriculture and Agri-Food Canada) and consultants with expertise in ecosystem classification. Revisions to the current Northwest Territories classification were based on recent concept-development work applied to the Taiga Plains (Ecosystem Classification Group 2007 [revised 2009]), the Taiga Shield (Ecosystem Classification Group 2008) and the Cordillera (Ecosystem Classification Group 2010).

The revision process employed a variety of spatial data sources including Landsat imagery, digital elevation models, hydrology, permafrost, bedrock geology, surficial geology, soils and climate that were displayed on a common base within the ESRI ArcGIS 9.1® geographic information system platform. This provided an efficient way to view landscapes from various perspectives. Air and ground verification of the proposed changes was an integral part of the revision process. Section 2 presents in general terms the GIS processes and data employed, the field data collection methods and the process by which concepts, GIS-based data and field information was integrated to produce the final map and report.

2.2 GIS Processes

2.2.1 Information Assembly

ESRI ArcGIS® 9.2 was the principal GIS software used to manage the spatial datasets. All datasets were transformed to a common projection (Lambert Conformal Conic, NAD 83 Datum) and maintained in an ArcGIS® 9.2 Geodatabase. Other software packages used to create and manipulate spatial data were ArcInfo® 8.3 (Unix), ArcInfo® 9.2 (PC) and ArcView® 3.2. A brief description of spatial themes is provided below.

Soil Landscapes of Canada

The *Soil Landscapes of Canada* (SLC) spatial database as modified by ENR using the Soil Carbon Digital Database of Canada was supplied as a polygon shapefile. It provided some useful attribute data and conceptual guidance for initial ecoregion line placement.

Digital Elevation Model (DEM)

This dataset is derived from Canadian Digital Elevation Data (CDED) files and consists of an ordered array of ground elevations at regularly spaced intervals. The source digital data for CDED at a scale of 1:250,000 are extracted from the hypsographic and hydrographic elements of the digital National Topographic Data Base. This dataset was supplied by ENR as a TIF file with a ground resolution of 125 metres.

Ecoclimatic Regions of Canada

The *Ecoclimatic Regions of Canada* Digital Database consists of an ArcInfo coverage with associated Polygon Attribute Table.

Peatlands

The *Peatlands of Canada* spatial and aspatial data were extracted directly from Tarnocai *et al*. (2005).

Satellite Imagery

Digital Landsat 7 ETM imagery was supplied by Environment and Natural Resources (ENR) as 3 band geoTIF orthorectified images in 5-4-3 band combination. The imagery was acquired during the months of June through September from 1999 to 2002. For some areas where ENR images were not available, Landsat 7 Orthorectified Imagery over Canada, Level 1 was downloaded from GeoBase® (http://www.geobase.ca).

2.2.2 Map Production and Database Update

All map products were created with ArcGIS® 9.2, utilizing the extensions 3D Analyst™ and Spatial Analyst™ for 3D surface visualization and analysis. Using these tools and the 125 m raster DEM, several new feature themes were created:

- Contours at 25, 50 and 100 m intervals;
- Hillshade raster themes of various sun angles and directions; and
- Vertical exaggeration of datasets to enhance surface variations in the landscape.

Two map products formed the basis for ecoregion analyses:

1) DEM theme maps consisting of a hillshade raster overlaid with preliminary ecoregion polygons and base features (hydro, transportation); and
2) Landsat 7 maps with preliminary ecoregion polygons and base features (hydro, transportation). Each of these two basic theme maps could then be overlaid with any other theme as required. The general working map scale was 1:500,000. Scales ranging from 1:100,000 to 1:750,000 were used as required.

Ecoregion boundary edits were done within an ArcGIS® ArcMap™ environment that provided the ability to incorporate various dataset file formats (vector, raster) and allowed for spatial editing based on the underlying themes.

2.3 Field Data Collection

An extensive aerial reconnaissance of the entire Southern Arctic area was conducted between July 15 and 29, 2009, using provisional ecoregion lines prepared from existing information as a sampling framework. Representatives of ENR (Bob Decker), Agriculture and Agri-Food Canada (Charles Tarnocai) and an ecological consultant (Dave Downing) participated. Flight lines were planned in advance to cover the area efficiently given aircraft and fuel limitations. The aerial survey spanned a total of 14 days, of

which 13 days were suitable for flying. A Eurocopter® AS350 B2 A-star rotary-wing aircraft was used. Aerial traverses totalled 10,500 km. A Panasonic® Toughbook 19 tablet computer with ArcPad™ 8 software and connected to a Garmin® Mobile 10 GPS receiver was used for navigation. With this system, the planned flight lines, Landsat imagery and provisional ecoregion lines could be simultaneously viewed and a Garmin® GPSMap76CSx global positioning system (GPS) unit with an external antenna provided real-time location information.

Information collected during aerial traverses included:

- Digital images, captured with a Nikon® D2Xs 12 megapixel single-lens reflex camera and an 18-200 mm zoom lens with vibration reduction;
- Geographic locations (waypoints), collected at the same time as digital images using a Garmin® GPSMap 76CSx GPS unit; and
- Comments referenced to waypoint and digital photo numbers that included photo direction and free-form remarks about landform, vegetation, permafrost, wildlife and other features.

Approximately 7,500 geo-referenced oblique-view aerial digital images were recorded, each with accompanying comments. On average, a geo-referenced image was collected and a comment recorded every two to three km during aerial surveys, or about every 30 seconds.[8] Figure 21 shows the flight lines flown during the aerial reconnaissance in July 2009; the Level III ecoregion theme is shown to illustrate transect coverage across each of these ecoregions[9]. Approximately 2,000 digital images were recorded at ground reconnaissance points.

Twenty-two ground stops were made where both general information on site conditions and geo-referenced digital images were recorded. More detailed sample plots were established at six additional locations; plot information collected included basic site, soil and vegetation information characteristics, along with representative geo-referenced digital images.

2.4 Post-field Data Review and Mapping

2.4.1 General Procedures

Digital images were organized by flight line and date to facilitate their use. All of the digital information themes outlined in Section 2.2 and Section 2.4.2 (below) were brought together on an ArcGIS 9.2® platform and manipulated to produce different views of landscapes that provided insights into processes and patterns. In addition, flight lines were overlaid on the thematic map layers; the digital images and associated comments were then reviewed to augment the vegetation, permafrost and landform patterns detectable through existing coverages and models. Ecoregion boundaries were finalized and ecoregion descriptions were completed in accordance with the conceptual framework agreed upon by members of the Ecosystem Classification Group. On-screen line adjustments were made using software editing tools.

2.4.2 Information Sources Used to Describe Ecoregions

A number of standard information sources were consulted during preparation of the ecoregion descriptions and are briefly discussed below.

Geology and Geomorphology

Two Geologic Survey of Canada (GSC) maps provided a good general overview of surficial geology (*Surficial Materials of Canada* [Fulton 1995]) and bedrock geology (*Geological Map of Canada* [Wheeler *et al.* 1997]). More detailed 1:250,000 scale bedrock and surficial geology maps were obtained from the GSC website[10] and provided further detail on the bedrock and surficial geology of individual ecoregions; refer to Table 4 below. Reports by Mackay (1958), Veillette (2004), Rampton (1988) and Anonymous (1986) provide excellent detailed descriptions of geology and geomorphology for much of the Tundra Plains.

Soils

The Canadian System of Soil Classification (Soil Classification Working Group 1998) is the authority for soil nomenclature. Soil Landscape of Canada (SLC) polygon delineations and associated attributes was one of several information sources used to assess soil types and distributions within ecoregions. Plot data collected by one of the authors (C.Tarnocai) and others prior to 2000 were used to augment soil descriptions for several ecoregions primarily in the Tundra Plains (Figure 20). A soil map (Anonymous 1986) was useful for parts of the Tundra Plain west of Cape Bathurst.

Vegetation

Extensive and detailed plot sampling was not undertaken during the 2009 Southern Arctic field program because of time constraints and the necessity to cover a large area in a few weeks. Most vegetation descriptions are therefore very general and are based on the Circumpolar Arctic Vegetation Map schema discussed in Section 1.5.1 that could most readily be applied to the interpretation of aerial oblique images. Where possible, more specific references are applied (e.g., Bradley *et al.* 1982, Fehr *et al.* 2006, Kemper 2006, Obst 2008, Zoltai *et al.* 1979, 1992, 1997).

Common and scientific vascular plant names used throughout this report follow *NWT Species 2006 – 2010* (Working Group on General Status of NWT Species 2006). A list of common and scientific plant names is provided in Appendix 1.

[8] The geo-referenced digital image location indicates the point at which the image was collected, not the image centre, as most of the images were oblique views and not directly below the aircraft.

[9] Level III ecoregion concepts are described in Sections 1.4 and 3.4.

[10] Geological Survey of Canada Map Image Rendering Database for Geoscience: gdr.nrcan.gc.ca/**mirage**/index_e.php

Table 4. Summary of principal published surficial and bedrock geology and soil information sources used in the classification of the Southern Arctic, Northwest Territories

Map Area	Level II or III Ecoregion	Level IV Ecoregion or general comment	Filename as provided on Geologic Survey of Canada website, or report citation
Surficial Geology			
Canada	Southern Arctic	Surficial Materials of Canada; entire area	gscmap-a_1880a_b_1995_mn01.pdf
Canada	Southern Arctic	Glacial history – Laurentide; entire area	gscmap-a_1702A_e_1987_mn1.pdf
Canada	Southern Arctic	Glacial history – Laurentide; entire area	gscmap-a_1253A_e_1968_mn1.pdf
Canada	Southern Arctic	Glacial history – areas west of Cape Bathurst	gscmap-a_1647a_e_1987_mn01.pdf
Northwest Territories	Southern Arctic (Tundra Plains).	Map and report covers Tuktut Nogait National Park (eastern Tundra Plains) and adjacent areas	Veillette 2004, Mackay 1958
Northwest Territories	Southern Arctic (Tundra Plains).	Reports and maps within reports cover Tuktoyaktuk Coastlands and Peninsula (Rampton) and Anderson River area (Mackay 1958)	gscmap-a_1647a_e_1987_mn01, Rampton 1988, Mackay 1958
Bedrock geology			
Canada	Southern Arctic	Entire area	gscmap-a_1712a_b_1991_mn01.pdf
Circumpolar Arctic	Southern Arctic, Arctic Islands	Entire area	gscof_5816_e_2008_mn01.pdf (map); gscof_5816_e_2008_mn02/mn03/mn04/mn05.pdf (legends); Harrison *et al.* 2008 (report)
Southern Arctic Islands, Southern Arctic (Cape Bathurst, Darnley Bay southern Melville Hills	Southern Arctic (Tundra Plains), Arctic Islands	Eastern Tundra Plains ecoregions	gscof_3845_e_2000_mn01.pdf
Soils			
Northwest Territories	Southern Arctic, Tundra Plains	Mackenzie Delta LA*n*, Richards Island LA*n*, Caribou Hills LA*n*, Tuktoyak Peninsula Lowlands LA*n*, Tuktoyaktuk Coastal Plain LA*n*, Anderson Upland LA*n*, part of Bathurst Peninsula Coastal Plain LA*n*	Anonymous 1986. Paper map only, no accompanying report.

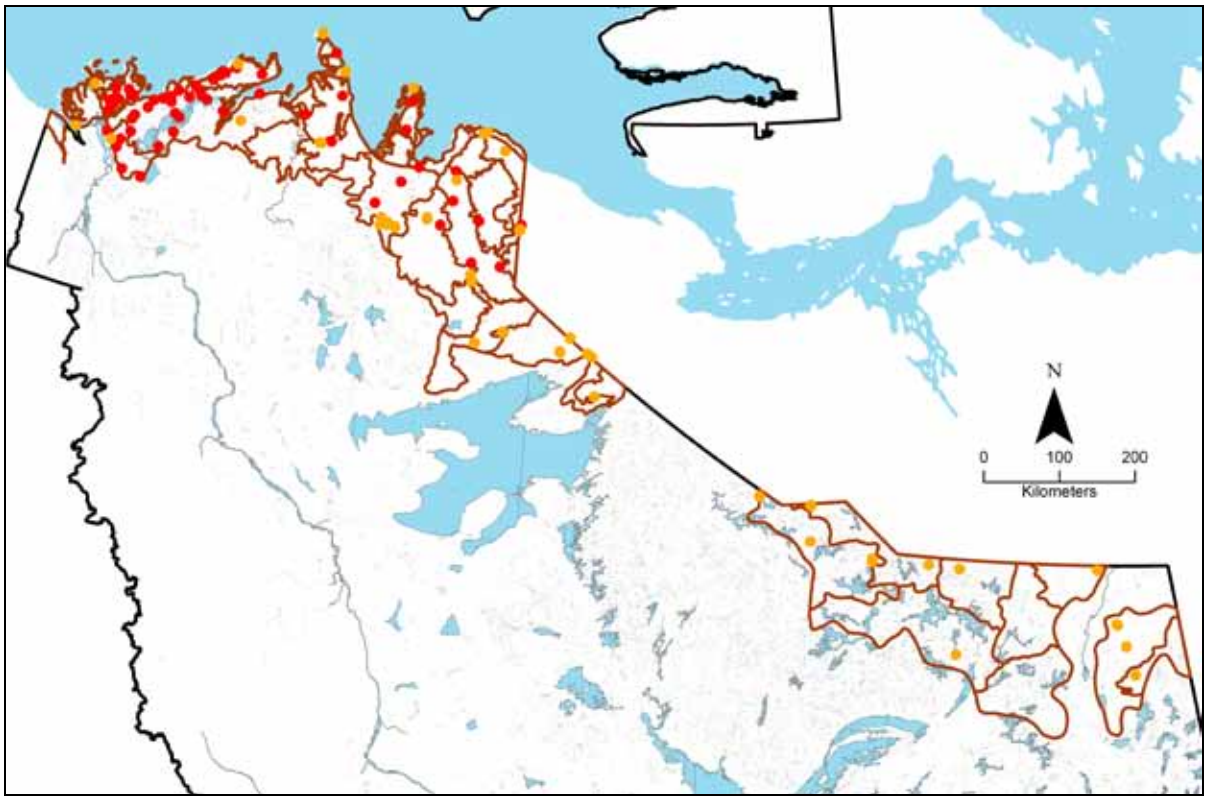


Figure 20. Plot and general ground reconnaissance locations with information used for ecoregion descriptions are shown here overlaid upon the outline of Level IV ecoregions. *Red* points are locations where soil data were collected prior to 2000 for federal research programs. *Orange* points are locations where basic plot information or reconnaissance information was collected during the 2009 field program. A detailed map of the Northwest Territories Southern Arctic classification is provided in Appendix 3; Level III and Level IV ecoregions are described in Sections 3.4 and 3.5.

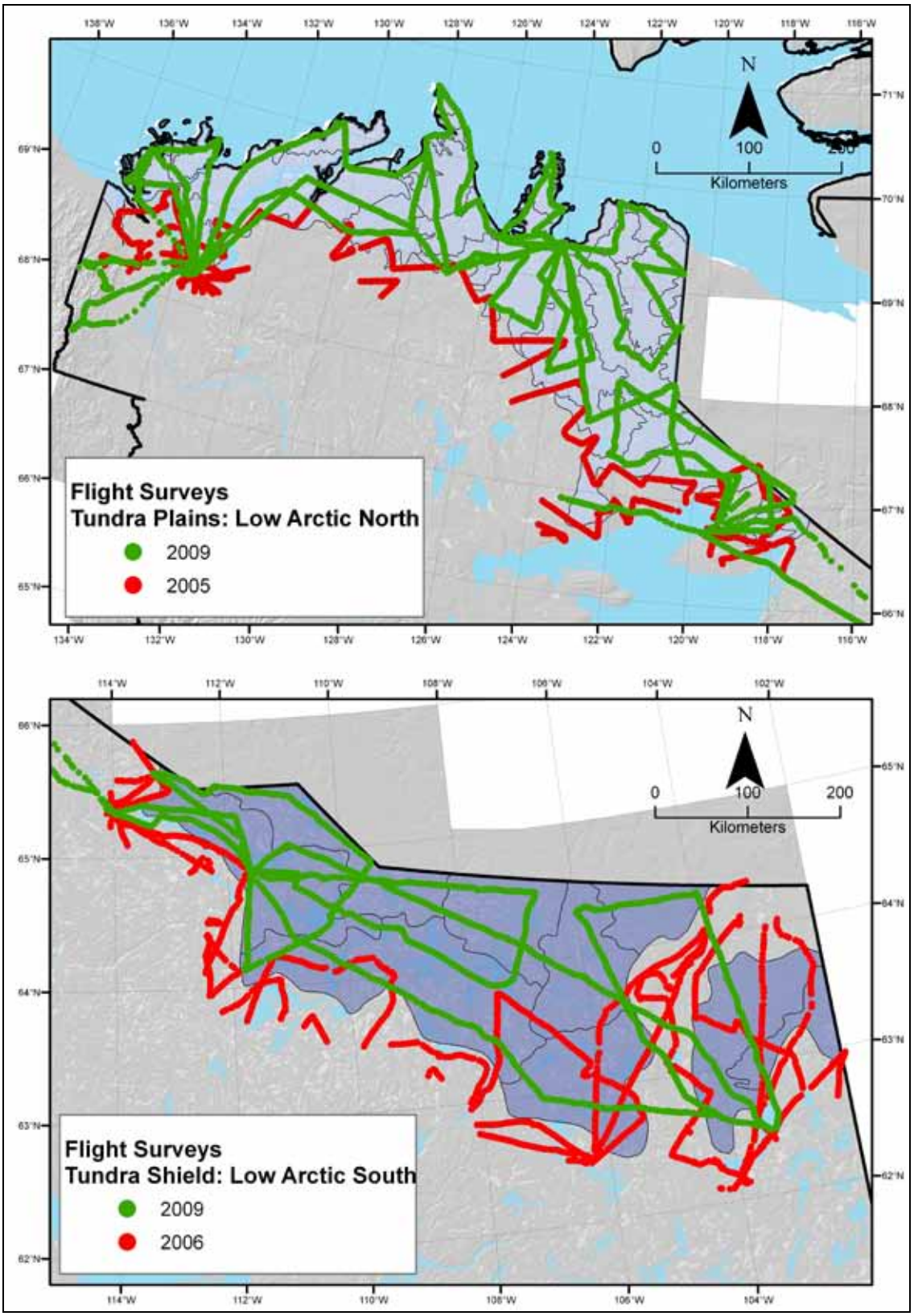


Figure 21. Transects flown during July 2009 are shown in green. Transects with useful coverage from the 2005 Taiga Plains survey (Ecosystem Classification Group 2007 [revised 2009]) and 2006 Taiga Shield survey (Ecosystem Classification Group 2008) are shown in red. Each transect line is actually a series of dots; each dot indicates an individual georeferenced digital photo location. A detailed map of the Northwest Territories Southern Arctic classification is provided in Appendix 3 and Level III ecoregions are described in Sections 3.4 and 3.5.

Section 3: Level II, Level III and Level IV Ecoregions of the Southern Arctic

3.1 Introduction

This section provides a general overview of the Southern Arctic and the two Level II ecoregions that are included within it (Section 3.2), a summary of how Level III and Level IV ecoregions are described (Section 3.3) and detailed descriptions of two Level III and 35 Level IV ecoregions (Sections 3.4 and 3.5). Within each Level III ecoregion, Level IV ecoregions are organized in the order of their occurrence on the map, reading from west to east and top to bottom.

Note that the ecoregion label numbers on the Southern Arctic ecosystem map (Appendix 3) and to the right of each Level IV ecoregion name in the title bar were determined in part by the existing framework of the continental *Ecological Regions of North America* (Commission for Environmental Cooperation 1997) discussed in Section 1.2. They do not correspond to the section numbers; for example, Section 3.4 presents attributes of the Level III Tundra Plains LA*n* Ecoregion, which corresponds most closely to ecoregion label 2.4.1 in the continental *Ecological Regions of North America.*[11]

3.2 Southern Arctic Summary

3.2.1 Overview

The Southern Arctic, part of the Level I Tundra Ecoregion, covers about 168,187 km^2, or 15 percent of the Northwest Territories mainland (1,141,400 km^2). It includes two Level II Ecoregions, the Tundra Plains and the Tundra Shield. The Tundra Plains Ecoregion includes the coastal plains and upland plateaus and hill systems that extend southward from the coastline to the broad tundra-forest transition zone forming the northern boundary of the Level II Taiga Plains Ecoregion north of Great Bear Lake. The Tundra Shield Ecoregion occurs at more southerly latitudes, extending north from the tundra-forest transition zone forming the northern boundary of the Level II Taiga Shield Ecoregion to the Northwest Territories – Nunavut border and beyond. These Level II ecoregions are briefly described in Sections 3.2.2 through 3.2.4 below and detailed descriptions of their component Level III and Level IV ecoregions are given in Sections 3.4 and 3.5. Figure 22 shows the Level I and Level II ecoregions within the Southern Arctic context.

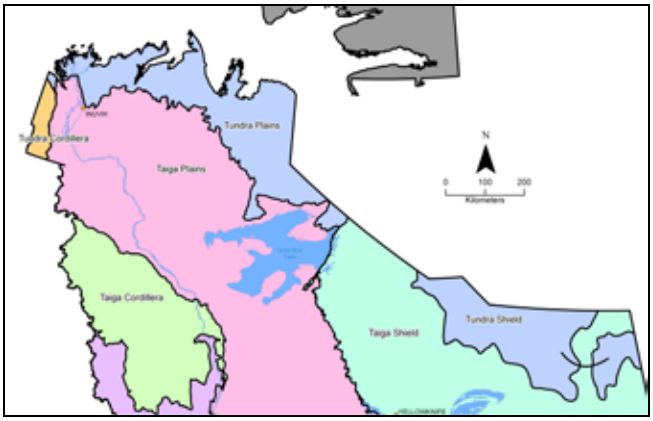
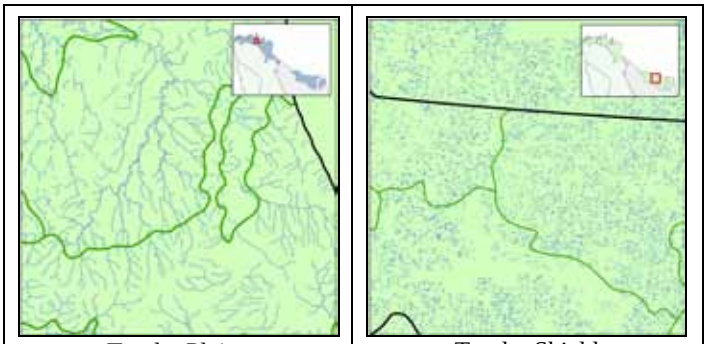


Figure 22. Level II Ecoregions within the Southern Arctic (blue-gray area of mainland) and part of the adjacent Level II Taiga Plains, Taiga Shield and Tundra Cordillera Ecoregions.

The Southern Arctic is an almost entirely treeless landscape of coastal plains and upland hill systems and plateaus, deeply dissected by broad valleys in places. The western portion (Tundra Plains) is underlain mainly by sedimentary bedrock mainly of Cambrian or more recent origin, with the youngest formations in the far west near the Mackenzie Delta and the oldest adjacent to the Northwest Territories – Nunavut border south of the Amundsen Gulf. Lowlands near the Beaufort Sea are a complex of glaciofluvial, till, lacustrine and marine sediments. Uplands to the south are covered by till blankets and veneers; an area at the highest elevations in the Melville Hills escaped glaciation for several hundred thousand years. The eastern portion (Tundra Shield) is a complex of ancient Precambrian sedimentary, granitic and volcanic bedrock that is exposed at the surface as extensive rocklands or covered by thin, discontinuous to thick, continuous till veneers and blankets crisscrossed by large eskers and marked in places by distinctive and extensive till drumlin fields.

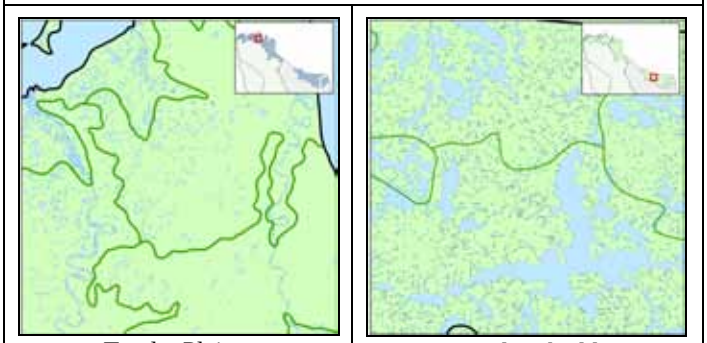
Lakes are more common, stream systems are less organized and peatlands are less extensive in the Tundra Shield compared to the Tundra Plains as shown in Figures 23 to 25. Figures 26 through 28 are generalized maps of bedrock geology, surficial geology and glacial history in the Southern Arctic; the Level IV ecoregion lines and map codes in these three figures are described in Sections 3.4 and 3.5 and shown in Appendix 3.

[11] The Level III unit names for the 2012 Southern Arctic ecosystem classification have been changed from those shown on the *Ecological Regions of North America* map to incorporate local and regional climatic and physiographic knowledge. For example, unit 2.4.1 is labeled as the "Amundsen Plains" on the *Ecological Regions of North America* map, but it spans the Tundra Plains Low Arctic and the Tundra Shield Low Arctic Ecoregions in the present ecological classification and therefore does not correspond to the current ecological boundaries for this unit.



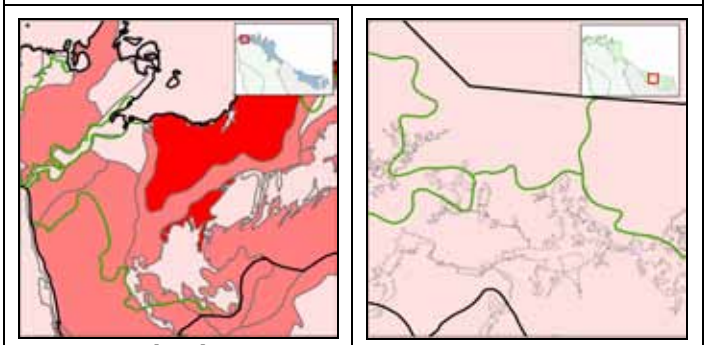
Tundra Plains | Tundra Shield

Figure 23. Stream patterns are generally better developed on the hilly terrain of the Tundra Plains than on the fractured bouldery rocklands of the Tundra Shield.



Tundra Plains | Tundra Shield

Figure 24. Lake density is variable in the Tundra Plains, with fewer lakes on hill systems and numerous lakes on lowlands and coastal plains. Lake density is more consistent in the Tundra Shield, where ponds and lakes are more evenly distributed and often follow bedrock fractures.



Tundra Plains | Tundra Shield

Figure 25. Peatland cover differs between the Tundra Plains and Tundra Shield. Peatland development is limited in the Tundra Shield, but can be extensive on the lowlands and coastal plains of the Tundra Plains. (Source: Tarnocai *et al.* 2005). Light pink = <6% peatlands; darker pink 6-25% wetlands, red = >25% peatlands.

Differences in surficial and bedrock geology and topography along with climate change from the higher latitudes of the Tundra Plains to the lower latitudes of the Tundra Shield contribute to differences in tundra vegetation; generally, the best development of tundra vegetation is in the lowlands of the Tundra Shield where there are thick till blankets and on the moist coastal lowlands east of Inuvik and south of Tuktoyaktuk, whereas sparse, dry tundra characterizes the high hills south of the Amundsen Gulf and the lichen-covered till drumlins and boulder fields of the Tundra Shield. These patterns help to characterize both Level III and Level IV ecoregions.

3.2.2 Level II Tundra Plains Ecoregion

The Level II Tundra Plains Ecoregion extends east from the Mackenzie Delta to the highlands east of Great Bear Lake and south from the coastline and the Northwest Territories – Nunavut border to tree line (the Taiga Plains boundary). It includes 95,631 km^2 or about 57 percent of the Southern Arctic within the Northwest Territories; Tuktoyaktuk and Paulatuk are the only named communities within this Ecoregion. The Level III Tundra Plains LA*n* Ecoregion shares the same boundary (refer to Section 1.4) and is influenced by continental and coastal Low Arctic climates. Most of the area was glaciated by the last Continental ice sheet, except for the highest elevation areas in the Melville Hills to the south and east and the northernmost parts of the Tuktoyaktuk Peninsula and Cape Bathurst. The area west of Cape Bathurst is underlain by bedrock of recent origin that is covered by a mixture of tills and fine to coarse glaciofluvial and marine deposits. To the east and south, recent till deposits overlie Paleozoic and Precambrian bedrock except at the highest elevations in the Melville Hills where older tills and eroded bedrock occur. Nearly continuous tundra occurs west of Cape Bathurst, with discontinuous to continuous tundra on the lowlands and uplands to the south and east of Cape Bathurst depending on parent materials, exposure and elevation. The range of tundra types indicates variation in both parent materials and climate. Permafrost is continuous and occurs in a variety of forms. One Level III and 26 Level IV ecoregions are defined within the Tundra Plains Ecoregion and are described in Section 3.4.[12]

3.2.3 Level II Tundra Shield Ecoregion

The Level II Tundra Shield Ecoregion occurs between the Northwest Territories – Nunavut border and tree line (the northern boundary of the Taiga Shield); it is divided into a large western sub-area and a small eastern sub-area by the partly treed valley of the Thelon River and adjacent uplands. It includes 72,556 km^2 or about 43 percent of the Southern Arctic within the Northwest Territories; there are no named communities within this Ecoregion. The Level III Tundra Shield LA*n* Ecoregion shares the same boundary (refer to Section 1.4) and is influenced by a continental Arctic climate. All of the area was covered by the last Continental ice sheet that left behind extensive till and outwash deposits and polished bedrock. Long sinuous eskers, the riverbed deposits of fast-flowing glacial rivers, cross the Ecoregion from west to east. Frost-shattered Precambrian granitic and sedimentary rocklands with patchy till blankets and veneers are prevalent in the higher western portion; deeper till blankets occur to the east. Fields of till drumlins carved by flowing ice cover thousands of square kilometres in the southeast portion.

[12] Level I, II, III and IV ecoregions are defined in Section 1.

High-centre polygons, non-sorted circles and other permafrost features are evidence of continuous permafrost; Cryosols are the dominant soils. Erect dwarf-shrub and low-shrub tundra are extensive on uplands, with sedge fens in seepage areas and lowlands. One Level III and nine Level IV ecoregions are defined within the Tundra Shield Ecoregion; the Level IV ecoregions and are differentiated mainly by bedrock proportion and surficial material type and distribution.

3.3 How Level III and Level IV Ecoregions are Described

Each Level III and Level IV ecoregion description in Sections 3.4 and 3.5 begins with a one- or two-sentence overview statement and a summary outlining the distinguishing ecosystem characteristics. Climate statistics (average annual temperature, average temperatures of the warmest and coldest months, average annual precipitation, wettest and driest months, average annual daily solar radiation input, average daily solar radiation input in June and December) are summarized at the Level III ecoregion level; for most Level IV ecoregions there is insufficient information to provide a meaningful summary. Where information is available, local climatic influences are discussed.

Within each Level III and Level IV ecoregion, the following attributes are described:

- Total area and elevation statistics (source: GIS spatial data);
- General description of ecoregion characteristics;
- Discussion of geology and geomorphology, including dominant bedrock types, surficial landforms and parent material characteristics and underlying geologic features that influence ecosystems (sources: Soil Landscapes of Canada polygon attributes within ecoregions, surficial and bedrock geology maps and 2005/2006/2009 digital photographs and field observations);
- Discussion of soil features. Soils are described to the Great Group level because this reflects the degree of reliability in the available data and because Great Groups can be reasonably related to major physiographic features and drainage characteristics (sources: Soil Landscapes of Canada polygon attributes within ecoregions; 2009 field observations; Anonymous 1986);
- Discussion of typical vegetation for the ecoregion (sources: 2005/2006/2009 digital photographs, a small sample plot dataset from fieldwork in 2009, *Circumpolar Arctic Vegetation Map* classes (CAVM Team 2003, Fehr *et al*. 2006);
- Discussion of water and wetland features;
- Discussion of notable features (sources: GNWT staff, publications and 2005/2006/2009 digital photographs, and field visits);
- Descriptive photographs, included with each ecoregion on facing pages.

Ecozones and Ecoregions of Canada descriptions (Ecological Stratification Working Group 1995) were reviewed and incorporated as appropriate.

A glossary of terms used within this report is provided in Appendix 5.

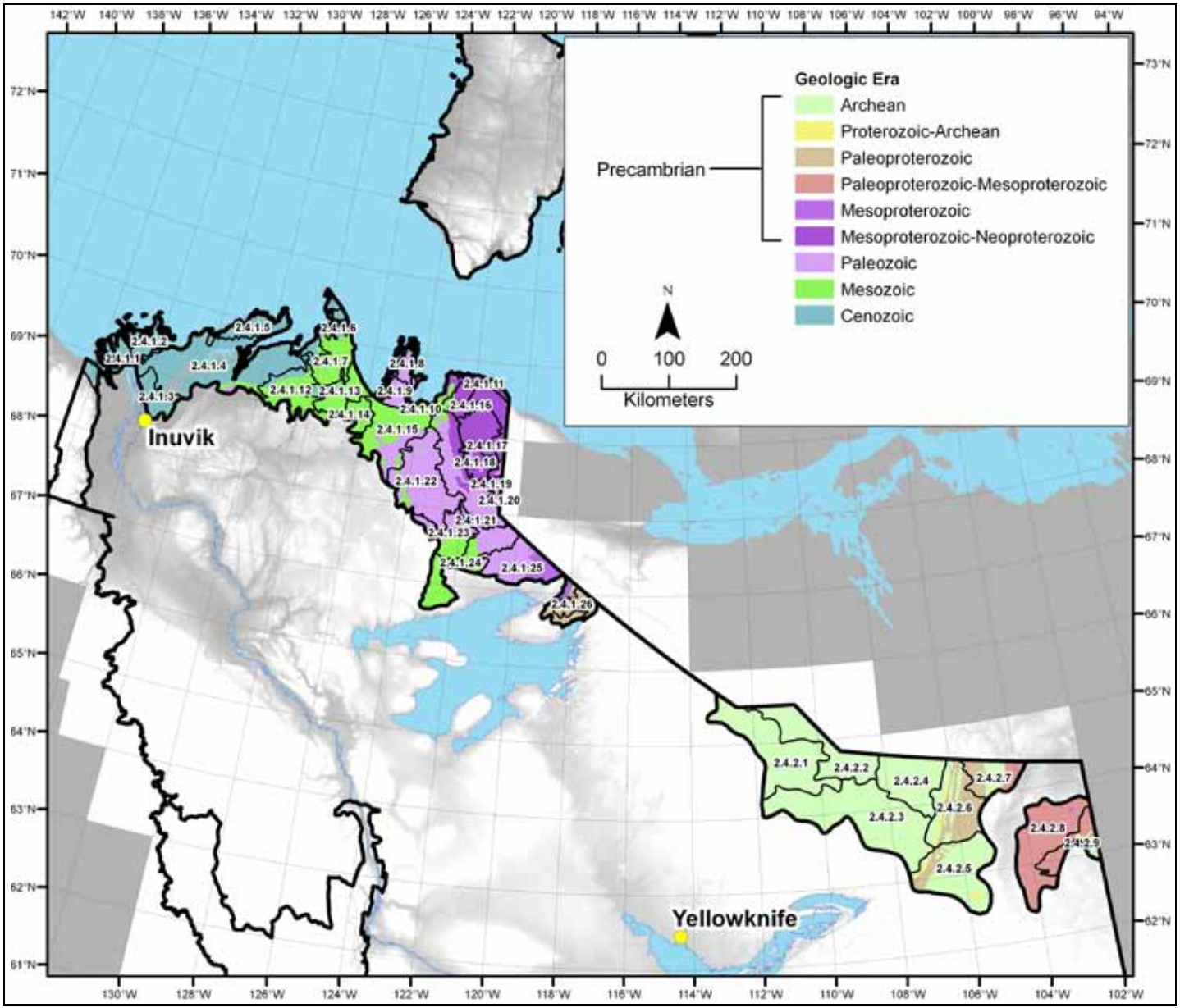


Figure 26. Generalized bedrock geology of the Southern Arctic showing major geologic age classes. (Source: Wheeler *et al.* 1997). Narrow black lines enclose numbered Level IV ecoregion units; refer to Sections 3.4 and 3.5 for descriptions.

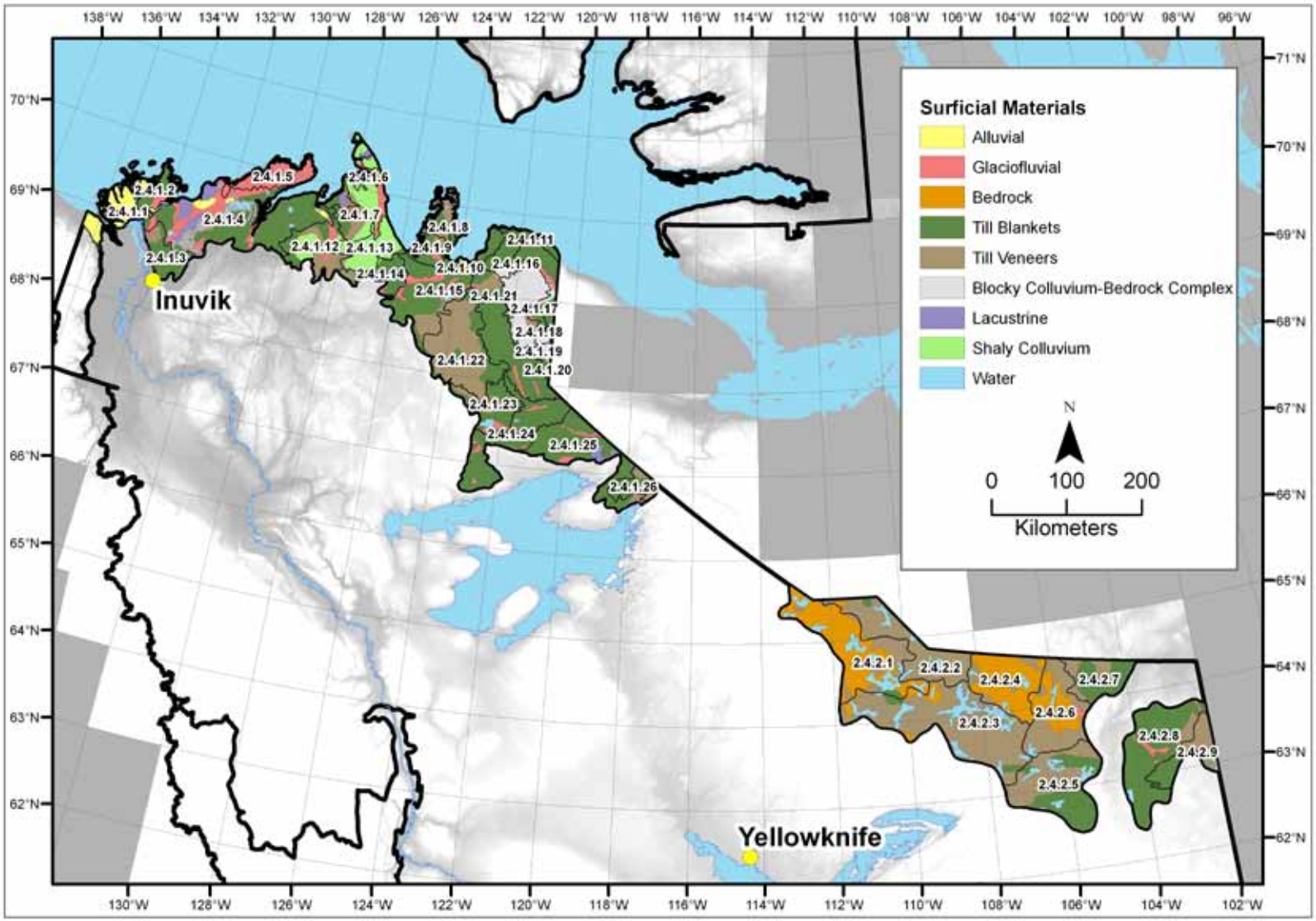


Figure 27. Generalized surficial geology of the Southern Arctic. (Source: Fulton 1995). Narrow black lines enclose numbered Level IV ecoregions; refer to Sections 3.4 and 3.5 for descriptions.

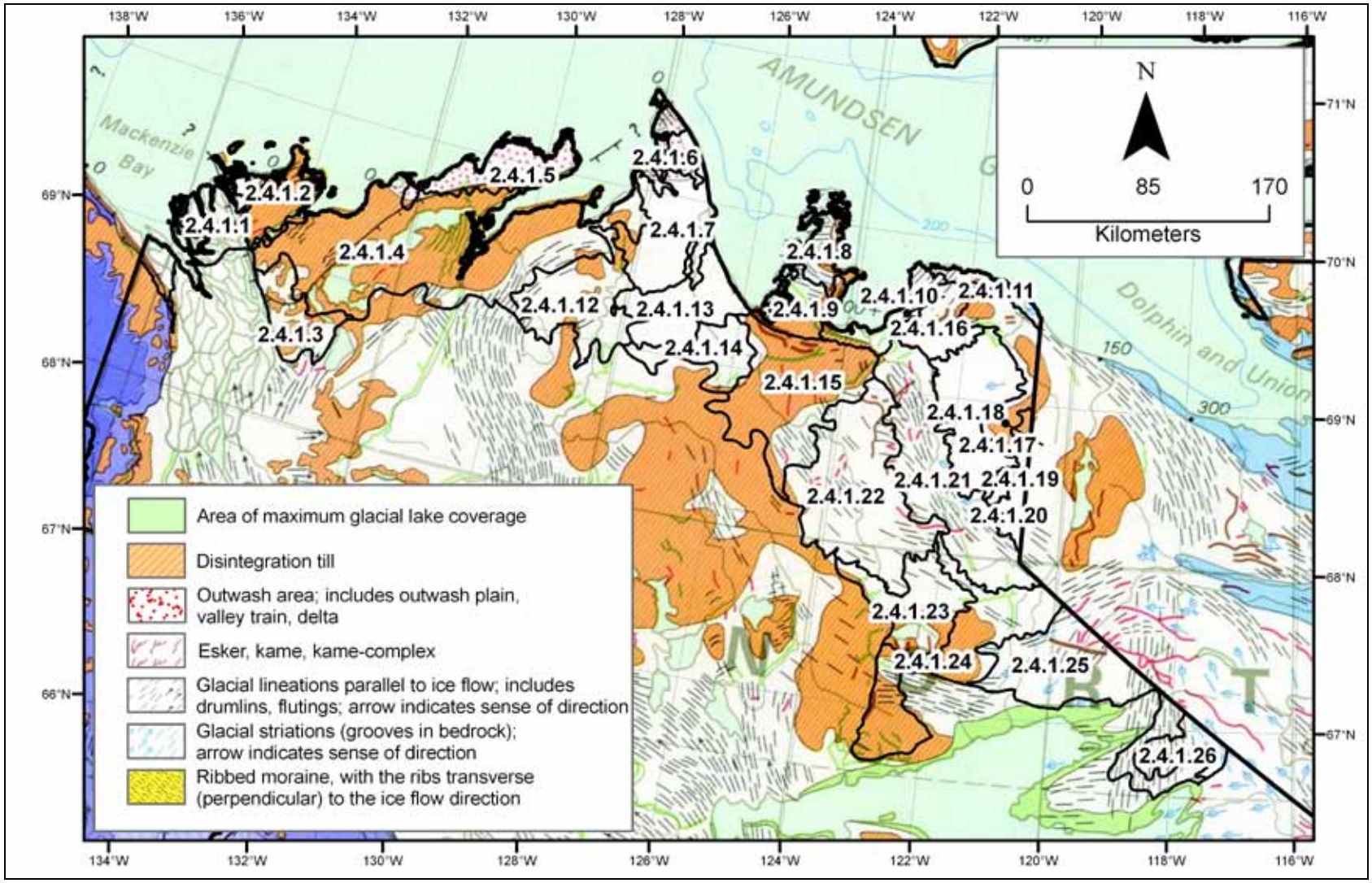


Figure 28a. Glacial history of the Tundra Plains (source: Prest *et al.* 1968). Narrow black lines enclose numbered Level IV ecoregions; refer to Section 3.4 for descriptions.

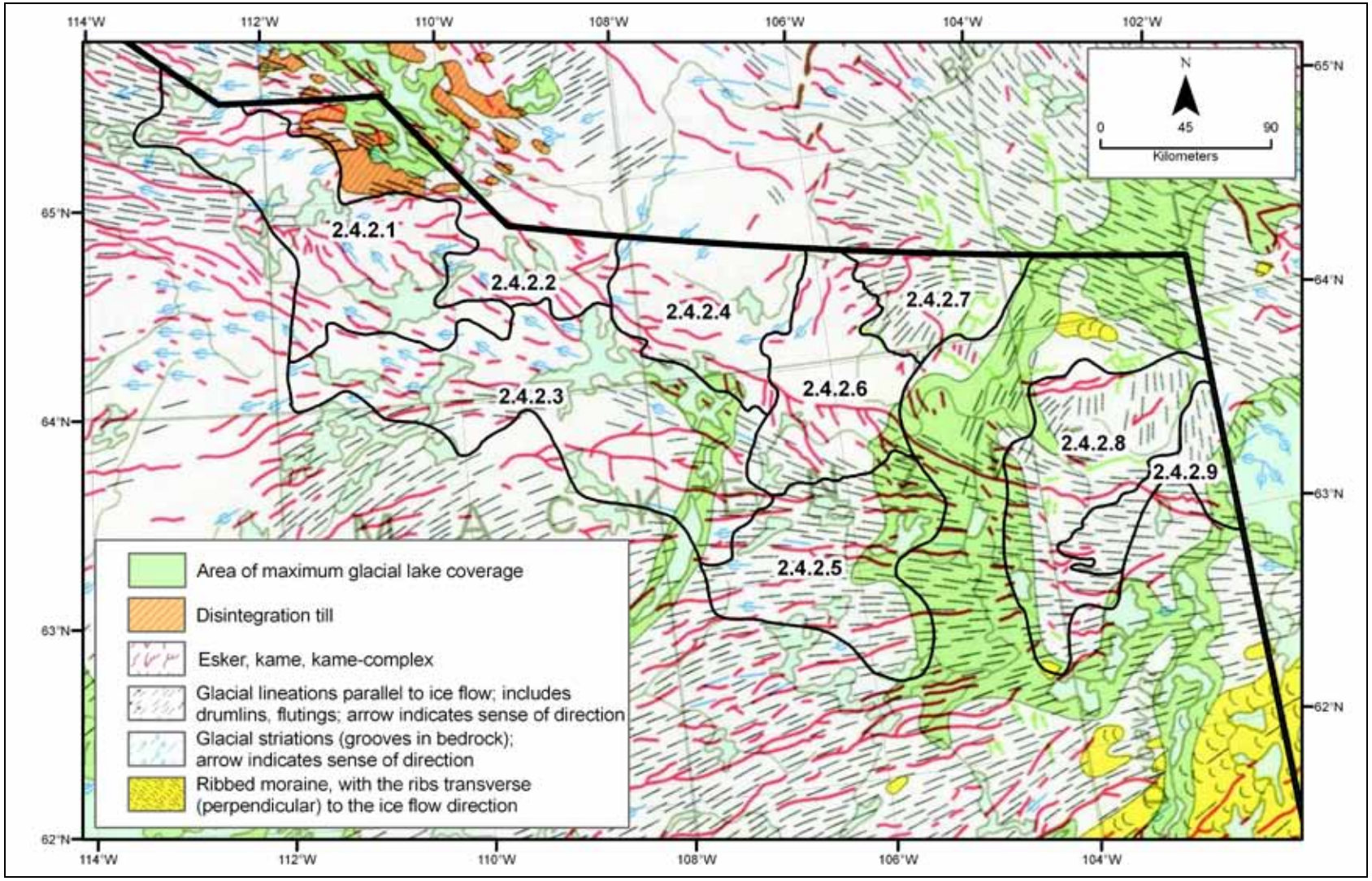


Figure 28b. Glacial history of the Tundra Shield (source: Prest *et al.* 1968). Narrow black lines enclose numbered Level IV ecoregions; refer to Section 3.5 for descriptions.

3.4 TUNDRA PLAINS LOW ARCTIC *north* (LA*n*) ECOREGION

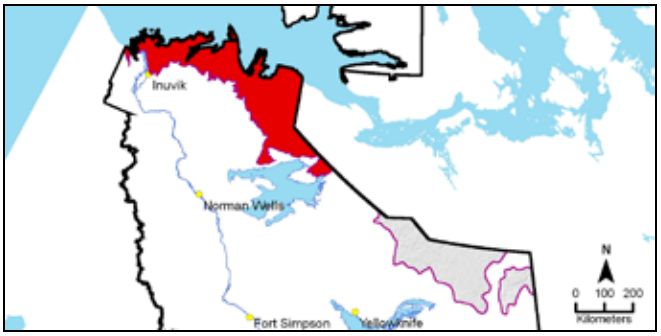
This landscape is typical of level low- to mid-elevation landscapes in the Tundra Plains; shallow to deep till blankets have been eroded by permanent and intermittent streams over centuries, producing well-drained upland areas occupied by sparse tundra (light gray tones on uplands), denser dry, low-growing sedge and dwarf-shrub tundra (gray-green tones) and seepage areas vegetated by wet sedge, cottongrass and shrub tundra (yellowish- green tones in midground).

The inset and the landscape above show tundra cover that is typical of the northern Low Arctic mainland tundra on moist to dry sites. Plant cover ranges from 20 to 80 percent, heights range from 5-15 cm and species include sedges, cottongrasses, dwarf willows, mountain avens and several other herbs, mosses and lichens. The brighter green linear area in the image is wet sedge-cottongrass tundra associated with a seepage track.

Arctic lupines have showy purple flowers and add colour to the midsummer tundra along with other common species such as louseworts, mountain avens, white heather, arctic poppies, cottongrasses, arnicas and ragworts.

3.4 TUNDRA PLAINS LOW ARCTIC *north* (LA*n*) ECOREGION

Overview: *The Tundra Plains LAn Ecoregion is the colder, drier, more northerly member of the two Southern Arctic Level III Ecoregions within the Northwest Territories. To the west, the Ecoregion is a landscape of coastal plains with continuous moist shrub and sedge tundra. In the central and eastern portions, the Ecoregion includes level to rolling uplands and hills that reach elevations of over 800 mASL with highly variable tundra development depending on site conditions.*



Total area: 95,631 km^2. Ecoregion shown in red.

General Description

The Level III Tundra Plains LA*n* Ecoregion is influenced by continental and coastal Low Arctic climates. Most of the area was glaciated by the last Continental ice sheet, but the highest elevation areas in the Melville Hills to the south and east and the northernmost parts of the Tuktoyaktuk Peninsula and Cape Bathurst were not. The area west of Cape Bathurst is underlain by bedrock of recent origin that is covered by a mixture of tills and fine to coarse glaciofluvial and marine deposits. To the east and south, recent till deposits overlie Paleozoic and Precambrian bedrock except at the highest elevations in the Melville Hills where older tills and eroded bedrock occur. Nearly continuous tundra covers the soil surface west of Cape Bathurst, with discontinuous to continuous tundra on the lowlands and uplands to the south and east of Cape Bathurst depending on parent materials, exposure and elevation. The range of tundra types indicates variation in both parent materials and climate. Permafrost is continuous and variable in form. Twenty-six Level IV ecoregions are defined within the Tundra Plains LA*n* Ecoregion.

Climate

The Ecoregion's vegetation and permafrost features reflect the influence of Low Arctic climates, characterized by very short, cold summers (July and August) and long, very cold winters (Ecoregions Working Group 1989). Frost and snowfall can be expected every month. There are only two permanent long-term data collection stations in the Tundra Plains LA*n* Ecoregion at Tuktoyaktuk and Cape Parry, north of Paulatuk; both locales are coastal and are probably modified by oceanic influences. Climatic statistics have been modelled over large areas using limited data by Agriculture and Agri-Food Canada (1997). Climate models at the ecodistrict level for the Tundra Plains LA*n* Ecoregion within the Northwest Territories provide the following general statistics. The average annual temperature is about –11^{o}C, the average temperature in January, the coldest month, is about –28^{o}C and +6 to +7^{o}C in July, the warmest month. Average annual precipitation is about 130 to 190 mm, with about half falling as rain and half as snow. The average annual daily solar input (refer to Section 1.4.2 for further explanation) is 8.5 to 9 mJ/m^2/day, with low values of 0.1 mJ/m^2/day in December and highs of 22 mJ/m^2/day in June. These average values are modified considerably by slope and slope aspect. Wind can be a significant factor in snow redistribution and plant survival. Refer to Section 1.4.1 for a general overview of climatic influences.

Topography, Geology, Soils and Hydrology

Lowlands and broad coastal plains occupy most of the western third of the Ecoregion from Cape Bathurst to the Mackenzie Delta. East and south of Cape Bathurst, the land rises steeply from narrow coastal plains to a series of plateaus and hills with maximum elevations reaching over 800 mASL in the Melville Hills. The western portion is underlain by recent (Cenozoic) sediments; towards the east and south, older sediments (Paleozoic to Precambrian shales, sandstones and limestones) occur and are frequently exposed in the Melville and Grandin Hills and along the valleys of major rivers and their tributaries. Glaciofluvial, alluvial and marine deposits are extensive on the western lowlands and coastal plains; elsewhere, till blankets and veneers are the dominant material, with locally extensive glaciofluvial deposits along several old meltwater channels. Parts of Cape Bathurst, the Tuktoyaktuk Peninsula and the highest elevations in the Melville Hills were not influenced by the most recent glaciation; the surficial materials in these areas are fine-grained to bouldery weathered tills (colluvium) or bedrock. Permafrost is continuous; ice-wedge polygons, frost-shattered bedrock, low- and high-centre polygons and non-sorted circles provide abundant evidence of its influence. Pingos are an interesting and widespread feature of the western coastal plains and lowlands. Cryosols are the dominant soil throughout, with Regosols and weakly developed Brunisols on valley slopes and alluvial terraces; there is no soil development on frost-shattered and exposed bedrock. Peatlands and organic soils are extensive on the lowlands of the Tuktoyaktuk Peninsula Coastal Plain LA*n*, Tuktoyaktuk Peninsula Coastal Lowland LA*n* and Central Horton Plain LA*n* Ecoregions, but peat deposits are generally thin. Several major rivers (Horton, Hornaday, Brock) flow to the Beaufort Sea from the Melville Hills. Lakes and ponds are more common on the western plains than on the eastern uplands.

Vegetation

Nearly continuous vegetation covers much of the western plains and lowlands, with dwarf and low-shrub tundra on uplands and sedge – moss – shrub tundra in wet areas. On the uplands to the east, vegetation cover varies from continuous shrub tundra and tussock tundra at lower elevations to discontinuous dry dwarf-shrub tundra at higher elevations and on the highly calcareous soils of the Parry Peninsula and Cape Bathurst. Low areas and seepage zones support sedge – moss – shrub tundra. Scattered individual trees and locally extensive open spruce woodlands do occur in the southernmost part of the Ecoregion mainly on southerly and westerly slopes and along river valleys; refer to Appendix 4 for a more detailed discussion of treeline within the Southern Arctic.

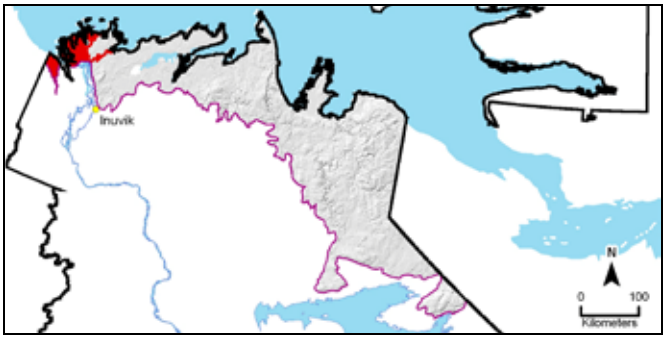
3.4.1 Mackenzie Delta LA*n* Ecoregion (ecoregion label 2.4.1.1)*

Overview: *The Mackenzie Delta LAn Ecoregion is a low, wet floodplain where fluvial and marine processes combine to produce a diverse wetland environment at the terminus of Canada's largest delta.*

Summary:

- Nearly level floodplain where silty riverborne sediments are deposited by the Mackenzie River and reworked by ocean waves, resulting in a mosaic of small ponds, stream channels and wetlands.
- Dominantly willow and sedge fens or tidal marshes.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 3,191 km^2 (2% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 0 (0 – 25).

General Description

The Mackenzie Delta LA*n* Ecoregion includes the northernmost part of Mackenzie River Delta, the largest delta in Canada. It is a nearly level floodplain with low, wet alluvial silts and clays, many shallow ponds and minor and major branches of the Mackenzie River. Shallow Bay divides the Ecoregion; areas near the shore of the Bay and coastlines of the Ecoregion adjacent to the Beaufort Sea are influenced by marine and freshwater processes and experience the full effects of oceanic climates. The Ecoregion includes several islands (Olivier Islands, Langley Island and Ellise Island) that are separated from the main Delta by brackish channels. A narrow eastern extension of the Ecoregion along the East Channel of the Mackenzie River to the mouth of Kugmallit Bay isolates the till and glaciofluvial plains of Richards Island Coastal Plain LA*n* Ecoregion from the mainland. Active fluvial processes (flooding, sediment deposition and reworking of the sediments by storm surges along the coastline) are characteristic of the entire Ecoregion and soils are typically calcium-rich; they are also saline in areas influenced by tides and storm surges. Trees are absent except along the southern boundary with the Taiga Plains Mackenzie Delta HS Ecoregion. Willow shrublands are dominant on slightly raised areas, with cottongrass, sedge and horsetail fens and coastal marshes in low areas.

Geology and Geomorphology

Flooding, ice scouring and wave action create a dynamic environment within the Ecoregion. Floods deposit silts and the deposits influence channel development. High water tables create a complex of shallow ponds and wetlands and storm surges or pack ice rework areas adjacent to the Beaufort Sea. Permafrost features such as low-centre polygons, drained lakes and pingos are scattered throughout the Ecoregion but are less common in this Ecoregion than in adjacent ecoregions, possibly because active fluvial and marine processes allow less development of such features.

Soils

Wet conditions and active processes limit soil development. Soils belong to the Shallow Bay association which is characterized by weakly to strongly calcareous fine-silty and fine-loamy alluvium and includes Regosolic Static Cryosols, Gleysolic Static Cryosols and Gleyed Cumulic Regosols (Anonymous 1986).

Vegetation

Flooding and deposition produce subtle drainage and moisture gradients that are indicated by plant community changes. On elevated areas (perhaps one to two metres above the water table), relatively tall willow shrublands develop, occasionally with balsam poplar along the southern fringes of the Ecoregion. Shorter willows, sedges, cottongrasses, reed bent-grass and horsetails occur on areas where the water table is close to the surface (sedge – moss – low-shrub and sedge – moss – dwarf-shrub wetlands described in Table 3, Section 1.5.1). Sedge – cottongrass – horsetail marshes with a few scattered willows dominate areas where the water table is at or above the surface. Tidal marshes and flats are sparsely vegetated by salt-tolerant plants such as alkali grass and are probably more extensive in this Ecoregion than in any other Ecoregion in the Southern Arctic because much of the Delta is at or just above sea level. Areas of active deposition, recent ice scouring or wave action are mostly unvegetated. A few stunted white spruce groves occur along the southern boundary. Kemper (2006) developed a community classification for part of this Ecoregion and the adjacent Richards Island Coastal Plain LA*n* Ecoregion.

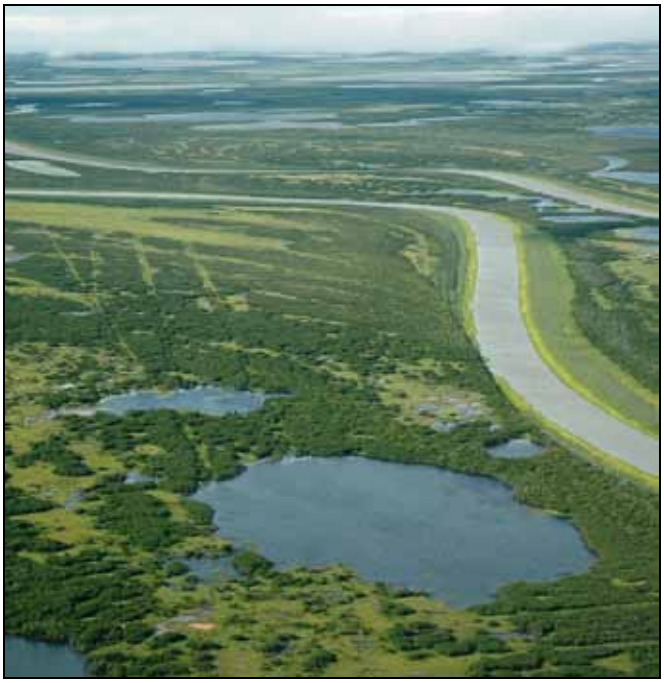
Water and Wetlands

Water and wetlands are definitive features of this Ecoregion. Ponds are less numerous in this Ecoregion than in the adjacent Mackenzie Delta HS Ecoregion, but marine influences are more prevalent. The Beaufort/Chukchi Seas Marine Ecoregion (Wilkinson *et al.* 2009) both influences and is influenced by the Mackenzie Delta LA*n* Ecoregion; nearshore waters have relatively low salinity because ocean waters are shallow and salinity is reduced by freshwater inputs from the Mackenzie River, pack ice and land-fast ice, but storm surges cause vegetation mortality. Sediments carried by the Mackenzie River make the nearshore waters turbid. Tidal ranges are small along the coast. There are numerous anastomosing channels near the Delta mouth; the largest named lakes are Coal Mine Lake (west of Shallow Bay), and Big and Kimialuk Lakes (east of Shallow Bay). Wetlands are extensive particularly in the areas surrounding Shallow Bay.

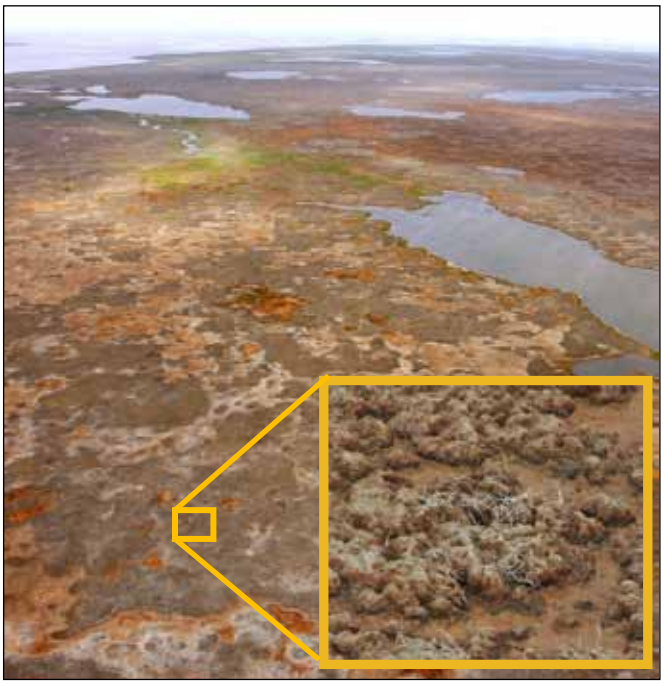
Notable Features

The Mackenzie Delta provides important wetland habitat for a variety of waterbirds, including more than 60,000 shorebirds. The Kendall Island Bird Sanctuary was created in 1961 to protect one of the three largest breeding colonies of Snow Geese in the western Arctic. During late August and September, the outer islands of this ecoregion are important staging areas for tens of thousands of Snow, White-fronted, Black Brant, Canada and Cackling Geese, and Tundra Swans.

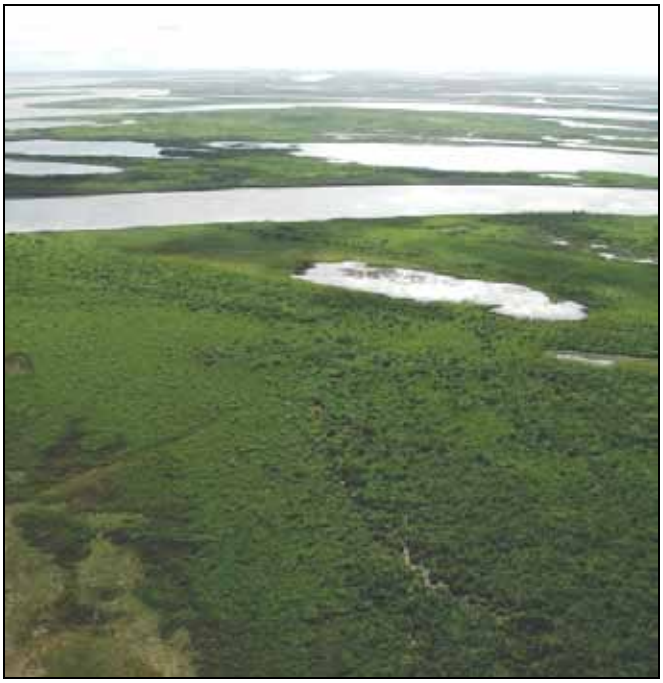
3.4.1 Mackenzie Delta LA*n* Ecoregion



Willow and sedge fens, many shallow ponds and stream channels are characteristic of the Mackenzie Delta LA*n* Ecoregion west of Shallow Bay. The cloud bank in the distance marks the approximate edge of Shallow Bay and the Beaufort Sea; fog and low cloud are relatively common in summer. Seismic lines for petroleum exploration (linear features) crisscross the Delta.



The mottled gray, brown and green tones are tidal mudflats with some vegetation development along the coastline of the Beaufort Sea on Langley Island east of Shallow Bay. The inset shows the bleached white branches of what were probably willows and the brown tones of dead sedge tussocks; storm surges that flood the outer reaches of the Delta with saline waters are largely responsible for plant mortality.



Further inland on Langley Island just north of Reindeer Channel, the muddy waters of the Mackenzie River deposit silts and clays; these provide wet, fertile sites on which freshwater willow, sedge and horsetail fens and marshes establish.

Tundra swans and many other migratory birds find suitable nesting and feeding habitat in the Ecoregion.

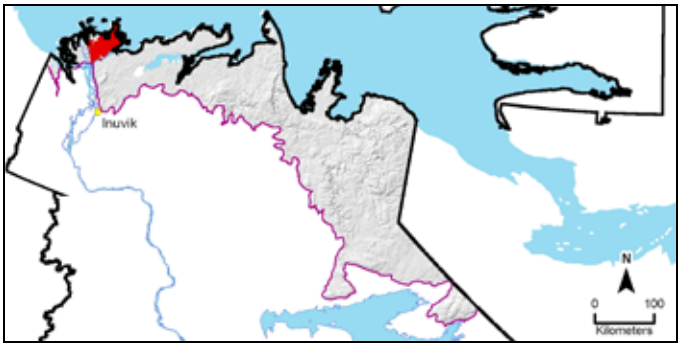
3.4.2 Richards Island Coastal Plain LA*n* Ecoregion (ecoregion label 2.4.1.2)*

Overview: *The Richards Island Coastal Plain LAn Ecoregion is a low-relief landscape with undulating to hummocky till and outwash deposits, numerous lakes and ponds, locally extensive pingos and mostly continuous tundra.*

Summary:

- Undulating to hummocky calcareous tills in the western two-thirds, with some outwash sands and gravels along the eastern coastline.
- Low-shrub tundra in the south, sedge – dwarf-shrub tundra in the north and sedge fens mainly on till materials.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 1,844 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 25 (0 – 70).

General Description

The Richards Island Coastal Plain LA*n* Ecoregion is separated from the mainland by an eastward extension of the Mackenzie Delta LA*n* Ecoregion. It is higher than the adjacent Mackenzie Delta LA*n* Ecoregion, reaching maximum elevations of 70 mASL and is not modified by fluvial or marine influences to nearly the same degree. The Ecoregion includes nine smaller islands collectively called the Outer Islands (Garry, Pelly, Hooper, Pullen, Reindeer, Summer, Hadwen and Hendrickson Islands and part of Kendall Island). Most of the Ecoregion is covered by fine-textured undulating to hummocky somewhat calcareous till deposits, but the central area is occupied by a lower-elevation marine plain and the eastern coastline and eastern islands are composed of sandy to gravelly outwash. There are many lakes and ponds; numerous pingos are associated with partly drained lake basins. Low-shrub and sedge – dwarf-shrub tundra form a continuous cover on the uplands, with sedge – moss fens on thin peats and minor tidal marsh and tidal flat areas in the lowlands.

Geology and Geomorphology

The Ecoregion was influenced by the most recent glaciation; both glacial and post-glacial processes have shaped the current landscape. Undulating to gently rolling fine-textured weakly to moderately calcareous tills cover about two-thirds of the area and include the smaller islands to the north and west of the Ecoregion. A central lower-lying area is a complex of lacustrine, glaciofluvial (Rampton 1988) and marine (Anonymous 1986) sediments. About 20 percent of the Ecoregion including the eastern coastline and the outlying eastern islands are nearly level glaciofluvial sands and gravels with thin till veneers and lacustrine pockets. Many large flow slides occur along sandy and silty coastal banks when ground ice thaws and there are fewer ponds and wetlands associated with this parent material than with either till or marine terrain (Anonymous 1986). Rampton (1988) notes the presence of eskers, kame and kettle complexes and extensive intertidal flats, the latter on the west side of the Ecoregion. Low- and high-centre polygons and ice-wedge polygons are common permafrost features. Mackay (1962) mapped over 100 pingos; they occur throughout the Ecoregion usually in association with drained lakes on tills.

Soils

Turbic Cryosols are associated with weakly to moderately calcareous fine clayey and fine loamy glacial till (Kittigazuit soil association) and marine clays (Naparotalik soil association). Static Cryosols are associated with sandy glaciofluvial materials where permafrost is deeper in the profile (Tibjak soil association) (Anonymous 1986).

Vegetation

Tundra cover is continuous except at the north end of the Ecoregion, where exposed soil occurs over about 20 percent of the area. Low-shrub tundra is dominant in the southern half of the Ecoregion on tills. On drier upland sites in the northern part, graminoid – prostrate dwarf-shrub – forb tundra is prevalent. Sedge – moss – low-shrub communities occur mainly on southern wetlands, often in association with drained lakes and low- and high-centre polygons. Wet sedge – moss – dwarf-shrub communities are more commonly found in the northern part of the Ecoregion, also in association with drained lakes and other low-lying areas. The general north to south trends in vegetation cover could reflect a climatic gradient where coastal influences such as wind and somewhat cooler temperatures might restrict the development of low-shrub tundra, which is more prevalent in southerly parts of the Tundra Plains. Sparsely vegetated tidal flats and tidal marshes are locally extensive on the west side of the Ecoregion. Kemper (2006) developed a community classification for part of this Ecoregion and the adjacent Mackenzie Delta LA*n* Ecoregion.

Water and Wetlands

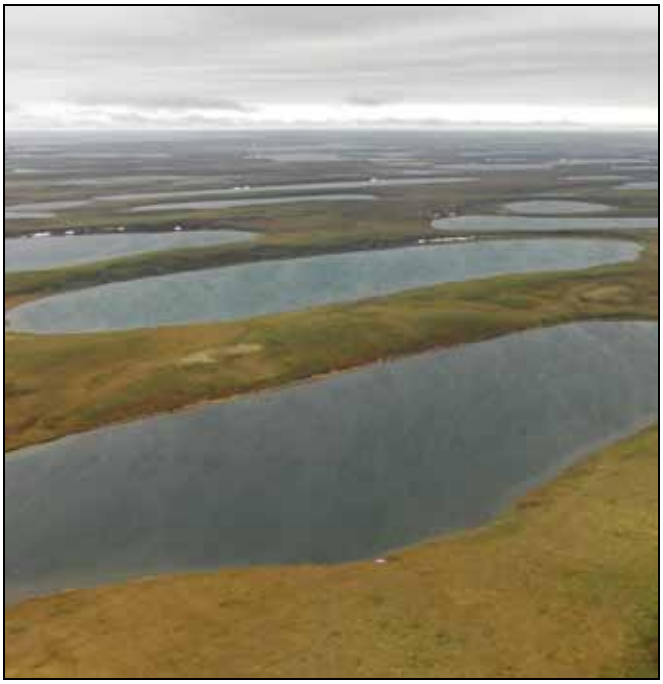
Pond and peatland distribution is determined by parent materials. Large, shallow lakes (Denis, Grassy, Pullen, Mid, Wolf and Willow Lakes) and thin peat deposits covering up to 25 percent of the landscape are associated with till materials. Smaller ponds, often with narrow sandy shorelines, are associated with glaciofluvial deposits and thin peat deposits cover less than about 10 percent of the landscape. Many of the lakes and ponds are partly drained and pingos have developed in some of the drained lake beds. The surrounding Beaufort/Chukchi Seas Marine Ecoregion (Wilkinson *et al.* 2009) would likely influence local climates in the northern part of the Ecoregion but except for local coastal erosion, would not influence landscape processes significantly compared to the low-lying adjacent Mackenzie Delta LA*n* Ecoregion.

Notable Features

Rampton (1988) cites evidence that warmer climates supported boreal forests on Richards Island and the Tuktoyaktuk Coastlands over 40,000 years ago before the last ice age. Mackay (1979, cited in Rampton 1988) indicated that the permafrost under Richards Island is at least 600 m thick and thins out to the south. A minor part of the Ecoregion lies within the Kendall Island Bird Sanctuary.

3.4.2 Richards Island Coastal Plain LA*n* Ecoregion

This image from the south end of the Ecoregion shows a gently undulating till landscape. In the right foreground, high-centre polygons and wet sedge- cottongrass tundra have developed in a shallow drained lake bed. The dark green dots are low shrubs (willows, dwarf birch). Taller shrubs grow along the streamcourse in the upper right.



There are differences in tundra cover between the south and north parts of the Ecoregion. This image from the northern portion shows a nearly continuous cover of sedge tundra with a few bare lighter coloured sandy patches. Low shrub growth is restricted to lower slopes and protected areas. The linear shape of many ponds indicates the direction of ice flow that molded the till into elongated forms.

Crumbling Point on Summer Island at the northeast extreme of the Ecoregion is well named. Silts and sands that formed the bottoms of glacial lakes fail when their icy permafrost cores thaw; the water saturates the soil and causes it to flow even on gentle slopes.

Caribou find suitable habitat on the sedge-dwarf-shrub tundra that dominates the northern half of the Ecoregion.

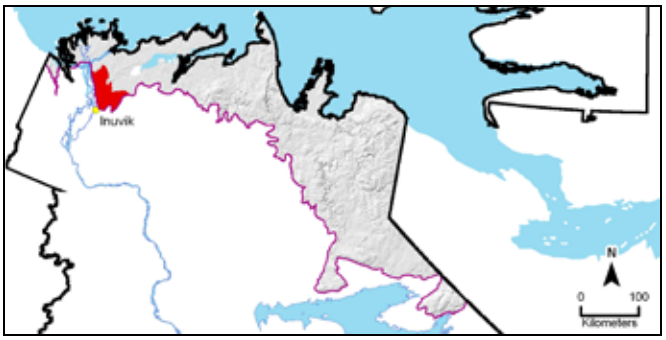
3.4.3 Caribou Hills LA*n* Ecoregion (ecoregion label 2.4.1.3)*

Overview: *The.Caribou Hills LAn Ecoregion is a range of till-covered hills with vegetation characteristic of milder Low Arctic climates.*

Summary:

- Thick till blankets over bedrock; rolling topography with few ponds in the north, hummocky topography in the south with higher pond density and pockets of lacustrine and glaciofluvial materials.
- Dominantly low-shrub and sedge tussock tundra, transitional to sparsely treed High Subarctic climates.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 2,266 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 125 (30 – 200).

General Description

The Caribou Hills LA*n* Ecoregion is a series of northwest to southeast trending hills that rise above the Mackenzie Delta HS (High Subarctic) Ecoregion to the west, the Tuktoyaktuk Coastal Plain LA*n* Ecoregion to the east and the lowlands of the Sitidgi Plain HS Ecoregion to the south. The western boundary with the Mackenzie Delta is clearly defined by a steep escarpment carved by numerous gullies. The Ecoregion is well-drained relative to surrounding areas; there are few ponds on the hill crests and slopes, but pond density is higher on wetter lowlands between the hills and along the eastern and southern boundaries. Fine-textured and moderately calcareous thick till blankets overlie shaly bedrock, with minor pockets of glaciofluvial and lacustrine materials. Tundra cover is continuous and dominated by low-shrub and sedge tussock communities. Earth hummocks are the dominant permafrost feature.

Geology and Geomorphology

Bedrock controls the overall topography of the Ecoregion and deeply gullied beds of sand, mudstone and coal are exposed along the escarpment that forms the western boundary. Most of the Ecoregion is blanketed by thick, clay to loam-textured moderately calcareous tills deposited by Laurentide glaciers about 13,000 years ago. These tills are well-drained and rolling with few ponds on the northernmost hills, grading to hummocky landscapes with more numerous ponds in the southern half. Fine-textured lacustrine deposits, coarser-textured glaciofluvial deposits and organic veneers occur in small pockets in lowlands between the hills and along the eastern boundary. Earth hummocks are a widespread permafrost feature within the Ecoregion and develop in clayey permafrost-affected soils (Tarnocai and Zoltai 1978). High-centre polygons are relatively common in drainages; pingos are uncommon and occur mainly on lowlands along the eastern boundary with the Tuktoyaktuk Coastal Plain LA*n* Ecoregion.

Soils

Turbic Cryosols are associated with weakly to moderately calcareous fine clayey and fine loamy glacial till (Kittigazuit soil association) and are the most extensive soil types. In lowlands to the north and east, Organic Cryosols form in local accumulations of peat (Kiktoreak soil association) (Anonymous 1986).

Vegetation

Vegetation patterns within the Ecoregion indicate a transitional Low Arctic to High Subarctic climate along its southern and southeastern boundary with the Sitidgi Plain HS Ecoregion of the Taiga Plains. White spruce groves characteristic of High Subarctic climates occur along lakeshores and southerly aspects near Eskimo Lakes and Noell Lake, increasing in size and density on the southerly slopes above Inuvik. The west-facing escarpment above the Mackenzie Delta supports dense spruce stands with tall willows and paper birch in sheltered gullies and tree line on the Delta lies north of the northern boundary of the Ecoregion. Low-shrub tundra, associated with milder Low Arctic climates, is prevalent on uplands in the southern half of the Ecoregion and in valleys and lowlands in the northern half. Tussock-sedge – dwarf-shrub – moss tundra is the most abundant tundra type on tills in the northern half and also occurs with low-shrub tundra in the southern half.

Water and Wetlands

Drainage patterns in the Ecoregion are linear or radial on slopes, reflecting the hilly topography. Radial drainage patterns[13] characterize the northern hills (North Storm Hills) on which there are only a few small ponds. Linear drainages are associated with hill slopes elsewhere; drainage patterns are less organized and ponds are more numerous in lowlands between the hills and adjacent to the Tuktoyaktuk Coastal Plain LA*n* Ecoregion. The largest named lakes are Noell and Jimmy Lakes in the south-central part of the Ecoregion; other named lakes include Wolverine, Peter, East Round, West Round and Bonnetplume Lakes and the westernmost arm of Eskimo Lakes. Wetlands are of limited local extent and occur mainly in stream drainages.

Notable Features

The deep gullies and exposed slopes of the escarpment between the Mackenzie Delta and the main part of the Ecoregion create diverse habitats ranging from dry grasslands and shrublands to dense, tall spruce and paper birch forests. The northern recorded limit of trembling aspen in the Northwest Territories is at 68°40' along this escarpment, approximately at the same latitude as Reindeer Station (Porsild and Cody 1980); there, it grows as a low shrub. This area was recommended for protection under the International Biological Program (Nettleship and Smith 1975).

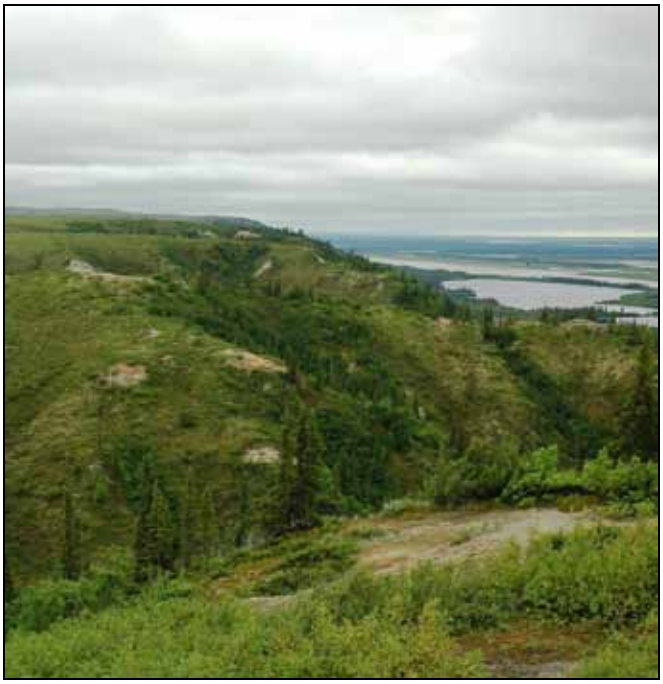
[13] Water drains away from the crest of a hill in several directions.

3.4.3 Caribou Hills LA*n* Ecoregion

Rolling till uplands are characteristic of the northern half of the Ecoregion, here showing the North Storm Hills. The polygonal patterns in the foreground are high-centre polygons that have formed over thousands of years in low, wet areas because of peat accumulation. The dominant vegetation on the surrounding uplands is sedge tussock tundra; both the tussocks and earth hummocks (mounds of earth forced up by permafrost) give a speckled appearance to the landscape.

The till deposits in the southern half of the Ecoregion have more local relief. Compare the hummocky appearance of this landscape east of Noell Lake and the higher frequency of small ponds to the relatively smooth rolling slopes of the hills in the image to the left. Vegetation is more variable as well, as indicated by mottled dark green (dwarf birch tundra), brown (sedge tussock tundra) and light green (sedge fen) tones.

Local patches of open white spruce woodland interspersed with dwarf birch tundra on lower-elevation southerly slopes south of Noell Lake occupy an area that is transitional between Low Arctic climates on the treeless uplands and High Subarctic climates on the adjacent Taiga Plains.



North of Inuvik, a steep escarpment over 100 m in height and about 60 km long separates the Low Arctic tundra uplands of the Ecoregion (upper left) from the sparsely treed High Subarctic Mackenzie Delta. Gullies and ridges create many different habitats, from dry grasslands and shrublands on the ridges to moist spruce and paper birch forests in the gullies.

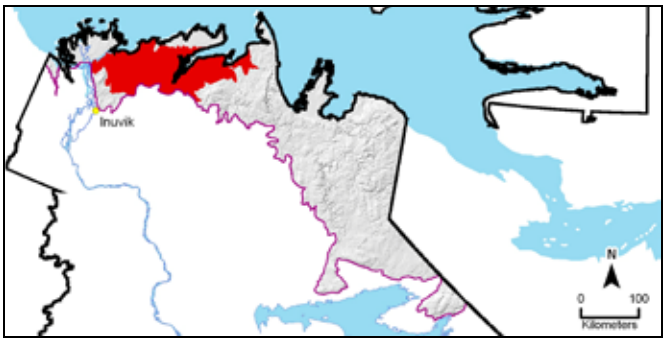
3.4.4 Tuktoyaktuk Coastal Plain LA*n* Ecoregion (ecoregion label 2.4.1.4)*

Overview: *The.Tuktoyaktuk Coastal Plain LAn Ecoregion, the largest ecoregion in the Southern Arctic, is a low-elevation till plain surrounding Eskimo Lakes and has continuous shrub and sedge tundra cover.*

Summary:

- Low elevation undulating to hummocky till plain divided by a low northeast-southwest trending ridge and Eskimo Lakes; numerous pingos, low-and high-centre polygons and ponds and high ice content in fine-textured sediments.
- Continuous shrub and sedge tundra; sedge wetlands more extensive north of Eskimo Lakes.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 14,816 km^2 (9% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 25 (0 – 80).

General Description

The Tuktoyaktuk Coastal Plain LA*n* Ecoregion is the largest Ecoregion in the Northwest Territories Southern Arctic. It is a low elevation predominantly till plain with numerous shallow ponds, wetlands and large lakes. A long, low-relief hill system composed of variably-textured tills and glaciofluvial sands and gravels runs northeast to southwest through the approximate centre of the Ecoregion. North of this hill system, till veneers on deep sands and complexes of till, fine-textured marine and lacustrine sediments occur in a belt about 30 to 40 km wide adjacent to the Beaufort Sea; pingos are very common and ponds and wetlands are extensive. South of this hill system lie the Eskimo Lakes, Liverpool Bay and a till-dominated, pond-studded landscape with pockets of outwash. Pingos are less common here than north of the hill system and wetlands are somewhat less extensive, but slope failures caused by permafrost thaws in fine-textured soils are more common. Low-shrub tundra forms a continuous cover on uplands across most of the Ecoregion, with sedge – low-shrub tundra in wetlands; the transition from Low Arctic to High Subarctic climates is indicated by the occurrence of stunted white spruce south of Eskimo Lakes. High ice content is characteristic of the permafrost in this Ecoregion. High-centre and low-centre polygons are common permafrost features throughout the Ecoregion and are most extensive in low-relief areas adjacent to the Beaufort Sea and Liverpool Bay.

Geology and Geomorphology

The Ecoregion was ice-covered during the last continental (Laurentide) glaciation and modern-day till, glaciolacustrine and glaciofluvial deposits have been strongly influenced by permafrost activity; many of the ponds have been created by thermokarst processes where underlying high ice-content permafrost has thawed. Because the Ecoregion is so large, it encompasses a wide range of landscape and permafrost features. These have been summarized above in the General Description and Rampton (1988, pp. 9-14) provides physiographic descriptions of 13 subunits occurring partly or wholly within the Ecoregion based on topographic and parent material characteristics. This Ecoregion and the adjacent Richards Island Coastal Plain LA*n* and Tuktoyaktuk Peninsula LA*n* Ecoregions have a very high density of pingos near the coastline (Mackay 1962). A striking feature of the Ecoregion is the series of fingerlike low-relief till peninsulas from 10 to 30 km in length that extend into Eskimo Lakes. Parallel glacial rivers that flowed underneath the ice along channels created by crevasses where two ice lobes met are thought to be the most likely origin of this feature (Rampton 1988).

Soils

Turbic Cryosols are the dominant soils on weakly to moderately calcareous fine clayey and fine loamy glacial till (Kittigazuit soil association). Static Cryosols are associated with well-drained glaciofluvial deposits (Tibjak soil association). Organic Cryosols occur with shallow peat deposits (Kiktoreak soil association) (Anonymous 1986) and are most extensive north of the northeast to southwest hill system indicated in the General Description.

Vegetation

Observed vegetation cover trends within the Ecoregion are related to parent materials and climate. Both low-shrub and erect dwarf-shrub tundra occur on uplands north of Eskimo Lakes and in the area between Rufus Lake and the coastline of Liverpool Bay; shrub components of the low-shrub tundra are willows and dwarf birches generally less than 50 cm in height, there are no trees and sedge – moss – low-shrub wetlands are extensive. South of Eskimo Lakes and Rufus Lake and east to the Mason River, low-shrub tundra is dominant and includes green alder, willows and dwarf birch. Alders and willows may exceed one metre in height and form dense thickets on slopes and alluvial flats. Sedge – moss – low-shrub wetlands are less extensive. Stunted white spruce five metres in height and about 100 years of age were noted during plot surveys in 2009 at about 69°27'N and 130°18'W; spruce groves become more common to the south within about 10 km of the Southern Arctic-Taiga Plains boundary. Tidal flats with sparse vegetation occur along the coast in a few places.

Water and Wetlands

Eskimo Lakes and Liverpool Bay are the dominant water features. Eskimo Lakes is divided into four main parts by the low till peninsulas discussed under the Geology and Geomorphology heading; water in the eastern lakes is brackish because of inflows from Liverpool Bay. Rufus, Kaglik, Urquhart and Parsons Lakes are other large lakes, all south of Eskimo Lakes. There are thousands of small ponds and lakes; many are shallow, but some occupy deep thermokarst depressions in glaciofluvial deposits. Kugaluk, Miner and Smoke Rivers are the main rivers and flow from the Anderson Uplands to the south. Wetlands are most extensive north of Eskimo Lakes.

Notable Features

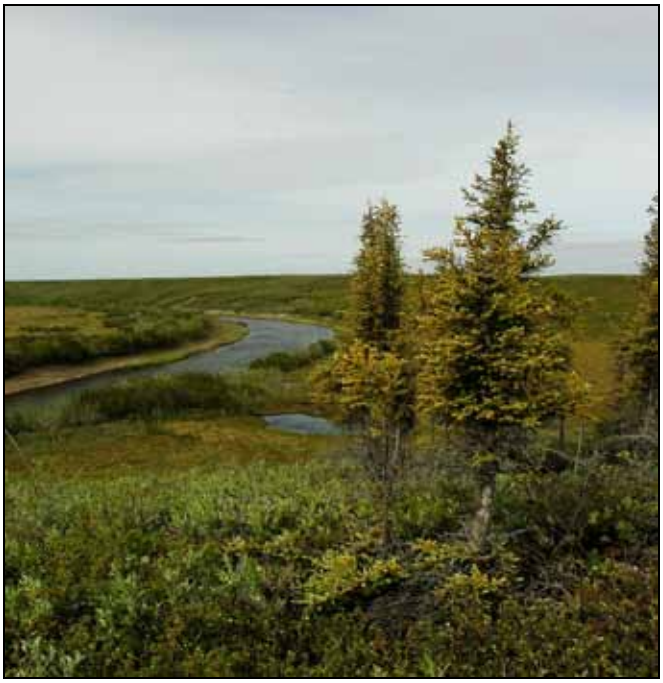
Nearly a quarter of the world's pingos occur in this and the adjoining Ecoregions. The Anderson River Delta Migratory Bird Sanctuary contains Brant and Snow Goose nesting colonies. It is also important for breeding and nonbreeding Tundra Swans, Greater White-fronted Geese and ducks. The Mason River Delta is of similar significance to waterfowl, and is a brood rearing area for Snow Geese from the Anderson River Delta. About 10 percent of the Canadian population of Black Brant nest in the Kugaluk–Moose- Smoke river Delta complex.

3.4.4 Tuktoyaktuk Coastal Plain LA*n* Ecoregion

This image shows a typical landscape within the Ecoregion and north of Eskimo Lakes. The small shrub-covered hill just to the right of centre is a pingo. It is surrounded by low-centre polygons and sedge – cottongrass wetlands in the bed of a drained lake. Uplands are a mix of low-shrub and sedge tundra.

South of Eskimo Lakes, undulating to hummocky till is typical. Continuous low-shrub tundra cover is characteristic of the southern Low Arctic and shows here as deep green tones. The polygonal patterns in the low areas are high-centre polygons; they have permafrost cores and deep organic deposits. A small grove of stunted white spruce is visible to the right of centre in the image.

The northeast- to southwest-trending low hills through the approximate centre of the Ecoregion were deposited by ice and glacial rivers. The pothole ponds with steep sides and the light-coloured sandy banks are typical of glacial outwash where blocks of glacial ice have thawed to produces deep, water-filled depressions.



The southernmost parts of the Ecoregion have a more moderate Low Arctic climate. A small grove of white spruce about five metres tall has established on a south facing slope above the Smoke River and tall willow-green alder shrub thickets grow along the river banks; both features indicate the influence of a somewhat milder southerly High Subarctic climatic regime.

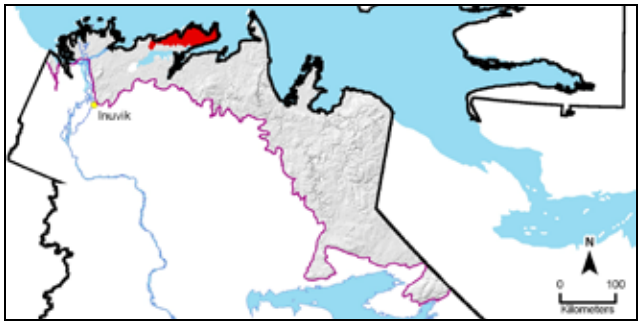
3.4.5 Tuktoyaktuk Peninsula Coastal Lowland LA*n* Ecoregion (ecoregion label 2.4.1.5)*

Overview: *The Tuktoyaktuk Peninsula Coastal Lowland LAn Ecoregion is a sandy low-relief coastal plain with extensive sedge wetlands and hundreds of shallow lakes.*

Summary:

- Low elevation level to gently undulating plain composed of glaciofluvial and eolian sands, pockets of lacustrine sands and silts and extensive high- and low-centre polygons.
- Sedge – dwarf-shrub wetlands are dominant, with sedge – dwarf-shrub tundra on the uplands.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 2,550 km^2 (2% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 5 (0 – 20).

General Description

The Tuktoyaktuk Peninsula Coastal Lowland LA*n* Ecoregion is a low-relief sandy plain nearly at sea level. It is bordered to the south by Liverpool Bay and the low sandy hills of the Tuktoyaktuk Coastal Plain LA*n* Ecoregion and to the north and east by the Beaufort Sea. The Ecoregion was unglaciated during the most recent glacial period, but outwash from the glaciers was deposited when sea levels were lower and has been reworked by wind and water. Glaciofluvial sands cover about 30 percent of the Ecoregion west and south of McKinley Bay; hundreds of small ponds formed by thawing permafrost and several large, shallow lakes are associated with this parent material. East of McKinley Bay, windblown sands form plains and dune fields, pockets of finer-grained materials occupy old lake beds and hundreds of shallow thermokarst lakes have developed. Rising sea levels over the last few thousand years have flooded large areas and produced extensive intertidal flats along the northern coastline. Wetlands are more extensive in this Ecoregion than in any other Ecoregion in the Southern Arctic; the dominant vegetation is sedge – dwarf-shrub fen, with sedge – dwarf-shrub tundra on the uplands. Low- and high-centre polygons are extensive and dominant permafrost features and pingos are common between McKinley Bay and Russell Inlet.

Geology and Geomorphology

The maximum local extent of the most recent (Laurentide) glaciation is believed to have reached the southern boundary of the Ecoregion; glacial meltwaters flowing from its terminus deposited sands west and south of McKinley Bay. Earlier Wisconsinan glacial events deposited fine outwash sands east of McKinley Bay. Wind has subsequently reworked these sands to produce extensive eolian sand plains, dune fields and oriented lakes; lacustrine deposits consisting of silts, sands and peat occupy drained lake basins. Rising sea levels since the last glaciation have inundated coastal areas and the low-elevation northern coastline is an intricate complex of sand spits, barrier bars, flooded lagoons and intertidal flats. The most extensive permafrost features are high- and low-centre polygons. Thermokarst lakes occupy shallow basins produced by thawing permafrost and pingos are locally common, but are not as numerous as in the adjacent Tuktoyaktuk Coastal Plain LA*n* Ecoregion. Retrogressive flow slides were not noted to occur within the Ecoregion (Mackay 1963), probably because of low ice content and minimal relief in the sandy deposits.

Soils

Organic Cryosols with mesic sedge and moss peats (Kiktoreak soil association) are dominant across the Ecoregion, accounting for approximately 80 percent of the area east of McKinley Bay and 60 percent of the area west of McKinley Bay. Uplands are weakly calcareous sands on which Static Cryosols with low ice content (Kidluit soil association) have developed (Anonymous 1986).

Vegetation

Tundra cover is continuous except for small areas where sand blowouts have occurred. The dominant community type is sedge – moss – dwarf-shrub wetland on poorly-drained sedge and moss peat soils. Erect dwarf-shrub tundra occupies well-drained sandy uplands. Tidal flats are sparsely vegetated, possibly due to harsh climates, excessive salinity and storm surges. This area is evidently more exposed to colder Low Arctic conditions than the adjacent Tuktoyaktuk Coastal Plain LA*n* Ecoregion because there are no trees or low - shrub tundra communities.

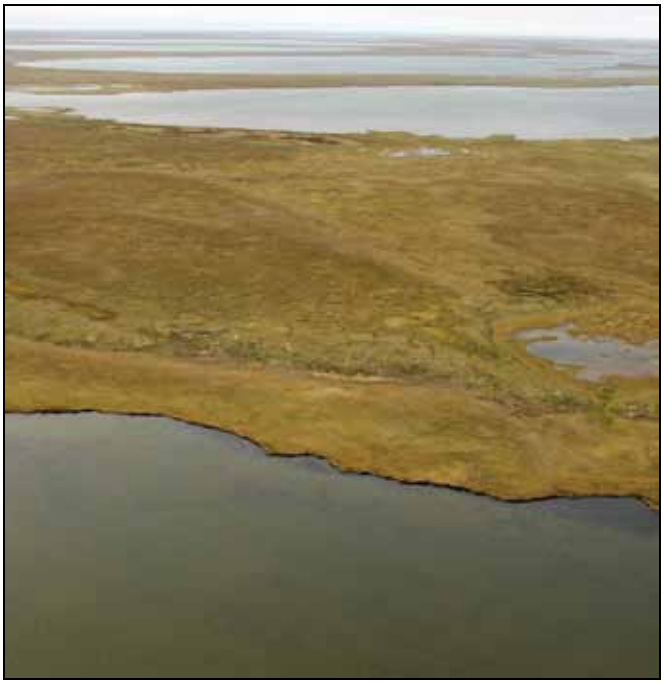
Water and Wetlands

There are numerous thermokarst lakes and ponds throughout the Ecoregion. The lakes range from one to five kilometres in size. Many are oriented in a north to south direction; prevailing east and west winds that preferentially erode the ends of the lakes are thought to be the cause (Côté and Burn 2002, Mackay 1958). Lakes are more numerous on the eolian plains east of McKinley Bay and wetlands are more extensive. The Ecoregion is surrounded by the Beaufort Sea and the Beaufort/Chukchi Seas Marine Ecoregion (Wilkinson *et al.* 2009); rising sea levels and storm surges along the north coast have produced lagoons, tidal flats and shallow brackish lakes.

Notable Features

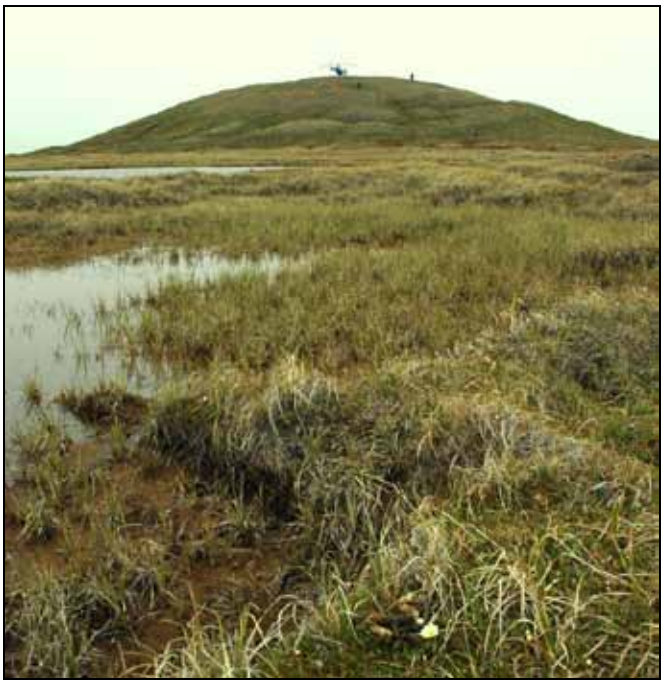
The extensive pre-glacial eolian landscapes and their associated oriented lakes, wetlands and tidal flats are unique within the Southern Arctic. Important moulting areas for tens of thousands of Snow, Greater White-fronted, Brant, Canada, and Cackling Geese occur along the sheltered and convoluted northwestern coastline of this Ecoregion.

3.4.5 Tuktoyaktuk Peninsula Coastal Lowland LA*n* Ecoregion

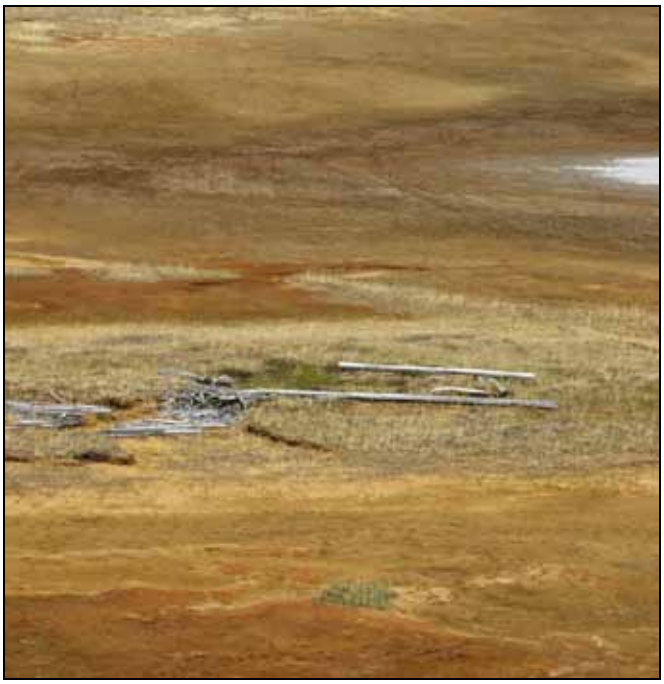


This landscape is typical of the interior eolian plains east of McKinley Bay and away from marine influences. The lakes are very shallow. There are a few slightly raised sandy uplands with sedge – dwarf-shrub tundra (centre of image) that are surrounded by low, wet peaty areas with sedge fens and patterned ground (low- and high-centre polygons). These areas provide good caribou habitat.

Along the northern coast, rising sea levels over the past several thousand years have flooded low-lying sandy areas and created brackish lagoons and tidal flats where there were once freshwater lakes. In this image, tidal flats appear as orange-brown areas (algae and other vascular and non-vascular salt-tolerant species) and low sandy uplands support sedge and dwarf-shrub tundra.



Sedge and cottongrass wetlands occupy low, poorly-drained areas. The image shows a low-angle view of a low-centre polygon, where the centres are occupied by water and sedges and the slightly higher rims (lower centre and right) are drier sedge – dwarf-shrub communities. A sandy ice-cored pingo about 20m high is in the background.



Even though the Ecoregion is far from the Mackenzie Delta, trees that floated down the Mackenzie River from boreal and subarctic regions have been transported by ocean waves and washed onshore by storm surges. These large weathered trunks lie on the east shore of McKinley Bay, nearly 200 km east of the Mackenzie Delta.

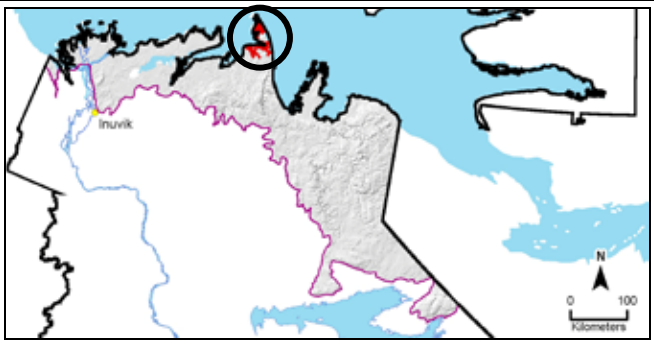
3.4.6 Cape Bathurst Coastal Plain LA*n* Ecoregion (ecoregion label 2.4.1.6)*

Overview: *The Cape Bathurst Coastal Plain LAn Ecoregion is a low-elevation landscape with river-carved terrain in the southern two-thirds and lake-dotted marine plains in the northern third.*

Summary:

- Low-relief alluvial and till plains in the southern third, alluvial and glaciofluvial deposits in the central third and marine clays in the northern third.
- Vegetation grades from low-shrub tundra in the south to dwarf-shrub tundra in the north.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 974 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 10 (0 – 40).

General Description

The Cape Bathurst Coastal Plain LA*n* Ecoregion, the most northerly Ecoregion on the mainland Northwest Territories, is a level to gently undulating plain separated by elevation and relief from the higher Bathurst Peninsula Upland LA*n* Ecoregion that borders it to the south. The Ecoregion includes two subunits. The southern two-thirds of the Ecoregion lies within the southern subunit and includes glaciofluvial and alluvial terraces along an abandoned course of the Horton River and marine lowlands adjacent to Harrowby Bay and an un-named estuary north of Maitland Point. The northern subunit covers the northern third of the Ecoregion including the Baillie Islands and is a flat marine plain with several large, shallow lakes. Dwarf-shrub tundra and sedge tundra are the most extensive tundra types on uplands; sedge – dwarf-shrub wetlands are associated with lowland poorly-drained areas in the southern subunit and are the dominant cover in the northern subunit. High- and low-centre polygons and ice-wedge polygons are dominant permafrost features throughout the Ecoregion and significant areas of bare soil occur in the northern subunit as a result of permafrost activity (frost heaving) in colder environments.

Geology and Geomorphology

The Ecoregion was unglaciated during the most recent glacial period. In the southern subunit, glacial rivers flowed down the meltwater valley now occupied by relic oxbows of the Horton River and deposited sands and gravels along the valley floor and sides (Rampton, 1988 p. 63). The marine clays and silts of the northern subunit were deposited in shallow seas that flooded the area in Pleistocene times. These sediments have a high ice content; thawing permafrost has created large, shallow thermokarst lakes, extensive areas of bare soil occur where frost heaving pushes fine-textured soils upward (earth hummocks) and ice layers and wedges are exposed along the coastline where thawing and wave erosion cause large blocks of soil to slump. Mammoth tusks and teeth have been found on the beaches below these wave-cut bluffs (Mackay 1958 p. 25). Tidal flats are a locally extensive component of the southern subunit along Harrowby Bay and at the mouth of the un-named estuary to the south of it. High- and low-centre polygons are a dominant landscape feature and low-centre polygons are often arrayed in striking gridlike patterns especially in the northern subunit.

Soils

Turbic Cryosols have developed in moderately calcareous marine deposits and weakly calcareous till and alluvial deposits in the northern and southern subunits, respectively (Anonymous 1986). Static Cryosols are likely associated with glaciofluvial and alluvial sands in the southern subunit and Organic Cryosols with low, wet areas across the Ecoregion.

Vegetation

Vegetation gradients from south to north probably indicate the increasing influence of the surrounding Beaufort Sea on climates of the central and northern subunits. Across the southern subunit low-shrub tundra and sedge – low-shrub wetland occur on moist and wet sites respectively and erect dwarf-shrub tundra is associated with drier areas. In the northern subunit, sedge – moss – dwarf-shrub wetlands occur extensively with low-centre polygons. Tussock-sedge – dwarf-shrub – moss tundra and erect dwarf-shrub tundra occur on moist to dry uplands, respectively and low-shrub tundra is absent, likely reflecting a trend to colder climates. Frost heaving of fine-textured marine materials in the northern subunit also produces locally extensive areas of bare ground.

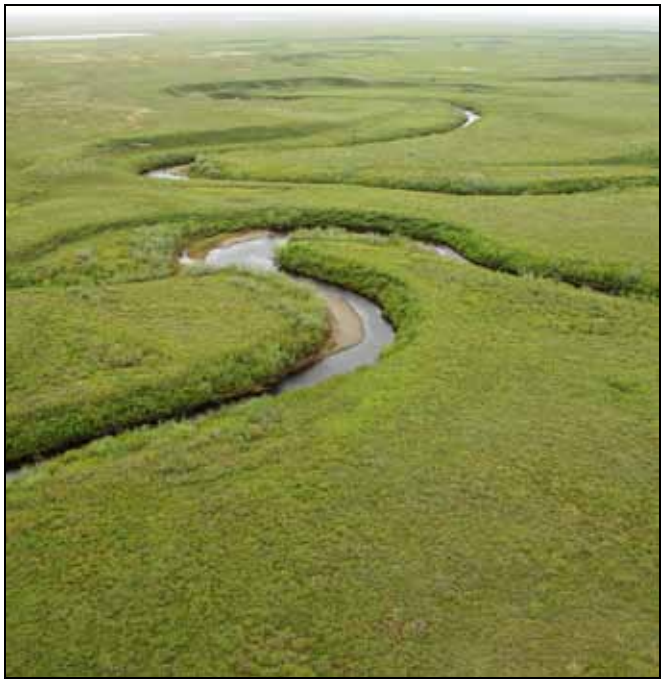
Water and Wetlands

The Horton River once flowed into Harrowby Bay, but sometime prior to 1826 it carved a new channel and now discharges into Darnley Bay (Mackay 1958); relict oxbow lakes and wetlands occupy the present-day valley. A few large, shallow oriented lakes occur in the northern subunit. The Beaufort/Chukchi Seas Marine Ecoregion (Wilkinson *et al.* 2009) surrounds the northern subunit and a major polynya (year-round open-water area) occurs in the vicinity of Cape Bathurst; beluga whales and other marine mammals rely upon this feature when pack ice is solidly frozen to shorelines in winter.

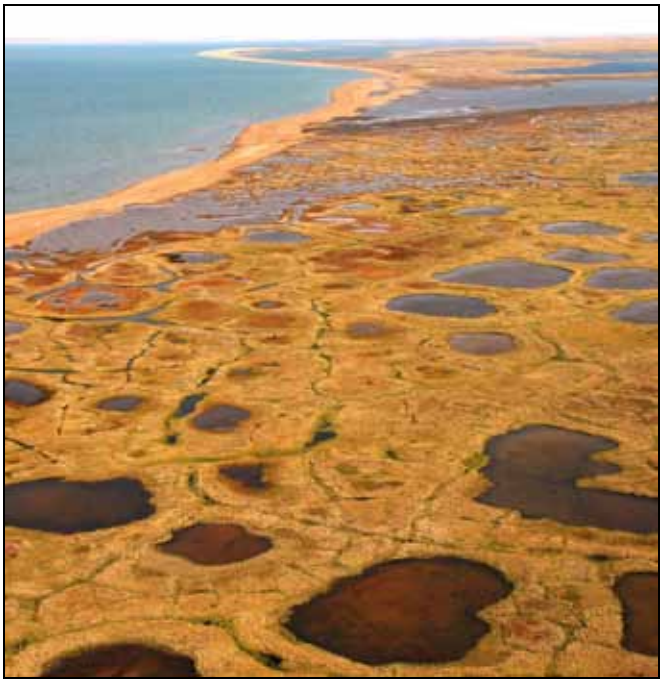
Notable Features

Harrowby Bay and the Old Horton Channel that formerly flowed into it provide moulting habitat for up to 10 percent of the Short-grass Prairie Population of Canada Geese, about two percent of the Mid-continent Population of Greater White-fronted Geese, and thousands of long-tailed Ducks (Latour *et al.* 2006). *Braya pilosa* (hairy rock cress) is endemic and is only known globally from this locale.

3.4.6 Cape Bathurst Coastal Plain LA*n* Ecoregion



Low-shrub tundra along a tributary of the Mason River lends a bright green tone to the landscape in the southernmost part of the Ecoregion and indicates the influence of a milder Low Arctic climate.



Along the southern shores of Harrowby Bay, tidal flats and low-centre polygons produce a complex of shallow freshwater to brackish ponds, sandy spits and salt-tolerant wetland communities. These areas provide important waterfowl habitat.

Permafrost activity - ice expansion and contraction in fractures - produces patterns that are sometimes strikingly regular. The features in this image are low-centre polygons with shallow ponds (algae and organic matter lend a brownish tone) and green sedge wetlands surrounding them. The permafrost features and vegetation indicate that the climate in this part of the Ecoregion is somewhat colder than in the southern part where they do not occur as extensively.

This south-looking view shows the northern tip of Baillie Islands, the farthest north point on the Northwest Territories mainland. The headlands are actively eroding as underlying permafrost thaws (white ice lenses in right-hand inset image), waves undercut the bank, and salt spray from storm surges kills the bankside vegetation (left-hand inset image [*photo credit: Suzanne Carrière*]).

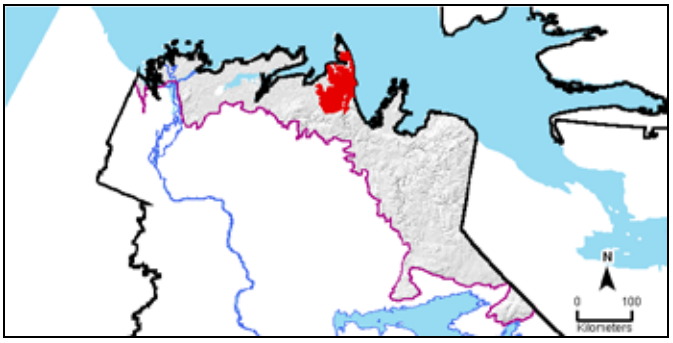
3.4.7 Bathurst Peninsula Upland LA*n* Ecoregion (ecoregion label 2.4.1.7)*

Overview: *The Bathurst Peninsula Upland LAn Ecoregion is a sloping, undulating to rolling till and colluvial plain with few lakes and a large glacial meltwater valley.*

Summary:

- Fine-textured tills and colluvium, large meltwater channel occupied by present-day Horton River and extensive glaciofluvial deposits.
- Low-shrub and sedge tussock tundra in south, dwarf-shrub tundra in north.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 4,257 km^2 (3% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 50 (40 – 160).

General Description

The Bathurst Peninsula Upland LA*n* Ecoregion is a sloping, undulating to gently rolling till and colluvial plain bordered by the steep plateau foreslopes of the North Horton Plateau LA*n* Ecoregion to the south, a major valley in the Anderson Upland LA*n* to the southwest and the low-elevation Cape Bathurst Coastal Plain LA*n* Ecoregion to the west and north. The northern half and the southeastern quadrant of the Ecoregion were unglaciated during the last glacial period; till blankets cover the southwestern quadrant. Numerous ponds are associated with the till deposits, but lakes are largely absent from the more weathered colluvium on unglaciated areas. The Horton River and glacial meltwaters have carved a deep, wide valley along the eastern side; the valley is filled with glaciofluvial and recent alluvial silts, sands and gravels. Burning coalbeds on scarps along the east coast are a well-known feature. Tundra cover is continuous and is dominated by tussock sedge and low-shrub tundra in the south with sedge and dwarf-shrub tundra in the northern third. Permafrost features (high- and low-centre polygons, ice-wedge polygons) are common and widespread.

Geology and Geomorphology

The Ecoregion is mostly underlain by light-coloured Cretaceous shales and mudstones that are easily erodable and in places, contain a significant quantity of bituminous coal. Burning coal seams are exposed along the northeastern coastline of the Ecoregion (the Smoking Hills); brightly multicoloured burned shales in other locations along the coast and on valley slopes above the Horton River indicate areas where similar combustion might have occurred in the past. Erosion of the shales has in places created spectacular badlands on the valley sides. Glaciers advanced as far as the southwestern quadrant of the Ecoregion in the last continental glaciation, leaving behind fine-textured till blankets and veneers derived from the shales and numerous lakes. The remainder of the Ecoregion was not glaciated at that time and erosion over long periods has produced gently undulating colluvial uplands with integrated drainages; sediments eroded from the uplands have filled in most of the lakes. A large glacial river carved the deep valley occupied by the Horton River and left behind thick glaciofluvial deposits that have subsequently been cut and reworked. Some time before 1826, the Horton River broke through a thin bedrock barrier, established a new outlet and built a delta into Franklin Bay; the old channel is now occupied by several long, shallow oxbow lakes connected by a small underfit stream.

Soils

Turbic Cryosols have developed in moderately acid to neutral, clay loam to sandy loam-textured till and colluvial materials on the uplands. Organic Cryosols have developed on thick peat deposits associated with high-centre polygons within infilled lake basins in colluvial areas and both low- and high-centre polygons in till-covered areas.

Vegetation

Vegetation gradients in this Ecoregion are comparable to those of the adjacent Cape Bathurst Coastal Plain LA*n* Ecoregion. From its southern boundary to the Mason River, low-shrub tundra and tussock-sedge – dwarf-shrub – moss tundra are the dominant cover types with sedge-low-shrub wetlands in wet lowlands. Tall (1-2 m) willow and green alder thickets occur on slopes in the far south along with a few stunted white spruce on south and west slopes that may have reached the area from more extensive groves along the Anderson River about 25 km to the west.[14] North of the Mason River, low-shrub tundra becomes less common and tussock-sedge – dwarf-shrub – moss tundra and erect dwarf-shrub tundra occur on moist to dry uplands. Towards Cape Bathurst, sedge – moss – dwarf-shrub wetlands associated with low-centre polygons become more common, low-shrub tundra is absent and erect dwarf-shrub tundra is prevalent on drier uplands often associated with ice-wedge polygons. Sulfurous fumes adjacent to burning coal seams along the coast have affected the vegetation inland of the coastline for several kilometres and only a few species can survive in scattered clumps within a few hundred metres of the coastal cliff edge.

Water and Wetlands

The Horton and Mason Rivers are the main watercourses within the Ecoregion. There are numerous lakes in the southwest quadrant and fewer elsewhere because of differences in parent materials discussed in the Geology and Geomorphology section. Wetlands are locally common in the Horton River valley but are isolated elsewhere, especially in unglaciated areas. The Beaufort/Chukchi Seas Marine Ecoregion (Wilkinson *et al.* 2009) lies adjacent to much of the Ecoregion.

Notable Features

This Ecoregion has a number of special features including burning coal seams and the Horton River valley floor, badlands and breakthrough. This is the main calving area for the Cape Bathurst Caribou herd.

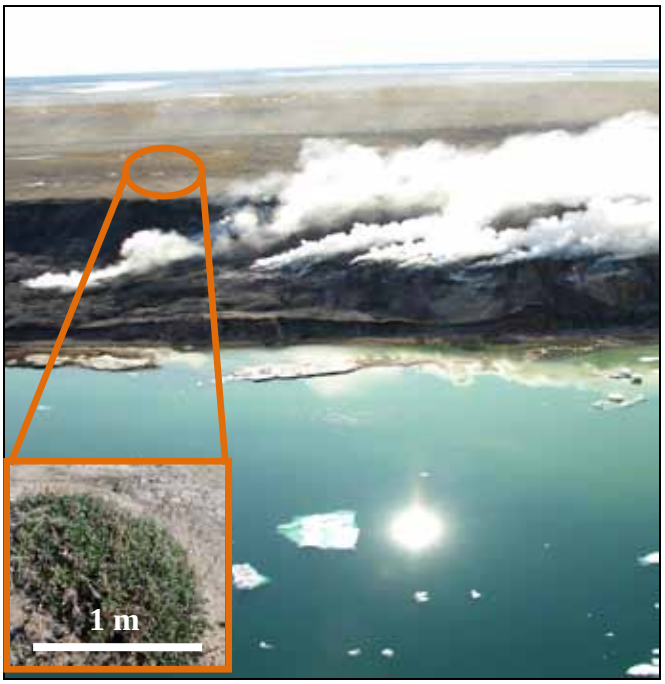
[14] Mackay (1958, p. 84) noted that "the country is difficult to traverse on foot because of the covering of scrub willows and ground birch".

3.4.7 Bathurst Peninsula Upland LA*n* Ecoregion

This low-relief landscape is typical of till-blanketed areas in the south-central and southwestern parts of the Ecoregion. Till hummocks with low-shrub and sedge tussock tundra are surrounded by peaty lowlands. The polygonal features in the lowlands are high-centre polygons, created by ice expansion in wedges under the polygonal cracks.

The north end of the Ecoregion is markedly different. This area was unglaciated by the most recent continental glaciers and was at one time the bottom of a Pleistocene sea. The climate is drier and colder than in the south. The grayish-brown areas are erect dwarf-shrub tundra with mountain avens and sedges on ice-wedge polygons; the green areas are sedge wetlands.

The Horton River cut through a thin coastal barrier about two centuries ago and created a new outflow into Darnley Bay; the present river channel, the new delta and the Beaufort Sea (note blue-white pack ice) are in the distance. In the foreground and midground is the former Horton River channel, now occupied by sedge wetlands and small ponds, and bordered by ice-fractured glaciofluvial terraces and light gray shaly valley walls.



Burning coal beds along the eastern coastline in the northern part of the Ecoregion are marked by a plume of smoke that is visible from long distances. Melting permafrost and wave erosion cause massive bank failures. Toxic sulfurous fumes severely limit plant growth as visible in the nearly barren area near the top of the bank; the inset photo shows one of the few plants that can grow here, a type of sage (*Artemisia Tilesii*).

3.4.8 Parry Peninsula Coastal Plain LA*n* Ecoregion (ecoregion label 2.4.1.8)*

Overview: *The Parry Peninsula Coastal Plain LAn Ecoregion is a dry bedrock-dominated undulating to rolling plain with thin, calcareous till veneers, small, shallow ponds and discontinuous tundra cover.*

Summary:

- Dolomite plain with thin, highly calcareous and stony till veneers; thicker till deposits in the southernmost part.
- Discontinuous dwarf-shrub tundra; wetlands occupy a minor area in the southern half and are mostly absent in the north.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.

Total area: 1,504 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 30 (10 – 80).

General Description

The Parry Peninsula Coastal Plain LA*n* Ecoregion is an undulating to rolling bedrock-controlled landscape with thin, stony and highly calcareous tills, small, shallow lakes, few wetlands and sparse tundra cover. It includes a jagged northern coastline with limestone cliffs, stacks and offshore islands, a central plain with numerous bedrock exposures and a southern sandy till belt. The adjacent Parry Peninsula Lowland LA*n* Ecoregion to the south has deeper till and outwash blankets that include larger lakes and wetlands and that support more continuous tundra. The sparse tundra development in the Ecoregion is similar in appearance to that which is characteristic of colder mid-Arctic climates on the Arctic Islands to the north; however, tundra development on the northern Parry Peninsula is inhibited more by the thin, highly calcareous soils than by climate. Permafrost features such as ice-wedge polygons are widespread in areas of deeper till and low- and high-centre polygons are associated with scattered wetlands.

Geology and Geomorphology

Paleozoic dolomites underlie the Ecoregion and are exposed at the surface in many places, forming high cliffs along the northern coastline. A discontinuous and highly calcareous stony till derived from glacial scouring of the bedrock during the last glaciation occurs across the northern two-thirds of the Ecoregion. Along the northern coastline, the presence of offshore islands, rock stacks and underwater shoals is evidence that lands formerly above sea level have been submerged (Mackay 1958). A thick till blanket about ten kilometres wide extends across the Ecoregion from east to west, forming its southern boundary; it includes kame deposits, end moraine, till drumlins and outwash. Narrow north- to south-trending end moraines extend north to about the centre of the Ecoregion. There are numerous permafrost features. Zoltai *et al.* (1979) noted the occurrence of both sorted and non-sorted circles; the sorted circles are characteristic of silty to fine-sandy soils in very cold climates. Ice-wedge polygons are common where the till is thick enough to allow such development; high- and low-centre polygons are associated with scattered wetlands.

Soils

Extremely calcareous fine-textured parent materials characterize this Ecoregion. Turbic Cryosols occur where till deposits are thick enough to support soil development. Static Cryosols are associated with thick, well-drained till and glaciofluvial deposits. Organic Cryosols are uncommon because the Ecoregion is dry and well-drained, restricting the extent of wetland development.

Vegetation

The deeply incised limestone headlands and peninsulas at the northern end of the Ecoregion are nearly barren; tundra cover is usually restricted to small areas where soil and water collect. This area and the thin, discontinuous till landscape to the south is called polar semi-desert by Zoltai *et al.* (1979). The dominant community type is prostrate dwarf-shrub – herb tundra and within the Northwest Territories portion of the Southern Arctic, its regional distribution is mostly restricted to the north half of the Parry Peninsula and upper elevations in the Melville Hills to the south (CAVM Team 2003). Zoltai *et al.* (1979) indicate that very high carbonate levels in till parent materials provide unfavourable conditions for plant growth on the Parry Peninsula. Continuous tundra (sedge – moss – dwarf-shrub wetland type) is restricted to wet, poorly-drained lowlands where it appears as green ribbons between the gray-toned uplands.

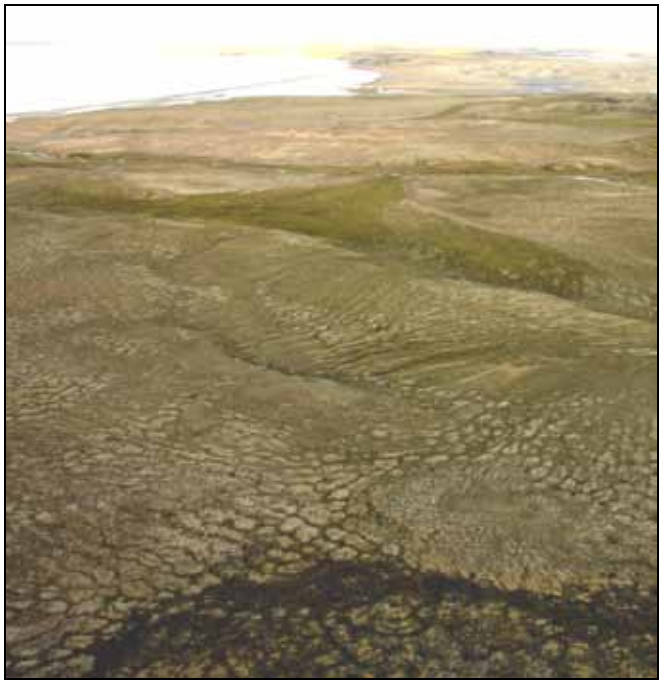
Water and Wetlands

Deep inlets and long, complex shorelines characterize the interface between this Ecoregion and the surrounding Beaufort/Chukchi Seas Marine Ecoregion (Wilkinson *et al.* 2009) in the northernmost third of the Ecoregion; coastal cliffs rise about 20 m above sea level. Several hundred small, shallow clear blue lakes and ponds occur on till and bedrock surfaces and there is no shoreline vegetation associated with most of them. One large un-named lake occurs just north of the till belt. There are no named rivers or streams. Wetlands occupy a minor area and almost all of them occur in the southern half of the Ecoregion.

Notable Features

The complex bedrock-controlled northern coastline with its deep inlets and narrow rocky peninsulas is a unique feature of this Ecoregion. The cliffs and offshore areas in the northern third of the Ecoregion are designated as an Important Bird Area. The Cape Parry Migratory Bird Sanctuary was created to protect the only Thick-billed Murre colony in the western Canadian Arctic. Lesser numbers of Common Murres and Black Guillemots are also found at the Cape, hundreds of kilometres from the nearest breeding colonies. Upwelling currents, open leads and polynyas provide a rich marine environment for seabirds and marine mammals (Latour *et al*. 2006).

3.4.8 Parry Peninsula Coastal Plain LA*n* Ecoregion



This image taken near the coastline of Darnley Bay is representative of the till-covered southern third. The small circular features are ice-wedge polygons; dwarf shrubs and sedges grow in the dark-coloured cracks and the light gray gravelly centres support very little vegetation. The brighter green area in the midground is a sedge fen in a lowland where sufficient water collects to allow the development of continuous tundra.

Layers of bedrock are exposed in low eroded cliffs along the western coastline. The till deposits here are very thin, there are few places for plants to take root and high carbonate levels and very dry conditions inhibit plant growth. The inset shows mountain avens (small white flowers at far right), sedges and lichens that are the most common plants in this area.

At the northern tip of the Ecoregion, dolomite cliffs rise 20 m or more from the Beaufort Sea; wave action over thousands of years has carved caverns (inset) and the ledges are home to nesting colonies of Thick-billed Murres.

Thick-billed Murres are found only in this locale in the Western Canadian Arctic, where the cliffs and the rich marine environment provide suitable habitat. The closest colonies in Alaska and Nunavut are more than 1300 km away.

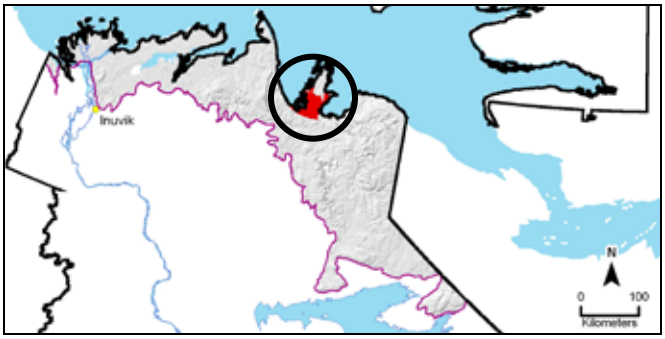
3.4.9 Parry Peninsula Lowland LA*n* Ecoregion (ecoregion label 2.4.1.9)*

Overview: *The Parry Peninsula Lowland LAn Ecoregion includes areas of continuous tundra and wetlands on level tills in the northern portion and discontinuous tundra on hummocky tills and outwash in the southern portion.*

Summary:

- Calcareous till veneers over ice-polished bedrock in the northern two- thirds, with hummocky tills and pitted outwash plains in the southern third.
- Continuous sedge – dwarf-shrub tundra and extensive wetlands in the northern two-thirds, with discontinuous tundra in the southern third.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 1,562 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 20 (0 – 160).

General Description

The Parry Peninsula Lowland LA*n* Ecoregion includes the southern half of the Parry Peninsula, bordered to the south by the plateau slopes of the Central Horton Plain LAn Ecoregion and to the north by the till belt that forms the southern boundary of the Parry Peninsula Coastal Plain LA*n* Ecoregion. It includes two subunits; the northern subunit occupies the northern two-thirds of the Ecoregion and is a low, flat plain with calcareous till veneers over bedrock and numerous relatively large, shallow lakes. The southern subunit includes the southern third of the Ecoregion and is composed of hummocky till and eroded glacial outwash plains; lakes are smaller and less numerous. Sedge – dwarf-shrub tundra is the dominant cover type in this Ecoregion and is more continuous than the dry patchy tundra characteristic of the Parry Peninsula Coastal Plain LA*n* Ecoregion to the north. Sedge fens and tidal flats are locally extensive, the latter in the Tom Cod and Langton Bay areas along the west side of the Ecoregion. High- and low-centre polygons and ice-wedge polygons are evidence of continuous permafrost and are more widespread in the southern subunit.

Geology and Geomorphology

Calcareous till veneers and blankets over Paleozoic dolomites characterize the northern subunit; ice-polished bedrock is exposed in a few places. The southern subunit is more complex. It includes a wide pitted sandy glacial outwash plain with many small lakes and hummocky till to the south; an irregular mostly low-relief ridge of hummocky till lies east of Tasseriuk Lake and forms the eastern boundary with the adjacent Darnley Bay Coastlands LA*n* Ecoregion. The nearshore areas of Langton and Tom Cod Bays on the Parry Peninsula subunit and the low-slope river deltas are subject to flooding during high tide and extensive tidal flats occur in these areas. Permafrost features such as high- and low-centre polygons and ice-wedge polygons are found throughout the Ecoregion but are more extensive in the southern subunit.

Soils

Turbic Cryosols occur on weakly acidic to neutral, sandy loam till veneers and blankets. Static Cryosols are associated with glaciofluvial sands and gravels. Organic Cryosols occur with high- and low-centre polygons where organic deposits are thick enough to allow their development.

Vegetation

The dominant vegetation type is graminoid – prostrate dwarf-shrub – forb tundra that is more or less continuous in the northern subunit, on thin tills over nearly level bedrock. Gravelly, windswept outwash plains, terraces and hummocky till deposits that characterize parts of the southern subunit are too well-drained and dry for continuous tundra and discontinuous prostrate dwarf-shrub – herb tundra is more commonly associated with these areas, often restricted to ice-wedge cracks or other sheltered microclimates. The Ecoregion is treeless and low-shrub tundra is uncommon. Erect dwarf-shrub tundra and graminoid – prostrate dwarf-shrub – forb tundra are associated with seepage slopes in meltwater channels and between eroded terraces. Wetlands are locally extensive in the northern subunit and between till and outwash uplands in the southern subunit; these areas support sedge – moss – dwarf-shrub communities. Alluvial and tidal flats support plant communities of variable composition that are adapted to various degrees of flooding and salinity.

Water and Wetlands

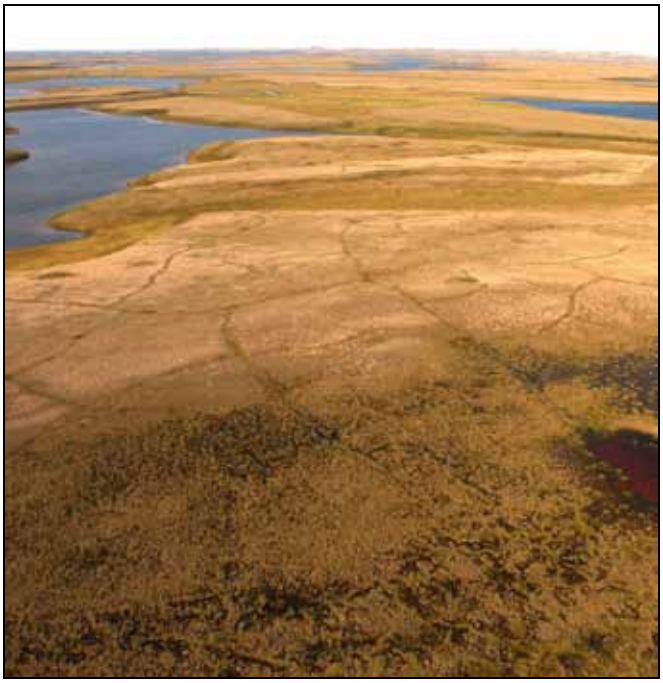
The northern subunit includes numerous large shallow lakes, of which the largest named waterbody is Tasseriuk Lake. Lakes in the southern subunit are associated with hummocky till and outwash and tend to be smaller but deeper. Streams have short reaches and poorly developed drainage patterns; the only named stream that traverses the Ecoregion is Foothills Creek. Wetlands are most extensive where flat terrain and high water tables promote the development of sedge fens with low-centre polygons; these conditions are most extensive in the northern subunit.

Notable Features

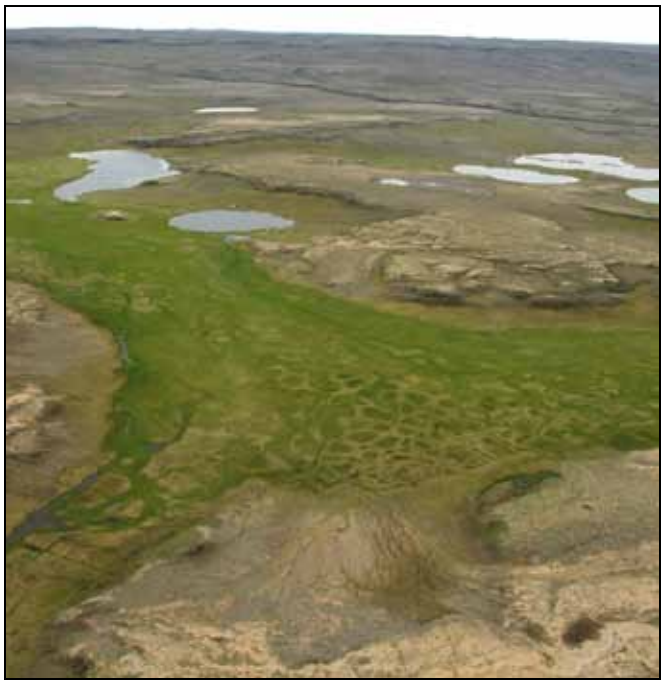
The extensive tidal flats and associated vegetation in Langton Bay and Tom Cod Bay provide valuable habitat for waterfowl and shorebirds. Both Mackay (1958) and Zoltai *et al.* (1979) note the presence of two large pingos west of Tasseriuk Lake as significant features.

3.4.9 Parry Peninsula Lowland LA*n* Ecoregion

The northern two-thirds of the Ecoregion is covered by thin till veneers, continuous upland tundra, shallow lakes and ponds and locally extensive wetlands. In this image, a low bedrock hill is visible (gray tones) in the lower left quadrant; it is surrounded by upland tundra and wetlands, the latter adjacent to a shallow pond.



The southern third of the Ecoregion includes both hummocky till deposited by glacial ice and pitted outwash deposited by glacial rivers. The landscape in this image west of Tasseriuk Lake is dominated by nearly level outwash terraces with discontinuous tundra; the large polygonal cracks are ice-wedge polygons. The lakes and ponds here are deeper than those in the northern part of the Ecoregion.



The lush green tones of sedge fens in wet depressions contrast starkly with the windswept, very dry hummocky till uplands that are characteristic of much of the southern third of the Ecoregion. The gridlike patterns in the foreground are low-centre polygons that form in wet areas over permafrost and represent the early stages of peatland formation.

Tom Cod Bay, shown here, and Langton Bay both have extensive tidal flats with a variety of habitats influenced by salinity and landscapes that are modified by tides and storm surges and over longer periods, by sea level changes. Barren sand flats (light brown tones in the foreground) are constantly affected by wind and water; somewhat more stable areas allow the development of salt-tolerant communities (dark greenish-brown tones in mid-image).

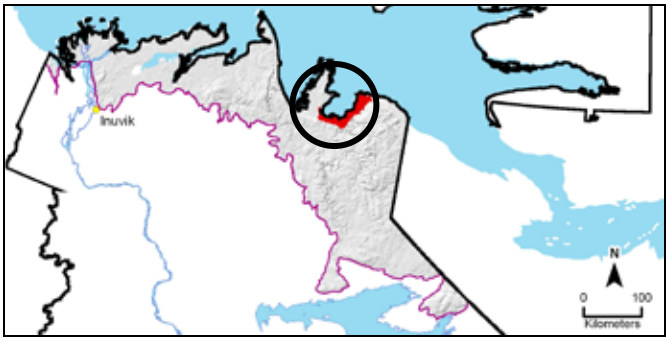
3.4.10 Darnley Bay Coastlands LA*n* Ecoregion (ecoregion label 2.4.1.10)*

Overview: *The Darnley Bay Coastlands LAn Ecoregion occupies a low-elevation belt between the Melville Hills and Darnley Bay and includes a variety of glacial and modern-day landforms and tundra vegetation types.*

Summary:

- A complex of till, glaciofluvial and fluvial deposits including drumlins, meltwater channels, active and inactive deltas, terraces and ancient beaches.
- A diverse array of continuous to discontinuous moist to dry tundra is produced by variable topography and parent materials.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 1,477 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 50 (0 – 200).

General Description

The Darnley Bay Coastlands LA*n* Ecoregion occupies a narrow belt 10 to 20 kilometres wide that includes level to hummocky lowlands between the plateau and hill slopes of three adjacent ecoregions to the south and Darnley Bay to the north. It extends east from the till ridge defining the eastern boundary of the Parry Peninsula Lowland LA*n* Ecoregion, continuing east and north to Cape Lyon. The Amundsen Coastlands LA*n* Ecoregion borders it to the east and has sparser vegetation cover associated with more discontinuous till deposits and larger areas of exposed bedrock. The Ecoregion is a complex of ridged and hummocky till, pitted glacial outwash plains, meltwater channels, modern alluvial and tidal deposits and ancient beach terraces. Sedge – dwarf-shrub tundra is the dominant cover type in this Ecoregion; tundra cover is typically more continuous than the dry patchy tundra characteristic of the Parry Peninsula Coastal Plain LA*n* Ecoregion to the north and east. Sedge fens and tidal flats can be locally extensive especially on the deltas of the Hornaday and Brock Rivers and lowlands adjacent to Darnley Bay. High winds especially in the Paulatuk – Argo Bay area limit plant growth on exposed areas. High- and low-centre polygons and ice-wedge polygons are common and are evidence of continuous permafrost.

Geology and Geomorphology

The Ecoregion includes a complex of bedrock types, mostly blanketed by glacial and fluvial deposits. The westernmost portion from Paulatuk to Argo Bay is underlain by Paleozoic dolomites and by a band of Cretaceous shales and silts with interbedded coal seams that extends east and northward parallel to the coastline. Proterozoic shales and siltstones underlie thin till deposits in the northeasternmost part of the Ecoregion (Balkwill and Yorath 1970; Okulitch 2000). A series of low-elevation flat gravel terraces and beaches were deposited in the southwest part of the Ecoregion along the base of the Melville Hills when sea levels were higher at some time in the past (Mackay 1958 p. 38); they are presently dry, eroded and sparsely vegetated. Narrow glacial meltwater channels run east to west between the Brock and Hornaday Rivers, flanked by gravelly, well-drained terraces. The area between the present-day Hornaday River and Argo Bay was the former Hornaday River channel (Mackay 1958 p. 85) and is now a complex of dry till and outwash uplands and wet lowlands. The northeast portion is characterized by lineated moraine (Veillette 2004, Mackay 1958); features include long, narrow till drumlins and ice-modified (crag and tail) bedrock both of which are oriented northeast to southwest. Both the Hornaday River and the Brock River have deposited large fan-shaped deltas that extend into Darnley Bay. Permafrost features such as high- and low-centre polygons and ice-wedge polygons are common throughout the Ecoregion.

Soils

Turbic Cryosols occur on weakly acidic to neutral, sandy loam to clay loam till veneers and blankets. Static Cryosols are associated with glaciofluvial sands and gravels. Organic Cryosols occur with high- and low-centre polygons where organic deposits are thick enough to allow their development. Regosolic soils are extensive on active lobes of the Brock and Hornaday River deltas.

Vegetation

A recent land cover classification (Fehr *et al.* 2006) for Tuktut Nogait National Park covers most of the Ecoregion and indicates that the main tundra cover for the area north of the Brock River including the lineated till features described previously is dry tundra (dryland sedges, other herbs, mountain avens and low-growing willows, comparable to the Circumpolar Arctic Vegetation Map graminoid – prostrate dwarf-shrub – forb tundra type [CAVM Team 2003]). South of the Brock River, Fehr *et al.* (2006) classify the area as a complex of mesic tundra (sedges, mountain avens and willows, comparable to the CAVM graminoid – prostrate dwarf-shrub – forb tundra type), tussock tundra (cottongrasses and sedges, comparable to the CAVM tussock-sedge – dwarf-shrub – moss tundra type) and shrub tundra (willows, arctic bearberry and mountain avens, comparable to the CAVM erect dwarf-shrub tundra type) on seepage slopes. Gravelly, windswept outwash plains, terraces and hummocky till deposits in this part of the Ecoregion are often too well-drained and dry for continuous tundra and discontinuous dry tundra is more commonly associated with these areas, where plant growth is often restricted to ice-wedge cracks or other sheltered microclimates. Alluvial and tidal flats support plant communities adapted to various degrees of flooding and salinity.

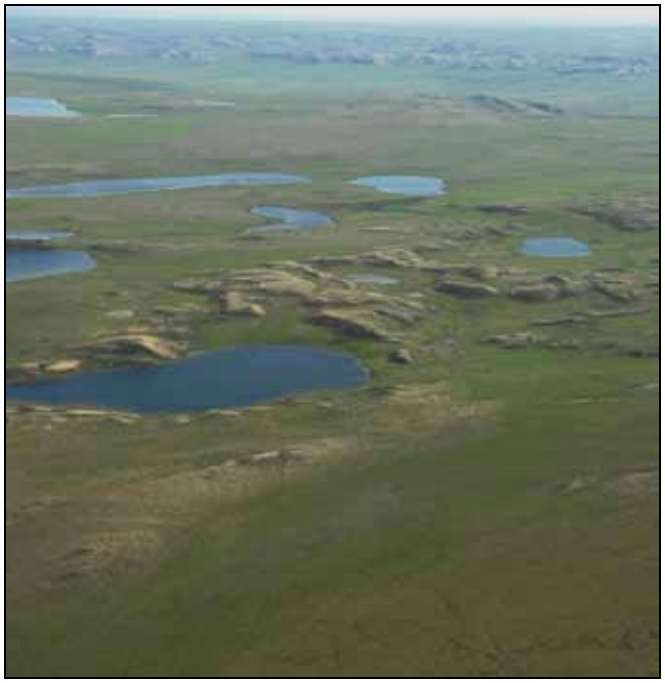
Water and Wetlands

There are only three named lakes (Moose, Reuben and Thrasher Lakes) and all occur in the westernmost part of the Ecoregion. Several long, linear lakes occur in the northeastern third and are associated with the lineated moraine features described previously. The lower reaches of the Hornaday and Brock Rivers cross the Ecoregion east of Paulatuk and terminate in broad, active deltas that grade into tidal flats. First and Second Creeks cross east to west between the Brock and Hornaday Rivers and occupy glacial meltwater channels. Wetlands are locally extensive in lowlands, mainly west of the Brock River. Darnley Bay is part of the Beaufort/Chukchi Seas Marine Ecoregion (Wilkinson *et al.* 2009).

Notable Features

The largest population of arctic char in the area, as well as other anadromous species such as Arctic lamprey, Arctic cisco, least cisco, inconnu and Arctic rainbow smelt occur in the lower Hornaday River. A stand of balsam poplar on the lower Hornaday River occurs well north of tree line (see facing page).

3.4.10 Darnley Bay Coastlands LA*n* Ecoregion



This landscape south of Paulatuk is typical of the western third of the Ecoregion and was once occupied by the Hornaday River. The raised areas are eroded gravelly till and outwash deposits that are sparsely vegetated by patchy dry tundra. The bright green areas are old channels that are moist to wet and support cottongrass and sedge tundra.

In the northern third of the Ecoregion, linear lakes and brownish-green sedge wetlands occupy lowlands between elongated till ridges formed when glacial ice flowed from northeast to southwest. The grayish tones on the till uplands are dry tundra; the polygonal patterns are ice-wedge polygons formed by permafrost.

The narrow channel of First Creek flows through a broad U-shaped valley that is well vegetated by tussock tundra, low-shrub tundra and sedge wetlands and occupied by several shallow lakes. The present-day creek is too small to have produced such a wide valley; it was carved by the rushing waters of glacial meltwater rivers thousands of years ago.

Tree line lies well south of this Ecoregion, but on the warm lower south-facing sheltered slopes of the Hornaday River along the southern boundary, this stand of balsam poplar (light green) and tall willows (grayish-green) has established. Other features of interest in this area include large (1-2m) ironstone concretions along the river shore (inset).

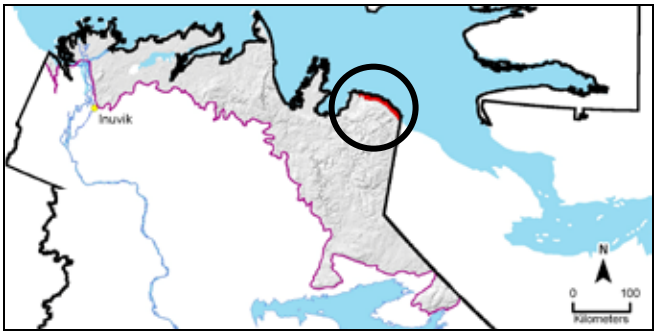
3.4.11 Amundsen Gulf Coastal Plain LA*n* Ecoregion (ecoregion label 2.4.1.11)*

Overview: *The.Amundsen Gulf Coastal Plain LAn Ecoregion is a dry gently sloping coastal landscape dominated by eroded bedrock in the western third and tills elsewhere; it is sparsely vegetated except on deeper tills, where more continuous dry tundra occurs.*

Summary:

- Precambrian dolomites and sandstones in the western third, with tills of varying thickness over bedrock elsewhere.
- Barren to sparsely vegetated landscape with dry tundra on deeper tills and outwash.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 704 km^2 (0.5% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 50 (0 – 160).

General Description

The Amundsen Gulf Coastal Plain LA*n* Ecoregion occupies a narrow linear belt about ten kilometres wide that includes level to gently sloping bedrock-controlled lowlands between the plateau and hill slopes of the East Melville Slopes LA*n* and West Melville Slopes LA*n* Ecoregions that border it to the south and Amundsen Gulf to the north. It extends east and south from the lineated morainic plains of the Darnley Bay Coastlands LA*n* to the Northwest Territories – Nunavut border and beyond. The western third of the Ecoregion is characterized by Precambrian dolomites and sandstones that often have pink to reddish hues and are in places deeply eroded. Elsewhere, till veneers and blankets overlie bedrock in most places and are thickest in the vicinity of the Roscoe River where they were molded into linear features by flowing glacial ice in the last glacial period. Outwash sands and gravels also occur in the Roscoe River area and sandy to silty marine deposits occupy lowlands near the coast. Barren and sparsely vegetated landscapes cover about half of the Ecoregion; the other half is dry tundra. There are very few lakes and wetlands. Ice-wedge polygons and non-sorted circles and stripes are evidence of permafrost and are most readily evident on deep till.

Geology and Geomorphology

Deeply eroded Precambrian dolomites and quartz sandstones, often with striking pink to red colourations, are a characteristic feature of the western third of the Ecoregion; till deposits are generally thin, discontinuous and calcareous. Marine silts and sands form veneers and blankets on low-lying areas along the coastline where they form complexes with gravelly tills and bedrock. A few erosion-resistant Precambrian intrusive sills and dikes form some of the coastal headlands in the Pearce Point area near the western boundary. Calcareous gravelly till veneers and blankets overlie bedrock south towards the base of the Melville Hills and to the east of Keats Point. Deep till and outwash deposits occur from the Roscoe River area south to the Ecoregion boundary and beyond into Nunavut; linear lakes, elongated till drumlins and fluted bedrock indicate glacial ice movement in a northwest or southeast direction. Permafrost features occur where deposits are sufficiently deep over bedrock to allow their formation. Ice-wedge polygons and non-sorted circles and stripes are the most common features.

Soils

Regosols and non-soils are associated with thin tills and exposed bedrock. Where till deposits do occur, they are typically very strongly to extremely calcareous with neutral to alkaline pH values. Turbic Cryosols occur with deeper tills and outwash deposits.

Vegetation

The dominant tundra type across this Ecoregion is prostrate dwarf-shrub – herb tundra (CAVM Team 2003). A recent land cover classification (Fehr *et al.* 2006) for Tuktut Nogait National Park includes all of this Ecoregion; under this classification, there are three extensive cover types. The rocky barrens type is scattered throughout, occupying between five and ten percent of the Ecoregion with the highest occurrence in the western third. It is characterized by very sparse plant cover (less than ten percent) dominated by mountain avens. The sparsely vegetated ground type occupies about half of the remaining area; dryland sedges, mountain avens and dwarf shrubs typically cover ten to 30 percent of the ground surface, with legumes in moister areas. The dry tundra type occupies the other half of the remaining area and has a similar floristic composition but higher plant cover (30 to 95 percent). The sparsely vegetated and dry tundra types are comparable to the CAVM prostrate dwarf-shrub – herb tundra type.

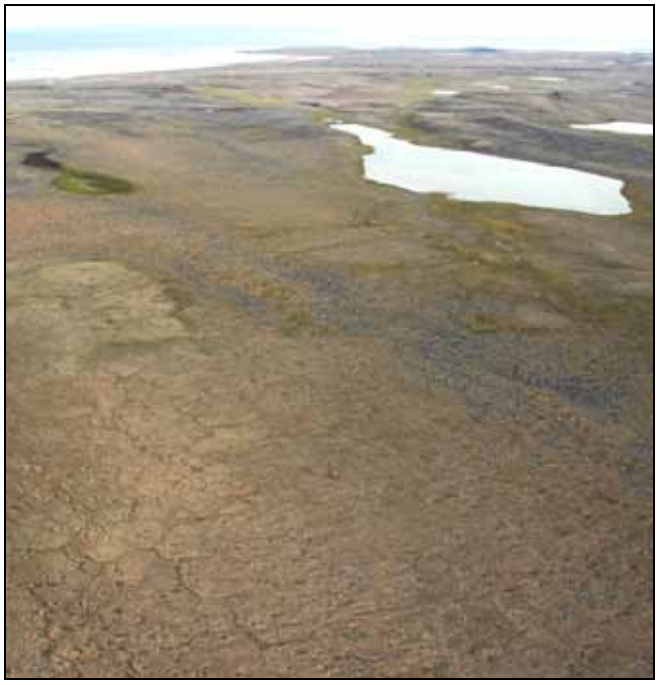
Water and Wetlands

There are no named lakes in the Ecoregion; lakes are small and sparsely distributed and some are elongated, confined by linear till and bedrock uplands that were modified by flowing glacial ice. The Roscoe River, the largest of three named rivers, flows through the Ecoregion from the East Melville Slopes LA*n* Ecoregion to the southwest. The other two named rivers are the Palgrave and Outwash Rivers that parallel the Roscoe River to the north and south respectively. Wetlands are scattered and restricted to channels and lowlands. The Amundsen Gulf borders the Ecoregion and is part of the Beaufort/Chukchi Seas Marine Ecoregion (Wilkinson *et al.* 2009).

Notable Features

The eroded coastal bedrock plains in the western third are unique geologic features. The Pearce Point area is locally important because the rocky headlands provide nesting habitat for the tundra subspecies of peregrine falcon and for golden eagles. It has also been the site of a long term small mammal research program.

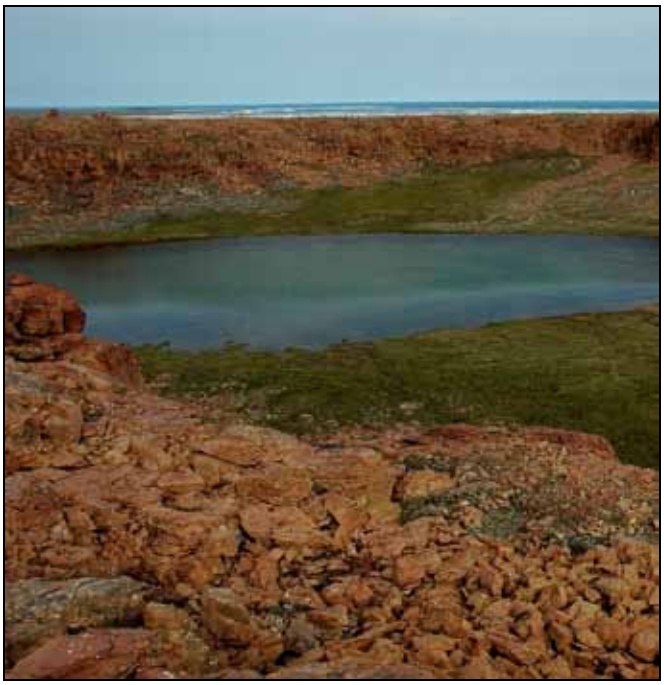
3.4.11 Amundsen Gulf Coastal Plain LA*n* Ecoregion



This landscape is typical of the northern coastlands, where thin tills, exposed bedrock and harsh, windy Arctic climates limit vegetation growth on the gray-toned uplands to patchy dry tundra. In lowlands where there are finer materials and sufficient water, small sedge and cottongrass wetlands can establish.

The Roscoe River cuts deeply into Precambrian limestones and sandstones along rock fractures. The nearly level areas in the foreground and on the left side of the image are river terraces deposited thousands of years ago by a much larger glacial river.

South of Keats Point, weathering over thousands of years has enlarged fractures in pink to reddish Precambrian dolomites and created spectacular terrain. Shallow ponds and sedge-cottongrass tundra occupy the fractures, but very little can grow on the extremely calcareous, exposed and dry bedrock uplands.



A ground view of the landscape to the left shows the influence of slope position and bedrock on vegetation growth. The frost-shattered dolomites in the foreground support only lichens and patchy tundra (mostly mountain avens and dwarf willows, here appearing as grayish patches in the lower right of the image). Seepage areas and finer calcium-rich soils on lower slopes support continuous cottongrass and sedge tundra.

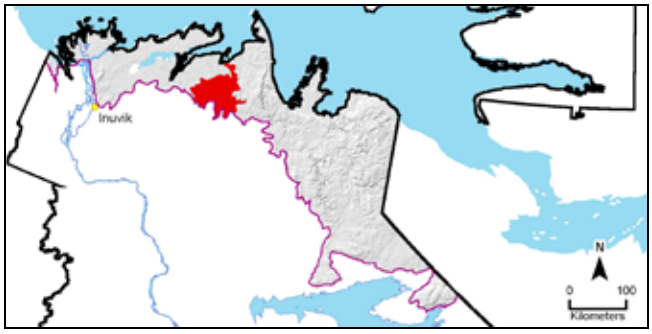
3.4.12 Anderson Upland LA*n* Ecoregion (ecoregion label 2.4.1.12)*

Overview: *The Anderson Upland LAn Ecoregion includes a rolling to hummocky central highland and sideslopes; tundra cover is continuous and trees are relatively common along the Anderson River.*

Summary:

- Central till highland with weathered tills and few lakes and extensive fluvial and glaciofluvial deposits along the Anderson River.
- Continuous low-shrub and tussock tundra, with open spruce groves at lower elevations in the southern third and along the Anderson River.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 4,196 km^2 (3% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 200 (60 – 350).

General Description

The Anderson Upland LA*n* Ecoregion is a northern continuation of the Taiga Plains Anderson Upland High Subarctic (HS) Ecoregion. It is composed of a central highland that reaches maximum elevations of about 350 mASL, surrounded by slopes to the north and west where it is bordered by the Tuktoyaktuk Coastal Plain LA*n* Ecoregion and to the east where the western edge of the Anderson River valley forms the eastern boundary of the Smoking Hills LA*n* Ecoregion. The central highland has pronounced rolling and hummocky terrain formed by old, weathered and rounded till deposits; it has only a few small lakes and well developed stream drainages both in the highlands and on the adjacent slopes. The slopes are blanketed by glacial tills and have a somewhat higher lake density. An extensive glaciofluvial and alluvial complex occurs along the Anderson River. The Ecoregion is characterized by continuous shrub and tussock tundra. Sparse white spruce woodlands with stunted trees occur occasionally on the highlands, with taller and denser woodlands on the sheltered valleys and well-drained terraces of the Anderson River and its tributaries, indicating the influence of both Low Arctic and somewhat milder High Subarctic climates. Permafrost features characteristic of cold Low Arctic climates such as ice-wedge polygons and high-centre polygons are uncommon.

Geology and Geomorphology

Cretaceous gray and black shales and hematites underlie most of the Ecoregion and are often exposed in river valleys, sometimes as colourful red-orange, yellow, gray and black outcrops and banks. The glacial history of the area has not been surveyed in detail; most of the area is covered with fine-textured, weakly calcareous tills, but the most recent continental glaciation might not have influenced part of this area and the Bathurst Peninsula to the north (Mackay 1958, cited in Zoltai *et al.* 1979). Support for this hypothesis is provided by Fulton (1995) who indicates that the central highland area is fine-grained colluvium and by aerial transects during the 2009 field season along which weathered till deposits with rounded features were noted. The broad Anderson River valley is occupied by a complex of eroded and actively failing valley slopes, recent fluvial terraces and older outwash terraces deposited by glacial rivers. Permafrost types that are associated with colder Low Arctic landscapes to the north, such as ice-wedge polygons and low- and high-centre polygons, are not common in this Ecoregion; a few occurrences of polygonal peat plateaus and earth hummocks are more typical of the Taiga Plains High Subarctic ecoregions to the south.

Soils

Turbic Cryosols are associated with weakly to moderately calcareous fine clayey and fine loamy glacial till (Kittigazuit soil association). In the northern and eastern portions of the Ecoregion where lake densities are higher and water tables are closer to the surface, Organic Cryosols form in local accumulations of peat with high- and low-centre polygons (Kiktoreak soil association) (Anonymous 1986).

Vegetation

Vegetation cover in the Ecoregion reflects both Low Arctic and High Subarctic climatic influences. Tundra cover is continuous. The main tundra types are erect dwarf-shrub tundra and low-shrub tundra with tall dwarf birch and willows as dominant species and tussock-sedge – dwarf-shrub – moss tundra. Small very sparsely treed stands of stunted white spruce less than five metres tall are scattered throughout the highlands. Warm, protected valley slopes and well-drained river terraces along the Anderson River to the northern boundary of the Ecoregion and along its tributaries support taller, denser woodlands; in the southern third of the Ecoregion at elevations below 150 mASL, tree growth can also be extensive. Appendix 4 discusses possible future modifications to the Southern Arctic – Taiga Plains boundary based on additional aerial information collected after 2005 when the northern boundary of the Taiga Plains was defined.

Water and Wetlands

The Anderson and Smoke Rivers are the only named watercourses. The Anderson River is confined to a relatively narrow, steep-walled valley in its course through the southern half of the Ecoregion, but has developed large meander loops and extensive fluvial terraces in the broad, flat valley through the northern half of the Ecoregion. Streams in the central highland and on the slopes surrounding it exhibit a dendritic form, reflecting the sloping nature of the Ecoregion. There are no named lakes. Lakes are small and widely scattered on the central highlands; lake density and wetland (high- and low-centre polygons and sedge – moss – low-shrub wetland tundra) occurrence increases to the northeast on more level terrain below the slopes.

Notable Features

The southern part of the Anderson River Delta Migratory Bird Sanctuary occurs in this Ecoregion; eight probable sightings of the almost extinct Eskimo Curlew were made along the Anderson River between 1961 and 1989 (Latour *et al.* 2006).

3.4.12 Anderson Upland LA*n* Ecoregion

The Ecoregion includes a rolling to hummocky central highland area with a few scattered pothole ponds. Continuous low-shrub tundra with dwarf birch and willows grows on fine-textured and weakly calcareous glacial tills; the yellowish-green vegetation in the foreground is tussock tundra composed of sedges and cottongrasses.

The smooth, weathered appearance of the rolling tills and meltwater valley walls in the southern part of the Ecoregion suggests that many thousands of years have probably passed since the tills were deposited by glacial ice and the meltwater valley was carved by glacial rivers. A few trees have established on a well-drained and relatively warm southeasterly slope; continuous low-shrub tundra grows within and adjacent to the valley.

Along the Anderson River, low elevations and protected, relatively warm and well-drained valley slopes and river terraces permit the development of locally extensive open white spruce woodlands and tall willow shrublands.

In some places along the Anderson River and its tributaries, exposed Cretaceous bedrock erodes to form badlands with very little vegetation and striking colour patterns. The dark gray to black bands are probably shale and coal layers; the pink and reddish-orange colours likely indicate the presence of iron oxides.

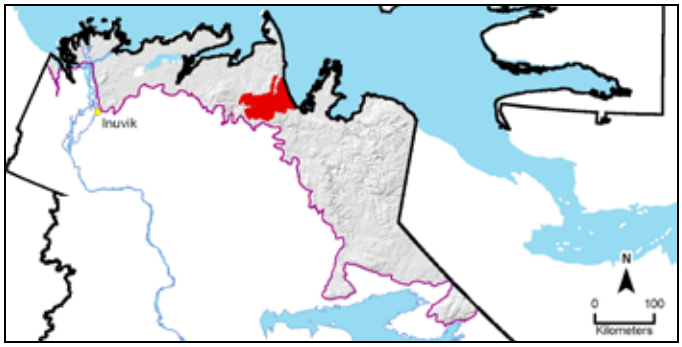
3.4.13 Smoking Hills LA*n* Ecoregion (ecoregion label 2.4.1.13)*

Overview: *The Smoking Hills LAn Ecoregion is a gently undulating unglaciated plateau with spectacular badlands, burning coal beds along the coast and continuous tundra.*

Summary:

- Colluvium and weathered till on unglaciated uplands with sparse lake distribution, deeply gullied plateau slopes with badland development, burning lignite beds.
- Continuous shrub and tussock tundra.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 3,326 km^2 (2% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 250 (160 – 320).

General Description

The Smoking Hills LA*n* Ecoregion is a level to gently undulating plateau with deeply dissected sideslopes that is elevated well above the adjacent Anderson River valley in the Anderson Upland LA*n* Ecoregion to the west, the lowlands of the Bathurst Peninsula Upland LA*n* Ecoregion to the north and Franklin Bay to the east. The slightly lower West Horton Plain LA*n* Ecoregion to the south is less eroded, has a somewhat higher lake density and is affected more by the combined influence of Low Arctic and High Subarctic climates. Cretaceous shales underlie most of the Ecoregion and erode to form extensive badlands especially to the northeast along both sides of the Horton River and to the west along the Anderson River. Small slope failures are locally common in badland areas. Weathered upland till and colluvial landforms and a very sparse lake distribution in the central and northeastern portions support published views that these parts of the Ecoregion were likely not glaciated during the most recent glacial period. The Horton River bisects the Ecoregion and is confined within a deep, steep-walled valley. Numerous small streams drain the uplands and have cut deep gullies into the plateau edges. The dominant vegetation cover is shrub tundra and tussock tundra. Ice-wedge polygons are the most common permafrost feature.

Geology and Geomorphology

Cretaceous shales underlie the Ecoregion and are frequently exposed on the actively eroding plateau edges where water and wind erosion have carved deep gullies and spectacular badlands. Open lignite seams along coastal slopes are burning in some places and brightly coloured strata are common and striking features there. The northern third of the plateau and the narrow northern extension are capped by Tertiary sands and gravels. Fulton (1995) maps these Tertiary deposits as sandy colluvial surface materials; Mackay (1958, cited in Zoltai *et al.* 1979) suggests that the most recent continental glaciation did not affect part of the Ecoregion. Aerial transects during the 2009 field season support this hypothesis; the central and northeastern portions are level to gently undulating landscapes with a smooth, weathered appearance and very few lakes, in contrast to parts of the Ecoregion to the south and west where lake density is higher and local topographic differences are more pronounced. Retrogressive flow slides are locally common along the plateau edges. Ice-wedge polygons are the most common permafrost type and non-sorted circles and stripes are also widespread. High-centre polygons have developed in a few places but are not as common as they are on the adjacent Bathurst Peninsula LA*n* Ecoregion to the north.

Soils

The extreme western edge of the Ecoregion is included within the Firth River mapsheet area (Anonymous 1986). It is likely that the Kittigazuit soil association mapped for this area (Turbic Cryosols associated with weakly to moderately calcareous, weakly acid to neutral silt loam to silty clay loam till) can be extended to the east across the plateau. Regosols and non-soils are associated with eroded areas and badlands along the plateau edges. Organic Cryosols are locally extensive, occurring with wetlands in linear lowlands east of the Horton River and in narrow channels and scattered pockets elsewhere.

Vegetation

The main tundra types are continuous low-shrub tundra with tall dwarf birch and willows as dominant species and continuous tussock-sedge – dwarf-shrub – moss tundra; both are probably indicative of locally warmer climates in the Tundra Plains. In the extreme southwest, a few scattered and stunted white spruce and a higher proportion of tall (1-2m) shrubs indicates a transition from Low Arctic to High Subarctic climates that becomes more apparent in the adjacent West Horton Plain LA*n* Ecoregion to the south. Small white spruce woodlands are also found on warm southerly valley slopes and well-drained river terraces along the Horton, Anderson and West River. Sedge – moss – low-shrub and sedge – moss – dwarf-shrub wetlands occur in stream drainages and low areas. The badlands and eroded slopes are mostly unvegetated.

Water and Wetlands

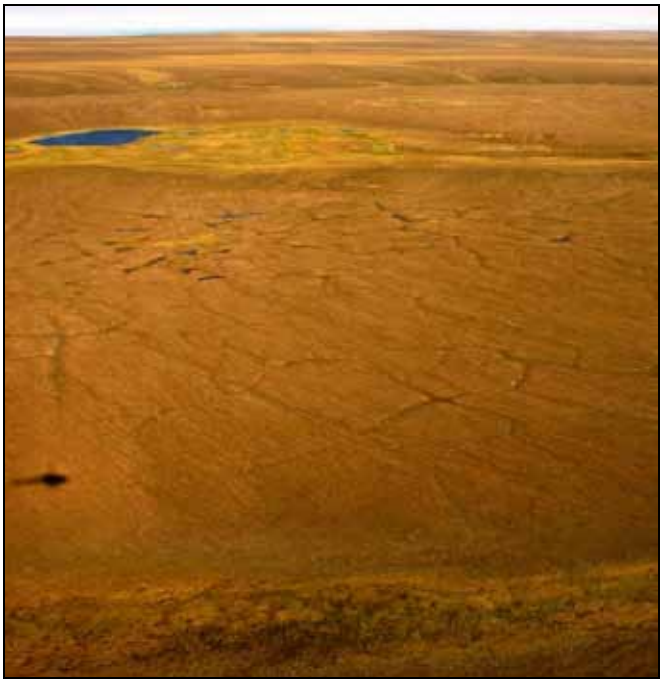
The Horton River and the Anderson River are the main watercourses; the Horton River meanders within a narrow confined valley through the Ecoregion and the upper slopes of the Anderson River valley are the western boundary of the Ecoregion. The West River valley follows part of the southern boundary of the Ecoregion with the adjacent West Horton Plain LA*n* Ecoregion. Lakes are small and sparsely distributed especially in the central and northeastern portions that were probably unglaciated in the most recent glacial period; there are no named lakes. Wetlands are mainly confined to drainage channels; east of the Horton River and in areas of higher lake density, they can be locally extensive in low-lying areas.

Notable Features

Brightly coloured rock exposures and burning lignite beds along the coast and spectacular badlands along the Horton and Anderson Rivers are notable features of this Ecoregion. Zoltai *et al.* (1979) indicated that the Horton River valley provides critical habitat for peregrine falcons which nest there.

3.4.13 Smoking Hills LA*n* Ecoregion

Gently undulating, weathered terrain is characteristic of the plateau both west and east of the Horton River. Low-shrub tundra (willows, dwarf birch) occupy moist to wet drainage channels and moist low-shrub tundra and sedge-cottongrass tussock tundra occupies higher areas. Much of the Ecoregion was not covered by glacial ice in the last continental glaciation about 15,000 years ago.



Close to the coastline, sedge wetlands (greenish-yellow areas in shallow drainages) and permafrost features such as ice-wedge polygons are locally common. Tussock tundra with sedges, cottongrasses and dwarf shrubs occurs on uplands.

Badlands are complex and nearly barren areas with narrow ravines and gullies and rounded to sharp crests formed when soft bedrock erodes. They are extensive in this Ecoregion along the coastline and along the Anderson and Horton Rivers, the latter barely visible in the upper left hand corner.

Sulfurous smoke from burning lignite (coal) beds along the deeply eroded coastline drifts across the adjacent uplands and undoubtedly inspired the name “Smoking Hills”.

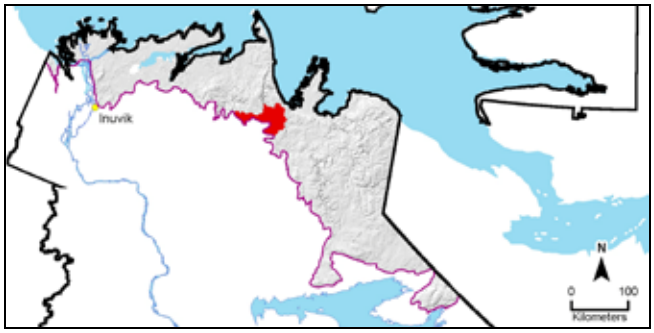
3.4.14 West Horton Plain LA*n* Ecoregion (ecoregion label 2.4.1.14)*

Overview: *The West Horton Plain LAn Ecoregion is a sloping to undulating till plain incised in places by streams; there is continuous tundra cover and a relatively high proportion of trees in river valleys.*

Summary:

- Bedrock plain blanketed by till and minor glaciofluvial deposits with low lake densities and incised stream channels.
- Continuous shrub and sedge-cottongrass tussock tundra on uplands, with white spruce in all major river valleys and on uplands in the south indicating a transition from Low Arctic to High Subarctic climates.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 2,119 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 250 (120 – 280).

General Description

The West Horton Plain LA*n* Ecoregion is a low-elevation till plain bisected by the Horton River. Its southern boundary is the Taiga Plains Anderson Plain High Subarctic (HS) ecoregion; the Central Horton Plain LA*n* Ecoregion lies to the north and east and has higher-relief till landforms, a higher proportion of glaciofluvial deposits and a markedly higher density of lakes. The higher and more dissected landscapes of the Smoking Hills LA*n* Ecoregion border it to the north. Cretaceous shales blanketed by fine-textured gently sloping to undulating tills produce locally variable landscapes; the shales are readily eroded and the Horton River and its tributaries have carved deep valleys in places. A few gravelly terraces well above the current river indicate the past influence of glacial rivers. Lakes are sparsely distributed compared to areas to the south and east. Low-shrub tundra and tussock tundra are the dominant tundra types and along with the common occurrence of white spruce in the southern half of the Ecoregion indicate the influence of both Low Arctic and less extreme High Subarctic climates. Permafrost features such as ice-wedge polygons are indicative of continuous permafrost.

Geology and Geomorphology

Gently sloping and undulating fine-textured till veneers and blankets are underlain by gray to black Cretaceous shales with coal beds. Bedrock is exposed in a few places along the steep valley walls in the lower reaches of Coal Creek and West River and within the narrow valley of the Horton River north of its confluence with these tributaries. Gravelly and sandy glaciofluvial terraces high above the present-day Horton River near the eastern boundary of the Ecoregion and also in the vicinity of Bekere Lake near the southwestern boundary are part of more extensive glacial outwash deposits to the east and west. Recently deposited gravel bars and fluvial terraces are common along the meandering southern reaches of the Horton River and some slope failures occur on the steeper valley slopes. Ice-wedge polygons occur in places and are most evident on glaciofluvial deposits. Other features typically associated with Low Arctic climates such as high- and low-centre polygons are not common, but polygonal peat plateaus which are characteristic of High Subarctic areas do occur along the southern boundary.

Soils

It is likely that the Kittigazuit soil association mapped for the area immediately to the west (Turbic Cryosols associated with weakly calcareous, acidic fine clayey and fine loamy glacial till) (Anonymous 1986) can be extended east across this Ecoregion. Organic Cryosols are associated with wet sedge tundra in lowlands.

Vegetation

The main tundra types are continuous low-shrub tundra with tall dwarf birch and willows as dominant species and continuous tussock-sedge – dwarf-shrub – moss tundra; both are probably indicative of locally warmer climates in the Tundra Plains. Open white spruce woodlands are common and widespread on valley slopes and together with the extensive occurrence of dwarf birch and the appearance of polygonal peat plateaus indicate that the climate of this Ecoregion is affected by both Low Arctic and High Subarctic influences. Sedge – moss – low-shrub and sedge – moss – dwarf-shrub wetlands occur in lowlands and drained lake beds and are more common in this Ecoregion than in the adjacent Smoking Hills LA*n* Ecoregion.

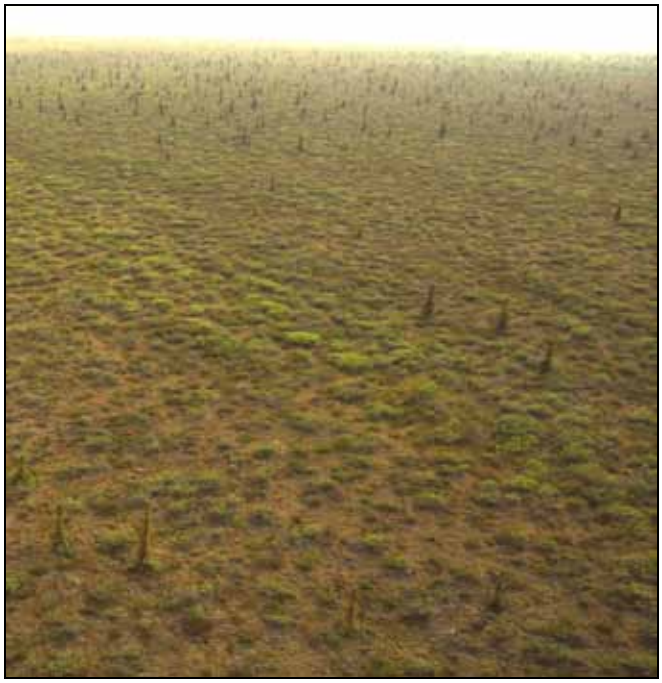
Water and Wetlands

The Horton River is the main water feature; it meanders through the south and central part of the Ecoregion in a broad and relatively shallow valley, but north of its confluence with Coal Creek and West River, it is confined to a deeper, more well-defined valley with steep slopes and some areas of exposed bedrock and colluvium. Coal Creek originates in the Smoking Hills LA*n* Ecoregion to the north. The valley of West Creek runs east to west; it parallels part of the northern boundary of the Ecoregion. Both Coal Creek and West River are confined within deep, relatively narrow valleys in their lower reaches where slope failures have exposed the underlying bedrock in a few places. The only large named lake is Bekere Lake along the southern boundary of the Ecoregion; lakes are sparsely distributed with the highest densities on the plains adjacent to the Horton River in the north. Wetlands are relatively common in swales between till uplands and in drained lake beds.

Notable Features

The combination of Low Arctic and High Subarctic climate influences and the varied topography within the Horton River valley and its major tributaries create diverse habitats. Zoltai *et al.* (1979) indicate that this part of the Horton River valley provides critical habitat for gyrfalcons.

3.4.14 West Horton Plain LA*n* Ecoregion



In the southwesternmost portion of the Ecoregion near the Taiga Plains – Southern Arctic boundary, stunted and widely spaced white spruce occur with tall shrubby tundra on gently undulating tills, indicating a transition to somewhat warmer climatic conditions that allow the growth of trees on uplands.

Coal Creek meanders through a shallow valley cut into Cretaceous shales at the north end of the Ecoregion. The uplands are undulating till deposits that support sedge and cottongrass tussock tundra. The lowlands are occupied by moist to wet sedge and shrub tundra and there are no trees on the uplands or in the valley.

This south-facing view along the Horton River in the north-central part of the Ecoregion shows the diversity of habitats within the valley – river and pond ecosystems, shrublands and sedge wetlands on the valley floor, open spruce woodlands and tall shrublands on the valley slopes and sedge and shrub tundra on the adjacent uplands.

The grayish-green area in the foreground is a gravelly glaciofluvial terrace, deposited thousands of years ago by glacial rivers flowing from ice sheets to the south and east. The cracks on the surface are permafrost features (ice-wedge polygons); the dry conditions only allow the growth of drought tolerant plants like mountain avens. The moister side slopes support more trees and shrubs.

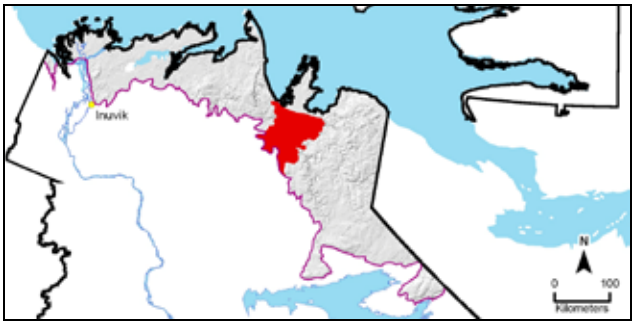
3.4.15 Central Horton Plain LA*n* Ecoregion (ecoregion label 2.4.1.15)*

Overview: *The Central Horton Plain LAn Ecoregion is a lake-studded landscape of hummocky to rolling till with dwarf-shrub and sedge tundra in the north and taller shrub tundra and sparse patchy woodlands in the south.*

Summary:

- Hummocky and rolling fine-textured till deposits with a wide east-west band of coarser-textured glaciofluvial materials in the centre.
- Dwarf-shrub and sedge tundra in the north grades to low-shrub tundra and patchy trees in the south.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 6,893 km^2 (4% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 250 (120 – 360).

General Description

The Central Horton Plain LA*n* Ecoregion is an extensive rolling to hummocky till plain with many large and small lakes and large glaciofluvial deposits. A short, relatively steep slope forms its northern boundary with the Parry Peninsula Lowlands LA*n* and Darnley Bay Coastlands LA*n* Ecoregions. To the east, the higher bedrock-controlled terrain of the Horton Upland LA*n* Ecoregion has thinner till veneers and a markedly lower lake density. The West Horton LA*n* Ecoregion to the west has gentler terrain, fewer lakes and less extensive glaciofluvial deposits. The treed uplands of the Taiga Plains Anderson Upland High Subarctic (HS) Ecoregion form the southern boundary. The highest terrain is in the northeast corner; the lowest terrain is along the base of the northern slope and in the deeply incised valleys of the Horton River and its tributaries. The largest lakes are mostly concentrated in deep till deposits in the northeastern quadrant west of the higher terrain. Thick till blankets overlie bedrock across most of the Ecoregion, except in the southeast corner where bedrock is exposed in places through thin till veneers. Glaciofluvial sands and gravels are deposited in a wide band through the central portion of the Ecoregion. Vegetation cover and permafrost features reflect both variations in parent materials and the transition from High Subarctic climates in the south to Low Arctic climates in the north. Tall shrub tundra, extensive shallow sedge peatlands and sparse and stunted conifer woodland patches occupy the southern third; dwarf-shrub and sedge tundra are dominant in the northern two-thirds, where Low Arctic permafrost features such as ice-wedge polygons also become more common.

Geology and Geomorphology

Cretaceous shales are overlain by thick till blankets across most of the Ecoregion. The highest lake densities coincide approximately with the mapped extent of hummocky disintegration till that extends well south into the Taiga Plains (Prest *et al.* 1968). In the southeast corner of the Ecoregion, glacial ice scoured Paleozoic limestones and dolomites and left thin tills with areas of exposed bedrock; lake density is comparatively low. Glaciofluvial terraces and ridges are extensive in the central portion and form a band about five to ten kilometres wide that is oriented approximately east to west; several of the largest lakes in the northern portion occur within these deposits. Ice-wedge polygons are commonly associated with the terraces and non-sorted stripes with hummocky till and glaciofluvial deposits. Retrogressive flow slides are common in the northern half of the Ecoregion and indicate the presence of continuous permafrost and ground ice under fine-textured tills.

Soils

Permafrost is continuous and Turbic Cryosols associated with active permafrost features are dominant; it is likely that sandy, acidic Static Cryosols with deeper active layers will occur in the southern part where High Subarctic climates have some influence and on deep well- to rapidly-drained glaciofluvial deposits where ice content is likely to be low. Organic Cryosols on thin sedge peats are common in the southern half of the Ecoregion.

Vegetation

Continuous low-shrub tundra and open spruce woodlands in the southern third transition to erect dwarf-shrub tundra and tussock-sedge – dwarf-shrub – moss tundra in the northern two-thirds. Patchy discontinuous dry tundra cover is common on well to rapidly drained glaciofluvial sands and gravels. Sedge – moss – low-shrub and sedge – moss – dwarf-shrub wetlands cover significant areas south of Fallaise Lake and their extent might indicate the combined influence of deeper tills and somewhat milder and moister High Subarctic climates. Wetlands are more localized in the northern third where they occur in drainages and lowlands between and around lakes. Sparse, stunted white spruce forms locally extensive woodlands in the southern third. Appendix 4 discusses possible future modifications to the Southern Arctic-Taiga Plains boundary in this area based on additional aerial information collected after 2005 when the northern boundary of the Taiga Plains (and the southern boundary of the Southern Arctic) was defined.

Water and Wetlands

High lake densities are a distinguishing characteristic of this Ecoregion. Most of the larger lakes are in the northeast quadrant. Named lakes include Binamé, Billy, Rummy, Fallaize, Stefansson and Gilmore Lakes; they range from five to over 40 square kilometres in area. The Horton River is the largest river and is confined within a narrow north- to south-trending valley roughly paralleling the western boundary; its tributaries are similarly located within deep valleys and the general area is characterized by pronounced topographic changes and fewer lakes. Other named watercourses include Whaleman River and Stefansson, Nangayuk and Rummy Creeks. Peatlands are common and extensive in the southern half of the Ecoregion (Tarnocai *et al.* 2005), but peat deposits are typically less than one metre thick in this area (Zoltai *et al.* 1992).

Notable Features

This Ecoregion has a higher density of lakes and proportionately more gravelly and sandy glaciofluvial terrain than any other Tundra Plains ecoregion west of the Parry Peninsula." The Eskimo Curlew was reported to be abundant in this area in the 1860s (MacFarlane 1891).

3.4.15 Central Horton Plain LA*n* Ecoregion

A typical landscape in the northern part of the Ecoregion includes hummocky till (gray-toned uplands) with ice-wedge polygons (netlike features on the hummocks), dry dwarf-shrub and sedge tundra on the till hummocks, numerous shallow lakes (distance) and narrow drainages with localized sedge and cottongrass wetlands.

A typical landscape in the southern part of the Ecoregion includes very open stands of white spruce a few metres in height with an understory of dwarf birch, northern Labrador tea and other shrubs. The treeless areas on the hilltops are shrubby tundra. Tree and tundra complexes are typical of High Subarctic climates and indicate that the Ecoregion contains elements of both Low Arctic and High Subarctic climates.

Extensive areas of dry sandy and gravelly outwash deposited by glacial rivers occur in the central part of the Ecoregion. The flat-topped uplands are old glacial river terraces. The network of cracks is created when rapid freezing causes the ground to shrink in early winter; when snowmelt flows into the shrinkage cracks, it freezes to produce ice wedges that force the cracks to widen.

Dwarf birch and willow tundra with its diverse community of shrubs, sedges, grasses and broad leaved herbs provides habitat for muskox within this Ecoregion; the stunted light green spires of white spruce in the distance indicate that this location is close to the Taiga Plains-Southern Arctic boundary, north of which tree growth is sparse or nonexistent.

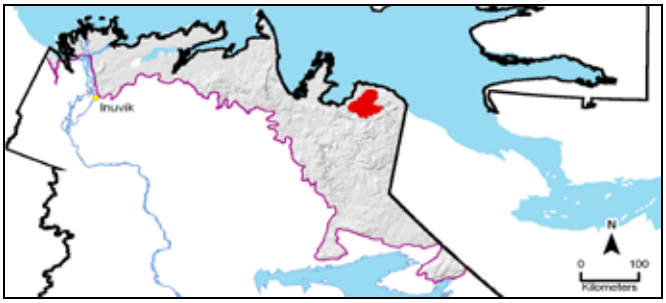
3.4.16 West Melville Slopes LA*n* Ecoregion (ecoregion label 2.4.1.16)*

Overview: *The West Melville Slopes LAn Ecoregion includes a central area of undulating to hummocky till flanked by gently to moderately inclined eroded slopes with dry dwarf-shrub tundra on the uplands.*

Summary:

- Three main subunits (a north and south subunit associated with slopes and thin tills and a central subunit with deeper tills).
- Dry dwarf-shrub tundra is the dominant plant cover.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 1,790 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 400 (80 – 520).

General Description

The West Melville Slopes LA*n* Ecoregion is a till-dominated landscape bounded on the north by the lowlands of the Darnley Bay Coastlands LA*n* Ecoregion, on the south by the high, cold plateau of the Melville Plateau LA*n* Ecoregion, on the east by the more rugged landscapes of the East Melville Slopes LA*n* Ecoregion and on the west by the watershed boundary between the Brock River and Hornaday River drainages. There are three subunits within this Ecoregion. The northern subunit is defined by gentle to moderate till slopes with a northwest aspect; the deeply incised valley in the lower reaches of the Brock River and several different tundra types are included within it. The central subunit occupies the nearly flat landscape between the main Brock River valley to the south and the 300 mASL contour to the north. This area is occupied by low-relief undulating to hummocky till plains with a higher lake density and fewer bedrock exposures than either the north or south subunits; it is vegetated by a complex of continuous dwarf-shrub and dry to wet sedge tundra. The southern subunit includes the moderately inclined toe slopes of the higher Melville Plateau LA*n* Ecoregion with numerous bedrock exposures, thin till veneers and discontinuous to continuous dwarf-shrub and sedge tundra. Low Arctic permafrost features such as ice-wedge polygons and non-sorted stripes are widespread throughout the Ecoregion.

Geology and Geomorphology

Most of the Ecoregion is underlain by Precambrian dolomites, with a small area of Cretaceous shales in the northwest corner and minor areas where Precambrian magma has intruded into the dolomites as narrow dikes and sills. Veillette (2004) and Zoltai *et al.* (1992) provide a comprehensive overview of surficial geology for Tuktut Nogait National Park, within which most of this Ecoregion lies. The sloping northern subunit includes loamy till veneers and blankets with a few bedrock outcrops, colluvium in the valleys and scattered glaciofluvial deposits; till drumlins occur in the eastern part of the subunit. The level central subunit is covered by thick undulating to hummocky loamy till deposits and very few bedrock outcrops except along the Brock River and its tributaries. The inclined southern subunit is characterized by eroded bedrock with numerous outcrops, thin till veneers that were likely deposited prior to the most recent Continental glaciation and colluvium in the valleys. Undulating to hummocky loamy tills occur in the western third of the southern subunit. The Brock River is deeply entrenched in a narrow multihued canyon of Precambrian dolomites with thin knifelike eroded remnants in places; the canyon changes to a wide valley in the lower reaches where the river flows through Cretaceous shales. Permafrost features typical of the Low Arctic, particularly ice-wedge polygons, are found throughout the Ecoregion.

Soils

Turbic Cryosols are dominant across most of the Ecoregion on the uplands; Zoltai *et al.* (1992) indicate that the tills on which they develop are moderately calcareous and acidic to neutral with loam to sandy clay loam textures. Organic Cryosols associated with thin organic deposits may be found on low areas in undulating to hummocky tills and on seepage slopes below rock exposures.

Vegetation

A recent land cover classification (Fehr *et al.* 2006) for Tuktut Nogait National Park covers most of the Ecoregion and indicates that the main tundra cover on uplands in the central and southern subunits and in the eastern part of the northern subunit is continuous dry tundra (dryland sedges, other herbs, mountain avens and low-growing willows, comparable to the Circumpolar Arctic Vegetation Map graminoid – prostrate dwarf-shrub – forb tundra type [CAVM Team 2003]). Fehr *et al.* (2006) classify wet lowlands and seepage slopes throughout the Ecoregion as a complex of mesic tundra (sedges, mountain avens and willows, comparable to the CAVM graminoid – prostrate dwarf-shrub – forb tundra type), tussock tundra (cottongrasses and sedges, comparable to the CAVM tussock-sedge – dwarf-shrub – moss tundra type). Shrub tundra (willows, arctic bearberry and mountain avens, comparable to the CAVM erect dwarf-shrub tundra type) is associated with seepage slopes. In the northwest corner of the Ecoregion, mesic tundra and shrub tundra are locally dominant and are associated with Cretaceous shales that weather to fine-textured relatively nutrient rich soils and with lower elevation, protected slopes within river valleys.

Water and Wetlands

There are only two named lakes within the Ecoregion (Siolik and Fish Lakes) and both are in the northern subunit. The central subunit has a higher lake and pond density than either the northern or southern subunits because of more level terrain. The Brock River is the main watercourse and is fed by a network of tributaries. Numerous small permanent and ephemeral streams flow perpendicular to contour in the northern and southern subunits.

Notable Features

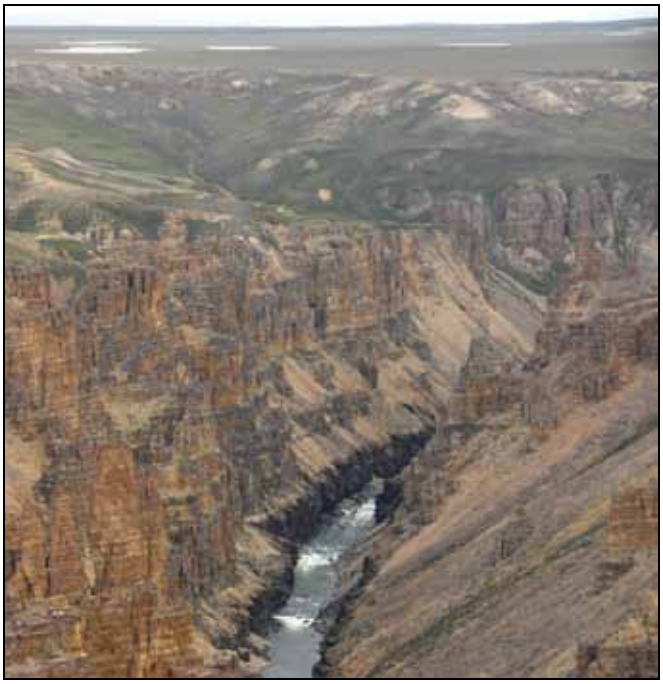
The Brock River canyon is a striking geological feature within the Ecoregion and provides nesting habitat for various raptors including Tundra Peregrine Falcons, Golden Eagles, Rough-legged Hawks and Gyrfalcons (Zoltai *et al.* 1992). A population of anadromous arctic char use the Brock River.

3.4.16 West Melville Slopes LA*n* Ecoregion

Eroded slopes occupy the northern part of the Ecoregion between its nearly level central part and the adjacent Darnley Bay Coastlands LA*n* Ecoregion. Till veneers overlie Precambrian bedrock. Dry dwarf-shrub and sedge tundra occurs in patches on the uplands and wet sedge tundra occupies stream drainages on the lowlands.

The nearly level landscapes in the central part of the Ecoregion are a complex of dry dwarf-shrub and sedge tundra on gentle to hummocky till blankets and wet sedge tundra (bright green) in the lowlands. Small shallow lakes and ponds are more common here than on the slopes to the north and south.

In the northeast corner of the Ecoregion, streams cut into Precambrian bedrock. Thin and relatively ancient glacial tills overlie the bedrock on the mist-shrouded highlands of the Melville Plateau LA*n* Ecoregion. In the foreground and midground, very sparse tundra grows on dry, well-drained river deposits, with wet sedge tundra in seepage areas along the streams.



The Brock River has cut a deep canyon into layered Precambrian dolomites, creating cliffs and knife-like bedrock stacks that provide good nesting habitat for birds of prey, including the Tundra Peregrine Falcon.

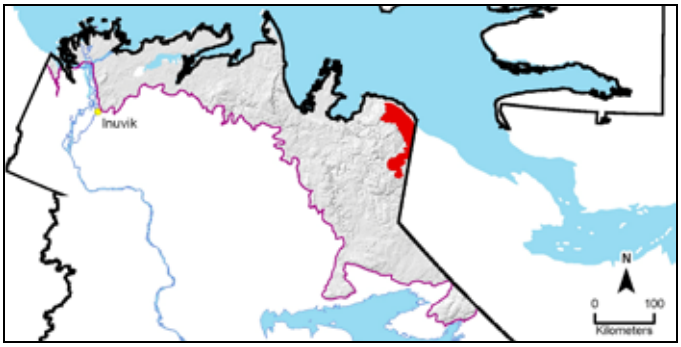
3.4.17 East Melville Slopes LA*n* Ecoregion (ecoregion label 2.4.1.17)*

Overview: *The East Melville Slopes LAn Ecoregion is a mid-elevation till plain with sparse dry tundra cover and a cold Low Arctic climate.*

Summary:

- Till veneers over bedrock in the northern subunit, deeper till blankets in the central and southern subunits.
- Dominantly sparse dry tundra across much of the northern and central subunits; dry and sparse tundra in the southern subunit.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 2,699 km^2 (2% of Southern Arctic Ecoregion). Ecoregion shown in red.	**Average elevation (range) mASL:** 600 (120 – 760).

General Description

The East Melville Slopes LA*n* Ecoregion is an eroded plateau mostly blanketed by thick tills. It includes three subunits: a small northern subunit consisting of a narrow, sloping belt of eroded bedrock with till veneers and numerous incised streams along the northern boundary of the Ecoregion between about 120 and 400 mASL; a more extensive central subunit of gently rolling hills and thick till deposits north of and including the Roscoe River valley reaching maximum elevations of about 640 mASL; and a southern higher-elevation subunit south of the Roscoe River. The Ecoregion is bordered on the west and south by the higher Melville Plateau LA*n* Ecoregion, on the northwest by the lower-elevation and lower-relief West Melville Slopes LA*n* Ecoregion and on the north by the lower-elevation Amundsen Gulf Coastal Plain LA*n* Ecoregion. It is bounded on the east by the Northwest Territories – Nunavut border but this landscape extends into Nunavut for some distance. Precambrian bedrock underlies the Ecoregion and is exposed in numerous places along eroded stream channels in the northern subunit. Undulating to hummocky till blankets the central and southern subunits and locally extensive glaciofluvial deposits occur along the Roscoe River. Sparse to continuous prostrate dwarf-shrub tundra is dominant and together with locally extensive ice-wedge polygons within which sorted circles have developed, gives the landscapes of the higher central and southern subunits a similar appearance to those responding to Mid-Arctic climatic influences on the Arctic Islands over 400 kilometres to the north.

Geology and Geomorphology

Precambrian limestones and dolomites underlie most of the Ecoregion. They often outcrop through thin till veneers along eroded stream valleys in the northern subunit. Veillette (2004) mapped a very small area of drumlinized till in the eastern portion of the northern subunit. Thick, undulating to hummocky till blankets are the dominant landform features in the central and southern subunits. Some of the tills at higher elevations in the central and southern subunits are thought to have been deposited prior to the most recent glaciation (Veillette 2004). The only extensive glaciofluvial deposits are along the Roscoe River and one large kame over a kilometre in diameter is a well-known landmark (Mt. Hooker) (Veillette 2004). Very large ice-wedge polygons within which both sorted and non-sorted circles and stripes occur were observed at higher elevations in the central and southern subunits during 2009 field surveys; these features are also characteristic of landscapes on the Arctic Islands where colder Mid-Arctic climates prevail. Zoltai *et al.* (1992) and Veillette (2004) both indicate that wetlands with thin peat deposits are common west of the large un-named lake in the southern subunit.

Soils

Turbic Cryosols derived from loamy to fine-sandy moderately calcareous tills are dominant across most of the Ecoregion with continuous permafrost. Regosols and weakly developed Brunisols are most extensive adjacent to the Roscoe River. Organic Cryosols are associated with peaty wetlands and are likely to be most extensive in the southern subunit according to Veillette (2004) and Zoltai *et al.* (1992).

Vegetation

The land classification for Tuktut Nogait National Park (Fehr *et al.* 2006) and the general vegetation mapping for the Park produced by Zoltai *et al.* (1992) indicate that sparse to continuous dry tundra covers much of the Ecoregion. Fehr *et al.* (2006) indicate that the sparsely vegetated ground type (in which dryland sedges, mountain avens and dwarf shrubs typically cover 10 to 30 percent of the ground surface) is the dominant cover type across most of the central and northern subunits. The dry tundra type (similar floristic composition but higher plant cover of 30 to 95 percent) occurs in about equal proportions with the sparsely vegetated ground type in the southern subunit and is most extensive in the western portions of the northern and central subunits. The sparsely vegetated ground type is similar to the Circumpolar Arctic Vegetation Map prostrate dwarf-shrub – herb tundra community defined by the CAVM Team (2003). This type is characteristic of a CAVM biophysical subzone that is comparable to the Mid-Arctic climates described by the Ecoregions Working Group (1989). The dry tundra ground type is similar to the CAVM graminoid – prostrate dwarf-shrub – forb tundra type. Sedge – moss – dwarf-shrub wetlands are associated with wet peat areas.

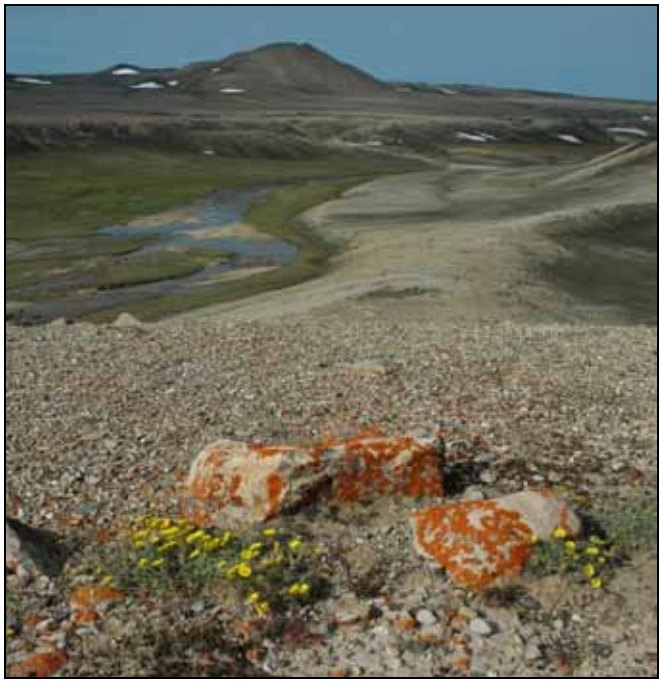
Water and Wetlands

There are no named lakes in the Ecoregion and most are less than a square kilometre in area. Lake densities are lowest in the northern subunit. The Roscoe and Palgrave Rivers are the only named rivers and the Roscoe River meanders through a broad valley in the southern part of the central subunit. Wetlands are most extensive in the southern subunit.

Notable Features

Most of this Ecoregion lies within Tuktut Nogait National Park. Although this Ecoregion has been assigned to the Low Arctic, it has vegetation and permafrost features that are characteristic of Mid-Arctic landscapes of Banks Island to the north and west and these features might reflect colder, drier conditions at higher elevations that could indicate a transition from Low Arctic to Mid-Arctic climatic conditions.

3.4.17 East Melville Slopes LA*n* Ecoregion



The northern subunit is a landscape of eroded stream channels and till-covered uplands. In the foreground, the bright yellow flowers of potentilla and the splashes of orange lichen on granite boulders add colour to the sparsely vegetated gravelly and sandy tills. In the distance, moist sedge and shrub tundra borders a narrow stream that occupies an eroded bedrock valley.

The central subunit is an undulating to hummocky till plain with small, shallow lakes. The gray-toned uplands are very dry and have patchy dwarf shrub tundra cover; the large ice-wedge polygons are created by permafrost action. Green lowlands between the till uplands and around the lakes are occupied by wet sedge tundra.

The southern subunit is a gently undulating till landscape that supports somewhat more plant growth than most of the central subunit. Wetlands occupy more extensive areas in this subunit than elsewhere in the Ecoregion and appear as green patches flanked by river terraces and low-relief till uplands with discontinuous tundra.

The Roscoe River meanders through a broad valley in the central part of the Ecoregion. The flat grayish-brown areas are sparsely vegetated gravelly terraces that have been deposited by river waters over the last few hundred to several thousand years; the narrow linear dark green patches are moist sedge meadows that grow in old stream channels.

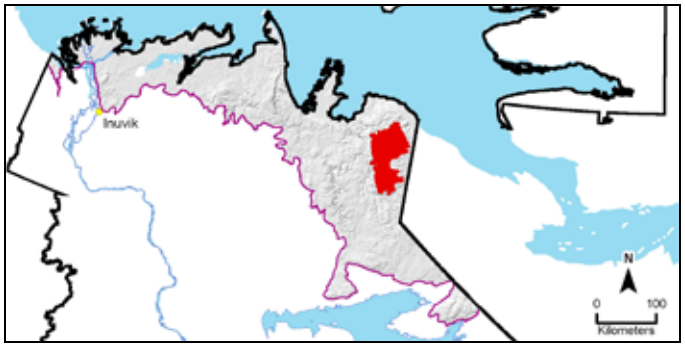
3.4.18 Melville Plateau LA*n* Ecoregion (ecoregion label 2.4.1.18)*

Overview: *The Melville Plateau LAn Ecoregion is the highest and coldest ecoregion in the Southern Arctic and was largely ice-free during the last continental glaciation.*

Summary:

- Exposed rubbly and weathered bedrock in the northwestern portion and ancient, weathered till veneers and blankets elsewhere.
- Sparse to continuous dry tundra, with moister tundra in seepage areas.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 4,570 km^2 (3% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 700 (400 – 860).

General Description

The Melville Plateau LA*n* Ecoregion is the highest-elevation Ecoregion in the Southern Arctic and includes two subunits. The northern subunit encompasses the northern half of the Ecoregion and is characterized by a gently domed bedrock-dominated plateau with extensive weathered and consolidated bedrock exposures in the western two-thirds of the subunit, almost no lakes, very sparse dry tundra cover on bedrock and moist to wet tundra on lower slope seepage areas. Ancient till blankets deposited before the most recent glaciation mostly cover the bedrock in the eastern third of the northern subunit; there are a few lakes and continuous to discontinuous dry tundra is typical, with some locally extensive peatland areas in the south-central areas. The southern subunit includes the southern half of the Ecoregion; it is a more complex landscape and is slightly lower in elevation than the northern subunit. The western two-thirds of this subunit is dissected by tributary streams of the Hornaday River that have carved deep valleys into bedrock, leaving small remnant plateaus of weathered and consolidated bedrock with patchy to continuous dry tundra as the dominant cover. The eastern third of the southern subunit is a higher area with less pronounced topography; it is blanketed by ancient tills that support sparse to continuous dry tundra cover, with some organic pockets. Tundra and permafrost features at high elevations within this Ecoregion are similar to those found in areas with Mid-Arctic climates on the southern Arctic Islands about 400 kilometres to the north.

Geology and Geomorphology

The northern subunit is underlain by weathered Precambrian quartzose and sandstone bedrock that is extensively exposed in the western two-thirds. Frost heaving and shattering have produced boulder fields in some areas; in others, sandy to loamy surface veneers have developed due to long-term bedrock weathering. The southern subunit is mostly underlain by Precambrian dolomites. In the west-central part of the southern subunit there is an extensive area of Paleozoic quartzose and conglomerate bedrock that erodes into distinctive flat-topped plateau remnants with deeply gullied sides (Veillette 2004). Bedrock exposures are common throughout the western half of the southern subunit. Elsewhere in both subunits, weathered tills that were deposited prior to the most recent Laurentide glaciation overlie the bedrock. Very large ice-wedge polygons and both sorted and non-sorted circles and stripes are common at higher elevations; the large polygons are similar to those encountered in the High Arctic and in unglaciated parts of the Yukon (Zoltai *et al.* 1992).

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Soils

Soil development is limited on bedrock exposures where there is either consolidated bedrock or frost-shattered rubble. On weathered bedrock and tills, Turbic Cryosols are prevalent. Soil textures range from silt loams to sandy loams; soils are typically neutral and are slightly calcareous on quartzite bedrock in the northern half to moderately calcareous on weathered tills and dolomite bedrock elsewhere in the Ecoregion (Zoltai *et al.* 1992).

Vegetation

The land classification for Tuktut Nogait National Park (Fehr *et al.* 2006) and the general vegetation mapping for the Park produced by Zoltai *et al.* (1992) indicate that rocky barrens with lichens on rock surfaces and very sparse vascular plant cover are dominant in the western two-thirds of the northern subunit and common in the western half of the southern subunit. Seepage slopes in these areas support locally extensive mesic tundra (similar to the Circumpolar Arctic Vegetation Map graminoid – prostrate dwarf-shrub – forb tundra type (CAVM Team 2003) and tussock tundra (similar to the CAVM tussock-sedge – dwarf-shrub – moss tundra type). The sparsely vegetated and dry tundra types defined by Fehr *et al.* (2006) occur in about equal proportions elsewhere and are similar to the CAVM prostrate dwarf-shrub – herb tundra type and graminoid – prostrate dwarf-shrub – forb tundra type, respectively. The sparsely vegetated ground type is characteristic of a CAVM biophysical subzone that is comparable to the Mid-Arctic climates described by the Ecoregions Working Group (1989). Sedge – moss – dwarf-shrub wetlands are associated with wet peat areas.

Water and Wetlands

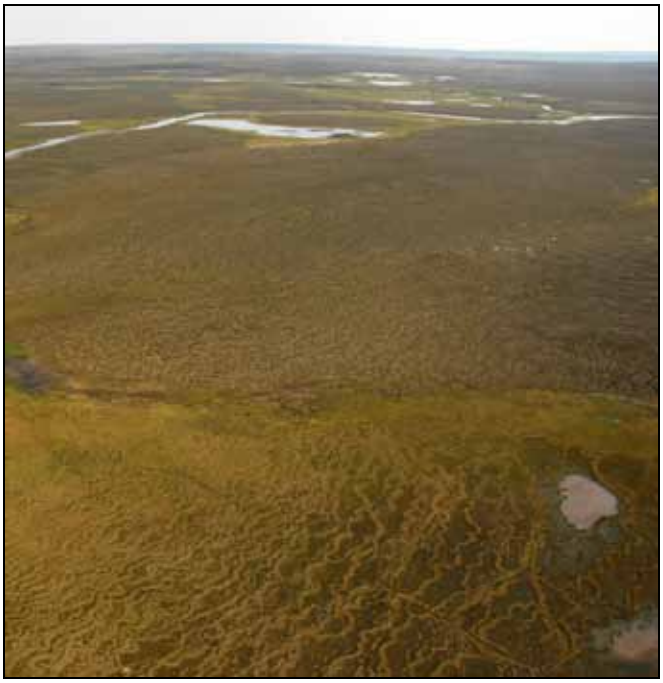
There are no named lakes in the Ecoregion; the largest lakes are in the southern subunit. The headwaters of the Brock River originate in the northern subunit. Stream density is highest in the southern subunit. Locally extensive organic deposits occur mainly in the northern subunit on tills; low- and high-centre polygons and occasionally northern ribbed fens are the associated permafrost features.

Notable Features

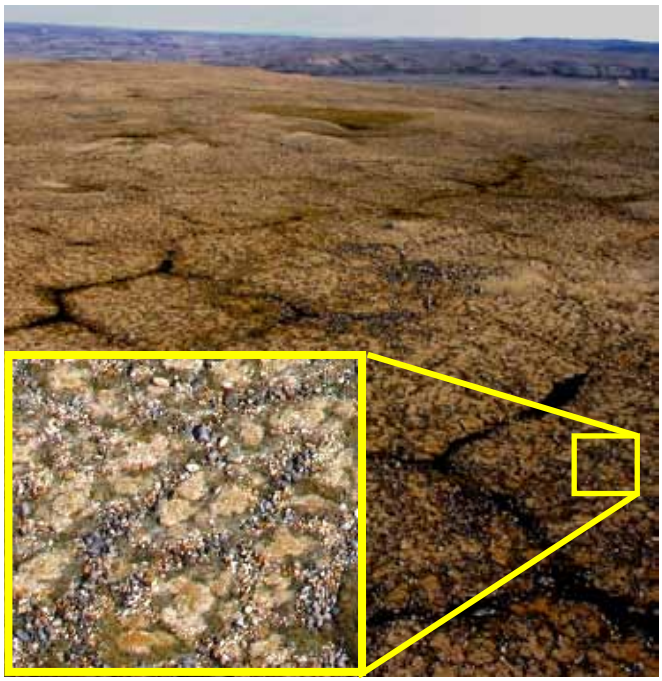
This Ecoregion includes the highest-elevation terrain in the Southern Arctic and contains the main calving grounds of the Bluenose-West Caribou herd. It has been assigned to the Low Arctic, but has vegetation and permafrost features that are characteristic of Mid-Arctic climates on the southern Arctic Islands; these features might reflect colder, drier conditions at higher elevations that could indicate a transition from Low Arctic to Mid-Arctic climatic conditions within the Ecoregion.

3.4.18 Melville Plateau LA*n* Ecoregion

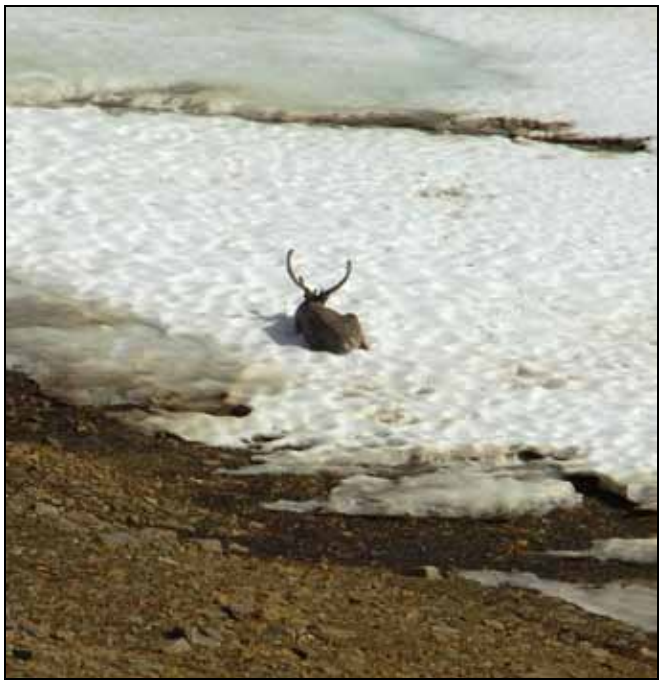
The highest elevations in the Ecoregion are a complex of frost-shattered bedrock with little vegetation (gray tones) and seepage areas watered by melting snow that support moist to wet sedge, cottongrass and dwarf-shrub tundra (green areas). The small golden circular patches in the boulder field at the bottom of the image are sorted circles, described in the box below.



Seepage waters collect in places in the north-central part of the Ecoregion where there are thick, ancient till blankets. Weathered till uplands appear in this image as gray-brown areas; an unusual northern ribbed fen occurs on relatively thick gently sloping peat deposits in the lower part of the image. The ribs have a threadlike appearance and are perpendicular to water flow, which is from left to right.



Large ice-wedge polygons on ancient tills in the northwest part of the Ecoregion are typical of the Arctic Islands where Mid- and High Arctic climates prevail. Within these large polygons (inset picture), frost heaving in bouldery tills associated with extremely cold conditions has produced sorted circles with fine-textured materials and sparse vegetation at the centre of the circle and boulders around the outside.



Caribou seek places where biting insects are less numerous in midsummer, such as this snowbank high in the south-central part of the Ecoregion.

3.4.19 Hornaday Valley LA*n* Ecoregion (ecoregion label 2.4.1.19)*

Overview: *The Hornaday Valley LAn Ecoregion is a complex of lowlands and steep-walled valleys with a variety of parent materials and tundra vegetation types.*

Summary:

- A northern lowland subunit with many lakes and till blankets and a southern stream-dissected subunit with thin tills, weathered bedrock and colluvial deposits.
- Dry dwarf-shrub and sedge tundra is dominant, with moist tundra between large lakes and on seepage slopes.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.

Total area: 730 km^2 (0.5% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 550 (440 – 620).

General Description

The Hornaday Valley LA*n* Ecoregion includes low-relief lowlands around several large lakes and the valley of a major tributary to the Hornaday River. It is surrounded to the north, west and south by the higher terrain of the East Melville Slopes LA*n*, Melville Plateau LA*n* and Hornaday Plateau LA*n* Ecoregions respectively and by the eastern continuation of the Melville Hills in Nunavut. The Ecoregion includes two distinctly different subunits, each of which occupies about half of the Ecoregion. The northern subunit is a level to undulating lowland with numerous lakes, poorly-defined drainage and till, lacustrine and organic deposits. The southern subunit is a higher-relief landscape with few lakes, well-defined drainages and shallow to deep valleys that contain the main Hornaday River tributary and its branches. Ancient tills, weathered bedrock and exposed consolidated bedrock are the main parent materials in this subunit. Continuous sedge and dwarf-shrub tundra is the dominant vegetation cover across the Ecoregion; moist to wet tundra is locally extensive around the largest lake in the northern subunit and on seepage slopes in the valleys of the southern subunit. Most of the Ecoregion except for the extreme north end was not influenced by the most recent glaciation. Upland vegetation features may indicate that this Ecoregion, like its neighbours, has characteristics of both Low Arctic and Mid-Arctic climates.

Geology and Geomorphology

Precambrian dolomites underlie most of the Ecoregion and are frequently exposed on the valley sides in the southern subunit. Tills throughout the Ecoregion were deposited before the most recent glaciation, except for the extreme north end that was influenced by Laurentide ice sheets. The northern subunit is blanketed by weathered tills, with extensive lacustrine deposits between the three largest lakes, a concentration of small glaciofluvial features and kame mounds near the largest lake and scattered but locally extensive organic deposits (Veillette 2004). The southern subunit has numerous bedrock exposures and colluvial deposits along steep valley walls, weathered bedrock and consolidated bedrock on some of the uplands and a locally extensive glaciofluvial deposit along the main Hornaday River tributary (Veillette 2004, Zoltai *et al.* 1992). There is a small area of weathered hummocky till in the northern part of the southern subunit and till veneers occur in patches throughout the subunit.

Soils

Turbic Cryosols are prevalent on weathered bedrock, tills and lacustrine deposits. Static Cryosols are likely associated with deep sandy glaciofluvial deposits where the active layer is deeper. Soil textures are generally sandy to loamy and soils are moderately calcareous on weathered tills and dolomite bedrock (Zoltai *et al.* 1992).

Vegetation

The Circumpolar Arctic Vegetation Map indicates that both prostrate dwarf-shrub tundra and nontussock sedge – dwarf-shrub – moss tundra occur in this area; both are characteristic of bioclimatic zones that span both Low Arctic and Mid-Arctic climates (CAVM Team 2003). Like the adjacent Melville Plateau LA*n* and East Melville Slopes LA*n* Ecoregions, this Ecoregion is probably transitional between Low and Mid-Arctic climates. The Tuktut Nogait National Park land classification (Fehr *et al.* 2006) similarly indicates that dry tundra (dryland sedges, mountain avens and dwarf shrubs typically covering more than 30 percent; CAVM equivalent is graminoid – prostrate dwarf-shrub – forb tundra) is the most extensive type, with mesic tundra (sedges, mountain avens and willows; CAVM equivalent is graminoid – prostrate dwarf-shrub – forb tundra) on lacustrine materials in the northern subunit and seepage slopes on valley walls in the southern subunit. Rocky barrens with sparse vegetation occur where there is exposed bedrock in the southern subunit. Sedge – moss – dwarf-shrub wetlands (CAVM Team 2003) occur with organic soils in the northern subunit.

Water and Wetlands

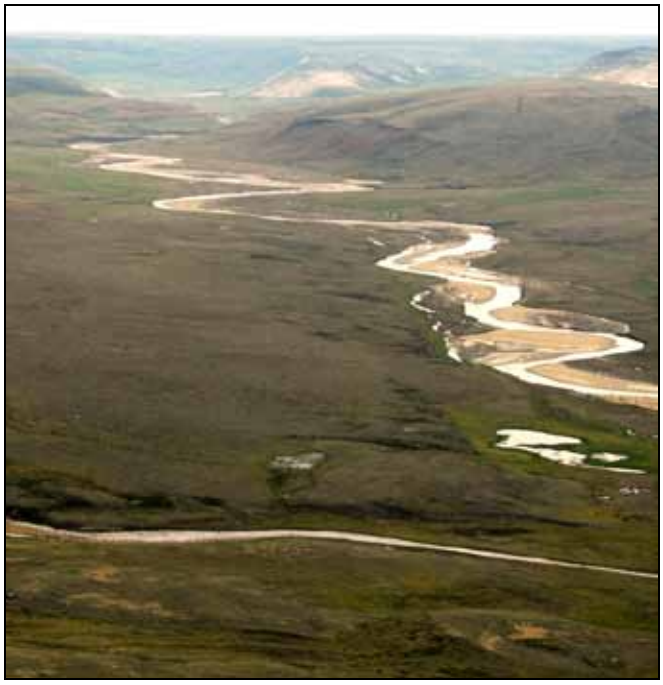
There are no officially named lakes in the Ecoregion, although the largest of three large lakes in the northern subunit is referred to as Hornaday Lake by Veillette (2004). Lakes and ponds are common on the lowlands of the northern subunit; stream drainages are not well organized. In contrast, stream drainages in the southern subunit are well defined and feed into a main tributary of the Hornaday River and there are very few lakes.

Notable Features

Well-preserved fossil wood found on the shores of Hornaday Lake appears to originate from beneath the lake. It has an estimated age of over 40,000 years and may have originated from an interglacial period. Most of it has been identified as spruce and larch, although some of the wood resembles white pine which is normally found in southern Canada (Veillette 2004, Zoltai *et al*. 1992).

3.4.19 Hornaday Valley LA*n* Ecoregion

This large lake, locally known as Hornaday Lake, is still partly ice-covered near the end of July. It is one of three large lakes and many smaller ones that occupy the lowlands in the northern part of the Ecoregion. Continuous dry to moist tundra covers old weathered till and ancient lakebed deposits. Part of the Melville Hills visible in the distance lie inside Nunavut.



Precambrian limestones are deeply eroded by streams in the southern part of the Ecoregion. Dry weathered bedrock and thin till layers overlie the upper slopes; the lower slopes are a mixture of thicker tills, eroded slope materials and sandy river deposits. Dry tundra covers most of the valley; brighter green areas support more productive sedge-dominated seepage communities.

The level areas in the centre of this image are ancient gravelly terraces deposited by swift-flowing glacial rivers. The patterned areas in the foreground are ice-wedge polygons that are formed when extreme cold causes the ground to shrink and crack; the cracks fill with water that freezes.

Caribou graze in large post-calving herds on lush sedge and cottongrass tussock tundra covering ancient tills and lakebeds near Hornaday Lake in the northern part of the Ecoregion. These caribou are part of the Bluenose-West Herd.

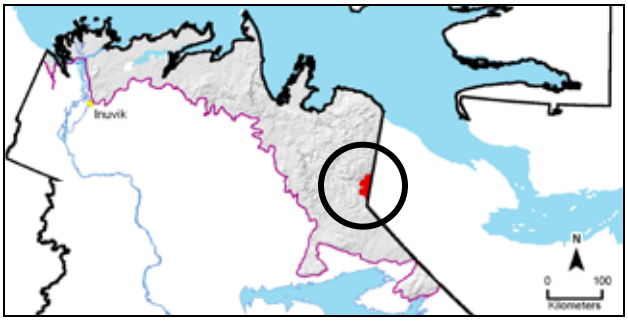
3.4.20 Hornaday Plateau LA*n* Ecoregion (ecoregion label 2.4.1.20)*

Overview: *The Hornaday Plateau LAn Ecoregion is a western outlier of the Nunavut Melville Hills and is dominated by bedrock in the north half and thin tills with dry tundra in the south half.*

Summary:

- Weathered and frost-shattered bedrock in the north half; thin to thick tills in the south half.
- Sparse tundra is dominant, with higher tundra cover on till-covered areas at lower elevations.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 624 km^2 (0.5% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 600 (480 – 700) .

General Description

The Hornaday Plateau LA*n* Ecoregion is the lower-elevation western extension of a high plateau in Nunavut that is part of the Melville Hills. It is bordered on the northwest by the valley of the Hornaday Valley LA*n* Ecoregion and on the southwest by the diverse more recently glaciated landscapes of the Hornaday Upland LA*n* Ecoregion. In the rolling terrain of the southern half, Paleozoic sandstones and Precambrian limestones are mostly covered by tills that were deposited before the most recent glaciation; there are a few small ponds. The northern half is a deeply dissected plateau outlier with exposed and weathered bedrock, patchy tills and almost no ponds. Most of the Ecoregion is sparsely vegetated by dry dwarf-shrub and sedge tundra; seepage areas at the base of slopes and in valleys support local patches of moister tundra.

Geology and Geomorphology

Most of the Ecoregion is underlain by early Paleozoic shales, sandstones and dolomites often interbedded in thin layers. The deeply eroded northwestern portion is underlain by grayish-white quartzites that are often exposed along the valley walls. Veillette (2004) and Zoltai *et al.* (1992) present evidence that the Ecoregion was not glaciated by the most recent Laurentide event. Weathered bedrock, frost-shattered bedrock, very thin tills and colluvial deposits on lower slopes characterize the northern half. Sandy to loamy ancient till veneers and blankets cover the bedrock in the southern half. Veillette (2004) maps small glaciofluvial pockets along the eastern boundary with Nunavut and small organic deposits associated with thicker tills in the southern half. Frost-shattered bedrock is the most evident permafrost feature in the northern half; ice-wedge polygons and non-sorted circles and stripes are commonly associated with till deposits.

Soils

Soils do not develop on barren bedrock or frost-shattered boulder fields in the northern half of the Ecoregion. Weakly acidic to neutral Turbic Cryosols with medium to fine textures are associated with weathered bedrock, till veneers and blankets. Organic Cryosols occur with small pockets of organic terrain in the southern half of the Ecoregion.

Vegetation

The Circumpolar Arctic Vegetation Map indicates that both prostrate dwarf-shrub tundra and nontussock sedge – dwarf-shrub – moss tundra occur in this area; both are characteristic of bioclimatic zones that span both Low Arctic and Mid-Arctic climates (CAVM Team 2003). The Tuktut Nogait National Park land classification (Fehr *et al.* 2006) indicates that sparsely vegetated tundra (dryland sedges, mountain avens and dwarf shrubs typically covering less than 30 percent of the ground surface; CAVM equivalent is prostrate dwarf-shrub – herb tundra) is the most extensive type especially in the northern half and on higher terrain in the south. Dry tundra has a similar vegetation composition to that of sparsely vegetated tundra, but plants cover more than 30 percent of the ground surface and it is more common on lower terrain. Mesic tundra (sedges, mountain avens and willows) is a minor component, occurring on seepage slopes below bedrock exposures and in low areas. Sedge – moss – dwarf-shrub wetlands (CAVM Team 2003) occur with organic soils in the northern subunit.

Water and Wetlands

There are no named waterbodies or rivers within the Ecoregion. Very few ponds occur on level areas in the northern half that is dominated by weathered and frost-heaved bedrock with thin patchy till deposits. There are more waterbodies in the southern half where till deposits are deeper. The only area where Veillette (2004) mapped organic deposits is in the southern half, where they occur in association with till veneers and blankets.

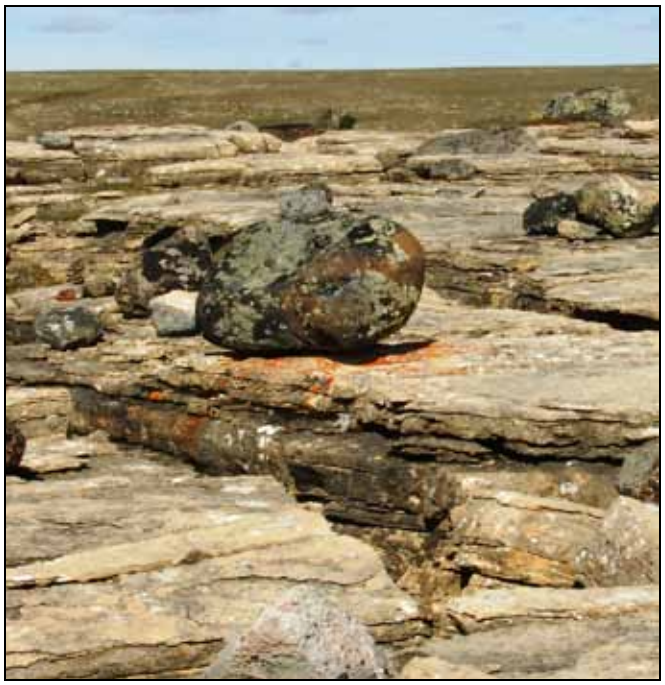
Notable Features

This Ecoregion is an important part of the Bluenose-West Caribou Herd calving grounds. Newborn calves in high elevation, poorly vegetated areas such as this Ecoregion often have higher survival because of less wolf and grizzly activity. This strategy allows maternal caribou to successfully trade-off nutrition for predator avoidance during the most critical days of the year for their young. "Nunataks" protruding above the ice sheet during the last glaciation provide biological refugia which were important for repopulating surrounding lands during deglaciation. The presence of two plant species, *Phlox richardsonii* (Richardson's phlox) and *Mertensia drummondii* (Drummond's bluebell), endemic to the northern Yukon and Alaska may be evidence of a refugium (Zoltai *et al.* 1992).

3.4.20 Hornaday Plateau LA*n* Ecoregion

The northwestern boundary of the Ecoregion is marked by a distinct escarpment. The whitish layer on the hillslope consists of cemented sands and gravels that were deposited in shallow Cambrian seas about 600 million years ago. Groundwater flowing from the base of the escarpment supports moist sedge and cottongrass tundra; the uplands have very sparse tundra vegetation.

Dwarf-shrub tundra grows in small patches on gravelly tills that blanket the bedrock. The white patch is remnant ice from a spring emerging below the bedrock; as it melts, it supplies moisture that allows better tundra growth in the seepage area to the right.



Rounded boulders sitting on exposed limestone blocks were left behind when glacial rivers washed fine-textured materials away from till layers that were deposited by glacial ice many thousands of years ago.

Arctic lupines and other herbs and dwarf shrubs carpet slopes that receive moisture from melting snow and groundwater.

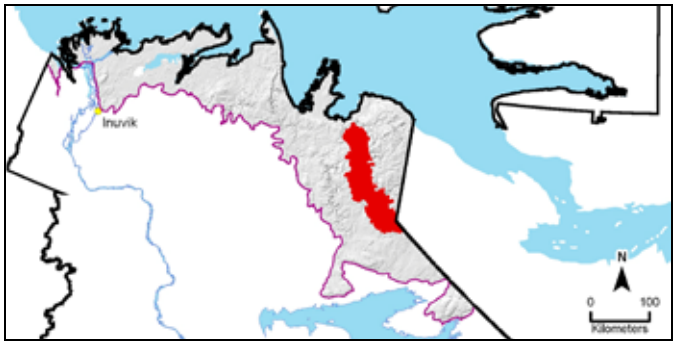
3.4.21 Hornaday Upland LA*n* Ecoregion (ecoregion label 2.4.1.21)*

Overview: *The Hornaday Upland LAn Ecoregion is topographically and geologically diverse; tills, bedrock and river-laid materials support a variety of tundra communities.*

Summary:

- The Hornaday River and its valley is the dominant feature; tills, bedrock, glaciofluvial and fluvial materials are all common and widespread.
- Dry dwarf-shrub and sedge tundra is the most common plant community type.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 7,176 km^2 (4% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 450 (150 – 650)

General Description

The Hornaday Upland LA*n* Ecoregion includes a wide range of terrain, bedrock and surficial geology features and tundra community types. Its western boundary with the Horton Upland LA*n* Ecoregion is along a height of land that defines a subregional watershed; the higher-elevation Melville Plateau LA*n* Ecoregion forms most of its eastern border. There are three subunits. The northern subunit averages 300 mASL in elevation and is a sloping, eroded upland occupying about 25 percent of the Ecoregion. The Hornaday River and its tributaries cut deeply into bedrock forming spectacular eroded landscapes and waterfalls; exposed and weathered bedrock with patchy tills is the main landform along the west side, with thicker tills elsewhere. The central subunit averages 450 mASL in elevation, is generally rolling to dissected and occupies the central 50 percent of the Ecoregion. The Hornaday River occupies a wider valley with both recent and glacial river deposits; exposed and weathered bedrock with patchy tills is dominant in the northern half and along the east side, with thicker tills in the southwest. The southern subunit averages 500 mASL in elevation, includes eroded outliers of the Melville Hills to the east and is gently undulating to rolling. Extensive glaciofluvial deposits parallel the Hornaday River which has a smaller floodplain here than in the central subunit; tills are the dominant material elsewhere. Very small portions of the central and southern subunits were probably not recently glaciated. Dry, mostly continuous dwarf-shrub and sedge tundra is the dominant community type on uplands througout, with mesic tundra in seepage areas and more complex patterns along the river and its tributaries. Permafrost features characteristic of the Low Arctic are abundant.

Geology and Geomorphology

The Ecoregion is underlain by Precambrian quartzites along the western side of the central and northern subunits and elsewhere by Paleozoic dolomites. Veillette (2004) mapped the distribution of bedrock, till and glaciofluvial features in the Ecoregion; these are summarized above in the General Description. Features of note are kame deposits in the southern subunit and some locally extensive eolian deposits associated with broad sandy fluvial flats along the Hornaday River in the central subunit. Colluvial deposits are common on the lower slopes of eroded valleys. Organic deposits are small and isolated and mostly occur with deeper tills in the southwest part of the central subunit. Common permafrost features include ice-wedge polygons, nonsorted stripes and circles, frost-shattered bedrock and in wet areas, low- and high-centre polygons.

Soils

Turbic Cryosols are the dominant soil type on neutral, loamy tills and weathered bedrock. Static Cryosols or Brunisols occur where the active layer is deeper (glaciofluvial and fluvial deposits not subject to disturbance) and Regosols on active fluvial and eolian areas and colluvial slopes. Zoltai *et al.* (1992) characterize most of the tills as loamy to fine-sandy with moderate calcareousness and the glaciofluvial and fluvial deposits as granular with moderate calcareousness.

Vegetation

The Circumpolar Arctic Vegetation Map assigns most of the Ecoregion to the graminoid – prostrate dwarf-shrub – forb tundra community type (CAVM Team 2003). Similarly, Fehr *et al.* (2004) mapped most of the Ecoregion as dry tundra (dryland sedges, mountain avens and dwarf shrubs typically covering more than 30 percent of the ground surface). They mapped the eastern half of the northern subunit as a complex of mesic tundra (sedges, mountain avens and willows; CAVM equivalent is graminoid – prostrate dwarf-shrub – forb tundra), tussock tundra (cottongrasses and sedges; CAVM equivalent is tussock-sedge – dwarf-shrub – moss tundra) and shrub tundra (willows, arctic bearberry and mountain avens; CAVM equivalent is erect dwarf-shrub tundra); these communities are probably associated with lower slopes of the Melville Hills that receive seepage waters. Fehr *et al.* (2006) map locally extensive areas along the Horton River in the central subunit as unvegetated sands and gravels; however, Zoltai *et al.* (1992) assign a "herbs – nudum" community type to these areas which do support widely dispersed herbs and dwarf shrubs.

Water and Wetlands

There are no named waterbodies in this Ecoregion. The largest lake, at the northern end of the central subunit, is locally referenced as Cache Lake (Veillette 2004). The Hornaday River is the dominant water feature; it has carved a wide floodplain in the southern and central subunits and a long, deep canyon in Precambrian dolomites in the northern subunit and its many tributaries drain the uplands and cut deep eroded valleys especially along the eastern boundary with the Melville Plateau LA*n* Ecoregion and adjacent to the West Melville Slopes LA*n* Ecoregion. Wetlands are scattered and cover small areas within the river valley and in the till areas of the southwest central subunit.

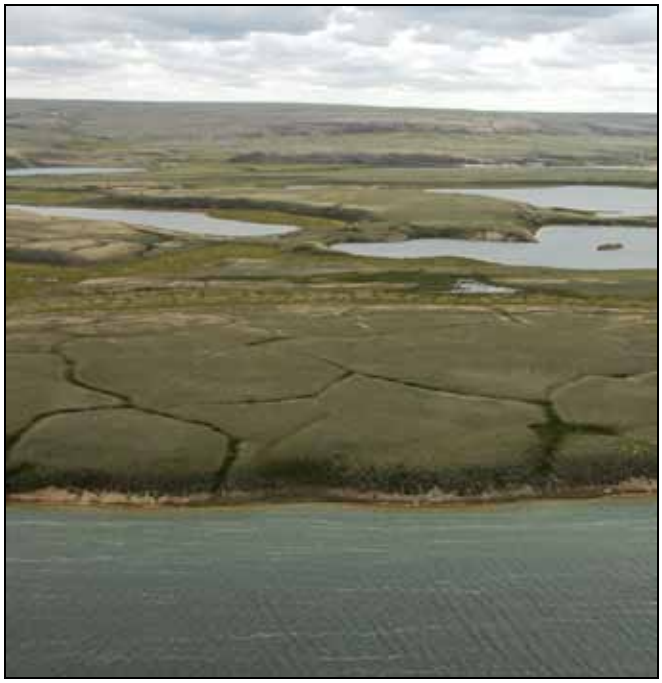
Notable Features

La Roncière Falls is a well-known feature on the Hornaday River. The steep river valley is critical nesting habitat for Peregrine Falcons, Gyrfalcons, Golden Eagles and Rough-legged Hawks.

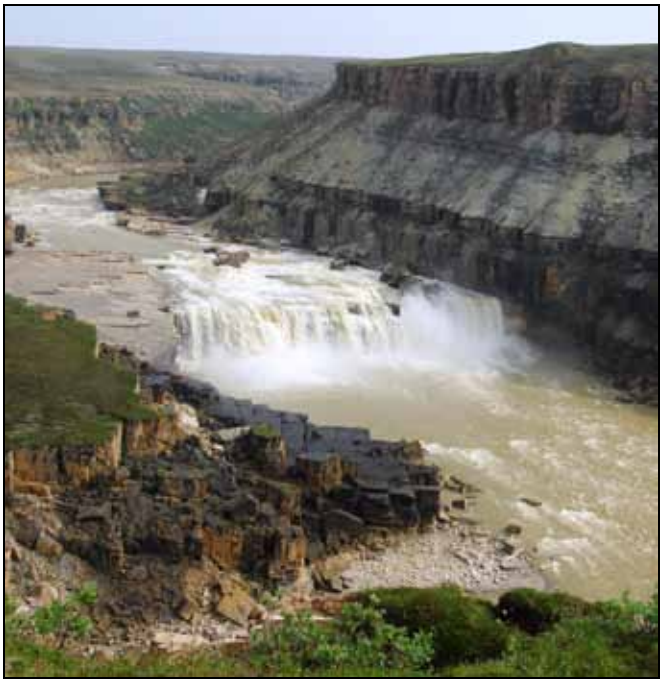
3.4.21 Hornaday Upland LA*n* Ecoregion

The Hornaday River has carved a deep canyon into Paleozoic dolomites in the northern part of this Ecoregion. Till and bedrock uplands on either side support a combination of dry tundra with dwarf shrubs and sedges (grayish-green tones on higher ground) and moist sedge tundra receiving seepage (brighter green tones beside canyon).

In contrast to the left-hand image, the Hornaday River occupies a broad valley in the central part of the Ecoregion. The whitish areas are sand bars that are sparsely vegetated and often disturbed by floodwaters or ice scouring. The adjacent uplands are a combination of glacial till and bedrock that support dry dwarf-shrub and sedge tundra.



Glacial rivers deposited thick sand and gravel layers in old meltwater channels in the southern part of the Ecoregion. The large cracks on the grayish dry tundra-covered glaciofluvial terrace in the foreground are formed by frost action. The till plains in the distance were formed when glacial ice melted and released large volumes of fine to coarse sediments.



La Roncière Falls tumbles over fractured bedrock within a deep limestone canyon along the lower reaches of the Hornaday River in the northern part of the Ecoregion. Mists from the falls provide a somewhat moister local environment that allows the growth of sedge, low-shrub and moss communities on the adjacent bedrock plates.

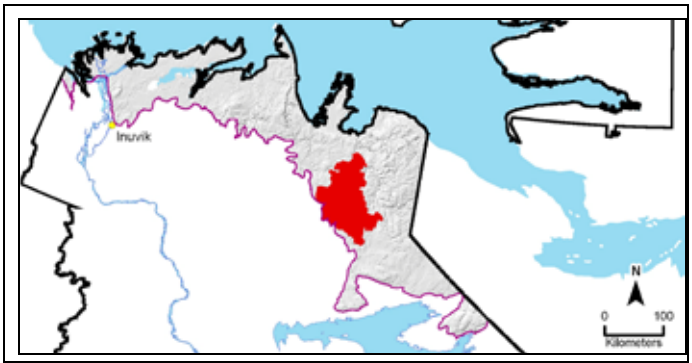
3.4.22 Horton Upland LA*n* Ecoregion (ecoregion label 2.4.1.22)*

Overview: *The Horton Upland LAn Ecoregion is a bedrock-controlled sloping till plain that is dissected by the Horton River and its tributaries, with vegetation that indicates a transition from Low Arctic to High Subarctic climates.*

Summary:

- Thin tills over dolomitic bedrock and glaciofluvial deposits.
- Open stunted spruce and low-shrub tundra in the south, a complex of dry to moist tundra throughout.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 8,530 km^2 (5% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 400 (200 – 550)

General Description

The Horton Upland LA*n* Ecoregion is a bedrock-controlled till landscape that slopes from east to west. The central third of the Ecoregion is dominated by the Horton River and its tributaries that have cut deeply into Paleozoic dolomites to produce a complex dissected landscape. The Ecoregion is bordered on the east by the Hornaday Upland LA*n* Ecoregion; a height of land separates these two Ecoregions. It is distinctly different from the till-blanketed lower-elevation terrain of the South Horton Plain LA*n*, Taiga Plains Anderson Plain HS (High Subarctic) and Central Horton Plain LA*n* Ecoregions to the south, southwest and northwest respectively. It has well-defined dendritic drainage systems and very few lakes. Till deposits are generally thin and there are numerous bedrock exposures. Dry, sandy to gravelly glaciofluvial terraces are common. Vegetation communities are highly variable depending on topography and parent materials. On thin upland tills, dry dwarf-shrub tundra is dominant; seepage slopes below bedrock outcrops and thicker tills support moist sedge and cottongrass tundra. Areas where lake density is higher generally have a higher proportion of moist to wet tundra. Conifers grow in the southern third of the Ecoregion and along most of the Horton River valley and its lower tributaries and along with willow and dwarf birch tundra indicate a transition from Low Arctic to High Subarctic climates. Permafrost features characteristic of the Low Arctic are common throughout.

Geology and Geomorphology

The Ecoregion is underlain by Precambrian dolomites that, although covered by thin till deposits, are frequently exposed. Thicker till deposits occur along the eastern side and are associated with higher lake densities. Sandy to gravelly glaciofluvial deposits are common throughout the Ecoregion and locally extensive along the Horton River and its major tributaries. Tors (eroded bedrock stacks) in stream channels along the eastern side of the Ecoregion might indicate that part of it was unglaciated in the most recent glacial period. Permafrost features characteristic of the Low Arctic are common and widespread and include high- and low-centre polygons, ice-wedge polygons, non-sorted circles and stripes and frost heaved and shattered bedrock. Ice-wedge polygons are less well developed in the southern part of the Ecoregion and along with vegetation, this trend probably indicates a Low Arctic to High Subarctic transition to the south.

Soils

Turbic Cryosols are probably the dominant soil type across the northern half of the Ecoregion. In the southern half, where High Subarctic climatic influences are evident, it is likely that Static Cryosols are also common and weakly acidic to neutral Brunisols will be associated with well-drained sandy and gravelly glaciofluvial deposits. Textures are variable; most parent materials are influenced by dolomitic bedrock and are probably calcareous.

Vegetation

The Circumpolar Arctic Vegetation Map assigns most of the Ecoregion to the graminoid – prostrate dwarf-shrub – forb tundra community type (CAVM Team 2003). Vegetation distribution within the Ecoregion is complex and is influenced by both climate and parent material distribution. Along the southern boundary with the Taiga Plains, tussock-sedge – dwarf-shrub – moss tundra and erect dwarf-shrub tundra are common. In the northern half of the Ecoregion, the graminoid – prostrate dwarf-shrub – forb tundra community type is characteristic of well-drained uplands. On thicker tills that hold moisture and on seepage slopes below bedrock outcrops, tussock-sedge – dwarf-shrub – moss tundra and sedge – moss – dwarf-shrub wetlands are widespread. Sparse stunted white spruce woodlands on uplands in the southern third of the Ecoregion, denser spruce stands on the valley sides and bottom of the Horton River and erect dwarf-shrub tundra in the southern half of the Ecoregion are all indicative of a Low Arctic to High Subarctic climatic transition.

Water and Wetlands

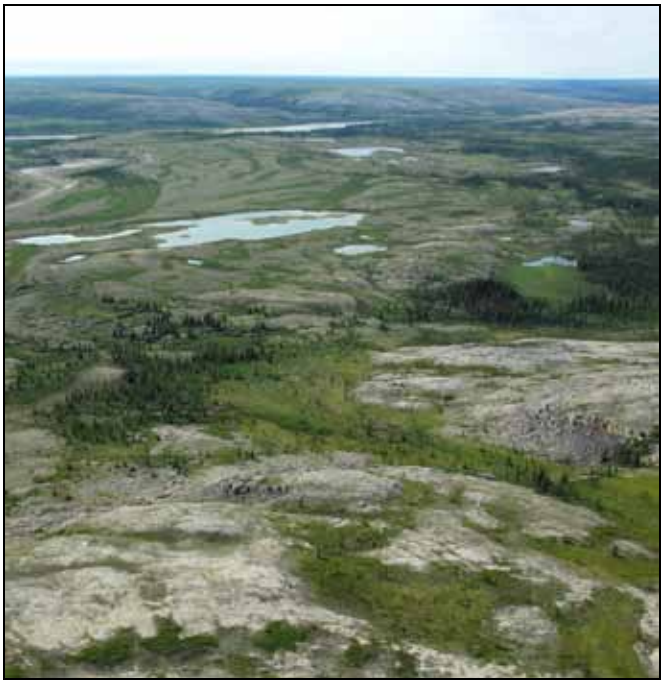
The Horton River and its tributaries are the dominant water features in the Ecoregion. Nangayuk Creek is the only other named watercourse. There are very few lakes; the highest lake densities are on thick till blankets along the eastern boundary and the only named lake (Erly Lake) is in the extreme southwest. Wetlands occur most frequently in areas of high lake density.

Notable Features

Field surveys in 2009 revealed evidence of ancient human habitation (caribou fences) in the southwestern area and one isolated pingo in a drained lake in the east-central portion. Cliffs in the area provide critical peregrine and Gyrfalcon habitat. Along the Horton River, some Gyrfalcons have been found nesting in trees, which has rarely been reported (Obst 1994).

3.4.22 Horton Upland LA*n* Ecoregion

This image shows most of the landforms and vegetation types typical of the northern half of the Ecoregion. In the foreground is moist sedge and cottongrass tussock tundra on till blankets (green tones), in the midground are dry till and bedrock uplands with dwarf-shrub tundra and in the distance are the eroded valleys of Horton River tributaries.



In the southern part of the Ecoregion, the Horton River (upper image in distance) occupies a valley that is wide in places. On the extreme right centre of this view, thin tills over bedrock on the valley edges support dry gray-toned tundra. Groves of dark green white spruce and bright green seepage tundra occupy moist areas on terraces in the midground and distance.

Limestone towers (tors) like this one in a tributary valley of the Horton River near the eastern boundary of the Ecoregion are erosional features that would probably not have survived glacial ice flows and might indicate that parts of the Ecoregion were not glaciated in the most recent ice age.

Pingos are common in the Tuktoyaktuk area, but are uncommon this far inland. This pingo occurs in a drained lake bed and formed when water froze and pushed up the overlying lakebed sediments. Dry tundra and shrub colonies cover the pingo surface; bright green wet sedge fens surround it. Numerous tracks leading to the pingo indicate the importance of these features to caribou and other species.

3.4.23 South Horton Plain LA*n* Ecoregion (ecoregion label 2.4.1.23)*

Overview: *The South Horton Plain LAn Ecoregion includes till and glaciofluvial deposits and occupies a shallow bowl-shaped plain.*

Summary:

- Complex of thin to hummocky till and terraced to pitted glaciofluvial deposits.
- Low-shrub tundra is the most extensive vegetation type; trees occur in the southern third and along the Horton River.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.

Total area: 3,436 km^2 (2% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 375 (300 – 450)

General Description

The South Horton Plain LA*n* Ecoregion is a level to gently undulating till and glaciofluvial landscape that occupies a shallow bowl-shaped plain surrounded by gently sloping highlands. It is bordered to the west by the Taiga Plains and the woodland-dominated Anderson Plain HS (High Subarctic) Ecoregion, to the south and east by the higher terrain of the Great Bear Upland LA*n* Ecoregion and to the north by the bedrock-controlled Horton Upland LA*n* Ecoregion. Tills are generally thin over Paleozoic sandstones in the north half and bedrock exposures are common. Thicker tills blanket dolomites and limestones south of Horton Lake. Glaciofluvial deposits are common throughout the Ecoregion with most occurring in two main areas east and north of Horton Lake. Dry dwarf-shrub tundra is restricted to the northern extreme; elsewhere, low-shrub tundra dominated by dwarf birch is the main cover type. Open, stunted conifer groves occur in the southern third of the Ecoregion and denser stands occur in the valleys of the Horton River and its tributaries and indicate a transition from Low Arctic to less extreme High Subarctic climates. Permafrost features typical of Low Arctic conditions are widespread throughout the Ecoregion.

Geology and Geomorphology

The Ecoregion is an eastern continuation of an extensive plain that includes the much larger Anderson Plain HS Ecoregion to the west. The north half is underlain by Cambrian and Devonian limestone, dolomite and calcareous shale bedrock that is often exposed at the surface through thin, discontinuous till deposits. The south half is underlain by Jurassic and Cretaceous sandstones and quartzites that are covered by thick till deposits, including areas of hummocky disintegration till that are the easternmost extent of large till deposits that extend well to the north and west (Prest *et al.* 1968). Fulton (1995) maps two extensive gravelly to sandy glaciofluvial deposits that are 30 kilometres in length and three to seven kilometres wide; one is along the south side of Horton Lake extending east and the other is about 30 kilometres to the north. Aerial transects in 2009 indicated that glaciofluvial materials are extensively distributed across the Ecoregion outside of these mapped areas and include glaciofluvial terraces, pitted glaciofluvial plains and kame mounds. This Ecoregion has a higher proportion of organic terrain than most other Southern Arctic ecoregions to the north and east. Permafrost features typical of Low Arctic climates are common; ice-wedge polygons occur throughout and high-centre polygons and non-sorted circles are more common north of Horton Lake.

Soils

Turbic Cryosols are associated with medium-textured acidic to neutral tills that are probably moderately calcareous. Static Cryosols and Brunisols are associated with well- to rapidly-drained sandy and gravelly tills and glaciofluvial deposits where the active layer is deeper and cryoturbation is less of an influence. Thin Organic Cryosols are associated with sedge fens.

Vegetation

Vegetation cover in the Ecoregion reflects both Low Arctic and High Subarctic climatic influences. Tundra cover is continuous. The main tundra types are erect dwarf-shrub tundra and low-shrub tundra with tall dwarf birch and willows as dominant species and tussock-sedge – dwarf-shrub – moss tundra in wetlands. At the extreme north end of the Ecoregion, prostrate dwarf-shrub – herb tundra communities occur on dry thin tills and glaciofluvial deposits. Small clumps or sparsely treed stands of stunted white spruce less than five metres tall occur throughout the southern third of the Ecoregion. Along the Horton River and its tributaries, protected valley slopes and well-drained river terraces support taller, denser woodlands. Appendix 4 discusses possible future modifications to the Southern Arctic – Taiga Plains boundary based on additional aerial information collected after 2005 when the northern boundary of the Taiga Plains was defined.

Water and Wetlands

The only named lake in the Ecoregion is Horton Lake with an area of about 175 square kilometres. Many small, shallow ponds occur in a narrow crescent-shaped lowland area that curves from the north to the west north of Horton Lake. The only named watercourse is the Horton River that occupies a shallow, wide valley for most of its length and flows from east to west. Numerous parallel drainages flow toward Horton Lake from the highlands of the Great Bear Upland LA*n* Ecoregion to the south, east and northeast.

Notable Features

The area north of Horton Lake may have been an important centre for muskoxen to repopulate range after widespread commercial extermination. Large post-calving herds of caribou frequent this area. Many species of birds and mammals mainly associated with boreal habitats are found in forested outliers.

3.4.23 South Horton Plain LA*n* Ecoregion

Hummocky glacial till deposits in the distance along the east shore of Horton Lake were deposited by glacial ice that carried large quantities of rock rubble. In the midground and foreground, small flat-topped eroded terraces are the remnants of glacial riverbeds; they are covered with dry tundra, cracked by permafrost and surrounded by wet sedge fens.

Thin tills overlie bedrock in the northern part of the Ecoregion. There are several types of tundra in this view. Dry tundra (grayish-green tones) includes dwarf shrubs and sedges and occurs on well-drained thin soils. Below the small bedrock cliff (midground) and in low-lying upland areas, surface waters and groundwater seepage support sedge (light green) and taller shrub (dark green) tundra.

Near the western boundary of the Ecoregion with the adjacent Anderson Plain HS Ecoregion, open white spruce woodlands and dwarf birch grow on dry sandy outwash deposited by glacial rivers. Potholes left by melting ice are occupied by shallow ponds; old stream channels are faintly visible in the foreground and midground.

A small stand of balsam poplar (silver-green leaves) occurs with tall willow on a warm, moist slope at the extreme south end of the Ecoregion.

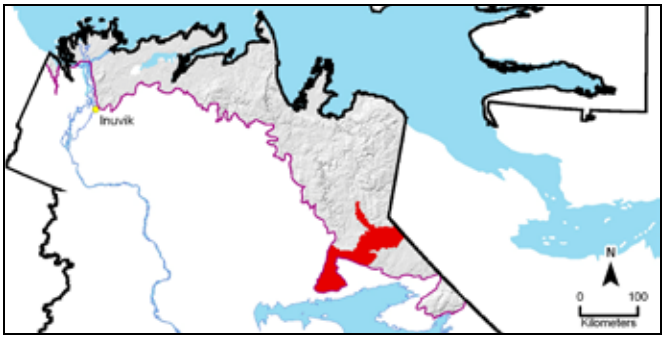
3.4.24 Great Bear Upland LA*n* Ecoregion (ecoregion label 2.4.1.24)*

Overview: *The Great Bear Upland LAn Ecoregion is a till-covered highland with extensive glaciofluvial gravels and sands and continuous tundra.*

Summary:

- A southern extension of the Melville Hills, with hummocky tills in the west, thinner tills in the east and glaciofluvial deposits throughout.
- Continuous low-shrub tundra with some tree growth in lowlands and on warm slopes in the southwestern half.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 6,228 km^2 (4% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 475 (350 – 700)

General Description

The Great Bear Upland LA*n* Ecoregion is an elongated irregularly shaped highland extending south from the Melville Hills to the north shore of Great Bear Lake. It is surrounded to the west, north, south and southeast respectively by the lower-elevation Great Bear Upland HS (High Subarctic – Taiga Plains), South Horton Plain LA*n*, Grandin Plain HS and Grandin Upland LA*n* Ecoregions; except for elevational differences, it is quite similar to the South Horton Plain LA*n* Ecoregion. Hummocky till overlies Paleozoic quartzites in the western half of the Ecoregion. Till deposits are generally not as thick in the eastern half and Paleozoic dolomites and limestones are exposed in places. Hundreds of ponds dot the landscape and many small streams that drain into the surrounding lower plains originate on the higher ridges. Glaciofluvial sands and gravels are common throughout the Ecoregion and include terraces, pitted outwash, eskers and kame deposits. Dry dwarf-shrub tundra occurs in the northern third of the Ecoregion on well-drained uplands. Low-shrub tundra with dwarf birch and willow is the most extensive type, with wet sedge tundra in depressions. On warm southerly exposures and well-drained gravelly soils in the southwestern half of the Ecoregion, sparse conifer growth occurs; there are locally extensive relatively dense stands in the lowest part between Horton and Great Bear Lakes. The northeastern half is treeless. Permafrost features typical of the Low Arctic occur throughout and together with the extensive occurrence of low-shrub tundra and trees along the southern and western boundaries, indicate that the Ecoregion is influenced by both Low Arctic and High Subarctic climates.

Geology and Geomorphology

The northeastern half of the Ecoregion is underlain by Cambrian-Devonian limestone, dolomite and calcareous shale bedrock that is often exposed at the surface through thin till deposits. The southwestern half is underlain by Jurassic-Cretaceous sandstones and quartzites that are mostly covered by hummocky disintegration till. Fulton (1995) has mapped several long, narrow glaciofluvial deposits within the Ecoregion that probably occupy meltwater channels carved by large glacial rivers. Glacial flutings in the lowest-elevation part of the Ecoregion between Horton Lake and Great Bear Lake indicate the influence of flowing glacial ice. Eskers, kame mounds, terraces and pitted outwash are common throughout the Ecoregion. Thin organic deposits are locally extensive. Permafrost forms typical of the Low Arctic that occur throughout the Ecoregion include ice-wedge polygons, non-sorted circles and stripes and high-centre polygons in wet areas.

Soils

Turbic Cryosols are associated with finer-textured tills that are probably moderately calcareous. Static Cryosols and Brunisols are associated with well- to rapidly-drained sandy and gravelly glaciofluvial and till deposits where the active layer is deeper and cryoturbation is less of an influence. Thin Organic Cryosols are associated with sedge fens.

Vegetation

Vegetation cover in the Ecoregion reflects both Low Arctic and High Subarctic climatic influences. Tundra cover is continuous. The main tundra types are low-shrub tundra with tall dwarf birch and willows as dominant species and tussock sedge – dwarf-shrub – moss tundra in moister areas. On dry exposed areas in the northeastern third of the Ecoregion, graminoid prostrate dwarf-shrub – forb tundra communities occur on thin tills and on glaciofluvial deposits. Sparse patches of stunted white spruce less than five metres tall occur on warm southerly slopes and in low-lying areas in the southwest half of the Ecoregion; in the lowest part between Horton and Great Bear Lakes, there are places where tree cover is denser and continuous. The southernmost part of the Ecoregion was identified as a largely treeless area in 2005 leading to its assignment to the Southern Arctic at that time based on incomplete coverage; 2009 aerial transects through the centre indicated that trees are relatively common below the high east-west ridge at the southern extreme. Appendix 4 discusses possible future modifications to the Southern Arctic – Taiga Plains boundary based on a better understanding of conifer distribution.

Water and Wetlands

There are no named lakes in the Ecoregion, but hundreds of small ponds are more or less evenly distributed. Many small streams follow erosion channels or old meltwater channels. Named streams and rivers include the Haldane, Bloody, Big Spruce and Horton Rivers, Omstead Creek and Glacier Ice Creek. Wetlands occupy depressions and meltwater channels and may be locally extensive.

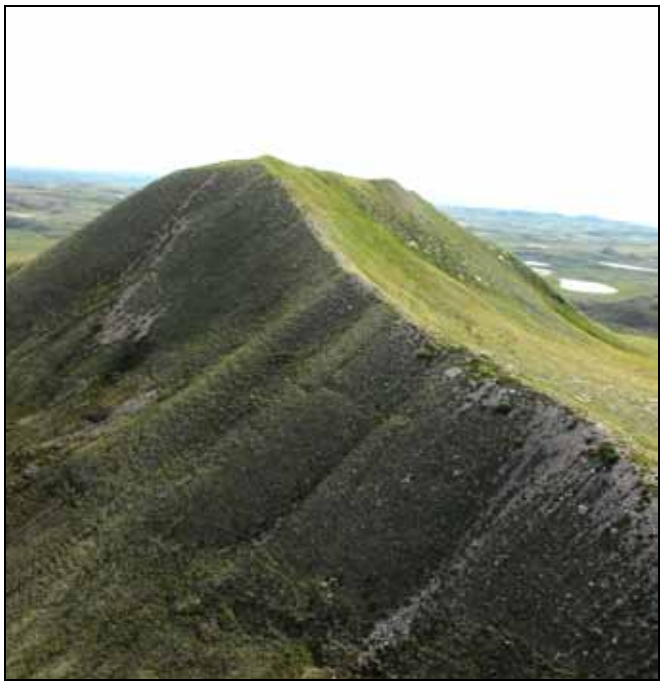
Notable Features

Outstanding kame features occur within this Ecoregion. Several important caribou migration paths cross this ecoregion. Good habitat is available year round for muskoxen.

3.4.24 Great Bear Upland LA*n* Ecoregion

The northern half of the Ecoregion is a treeless tundra plain. In this view, shallow ponds and bright-green sedge fens occupy a channel that once carried glacial meltwaters. Dry dwarf-shrub tundra (greenish-gray) covers gravelly tills adjacent to the channel; the small gray scar at the bottom left is a slump that developed when permafrost melted.

In the southernmost part of the Ecoregion near its border with the Taiga Plains, black and white spruce form small groves on well-drained and relatively warm sandy to gravelly tills and glacial river deposits. Higher landscapes just to the east of this locale are treeless.



This sharply-ridged hill in the central part of the Ecoregion is a kame mound that was formed when glacial meltwaters flowing alongside and over stagnant glacial ice dropped silts, sands and gravels on ice-free lands adjacent to the ice front.

Arctic ground squirrels inhabit sandy mounds that support dwarf shrubs like arctic bearberry and willow, and tall reed grasses.

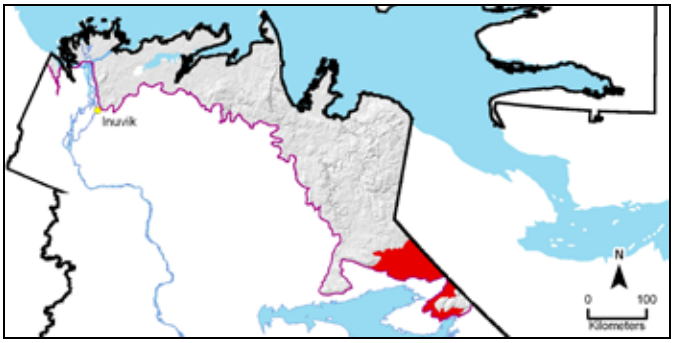
3.4.25 Grandin Upland LA*n* Ecoregion (ecoregion label 2.4.1.25)*

Overview: *The Grandin Upland LAn Ecoregion is a complex of exposed bedrock and till deposits; dry to wet tundra and scattered tree groves indicate the combined influence of High Subarctic and colder Low Arctic climates.*

Summary:

- Extensive till and bedrock complex to the northwest, with thicker tills and less bedrock on the lower slopes of the Grandin Hills to the southeast.
- Dry to wet shrub and sedge tundra, exposed bedrock and mixed conifers as individuals or open woodlands.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 6,524 km^2 (4% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 375 (225 – 450)

General Description

The Grandin Upland LA*n* Ecoregion is a gently sloping till-dominated plain that slopes gently upward to its eastern boundary along the Northwest Territories – Nunavut border and extends south and east to form a mid-elevation belt between the higher Grandin Hills LA*n* Ecoregion and the lower Taiga Plains Grandin Upland HS (High Subarctic) Ecoregion. It is geologically and geomorphologically more variable than surrounding Ecoregions. There are two subunits. The larger northern subunit is underlain by Paleozoic limestones and dolomites; bedrock exposures are common and locally extensive and occur as frost-shattered pavements, hills and cliffs. Glacial ice scoured much of this subunit and left behind a complex of linear lakes, polished bedrock, tills of variable thickness, glaciofluvial sands and gravels and finer-textured lacustrine deposits. The narrow, crescent-shaped southern subunit surrounds the higher Grandin Hills LA*n* Ecoregion. Precambrian dolomites, sandstones and volcanic rock are the predominant bedrock types and are mostly blanketed by thicker tills, but are exposed in places; seepage and streamflow from the Grandin Hills LA*n* Ecoregion contribute to the development of locally extensive wetlands. The dominant vegetation types are low-shrub tundra and sedge tussock tundra. White spruce groves occur locally throughout the southern subunit and the southern half of the northern subunit and together with the widespread occurrence of Low Arctic permafrost features, indicate that most of this Ecoregion is influenced by both High Subarctic and Low Arctic climates.

Geology and Geomorphology

The bedrock underlying the Ecoregion includes both Cambrian and Precambrian formations; their distribution is summarized in the General Description section. Numerous southwest- to northeast-trending eskers and a few kame mounds occur along the Northwest Territories – Nunavut border in the northern subunit. Localized glaciofluvial deposits are found in both subunits. Fulton (1995) maps an extensive lacustrine area that extends into the Ecoregion from the adjacent Grandin Plain HS Ecoregion to the west. Widespread Low Arctic permafrost features include ice-wedge polygons, well-defined non-sorted circles and stripes and frost-shattered bedrock; high-centre polygons are present at higher elevations where trees do not occur.

Soils

Turbic Cryosols are widespread on tills. Static Cryosols and Brunisols are associated with well- to rapidly-drained sandy and gravelly glaciofluvial and till deposits where the active layer is deeper and cryoturbation is less influential. Thin Organic Cryosols are associated with sedge fens.

Vegetation

The Circumpolar Arctic Vegetation Map indicates that the general area occupied by the Ecoregion is a complex of several Low Arctic tundra types and very open conifer woodlands. Higher elevations in the northern part of the northern subunit are dominantly graminoid – prostrate dwarf-shrub – forb tundra (sedges, cottongrasses, mountain avens, dwarf willows) on dry well-drained tills and glaciofluvial deposits. Elsewhere in this subunit and throughout the southern subunit, tundra types associated with dry to moist sites are prevalent and include erect dwarf-shrub tundra (dwarf birch, willows, northern Labrador tea, blueberry), low-shrub tundra (dwarf birch, willows and green alder more than 40 cm tall), tussock-sedge – dwarf-shrub – moss tundra (tussock-forming sedges and cottongrasses, prostrate and erect dwarf shrubs) and sedge – moss – dwarf-shrub wetlands, the latter occurring most extensively in the southern subunit on seepage slopes below the Grandin Hills. Low-growing and widely spaced individual white and black spruce trees and open groves are widespread in the southern half of the northern subunit and throughout the southern subunit and indicate the transition between Low Arctic and High Subarctic climates. Appendix 4 discusses possible future modifications to the Southern Arctic – Taiga Plains boundary based on additional aerial information collected after 2005 when the northern boundary of the Taiga Plains was defined.

Water and Wetlands

Waterbodies are most common in the northern subunit and most of the largest lakes are associated with the linear features scoured by glacial ice near the Northwest Territories – Nunavut border. Lac le Roux is the only named lake. There are numerous named watercourses, including the Haldane, Dease, East and Greenhorn Rivers and Janitzi, Blood, Cosmo, Anderson and Bunn Creeks. Many of these watercourses are confined to narrow channels and include many rapids where the streams flow over exposed bedrock. Wetlands are locally extensive throughout the Ecoregion and occupy relatively large portions of the southern subunit.

Notable Features

Bluenose-East Caribou use this Ecoregion in relatively high densities for rutting in the fall, and migrate through this area between calving and wintering ranges (Veitch *et al.* 2008). The southern subunit is part of the Caribou Point peninsula that has been recommended for status under the Northwest Territories Protected Areas Strategy.

3.4.25 Grandin Upland LA*n* Ecoregion

Ice-polished bedrock exposures (grayish tones in lower right image) and discontinuous, boulder tills covered by low-shrub and sedge tussock tundra are extensive across the northern subunit, the largest part of the Ecoregion.

The southern subunit mainly surrounds the adjacent Grandin Hills LA*n* Ecoregion and receives seepage from it. Bedrock exposures do occur but are not as dominant and because of the seepage, wet sedge and low-shrub tundra are prevalent. Conifers are common and indicate the influence of a slightly less extreme High Subarctic climate.

Limestone cliffs about 40 km inland from Great Bear Lake provide good nesting habitat for some kinds of raptors, such as gyrfalcons. The habitat around these cliffs is diverse, with stunted conifer groves on protected slopes, dry to wet tundra communities, many small ponds and exposed, ice-polished and frost-shattered bedrock.

This ptarmigan chick blends almost invisibly into the sedge and low-shrub tundra. Ptarmigans are year-round residents and forage for berries, seeds, leaves and buds. They turn white in winter to match the snow-covered landscape.

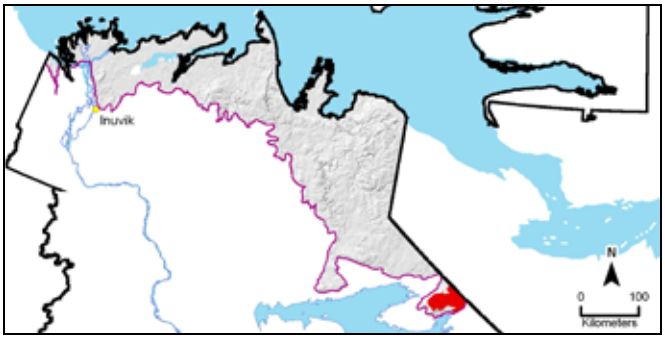
3.4.26 Grandin Hills LA*n* Ecoregion (ecoregion label 2.4.1.26)*

Overview: *The Grandin Hills LAn Ecoregion is a high-elevation till and bedrock complex with a diverse array of tundra types.*

Summary:

- Higher elevation rugged eastern half with exposed bedrock and patchy till, lower elevation western half with till blankets.
- Low-shrub tundra on thick tills and various tundra types on patchy tills depending on moisture.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 1,639 km^2 (1% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 550 (400 – 700)

General Description

The Grandin Hills LA*n* Ecoregion includes the highest elevation terrain in the Tundra Plains that lies south of the Melville Hills and its outliers. It slopes upward from west to east and is surrounded by the lower-elevation Grandin Upland LA*n* Ecoregion. Its eastern boundary in the Northwest Territories is the Nunavut – Northwest Territories border but it extends for some distance into Nunavut; its southeastern border is formed by the granitic terrain of the adjacent sparsely forested Coppermine Upland HS (High Subarctic) and Radium Hills North HS Ecoregions of the Taiga Shield. The western half of the Ecoregion is a lower-elevation, gently rolling to undulating till plain with only a few bedrock exposures. The eastern half is a more rugged high-elevation landscape of frost-shattered bedrock with till veneers. Tundra development is dependent on till thickness and distribution. In the western half, dry to moist conditions on continuous till blankets support continuous shrub and sedge tundra. In the higher-elevation eastern half, tundra occurs in patches where till deposits are thick enough to hold adequate moisture for plant growth. Higher elevations and colder conditions exclude trees from all but a very few places in this Ecoregion. Well developed permafrost features are associated with deeper tills of the western half.

Geology and Geomorphology

The Ecoregion is underlain by Precambrian sedimentary and volcanic bedrock. It was completely ice-covered during the most recent Continental glaciations and north-south glacial striations and a few drumlins are evidence of glacial ice movement across the western half, where tills blanket the bedrock. In the eastern half, bedrock is commonly exposed and can form extensive rocklands where thin till veneers occur in discontinuous patches; frost heaved and shattered rock is commonly mixed with thin till veneers in these more rugged, high-elevation landscapes. Glaciofluvial deposits occur in a few isolated pockets. Permafrost features characteristic of Low Arctic conditions include non-sorted circles and stripes and ice-wedge polygons; these are best developed on the thick till blankets and undulating to gently rolling terrain of the western half.

Soils

Turbic Cryosols are widespread on tills. Static Cryosols and Brunisols are associated with isolated pockets of well- to rapidly-drained sandy and gravelly glaciofluvial deposits where the active layer is deeper and cryoturbation is less of an influence. Thin Organic Cryosols are associated with sedge fens.

Vegetation

The Circumpolar Arctic Vegetation Map indicates that the general area occupied by the Ecoregion is a complex of several Low Arctic tundra types. Tundra development is controlled by parent materials and seepage. In the eastern half, extensive exposed bedrock limits tundra development and patchy graminoid – prostrate dwarf-shrub – forb tundra (sedges, cottongrasses, mountain avens, dwarf willows) is most common; on lower slopes where seepage occurs and water collects, tussock-sedge – dwarf-shrub – moss tundra and sedge – moss – dwarf-shrub wetlands develop. Rock lichen communities occur as variably-sized patches on exposed bedrock. Continuous tundra on dry to moist sites is dominant on deeper tills in the western half and includes erect dwarf-shrub tundra (dwarf birch, willows, northern Labrador tea, blueberry), low-shrub tundra (dwarf birch, willows and green alder more than 40 cm tall), tussock-sedge – dwarf-shrub – moss tundra (tussock forming sedges and cottongrasses, prostrate and erect dwarf-shrubs) and sedge – moss – dwarf-shrub wetlands.

Water and Wetlands

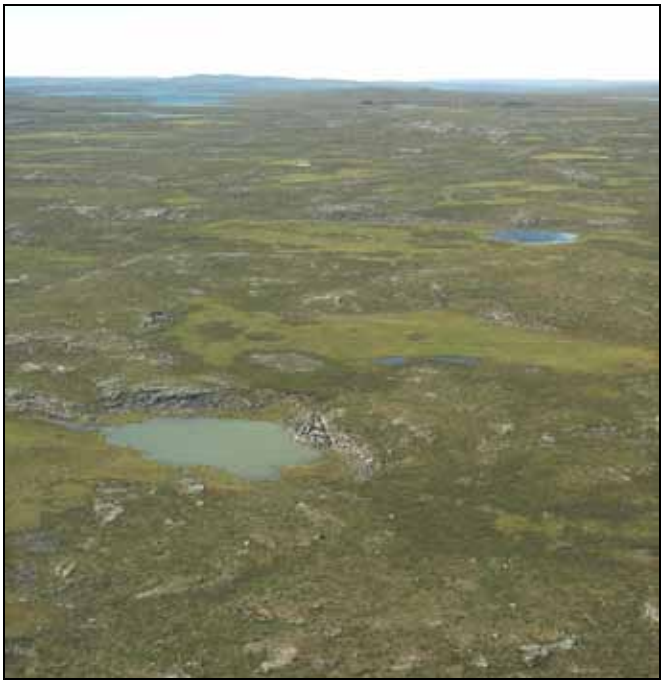
Lady Nye Lake near the Nunavut – Northwest Territories boundary is the only named lake. The Ecoregion is the headwaters of numerous named creeks and rivers. Bunn, Melville, Janitzi, Blood and Cosmo Creeks and the East River all flow into Great Bear Lake. The Bigtree River is part of the Coppermine River drainage. Wetlands are relatively common especially in the more gentle terrain of the western half but are not extensive.

Notable Features

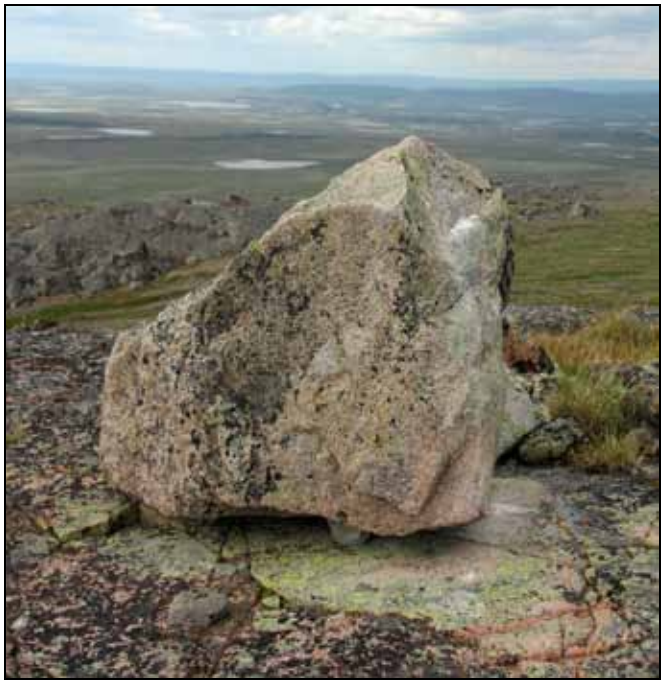
This is the highest-elevation Ecoregion south and east of the Melville Hills and its outliers and is the most southeasterly of the Tundra Plains ecoregions. Caribou seek these high windswept rock outcrops for relief from insect harassment. This Ecoregion lies entirely within the Caribou Point peninsula that has been recommended for status under the Northwest Territories Protected Areas Strategy.

3.4.26 Grandin Hills LA*n* Ecoregion

The lower-elevation western half of the Ecoregion is a nearly level to gently rolling plain with thick till blankets and a continuous cover of shrub tundra (darker green tones) on moist soils with sedge tundra in depressions and surrounding ponds and lakes (brownish-green tones).



The higher-elevation eastern half of the Ecoregion is a more rugged landscape, with frost-shattered bedrock exposed in many places through thin, discontinuous boulder tills. Tundra cover is patchy and includes dry dwarf-shrub tundra, moist low-shrub tundra and wet sedge-cottongrass tussock tundra.



This large (about $1m^3$) granitic boulder near the Northwest Territories – Nunavut border is actually resting several centimetres above the underlying bedrock, supported on three small pebbles. It was left behind by flowing glacial meltwaters that washed the finer till materials away. Rock lichens give a mottled tone to the boulder and surrounding bedrock.

The diverse, hilly tundra landscapes in this Ecoregion and in the adjacent areas provide excellent habitat for caribou.

3.5 TUNDRA SHIELD LOW ARCTIC *south* (LA*s*) ECOREGION

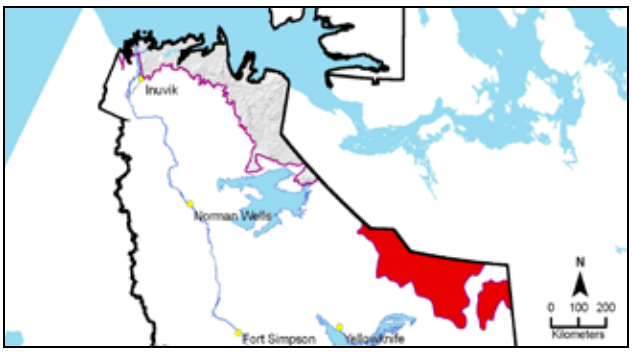
This view of the central Tundra Shield (Level IV Hanbury Plain LA*s* Ecoregion) is typical of the central and western parts of the Ecoregion which are characterized by many shallow ponds, frost shattered bedrock and till veneers and blankets. The light-green tones are a complex of dwarf-shrub, sedge and low-shrub tundra. .

The Tundra Shield Low Arctic (south) Ecoregion supports somewhat taller and more diverse tundra than much of the colder Tundra Plains Low Arctic (north) Ecoregion. Dwarf birch, northern Labrador tea, alpine bilberry, willows, sedges, cottongrasses, lichens and mosses are typical of these communities.

Alpine azalea is a colourful dwarf shrub with leathery leaves. It occurs across the Northern Hemisphere in arctic and alpine areas.

3.5 TUNDRA SHIELD LOW ARCTIC *south* (LA*s*) ECOREGION

Overview: *The Tundra Shield LAs Ecoregion has a more moderate Low Arctic climate than the Tundra Plains LAs Ecoregion. It is a complex of rocklands, till and outwash plains crisscrossed by long eskers and dotted with thousands of lakes. Shrub tundra is the main vegetation cover, with lichen tundra dominating extensive dry till deposits in the southeast.*



Total area: 72,556 km^2. Ecoregion shown in red.

General Description

The Level III Tundra Shield LA*n* Ecoregion is influenced by a continental Arctic climate. All of the area was covered by the last Laurentide ice sheet that left behind extensive till and outwash deposits and polished bedrock. Long sinuous eskers, the signature landforms of fast-flowing glacial rivers, cross the Ecoregion from west to east. Frost-shattered Precambrian granitic and sedimentary rocklands with patchy till blankets and veneers are prevalent in the higher western portion; deeper till blankets occur to the east. Fields of till drumlins sculpted by flowing ice cover thousands of square kilometres in the southeast portion. High-centre polygons, non-sorted circles and other permafrost features are evidence of continuous permafrost; Cryosols are the dominant soils. Erect dwarf-shrub and low-shrub tundra are extensive on uplands, with sedge fens in seepage areas and lowlands. Nine Level IV ecoregions are defined within the Tundra Shield LA*n* Ecoregion and are differentiated mainly by bedrock proportion and surficial material type and distribution.

Climate

The Ecoregion's vegetation and permafrost features reflect the influence of Low Arctic climates, characterized by very short, cold summers (July and August) and long, very cold winters (Ecoregions Working Group 1989). Frost and snowfall can be expected every month. There are no permanent long-term data collection stations in the Tundra Shield LA*n* Ecoregion. Climatic statistics have been modelled over large areas using limited data by Agriculture and Agri-Food Canada (1997). Climate models at the ecodistrict level for the Tundra Shield LA*s* Ecoregion within the Northwest Territories (1997) provide the following general statistics. The average annual temperature is about –9°C, the average temperature in January, the coldest month, is about –30°C and +10 to +12°C in July, the warmest month. Average annual precipitation is about 200 to 300 mm, with about 60 percent falling as rain and 40 percent as snow. The average annual daily solar input (refer to Section 1.4.2 for further explanation) is 9 to 10 mJ/m^2/day, with low values of 0.7 mJ/m^2/day in December and highs of 22 mJ/m^2/day in June. These average values are modified considerably by slope and slope aspect. Wind can be a significant factor in snow redistribution and plant survival. Refer to Section 1.4.1 for a general overview of climatic influences.

Topography, Geology, Soils and Hydrology

The Ecoregion slopes gently downward from the northwest to the southeast; the highest elevations are in the vicinity of Contwoyto Lake at over 500 mASL in the northwest portion; there is also a small hill system in the southeast corner, north of Mosquito Lake and east of the Thelon River valley. Two major bedrock complexes are separated by the McDonald Fault that lies to the west of the Thelon River valley, extending northeast from the East Arm of Great Slave Lake where it forms a prominent escarpment. The western complex is composed of very old Precambrian sedimentary rocks and intrusive granitoids. The eastern complex includes a belt of ancient Precambrian intrusive and metamorphic bedrock paralleling the McDonald Fault, east of which are somewhat younger Precambrian sedimentary rocks. The entire area was ice-covered during the most recent (Laurentide) continental glaciation. Discontinuous bouldery till blankets and veneers and extensive rocklands are prevalent west of the Thelon River. Continuous till blankets and extensive till drumlin fields occur in the uplands east of the Thelon River valley and north of Mosquito Lake. Long eskers, often flanked by outwash plains, trend northwest to southeast across much of the Ecoregion. Permafrost is continuous; ice-wedge polygons, frost-shattered bedrock, high-centre polygons and non-sorted circles provide abundant evidence of its influence. Cryosols are the dominant soil throughout, with Regosols and weakly developed Brunisols on valley slopes and alluvial terraces; there is no soil development on frost-shattered and exposed bedrock. The highest lake densities and the largest lakes occur west of the McDonald Fault.

Vegetation

Erect dwarf-shrub tundra and low-shrub tundra occurs in patches on the rocklands and discontinuous bouldery tills west of the Thelon River valley. Two tundra variants that are not described on the Circumpolar Arctic Vegetation Map (CAVM Team 2003) but that are described elsewhere (Ecosystem Classification Group 2008, Bradley *et al.* 1982) are heath – lichen tundra in which yellow and black lichen cover are dominant (till drumlin fields) and rock lichen communities that partially cover exposed rock and bouldery till. Low wet areas are occupied by a complex of sedge – moss – low-shrub and sedge – moss – dwarf-shrub tundra; peatlands are uncommon. Obst (2008) mapped the distribution of 15 upland and wetland vegetation types in the Daring Lake area; these types are likely applicable to similar landscapes across the Tundra Shield.

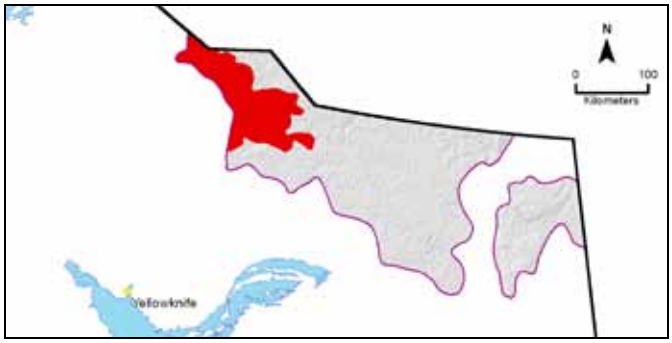
3.5.1 Point Upland LAs Ecoregion (ecoregion label 2.4.2.1)*

Overview: *The Point Upland LAs Ecoregion is a rugged, bedrock dominated landscape with extensive bouldery tills and patchy dwarf-shrub and rock lichen communities.*

Summary:

- Bedrock and bouldery till plains west of Lac de Gras; bouldery till plains with finer-textured materials east of Lac de Gras.
- Dwarf-shrub tundra and rock lichen communities on bedrock and boulders are the dominant vegetation types.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 11,032 km^2 (7% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 450 (400-500)

General Description

The Point Upland LAs Ecoregion is the mostly treeless northern continuation of the Taiga Shield Point Upland HS (High Subarctic) Ecoregion; it includes more extensive areas of exposed bedrock than the neighbouring and somewhat higher Contwoyto Upland LAs Ecoregion to the north and the Mackay Upland LAs Ecoregion to the south. West of Lac de Gras, the Ecoregion is dominated by rugged Precambrian rocklands often blanketed by bouldery till that limits tundra development to scattered patches. East of Lac de Gras, finer-textured tills allow more extensive tundra development. A few large lakes that follow major fault lines, hundreds of small, shallow ponds and small eskers a few kilometres in length contribute to landscape diversity. Permafrost is continuous and indicated by non-sorted and sorted circles and frost-shattered bedrock. Discontinuous low-shrub and erect dwarf-shrub tundra are dominant, with rock lichen communities on till boulders and exposed bedrock. Stunted individual white spruce trees and small groves occur near the boundary with the Taiga Shield Point Upland HS Ecoregion, indicating the transition from High Subarctic to more extreme Low Arctic climates.

Geology and Geomorphology

A rugged, broken landscape dominates the Ecoregion west of Lac de Gras, where fractured and ice-scoured Precambrian granitic and sedimentary bedrock is exposed over large areas, often occurring with frost-shattered bouldery till plains. East of Lac de Gras, bouldery tills are common but have sufficient fine materials for the development of permafrost features such as non-sorted circles. Small eskers a few kilometres in length are often associated with outwash plains; both occur throughout the Ecoregion and include a range of textures from sands to boulders. Permafrost is continuous; its expression is mostly seen as frost-shattered bedrock and non-sorted circles where there are finer-textured till deposits.

Soils

Mineral soils are Turbic and Static Cryosols, the latter more characteristic of deep, well-drained coarse-textured deposits such as eskers. Soils are thin or absent on exposed bedrock. Organic Cryosolic soils are associated with high-centre polygons and wetlands.

Vegetation

Much of the Point Upland LAs Ecoregion is shrub and sedge tundra; bilberry, mountain cranberry, black crowberry, red bearberry, dwarf birch, mountain avens, lichens, sedges and cottongrasses are common species. The main vegetation types are erect dwarf-shrub tundra and low-shrub tundra. They occur with nearly continuous cover on finer-textured till veneers in the central and southern third of the Ecoregion, but as patches in the northwestern third where rocklands and bouldery tills dominate the landscape. Till boulders and exposed bedrock support rock lichen communities. Scattered clumps and individuals of stunted white spruce occur within about 20 kilometres of the boundary between this Ecoregion and the neighbouring Taiga Shield Point Upland HS Ecoregion, indicating a broad transition zone between High Subarctic and Low Arctic climates in this area. Seepage zones and low-lying areas support localized sedge – moss – low- and dwarf-shrub wetlands, with tall willow and alder shrublands in stream drainages and along lakeshores near the Tundra Shield – Taiga Shield boundary. Obst (2008) mapped the distribution of 14 upland and wetland vegetation types in the Daring Lake area.

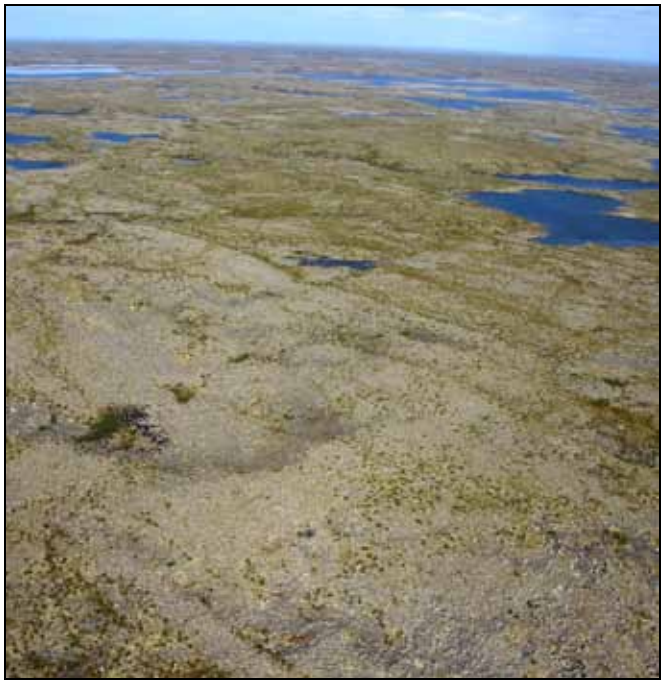
Water and Wetlands

Lac de Gras and Afridi, Courageous, Itchen, Mackay, Point, Thonokied and Yamba Lakes are the largest waterbodies in the Ecoregion. The Coppermine River flows through the Ecoregion to the northeast. Wetlands are scattered and are more common east of Lac de Gras where somewhat finer till materials occur. High-centre polygons are uncommon especially in the central and western rockland-dominated areas where peat accumulation occurs at very slow rates.

Notable Features

Extensive boulder fields covering many square kilometres and containing huge erratics are a unique feature of this Ecoregion. Breeding Eskimo Curlews were reported at Point Lake (Swainson and Richardson 1831). The Daring Lake Research Station is located in the central portion of this Ecoregion and supports Canadian and international Arctic researchers.

3.5.1 Point Upland LAs Ecoregion



Hummocky frost-shattered bedrock, bouldery till deposits and deep lakes occupying bedrock fractures are characteristic of the Ecoregion west of Lac de Gras. Some areas (light gray tones) are barren of vegetation except for lichen crusts; the speckled yellowish-green tones are small patches of dwarf-shrub tundra that are associated with moister areas and pockets of finer-textured tills.

The landscapes east of Lac de Gras in this image contrast sharply with the western rocklands shown on the image to the left. The terrain is nearly level to undulating and although bouldery till is the dominant deposit, higher proportions of fine materials allow the development of a more continuous tundra cover.

A closer view of the landscape shown in the upper left image reveals how tundra develops along fractures and between knobs of ice-polished bedrock, where finer-textured materials collect and hold moisture in depressions.

Barren-ground grizzly bears forage along lakeshores where low-shrub tundra and diverse landscapes provide feeding opportunities.

3.5.2 Contwoyto Upland LAs Ecoregion (ecoregion label 2.4.2.2)*

Overview: *The Contwoyto Upland LAs Ecoregion includes level to hummocky bouldery till deposits on which nearly continuous shrub tundra cover has developed.*

Summary:

- Bouldery till plains with sufficient fine textured materials to support continuous tundra development occur throughout.
- Dwarf-shrub tundra is the most common tundra type, but low-shrub tundra is prevalent in the eastern third.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.

Total area: 6,994 km^2 (4% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 500 (400-500)

General Description

The Contwoyto Upland LAs Ecoregion is the highest-elevation Level IV ecoregion in the Tundra Shield. It is bordered on the south and east respectively by the slightly lower-elevation Point Upland LAs Ecoregion and Healey Upland LAs Ecoregion, both of which have a higher proportion of exposed bedrock. Till hummocks and bouldery till veneers and blankets cover the underlying Precambrian bedrock which outcrops as scattered ice-scoured and frost-shattered knobs and hills. Small eskers, outwash plains and local kame deposits occur throughout. Permafrost is continuous and is indicated by extensive well-developed non-sorted circles and nets. Erect dwarf-shrub tundra is the dominant vegetation type and is generally continuous; low-shrub tundra is locally extensive in the eastern portion.

Geology and Geomorphology

This Ecoregion and the adjacent Point Upland LAs Ecoregion are underlain by a complex of Precambrian granitic and sedimentary bedrock. Although rock exposures do occur throughout the Ecoregion, the bedrock is mostly overlain by bouldery till veneers and blankets and hummocky till deposits; a variable proportion of fine materials in combination with available moisture influences the type and degree of tundra development, with higher tundra cover typical of moist, finer-textured tills. Small eskers generally trending northwest – southeast are scattered throughout as are small kame deposits. Non-sorted circles are the most widespread evidence of permafrost.

Soils

Mineral soils are Turbic and Static Cryosols, the latter more characteristic of deep, well-drained coarse-textured deposits such as eskers. Organic Cryosolic soils are associated with high-centre polygons and wetlands.

Vegetation

The main vegetation types are erect dwarf-shrub tundra and low-shrub tundra that occur with nearly continuous cover across most of the Ecoregion. Erect dwarf-shrub tundra is the most common tundra type, but low-shrub tundra is locally extensive on the gently undulating till plains between Glowworm and Muskox Lakes. Rock lichen communities colonize till boulders and exposed bedrock. No trees were noted anywhere in the Ecoregion during 2009 field surveys. Seepage areas and low-lying terrain support localized sedge – moss – low and dwarf-shrub wetlands, with tall willow and alder shrublands in stream drainages and along lakeshores.

Water and Wetlands

Lac du Sauvage, Contwoyto (Fry Inlet), Glowworm, Muskox, Pellatt and Sterlet Lakes are the largest waterbodies in the Ecoregion; there are numerous small, shallow lakes and ponds. Muskox Lake is part of the Back River which is the only major watercourse. There are numerous shallow lakes and ponds, some of which occupy linear depressions produced by bedrock faults. High-centre polygons occur in a few places, usually in channels between lakes where water tables are high enough to sustain moss growth. Sedge and cottongrass shore fens occur in a few locales along shallow lakes.

Notable Features

This Ecoregion is the highest-elevation landscape in the Tundra Shield within the Northwest Territories. It is part of the seasonal migration route for the Bathurst caribou herd, and post-calving aggregations, wandering bulls and rutting caribou may be found at any time of the year in this Ecoregion. The source of the Back River (Great Fish River) is at Muskox Lake, in the northeast corner of this Ecoregion. This river forms the northern boundary of the Thelon Wildlife Sanctuary in Nunavut and is a key waterway to the Arctic coast. The winter road from Lupin Mine on Contwoyto Lake, Nunavut crosses the boundary into this Ecoregion as the only road access Nunavut has with the rest of Canada.

3.5.2 Contwoyto Upland LA*s* Ecoregion

A typical landscape in the northern part of the Contwoyto Upland LA*s* Ecoregion includes many small, shallow lakes separated by till blankets, veneers and hummocks that support a continuous low-growing erect dwarf-shrub tundra. The gray patches are bouldery till deposits. The deeper green tones in the foreground are taller dwarf birch shrubs growing on a locally warmer slope.

Low-shrub tundra and a well developed network of non-sorted circles are characteristic of areas in the east part of the Ecoregion near Muskox Lake. Low-shrub tundra can be differentiated from erect dwarf-shrub tundra because of its somewhat deeper green hue. A narrow linear bedrock exposure is visible in the midground.

This esker was deposited by fast-flowing glacial river waters either underneath or on the surface of a glacier. It is composed of sands, gravels and cobbles. The variations in plant cover as indicated by tone and texture in the image reflect differences in temperature, water and nutrients at different places on the sideslopes. Eskers are places of relatively high habitat diversity in the Low Arctic.

High-centre polygons are formed by the long-term accumulation of moss peats and other organic deposits. They occur locally in the Ecoregion where the water table is consistently high, as in this shallow drainage between ponds. The dark linear features are water-filled cracks that surround higher (1 to 2 m) organic mounds.

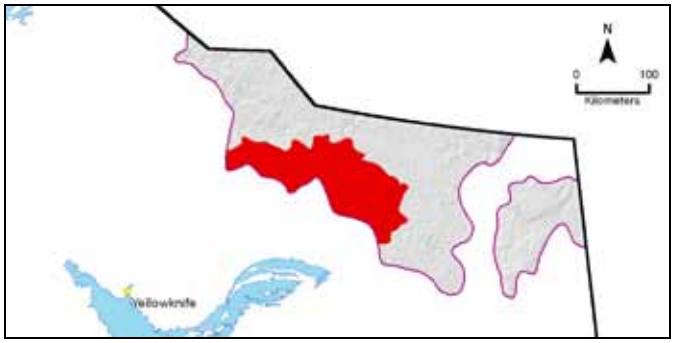
3.5.3 Mackay Upland LAs Ecoregion (ecoregion label 2.4.2.3)*

Overview: *The Mackay Upland LAs Ecoregion is a level to hummocky upland landscape with deep till blankets, bouldery till and minor areas of exposed bedrock; dry upland tundra is dominant.*

Summary:

- Western third is mainly level to undulating till; central and eastern third are undulating to hummocky till.
- Complex of dwarf-shrub and low-shrub tundra, with minor wetland occurrences and stunted trees near the Taiga Shield – Tundra Shield boundary.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 15,871 km^2 (9% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 450 (400-500)

General Description

The Mackay Upland LAs Ecoregion is a northern treeless extension of the Taiga Shield Mackay Upland HS (High Subarctic) Ecoregion, but has less pronounced topography. The Point Upland LAs Ecoregion to the north has a higher proportion of exposed bedrock and more variable topography. The eastern half of the Ecoregion is an undulating to hummocky bouldery till plain with scattered bedrock exposures; its eastern boundary coincides with a bedrock change along a fracture zone west of the McDonald Fault and the extreme southeast corner includes ice-modified till features (drumlins). The western half of the Ecoregion is a gently undulating till plain. On deeper tills, upland permafrost features such as non-sorted circles are common. Erect dwarf-shrub tundra and low-shrub tundra are the dominant vegetation cover types, often occurring as complexes in networks of non-sorted circles. Along the Tundra Shield – Taiga Shield boundary, a few stunted tree groves and scattered tall shrub communities occur and are indicative of a Low Arctic – High Subarctic climate transition.

Geology and Geomorphology

Most of the exposed or underlying Precambrian bedrock is a complex of granitic and sedimentary origins. Till veneers and blankets cover much of the Ecoregion and are typically bouldery and coarse-textured (sandy loams to loamy sands). The western third and southeastern corner have deeper till blankets and the appearance of till drumlins east of Artillery Lake marks a transition to the ice-sculpted sandy and gravelly till drumlin plains that characterize the Whitefish Plain LAs Ecoregion. Small outwash terraces and eskers ranging from several hundred metres to several kilometres in length are scattered throughout; eskers have an east-west orientation. Scattered bedrock exposures occur mainly in the east half of the Ecoregion. Non-sorted circles, sometimes accompanied by solifluction on finer-textured soils, are the most extensive evidence of continuous permafrost within the Ecoregion, but shallow swales between till and bedrock uplands collect water and support the development of widely dispersed localized high-centre polygon fields.

Soils

Turbic Cryosols and Static Cryosols, the latter associated with deep sandy to gravelly deposits, occur across the Ecoregion. Organic Cryosols are associated with wetlands.

Vegetation

The main vegetation types are erect dwarf-shrub tundra and low-shrub tundra on uplands. These communities occur with nearly continuous cover on finer-textured till veneers across much of the Ecoregion. In the central portion where there is more topographic variability and a higher proportion of bouldery till, cover is discontinuous. Extensive fields of non-sorted circles in the southern half of the Ecoregion are vegetated by erect dwarf-shrub tundra (centre of circles) and low-shrub tundra (circle rims with dwarf birch). Till boulders and exposed bedrock support rock lichen communities. In the extreme southeast, till drumlins support both erect dwarf-shrub and lichen tundra. Scattered small groves and individuals of stunted white spruce occur inside the Ecoregion within about 20 kilometres of the mapped boundary with the neighbouring Taiga Shield Mackay Upland HS Ecoregion. Seepage zones and low-lying areas support localized sedge – moss – low-shrub and dwarf-shrub wetlands, with tall willow and alder shrublands in stream drainages and along lakeshores indicating somewhat more favourable climatic conditions near the Tundra Shield – Taiga Shield boundary.

Water and Wetlands

Numerous large lakes occur within this Ecoregion, including Aylmer, Clinton-Colden, Fletcher, Kirk, Mackay, Ptarmigan and Taylor Lakes and the north end of Artillery Lake. The Thonokeid River flows into Aylmer Lake, the Lockhart River flows into Artillery Lake and the Hanbury River flows east from Clinton-Colden Lakes toward its confluence with the Thelon River. As is characteristic of most ecoregions within the Tundra Shield, wetlands may be locally extensive but cover less than five percent of the total landscape area. High-centre polygons are usually associated with them.

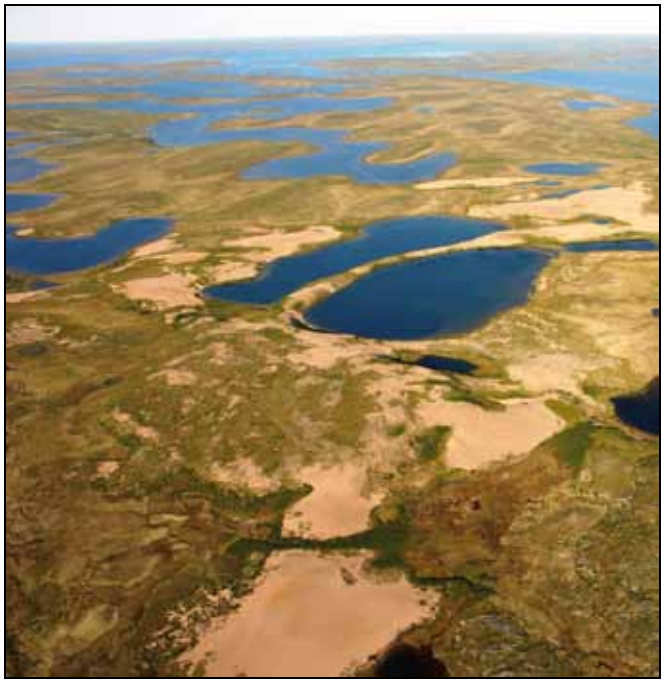
Notable Features

The Hanbury River is a tributary of the Thelon River, which flows into the Hudson Bay Watershed and the Lockhart River is part of the Arctic Watershed. These watercourses and the interconnected large lakes have provided important travel routes for caribou and muskox hunters, barren land trappers and explorers. Muskoxen have slowly been reoccupying former range in this Ecoregion.

3.5.3 Mackay Upland LAs Ecoregion

Nearly level blankets of silty, sandy and clayey tills in the western half of the Mackay Upland LA*s* Ecoregion support continuous tundra cover. This network of non-sorted circles is a complex of dwarf –shrub tundra less than 20 cm high (lighter tones) and low-shrub tundra (darker green circle perimeters) more than 20 cm high.

The landscape south of Aylmer Lake is undulating to hummocky and in places, exposed bedrock and bouldery till (gray tones in right midground) restrict tundra development to places where there is thin till cover. The dark green tones in the foreground are low-shrub communities with dwarf birch; the lighter yellowish-green tones are erect dwarf-shrub tundra.



Sandy-textured tills, outwash deposits and eskers dominate the extreme southeast, east of Artillery Lake. The outwash fan and esker in the foreground and midground (light pinkish-tan) is gravelly sand. The elongated shapes of till drumlins that were formed when ice flowed over glacial debris are emphasized by the irregular shorelines of small lakes to the upper left.

Muskoxen favour low-shrub tundra habitats where there is sufficient forage.

3.5.4 Healey Upland LAs Ecoregion (ecoregion label 2.4.2.4)*

Overview: *The Healey Upland LAs Ecoregion is a fractured bedrock and bouldery till dominated landscape with sparse tundra development.*

Summary:

- Fractured Precambrian granitic and sedimentary bedrock, bouldery till and minor areas of finer-textured till blankets.
- Discontinuous erect dwarf-shrub tundra occurs between boulders and in depressions and fractures.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.

Total area: 6,463 km^2 (4% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 375 (350-425)

General Description

The Healey Upland LAs Ecoregion is a rough and broken expanse of fractured and ice-scoured Precambrian bedrock and bouldery till. The Hanbury Plain LAs Ecoregion to the east, the Mackay Upland LAs Ecoregion to the south and the Contwoyto Upland LAs Ecoregion to the west all have higher proportions of finer-textured till and more continuous tundra development. Widely scattered small eskers and outwash deposits occur mainly in the south half. Permafrost is continuous, but permafrost features such as non-sorted circles and high-centre polygons occur mainly with deeper tills along the western and southern boundary north of Clinton-Colden Lake. Dwarf-shrub and lichen tundra occurs in patches between boulders, in fractures and on thin till deposits where there is sufficient moisture; there are a few locally extensive areas of continuous shrub tundra north of Clinton-Colden Lake.

Geology and Geomorphology

A complex of Precambrian granitoid intrusive and sedimentary bedrock lies just below or at the surface. Exposed, fractured bedrock and discontinuous bouldery till veneers form extensive rocklands with local relief of a few metres. There are scattered patches of deeper, finer-textured tills that blanket the bedrock, the most extensive of which occurs just north of Clinton-Colden Lake in a narrow crescent along the south and west boundary. Low, narrow gravelly and sandy eskers a few kilometres in length are uncommon features. Permafrost features such as non-sorted circles are locally common and widespread in the deeper till areas, but are not well developed elsewhere. Netlike patterns of sorted circles are indicative of very cold climates and occur with bouldery till in a few places.

Soils

Soil development is restricted by bedrock and bouldery till. Where soils do occur they are generally Turbic Cryosols. Organic Cryosols are associated with wetlands.

Vegetation

Plant cover is sparse across much of the Ecoregion, occurring as patches between boulders in bouldery till fields and along fractures and in slight depressions in bedrock where pockets of finer-textured mineral soil collect and hold enough water to allow plant establishment. Erect dwarf-shrub tundra and lichen tundra are the dominant cover types, with lichen crusts covering most exposed rock surfaces. Low-shrub tundra forms complexes with lichen tundra and dwarf-shrub tundra in places and is most extensive on finer-textured tills with non-sorted nets and circles near Clinton-Colden Lake.

Water and Wetlands

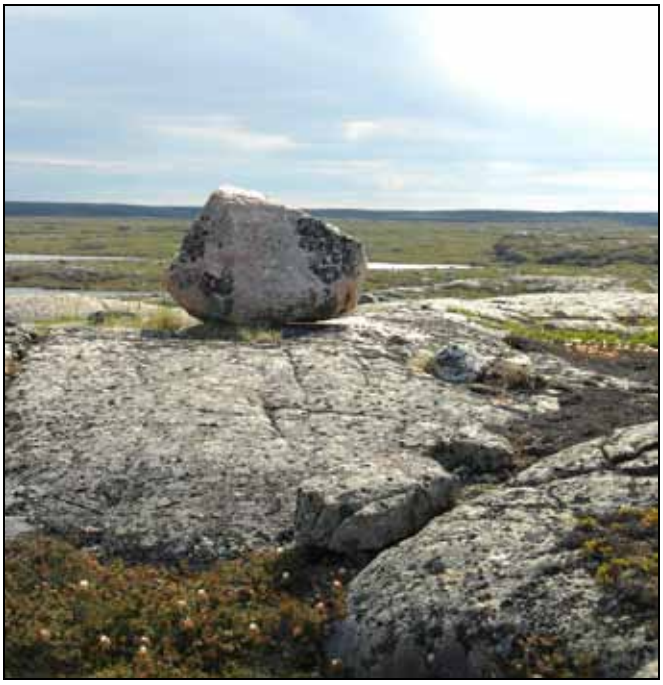
The only named lakes are Healey, Tarantula and Clinton-Colden Lakes. Clinton-Colden Lake extends into the Ecoregion through deep north-trending bays. Lakes on the east side of the Ecoregion tend to be long and narrow, following faults that trend north to south. An unnamed tributary flows eastward to the Baillie River in the adjacent Hanbury Plain LAs Ecoregion. Wetlands occupy less than five percent of the total area and occur in fractures and low areas with thin peat layers or in depressions and flow channels on till blankets.

Notable Features

This Ecoregion has a higher proportion of exposed bedrock and boulders than any other ecoregion in the Tundra Shield. The bouldery till fields and patchy vegetation provide optimal habitat for arctic hares. This Ecoregion straddles a major watershed divide; the western two-thirds drains into the Arctic Watershed, but the eastern third drains into the Hudson Bay Watershed via the Baillie River.

3.5.4 Healey Upland LAs Ecoregion

The gray tones of bouldery till and exposed, frost-shattered Precambrian granites and sedimentary rock extend into the far distance of this typical landscape in the south-central part of the Ecoregion. The green patches in the foreground and midground are dry dwarf-shrub tundra communities that occupy protected areas where fine soils collect and hold moisture and nutrients.



A large granitic till boulder rests on an ice-polished rock knob in the north-central part of the Ecoregion, east of Tarantula Lake. In the foreground, northern Labrador tea up to 20 cm and Arctic bearberry are the main components of shrub tundra that grows in protected patches. The dark tones on the right-hand side of the image are lichen tundra. The dark patches on the boulder are lichen crusts.

Permafrost in fine-textured till materials has produced a network of non-sorted circles with non-vegetated centres and outer edges defined by dwarf shrubs and sedges. The inset shows the general location of this view, north of Clinton-Colden Lake in the southwest corner of the Ecoregion.

The ridge running vertically through the centre of this image near the southeastern boundary of the Ecoregion is a bouldery esker with dwarf-shrub and lichen tundra on its slopes. It is flanked by dark green tall willow shrublands in the foreground and a bright-green patch of sedge tundra on the right. All three features are uncommon in this Ecoregion.

3.5.5 Whitefish Plain LAs Ecoregion (ecoregion label 2.4.2.5)*

Overview: *The Whitefish Plain LAs Ecoregion is a level to rolling till and outwash plain with continuous tundra cover.*

Summary:

- Extensive till drumlin fields crossed by eskers and outwash plains.
- Continuous heath – lichen and dwarf-shrub tundra, with minor areas of sedge tundra in wet depressions.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.

Total area: 9,200 km^2 (5% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 375 (325-450)

General Description

The Whitefish Plain LAs Ecoregion, a mostly treeless northern continuation of the Taiga Shield Whitefish Plain HS (High Subarctic) and Sid Plain HS Ecoregions, is a landscape dominated by level to rolling till and ridged to hummocky outwash. Deeper, less bouldery till blankets, less exposed bedrock and more extensive outwash deposits separate this Ecoregion from the Mackay Upland LAs and Hanbury Plain LAs Ecoregions to the west and north, respectively. The Ecoregion's northeastern boundary parallels the valley break of the Thelon Valley HS Ecoregion. The most striking features of the Ecoregion are the extensive till drumlin fields and long sandy to gravelly eskers, often flanked by outwash plains. Continuous yellow and black lichen tundra covers the tops of the frost-cracked drumlins, with dwarf-shrub tundra on the sideslopes and sedge fens in the swales between drumlins; a few scattered trees occur in relatively warm, well-drained locales.

Geology and Geomorphology

Most of the Ecoregion is underlain by Precambrian metamorphic bedrock; a few exposures in the northeast and central parts of the Ecoregion have been frost-shattered or polished by glacial ice. Thick till deposits throughout the Ecoregion have been molded by flowing glaciers into elongated drumlins that are strongly patterned by ice-wedge polygons on their crests and upper slopes. Eskers run generally east to west and overlie till blankets; they are mainly sandy to gravelly, as are the outwash plains that occur adjacent to the eskers. Two major eskers cross the extreme southeast part of the Ecoregion and one very long discontinuous esker spans the northern half of the Ecoregion from west to east. A locally extensive hummocky outwash deposit occurs southeast of Garde Lake in the south-central part. Beach ridges east of Tyrrell Lake in the southeast corner were probably left by the retreat of Glacial Lake Thelon. Small eolian plains and dunes are associated with sandy outwash. Ice-wedge polygons on till drumlins, frost-shattered bedrock and a few scattered high- and low-centre polygons on organic deposits are evidence of continuous permafrost.

Soils

Well-drained Static and Turbic Cryosols and Brunisols occur on the till plains and drumlins; Brunisols and Regosols are more likely to be associated with rapidly-drained eskers and outwash deposits. Poorly-drained areas between till drumlins develop thin peat deposits; the slow accumulation of organic matter over hundreds or thousands of years is associated with the development of low- and high-centre polygons.

Vegetation

Tundra cover is generally continuous. The most extensive tundra types are heath – lichen tundra dominated by yellow and black lichens with secondary dwarf-shrub components (till drumlin fields) and erect dwarf-shrub tundra on till plains. Low wet areas are occupied by a complex of sedge – moss – low-shrub and sedge – moss – dwarf-shrub wetlands. Eskers and outwash plains provide many different microhabitats from well-drained crests and warm southerly aspects to cooler northern slopes and moist to wet depressions; they support a correspondingly diverse array of lichen, sedge and shrub tundra communities, including taller shrub tundra types with crowberry, dwarf birch, green alder, willow and common juniper. Sandy soils along lakeshores and on protected lower esker slopes warm more quickly in summer and allow the establishment and growth of a few scattered white and black spruce groves.

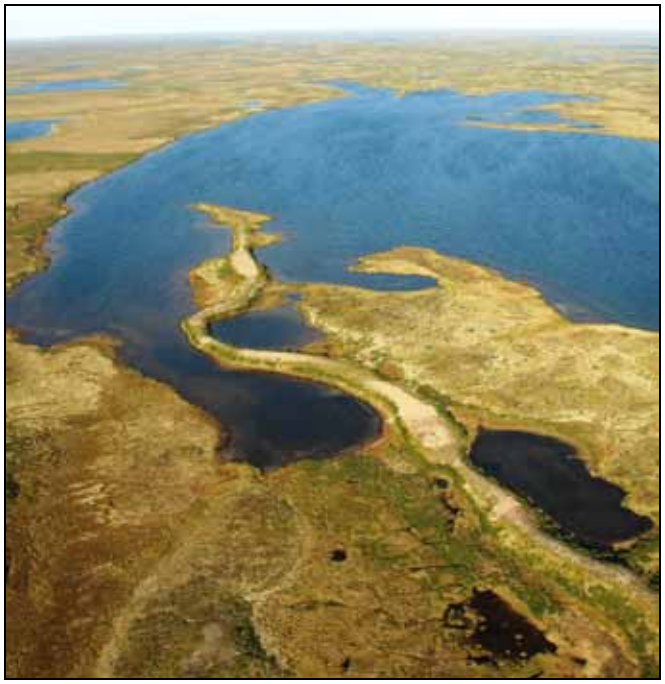
Water and Wetlands

Streams in this Ecoregion drain into the Thelon River which is part of the Hudson Bay Watershed. Tyrrell Lake is the largest of several major waterbodies occurring within the Ecoregion; the others are Mary Frances, Campbell, Williams, Zucker, Garde, Radford, Island, Noyes and Bewick Lakes. Most of the lakes and ponds have irregular shorelines, probably because thick tills have partly or completely filled deep rock fractures that otherwise control lake orientation in adjacent bedrock-dominated ecoregions. The Mary Frances River is the only major watercourse. Wetlands are scattered across the till plains and between drumlins and are mostly sedge tundra with thin peat layers.

Notable Features

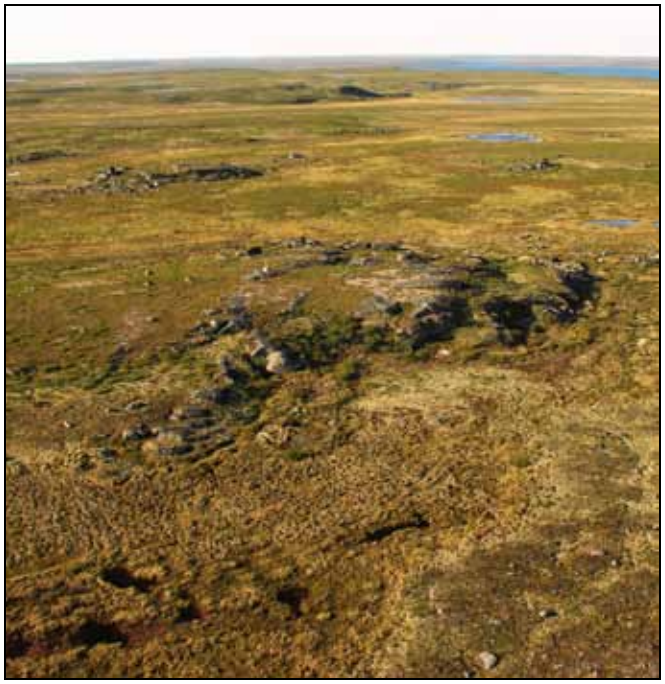
The most extensive eskers in the Southern Arctic occur in this Ecoregion. These sandy formations are critical denning habitat for wolves, grizzlies, arctic ground squirrels, and both red and arctic foxes.

3.5.5 Whitefish Plain LAs Ecoregion

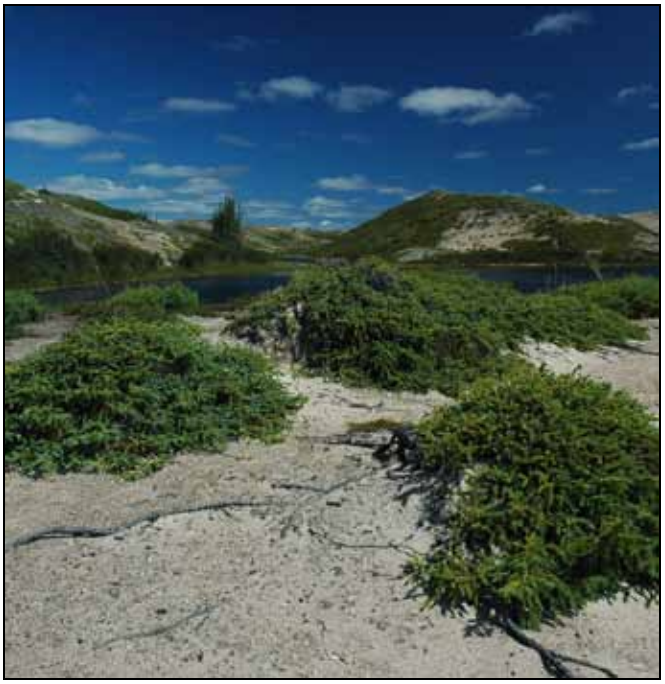


The western part of the Ecoregion is a well-drained undulating till plain with a continuous cover of dwarf-shrub and heath – lichen tundra. The narrow curved ridge of sand and gravel extending into the lake is an esker; it is flanked in the foreground by small wetlands (low-centre polygons and sedge fens).

Till drumlins are a prominent feature in the central and southern portions of the Ecoregion. The tops of the drumlins are patterned by frost cracks and vegetated by black and yellow lichens and dwarf shrubs. The lower slopes are somewhat moister and support shrub tundra communities. Wet sedge – cottongrass – shrub tundra and shallow lakes occupy the swales between drumlins.



Some areas in the northeast and central parts of the Ecoregion have bedrock close to or at the surface. The hummocks in the midground and background are Precambrian metamorphic bedrock surrounded by bouldery till plains with erect dwarf-shrub tundra.



Eskers and hummocky outwash plains provide many different habitats, including warm southerly slopes with enough moisture for trees to grow north of tree line, dry and windblown upper slopes that support dwarf-shrub tundra and wetlands. The cushionlike plants in the foreground are stunted white spruce on a dry, gravelly beach.

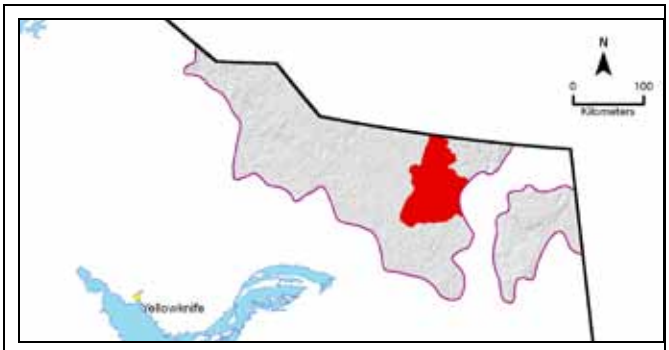
3.5.6 Hanbury Plain LAs Ecoregion (ecoregion label 2.4.2.6)*

Overview: *The Hanbury Plain LAs Ecoregion is a level, bedrock-dominated plain with thin till veneers, numerous linear lakes and shrub tundra.*

Summary:

- Thin till veneers over bedrock in the western two-thirds, with somewhat deeper tills in the eastern third; linear lakes are a distinguishing feature of this Ecoregion.
- Low-shrub tundra is the most extensive tundra type; erect dwarf-shrub tundra is usually associated with thin tills in the northern half.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 7,262 km^2 (4% of Southern Arctic Ecoregion). Ecoregion shown in red.	**Average elevation (range) mASL:** 375 (350-450)

General Description

The Hanbury Plain LA*s* Ecoregion is a nearly level complex of till veneers and discontinuous till on bedrock. It is neither as rugged as the Healey Upland LA*s* Ecoregion to the west nor does it have extensive deep tills like the Baillie Plain LA*s* and Whitefish Plain LA*s* Ecoregions to the east and south, respectively. Most of the lakes are narrow and linear, following north-south trending faults in glacially scoured and frost-shattered Precambrian sedimentary and metamorphic bedrock. Gravelly and sandy outwash deposits occur in the southeast; small eskers are scattered throughout. Low-shrub tundra is dominant on till veneers in the eastern two-thirds of the Ecoregion, with erect dwarf-shrub tundra on discontinuous tills over bedrock and on till drumlins in the northeast and southeast, along with heath – lichen tundra. A few trees occur in favourable locales in the central and southern portions near the boundary with the Level III Taiga Shield High Subarctic Ecoregion. Sorted and non-sorted circles, ice-wedge polygons and high-centre polygons are common permafrost features.

Geology and Geomorphology

The Ecoregion is underlain by Precambrian sedimentary and metamorphic bedrock which is exposed at the surface especially in the central and northwest portions; thin discontinuous bouldery till patches are interspersed with exposed, often frost-shattered rock. Elsewhere, bedrock is covered by till veneers, blankets and outwash deposits. Hundreds of narrow linear lakes and ponds with a north to south orientation follow bedrock faults and fractures in the west half and are a distinctive feature of the Ecoregion. Somewhat deeper till blankets in the eastern third are indicated by the presence of till drumlins and by more irregular lake and pond shorelines. The southeast quadrant also includes a locally extensive gravelly and sandy outwash area, where a few beach ridges likely indicate the western extent of Glacial Lake Thelon. Small eskers are scattered throughout. Continuous permafrost is indicated by sorted and non-sorted circles, ice-wedge polygons and high-centre polygons.

Soils

Soil development is restricted by thin tills and exposed bedrock. Mineral soils are Turbic and Static Cryosols, the latter more characteristic of deep, well-drained coarse-textured deposits such as eskers and till drumlins. Organic Cryosols are associated with high-centre polygons and wetlands.

Vegetation

Low-shrub tundra is the most extensive tundra type and along with non-sorted circles, probably reflects the influence of slightly more moderate climates that influence the partially treed Taiga Shield – Thelon Valley HS (High Subarctic) Ecoregion to the east. Erect dwarf-shrub tundra is commonly associated with thin discontinuous tills and is more prevalent in the north. Heath – lichen communities grow on the crests and upper slopes of till drumlins. Sedge wetlands with shallow organic layers, scattered cottongrass tussock fens and high-centre polygons with deeper peat deposits occupy low areas. Outwash plains and eskers support highly diverse shrub-dominated upland tundra and sedge – cottongrass wetland communities. Small groves of trees occur on south facing gravelly and sandy esker, outwash and shoreline locations as far north as the centre of the Ecoregion.

Water and Wetlands

Moraine Lake is the largest waterbody in the Ecoregion; its elongated linear shape and that of many other surrounding lakes clearly indicates the controlling influence of north- to south-trending fault lines. Other large lakes include Sifton Lake, Darrell Lake, Hanbury Lake and Maze Lake, the latter with numerous boulders and bedrock outcrops. The Hanbury River is the largest watercourse and traverses the southern third of the Ecoregion; it flows east into the Thelon River along with the Baillie and Darrell Rivers that flow through the central and northern portions. Most of the Ecoregion is part of the Hudson Bay watershed.

Notable Features

Most of this Ecoregion was encompassed by the original Thelon Game Sanctuary until 1956 when almost all of it was excluded. It was later renamed Thelon Wildlife Sanctuary. The boundaries of the sanctuary were reshaped to withdraw areas with mineral potential and better reflect the distribution of muskoxen at that time.

3.5.6 Hanbury Plain LAs Ecoregion

This image southwest of Moraine Lake is representative of landscapes in the western half of the Ecoregion. The long linear lake in the upper right part of the image follows a bedrock fault and is surrounded by thin bouldery tills. Low-shrub and erect dwarf-shrub tundra are the dominant cover types; wetland development is restricted to small lowland areas adjacent to ponds.

The eastern third of the Ecoregion has more continuous and deeper till deposits. Finer-textured till materials and gentler terrain allows the development of more extensive wetlands, such as the high-centre polygons in the foreground (dark water tracks surrounded by shrub tundra on peat soils).

Gravelly and sandy outwash deposited by glacial rivers and lakes is common and locally extensive in the southeast corner of the Ecoregion. This outwash terrace, indicated by sparsely vegetated tan-coloured sands and gravels, is surrounded by tills. The parallel sand and gravel lines are likely the remnant shorelines of glacial Lake Thelon which filled the Thelon Valley to the east when the last glaciers melted.

Scattered Krummholz tree colonies (lower centre) and tall shrublands bordering a creek with bright-green sedge fens indicate the influence of slightly more moderate High Subarctic climates that prevail in the Thelon Valley about 10 km to the east. Ecoregion boundaries are often less precisely defined than implied by their representation on maps because they include broad climatic transitions.

3.5.7 Baillie Plain LAs Ecoregion (ecoregion label 2.4.2.7)*

Overview: *The Baillie Plain LAs Ecoregion is a gently sloping till plain with a low central bedrock dominated ridge and nearly continuous sedge – shrub tundra.*

Summary:

- Low bedrock ridge with thin tills surrounded by a till plain with bouldery to fine-textured tills and scattered eskers and outwash deposits.
- Moist sedge – shrub tundra is the dominant vegetation type.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.

Total area: 3,755 km^2 (2% of Southern Arctic Ecoregion). Ecoregion shown in red.	**Average elevation (range) mASL:** 325 (300-400)

General Description

The Baillie Plain LAs Ecoregion is a gently sloping till plain bordered on the east by the partly treed Thelon Valley HS (High Subarctic) Ecoregion and on the west by the more rugged and bedrock-dominated Hanbury Plain LAs Ecoregion. A low north to south ridge through the north-central part of the Ecoregion has exposed ice-polished bedrock knobs, thin discontinuous tills, patchy tundra, shallow lakes and scattered wetlands. The surrounding till-dominated landscapes support a continuous cover of sedge tundra in low moist areas and erect dwarf-shrub tundra on drier uplands. Ice modified tills (drumlins) occur in a few places; eskers and outwash terraces and plains are not extensive but occur throughout. Ice-wedge polygons, non-sorted circles and high- and low-centre polygons are evidence of continuous permafrost.

Geology and Geomorphology

Precambrian metamorphic bedrock underlies a low north to south trending ridge in the north-central part of the Ecoregion and is flanked by parallel north to south bands of Precambrian intrusive bedrock to the west and Precambrian sedimentary bedrock to the east. The ridge is characterized by exposed and ice-polished bedrock knobs surrounded by thin bouldery tills. Till deposits are deeper in the landscapes surrounding the ridge where there are fewer bedrock exposures. Moderately calcareous silty tills occur in the eastern third of the Ecoregion; their unusual pink to red hues might reflect a possible origin from the red-weathering Precambrian Dubawnt igneous bedrock in the vicinity of Dubawnt Lake to the east of the Thelon River. Till drumlins occur throughout, mainly north of the Baillie River and its main tributaries and indicate local east to west ice flows. Long, narrow eskers occur in a few places and are mainly north to south trending. Outwash deposits are associated with them and with an eastern tributary of the Baillie River occupying a wide, shallow sinuous glacial meltwater channel in the lower half of the Ecoregion. Continuous permafrost is indicated by non-sorted circles, ice-wedge polygons, high-centre polygons and low-centre polygons.

Soils

Turbic Cryosols occur on the till plains and drumlins; Brunisols and Regosols are likely to be associated with rapidly-drained eskers and outwash deposits. Poorly-drained areas between till drumlins and on the till plains develop thin peat deposits; the slow accumulation of organic matter over hundreds or thousands of years is associated with the development of low- and high-centre polygons.

Vegetation

Much of the Ecoregion is vegetated by continuous sedge – dwarf-shrub – moss tundra that is associated with moderately moist tills. Erect dwarf-shrub tundra occurs with drier well-drained uplands, eskers and outwash deposits and heath – lichen tundra is dominant on frost-cracked till drumlin crests and upper slopes. Low-shrub tundra associated with somewhat more moderate climates is uncommon and occurs mainly on moist southerly slopes and in sheltered locales on eskers and outwash deposits. Sedge – dwarf-shrub – moss wetlands are associated with wet lowland areas.

Water and Wetlands

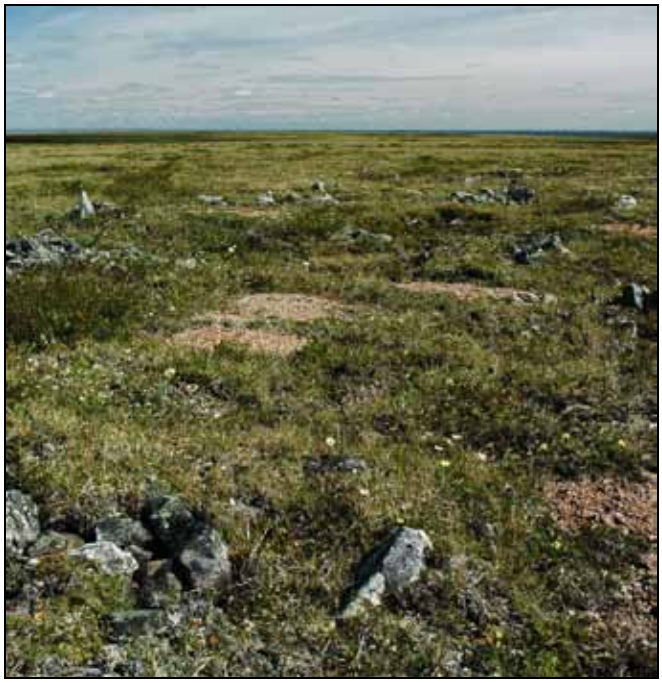
Hundreds of small lakes and ponds dot the landscape; there are fewer lakes on the low bedrock ridge that runs north-south through the north-central part of the Ecoregion than elsewhere. The Baillie River closely parallels the western boundary of the Ecoregion and is the only named watercourse; several tributaries that flow through broad, shallow meltwater channels occupied by small lakes flow into it. Biologist Lake is the only named waterbody, in the northeast corner of the Ecoregion. Wetlands are scattered and uncommon on the low bedrock ridge in the north-central portion, but are more extensive on the surrounding nearly level till plains; sedge fens, high-centre polygons and low-centre polygons are common.

Notable Features

The importance of this area for muskoxen and their habitat was recognised in 1956 when almost all of this Ecoregion was contained within the reshaped Thelon Wildlife Sanctuary. The small, shallow ponds and extensive sedge – shrub tundra are used by moulting Canada Geese of the Short-grass Prairie Population. This may be a strategy to prevent over-exploitation of food resources from ranges occupied by nesting geese. The eskers and outwash terraces that occur throughout this Ecoregion provide favourable burrowing conditions for arctic ground squirrels.

3.5.7 Baillie Plain LAs Ecoregion

Till plains with a few bedrock exposures (darker gray patches), many small, shallow ponds and nearly continuous sedge – shrub tundra are typical landscapes in the Ecoregion.



This ground view of a till plain in the eastern part of the Ecoregion shows several features. The dominant tundra type is sedge (light green) with darker green patches of dwarf birch and the small white flowers of mountain avens. Frost-heaved till boulders and the pink-hued gravelly centres of non-sorted circles indicate permafrost action.

The elongated shapes of till drumlins and the lakes that occupy low areas between them indicate an east to west ice flow direction in this north-facing view. The drumlin tops are vegetated by dark-toned lichen tundra and dwarf-shrub tundra. Yellowish-green sedge fens occupy low areas around and between ponds.

Arctic ground squirrels are widespread within the Ecoregion and live in large colonies on till hummocks where fine-textured materials dominate. Note the old excavation in the right-central part of this image where a barren-ground grizzly dug into a colony in search of prey.

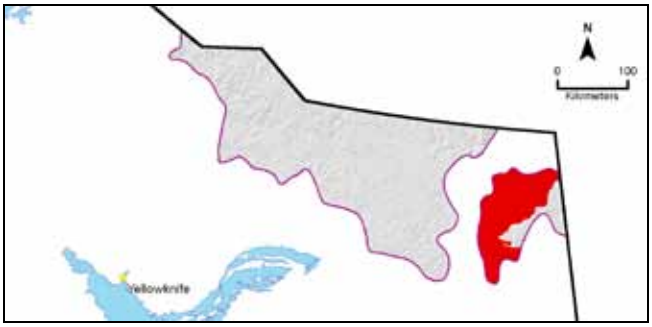
3.5.8 Clarke Upland LAs Ecoregion (ecoregion label 2.4.2.8)*

Overview: *The Clarke Upland LAs Ecoregion is an undulating to rolling till and outwash landscape dominated by dry lichen and dwarf-shrub tundra.*

Summary:

- Bouldery till uplands north of the Clarke River, finer-textured tills south of the river and extensive outwash terraces along the river
- Dominantly dry heath – lichen tundra on uplands and sedge tundra in moist to wet lowlands.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.



Total area: 9,004 km^2 (5% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 325 (200-450)

General Description

The Clarke Upland LAs Ecoregion is an undulating to rolling till and outwash landscape dominated by dry lichen and dwarf-shrub tundra; it slopes gently to the northeast and west toward the Thelon River. The lower-elevation partly treed Taiga Shield Thelon Valley HS (High Subarctic) Ecoregion borders it to the west. The Dubawnt Plain LAs Ecoregion to the east has a higher proportion of moist low-shrub tundra and wet sedge tundra. Bouldery till uplands occur north of the Clarke River, hummocky finer-textured till and wetland complexes occur south of the Clarke River and a unique complex of outwash terraces, till drumlins and small wetlands occurs adjacent to the Clarke River. Dwarf-shrub tundra and heath – lichen tundra are associated with bouldery tills, till hummocks and outwash plains. Wet sedge tundra is associated with wetlands south of the Clarke River. Small spruce woodlands on hummocky till along and south of the Clarke River below about 350 mASL and on a few eskers in the northern portion indicate that climates in this Ecoregion are probably transitional between Low Arctic and High Subarctic. Non-sorted circles on fine-textured tills and ice-wedge polygons on till hummocks and outwash deposits provide evidence of continuous permafrost.

Geology and Geomorphology

Precambrian sedimentary bedrock underlies the entire Ecoregion and is exposed in a few places. Till blankets cover much of the Ecoregion, but textures are highly variable. Dry, gravelly and bouldery till hummocks and drumlins are the dominant landforms north of the Clarke River. South of the Clarke River, finer-textured tills are more common as indicated by a higher density of water bodies and a higher proportion of wetlands. The tills are often pink-hued, indicating a possible source of origin in Precambrian Dubawnt igneous bedrock to the east. Extensive outwash terraces parallel the Clarke and Finnie Rivers and form complexes with till deposits. Several large eskers cross from east to west north and south of the Clarke River. A few ancient beach ridges on outwash and till deposits in the southwest part of the Ecoregion indicate the eastern extent of glacial Lake Thelon. Permafrost is continuous and is indicated by the widespread occurrence of ice-wedge polygons on till drumlins and outwash deposits and by non-sorted circles on tills.

Soils

Brunisolic Turbic Cryosols are likely the most common soil type associated with finer-textured silty to sandy tills where the active layer is relatively thin. Static Cryosols and Regosols are likely associated with well-drained coarse-textured outwash and esker deposits where the active layer is deeper. Organic Cryosols are associated with wetlands.

Vegetation

Heath – lichen tundra and erect dwarf-shrub tundra are the dominant vegetation types in this Ecoregion and occur on well to rapidly drained hummocky till and outwash plains and terraces. Sedge – dwarf-shrub – moss tundra occurs with moister, finer textured tills and sedge – moss – dwarf-shrub wetlands occupy the low areas between till hummocks and drumlins. Locally extensive patches of tussock-sedge – dwarf-shrub – moss tundra occur south of the Clarke River. A few white spruce groves and small woodlands are present in the Clarke River valley and south toward Beaverhill Lake generally below 350 mASL and indicate that this Ecoregion is influenced by both Low Arctic and High Subarctic climates.

Water and Wetlands

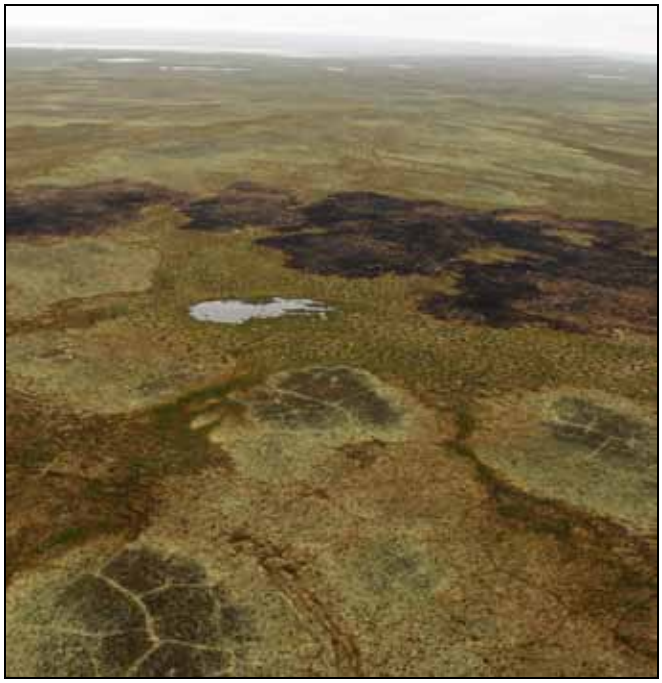
Lake and pond distribution and density is dependent in part on parent materials; there are fewer waterbodies on the extensive bouldery till uplands north of the Clarke River than on the generally finer-textured till plains to the south. Coldblow, Carter and Beaverhill Lakes are the major named lakes and all occur on the west side of the Ecoregion. The Clarke River flows from east to west across the north-central portion into the Thelon River and is bordered by extensive outwash and fluvial deposits; the Ecoregion is part of the Hudson Bay Watershed. The Finnie River flows north through the central and northeastern part of the Ecoregion into the Thelon River and has extensive outwash deposits along its lower reaches. Wetlands are relatively uncommon in bouldery till, but south of the Clarke River they are locally extensive between till hummocks and drumlins.

Notable Features

The northern third of the Ecoregion is in the Thelon Wildlife Sanctuary where muskoxen use windswept highlands for winter range. The outwash and till complexes adjacent to the Clarke River have a unique topography and pattern that is starkly revealed by the development of tundra types adapted to the wide range of moisture conditions. That part of the Ecoregion below about 350 mASL could be regarded as a Low Arctic – High Subarctic climatic transition area. Rugged terrain, lack of navigable rivers, and distance from trading posts and population centres have minimised human activity in this Ecoregion.

3.5.8 Clarke Upland LAs Ecoregion

Bouldery, rapidly drained till with sparse heath – lichen tundra is typical of the northern half of the Ecoregion. The gray areas are boulder till with little vegetation. The dark brownish-black and light yellow areas are heath – lichen tundra; the inset shows two common species, the black lichen *Cornicularia* and northern Labrador tea, a dwarf heath shrub. Sedge wetlands occupy low wet areas and are indicated by greenish tones.



South of the Clarke River, tills tend to be finer textured and support more continuous tundra. This landscape includes well drained till hummocks and drumlins with heath – lichen tundra (dark gray and yellowish tones with polygonal frost cracks) and low, wet areas with low-shrub and sedge tundra (greenish-brown tones). The large black patch just above the image centre is an unusual and recent lightning-caused tundra fire.

The Finnie River flows north through this striking landscape of sandy outwash deposited by glacial rivers thousands of years ago. The tops of the terraces are covered by dark-toned heath – lichen tundra; the moister sideslopes and ancient stream channels support sedges and taller shrubs.

White spruce woodlands on a level till plain south of the Clarke River indicate a High Subarctic to Low Arctic transitional climate.

3.5.9 Dubawnt Plain LAs Ecoregion (ecoregion label 2.4.2.9)*

Overview: *The Dubawnt Plain LAs Ecoregion is a level to undulating till plain with a mix of Low Arctic tundra and High Subarctic woodlands.*

Summary:

- Low elevation, low-relief till plain.
- Shrub tundra characteristic of the southern Low Arctic and locally extensive conifer woodlands.

* ecoregion label codes are shown on map in Appendix 3; refer to Section 3.1 for discussion of code assignment.

Total area: 2,973 km^2 (2% of Southern Arctic Ecoregion). Ecoregion shown in red.

Average elevation (range) mASL: 300 (250-450)

General Description

The Dubawnt Plain LAs Ecoregion is a level to undulating till plain that slopes from southwest to northeast. The Clarke Upland LAs Ecoregion surrounds it on the north and west and has higher proportions of outwash, till drumlins and dry upland lichen and dwarf-shrub tundra than this Ecoregion does. Bedrock exposures occur, but are uncommon. Locally extensive spruce groves in the central portion of the Ecoregion and the predominance of low-shrub tundra throughout indicates that the climate is transitional between Low Arctic and High Subarctic, a characteristic it shares with the somewhat more rugged Taiga Shield Sid Plain HS (High Subarctic) Ecoregion to the south. Wetlands are more extensive in this Ecoregion than in other Tundra Shield ecoregions. Non-sorted circles are evidence of continuous permafrost and occur throughout the Ecoregion.

Geology and Geomorphology

Most of the Ecoregion is a northeast-sloping plain underlain by Precambrian conglomerates and sandstones. Pink to reddish sandy and gravelly tills may have their origin in both Precambrian Dubawnt Group igneous bedrock in the vicinity of Dubawnt Lake and in sandstones. The western half of the Ecoregion is covered by deep till blankets that have not been molded into drumlins by flowing glacial ice as they have in the adjacent Clarke Upland LAs and Sid Plain HS Ecoregions to the north and south. The eastern half has thinner till deposits, reflected by a higher frequency of bedrock exposures and a higher density of linear lakes and ponds influenced by underlying bedrock fractures. There are only minor outwash occurrences and a few small eskers, in contrast to the extensive outwash and esker occurrences in adjacent Ecoregions. Thin glaciolacustrine deposits probably occur adjacent to Dubawnt Lake. Non-sorted circles are the most common indication of continuous permafrost; ice-wedge polygons occur on till hummocks in the northeast portion.

Soils

Turbic Cryosols are the predominant upland soil type occurring extensively with sandy to gravelly non-sorted circles. Organic Cryosols with thin peat layers are associated with wetlands.

Vegetation

Areas east and north of Ernie Lake in the eastern third of the Ecoregion are a complex of heath – lichen tundra, erect dwarf-shrub tundra and sedge – moss – dwarf-shrub wetlands. South and west of Ernie Lake, low-shrub tundra dominated by dwarf birch between 20 and 40 cm tall is the main upland vegetation type, forming complexes with extensive sedge wetlands on the level till plains. Locally extensive white spruce woodlands occur with well-drained gravelly and bouldery till in the narrow middle portion of the Ecoregion and together with the extensive occurrence of low-shrub tundra and non-sorted circles, indicate a transitional Low Arctic – High Subarctic climate.

Water and Wetlands

This Ecoregion lies wholly within the Hudson Bay Watershed. Part of Dubawnt Lake occupies the southeast corner of the Ecoregion adjacent to the Northwest Territories – Nunavut boundary. Ernie Lake, also in the southeast portion, is the only other named lake. Lakes and ponds are more linear and occur with higher density in the eastern half than in the west, a trend that is probably correlated with thinner tills and a correspondingly larger bedrock influence to the east. The Finnie River flows eastward and northward through the Ecoregion from the adjacent Clarke Upland LAs Ecoregion; the Dubawnt River flows into Dubawnt Lake in the extreme southeast corner. Wetlands are more extensive in this Ecoregion than in most other Ecoregions in the Tundra Shield.

Notable Features

Vegetation patterns indicate that this Ecoregion is influenced by both High Subarctic and Low Arctic climates; it is different than other Tundra Shield ecoregions because the climate together with better soil moisture and nutrient levels afforded by deep tills encourages regionally extensive low-shrub tundra development and locally extensive spruce woodland growth. Some wildlife species of birds and mammals mainly associated with boreal habitats may be found in these forested outliers.

3.5.9 Dubawnt Plain LAs Ecoregion

In the southwest part of the Ecoregion, gently undulating plains covered with thick till blankets support extensive low-shrub tundra with bog birch and willows (darker green tones).

In the northeast part of the Ecoregion, bedrock is very close to the surface; in this image, the underlying bedrock gives the appearance of wavelike ripples. A thin layer of bouldery till overlies the bedrock and is carpeted by a more or less continuous cover of dwarf-shrub and sedge tundra.

There are extensive conifer groves in the central third of the Ecoregion, reflecting the influence of somewhat less extreme High Subarctic climates that allow trees to germinate and grow. The brownish patches are wet sedge fens.

The soil in this pit (about 30 cm deep) has been mixed ("cryoturbated") by permafrost. The dark-coloured tongue extending downward is carbon-rich organic matter that has been drawn down from the surface by frost action. This process has enriched Arctic soils with vast amounts of carbon and they are globally important as carbon storehouses (Tarnocai *et al.* 2009).

The Southern Arctic provides important seasonal range for several herds of barren-ground caribou. Critical calving areas can be found within portions of the northern and western Tundra Plains. *Photo: A. Gunn*

Muskoxen can be found, generally at low densities, throughout most of the Southern Arctic. Once nearly extirpated from the Arctic, populations have since recovered and now number in the tens of thousands. *Photo: D. Downing*

Barren-ground grizzlies range, generally at very low densities, throughout the Southern Arctic. Increasing bear-human conflict due to industrial activity is a concern for this "vulnerable" population of tundra-inhabiting grizzlies. *Photo: D. Downing*

Snowy Owls are a circumpolar species that breeds throughout the Southern Arctic. Snowy Owls nest on the ground, usually on mounds or boulders. Population fluctuations of the primary prey (lemmings) have a direct impact on owl breeding success. *Photo: D. Johnson*

Peregrines are globally the most widespread bird of prey. They breed throughout the Southern Arctic, wherever suitable nesting sites (cliffs) and prey, mostly medium-sized birds, are found. *Photo: G. Court*

Unlike most waterfowl that moult twice, Long-tailed Ducks go through three distinct plumages during the year, with partial overlapping moults in between. It is one of the deepest diving ducks, capable of reaching depths of up to 60m. *Photo: L. Spitalnik*

Section 4: Mammals and Birds of the Southern Arctic

4.1 Introduction

The Level II Southern Arctic ecoregions contain a limited number of species that inhabit the tundra biomes above the forest-tundra transition of the High Subarctic ecoregions. Open habitats are almost continuous and animal mobility is seldom restricted by steep slopes, forests or glaciers, allowing some populations to be rather widespread. The Tundra Shield is strongly influenced by continental climate patterns. Habitats in the Tundra Plains are moderated by the Beaufort Sea, and temperatures are moderated by a regional south- to north-declining elevation gradient, as well as by rivers that carry relatively warm waters from the south. Trees, tall shrubs, and associated wildlife species occur well north of the Tundra Plains boundary along river valleys that offer favourable temperature, shelter and soil conditions.

Many boreal birds and mammals are very near their northerly limit at tree line, and some extend their range at low density into some parts of the Southern Arctic. Faunal diversity, densities and habitats are greatly affected by temperature gradients, geomorphology, and vegetation complexity.

Although the Tundra Shield is characterised by a high coverage of water, most of the lakes are too deep and cold to provide adequate food and shoreline cover for waterfowl and shorebirds. Species that depend on marshy nesting sites and plant or invertebrate food sources are more concentrated in and near shallow ponds and river deltas of the Tundra Plains. In many species of waterfowl, males and non-nesting females have moulting areas separate from nesting areas. This appears to be an adaptation for dispersing food exploitation and predation during the critical period of brood rearing. Important moulting areas, used by tens of thousands of geese and diving ducks, occur from the sheltered convoluted northwestern coastline in the Tuktoyaktuk Peninsula Coastal Lowland LA*n* Ecoregion, around Liverpool Bay (Tuktoyaktuk Coastal Plain LA*n* Ecoregion)[15] east to Bathurst Peninsula.

Much of the Tundra Plains has been shaped by rivers that erode channels and deposit alluvial sediments. Watercourse volumes and pathways have undergone dramatic changes prior to and during glaciation, and as the glaciers melted, through the drainage of glacial lakes. Biodiversity and biomass are highest on the better developed soils of ancient and present-day deltas. The Mackenzie Delta extends from the Taiga Plains into the Tundra Plains and supports productive terrestrial and aquatic habitats. Favourable conditions allow many wildlife species typical of forested habitats to extend their distribution into the Mackenzie Delta tundra.

About 30 species of land mammals are regular seasonal or permanent inhabitants of the Southern Arctic. Other than the polar bear, none are exclusive to this biome. Collared and brown lemmings, root voles, arctic fox and arctic ground squirrel are well adapted to tundra but also occur south of the tree line. Many wildlife species such as barren-ground caribou and tundra wolves make annual migrations between habitats above and below tree line. Forest dwellers such as Canadian lynx, marten, American beaver, porcupine, American red squirrel and snowshoe hare occasionally wander into treed areas along valleys and at lower elevations in the Southern Arctic.

Whales, seals and walrus are marine mammals that typically range offshore (beyond the geographic scope of this report), but there are exceptions. Whenever a bowhead whale becomes beached along the seacoast, it provides an enormous amount of food for scavenging mammals and birds. In summer, beluga whales concentrate in the shallow estuaries of the major rivers where they bask and feed in the warm waters. Ringed seals are the most common pinniped in the Beaufort Sea, but are usually associated with pack ice and rarely come near shore. Closely related harbor seals are rare in the eastern Beaufort Sea. Bearded seals, more associated with shallow coastal areas and estuaries, occasionally swim up the main Mackenzie River channels. Harp and hooded seals are Atlantic species but a few have been reported as far west as the Mackenzie Delta. Pacific walrus had regular hauling-out places in the eastern Beaufort Sea, but were probably exterminated during the last years of the whaling period. Now, rare visitors stray from Alaskan waters as far east as Franklin Bay.

At least 115 species of birds nest in the Southern Arctic, about 30 percent fewer than the number that nest in High Subarctic areas of the Northwest Territories. Many birds typical of Taiga ecoregions that breed in the Tundra Plains are not known to nest in the Tundra Shield, even though migration distance from winter range may be shorter. In part, this could be due to a difference in habitat productivity; the richer fine-textured soils of the Tundra Plains and less exposed bedrock at least at lower elevations to the west of the Melville Hills are more favourable to the development of continuous shrub and herb tundra and more productive wetlands.

As many as 20 bird species could be occasional visitors to the Southern Arctic, but this is difficult to estimate because observations are sporadic and irregular. Tuktoyaktuk and Paulatuk are the only communities in the Tundra Plains, and there are no

[15] All ecoregions with the suffix LA*n* are discussed in Section 3.4 of this report. All ecoregions with the suffix LA*s* are discussed in Section 3.5 of this report.

permanent communities in the Tundra Shield. Ground-based access is limited in the tundra, and conventional sources of information such as the annual Christmas Bird Count and North American Breeding Bird Survey are generally not available.

Almost all birds that nest in the Southern Arctic migrate south for the winter. The only species that reside year-round are Willow Ptarmigan, Rock Ptarmigan, Gyrfalcon, Snowy Owl, Common Raven, and Gray Jay, and many of these make short southerly migrations within the Southern Arctic. There are also some populations of winter residents from nesting areas further north on the Arctic Islands.

The Southern Arctic shares a large number of forest birds that are typical of the adjacent Taiga Shield and Taiga Plains, but at much lower densities. It also has a few species not found in the south whose breeding activities are primarily associated with tundra habitats. These include the Gyrfalcon, Tundra Swan, Cackling Goose, Greater Scaup, Long-tailed Duck, Willow and Rock Ptarmigan, Baird's, Pectoral and Semipalmated Sandpipers, Red-necked Phalarope, American Golden-plover, Semipalmated Plover, Horned Lark, Smith's and Lapland Longspurs, Snow Bunting and American Pipit. Much of the seacoast is characterised by lagoons, bays, tidal flats, river deltas and barrier bars that are important for waterbirds, especially during the moulting and brood-rearing seasons.

The establishment of moulting areas separate from brood-rearing areas is a common strategy for waterfowl, possibly to distribute exploitation of food resources and reduce predation intensity. Several species of ducks, loons, gulls and jaegers depend on open leads and polynyas in offshore sea ice for migration pathways and food. The most important offshore staging area is between Cape Dalhousie (Tuktoyaktuk Peninsula Coastal Lowland LA*n* Ecoregion) and the Baillie Islands (Cape Bathurst Coastal Plain LA*n* Ecoregion)[16]. It is heavily used by sea birds even in years when open water is greatly restricted by dense masses of broken pack ice.

Many Southern Arctic ecoregions are remote environments to survey and our knowledge base on the abundance and distribution of most mammals and birds lacks depth. John Richardson and Richard King, surgeons attached to John Franklin's (1819-1822, 1825-27) and George Back's (1833-35) exploration parties, recorded information on wildlife they encountered. Richardson continued this work during his 1851 expedition to search for Franklin after his ill-fated Northwest Passage voyage. James Anderson (1855) and James McKinley (1890) were officers of the Hudson's Bay Company who recorded observations during overland travels. Ernest Thompson Seton and Rudolph Anderson collected faunal specimens during 1909-1910 natural history expeditions into the Southern Arctic.

Other travellers such as Guy Blanchet, William Hoare, Caspar Whitney, and Warburton Pike contributed wildlife observations during the early 1900s. Charles Clarke's detailed biological investigations of the Thelon Game Sanctuary in 1936-1937 have served as a useful benchmark for comparison with present day wildlife distribution and abundance.

Periodic declines of caribou populations and hardship for northern residents prompted a Royal Commission on developing muskox and reindeer industries. In 1929, the Canadian government bought 3,000 Siberian reindeer from Alaska with the intent to train Inuit herdsmen, provide a more reliable food source, and relieve some of the hunting pressure on caribou. The animals were released into a 17,094 km^2 Reindeer Grazing Reserve (later expanded to 46,361 km^2)[17] created east of the Mackenzie River where caribou had been depleted. Over the ensuing years, many of the reindeer strayed from the introduced herd. Some undoubtedly joined caribou herds and hybridization took place. This process was accelerated when growing caribou populations began reoccupying former range west of the Anderson River.

Subsequent declines of caribou populations stimulated biological research in the late 1940s by the Canadian Wildlife Service, led by Alexander Banfield and John Kelsall, and continued by Donald Thomas.

The Tundra Shield and Tundra Plains each have large protected areas. The Thelon Game Sanctuary was created in 1927 for the main purpose of conserving the last few herds of muskoxen left on the mainland. It has been renamed the Thelon Wildlife Sanctuary and after some boundary changes in 1956, it now includes almost all of Baillie Plain LA*s*, eastern Hanbury Plain LA*s* and the northern third of Clark Upland LA*s*.

Tuktut Nogait National Park was created in 1998 to protect various natural features, particularly Bluenose-West caribou calving grounds and raptor nesting habitat. The park expanded in 2005 and encompasses all or most of West Melville Slopes LA*n*, East Melville Slopes LA*n*, Melville Plateau LA*n*, Hornaday Valley, Hornaday Plateau LA*n* and Hornaday Upland LA*n* Ecoregions. It also contains the eastern edges of Horton Upland LA*n* and South Horton Plain LA*n* Ecoregions, and the northern edge of Great Bear Upland LA*n* Ecoregion. The Tundra Plains also contains smaller bird sanctuaries created in 1961 at Kendall Island, the Anderson River Delta and Cape Parry.

[16] These Level IV ecoregions are discussed in Section 3.4. of this report

[17] Recently, the Reindeer Grazing Reserve has been divided into three parcels of land that cover much less area.

4.2 Mammals of the Southern Arctic

4.2.1 Ungulates

Moose are generally considered to be forest dwellers that are dependent on woody vegetation for food. At higher latitudes, willow is particularly critical. Some animals migrate into the Tundra Plains along river valleys for the summer, especially the Anderson and Horton River valleys (Anderson Upland LA*n*, Smoking Hills LA*n*, West Horton Plain LA*n* and Central Horton Plain LA*n* Ecoregions), where willow is abundant. Other observations have been reported at several locations in the Mackenzie Delta LA*n*, Tuktoyaktuk Coastal Plain LA*n*, and Cape Bathurst Coastal Plain LA*n* Ecoregions. When snow accumulates, moose usually retreat to the forest where forage is more accessible. In some areas, such as west of the Horton River, they may winter in willow thickets. In the Tundra Shield, dense willow stands are much scarcer and the only record of moose is from the Daring Lake area (Point Upland LA*s* Ecoregion).

In the Southern Arctic, especially the Tundra Plains, sheltered valleys with pockets of forest or areas with tall, lush willow growth provide seasonal habitat for moose. *Photo: D. Downing*

Several herds of barren-ground caribou occur in the Southern Arctic. Winter range selection and overlap may vary from one year to the next. The Bathurst, Ahiak, Beverly and Qamanirjuaq herds are mainly associated with the Tundra Shield during migration between calving grounds in Nunavut and wintering areas in the Taiga Shield. The Bluenose-East, Bluenose-West and Cape Bathurst caribou herd migrate from the Tundra Plains into their wintering areas in the Taiga Plains. The Melville Plateau LA*n* and Hornday Plateau LA*n* Ecoregions encompass part of the traditional calving area of the Bluenose-West caribou herd. The Cape Bathurst caribou calving grounds are located in the Cape Bathurst Coastal Plain LA*n* and Bathurst Peninsula Upland LA*n* Ecoregions. Many of the animals on Richards Island and the Tuktoyaktuk Peninsula are probably caribou/reindeer hybrids.

Barren-ground caribou are the most widely distributed and numerous subspecies of caribou in the Northwest Territories. Several herds occupy seasonal ranges throughout the Southern Arctic. *Photo: D. Downing*

Peary caribou are a form of barren-ground caribou that inhabit the high Arctic Islands. In 1951, wanderers reached the mainland at Nuvorak Point (Tuktoyaktuk Peninsula Coastal Lowland LA*n* Ecoregion), and Harrowby Bay (Cape Bathurst Coastal Plain LA*n* Ecoregion).

Caribou, such as these dark-bodied mature bulls observed on Richards Island (western Tundra Plains) in July, may share genetics (hybridize) with reindeer that were introduced into the area in 1929 from Alaska (Canadian Reindeer Project). *Photo: D. Downing*

Muskoxen populations in Canada were decimated in the late 1800s because of trade for their hides. From 1861 to 1898, the Hudson's Bay Company post at Fort Rae received, "from near the Coppermine", over 5,000 muskox hides which was more than all other Mackenzie District posts combined. Protection has enabled a remarkable comeback and they have been successful in reoccupying most of their historical range, including the Southern Arctic.

Muskoxen, having successfully reoccupied their former ranges throughout much of the Southern Arctic, have recently expanded into the northern forests to the south, areas well beyond their known historic distribution. *Photo: R. Decker*

4.2.2 Large Carnivores

The occasional lynx is to be expected in wooded valleys such as some parts of the upper Horton River (Horton Upland LA*n* and South Horton Plain LA*n* Ecoregions), during years of snowshoe hare population irruptions. They sometimes wander far beyond their normal range above tree line in search of food when hares become scarce.

Tundra wolves that occupy the Southern Arctic are transient and depend almost entirely on migrating caribou that they follow for great distances between wintering and calving grounds. Eskers and other sandy locations in the Tundra Shield are important denning habitat for the tundra wolf population and for grizzlies and both red and Arctic foxes. The most extensive eskers in the Southern Arctic occur in the Whitefish Plain LA*s* Ecoregion.

Tundra wolves range throughout the Southern Arctic. Also known as caribou wolves, they are nomadic; traveling above and below treeline following the seasonal movements of their main prey, barren-ground caribou. *Photo: D. Downing*

Arctic foxes are long distance travellers most common in coastal areas of the Tundra Plains. They are characterised by two winter pelage colour phases – white and blue. In the Southern Arctic, the blue phase occurs in only one to two percent of the population. Red foxes are widely distributed.

Arctic foxes, circumpolar in distribution, range throughout the Southern Arctic. Abundance of its main prey, lemmings and voles can influence breeding success. Confined largely to tundra areas, food shortages can cause them to venture into forested areas to the south. *Photo: R. Decker*

Concerns about grizzly bear populations in the Northwest Territories have resulted in hunting restrictions; there has never been an open season for grizzlies in the Southern Arctic. Although genetically very similar to the bears of the Cordillera, "barren-ground" grizzlies tend to be smaller and lighter in colour. East of the Mackenzie River, they are more widespread and abundant in the Southern Arctic than in either the Taiga Plains or Taiga Shield.

Red foxes are the most widely distributed carnivore in the world. They range throughout the Northwest Territories as far north as some of the Arctic islands. Although more common in forested areas, they can be found throughout the Southern Arctic. *Photo: D. Johnson*

Black bears have occasionally been reported in the Mackenzie Delta, and wooded valleys in the Tundra Plains (Caribou Hills LA*n*, Tuktoyaktuk Coastal Plain LA*n* and Anderson Upland LA*n* Ecoregions). In 1957, a wanderer was reported in the Tundra Shield east of Artillery Lake (Whitefish Plain LA*s* Ecoregion).

Polar bears spend most of their time offshore and occasionally wander along the coast and inland. Maternity denning occurs intermittently on outer islands and rarely on the mainland of the Tundra Plains.

Polar bears are distributed throughout the circumpolar north, including the northern coastal areas of the Tundra Plains. Most time is spent out on the sea ice pursuing their main prey, ringed and bearded seals. In summer, disappearing sea ice forces them onto land.
Photo: R. Decker

4.2.3 Mustelids

Marten and mink sometimes appear in wooded valleys of the Tundra Plains.

Although river otters rarely venture beyond tree line, a few have been reported in the Mackenzie Delta LA*n*, Tuktoyaktuk Coastal Plain LA*n*, Bathurst Peninsula Upland LA*n* and Anderson Upland LA*n* Ecoregions.

Marten are forest dwellers that can be found along the southern Tundra Plains, wherever sheltered wooded valleys occur. Marten harvested from the Anderson River (Tundra and Taiga Plains) are renowned for their larger size and exceptional fur quality.
Photo: P. Nicklen

Wolverines are widely distributed at low densities and occupy large home ranges. They occur in all habitats of the Northwest Territories, including Arctic tundra. Largely opportunistic, this largest member of the mustelid family is attracted to areas where concentrations of ungulates and carrion provide a source of food.

The wolverine, the largest member of the weasel family, ranges throughout the forests and tundra of the mainland Northwest Territories. There are concerns about increased access and harvesting pressure in recent years, especially with the more vulnerable tundra populations.
Photo: A. Yu

Short-tailed and least weasels are widely dispersed throughout many different habitats. Weasel abundance is largely dependent on small mammal populations.

4.2.4 Large Rodents

American beaver occasionally wander into the Southern Arctic Plains along treed or willowy rivers whose headwaters lie in the Taiga Plains.

The American beaver, the largest rodent in North America, is widely distributed in Canada. It occurs throughout all of the forested watercourses, as well as those in some adjacent tundra areas, where suitable woody food sources are available. *Photo: D. Jones*

Muskrats require marshy wetlands that do not freeze to the bottom in winter. They are most often found in the Mackenzie Delta, Richards Island Coastal Plain LA*n* and Tuktoyaktuk Coastal Lowland LA*n* Ecoregions. They are rarely found in the Tundra Shield.

American red squirrels were reported from the Reindeer Station area where a strip of forest extends from the East Channel of the Mackenzie River onto the slopes of the escarpment (Caribou Hills LA*n* Ecoregion). They are also expected to occur in treed valleys and low-elevation plains in southerly parts of the Tundra Plains, adjacent to the Taiga Plains, and in treed pockets within the Clarke Upland LA*s* and Dubawnt Plain LA*s* Ecoregions in the Tundra Shield.

Arctic ground squirrels range across all ecoregions wherever soil is dry or sandy enough to allow burrowing, especially in areas like the Hanbury Plain LA*s* Ecoregion. They avoid organic soils. In the Richards Island Coastal Plain LA*n* Ecoregion, habitat conditions are suitable in the old delta which existed previous to the last glaciation.

Arctic ground squirrels, the largest of North American ground squirrels, inhabit the entire Southern Arctic, wherever suitable burrowing habitat is available. Eskers, moraines, river flats and terraces, lake shores and ridges are favoured habitat. *Photo: D.Downing*

4.2.5 Voles and Lemmings

These small mammals are important prey for most carnivores and birds of prey. Their fluctuating numbers greatly influence the distribution and abundance of predators that depend on them.

The nearctic collared lemming and Richardson's collared lemming are no longer considered subspecies. The nearctic collared lemming, the most widespread, occupies the entire Tundra Plains and its population overlap with Richardson's collared lemming in the Southern Arctic is in the central part of the Tundra Shield. Richardson's collared lemming ranges westward from Hudson Bay and its western limit beyond Whitefish Plain LA*s*, Clarke Upland LA*s* and Dubawnt Plain LA*s* Ecoregions in the Tundra Shield is unknown. Both species prefer the leaves of shrubs and forbs.

Collared lemmings, well adapted to Arctic environments, are the only rodents that change their pelage from brown to white in winter. Two species are found in the Southern Arctic. Elongated forked front claws, used for digging, have often been called "little hooves" by native northerners. *Photo: G. Vyn*

The brown lemming is North America's only true lemming in the genus *Lemmus*. It is often sympatric with collared lemmings across the Southern Arctic, except that brown lemmings prefer wetter tundra where they subsist mainly on grasses and sedges. Extraordinary population fluctuations have often been described as chaotic, rather than following linear oscillations.

Brown lemmings are found throughout the Southern Arctic. Their range on the mainland Northwest Territories extends into northern portions of the Taiga Plains and Taiga Shield. Their distribution is often similar to collared lemmings but favour wetter habitats. *Photo: K. Broadway*

Under favourable conditions, high population growth is enhanced by year round reproduction and frenzied dispersal may follow peak densities.

Red-backed voles are found in northern taiga, as well as arctic tundra west of Hudson's Bay. Evidence suggests that tundra populations may compensate for higher over-winter mortality by having larger litters that are skewed more towards females. Although their varied diet sometimes includes a large proportion of fungi, berries seem to be preferred.

Meadow voles are probably the most widely distributed rodent in Canada, extending their range northward across the entire Southern Arctic. They require loose organic soils for tunnelling and feed on grasses, roots and seeds. Breeding may continue through winter if snow conditions are favourable.

Taiga voles, also known as yellow or chestnut-cheeked voles, are large voles that have been reported from the Tundra Plains in the past but there are no records from recent times. Specialised habitat conditions that tend to be ephemeral may be why highly irruptive populations can disappear from areas for decades. A colony of this species could possibly be found anywhere in the Southern Arctic. Burrows with large dirt piles at entrances are obvious signs of taiga vole presence. They eat predominately grasses, horsetails and berries in summer, while relying on stored rhizomes for winter.

The root vole, formerly known as the tundra vole, is restricted to Eurasia and northwestern North America. Though widespread in the Tundra Plains, root voles are absent from the Tundra Shield. Population fluctuations show a high degree of synchrony with those of sympatric lemmings. As its name implies, roots comprise a significant component of its diet.

Root or tundra voles are medium-sized voles that inhabit damp tundra and wet meadows, in the Tundra Plains, usually near water. They are active burrowers, creating large tunnels above the permafrost where they store grasses, sedges, seeds and roots. *Photo: C. McCaffery*

4.2.6 Lagomorphs

Arctic hares prefer rocky, hilly landscapes. These habitats are most widespread in the Tundra Shield, and hares may be locally abundant in boulder fields that occur in some areas such as the Point Upland LA*s* and Healey Upland LAs Ecoregions. These hares are rarely found in the low relief coastal ecoregions of the Tundra Plains.

During years of population irruptions, snowshoe hares often invade dense willow habitats of the Mackenzie Delta and Richards Island. They may also range into wooded valleys in some parts of the upper Horton River (South Horton Plateau LA*n* and Horton Upland LA*n* Ecoregions).

Arctic hares range throughout the tundra regions of the Canadian Arctic. In the Southern Arctic, they are most abundant in boulder-strewn, hilly areas common in the Tundra Shield and the more rugged rocky areas of the eastern Tundra Plains. *Photo: R. Mulders*

4.2.7 Insectivores

Shrews, like many other small mammals, undergo wide population fluctuations. Information on their distribution and abundance is very limited. Proper identification in the field and taxonomy may be a problem. Masked, tundra, barren-ground and arctic shrews have been reported from a few localities in the Southern Arctic.

Arctic shrews are native to North America. Contrary to what their name suggests, they are more common in boreal and taiga forests than in the Arctic. This shrew has a distinctive tricoloured coat. *Photo: P. Meyers*

4.3 Birds of the Southern Arctic

4.3.1 Geese and Swans

Tundra Swans breed throughout the Southern Arctic, and are most abundant on the vast network of ponds stretching from the Mackenzie Delta through Richards Island and the Tuktoyaktuk Peninsula to the mouth of the Mason River (Tuktoyaktuk Coastal Plain LA*n* Ecoregion). Concentrations of large pre-moulting flocks occur in the Mackenzie Delta, and the mouths of the Kugaluk and Anderson Rivers (Tuktoyaktuk Coastal Plain LA*n* Ecoregion). Occasional reports of larger birds in the Tundra Plains may be Trumpeter Swans which were reported as far east as Franklin Bay in historic times.

Tundra Swans are the most numerous and widespread of North American swans. They breed throughout the Southern Arctic and are particularly abundant in the western Tundra Plains, where small shallow lakes and ponds provide optimal habitat. *Photo: D. Johnson*

Canada Geese breed in singular pairs throughout the Southern Arctic, especially in the Mackenzie Delta and Richards Island. The Tundra Shield is used mainly for moulting. Continental-wide numbers have dramatically increased in recent decades. Up to 20 percent of the Short-grass Prairie population of Canada Geese moults in either the lower Kugaluk River (Tuktoyaktuk Coastal Plain LA*n* Ecoregion), or the Old Horton Channel (Cape Bathurst Coastal Plain LA*n* Ecoregion).

Cackling Geese breed in the Tundra Plains. Nesting sites may be established in coastal marshes, along ponds and streams, or on steep slopes near water. Until 2004, they were considered to be the smallest subspecies of the Canada Goose. By the early 20th century, over-hunting and loss of habitat were responsible for very low numbers. Subsequent conservation measures have resulted in recovery in most of its range.

Greater White-fronted Geese are usually the first to arrive in spring. Solitary pairs breed throughout the Southern Arctic in upland and coastal tundra, especially Liverpool Bay and lower Anderson River (Tuktoyaktuk Coastal Plain LA*n* Ecoregion). Populations have been fairly stable.

Brant, the species of goose most associated with marine habitats, is also known locally as "sea goose". This colonial nester is one of the smallest geese in body size and lays the fewest number of eggs. They feed on grasses and sedges in the littoral zone, and because nesting is very near the tide-line, they are quite vulnerable to early season storm surges. The Anderson River Delta - Mason River Delta - Wood Bay (Tuktoyaktuk Coastal Plain LA*n* Ecoregion) area is critical habitat for Brant. Since the 1980s, numbers in this area have decreased, possibly because of nest predation by grizzlies or changes in vegetation in the outer Delta. After steady declines since the 1960s, total numbers in North America have recently began to surge as other populations extend their wintering range northward and learn to exploit agricultural lands as a food resource.

Brant, short-billed, small-bodied geese, breed throughout Arctic coastal areas. "Black" Brant, the subspecies found in the Tundra Plains, are darker in colour than the eastern "Atlantic" Brant. Black Brant winter from the Aleutian Islands to northern Mexico. *Photo: S. Streit*

Snow Goose populations have been growing exponentially since the 1960s. Marshy areas on Kendall Island (Mackenzie Delta LA*n* Ecoregion) and Anderson Delta are two of the three main nesting colonies in the western Arctic where densities may reach 500 pairs per km^2.

Ross's Goose, which breeds in the Coronation Gulf of Nunavut and Banks Island, is an infrequent transient in the Tundra Plains.

The western Tundra Plains contains important breeding areas for Snow Geese. This tundra-nesting species has experienced dramatic population growth recently to the extent that both breeding and salt-marsh wintering habitats are becoming severely degraded.
Photo: R. Decker

4.3.2 Ducks

Surface-feeding ducks found in the Southern Arctic generally have their population centres located further south. Because their habitats are much more impacted by drought than diving ducks, numbers of dabbling ducks tend to be less stable and may appear in the Southern Arctic more often during dry years in the northern prairies.

The Northern Pintail is the most widely distributed dabbling duck in the world, and is particularly common in the Tundra Plains. Preferred nesting sites occur in seasonal wetlands and shallow ponds.

Northern Pintails are a widely distributed duck species, breeding in northern areas throughout North American, Europe and Asia. They are the most common breeding dabbling duck in the Southern Arctic.
Photo: L. Spitalnik

Mallards, the most common duck in North America, breed extensively distributed in ponds across the Southern Arctic.

American Wigeon, Green-winged Teal, and Northern Shoveller are present in shallow lakes and marshes. Gadwall have extended their breeding range northward in recent decades, becoming rare transients in the Tundra Plains.

Diving ducks occur across the Southern Arctic in much greater numbers. Many nest inland and moult on the seacoast. Important moulting areas occur from the Tuktoyaktuk Coastal Lowland, around Liverpool Bay to Bathurst Peninsula.

Mallards are widely distributed throughout the northern hemisphere. They breed through the Southern Arctic but likely most common along the southern edge and western Tundra Plains. Mallards are the wild ancestors of most domestic ducks. *Photo: L. Spitalnik*

Large numbers of White-winged Scoters nest on the Anderson River, and moulting flocks occupy Wood Bay and Langton Bay (Parry Peninsula Lowland LA*n* Ecoregion).

Surf Scoters nest inland and moult in great numbers at Wood Bay, Harrowby Bay and Ikpisugyuk Bay (Cape Bathurst Coastal Plain LA*n* Ecoregion).

White-winged Scoters are large, dark-coloured, stocky diving ducks that breed throughout the Southern Arctic, but are likely more common in the Tundra Plains. They prefer salt-water coasts but will breed further inland than the other two scoter species. *Photo: S. Streit*

Black Scoters have not been well studied and only a few nests have ever been found. It is not known whether the birds that occasionally appear on the Southern Arctic Plains coast are actually nesting, or are non-breeders from the Bering Sea. Nesting has been confirmed at Daring Lake within the Tundra Shield (Point Upland LA*s* Ecoregion). Common Goldeneye and Common Mergansers are cavity nesters that require trees. In some years, thousands of sub-adult non-breeders from further south flock to Liverpool Bay and Finger Lakes for moulting.

Red-breasted Mergansers nest along streams and lakes across the Tundra Plains and Tundra Shield, but more often close to the coast. Moulting flocks may be found at Liverpool Bay, and some of the larger rivers and lakes.

Long-tailed Ducks usually locate their nests close to the water's edge, especially on the Anderson River delta, in Langton Bay and on Nicholson Island (Tuktoyaktuk Coastal Plain LA*n* Ecoregion), and also on lake islands or ponds further inland. Moulting and migrating flocks are more often found on seacoasts, and may frequent Wood Bay, Cape Parry (Parry Peninsula Coastal Plain LA*n* Ecoregion), and Baillie Islands in large numbers.

The Red-breasted Merganser gets its common name from the plumage of adult males. It prefers salt water more than the other two species of merganser. It is possibly the fastest bird in level flight, reaching speeds of 161 km/h. *Photo: L. Spitalnik*

Greater Scaup are widespread in the Southern Arctic and are especially attracted to ponds near Anderson Delta for breeding. Husky Bend on the Anderson River (Anderson Upland LA*n* Ecoregion) and Wood Bay are important areas for moulting. Differentiation from Lesser Scaup is often difficult in the field, but Greater Scaup are the species most often identified in the Southern Arctic when careful observations are made. Although both species still number in the millions, populations have mysteriously dropped almost 40 percent below the North American Waterfowl Management Plan goal since the 1980s. Most of this decline has been in western Canada.

Canvasbacks are primarily a species of western North America. Fairly common in the Mackenzie Delta and Richards Island, they rarely nest in other ecoregions of the Tundra Plains. After record lows in the 1980s, Canvasback populations are rebounding.

Common Eiders are a sea duck that usually breed within a few hundred metres of shore. They often seek out islands and barrier bars that become ice free early in the breeding season, and that afford protection from arctic

fox depredation. The largest breeding colonies are on Victoria Island. On the Southern Arctic mainland, Parry Peninsula Coastal Plain LA*n* Ecoregion has the highest density of nesting pairs. Otherwise, mainland colonies tend to be smaller, distributed irregularly, and solitary nesting often occurs. Historically, Liverpool Bay, Cape Dalhousie, old Horton River mouth (Cape Bathurst Coastal Plain LA*n* Ecoregion), and Franklin Bay (Bathurst Peninsula Upland LA*n*, Parry Peninsula Coastal Plain LA*n* and Parry Peninsula Lowland LA*n* Ecoregions) supported major breeding colonies but these are now much reduced. A moult migration begins in July and proceeds westward to the Bering and Chukchi seas. Large offshore flocks pass the northwest coast of Tuktoyaktuk Peninsula, Cape Parry and Baillie Islands. Many females that do not join this migration remain in coastal bays.

Common Eiders, the largest of ducks in the northern hemisphere, are also the most abundant, variable and widespread of the eiders. Four of seven subspecies of this largely Arctic coastal breeder, varying in head and bill markings, occur in North America. *Photo: A.Trepte*

Less confined to marine habitats than Common Eiders, King Eiders may nest earlier and in tundra ponds further inland. Males and non-breeders spend most of the summer on salt water. Although their main nesting areas are on Banks and Victoria islands, some nest around Anderson Delta and Franklin Bay.

King Eiders are sea ducks that breed throughout circumpolar Arctic regions and are highly gregarious for much of the year. Their scientific name (*spectabilis)* means "worth seeing" due to the striking colours and patterns of the adult males. *Photo: L. Spitalnik*

King Eiders undergo a westward moult migration similar to Common Eiders. Both species winter mainly around the Aleutian Islands in the Bering Sea, or northward wherever they can find open water. During spring migration into the western Canadian Arctic, King Eiders and other sea birds may suffer heavy mortalities due to starvation if Beaufort Sea ice break-up is late.

4.3.3 Grouse

Willow Ptarmigan are year-round residents in heavily vegetated habitats and undergo seasonal movements through most of the Southern Arctic. Males tend to remain on tundra during winter, while females are more likely to migrate below treeline. Cycles of dramatic population fluctuations are not well understood.

Rock Ptarmigan prefer sparsely vegetated rocky plains and dryas tundra. They are not as common as Willow Ptarmigan and migrate shorter distances.

Willow Ptarmigan are the largest and most common of the two ptarmigan species in the Southern Arctic and undertake longer migrations than Rock Ptarmigan. The famous Red Grouse of the British Isles are a subspecies of the Willow Ptarmigan. *Photo: D. Johnson*

4.3.4 Loons and Grebes

These birds are awkward on land, prefer to dive rather than fly when escaping enemies, and feed on fish and invertebrates. Restricted powers of locomotion for loons on land probably hinder coastal nesting because of tides.

Pacific Loons are the most abundant loon in the Southern Arctic. They prefer to nest on ponds with islands and grassy shorelines. Non-breeders are more often found in coastal bays and estuaries.

Yellow-billed Loons breed in the Tundra Shield and the Arctic Islands, but there is no recent evidence of nesting in the Tundra Plains. In the 1860s, MacFarlane presumed that they nested around Liverpool and Franklin Bays. Although not considered to be at risk, it breeds at low density within a restricted range.

Red-throated Loons are able to nest earlier than other loons on relatively small ponds, but must feed in the sea or larger lakes and rivers.

Common Loons are closely related to Yellow-billed Loons and generally there is very little range overlap.

Common Loons, more prevalent below tree line, occur on some of the larger Southern Arctic lakes and rivers where nesting habitat is more secure from shoreline development and other adverse human activities.

Yellow-billed Loons, the largest member of the loon family, breed in the Arctic, are found further north than Common Loons, and prefer larger freshwater ponds and lakes for nesting. *Photo: G. Vyn*

Red-necked Grebes and Horned Grebes have occasionally been observed in marshes and shallow lakes of the Mackenzie Delta and Richards Island.

4.3.5 Eagles and Hawks

Until the 1960s, birds of prey in the Southern Arctic suffered to varying degrees from the ill-effects of organopesticides. All species are now recovering after the global implementation of pesticide controls.

Golden Eagles nest on steep cliffs and escarpments. The most predatory of the eagles, they hunt widely for arctic ground squirrels, arctic hares, and newborn caribou calves over various types of terrain.

Bald Eagles are rare on the tundra, probably because of their dependency on trees for nesting and roosting. Most appearing in the Southern Arctic are probably wanderers from the Taiga Plains and Taiga Shield. Large fish are an important part of their diet; they are usually close to lakes and rivers when they are ice free. Carrion becomes more important as a food item when fish are unavailable.

Golden Eagles are formidable birds of prey - large, fast and agile, with powerful talons. They are widely distributed in North America but most common in the west. They breed throughout the Southern Arctic and favour high cliffs as nesting sites. *Photo: Zoo Ostrava*

The Rough-legged Hawk is the most common raptor in the Southern Arctic and feeds chiefly on small mammals such as lemmings, voles, and arctic ground squirrels. It nests mainly on cliffs, but will sometimes use tundra hummocks. It often competes for cliff nesting sites with Peregrine Falcons, Gyrfalcons and Common Ravens that sometimes use abandoned Rough-legged Hawk nests.

Rough-legged Hawks are moderately large, broad-winged hawks that breed throughout the tundra and taiga regions of North America and Eurasia. They exhibit considerable variation in plumage colouration from very light to almost completely black. *Photo: G. Vyn*

Peregrine Falcons have recovered from extreme lows in the 1960s and 1970s to become the most common falcon in the Southern Arctic. Abundance on the tundra depends on the availability of steep cliff-nesting sites, but they may also select other raised sites offering wide views. Their main source of food is shorebirds that they take in flight. The canyons of the Hornaday River (Hornaday Upland LA*n* Ecoregion) and Brock River (West Melville Slopes LA*n* Ecoregion) are particularly important for nesting.

Gyrfalcons are the largest falcon in the world and in highest demand for falconry as the "bird of kings". They often use stick nests constructed by other large birds. During the breeding season, they have been known to cache food near the nest. Inland, the bulk of their diet consists of ptarmigan which they catch mostly on the ground and arctic ground squirrels. In coastal areas of the Tundra Plains, gulls and waterfowl caught in flight may become more important. They also prey on arctic hares and small mammals. Its winter range appears to be larger than any other raptor. Some Gyrfalcons hunt over pack ice for gulls and guillemots in winter.

Merlins are the smallest falcon of the Southern Arctic. Many of those occurring north of the tree line may be wanderers. They seem to prefer areas that contain trees or tall willows such as along the Hornaday River (Hornaday Upland LA*n* Ecoregion) and Anderson River. Rock ledges or scrapes on the ground may be used for nesting in treeless areas. They prey mainly on small birds.

Northern Harriers are ground nesters and appear erratically in some parts of the Southern Arctic. They generally hunt in wetlands for small mammals and birds.

Northern Goshawks have been occasionally reported in the Tundra Plains. They are probably wanderers from the boreal forest as they require large trees for nesting and depend on snowshoe hares and grouse for most of their food requirements.

The Gyrfalcon is the falcon most associated with tundra. It is polymorphic in three colour phases - white, grey, and dark. Carbon dating of nest sites on rock ledges in Greenland suggests that they may have been continually occupied for several thousand years. *Photo: O. Larsen*

4.3.6 Wading Birds

Sandhill Cranes are the only long-legged wading birds to inhabit the Southern Arctic. Omnivorous feeding habits and preference for open habitats allow them to be widespread across the tundra. It is one of the few crane species in the world that is still common and populations may be increasing.

Sandhill Cranes are large, tall gray birds that breed in open grasslands, meadows, wetlands and tundra throughout the Southern Arctic. The rusty-brown colouration is a result of staining, most likely from feeding in iron-rich mud and then preening their feathers. *Photo: T. Sohl*

4.3.7 Shorebirds

The majority of this very diverse group are circumpolar and breed at high latitudes. Until the early 1900s, most of the bulkier plovers, dowitchers, curlews, godwits, snipes and phalaropes were highly sought after as game birds. Large numbers were shot by market hunters before the Migratory Bird Treaty Act was passed in 1918 followed by protective legislation in Argentina (1920) where many species winter. Those acts imposed conservation measures, including full protection to the most vulnerable species. Populations of the small sparrow-sized sandpipers, collectively known as "stints" or "peeps," have generally remained fairly secure and stable.

Species that have extensive breeding ranges but are not common above tree line include Spotted and Solitary sandpipers, and Lesser Yellowlegs. Others such as White-rumped Sandpipers, Dunlins, Red Knots, Sanderlings and Ruddy Turnstones occasionally visit the Southern Arctic as nonbreeders and might rest there during migration, but their main breeding ranges may be further out in the Arctic Islands, Nunavut or Alaska. Some species that were reported as nesting in the Low Arctic during historic times may have withdrawn the southerly limits of their breeding range to Mid-Arctic due to climate change.

Wilson's Snipe have a wide distribution across Canada and the northern United States that might have extended into the Southern Arctic in recent decades. It uses dense willow more than other shorebirds, but prefers meadows. Wilson's Snipe has been more resilient to intense hunting pressure during the last century than most shorebirds, and is still a popular game bird in many parts of North America.

American Golden Plovers breed across the Southern Arctic and are associated mainly with low-shrub tundra, high-centre polygons, dry vegetated knolls and slopes. They were intensively hunted before the Migratory Bird Treaty Act was invoked, but their populations have recovered and they are now one of the most abundant shorebirds seen during migration periods along the coast.

American Golden Plovers breed in northern Canada and Alaska and are highly territorial. Males usually incubate during the day, and females resume at night. Chicks are precocious and can find food within a few hours of hatching. *Photo: C. Eckert*

Black-bellied Plovers nest at low density in wet tundra of the Tundra Plains, and migrants have been observed in the Tundra Shield. They are more common in some of

the Arctic Islands and further east along coastal areas in Nunavut. The wariness of this large plover allowed it to retain healthy populations when other species were devastated by market hunting.

The Semipalmated Plover is the smallest plover in the Arctic and is found in all areas. It prefers sparsely vegetated gravel and low-centre polygon habitats for nesting. Its numbers are fairly stable.

Black-bellied Plovers are the largest of North American Plovers. They breed in Arctic habitats that may include the coastal regions in the Tundra Plains. They may be seen throughout the Southern Arctic during migration. *Photo: L. Spitalnik*

Baird's Sandpiper is a stint that undergoes a long distance migration to wintering grounds in South America, often completing the 15,000 km flight in less than five weeks. Unlike most other sandpipers, the tips of its long wings extend beyond the tail at rest, breeding is confined to North America, it mainly associates with dry inland landforms, and it is less of an insistent wader.

Least Sandpipers, with an average weight of 28 g and length of 15 cm, are the smallest shorebird in the world. Males carry out most of the incubation duties, and broods from many families congregate after hatching.

The Semipalmated Sandpiper is the second smallest shorebird in the Southern Arctic. It It uses well-drained sites for nesting and adjacent wet tundra for feeding.

The Semipalmated Sandpiper is named from the partial webbing between its toes. Females normally desert their broods within 10 days of hatching, leaving them to the care of the male. Males usually tend the chicks until they fledge,. *Photo: L. Spitalnik*

Long-billed Dowitchers feed on invertebrates by probing their long sensitive bills into mud. Both sexes share incubation of the eggs, but only the male takes care of the young after they hatch. The population may be increasing because of breeding range expansion into Siberia.

Eskimo Curlews may have been the most numerous shorebird in North America with populations into hundreds of thousands. Their breeding grounds were described as the barren lands within the Arctic Circle, but MacFarlane (1891) (Tundra Plains) and Richardson (1831) (Tundra Shield) are the only references that exist for northern Canada. It was a highly sought after, easily hunted game bird relying upon winter habitat that was converted to agricultural uses; consequently, its numbers rapidly plummeted in the late 1800s. Now, they are probably extinct. The last specimen was shot in Barbados in 1963. Since then, no sightings have been confirmed during intensive surveys of nesting and wintering grounds.

Whimbrels nest in wet grass and moss tundra with dry hummocks. They are one of the more widespread shorebirds in the world, and the main breeding population of the Southern Arctic is scattered west of Franklin Bay. By the end of the 19th century, hunting on their migration routes had taken a heavy toll. Although this bird's numbers have since rebounded, other factors have recently been causing population decline.

The Whimbrel is a large curlew with a very extensive global breeding and wintering range. It is the only Canadian arctic shorebird (other than except Eskimo Curlew) with a long down-curved bill. *Photo: S. Streit*

The Hudsonian Godwit nests in both tundra and taiga habitats. The species has not fully recovered from the market hunting days, and is still quite vulnerable because of enigmatic breeding range and loss of winter habitat. Nevertheless, populations have risen to the point that it no longer considered one of North America's rarest birds.

Hudsonian Godwits are one of the largest shorebirds in the Southern Arctic, but the smallest of the four godwit species found worldwide. They are characterised by long, slightly upturned bills. Breeding populations are concentrated in the Tundra Plains and the west shore of Hudson's Bay. *Photo: L. Spitalnik*

Red-necked Phalaropes nest throughout the Southern Arctic and are often the most common shorebird occurring near low-centre polygons and sedge meadows during the nesting season, when they are dependent on shallow freshwater ponds for foraging. After nesting, this bird is pelagic, spending up to nine months in open oceans.

Red Phalaropes prefer coastal areas for nesting and is more pelagic than other phalaropes. Both Red and Red-necked Phalaropes winter offshore and are two of the few shorebirds that do so.

Red-necked Phalarope females are larger and more brightly coloured than males, pursue multiple male partners, and compete for nesting territory. After laying eggs, females leave to migrate, while males incubate and care for the young. Phalaropes have lobed toes and often feed by swimming in tight circles. *Photo: J. Nagy*

Pectoral Sandpipers prefer grassy habitats and are one of the most abundant shorebirds during migration along the coast. They are medium-sized shorebirds; males are larger than females, which is unusual among sandpipers.

Buff-breasted Sandpipers are medium-sized shorebirds that occupy a restricted breeding range, mostly in the western Arctic. Like Pectoral Sandpipers, they also prefer grasslands and males are larger than females. The "lek" formation that Buff-breasted Sandpipers engage in is a unique breeding behaviour among North American shorebirds. In a lek formation, males display for females in large groups. Females mate at the lek, then return to their nests, usually a mossy hummock near water, to raise the young on their own. Their numbers may have originally been in the millions, but populations were probably reduced to ten percent of their original numbers by market hunting. Subsequent habitat loss along migration routes and wintering habitats has retarded population recovery.

Buff-breasted Sandpiper males are larger than females, which is unusual among sandpipers. The "Lek" formation that Buff-breasted Sandpipers engage in is a unique breeding behaviour among North American shorebirds. In a lek, males display for females in fairly dense groups. *Photo: L. Spitalnik*

The Stilt Sandpiper is another of the few shorebirds that restricts its breeding to North America. Unlike related species, it is primarily associated with freshwater, and is seldom found on seacoasts. It nests in sedge tundra near water, feeding more extensively outside of its nesting territory. Restricted breeding and wintering distributions, relatively small numbers, and unknown trends in population may be of concern.

4.3.8 Gulls, Terns, and Jaegers

Bonaparte's and Mew gulls are occasionally observed in the Southern Arctic, but occur mainly below tree line.

Glaucous Gulls are the most plentiful and widespread gull in the Tundra Plains. They breed in colonies or pairs in a wide variety of habitats including cliffs, beaches, and inland lakes, primarily near the Arctic coast.

Herring Gulls are wide ranging foragers across the Southern Arctic, and are the most plentiful gulls in the Tundra Shield.

Thayer's Gulls are infrequent visitors from breeding grounds in the Arctic Islands. As intermediates between Herring Gulls and Iceland Gulls, they may be difficult to distinguish from those two species.

Sabine's Gulls usually nest on low, flat terrain near fresh water, and feed primarily in fresh water or on land. Although colonial in the Tundra Plains such as at Cape Bathurst and Langton Bay, this species is more abundant on high Arctic Islands.

Glaucous Gulls are very large, heavy-billed gulls with pale plumage and white wing tips. Besides feeding on carrion, human reuse, small mammals, they are active predators of eggs and fledglings at seabird nesting colonies. *Photo: G. Vyn*

Ivory Gulls, occasionally observed in the Mackenzie Delta, have a limited migration between High Arctic nesting areas and lower Arctic wintering areas. They are the most endangered gull in North America and are highly sensitive to disturbance at nesting time; all but a few colonies in the High Arctic have been permanently abandoned. In 1826, Richardson observed Ivory Gulls breeding in great numbers on the high cliffs at the extremity of Cape Parry, where they attended the whale fishery to scavenge on blubber.

Herring Gulls are the most common gull species in Canada, benefitting from food resources available at garbage dumps. These large, usually colonial-nesting gulls, breed throughout much of the Southern Arctic, and are replaced by closely related Thayer's Gulls at higher latitudes. *Photo: L. Spitalnik*

Arctic Terns breed throughout the circumpolar Arctic and sub-Arctic regions including all the Southern Arctic and are widespread around lakes and coastal areas. They usually nest in pairs or small groups on barrier bars, islands and delta marshes.

The Parasitic Jaeger is the most abundant and widespread of the Southern Arctic jaegers, preying mainly on small birds and eggs. As their name implies, these jaegers are the most adept at "kleptoparasitism", i.e. the habit of robbing food from other seabirds. Plumage occurs in dark and pale colour morphs, with intermediate variations. It has been puzzling to scientists why the morphs occur in stable proportions and vary according to latitude, with dark morphs increasing in predominance from north to south throughout the breeding range.

Sabine's Gulls are small, strikingly patterned gulls with a distinctive notched tail. As the only member of its genus *Xema*, the Sabine's Gull has many behaviours resembling terns more than gulls, and its nests are often interspersed with those of Arctic Terns. *Photo: R. Decker*

Long-tailed Jaegers are the smallest and least aggressive as robbers. They eat a wide variety of animal matter and are the most insectivorous of the jaegers in summer.

The Pomarine Jaeger is the largest and least abundant of the jaegers. It is most often found near water in coastal areas or large lakes, mainly feeding on lemmings when their populations are high. These birds may not breed when lemming numbers are low. Mitochondrial DNA evidence suggests that the Pomarine Jaeger could have developed as a distinct species after originally being a hybrid between the Great Skua and a species of lesser skua.

Arctic Terns can live up to 20 years and spend more time offshore than any other terns. Arctic Terns experience two summers each year as they undergo the longest migration by any known animal. From northern breeding grounds to the oceans around Antarctica, the round trip each year is about 70,900 km. *Photo: J. Meikle*

Another possibility is that the Pomarine Jaeger crossed with a species of Southern Hemisphere skua, producing the Great Skua as the hybrid offspring, perhaps appearing as recently as the 15th century.

Jaegers (German word for hunters) are part of the predatory gull-like family known as skuas. Of the three species that occur in the Southern Arctic, Long-tailed Jaegers are the smallest in body size. Known for their long central tail feathers during the breeding season, these are often broken or missing later in the year. *Photo: G. Vyn*

4.3.9 Auks

Cape Parry (Parry Peninsula Coastal Plain LA*n* Ecoregion) offers nesting habitat for murres and guillemots. The Thick-billed Murre colony on the seafront cliffs may have fairly recent origins. It was not mentioned by Richardson in 1826 or 1848 when he visited Cape Parry. The murres were first documented by Clarke in 1942, but he did not report whether they were nesting. As the only colony of its kind in the western Arctic, it is more isolated than any other Thick-billed Murre colony in the world, 1300 km from the nearest colony in Nunavut or Alaska. Since 1979, some Common Murres have also appeared at Cape Parry. Their nearest neighbouring colony is at Cape Lisburne on the Chukchi coast of Alaska, 1500 km away.

Thick-billed Murres breed in large colonies in Arctic regions of the northern hemisphere where it is one of the most abundant of seabirds. The only colony in the Southern Arctic is at Cape Parry. They winter mostly in ice-free waters within the breeding range and can dive to depths of 180m. *Photo: D. Downing*

Although Black Guillemots have been observed in the Cape Parry area since 1980, evidence of breeding has been very limited. The only other known breeding colony in the Canadian western Arctic is 450 km to the west at Herschel Island. Nesting records there do not predate 1958 and these birds probably originated from the Alaskan Pacific coast. Black Guillemots sometimes build their nests in abandoned buildings or man-made debris, consequently, it has been speculated that they may be able to extend their breeding range into areas where natural landscape requirements are lacking.

4.3.10 Owls

Short-eared Owls hunt in wet meadows throughout the Southern Arctic and are widely distributed in the northern hemisphere. Although their abundance is closely associated with small mammal populations, there is concern in Canada about a long term decline.

Short-eared Owls are medium sized, ground-nesting owls having a nearly worldwide distribution that includes the Southern Arctic. Their slightly upturned wing angles, and buoyant wing-beats give them a distinctive flight pattern. Active during the day, they are easier to observe than most other owls. *Photo: L. Spitalnik*

Snowy Owls are winter residents that occasionally nest on ridges and hilltops in the Southern Arctic, but occur more commonly in the Arctic Islands and Nunavut. Hummocks and other minor prominences are important as lookouts. These owls breed prolifically when lemmings are plentiful, and emigrate from the Arctic during winters when populations of these small mammals are low.

Great Horned Owls are the most widespread strigid in North America and occasionally wander north of tree line in the Mackenzie Delta. The Hawk Owl is another forest species that occasionally ventures further north.

4.3.11 Woodpeckers

As cavity nesters, the woodpecker's reliance on trees limits its range in the Southern Arctic. Northern Flickers are the most omnivorous of this group, and may be found in areas of the Tundra Plains where trees occur. They have not been reported from the Tundra Shield.

Hairy Woodpeckers have been observed in tall willows and treed areas of the Anderson River and tributary valleys (Tuktoyaktuk Coastal Plain LA*n* and Anderson Upland LA*n* Ecoregions).

Great Horned Owls are large, adaptable and powerful predators that prey on a wide variety of medium-sized mammals and birds, including other owls. They inhabit nearly every type of habitat from the subarctic North America, south to Tierra del Fuego. *Photo: L. Spitalnik*

4.3.12 Flycatchers

This group specializes in flying insects, which are available only for a few weeks during the brief Arctic summer. Say's Phoebes are the only flycatcher to breed in the Southern Arctic. They are thinly distributed and nest in human infrastructure and rocky cliffs across the Tundra Plains.

Say's Phoebe is a medium sized tyrant flycatcher of western North America that breeds further north than any others in this family. Drab colouration allows this bird to blend easily into its environment. It primarily eats flying insects and will supplement its diet with other invertebrates and berries. *Photo: L. Spitalnik*

4.3.13 Corvids

Common Ravens are the main carrion scavengers in the Southern Arctic and are found across all types of terrain. Gray Jays are not common above the tree line.

4.3.14 Larks

Horned Larks, the only true larks of North America, prefer sparsely vegetated rocky plains and are one of the most abundant species in Southern Arctic areas. They are mainly insectivorous in summer and seeds become more important during migration.

Horned Lark males in summer are readily identified by their striking black and yellow face patterns and small feather tufts "horns" on top of the head. When foraging, this bird walks rather than hops. Horned Larks in the Southern Arctic are of the migratory northern race. The prairie race may be present year round in southern Canada. *Photo: L. Spitalnik*

4.3.15 Swallows

This group is characterised by colonial nesting behaviour. They sometimes nest solitarily and the largest colonies are found below treeline. Because of their food requirements, weather-related starvation is likely the most important cause of adult mortality during the breeding season. Cliff Swallows are most common in the Southern Arctic where there are suitable nesting sites, sheltered by overhangs.

The Barn Swallow's original nesting habitat in caves, crevices and hollow trees has largely been forsaken in favour of man-made structures. These swallows have nested in derelict buildings at Stanton, a community on the coast east of the Anderson River Delta that was abandoned in the 1950s (Tuktoyaktuk Coastal Plain LA*n* Ecoregion). In the Tundra Shield, one wanderer was observed at Daring Lake.

Tree Swallows are the least colonial and require cavities for nesting. A few may nest in forested outliers and man-made structures in the Southern Arctic. When insect activity is constrained by cool weather, this swallow may supplement its diet with berries and other vegetable matter.

Bank Swallows, known as Sand Martins in Europe, are the smallest and one of the most gregarious of the swallows. They excavate nesting burrows in steep sandy riverbanks or bluffs that are often unstable, and colonies may have to frequently relocate. Bank Swallows have been observed at a few locales on the Anderson River, but have yet to be reported from the Tundra Shield.

Cliff Swallows have white foreheads, buff rumps and short squared tails that differentiates them from the other species of swallow occurring in the Southern Arctic that have longer forked tails. Natural sites for their conical mud nests are on overhanging cliffs, but they readily use manmade structures. *Photo: S. Streit*

4.3.16 Chickadees

The Boreal Chickadee, as its name implies, is a boreal forest bird but there are some historical records for the Tundra Plains where alder groves occur. They may be induced to go north during population irruptions in the Taiga.

4.3.17 Thrushes

The American Robin is the largest and most abundant member of the thrush family. Its North American population has been estimated at about 320 million. A varied diet that includes a large selection of berries and invertebrates and a wide tolerance of nesting conditions are two of the reasons why this bird is so widespread in the Southern Arctic.

The American Robin is the most widespread thrush in North America, recorded in Breeding Bird Surveys for every province, territory and state. This is the only thrush to range across the entire Southern Arctic. It was named after the European Robin because of its rusty-orange breast, but this smaller bird is a member of the flycatcher family. *Photo: J. Nagy*

Gray-cheeked Thrushes are also omnivorous. These thrushes range the furthest north of any of the spotted thrushes, but require dense shrub habitats and are not often observed above tree line.

Northern Wheatears generally nest in Cordilleran ecoregions to the west where they seek out sparsely vegetated rocky plains, inland cliffs, and vertical faces. However, there is a report in 1963 from near the mouth of the Anderson River, and in 1988 a pair with young was observed in Hornaday Canyon.

The Gray-cheeked Thrush is the only one of Canada's six spotted thrushes to reach the southern Arctic. It is not easily observed because of its cryptic colouration and preference for dense shrubby habitat.
Photo: L. Spitalnik

4.3.18 Pipits

American Pipits are one of the few songbirds that nest exclusively in arctic and alpine tundra. They prefer sparsely vegetated rocky landscapes, raised beaches and cliffs with talus slopes. Although this may be the most abundant bird in the Southern Arctic, the population trend is a small, statistically insignificant decline over the last 40 years in North America. Pipits are insectivorous in the summer and add seeds to their diet in the fall.

4.3.19 Waxwings

Bohemian Waxwings feed primarily on berries in summer, supplemented by insects. Reported from Cache Lake (Hornaday Upland LA*n* Ecoregion), they may also be expected in other ecoregions wherever there are tree groves suitable for nesting. Presence of this highly irruptive and nomadic species may vary according to population fluctuations further south.

The American Pipit is a small, slender, drab bird that resembles sparrows. It can be distinguished by its thin bill and its habit of bobbing its tail. Previously known as one of seven subspecies of Water Pipit, recent taxonomic studies have shown that it is best regarded as a distinct species. *Photo: J. Nagy*

4.3.20 Warblers

Yellow Warblers, the most widespread warbler in the Southern Arctic, are especially attracted to alder and tall willow thickets near streams. Although brood parasitism by Brown-headed Cowbirds and loss of riparian habitat negatively impacts many populations, numbers in western North America have been increasing.

Blackpoll, Yellow-rumped and Wilson's warblers, as well as Northern Waterthrushes, may breed at very low densities in tall shrubland habitats of the Tundra Plains. Breeding in the Tundra Shield has not been observed.

The Yellow Warbler is sometimes referred to as a "superspecies" because of its large group of subspecies across North and South America. All have predominantly yellow plumage and prefer wet shrubby habitats. *Photo: L. Spitalnik*

4.3.21 Sparrows

Some ground-foraging seed eating sparrows, common at lower latitudes, range as far north as the Southern Arctic.

American Tree Sparrows, (not closely associated with trees) are found throughout Northern Canada and Alaska, including the Southern Arctic. They nest on the ground and are particularly common where there are tall willows and alder. These sparrows forage for seeds and insects on the ground and in low bushes.

Savannah Sparrows are comprised of many subspecies, all of which select a range of habitats that contain short vegetation heights. These preferences also include Arctic tundra where the Northwestern Savannah Sparrow subspecies is widely distributed.

White-crowned Sparrows have a wide breeding range in boreal and tundra regions of North America. Open habitats are used extensively in their search for seeds and invertebrates. They often nest on the ground, especially if no trees are available.

The American Tree Sparrow was named because of its resemblance to the Eurasian Tree Sparrow. The North American bird is actually a ground dweller that extends its range above treeline. Thermoregulation demands at high latitudes require this sparrow to eat at least 30% of its body weight each day. *Photo: L. Spitalnik*

Harris's Sparrow is the only endemic breeding bird in Canada. It may be found in treeless habitats, but is more often associated with the forest-tundra transition. Populations are stable or may be declining, but an expanding winter range could be reducing numbers in traditional range.

Fox Sparrows and Dark-eyed Juncos are rare visitors to the Southern Arctic.

4.3.22 Longspurs and Buntings

In 2010, the International Ornithological Congress assigned this group of species to its own family (Calcariidae), separate from the sparrows (Emberizidae). Unlike most birds with different breeding and non-breeding plumages, longspurs molt only once a year in the fall.

The Lapland Longspur is one of the most abundant breeding birds in the Southern Arctic, and is circumpolar in distribution. It prefers wet tundra, thickly vegetated upland areas, sedge-lined stream and pond edges, and sedge meadows.

The Lapland Longspur is a ground forager that eats mainly insects during the summer, and then switches to seeds and fruit during the other seasons. Winter flocks may number in the millions. Longspur refers to the elongated claw of the hind toe. *Photo: J. Meikle*

Smith's Longspurs, one of the more brightly patterned songbirds of the Southern Arctic, is sparsely distributed in its breeding areas that are restricted to northern Canada and Alaska. They nest on dry, grassy, and hummocky tundra. Each female pairs and copulates with two or three males for a single clutch of eggs, while each male mates with two or more females (polygynandrous).

Snow Buntings are consistently plentiful and widely distributed across Arctic and alpine environments. Sparsely vegetated rocky plains, sea cliff talus, and inland escarpments provide crevices for nest sites.

Snow Buntings are usually the first land bird to arrive in spring and last to leave in fall. No other passerine nests as far north as this species and unlike most other passerines, it has feathered tarsi as an adaptation to its harsh environment. It is another one of the few birds that only moults once. *Photo: L. Spitalnik*

4.3.23 Blackbirds

Rusty Blackbirds prefer to nest in treed wetlands, although their range has extended northward in recent decades to include riparian willow thickets in the Southern Arctic. It has become the only blackbird to breed on the tundra. Surveys suggest that Rusty Blackbird numbers are stable in the Northwest Territories, but there is concern about a wider decline in North America.

4.3.24 Finches

This family is characterised by their robust bills adapted to a diet that consists mainly of seeds. Common and Hoary Redpolls are circumpolar in taiga and tundra, and in most cases, the only representatives of the finch family in the Southern Arctic. Although these birds are often found on open tundra, they are mainly associated with slopes containing willow, alder, and other erect shrubs. Both species occur in populations that are considered abundant and secure, but populations fluctuate according to food supply.

Pine Grosbeaks and White-winged Crossbills are occasionally found in Tundra Plains valleys that support the growth of spruce trees (Anderson Upland LA*n* Ecoregion).

Hoary Redpolls are slightly smaller and paler than the closely related Common Redpoll. Both species often flock together during migration and in winter. Although there is considerable overlap in their tundra breeding range, Hoary Redpolls prefer more open habitats for nesting. *Photo: D. Johnson*

4.3.25 Vagrants

Some species are occasional visitors, far from their breeding range or migration routes, and are not a significant avian component of Southern Arctic ecoregions.

Barnacle Goose – a Eurasian species, was killed at Paulatuk (Darnley Bay Coastlands LA*n* Ecoregion) in 1942.

Steller's Eider – Cape Bathurst (Cape Bathurst Coastal Plain LA*n* Ecoregion) in 1912.

Horned Grebe – Lac de Gras (Point Upland LA*s* Ecoregion)

Pied-billed Grebe – Clinton-Colden Lake (Mackay Upland LA*s* Ecoregion)

White Pelican – single observation from Liverpool Bay (Tuktoyaktuk Coastal Plain LA*n* Ecoregion).

Whooping Crane – Anderson Delta (Tuktoyaktuk Coastal Plain LA*n* Ecoregion) in 1949.

Killdeer – Richards Island Coastal Plain LA*n* Ecoregion and Anderson Delta (Tuktoyaktuk Coastal Plain LA*n* Ecoregion).

Greater Yellowlegs – pair with young at Anderson Delta (Tuktoyaktuk Coastal Plain LA*n* Ecoregion) in 1963.

Western Sandpiper – Anderson Delta (Tuktoyaktuk Coastal Plain LA*n* Ecoregion).

Bar-tailed Godwit – Anderson Delta (Tuktoyaktuk Coastal Plain LA*n* Ecoregion).

Sharp-tailed Sandpiper – offshore from Richards Island Coastal Plain LA*n* and Moose Channel (Mackenzie Delta LA*n* Ecoregion).

Least Auklet – one found dead in 1927 on the ice near Kittigazuit (Tuktoyaktuk Coastal Plain LA*n* Ecoregion) has been the only report of this species east of Point Barrow, Alaska.

Common Nighthawk – reported from Daring Lake (Point Upland LA*s* Ecoregion).

Belted Kingfisher – Anderson Delta (Tuktoyaktuk Coastal Plain LA*n* Ecoregion).

American Three-toed Woodpecker – Anderson River in 1955. (Anderson Upland LA*n* Ecoregion).

Alder Flycatcher – Toker Point (Tuktoyaktuk Coastal Plain Ecoregion.

Western Kingbird – Cape Dalhousie (Tuktoyaktuk Peninsula Coastal Lowland LA*n* Ecoregion) in 1972.

Northern Shrike – reported from Daring Lake (Point Upland LA*s* Ecoregion).

Black-billed Magpie – one shot at Cape Parry (Parry Peninsula Coastal Plain LA*n* Ecoregion) early 1960s?

Gray-headed Chickadee – regular inhabitants of Alaska and northern Yukon, and two were observed at Reindeer Station (Caribou Hills LA*n* Ecoregion) in 1989.

Rock Wren – Stanton (Tuktoyaktuk Coastal Plain LA*n* Ecoregion) in 1959, far beyond northerly limits in the western provinces.

European Starling – Anderson Delta (Tuktoyaktuk Coastal Plain LA*n* Ecoregion) in 1963, and abandoned buildings at Stanton (Tuktoyaktuk Coastal Plain LA*n* Ecoregion) in 1975.

Yellow Wagtail – Toker Point (Tuktoyaktuk Coastal Plain LA*n* Ecoregion) Breeding range primarily Alaska and northern Yukon.

Varied Thrush – Husky Bend on the Anderson River (Anderson Upland LA*n* Ecoregion) in 1964.

Lincoln's Sparrow – reported from Daring Lake (Point Upland LA*s* Ecoregion).

Chipping Sparrow – on Horton River (Horton Upland LA*n* Ecoregion) in1996.

White-throated Sparrow – Anderson Delta (Tuktoyaktuk Coastal Plain LA*n*), Daring Lake (Point Upland LA*s* Ecoregion).

Dark-eyed Junco – Lac de Gras (Point Upland LA*s* Ecoregion) in 1996.

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Dwarf birch (*Betula glandulosa*) is a common shrub throughout the Northwest Territories; its thick, leathery leaves are adapted to the intense sun and drying winds of the brief Arctic summer. In the Southern Arctic, it is most abundant in the southern part of the Tundra Shield and Tundra Plains where it is slightly warmer and moister. *Photo: R. Decker*

Green alder (*Alnus viridis*) is another common shrub throughout the Northwest Territories. Its leaves are larger and thinner than those of dwarf birch and it requires sites that are relatively warm, moist and protected from wind such as erosion gullies and shorelines. *Photo: R. Decker*

Northern Labrador tea (*Ledum palustre*) has narrow leathery evergreen leaves that reduce water loss from the leaf surfaces and provide a high degree of drought tolerance; it is found in drier places than either dwarf birch or green alder. This shrub is usually less than 20 cm tall and is common and widespread on the Northwest Territories mainland on dry to wet sites.
Photo: R. Decker

Black crowberry (*Empetrum nigrum*) is a creeping evergreen shrub that has needle-like leaves and sweet, juicy berries. It always grows in acidic soils and like the other three shrubs on this page, is widespread and common across the Northwest Territories mainland, occurring only occasionally in the western Arctic Islands where it is generally too cold and dry.
Photo: R. Decker

Appendix 1. Selected Plant Species of the Southern Arctic

For the reader's convenience, the following plant species list is sorted by both scientific and common name. Vascular plant scientific and common names follow NWT Species 2011-2015 (Working Group on General Status of NWT Species (2011). The list names the most common species or genera and a few of interest because they are rare, uncommon or associated with specific habitats.

Scientific names are based on the Flora of North America[1]. Non-vascular plant names follow those given in *Alberta Plants and Fungi – Master Species List and Species Group Checklists* (Alberta Environmental Protection 1993).

Alnus viridis (Chaix.) DC.	green alder
alkali grass	***Puccinellia*** spp.
alpine azalea	***Loiseleuria procumbens*** (L.)Desv.
alpine bilberry, bilberry	***Vaccinium uliginosum*** L.
alpine bistort	***Bistorta vivipara*** L.(Gray)
American lyme grass (one of two species that survives close to burning coal beds on Bathurst Peninsula; refer to Section 3.4.7, this report)	***Leymus mollis*** (Trin.) Pilg.
Andromeda polifolia L.	bog rosemary
Arctostaphylos rubra (Rehd. & Wils.) Fern)	red bearberry
Artemisia Tilesii Ledeb(one of two species that survives close to burning coal beds on Bathurst Peninsula; refer to Section 3.4.7, this report)	Tilesius Sagebrush
balsam poplar	***Populus balsamifera*** L.
Betula glandulosa Michx., ***Betula pumila*** L. var**.** ***glandulifera*** Regel.	dwarf birch, ground birch
Betula papyrifera Marsh.	paper birch, white birch
Bistorta vivipara L.(Gray)	alpine bistort
black crowberry	***Empetrum nigrum*** L. subsp. ***hermaphroditum*** (Lge.) Böcher.
black spruce	***Picea mariana*** (Mill.) BSP.
bog rosemary	***Andromeda polifolia*** L**.**
Braya pilosa Hooker (rare endemic species)	hairy rock cress, pilose braya
Calamagrostis canadensis (Michx.) Beauv.	reed bent-grass, bluejoint
Carex atherodes Spreng.	awned sedge
Carex spp.	sedges
Cassiope tetragona (L.) D. Don	mountain-heather, Arctic white heather
Cladonia spp., ***Cladina*** spp**.**	lichens, reindeer lichens
cloudberry, baked-apple	***Rubus chamaemorus*** L.
common bearberry	***Arctostaphylos uva-ursi*** (L.) Spreng.
cottongrass	***Eriophorum*** spp.
Dryas integrifolia M.Vahl.	mountain avens (entire-leaved mountain avens)
dwarf birch, ground birch	***Betula glandulosa*** Michx., ***Betula pumila*** L. var**.** ***glandulifera*** Regel .
Empetrum nigrum L. subsp. ***hermaphroditum*** (Lge.) Böcher	black crowberry
Equisetum spp.	horsetails
Eriophorum spp.	cottongrass
green alder	***Alnus viridis*** (Chaix.) DC.
hairy rock cress, pilose braya (rare endemic species)	***Braya pilosa*** Hooker
horsetails	***Equisetum*** spp.
junipers	***Juniperus*** spp.
Kobresia myosuroides (Vill.) Fiori & Paol.	Pacific kobresia
Pacific kobresia	***Kobresia myosuroides*** (Vill.) Fiori & Paol.
Lapland poppy	***Papaver lapponicum*** (Tolm.) Nordhagen
Ledum palustre subsp. ***decumbens*** (Aiton) Hultén	northern Labrador tea, narrow-leaved Labrador tea
Leymus mollis (Trin.) Pilg. (one of two species that survives close to burning coal beds on Bathurst Peninsula; refer to Section 3.4.7, this report)	American lyme grass

1. http://hua.huh.harvard.edu/FNA/. Information on vascular plant nomenclature sources provided by Suzanne Carrière, Government of the Northwest Territories, February 2007.

Loiseleuria procumbens (L.)Desv.	alpine azalea
lichens, reindeer lichens	***Cladonia*** spp., ***Cladina*** spp**.**
marsh ragwort	***Senecio congestus*** (R.Br.) DC**.**
moss campion	***Silene acaulis*** L.
mountain avens (entire-leaved mountain avens)	***Dryas integrifolia*** M.Vahl.
mountain cranberry, rock cranberry, bog cranberry	***Vaccinium vitis-idaea*** L.
mountain-heather, Arctic white heather	***Cassiope tetragona*** (L.) D. Don
northern Labrador tea, narrow-leaved Labrador tea	***Ledum palustre*** subsp. ***decumbens*** (Aiton) Hultén
Nuphar variegata Durand	variegated pond lily
Pacific kobresia	***Kobresia myosuroides*** (Vill.) Fiori & Paol.
Papaver lapponicum (Tolm.) Nordhagen	Lapland poppy
paper birch, white birch	***Betula papyrifera*** Marsh
peat mosses	***Sphagnum*** spp, ***Drepanocladus*** spp.
Pedicularis sudetica Willd.	Sudetan lousewort
Phlox richardsonii Hooker (uncommon in NWT)	Richardson's phlox
Picea glauca (Moench) Voss	white spruce
Picea mariana (Mill.) BSP.	black spruce
Populus balsamifera L.	balsam poplar
Populus tremuloides Michx.	trembling aspen
prickly rose	***Rosa acicularis*** Lindl.
Puccinellia spp.	alkali grass
red bearberry	***Arctostaphylos rubra*** (Rehd. & Wils.) Fern)
Richardson's phlox (uncommon in NWT)	***Phlox richardsonii*** Hooker
Rosa spp.	wild and prickly rose
rough fescue	***Festuca altaica*** Trin.
Rubus chamaemorus L.	cloudberry, baked-apple
Salix spp.	willows
sedges	***Carex*** spp.
Senecio congestus (R.Br.) DC	marsh ragwort
Silene acaulis L.	moss campion
Sphagnum spp.	peat mosses
Sudetan lousewort	***Pedicularis sudetica*** Willd.
Tilesius Sagebrush (one of two species that survives close to burning coal beds on Bathurst Peninsula; refer to Section 3.4.7, this report)	***Artemisia Tilesii*** Ledeb.
trembling aspen	***Populus tremuloides*** Michx.
twinflower	***Linnaea borealis*** L**.**
Vaccinium uliginosum L.	alpine bilberry, bilberry
Vaccinium vitis-idaea L.	rock cranberry, bog cranberry, mountain cranberry
white birch, paper birch	***Betula papyrifera*** Marsh
white spruce	***Picea glauca*** (Moench) Voss
willows	***Salix*** spp.
wild and prickly rose	***Rosa*** spp.

Arctic bearberry (*Arctostaphylos rubra*) is another low-growing shrub that is widespread throughout the Northwest Territories on acid soils. In late July and early August, its leaves and edible but unappealing berries turn a brilliant crimson and splash colour across the early fall tundra landscapes. *Photo: R. Decker*

Bog laurel (*Andromeda polifolia*) grows in wet nutrient poor fens throughout the boreal forest; it is also common in the Southern Arctic. It is similar to but smaller than northern Labrador tea, to which it is related and is very poisonous. *Photo: R. Decker*

Mountain avens (*Dryas integrifolia*) often grows together with the larger-leaved Arctic willow (*Salix arctica*). Both plants are well adapted to cold and dry conditions; they form low cushions and their leaves are thick and hairy, helping to conserve water. Their low stature (less than 5 cm) allows them to grow more quickly in the thin layer of sun-warmed air at the soil surface in summer and in winter, they avoid damage by windborne ice crystals. The inset shows a mountain avens flower. *Photo: D. Downing/ inset J. Nagy*

The Lapland poppy (*Papaver lapponicum*) has large, showy flowers that turn to face the sun as it moves around the horizon. The rays of the flower form a parabolic dish that focuses the sun's energy on the central green ovary; its temperature can be several degrees warmer than the surrounding air and because of this, the seeds it contains can mature in the short Arctic summer.
Photo: R. Decker

Sudetan lousewort (*Pedicularis sudetica*) is a showy plant of moist calcareous places that occurs throughout the Northwest Territories as far north as the Arctic Islands. The dense hairs on its flower stalk may help to create a somewhat warmer microenvironment for seed maturation. *Photo: R. Decker*

Alpine bistort (*Bistorta vivipara*) is widespread throughout Canada. It is usually found in moist meadows and has an unusual method of reproduction; the lower reddish "flowers" on the flower stalk are actually bulblets that fall off and root to produce new plants. *Photo: R. Decker*

American lyme grass (*Leymus mollis*) is widespread throughout North America. It is one of two vascular species that can survive the sulphurous plumes immediately downwind of burning coal seams in the Bathurst Peninsula Upland LA*n* Ecoregion (Section 3.4.7 of this report). *Photo: R. Decker*

Richardson's phlox (*Phlox richardsonii*) is an uncommon and locally distributed species from the Arctic coastline near the Mackenzie Delta, ranging north to the western Arctic islands and west to Alaska. *Photo: J. Nagy*

Appendix 2. Changes to 1996 Ecozones and Ecoregions

Introduction

This Appendix summarizes the changes made to the 1996 version of the Southern Arctic Ecoregion as defined by the Ecological Stratification Working Group (1995) that have resulted in the revised Northwest Territories classification presented in this report. The process was similar to revisions applied to the 1996 Taiga Plains, Taiga Shield and Cordillera Ecozones (Ecosystem Classification Group 2007 [revised 2009], 2008, 2010) and improvements included:

- Refinements to existing ecoregion and ecozone boundaries;
- Subdivision of existing ecoregions into more ecologically homogeneous map units;
- Inclusion of a climatic component by applying concepts from the 1989 *Ecoclimatic Regions of Canada* classification; and
- Enhancement of ecoregion names to reference not only the geographic locale, but also the main landform, the regional climate and elevational descriptors.

From 1996 to early 2006, the Canadian National Ecological Framework was used to delineate and describe ecosystem units within the Northwest Territories (Ecological Stratification Working Group 1995; Downing *et al.* 2006). Discussions with other experts in Canada and the United States in May 2006 led to adoption of a North American continental ecosystem classification scheme (refer to Section 1.2 for further discussion).

The North American ecosystem classification system is a multi-level continental framework for delineating and describing ecosystems; the Government of the Northwest Territories use this system for planning and reporting purposes. The top four levels of the continental framework as applied in the Northwest Territories to the Taiga Plains, Taiga Shield, Cordillera and Southern Arctic are Level I ecoregions, Level II ecoregions, Level III ecoregions and Level IV ecoregions.

An intensive field program to review the existing 1996 national framework was carried out in July and August 2009 (refer to Section 2 of this report) and about 7,500 geographically referenced oblique aerial digital photographs were collected along with ground survey data throughout the Southern Arctic within the Northwest Territories. General ecoregion descriptions and map unit delineations were finalized with the participation of Federal and Territorial representatives in two four-day workshops in November 2009 and December 2010.

Record of Changes to 1996 Classification

A three-part naming convention has been adopted for Level IV ecoregions to provide better information on where they are located and what their physiographic and climatic characteristics are. This naming convention is described in Section 1.5.

Compared to the 1996 National Ecological Framework in which 10 ecoregions were identified in the Northwest Territories portion of the Southern Arctic Ecozone, the revised Northwest Territories ecosystem classification delineates 35 Level IV ecoregions within a revised concept for the Southern Arctic which includes small portions of the 1996 Taiga Shield, Taiga Plains and Northern Arctic Ecozones. Changes between the 1996 and 2012 versions of the Southern Arctic Level II ecoregions and their Level III and Level IV ecoregion components are summarized in Table 5. Some of the 2012 Level IV ecoregions span more than one 1996 ecoregion and in these cases, the 2012 Level IV ecoregion is compared to the 1996 ecoregion that occupies the largest proportion of its area.

The 1996 Southern Arctic Ecozones and Ecoregions are shown in Figure 29 and the 2012 Level III and Level IV Southern Arctic Ecoregions are shown in Figure 30. Individual ecoregions are named in Figure 29 but not in Figure 30; patterns and colours corresponding to major physiographic elements in the 2012 Southern Arctic graphically illustrate these broad-scale changes.

Table 5. Summary of changes between the 1996 Southern Arctic Ecozone and 2012 Level II, Level III and Level IV Ecoregions of the Southern Arctic. Level III Ecoregions are indicated by the suffixes LA*n* (Low Arctic north) and LA*s* (Low Arctic south). Where a 2012 Level III/IV ecoregion spans more than one 1996 ecoregion, it is assigned to the 1996 ecoregion where the majority of its area lies.

1996 Ecozone	2012 Level II Ecoregion	1996 Ecoregion	2012 Level III and Level IV Ecoregion	Main Changes
Southern Arctic	**Southern Arctic: Tundra Plains**	**Yukon Coastal Plain**	Msckenzie Delta LA*n*	Formerly part of both the 1996 Yukon Coastal Plain and Tuktoyaktuk Coastal Plain, both of which have identical characteristics in the area defined by the Mackenzie Delta LA*n* Ecoregion.
		Tuktoyaktuk Coastal Plain	Richards Island Coastal Plain LA*n*	Differentiated from the Mackenzie Delta LA*n* Ecoregion by slightly higher elevation, different parent materials and processes (till on Richards Island Coastal Plain LA*n* Ecoregion and alluvium on Mackenzie Delta LA*n* Ecoregion) and different water, wetland and vegetation features.
			Caribou Hills LA*n*	Higher, rolling terrain with fewer ponds and wetlands than the adjacent level to hummocky Tuktoyaktuk Coastal Plain LA*n* Ecoregion.
			Tuktoyaktuk Coastal Plain LA*n*	The boundary of this Ecoregion is generally comparable to that of the 1996 Tuktoyaktuk Coastal Plain.
			Tuktoyaktuk Peninsula Coastal Lowland LA*n*	The boundary of this Ecoregion is comparable to that of the 1996 Tuktoyaktuk Coastal Plain. It is a lower, wetter plain than the adjacent Tuktoyaktuk Coastal Plain LA*n* Ecoregion.
		Anderson River Plain	Cape Bathurst Coastal Plain LA*n*	Level to gently undulating plain separated by elevation and relief from the higher Bathurst Peninsula LA*n* Ecoregion to the south.
			Bathurst Peninsula Upland LA*n*	A sloping, undulating to gently rolling till and colluvial plain bordered by the steep plateau foreslopes of the North Horton Plateau LA*n* Ecoregion to the south, a major valley in the Anderson Upland LA*n* to the southwest and the low-elevation Cape Bathurst Coastal Plain LA*n* Ecoregion to the west and north.
			Anderson Upland LA*n*	This Ecoregion is a till-dominated highland surrounded by lower-elevation ecoregions; it is more strongly affected by High Subarctic climatic influences than other Level IV Ecoregions that lie within the boundaries of the 1996 Anderson River Plain Ecoregion.
			Smoking Hills LA*n*	Plateau with deeply dissected sideslopes and badlands that is elevated well above the adjacent Anderson River valley (Anderson Upland LA*n* Ecoregion) and the lowlands of the Bathurst Peninsula Upland LA*n* Ecoregion to the north. The West Horton Plain LA*n* Ecoregion to the south is more strongly influenced by High Subarctic climates.
			West Horton Plain LA*n*	Low-elevation dissected plain influenced by High Subarctic and Low Arctic climates; different from other Level IV Ecoregions that lie within the boundaries of the 1996 Anderson River Plain Ecoregion.
		Amundsen Gulf Lowlands (Northern Arctic Ecozone)	Parry Peninsula Coastal Plain LA*n*	Both of these Ecoregions were included within the 1996 Northern Arctic Ecozone, which is characterized as colder and drier than the Southern Arctic Ecozone. This assignment was probably based in part on the observation that tundra cover is discontinuous. It is more probable that discontinuous tundra cover is attributable to the dominance of thin, highly calcareous soils that limit plant growth than to colder climates.
			Parry Peninsula Lowland LA*n*	
		Coronation Hills	Darnley Bay Coastlands LA*n*	Level to hummocky lowlands along the Beaufort Sea coast; somewhat moister with more continuous tundra than the adjacent Amundsen Gulf Coastlands LAn Ecoregion to the east and lower than the West Melville Hills and East Melville Hills LA*n* Ecoregions.
			Amundsen Gulf Coastlands LA*n*	Refer to Darnley Bay Coastlands LA*n* Ecoregion above.
			West Melville Hills LA*n*	Higher than the Darnley Bay Coastlands LA*n* and Amundsen Gulf Coastlands LA*n* Ecoregions and occurs at lower elevations with lower relief and more moderate climates than the East Melville Hills LA*n* Ecoregion
			East Melville Hills LA*n*	Refer to West Melville Hills LA*n* Ecoregion above.
		Dease Arm Plain	Central Horton Plain LA*n*	The 1996 Dease Arm Plain Ecoregion includes a number of Taiga Plains and Tundra Plains ecoregions and spans two 2012 climatic regions (High Subarctic and Southern Arctic – Low Arctic [north]). The Central Horton Plain LA*n* Ecoregion is a lake-studded rolling to hummocky low-elevation till plain.
			Great Bear Upland LA*n*	Both of these Ecoregions occur at higher elevations than the Central Horton Plain LAn Ecoregion with more exposed bedrock and fewer lakes.
			Grandin Upland LA*n*	

Table 5. (continued)

1996 Ecozone	2012 Level II Ecoregion	1996 Ecoregion	2012 Level III and Level IV Ecoregion	Main changes
Southern Arctic	**Southern Arctic: Tundra Plains**	**Bluenose Lake Plain**	Melville Plateau LA*n*	The 1996 Bluenose Lake Plain Ecoregion generally occupies higher elevation terrain than its neighbours. The Melville Plateau LA*n* Ecoregion is the highest and coldest Ecoregion in the Northwest Territories Southern Arctic, with sparse tundra cover. It was not covered by ice in the most recent glaciation.
			Hornaday Valley LA*n*	The Hornaday Valley LA*n* Ecoregion includes low-relief lowlands around several large lakes and the valley of a major tributary to the Hornaday River. It is bordered by the higher-elevation Melville Plateau LA*n* and Hornaday Plateau LA*n* Ecoregions.
			Hornaday Plateau LA*n*	Similar to the Melville Plateau LA*n* Ecoregion but at somewhat lower elevations.
			Hornaday Upland LA*n*	Lower-elevation than the preceding three ecoregions, with thicker till cover and more continuous tundra cover.
			Horton Upland LA*n*	Bedrock-controlled lower-elevation ecoregion that is milder than the preceding four ecoregions, with some woodlands in major river valleys.
			South Horton Plain LA*n*	Till-dominated landscape with continuous tundra that is somewhat milder than the Horton Upland LA*n* Ecoregion as indicated by sparsely treed woodlands on uplands in the southern third of the Ecoregion.
		Grandin Plains (Taiga Plains Ecozone)	Grandin Hills LA*n*	The Grandin Plains Ecoregion was assigned to the Taiga Plains in 1996, but was revised to include High Subarctic and Low Arctic Level III Ecoregions and Level IV Ecoregions from the Taiga Plains and Tundra Plains. The Grandin Hills LA*n* Ecoregion is a high-elevation complex of till blankets and veneers with discontinuous to continuous tundra.
	Southern Arctic: Tundra Shield	**Takijua Lake Upland**	Point Upland LA*s*	The 1996 Takijua Lake Ecoregion includes both High Subarctic and Low Arctic Level III Ecoregions and Level IV Ecoregions from the Taiga Shield and Tundra Shield. A complex of exposed bedrock and till veneers and blankets; dwarf-shrub tundra and rock lichen communities are common.
			Contwoyto Upland LA*s*	The highest-elevation ecoregion in the Tundra Shield. Somewhat less exposed bedrock than the Point Upland LA*s* and Healey Upland LA*s* Ecoregions.
			Healey Upland LA*s*	A rough, broken expanse of fractured and ice-scoured bedrock and till and mostly discontinuous tundra. The eastern third of this Ecoregion occurs within the 1996 Garry Lake Lowland and is characterized by linear lakes that follow bedrock faults.
		Garry Lake Lowland	Hanbury Plain LA*s*	Till veneers and blankets with continuous to patchy tundra; a few trees in the central and southern portions indicate the influence of more moderate High Subarctic climates.
		Coppermine River Upland (Taiga Shield Ecozone)	Mackay Upland LA*s*	Level to hummocky till that supports a complex of dwarf-shrub and low-shrub tundra, with stunted trees near the southern boundary indicating a transition to less cold High Subarctic climates.
			Whitefish Plain LA*s*	This Ecoregion has deeper till blankets and less exposed bedrock than the Mackay Upland LA*s* and HanburyPlain LA*s* Ecoregions and has extensive till drumlin fields and long eskers.
		Back River Plain	Baillie Plain LA*s*	Nearly continuous sedge and shrub tundra on a level till plain.
		Dubawnt Lake Plain/Upland	Clarke Upland LA*s*	Upland that occupies a highland between the Thelon River valley and the lowlands of the Dubawnt Plain LA*s* Ecoregion.
			Dubawnt Plain LA*s*	This Ecoregion is transitional between Low Arctic and High Subarctic climates and occupies a low-elevation, low-relief till plain that supports low-shrub tundra characteristic of the southern Low Arctic and extensive conifer woodlands.

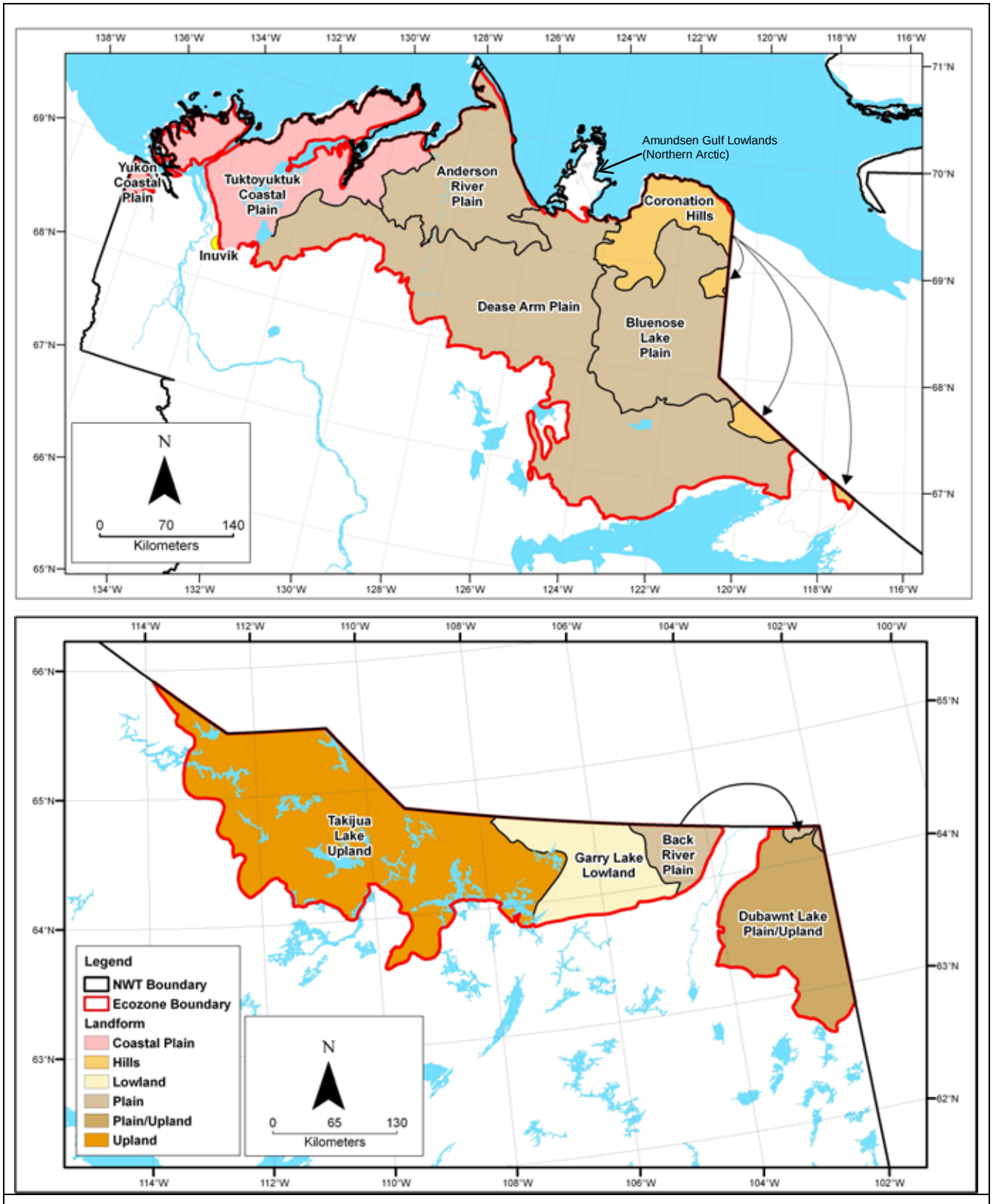

Figure 29. 1996 National Ecological Framework: Ecoregions of the Southern Arctic Ecozone, Northwest Territories. The area corresponding to the Tundra Plains is on the upper map; the area corresponding to the Tundra Shield is on the lower map. Ten ecoregions were mapped for the Southern Arctic in 1996. Some areas of the 1996 Taiga Shield Ecozone (portion of the Coppermine River Upland Ecoregion – not shown), Taiga Plains Ecozone (portion of the Grandin Plains Ecoregion – not shown) and Northern Arctic Ecozone (portion of the Amundsen Gulf Lowlands – upper map) were reassigned to the Southern Arctic in the 2012 classification.

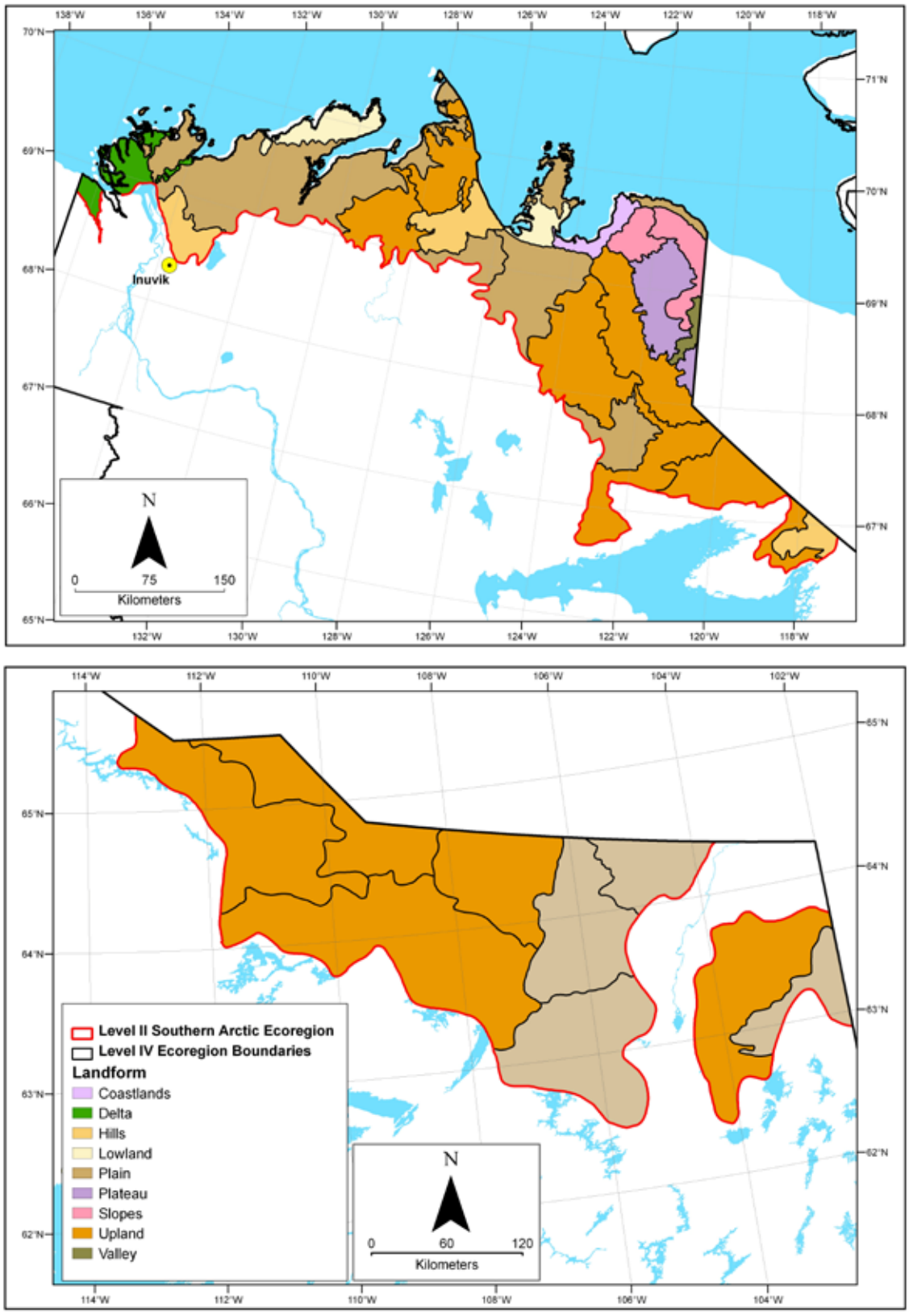

Figure 30. 2012 Level II and Level IV Ecoregions and major physiographic elements of the Level II Southern Arctic Ecoregion, Northwest Territories**.** The Tundra Plains is on the upper map; the Tundra Shield is on the lower map. Refer to Appendix 3 for ecoregion labels and legend.

Appendix 3. Ecological Regions of the Northwest Territories: SOUTHERN ARCTIC

Ecoregion Labels

(Figure 31, facing page)

Level I Tundra Ecoregion (ecoregion label 2)
Level II Southern Arctic Ecoregion (ecoregion label 2.4)
Level III Tundra Plains Low Arctic North (LA*n*) Ecoregion (ecoregion label 2.4.1; report section 3.4)
2.4.1.1 Mackenzie Delta LA*n*
2.4.1.2 Richards Island Coastal Plain LA*n*
2.4.1.3 Caribou Hills LA*n*
2.4.1.4 Tuktoyaktuk Coastal Plain LA*n*
2.4.1.5 Tuktoyaktuk Peninsula Coastal Lowland LA*n*
2.4.1.6 Cape Bathurst Coastal Plain LA*n*
2.4.1.7 Bathurst Peninsula Upland LA*n*
2.4.1.8 Parry Peninsula Coastal Plain LA*n*
2.4.1.9 Parry Peninsula Lowland LA*n*
2.4.1.10 Darnley Bay Coastlands LA*n*
2.4.1.11 Amundsen Gulf Coastal Plain LA*n*
2.4.1.12 Anderson Upland LA*n*
2.4.1.13 Smoking Hills LA*n*
2.4.1.14 West Horton Plain LA*n*
2.4.1.15 Central Horton Plain LA*n*
2.4.1.16 West Melville Slopes LA*n*
2.4.1.17 East Melville Slopes LA*n*

Level III Tundra Plains Low Arctic North (LA*n*) Ecoregion (Continued)
2.4.1.18 Melville Plateau LA*n*
2.4.1.19 Hornaday Valley LA*n*
2.4.1.20 HornadayPlateau LA*n*
2.4.1.21 Hornaday Upland LA*n*
2.4.1.22 Horton Upland LA*n*
2.4.1.23 South Horton Plain LA*n*
2.4.1.24 Great Bear Upland LA*n*
2.4.1.25 Grandin Upland LA*n*
2.4.1.26 Grandin Hills LA*n*
Level III Tundra Shield Low Arctic South (LA*s*) Ecoregion (ecoregion label 2.4.2; report section 3.5)
2.4.2.1 Point Upland LA*s*
2.4.2.2 Contwoyto Upland LA*s*
2.4.2.3 Mackay Upland LA*s*
2.4.2.4 Healey Upland LA*s*
2.4.2.5 Whitefish Plain LA*s*
2.4.2.6 Hanbury Plain LA*s*
2.4.2.7 Baillie Plain LA*s*
2.4.2.8 Clarke Upland LA*s*
2.4.2.9 Dubawnt Plain LA*s*

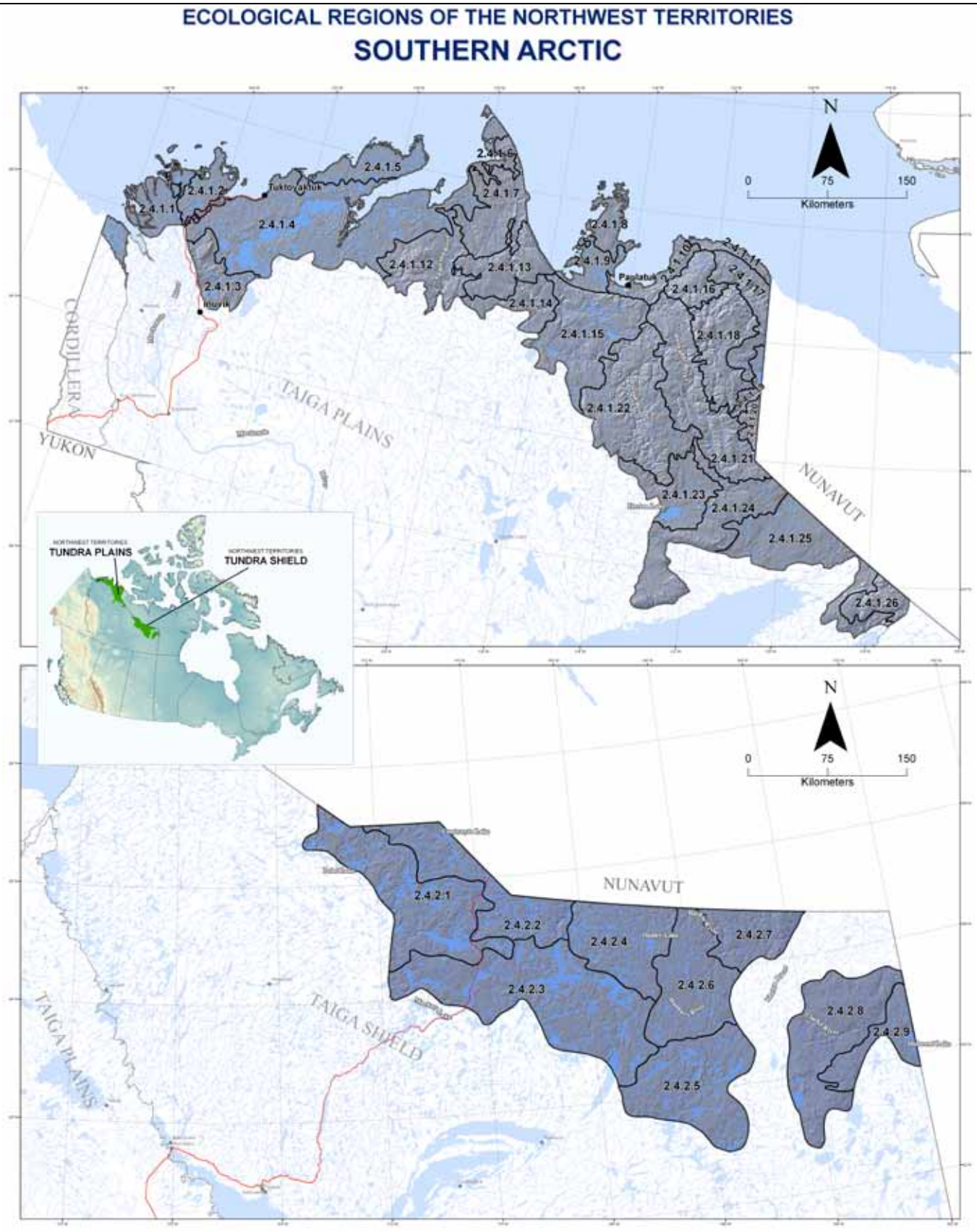

Figure 31. 2012 Level II and Level IV Ecoregions of the Southern Arctic. Level IV ecoregion names corresponding to the numbered ecoregion labels are provided on the facing page and a large fold-out map is enclosed in the pocket sleeve at the back of printed versions of the report. Level I, II, III and IV ecoregions are explained in Sections 1 and 3 of the report.

Appendix 4. Suggested revisions to the Tundra Plains – Taiga Plains boundary

Tree line is defined as the uppermost elevation or northern limit of tree growth, usually on upland sites. Individuals of a species that typically grows to tree size and that are at least two to three metres tall are considered to be trees. The arctic tree line is a line north of which tree cover occupies less than 0.5 percent of the area. South of the arctic tree line or at lower elevations in protected locales (for example, along major valleys of the Anderson, Horton and Thelon Rivers) is the forest-tundra zone where forest and tundra both occur in varying proportions in response to topography, elevation and latitude.

Timoney (1995) provided a regional map and explanation of arctic tree line location across Canada, including the Northwest Territories. Aerial surveys conducted in 2006 in support of the Taiga Shield Ecoregion classification (Ecosystem Classification Group 2008) were of sufficient aerial extent to verify the accuracy of this line for the Taiga Shield. Logistic constraints (fuel availability and aircraft range) did not allow this degree of coverage in 2005, when aerial surveys in support of the Taiga Plains Ecoregion classification (Ecosystem Classification Group 2007 [revised 2009]) were completed. Consequently, the existing 1996 Southern Arctic – Taiga Plains boundary was accepted without modification along much of its length.

The 2009 aerial survey in support of the Southern Arctic Ecoregion classification (this report) provided an opportunity to obtain better coverage along the Taiga Plains – Southern Arctic boundary. The improved coverage combined with more extensive and higher-resolution satellite imagery than was available in 2007 when the Taiga Plains – Southern Arctic boundary was mapped resulted in a better understanding of arctic tree line limits and a closer approximation to the tree line mapped by Timoney (1995). The principal differences shown below in Figure 32 include extensions of treed areas north of the mapped 2007 Southern Arctic – Taiga Plains boundary along the Anderson and Horton Rivers and on lower-elevation terrain in the southern third of the Anderson Upland LA*n*, West Horton Plain LA*n* and Tuktoyaktuk Coastal Plain LA*n* Ecoregions.

This information may be applied to future revisions of the Northwest Territories Ecosystem Classification, to the current application of both the Southern Arctic and Taiga Plains classifications and to the use of this information as a benchmark against which future changes may be assessed. Tree line position has shifted significantly in the past in response to climate change (Spear 1993, Ritchie and Hare 1971) and will almost certainly do so in future.

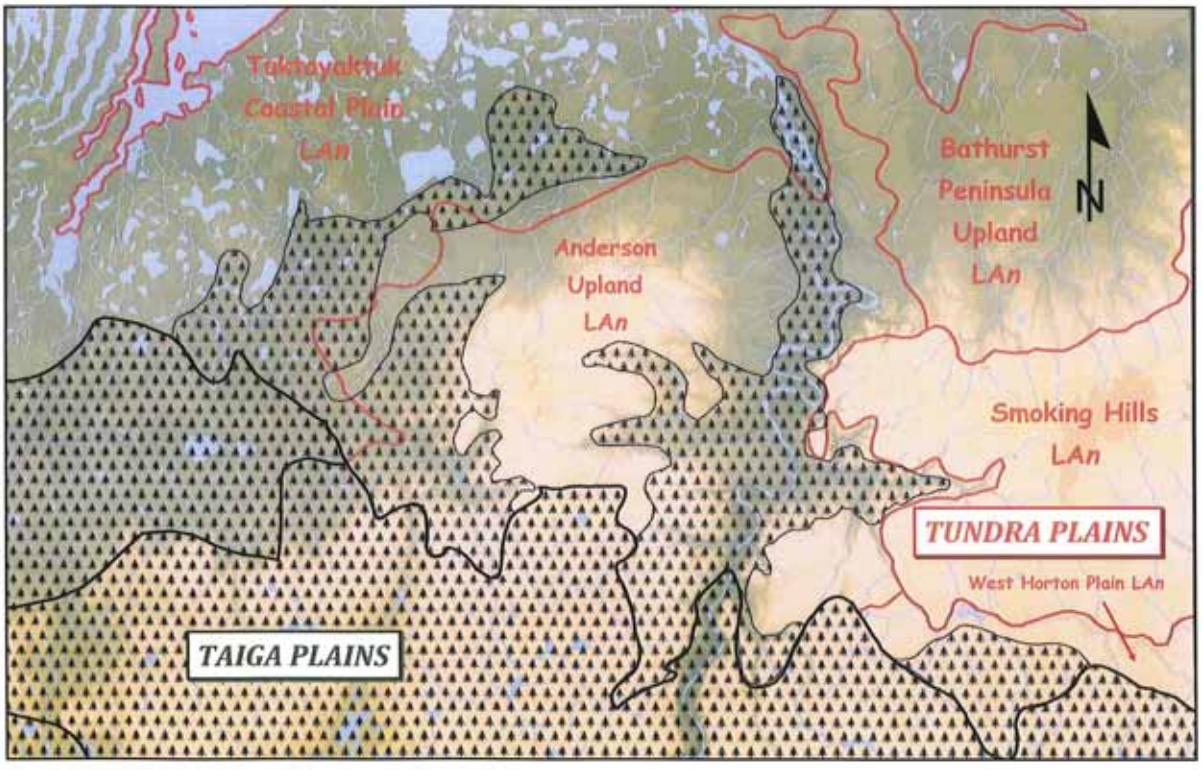

Figure 32. Tree line extensions in the Southern Arctic Level II Tundra Plains Ecoregion. The area shaded by tree symbols is below tree line. The northernmost heavy black line is the Taiga Plains – Tundra Plains boundary which in 2007 was thought to represent the northern limit of extensive tree groves.

Appendix 5. Glossary of Terms

The following definitions are taken mainly from *Terminology of Ecological Land Classification in Canada* (Cauboue *et al.* 1999) and *Soil and Environmental Science Dictionary* (Gregorich *et al.* 2001), supplemented by *Glossary of terms in Soil Science* (Canadian Society of Soil Science 1976), *Multi-language glossary of permafrost and related ground-ice terms* (van Everdingen, 2005), *Glossary of Permafrost and Related Ground-ice Terms* (National Research Council 1988) and *Wetlands of Canada* (National Wetlands Working Group 1988). W.W. Pettapiece compiled most of this glossary from the listed sources; many of the permafrost terms are referenced in van Everdingen (2005) and National Research Council (1988).

A horizon – A mineral horizon formed at or near the surface in the zone of removal of materials in solution and suspension, or maximum accumulation of organic carbon, or both.

Ae – A horizon that has been eluviated of clay, iron, aluminum, or organic matter, or all of these.

Ah – A horizon in which organic matter has accumulated as a result of biological activity.

Ap – A horizon markedly disturbed by cultivation or pasture.

abiotic – Describing the nonliving components of an ecosystem.

Abundance – dominance – This term expresses the number of individuals of a plant species and their coverage in a phytosociological survey. The scale generally used is that of J. Braun-Blanquet from which stemmed many variations. It is based on the coverage of individuals for classes with coverage higher than 5 percent and on the abundance for classes with a lower percentage; frequently, this is also referred to as "cover-abundance". See **Braun-Blanquet** method.

acid igneous rock – Describing igneous rock composed of >66% silica.

acidic (soil) – Having a pH value of less than 7.0.

active delta marsh – A marsh occupying lowlands on deltas, usually with drainage connections to active river channels. The marsh is subject to inundation at least once during a season, followed by a slow drawdown of the water levels. A high rate of sedimentation may occur in many parts of the marsh.

active layer – The seasonal thaw zone at the surface of permafrost terrain.

advance regeneration – Young trees under existing stands. Regeneration established before logging that has survived the logging operation.

aeolian (eolian) – Referring to mineral particles moved and sorted by wind, usually fine sands and coarse silt. See dune and loess.

aerobic – Occurring in the presence of oxygen as applied to chemical and biochemical processes; opposite of anaerobic.

aggregate – A group of soil particles cohering in such a way that they behave mechanically as a unit.

albedo – A measurement of reflected energy. Albedo is the coefficient of reflectance, usually applying only to short-wave radiation.

alkaline – Having a pH value of >7.0.

alliance – A vegetation classification level in the Braun-Blanquet system, a collection of associations with similar physiognomy and the same dominant and constant species. See **Braun-Blanquet method.**

alluvium – Mineral material deposited by flowing water, usually sands, silts and gravels.

alpine – The ecological zone that occurs above an elevational tree line, characterized by a distinct climate and vegetation.

alvar – Swedish term for an unusual landform which occurs when soils are scraped away from bare limestone bedrock by ice, wind and water. Alvars and associated biota are globally rare features.

anaerobic – Occurring in the absence of oxygen as applied to chemical and biochemical processes.

anthropogenic – Human-made or human-modified materials such that their initial physical properties have been drastically altered.

aquatic – Living or growing in water.

arable land – Land that is cultivated or suitable for cultivation (as opposed to grazing or non-cultivated land).

arctic – The ecological zone north of the latitudinal tree line, characterized by a distinct climate and vegetation.

arid – Describing a soil, climate or region where vegetation may not grow due to a severe lack of water.

aspect – The orientation of a slope face, expressed using a compass direction.

association –

1. A classification level in the Braun-Blanquet system, which is a subdivision of a formation based on floristic composition, an abstract plant community.
2. Sometimes used as a general term for a collection of vegetation stands with similar composition and structure.

avalanche – A form of mass wasting involving snow and ice.

Azonal – Vegetation (or soil) that develops on atypical conditions such as flooded or rapidly drained sites.

B horizon – A subsoil horizon characterized by one of:

a) An enrichment in clay, iron, aluminum, or humus (Bt or Bf).
b) A prismatic or columnar structure that exhibits pronounced coatings or stainings associated with significant amounts of exchangeable sodium (Bn or Bnt).
c) An alteration by hydrolysis, reduction, or oxidation to give a change in colour or structure from the horizons above or below, or both (Bm).

badland – A complex, nearly barren landscape of narrow ravines and gullies and rounded to sharp crests formed when soft bedrock erodes.

basal area – The area occupied by a plant near the ground surface; measured across the stem of a tree 1.3 to 1.5 m above the ground surface, or across a clump in the case of graminoids, usually 2 to 3 cm above the ground surface.

bedrock – The solid rock underlying soils and the regolith or exposed at the surface.

bioclimate – All the climatic conditions (climate factors) of a region that have a fundamental influence on the survival, growth and reproduction of living organisms.

biocoenosis – A group of interacting organisms including both plants and animals.

biodiversity – Totality of the richness of biological variation, ranging from within-species genetic variation, through subspecies and species, to communities and the pattern and dynamics of these on the landscape.

Biogeoclimatic Ecosystem Classification (BEC) in British Columbia – A hierarchical ecosystem classification system applied in British Columbia that describes the variation in climate, vegetation and site conditions throughout the province.

biogeoclimatic zone – A level in the British Columbia Biogeoclimatic ecosystem classification system that represents areas with the same regional climate. See **ecoclimatic region**, **ecoregion** and **ecological region**.

biogeocoenosis – A group of interacting organisms living together in a particular environment, an ecosystem.

biogeography – A branch of biology or of geography that deals with the geographical distribution of plants and animals.

biomass – The mass of living organisms within a defined space, usually expressed in kg/ha or g/m2 of dry matter.

biome – Major biotic community composed of all the plants and animals and smaller biotic communities. The smaller communities in a biome possess similarities in gross external appearances (deciduous trees, grasslands, etc.) and gross climatic conditions (desert, tropical, etc.). A particular biome is defined in terms of the characteristic vegetation forms (or life forms).

Biophysical Land Classification – An approach to land classification that combines the physical and biological components of the environment. This hierarchical classification system originally included four levels, within which the physical components of classification are sometimes more heavily weighted than the biological components. The term biophysical was subsequently replaced by "ecological".

biota – The living component of an ecosystem.

biotic – Pertaining to life.

Black – A soil classification Great Group or Subgroup designation indicating a surface (Ah or Ap horizon) colour value darker than 3.5 moist and dry, with a chroma less than 2, dry (grassland or parkland soils with generally greater than 4 percent organic matter).

bog – Ombrotrophic (nutrient poor) peatland that is acidic (generally unaffected by nutrient-rich groundwater) and usually dominated by heath shrubs and *Sphagnum* mosses and that may include open-growing, stunted woodlands of black spruce or other tree species.

boreal –

1. Pertaining to the north.
2. A climatic and ecological zone that occurs south of the subarctic, but north of the temperate hardwood forests of eastern North America, the parkland of the Great Plains region and the montane forests of the Canadian cordillera.

boulder – Rock fragment over 60 cm in diameter. In engineering, practice boulders are over 20 cm in diameter.

brackish – Water with a salt content between that of fresh and sea water. Brackish water usually has 5-10 parts of salt per thousand.

Braun-Blanquet method – An approach to classifying vegetation that utilizes floristic composition (i.e. characteristic species and associations), developed in central and southern Europe. Includes the ZurichMontpellier School of Phytosociology.

break of slope – An abrupt change in slope steepness.

breccia – Bedrock formed from angular particles cemented together by hardened clay.

broadleaved forest – See **deciduous forest.**

Brown – A soil classification Great Group or Subgroup designation indicating a surface (Ah or Ap horizon) colour value darker than 3.5 moist and 5.5 dry with a chroma less than 3.5 moist (grassland soils with less than about 2% organic matter).

Brunisol – A soil of the Brunisolic Order.

Brunisolic –

1. An Order of soils whose horizons are developed sufficiently to exclude them from the Regosolic Order but lack the degrees or kinds of horizon development specified for soils in other orders. They always have Bm or Btj horizons. The order consists of Melanic, Eutric, Sombric and Dystric Great Groups.
2. A soil classification Subgroup designation indicating the formation of a Bm or Btj horizon within the Ae of a Luvisolic soil (a strongly degraded Luvisol).

bulk density, soil – The mass of dry soil per unit bulk volume.

C horizon – A mineral horizon comparatively unaffected by the pedogenic processes operative in the A and B horizons except for the process of gleying (Cg) or the accumulation of calcium carbonate (Cca) or other salts (Csa). A naturally calcareous C horizon is designated Ck.

calcareous soil – Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with cold 0.1 N hydrochloric acid.

C:N ratio – The ratio of the weight of organic carbon to the weight of total nitrogen in a soil or in an organic material.

Canadian System of Soil Classification – Hierarchical soil classification system in which the conceptual classes are based upon the generalization of properties of real bodies of soil. Taxa are defined on the basis of observable and measurable soil properties that reflect processes of soil genesis and environmental factors.

canopy – The more or less continuous cover of branches and foliage formed by the crowns of trees.

canopy closure – The degree of canopy cover relative to openings.

capability – A natural ability to support a selected activity such as agriculture or recreation.

catchment area – See **drainage basin.**

channel marsh – A marsh occurring in well-defined, abandoned channels where stream flow is discontinuous or blocked.

characteristic species –

1. A diagnostic species used to separate plant community types within the Braun-Blanquet vegetation classification system.
2. Characteristic species may occur in more than *one* community, but are significant (e.g., much more abundant) in only one community.
3. A species with high cover (abundance) and presence.

Chernozem – A soil of the Chernozemic Order.

Chernozemic – An Order of soils that have developed under xerophytic or mesophytic grasses and forbs, or under grassland – forest transition vegetation, in cool to cold, subarid to subhumid climates. The soils have a dark-coloured surface (Ah, Ahe or Ap) horizon and a B or C horizon, or both, of high base saturation. The order consists of Brown, Dark Brown, Black and Dark Gray Great Groups.

Chinook – A warm, dry wind characteristic of southern Alberta and northern Montana created by moisture condensation and precipitation on the western side of the mountains and compression as the dry air descends onto the plains. In the Northwest Territories, similar conditions produce Chinook-like winds in the Fort Liard area.

chroma – A measure of colour strength in the Munsell Soil Colour Chart.

chronosequence – A chronosequence is a sequence through time. Often, it refers to a secondary successional sequence within a set of plant communities.

classification – The systematic grouping and organization of objects, usually in a hierarchical manner.

clay –

1. Mineral particles <0.002 mm in diameter.
2. Soil and texture class with approximately a 40 to 60% composition of clay size particles.

climate – The accumulated long-term effects of weather that involve a variety of heat and moisture exchange processes between the earth and the atmosphere.

climatic climax – Stable, self-perpetuating vegetation developed through succession in response to long-term climatic conditions, as opposed to edaphic climax. **Edaphic climax** – Stable, self-perpetuating vegetation developed through succession on azonal sites. See also **climax**.

climatic index – Number indicating a combination of climatic factors, most often temperature and precipitation, in order to describe the vegetation distribution.

climax – Stable, self-perpetuating vegetation that represents the final stage of succession.

cluster analysis – A multidimensional statistical analysis technique used to group samples according to their degree of similarity.

classification, soil – The systematic arrangement of soils into categories and classes on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties.

clay – As a particle-size term: a size fraction mm equivalent diameter.

clod – A compact, coherent mass of soil produced by digging or plowing.

coarse fragments – Rock or mineral particles 2.0 mm in diameter.

coarse texture – The texture exhibited by sands, loamy sands and sandy loams except very fine sandy loam. A soil containing large quantities of these textural classes.

codominant – Trees with crowns forming the general level of the main canopy in an even-aged stand of trees. Two plant species of similar stature and cover that occur on the same site.

collapse scar – That portion of a peatland where the whole or part of a palsa or peat plateau has thawed and collapsed to the level of the surrounding peatland.

collapse scar bog – A circular or oval-shaped wet depression in a perennially frozen peatland. The collapse scar bog was once part of the perennially frozen peatland, but the permafrost thawed, causing the surface to subside. The depression is poor in nutrients, as it is not connected to the minerotrophic fens in which the palsa or peat plateau occurs.

collapse scar fen – A fen with circular or oval depressions, up to 100 m in diameter, occurring in larger fens, marking the subsidence of thawed permafrost peatlands. Dead trees, remnants of the subsided vegetation of permafrost peatlands, are often evident.

colluvium – Unconsolidated materials moved by gravity, often occurring at the base of a slope.

community – An assemblage of organisms that interact and exist on the same site.

community type – A group of vegetation stands that share common characteristics, an abstract plant community.

companion species – In phytosociology, a species occurring in several associations with relatively the same frequency, or a species characteristic of another association, but having a lower frequency.

competition – The interaction between organisms resulting from common use of a limited resource. Intraspecific competition occurs within the same species, while interspecific competition arises between different species.

conglomerate – Bedrock formed from rounded particles cemented together by hardened clay.

conifer – A cone-bearing plant (except for the taxaceous family) belonging to the taxonomic group Gymnospermae.

coniferous forest – A plant community with a cover made up of 75% or more conifers.

consistence – The degree of soil cohesion and adhesion based on its resistance to deformation.

consociation – A classification level within the Scandinavian approach to vegetation classification, a collection of sociations with the same dominant species.

constant species – A species occurring more than 80% of the time within a particular plant community type.

constraint – A factor that limits the optimal condition, such as steep slopes or cold temperatures, usually associated with land use capability assessments.

continuous permafrost – Permafrost occurring everywhere beneath the exposed land surfacethroughout a geographic region with the exception of widely scattered sites, such as newly deposited unconsolidated sediments, where the climate has just begun to impose its influence on the thermal regime of the ground**,** causing the development of continuous permafrost

continuous permafrost zone – The major subdivision of a permafrost region in which permafrost occurs everywhere beneath the exposed land surface with the exception of widely scattered sites.

control section – The minimum depth used to classify a soil, usually 1.0 m for mineral soils and 1.6 m for organic deposits.

cordillera – An elongated range of mountains.

corridor – In a landscape, a narrow strip of land that differs from the matrix on either side. Corridors may be isolated strips, but are usually attached to a patch of somewhat similar vegetation.

coulee – A western Canadian term for a steep-sided prairie valley. It may refer to valleys that have a relatively broad bottom, often as a result of a glacial meltwater channel or to v-shaped gullies caused by more recent erosion.

cover – The area of ground covered with plants of one or more species, usually expressed as a percentage.

cover type – A very general unit of vegetation classification and mapping based on existing plant cover, e.g., closed-canopied deciduous forest, pasture, or native prairie.

crag- and - tail – a streamlined hill or ridge resulting from overriding glacial ice and consisting of a knob of resistant bedrock (the crag), with an elongate tapering body (the tail) of softer more erodible bedrock or till, or both, on its lee side.

cryoplanation terrace – Large benches carved in hillslopes in the tundra zone of unglaciated areas. Accumulation of snow against the proximal part of a terrace surface and its subsequent melt bring about processes of frost shattering, mass movement, rill wash and slope wash.

Cryosol – A soil of the Cryosolic Order.

Cryosolic – An Order of soils formed in either mineral or organic materials that have perennially frozen material within 1 m of the surface in some part of the soil body (or within 2 m if the pedon has been strongly cryoturbated). The mean annual temperature is less than 0^0C. The order consists of Turbic, Static or Organic Great Groups based on degree of cryoturbation and the nature of the soil material.

cryoturbation – Irregular structures formed in earth materials by deep frost penetration and frost action processes and characterized by folded, broken and dislocated beds and lenses of unconsolidated deposits, included organic horizons and even bedrock. Terms such as “frost churning” and “frost stirrings” are not recommended.

Cumulic – A soil classification Subgroup designation indicating successive mineral layers that result from deposition of materials (e.g., flood plain deposits).

Dark Brown – A soil classification Great Group or Subgroup designation indicating a surface (Ah or Ap horizon) colour value darker than 3.5 moist and 4.5 dry with a chroma greater than 1.5, dry (grassland soils with organic matter content in the 2% to 4% range).

Dark Gray – A soil classification Great Group or Subgroup designation indicating a surface (Ah or Ap horizon) colour value darker than 3.5 moist and 3.5 to 4.5 dry with a chroma of 1.5 or less (transition forest soils with less than about 2% organic matter).

dbh – The diameter of a tree at breast height. Diameter is measured at 1.3 to 1.5 m above ground surface.

deciduous – Refers to perennial plants from which the leaves abscise and fall off at the end of the growing season.

deciduous forest – A plant community with a cover made up of 75% or more of deciduous trees. *Syn.* broadleaved forest.

degree-day – A measure of temperature above or below a reference temperature that is generally added up for a certain period. Thus it is a cumulative measurement of the quantity of energy available for growth that makes it possible to compare growth conditions between regions.

delta – Alluvial deposits at the mouth of a river, usually triangular in outline with low relief.

deposit – See surficial materials.

depression – An area that is lower than the general surrounding landscape, usually less well-drained than the surrounding terrain.

diagnostic species – Plant species used to distinguish plant communities based on their presence or absence and on their abundance.

differential species – A diagnostic species that occurs primarily within one or a few plant community types, but that is less abundant and with lower constancy than characteristic species. It may be present in other communities, but with lower abundance and constancy.

discontinuous permafrost – Permafrost occurring in some areas beneath the exposed land surface throughout a geographic region where other areas are free of permafrost.

diversity – The richness of species within a given area. Diversity includes two distinct concepts:

1. Richness of species.
2. Evenness in the abundance of the species.

domain – Territory including all the regions having the same vegetation or climatic groups on modal sites.

dominant – A plant with the greatest cover and/or biomass within a plant community. The tallest trees within a forest stand, which extend above the general canopy.

drainage – The removal of excess water from soil as a result of gravitational flow. Soil drainage refers to the frequency and duration of periods when the soil is not saturated. Terms used are – excessively, well, moderately, imperfectly and poorly-drained.

drainage basin – Area tributary to or draining to a lake, stream, reservoir or other body of water. *Syn.* catchment area. See also **watershed.**

drift – A glacial deposit.

droughty soil – A soil with low water supplying capacity (sandy or very rapidly drained soil).

drumlin – A smooth, elongated hill created by flowing glacial ice. The long axis and tapered end are oriented in the direction of glacial ice flow. See also **crag-and-tail**.

dryland farming – The practice of crop production in low-rainfall areas without irrigation.

duff – A general term for the litter and humus layers of the forest floor.

dune – A low hill or ridge of sand that has been sorted and deposited by wind.

Dystric – A soil classification Great Group designation indicating Brunisolic soils with an acidic solum – a pH (0.01M Ca Cl_2) of less than 5.5 for at least 25 cm starting at the top of the B horizon.

dystrophic – Referring to a physical environment very unbalanced from a nutritive standpoint due to an excess or a significant lack of a mineral or organic element.

earth hummock – A hummock having a core of silty and clayey mineral soil which may show evidence of cryoturbation**.** Earth hummocks are a type of non-sorted circle (see also *patterned ground*) commonly found in the zone of continuous permafrost. They develop in materials of a high silt and clay content and/or of high ice content.

ecoclimatic province – A broad complex of ecoclimatic regions that have similar climatic conditions as reflected by vegetation. Examples of such units generally approximate continental climatic zones. See **vegetation** zone.

ecoclimatic region – An area characterized by a distinctive regional climate as expressed by vegetation. Equivalent to a **domain**.

ecodistrict – A subdivision of an ecoregion based on distinct assemblages of relief, geology, landform, soils, vegetation, water and fauna. Canadian ecological land classification (ELC) system unit. Scale 1:500,000 to 1:125,000. The subdivision is based on distinct physiographic and/or geological patterns. Originally referred to as a land district. See **ecological district.**

ecological district – Portion of land characterized by a distinctive pattern of relief, geology, geomorphology and regional vegetation. See **ecodistrict.**

ecological factor – Element of the site that can possibly influence living organisms (e.g., water available for plants). This term is also frequently used to refer to ecological descriptors.

Ecological Land Classification (ELC) – The classification of lands from an ecological perspective, an approach that attempts to identify ecologically similar areas. The original system proposed by the Subcommittee on Biophysical Land Classification in 1969 included four hierarchical levels that are currently called ecoregion, ecodistrict, ecosection and ecosite. Ecozone, ecoprovince and ecoelement were later added to the upper and lower levels of the hierarchy.

ecological range – Interval included between the lower and upper limits of an ecological factor allowing the normal development of a specific organism (or a group of organisms). *Syn.* range of tolerance or ecological amplitude.

ecological region – A region characterized by a distinctive regional climate as expressed by vegetation.

ecological unit – Very general term used to refer to a mapping or classification unit of any rank and based on ecological

criteria.

ecology – Science that studies the living conditions of living beings and all types of interactions that take place between living beings on the one hand and living beings and their environment on the other hand.

ecoprovince – A subdivision of an ecozone that is characterized by major assemblages of landforms, faunal realms and vegetation, hydrological, soil and climatic zones. Canadian ecological land classification (ELC) system unit.

ecoregion – An area characterized by a distinctive regional climate as expressed by vegetation. Canadian ecological land classification (ELC) system unit. Scale 1:3,000,000 to 1:1,000,000. Originally referred to as a land region. See **ecological region** and **biogeoclimatic zone**.

ecosite –

1. A subdivision of an ecosection that consists of an area of land with a particular parent material, having a homogeneous combination of soils and vegetation. A Canadian ecological classification (EC) system mapping unit usually mapped at a scale of 1:50,000 to 1:10,000. Originally referred to as a "land type".
2. In Alberta, ecosite is defined as an area with a unique recurring combination of vegetation, soil, landform and other environmental components.

ecosystem –

1. A complex interacting system that includes all plants, animals and their environment within a particular area.
2. The sum total of vegetation, animals and physical environment in whatever size segment of the world is chosen for study.
3. A volume of earth – space that is set apart from other volumes of earth – space in order to study the processes and products of production, particularly those transactions between a community of organisms and its nonliving environment.

ecotone – The transition zone between two adjacent types of vegetation that are different.

ecotype – A group of individuals of the same species that are genetically adapted to local ecological conditions.

ecozone – An area of the earth's surface representing large and very generalized ecological units characterized by interacting abiotic and biotic factors; the most general level of the Canadian ecological classification (EC) system.

edaphic – Related to the soil.

edaphic climax – See **climax**.

edaphic grid – A two-dimensional graphic illustrating the relationship between soil moisture and soil fertility.

edatopic grid – See **edaphic grid**.

elevational zone – Altitudinal zonation of vegetation.

elfinwood – See **krummholz.**

eluviation – The general process of removing, or leaching of, materials from a soil horizon in solution or suspension.

emergent vegetation – Plant species that have a part extending below the normal water level. Such plants are adapted to periodic flooding and include genera such as *Carex, Scirpus and Typha.*

endangered species – Any indigenous species of fauna or flora whose existence in Canada is threatened with immediate extinction throughout all or a significant portion of its range, owing to the actions of humans.

endemic – An organism confined to a certain geographical area.

environment – The summation of all living and nonliving factors that surround and potentially influence an organism.

eolian – See **aeolian.**

erosion – The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

esker – A long, usually narrow ridge of coarse-textured materials deposited on or under glaciers by flowing meltwaters. Eskers can be tens of metres high and hundreds of kilometres long.

Eutric – A soil classification Great Group designation indicating Brunisolic soils with a relatively high degree of base saturation – a pH (0.01M Ca Cl_2) of 5.5 or higher for 25 cm starting at the top of the B horizon.

eutrophic – Refers to nutrient rich status and little or no acid.

evapotranspiration – The combined loss of water by evaporation from the soil surface and by transpiration from plants.

exposure – Location of a site with respect to an environmental factor such as the sun, rain or wind.

fan (alluvial fan) – Unconsolidated materials at the base of a steep slope that were carried and deposited by flowing water; these deposits generally have a conical shape.

fauna –

1. A general term for animals.
2. A list of the animal species present in an area.

fen – A peat-covered or peat-filled wetland with a water table which is usually at or above the surface. The waters are mainly nutrient-rich, minerotrophic waters from mineral soils. The vegetation consists mainly of sedges, grasses, reeds and brown mosses with some shrub cover and at times, a scanty tree layer.

fertility, soil – The status of a soil with respect to the amount and availability of elements necessary for plant growth.

field guide – A field document with keys to identify a plant community, a forest type or a site from biological and physical criteria. These keys may include complete descriptions of plant communities, forest types or forest sites of the region concerned.

fibric – An organic layer containing large amounts of weakly decomposed material whose origins are readily identifiable.

fine texture – Consisting of or containing large quantities of the fine fractions, particularly of silt and clay.

fire climax – Plant community that is maintained by repeated fires.

flark – A Swedish term to designate an elongated, wet and muddy depression in a patterned peatland.

flat bog – A bog having a flat, featureless surface and occurring in broad, poorly defined depressions.

flood plain – An area adjacent to a stream or river, consisting of alluvial sediments, that is periodically inundated during periods of high stream flow.

flora –

1. A general term for plants.
2. A list of the plant species present in an area.

fluvial – Related to stream flow and its associated erosional/depositional processes.

fluvioeolian – Referring to sediments that have been deposited or reworked by both fluvial and aeolian processes; the deposits cannot be separated as either fluvial or aeolian.

fluvio-glacial – See **glaciofluvial.**

fluviolacustrine – Describing lacustrine deposits that have been partially reworked by fluvial processes.

floodplain – The land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

fluvial – Material that has been transported and deposited by streams and rivers (also alluvial).

foothills – Low subsidiary hills at the foot of a mountain.

forb – "Forb" is only used for herbaceous plants and is generally used for broad-leaved herbs, regardless of whether they are monocots or dicots (e.g., *Maianthemum* is a forb).

forest – A relatively large assemblage of tree-dominated stands.

forest floor – Organic layer on soil surface consisting of one or more of L, F and H horizons.

forest region – A major geographical zone characterized by a broadly uniform topography and the same dominant tree species.

forest site –

1. Portion of land whose physical and biological characteristics are sufficiently homogeneous to justify a specific silviculture, for a given species, with an expected productivity falling within known limits.
2. Forest planning unit whose bioclimatic, physical and plant characteristicsimply some given silvicultural potential and constraints.

forest site type – Summary and synthesis of the characteristics of similar forest sites grouped according to topographic and geomorphological location, nature of soil, floristic composition and vegetation dynamics, etc. It is a classification unit but is often used to name a portion of an area as well as a typological unit.

forest type – An assemblage of forest sample plots with similar floristic composition, forest productivity and site properties. See **vegetation type** and **association**.

forest typology – Study and classification of forest site (or forest types) according to growing sites, composition and stand evolution.

formation –
1. A regional vegetation zone composed of plants with similar physiognomy and environmental conditions.
2. A primary unit of bedrock in stratigraphy.

friable – A consistency term pertaining to the ease of crumbling of soils.

frost-free period – Season of the year between the last frost of spring and first frost of fall.

frost boil – See **earth hummock**

genotype – The genetic constitution of an individual that may be transmitted.

geomorphology – The study of landforms and their origin.

glaciation – The formation, movement and recession of glaciers or ice sheets.

glacier – A mass of ice that develops as a result of snow and ice accumulation over a long period of time and that moves laterally from the centre of accumulation.

glaciofluvial – Pertaining to the meltwater streams. flowing from wasting glacier ice and especially to the deposits and landforms produced by streams; relating to the combined action of glaciers and streams.

glaciolacustrine – Pertaining to or characterized by glacial and lacustrine conditions. Said of deposits made in lakes affected by glacier ice or by meltwaters flowing directly from glaciers.

Gleysol – A soil of the Gleysolic Order .

Gleysolic – An Order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas, or prominent mottling, or both, in some horizons. The Order includes Gleysol, Humic Gleysol and Luvic Gleysol Great Groups.

gradient (ecological gradient) – Continuous and regular variation of one or more ecological faetors.

graminoid – A plant that is grass-like; the term refers to grasses and plants that look like grasses, i.e. only narrow-leaved herbs; in the strictest sense, it includes plants belonging only to the family *Poaceae.*

grassland – Vegetation consisting primarily of grass species occurring on sites that are arid or at least well-drained.

gravel – Rounded rock particles with sizes ranging from 2 mm to 75 mm in diameter. **gravelly** – Containing appreciable or significant amounts of gravel.

Gray – A soil classification Great Group designation indicating a surface (Ae or Ap horizon) colour value 5 or higher, dry (forest soils with organic matter content less than 2 percent).

Great Group – A subdivision of a soil order having some properties that reflect differences in the strength of soil-forming processes.

ground cover – The overall canopy cover of a plant community without reference to different strata.

groundwater – The subsurface water that is below the water table. That portion of the hydrosphere which at any particular time is either passing through or standing in the soil and the underlying strata and is free to move under the influence of gravity.

growing degree-days – Accumulated heat units above a threshold temperature of 5^0C. See **degree-day.**

growing season – Number of days where the mean temperature is equal to or above 5°C.

habitat – The place in which an animal or plant lives. The sum of environmental circumstances in the place inhabited by an organism, population or community.

hardwood – A tree with broad leaves such as *Acer, Fraxinus, Populus and Quercus*.

heath – Uncultivated land generally dominated by shrubs, such as ericaceous ones.

herb (herbaceous) – A nonwoody vascular plant.

high-centre polygons – See **low-centre polygons**.

hill – A prominence smaller than a mountain, usually <300 m.

hilly – Large landform elements with local relief in the 200 to 500 m range. This includes foothills, dissected plateaus and major uplands.

horizon – The basic unit of soil classification that is a horizontal layer of mineral or organic material having differentiated characteristics as a result of soil-forming processes.

horizontal fen – A fen with a very gently sloping, featureless surface. This type of fen occupies broad, often ill-defined depressions and may be interconnected with other fens. Peat accumulation is generally uniform.

hue – One of the three variables of colour. A colour or shade of colour in the Munsell Soil Colour Chart such as red, green, or blue.

humic – An organic layer of highly decomposed material containing little fibre.

humification – The processes by which organic matter decomposes to form humus.

humus – A general term for partially or completely decomposed plant litter; well decomposed organic matter.

humus form – Group of soil horizons located at or near the surface of a pedon, which have formed from organic residues, either separate from, or intermixed with, mineral materials.

hummocky – A landform characterized by a complex surface of low- to moderate-relief (local relief generally less than 10 m) knolls and mounds of glacial sediments separated by irregular depressions, all of which lack linear or lobate forms (also called knob and kettle). Slopes are generally less than 0.8 km with gradients greater than 5 percent and up to 30 percent,

hydromorphic soil – A general term for soils that develop under conditions of poor drainage in marshes, swamps, seepage areas, or flats.

hydrophyte – A plant growing in water. In some cases, only the inflorescence lives out of the water.

ice-contact deposit – Deposits that occur when in contact with ice, such as kames and eskers.

ice-wedge polygon – A feature associated with areas of continuous permafrost in dry to moist mineral soil. When soil cools quickly, it shrinks and cracks form. Spring and summer meltwater flow into the cracks and freeze upon contacting the permafrost, creating ice wedges. This ice wedge cracks in subsequent years and ice accretion continues; the ice wedge can become a metre or more in width.

igneous rock – A type of rock that forms from the solidification of magma.

immature soil – A soil with indistinct or only slightly developed horizons.

impeded drainage – A condition which hinders the movement of water through soils under the influence of gravity.

impervious – Resistant to penetration by fluids or by roots.

inactive delta marsh – A marsh occupying higher portions of a delta, usually some distance from active river channels. The marsh is inundated only during very high flood stages or by wind –driven waves. Shallow water may be impounded for long periods of time.

indicator species – Species, usually plants, used to indicate an ecological condition such as soil moisture or nutrient regime that may not be directly measured.

insolation – Radiant energy received from the sun.

inventory – The systematic survey, sampling, classification and mapping of natural resources.

irrigation – The artificial application of water to the soil for the benefit of growing crops.

isohyet – Lines of equal precipitation.

isostatic rebound – A general rise in the land surface following the removal of thick glacial ice.

isotherm – Lines of equal temperature.

kame – A conical hill or irregular ridge of sand and gravel that was deposited in contact with glacier ice.

karst – Surface and subsurface features created by the dissolving of soluble rock such as limestone or gypsum, which results in such features as caverns and sinkholes.

kettle – A depression created by the melting of glacial ice that was buried in moraine.

key – A taxonomic tool used to identify unknown objects (e.g., plants or plant communities) through the use of paired questions.

krummholz – Scrubby, stunted growth form of trees, often forming a characteristic zone at the limit of tree growth in mountains.

lacustrine – Material deposited in lake water and later exposed; sediments generally consisting of stratified fine sand, silt and clay.

landform –

1. A topographic feature.
2. The various shapes of the land surface resulting from a variety of actions such as deposition or sedimentation, erosion and earth crust movements.

landscape –

1. All the natural features such as fields, hills, forests, water, etc., which distinguish one part of the earth's surface from another part. Usually that portion of land or territory which the eye can comprehend in a single view, including all its natural characteristics.
2. A heterogeneous land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout. Landscapes can vary in size, down to a few kilometres in diameter.

landscape ecology –

1. A study of the structure, function and change in a heterogeneous land area composed of interacting ecosystems.
2. The scientific basis for the study of landscape units from the smallest mappable landscape cell to the global ecosphere landscape in their totality as ordered ecological, geographical and cultural wholes.

Remark.: This concept fluctuates greatly from one author to the other. Nevertheless, the concept generally recognizes the importance of interactions between landscape elements, the necessity of a global approach and the importance of human activities. Impact of human activities on the landscape is recognized with the concept but it also recognizes the constraints imparted by the biophysical properties of the landscape.

landscape element – The basic, relatively homogeneous, ecological unit, whether of natural or human origin, on land at the scale of a landscape.

Layer – See **stratum**.

leaching – The removal of soluble materials from a soil horizon by percolating water.

levee – Flood-deposited fluvial materials; when floodwaters overflow streambanks, the resulting fluvial deposits accumulate and raise the streambanks above the adjacent floodplain**.**

level – Refers to land without slope.

limiting factor – Ecological factor that limits the development of an organism by its presence, absence or quantity irrespective of the state of other factors.

lithic – A feature of a soil subgroup which indicates a bedrock contact within the limits of the control section.

litter – The uppermost portion of plant debris on the soil surface, usually not decomposed.

loess – Material transported and deposited by wind and consisting of predominantly silt-sized particles.

lowland – Extended plains or land that occur below a significantly elevated area.

low-centre polygon – A feature of continuous permafrost in wet terrain (e.g., drained lakes). Ice wedges develop in cracks, pushing up soil ridges adjacent to the wedges and creating dams that trap water inside the resulting polygons. The features appear as high-rimmed ridges surrounding wet shallow central pools of water. Over hundreds or thousands of years, peat deposits build up and eventually create a dome-shaped surface; these features are referred to as **high-centre polygons**.

loam – See **soil texture**. A mixture of sand, silt and clay.

loose – A soil consistency term.

Luvisol – A soil of the Luvisolic Order.

Luvisolic – An Order of soils that have eluvial (Ae) horizons and illuvial (Bt) horizons in which silicate clay is the main accumulation product. The soils developed under forest of forest-grassland transition in a moderate to cool climate. The Order includes Gray Brown Luvisol and Gray Luvisol Great Groups (the latter is the most common in western Canada).

macroclimate – Regional climate related to geographical location and relief.

mapping unit – Unit that allows the definition of a geographical reference context.

marsh – A wetland with a mineral or peat substrate inundated by nutrient rich water and characterized by emergent graminoid vegetation.

massif – A large mountain mass, or a group of connected mountains that form a mountain range.

meadow – A moist area usually dominated by grasses or forbs.

mean – The average of a range of numeric values.

meander – Looped pattern of a stream course.

median – The midpoint value above and below which 50 percent of numeric observations fall.

medium texture – Intermediate between fine-textured and coarse-textured (soils). (It includes the following textural classes: very fine sandy loam, loam, silt loam and silt).

meltwater channel – A valley-like feature created by flowing water that originated from the melting of glacial ice.

mesic –

1. Describing the sites that are neither humid (hydric) nor very dry (xeric). Average moisture conditions for a given climate.
2. An organic layer of intermediately decomposed material (between that of fibric and humic).

mesoclimate – Macroclimate that undergoes local modifications to many of its elements. The climate of a forest or a slope is a mesoclimate.

mesotrophic – Medium nutrient status and moderately acidic.

metamorphic rock – Rock formed from preexistant rock after undergoing natural geological processes such as heat or pressure. It differs from the original rock in terms of its physical, chemical or mineral properties.

microclimate – Localized climatic conditions ranging down to conditions at the stand or even individual plant environment level.

mineral soil – A soil that is largely composed of unconsolidated mineral matter.

minerotrophic – Nourished by mineral water. It refers to wetlands that receive nutrients from mineral groundwater in addition to precipitation by flowing or percolating water.

mixed-wood – Forest stands composed of conifers and angiosperms each representing between 25 and 75% of the cover; for example, trembling aspen and white spruce mixed-wood forests.

modal site – A well to moderately well-drained site without topographic or edaphic extremes that could reflect the influences of regional climate rather than local site conditions. Also used to describe typical site conditions for an ecosystem unit. See **normal, zonal** and **reference site.**

moder – Partially decomposed litter as a result of soil faunal activity, usually not matted.

moderately-coarse texture – Consisting predominantly of coarse particles. (In soil textural classification, it includes all the sandy loams except the very fine sandy loam).

moderately-fine texture – Consisting predominantly of intermediate and fine sized particles. (In soil textural classification, it includes clay loam, sandy clay loam and silty clay loam).

moisture deficit – A condition that occurs when evaporation and/or transpiration exceeds the available water supply.

moisture regime – Refers to the available moisture supply for plant growth estimated in relative or absolute terms.

mor – Raw plant litter, usually matted, with a distinctive boundary that occurs at the mineral soil surface, in which fungal activity is the primary method of decomposition.

moraine – A mound, ridge, or other distinct accumulation of generally unsorted, unstratified glacial drift, predominantly till, deposited chiefly by direct action of glacier ice, in a variety of topographic landforms that are independent of control by the surface on which the drift lies (19).

morphology, soil – The physical constitution, particularly the structural properties, of a soil profile as exhibited by the kinds, thickness and arrangement of the horizons and by the structure, consistence and porosity of each horizon.

mountain – Land with large differences in relief, usually refers to areas with more than 600 m of relief.

Munsell colour system – A colour designation system that specifies the relative degree of the three simple variables of colour: hue, value and chroma. For example: 10YR 6/4 is a colour with a hue 10-YR, value -6 and chroma -4. These notations can be translated into several different systems of colour names as desired. See chroma, hue and value.

mull – Decomposed organic matter that has been incorporated with mineral soil; could represent an Ah horizon,

Munsell Soil Colour Chart – A booklet of standardized colour chips used to describe soil horizon colours.

mycorrhiza – The symbiotic association of fungi with the roots of seed plants.

natural province – Vast land mass (of the order of 100,000 km^2) with characteristic features determined by major geological events. There are 3 Natural Provinces recognized in Alberta).

natural region – In Alberta, an extensive land mass (of the order of 20,000 km^2) characterized by permanent geographic

boundaries (geological, physiographic, etc.) and a certain uniformity and individuality of climatic, topographical, geomorphological and biological conditions.

natural subregion – In Alberta, an extensive land mass (of the order of 10,000 km^2) characterized by permanent geographic boundaries (geological, physiographic, etc.) and a certain uniformity and individuality of climatic, topographical, geomorphological and biological conditions.

neutral soil – A soil having a pH value of approximately 7.0 in the surface horizons.

niche – A unique habitat or set of conditions that allows a species to exist with minimalcompetition from other species.

nonsoil – rock, water, snow or ice, mineral or organic material <10 cm thick over rock or soil materials displaced by unnatural processes such as earth fill.

non-sorted circle – A non-sorted circle is a *patterned ground* form that is equidimensional in several directions, with a dominantly circular outline which lacks a well-defined border of stones and has a centre composed of a mixture of textures from fine through coarse mixed with gravels, cobbles and boulders. A network of non-sorted circles that meet is referred to as a non-sorted net. Non-sorted stripes form under the same influence of frost action as non-sorted circles, but because they form on slopes, they flow and elongate perpendicular to contour.

normal site – A site with deep loamy soils, with neither a lack nor an excess of soil nutrients, located in welldrained positions in the landscape and neither protected from, nor exposed to, local climatic extremes. See **zonal, modal** and **reference** site.

northern ribbed fen – A fen with parallel, low peat ridges ("strings") alternating with wet hollows or shallow pools, oriented across the major slope at right angles to water movement. The depth of peat exceeds 1 m.

nutrient – Usually refers to one of a specific set of primary elements found in soil that are required by plants for healthy growth, such as nitrogen, phosphorus, potassium, calcium, magnesium and sulphur.

nutrient regime – The relative level of nutrient availability for plant growth.

old growth – A stand of mature or overmature trees relatively uninfluenced by human activity.

oligotrophic – A condition of low nutrient status and acidic reaction).

ombrotrophic – An ecological system that derives its nutrients solely (or primarily) from precipitation.

Order – The highest taxonomic level in the Canadian System of Soil Classification, reflecting the nature of soil environment and the effects of dominant soil-forming processes.

Organic –

1. An Order of soils that have developed dominantly from organic deposits. The majority of organic soils are saturated for most of the year, unless artificially drained. The Great Groups include Fibrisol, Mesisol, Humisol and Folisol.
2. A soil classification Great Group designation indicating a Cryosolic soil formed in organic materials (e.g., a bog with permafrost).

organic matter – The decomposition residues of biological materials derived from: (a) plant and animal materials deposited on the surface of the soils; and (b) roots and micro-organisms that decay beneath the surface of the soil.

Orthic – A soil classification Subgroup designation indicating the usual or typical (central concept) for the Great Group.

outcrop – Exposure of bedrock at the ground surface.

outwash – Materials washed from a glacier by flowing water and laid down as stratified sorted beds. Generally, it is made up of stratified sand and/or gravel.

overstory – The uppermost continuous layer of a vegetation cover, e.g., the tree canopy in a forest ecosystem or the uppermost layer of a shrub stand.

paralithic – Poorly consolidated bedrock which can be dug with a spade when moist. It is severely constraining but not impenetrable to roots.

palsa – A peaty permafrost mound possessing a core of alternating layers of segregated ice and peat or mineral soil material. Palsas are typically between 1 and 7 metres in height and a few metres to 100 metres in diameter**.**

parent material – The unconsolidated and more or less chemically unweathered material from which soil develops by pedogenic processes.

parkland – Relatively open forest at both low and high elevations; open in nature.

particle size – The size of a mineral particle as measured by sedimentation, sieving, or micrometric methods. Also referred to as grain size.

patterned ground – A general term for circles, polygons, stripes, nets and steps created by frost action.

peat – An accumulation of partially decomposed plant matter under saturated conditions.

peat moss – In scientific literature, peat material is classified on the basis of its botanical composition. The most common moss peat materials are feather moss peat, brown moss peat, *Drepanocladus* moss peat and *Sphagnum* peat.

peat plateau bog – A bog composed of perennially frozen peat, rising abruptly about 1 m from the surrounding unfrozen fen. The surface is relatively flat and even and often covers very large areas. The peat was originally deposited in a non-permafrost environment and is often associated with collapse scars or fens.

peaty – A soil classification phase designation indicating an accumulation of 15 cm to 40 cm of surface peat (15 – 60 cm if fibric).

peatland – Peatlands (organic wetlands) are characterized by more than 40 cm peat accumulation on which organic soils (excluding Folisols) develop.

ped – A unit of soil structure such as a prism or granule, which is formed by natural aggregates.

pediment – Any relatively flat surface of bedrock (exposed or veneered with alluvial soil or gravel) that occurs at the base of a mountain or as a plain having no associated mountain.

pedogenesis – The mode of origin of the soil, especially the processes or soil-forming factors responsible for the development of the solum.

pedology – The aspects of soil science dealing with the origin, morphology, genesis, distribution, mapping and taxonomy of soils.

pedon – A real unit of soil, the smallest homogenous, three-dimensional unit that can be considered a soil.

peninsula – A land area surrounded on three sides by water and connected to a main land mass on the fourth side.

percolation, soil water – The downward movement of water through soil; especially, the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

periglacial – The processes, conditions, areas, climates and topographic features at the immediate margins of former and existing glaciers and ice sheets and influenced by the cold temperature of the ice. Permafrost is a periglacial process.

permafrost – Ground (soil or rock and included ice and organic materials) that remain at or below 0o C for at least two consecutive years.

pH – A measure of acidity or alkalinity of a solution, based on hydrogen ion concentration. Refer to **reaction, soil.**

phase – Judged to meaningfully subdivide the unit, especially for management purposes. The phase is not a formal category in the taxonomy.

phenotype – The observable structural and functional properties of an organism that derive from the interaction between its genotype and its environment.

physiognomy – The general appearance of vegetation by broadly defined life forms, such as forest or grassland.

physiographic region – Topographically similar landscapes with similar relief, structural geology and elevation at a mapping scale of 1:1,000,000 to 1:3,000,000.

physiographic subregion – A subdivision of a physiographic region based on distinct patterns of relief, geology and geomorphology and drainage pattern and density at a mapping scale of 1:250,000 to 1:1,000,000.

physiography – The study of the genesis and evolution of land forms.

pingo – A mound of earth-covered ice found in the Arctic, Subarctic and Antarctica that can reach up to 70 metres in height and up to 2 kilometres in diameter. The term originated as the Inuit word for a small hill. They are most common in Canada along the coastal plains of the Tuktoyaktuk Peninsula. They form in the former basins of drained lakes. When water over 2 m deep is present in the Southern Arctic, lakes do not normally freeze to the bottom, allowing a thaw zone to develop between the lake bottom and the underlying continuous permafrost. If the lake waters drain away, the thaw zone is exposed, allowing the ground surface to freeze in winter, trapping a lens of liquid water between the frozen surface and the underlying permafrost. This lens gradually freezes and expands, deforming part of the drained lake bottom into a dome shape, or pingo, that eventually cracks as the soil tension becomes too great. The pingo continues to grow until all of the water in the lens freezes solid. Subsequent exposure of the ice core to sun in the cracked centre of the pingo can lead to melting and ultimately to collapse as the soil is no longer supported by the ice core.

pioneer species – Plant species that initially invade a newly exposed surface.

plain – A relatively large, level, featureless topographic surface.

plant community – A concrete or real unit of vegetation or a stand of vegetation.

plateau – An elevated area with steep-sided slopes and a relatively level surface

platy – Consisting of soil aggregates that are developed predominately along the horizontal axes, laminated; flaky.

plot – A vegetation sampling unit used to delineate a fixed amount of area for the purpose of estimating plant cover, biomass, or density. Plots can vary in their dimensions depending on the purpose of the study and the individual researcher.

polar desert – Treeless areas, generally north of the arctic tree line, where vegetation covers 0-10% of the surface, the rest being unvegetated soil surface.

polar semi-desert – Treeless areas, generally north of the arctic tree line, where vegetation covers 10-75% of the surface, the rest being unvegetated soil surface.

polygonal peat plateau bog – A perennially frozen bog, rising about 1 m above the surrounding fen. The surface is relatively flat, scored by a polygonal pattern of trenches that developed over ice wedges. The permafrost and ice wedges developed in peat originally deposited in a non-permafrost environment**.** Polygonal peat plateaus are commonly found near the boundary between the zones of discontinuous and continuous permafrost.

population – A group that includes all possible members of a species in a territory at a given time.

postglacial – Occurring after glaciation.

potential – General evaluation of the possible biological productivity or carbon production potential of a site resource (or an area) usually expressed in terms of values to an appropriate management regime. It may be generally established or estimated from site components that represent a permanent character (e.g., soil quality).

potential climax – The species or plant community that will form the climax vegetation on a site. The existing species or plant association may be different from the potential climax due to site disturbance and successional stage.

prairie – An extensive area of native upland grass with a semi-arid to arid climate.

precipitation – A collective term for snowfall and rainfall.

primary succession – See **succession.**

pristine – An undisturbed natural condition.

productivity – A measure of the physical yield of a particular crop. It should be related to a specified management. Merchantable wood volume productivity is generally expressed in m3/ha/yr. It may be further subdivided into types (gross, net, primary).or allocations (leaves, wood, above ground, below ground).

profile, soil – A vertical section of the soil through all its horizons and extending into the parent material.

proglacial – Pertaining to all observable phenomena on the face of a glacier or just beyond its ablation area.

quadrat – A vegetation sampling unit with specific dimensions and shape.

quartzite – **A** hard, metamorphic rock derived from sandstone through heating and pressure. Pure quartzite is usually white to grey. Quartzites often occur in various shades of pink and red due to varying amounts of iron oxide. It is resistant to weathering and because of the nearly pure silica content, breaks down to sand particles and provides little in the way of soil-forming materials.

reaction, soil – The degree of acidity or alkalinity of soil, usually expressed as a pH value reflecting the concentration of hydrogen ion, with lower numbers indicating higher hydrogen ion concentrations. Strongly acidic soils have a pH less than about 5.5, moderately acidic soils have a pH of 5.5 to 6.5, circumneutral (weakly acidic to weakly alkaline) soils have a pH of 6.5 to 7.5, moderately alkaline soils have a pH of 7.5 to 8 and strongly alkaline soils have a pH greater than 8.

range – An extended group or series, especially a row or chain of mountains.

rare species – Any indigenous species of fauna or flora that, because of its biological characteristics, or because it occurs at the fringe of its range, or for some other reasons, exists in low numbers or in very restricted areas of Canada but is not a threatened species.

reconnaissance – A level of field analysis that involves relatively quick sampling for the purpose of obtaining general information about an area. In some cases, sampling quality may be high, but the intensity of sampling is very low relative to the size of the total area being studied.

reference site – A site that serves as a normal or modal condition, an "average" or benchmark in terms of vegetation, soil and general site conditions. See **modal, normal** and **zonal site.**

regeneration – The renewal of a forest crop by natural or artificial means. Also the new crop so obtained. The new crop is

generally less than 1.3 metres in height.

Rego – A soil classification Subgroup designation indicating a sol profile with little or no B horizon – an AC profile (often caused by erosion truncation)

regolith – The unconsolidated mantle of weathered rock and soil material overlying solid rock.

Regosol – A soil of the Regosolic Order.

Regosolic – An Order of soils having no horizon development or development of the A and B horizons insufficient to meet the requirements of the other orders. Included are Regosol and Humic Regosol Great Groups.

relief – The difference between extreme elevations within a given area (local relief).

remote sensing – The gathering and interpretation of land-based information by indirect methods such as aerial photography or satellite imagery.

residual material – Unconsolidated and partly weathered mineral materials accumulated by disintegration of consolidated rock in place.

residual soil – Soil formed from, or resting on, consolidated rock of the same kind as that from which it was formed and in the same location.

ridge – **A**n elongate crest or a linear series of crests; a range of hills or mountains.

riparian – Refers to terrain, vegetation or simply a position adjacent to or associated with a stream, flood plain, or standing waterbody.

rock – A consolidated mass of mineral matter; a general term for stones.

rolling – A landform characterized by a regular sequence of moderate slopes producing a wavelike pattern of moderate relief (20 to 100 metres). Slope lengths are often 1.6 km or greater with gradients usually greater than 5 percent.

runnel – A pattern of alternating flow channels and interchannel uplands perpendicular to contour. In permafrost-affected areas, light and dark-striped patterns on hill slopes are runnels; the light stripes are usually sparsely treed, lichen covered interchannel areas with permafrost close to the surface and the dark stripes are shallow drainage channels vegetated by dwarf birch, willow and other shrubs with a thicker active layer.

runoff (run-off) – The portion of the total precipitation in an area that flows on the surface of the land, without entering the soil, reaches streams and flows away through stream channels.

saline soil – A nonalkali soil containing soluble salts in such quantities that they interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 dS/m (formerly mmhos/cm), the exchangeable-sodium percentage is less than 15 and the pH is usually less than 8.5.

salinization – The process of accumulation of salts in soils.

sand – A soil particle between 0.05 and 2.0 mm in diameter.

saturation percentage – The amount of water required to saturate a unit of soil (often correlated with sodicity).

saprolite – See **residual soil**.

scree – See **talus**.

secondary succession – See **succession.**

sedimentary rock – A rock formed from materials deposited from suspension or precipitated from solution and usually more or less consolidated.

seepage – The slow movement of water near the soil surface, often occurring above an impermeable subsoil layer or at the boundary between bedrock and unconsolidated material that is exposed at ground surface, usually occurs downslope of the recharge area.

seral – Recognizably different succession stages along a successional path or sere.

seral stage – See **successional stage.**

shade tolerant – Plants capable of growing and successfully reproducing beneath the shading canopy of other species.

shield rock – Crystalline Precambrian rock that forms the core of continents.

shrub – A perennial plant usually with a woody stem, shorter than a tree, often with a multi-stemmed base.

shrubland – An area dominated by shrubs, usually individual plants not in contact and with a herbaceous ground cover.

silt – Mineral particles with a diameter of 0.05 to 0.002 mm.

site –

1. The place or the category of places, considered from an environmental perspective that determines the type and quality of plants that can grow there.
2. All the physical elements of a forest site (climate, deposit, drainage, etc.). It is a relatively homogeneous area in its physical permanent conditions.

site index (SI) – An expression of forest site quality based on the height of dominant and co-dominant trees at a specific age.

slope –

1. An inclined surface.
2. The steepness of an inclined surface, measured in degrees or percentages from the horizontal.

slope fen – A fen occurring mainly on slowly draining, nutrient enriched seepage slopes. Pools are usually absent, but wet seepage tracks may occur. Peat thickness seldom exceeds 2 metres.

slough – A Western Canadian term for a shallow prairie pond that largely disappears in late summer, often with a muddy bottom.

softwood – A coniferous tree such as *Pinus* (pine) or *Picea* (spruce) and/or forest type with a cover made up of 76 to 100 percent conifers.

soil – Unconsolidated mineral material or organic material >10 cm thick that occurs at the earth's surface and is capable of supporting plant growth. It is also the zone where the biological, physical and atmospheric components of the environments interact.

soil map – A map showing the distribution of soil types or other soil mapping units in relation to the prominent physical and cultural features of the earth's surface.

soil moisture – Water contained in the soil.

soil profile – A vertical section of the soil through all its horizons and extending into parent material.

soil structure – The combination or arrangement of primary soil particles into secondary compound units or peds. The secondary units are characterized and classified on the basis of size, shape and degree of distinctness into classes, types and grades, respectively. Common terms for kind of structure are single grain, amorphous, blocky, subangular blocky, granular, platy, prismatic and columnar.

soil survey – The systematic classification, analysis and mapping of soils within an area.

soil zone – A large area dominated by a zonal soil that reflects the influence of climate and vegetation.

solar radiation – See **insolation**.

solifluction – the downslope movement of water-saturated soil in a viscous or plastic state over an impermeable layer, often permafrost. The presence of an impermeable permafrost layer prevents the internal drainage of the soil, forcing the soil to flow down the slope. During warm periods the surface layer thaws and slides across the frozen layer, slowly moving downslope due to frost heave.

Solonetz – A soil of the Solonetzic Order.

Solonetzic – An Order of soils developed mainly under grass or grass–forest vegetative cover in semi-arid to subhumid climates. The soils have a stained brownish or blackish solonetzic B (Bn, Bnt) horizon that can be very hard when dry and a saline C-horizon. The order includes the Solonetz, Solodized Solonetz and Solod Great Groups.

solum – The upper horizons of a soil in which the parent material has been modified and in which most plant roots are contained. It usually consists of A and B horizons.

sorted circle – a type of permafrost-related patterned ground that forms under extremely cold conditions when frost action pushes parent materials to the surface; the centre of the circle is occupied by sparsely vegetated finer-textured materials, with a ring of gravels, cobbles and boulders around the outside. A network of sorted circles that meet is referred to as a sorted net. Sorted stripes form under the same influence of frost action as sorted circles, but because they form on slopes, they flow and elongate perpendicular to contour.

species – A group of organisms having a common ancestry that are able to reproduce only among themselves.

spring fen – A fen nourished by a continuous discharge of groundwater. The surface is marked by pools, drainage tracks and occasionally somewhat elevated "islands". The nutrient level of water is highly variable between locations.

stand – A collection of plants having a relatively uniform composition and structure and age in the case of forests.

stand density – A quantitative measure of tree cover on an area in terms of biomass, crown closure, number of trees, basal

area, volume, or weight.

stand structure – The distribution of trees in a stand or group by age, size, or crown classes.

stratum – Horizontal levels in vegetation (e.g., canopy, shrub stratum, herb stratum) or soil (soil layers or strata).

string bog – a pattern of narrow (2-3 metres wide), low (less than 1 metre deep) ridges oriented at right angles to the direction of drainage. Wet depressions or pools occur between the ridges. The water and peat are very low in nutrients, as the water has been derived from ombrotrophic wetlands. Peat thickness exceeds 1 metre.

stone – Rock fragment with a diameter ranging from 25 to 60 cm.

story – A horizontal stratum or layer in a plant community; in forest appearing as one or more canopies.

subalpine – A zone in the mountains that occurs below the alpine.

subarctic – A zone immediately south of the Arctic characterized by stunted, open-growing spruce vegetation.

subclimax – Successional stage of a plant community preceding the climax.

subgroup – A subdivision of a soil great group, differentiated on the basis of the kind and arrangement of horizons that indicate conformity to the central concept of the great group, intergrading towards soils of another order, or other special features.

subsoil – A general term referring to the underlying part of the soil itself and that is often considered as being located under the A horizon.

substrate – The medium on which a plant grows.

succession – The progression within a community whereby one plant species is replaced by another until a stable assemblage for a particular environment is attained. **Primary succession** occurs on newly created surfaces, while **secondary succession** involves the development or replacement of one stable successional species by another on a site having a developed soil. Secondary succession occurs on a site after a disturbance (fire, cutting, etc.) in existing communities.

successional stage – Stage in a vegetation chronosequence in a given site. *Syn.* seral stage.

surficial materials – Unconsolidated materials that occur on the earth's surface.

swamp – A mineral-rich wetland characterized by a dense cover of deciduous or coniferous trees, or shrubs.

sympatric – In evolutionary biology and biogeography, sympatric and sympatry are terms referring to organisms whose ranges overlap or are even identical, so that they occur together at least in some places. (source: http://en.wikipedia.org/wiki/Sympatric_speciation, accessed April 10 2012).

taiga – Refers to a coniferous boreal forest. Often, this term is used to refer to the vegetation zone of transition between boreal forest and tundra. This vegetal formation corresponds to a forest – tundra.

talus – A collection of fallen disintegrated material that has formed a pile at the foot of a steep slope.

terrace – Relatively level benches that are created and occur adjacent to streams or rivers, sometimes sharp or low breaks occur between individual terrace surfaces. These features are formed during a period of fluvial stability followed by a period of down cutting by a stream.

terrain See **topography.**

terrestrial – Pertaining to land as opposed to water.

Terric – A soil classification Subgroup designation indicating a mineral substrate within 40 cm to 140 cm of the surface (shallow peat).

texture – The relative proportions of sand, silt and clay (the soil separates) and coarser materials in a mineral sample. It is described in terms such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam and clay that are often grouped into classes according to specific needs (fine texture, medium texture, moderately coarse texture, etc.).

thermokarst – The process by which characteristic landforms result from the thawing of ice-rich permafrost or the melting of massive ice.

thermokarst lake – A lake occupying a closed depression formed by settlement of the ground following thawing of ice-rich permafrost or the melting of massive ice.

threatened species – Any indigenous species of fauna or flora that is likely to become endangered in Canada if the factors affecting its vulnerability are not reversed.

till (glacial till) – Unstratified drift, deposited directly by a glacier without being reworked by meltwater. See also **moraine**

tor – Isolated rock outcrops; heavily weathered pillar-like remnants atop flat ridges; castellation above the surrounding terrain. Tors typically contain jointed blocks piled one upon the other.

topography – The physical features of an area such as land shape and relief.

toposequence – A sequence of related soils that differ one from the other primarily because of topography and its influence on soil-forming processes. The relationship between soil and vegetation types, primarily a response to different relief.

tree – A woody plant usually with a single main stem.

tree line – The uppermost elevation or northern limit of tree growth, usually on upland sites. Trees are considered to be individuals of a species that typically grows to tree size and that are over 2.5 m tall. The arctic tree line is a line north of which tree cover occupies less than 0.5% of the area. South of the arctic tree line or at lower elevations (for example, along major valleys of the Anderson, Horton and Thelon Rivers) is the forest-tundra zone where forest and tundra both occur in varying proportions in response to topography, elevation and latitude.

tundra – Treeless terrain, with a continuous cover of vegetation, found at both high latitudes and high altitudes. Tundra vegetation comprises lichens, mosses, sedges, grasses, forbs and low shrubs, including heaths and dwarf willows and birches. This vegetation cover occurs most widely in the zone immediately north of the boreal forest including the treeless parts of the forest-tundra ecotone adjacent to the tree line. In high altitudes, tundra occurs immediately above the forest zone and the upper altitudinal timberline. The term "tundra" is used to refer to both the region and the vegetation growing in the region. It should not be used as an adjective to describe lakes, polygons or other physiographic features. Areas of discontinuous vegetation in the polar semi-desert of the High Arctic are better termed **barrens**. Unvegetated areas of polar desert may be caused by climatic (too cold or too dry) or edaphic (low soil nutrients or toxic substrate) factors or a combination of both.

Typic – A soil classification Subgroup designation indicating a depth of more than 140 cm of organic material.

undergrowth – All the shrubs, herbaceous plants and mosses growing under a canopy.

understory – Vegetation growing beneath taller plants such as trees or tall shrubs.

undulating – A landform with a regular sequence of gentle slopes producing a wavelike pattern of low local relief. Slopes are generally less than 0.8 km long with gradients of less than 5 percent.

uneven-aged – Of a forest, stand, or forest type in which intermingling trees differ markedly in age.

upland –

1. A general term for an area that is elevationally higher than the surrounding area, but not a plateau.
2. An area that is not a wetland and that is also not imperfectly or poorly-drained.

valley – Any hollow or low-lying area bounded by hill or mountain ranges and usually traversed by a stream.

value, colour – One of the three variables of colour. A Munsell Soil Colour Chart notation that indicates the lightness of a colour.

vegetation – The general cover of plants growing on the landscape.

vegetation structure – The vertical stratification associated with a plant community.

vegetation type –

1. An abstract vegetation classification unit, not associated with any formal system of classification.
2. In phytosociology, the lowest possible level to be described. See **forest type** and **association**.

vegetation zone – A naturally occurring band of vegetation that occupies a particular environment such as an elevational zone (e.g., subalpine zone).

veneer – A thin layer of unconsolidated material between 10 and 100 cm thick that does not mask the topographic character of the underlying terrain.

veneer bog – A bog occurring on gently sloping terrain underlain by generally discontinuous permafrost. Although drainage is predominantly below the surface, overland flow occurs in poorly defined drainage ways during peak runoff. Peat thickness is generally less than 1.5 metres.

von Post humification scale – A manual method for estimating degree of decomposition of peat materials. It is a 10 point scale with assessment based on colour of drained water and structure of hand squeezed material.

watershed – All lands enclosed by a continuous hydrologic – surface drainage divide and lying upslope from a specified point on a stream. See **drainage basin**.

water table – The upper surface of groundwater or that level below which the soil is saturated with water.

weathering – The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.

wetland – Land that is saturated with water long enough to promote hydric soils or aquatic processes as indicated by poorly-drained soils, hydrophytic vegetation and various kinds of biological activity that are adapted to wet environments.

wildlife – Natural fauna, usually limited to macro-organisms such as mammals, birds, reptiles and amphibians.

windfall – A tree uprooted or broken off by wind and areas containing such trees.

woodland – woody plants 2-8 metres tall growing somewhat closely spaced.

xeric – Describes a dry site.

zonal – Describing a soil that reflects the influence of climate and climactic vegetation (e.g., Luvisol).

zonal site – Site with conditions that could potentially support climatic climax plant communities and their associated soils and thus reflect the regional climate. See **normal, modal** and **reference** site.

zonation – The natural stratification of the landscape in response to significant area differences.