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RECONNAISSANCE VEGETATION STUDIES ON WESTERN VICTORIA ISLAND, CANADIAN ARCTIC ARCHIPELAGO

Project 760058

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Abstract

Reconnaissance observations of the flora and plant communities of western Victoria Island suggest that surficial materials strongly influence the flora. The widespread calcareous glacial deposits support a variety of calciphilous plant communities and flora. All three broad arctic ecosystems (Low, Mid, and High Arctic) occur on western Victoria Island. The Low Arctic ecosystem is the most extensive, occurring along the southwest coast of Prince Albert Peninsula, coastal areas of Diamond Jenness Peninsula and up Kuujjua River valley, and most of Wollaston Peninsula; dwarf shrubs dominate most plant communities and vegetation cover is nearly continuous. The High Arctic ecosystem is restricted to northern Victoria Island and to areas above 500 m in Shaler Mountains and parts of Diamond Jenness Peninsula. The Mid Arctic ecosystem occurs mainly in central Prince Albert and Diamond Jenness peninsulas. Around Minto Inlet rare tree-sized (2 to 5 m-high) thickets of willow occur in some sheltered valleys and along river terraces. The vegetation of western Victoria Island is compared with calciphilous vegetation of the southern Queen Elizabeth Islands, Banks, Somerset, and Prince of Wales islands, and with vegetation on noncalcareous surficial materials of north-central District of Keewatin. Several bioclimatic zones are suggested, including an extension of the 'mini-forest zone' from the Queen Elizabeth Islands and an erect shrub limit and an erect shrub-forest limit in wetlands.

Résumé

L'étude préliminaire de la flore et des associations végétales de l'ouest de l'île Victoria suggère que les matériaux de surface influent grandement sur la flore. Les vastes dépôts glaciaires calcaires supportent une gamme d'associations végétales et de plantes calcicoles. Les trois grands écosystèmes arctiques (Bas-Arctique, Arctique moyen, Extrême-Arctique) se manifestent dans l'ouest de l'île Victoria. L'écosystème du Bas-Arctique est le plus vaste; on le trouve le long de la côte sud-ouest de la péninsule Prince-Albert, dans les régions côtières de la péninsule Diamond Jenness et en amont de la vallée de la rivière Kuujjua, ainsi que dans la plus grande partie de la péninsule Wollaston; des arbustes nains dominent la plupart des associations végétales et la couverture végétale y est presque continue. L'écosystème de l'Extrême-Arctique est limité à la partie nord de l'île Victoria et aux régions des monts Shaler et de certaines parties de la péninsule Diamond Jenness situées à une altitude supérieure à 500 m. L'écosystème de l'Arctique moyen se rencontre surtout dans la partie centrale des péninsules Prince-Albert et Diamond Jenness. On trouve de rares halliers de saules (2 à 5 m de haut) dans certaines vallées abritées et le long de terrasses fluviatiles autour de l'inlet Minto. L'auteur compare la végétation de l'ouest de l'île Victoria à la végétation calcicole de la partie sud des îles Reine-Élisabeth et des îles Banks, Somerset et Prince-de-Galles et à celle des dépôts de surface non calcaires de la partie nord-centrale du district de Keewatin. Elle propose plusieurs zones bioclimatiques, notamment une extension de la "zone de la micro-forêt" à partir des îles Reine-Élisabeth, et des limites des zones d'arbustes droits et de forêts d'arbustes droits dans les marécages.

Introduction

During the summer of 1982 Terrain Sciences Division, Geological Survey of Canada, initiated a Quaternary mapping project on western Victoria Island, west of 110°W (87 D, F-H; 88 A, B; parts of 77 B, C, F, G; 78 B). As part of this group, I studied the flora of the area and the relationships between plant communities and surficial materials. Fieldwork was done from three camps: Cape Wollaston, with J-S. Vincent; Natkusiak Peninsula, with D.A. Hodgson and J. Bednarski; and near Mount Bumpus, Wollaston Peninsula, with D.R. Sharpe and M.F. Nixon (Fig. 9.1). During the latter part of July and early August we conducted helicopter traverses to the three areas while based at Holman (Fig. 9.1), and in August I conducted detailed studies of plant communities around Holman.

The extensive calcareous tills, ice contact and glaciofluvial deposits, which cover most of western Victoria Island (Fyles, 1963), provide an opportunity to study calciphilous plant communities on chemically and texturally similar substrates over an elevation interval of more than 500 m and along a 550 km north-south transect, from Richardson Islands along the south coast to Peel Point in the northwest (Fig. 9.1).

The glacial deposits are derived from the dominantly calcareous bedrock of Victoria Island described by Thorsteinsson and Tozer (1962). Noncalcareous extrusive basalt lava flows occur in the central Shaler Mountains; where this type of rock outcrops, the weathering products are predominantly felsenmeer. Only rarely (in local pockets) does the weathered basalt form the gravel and sand required to support vascular plants; well vegetated sites in areas underlain by basalt commonly are veneered by calcareous till.

Arctic Ecosystems

Low, Mid, and High Arctic ecosystems (Polunin, 1951; Young, 1971) occur on western Victoria Island. The Arctic ecosystem begins at the limit of coniferous trees and ends in the region where climate no longer permits plants to survive.

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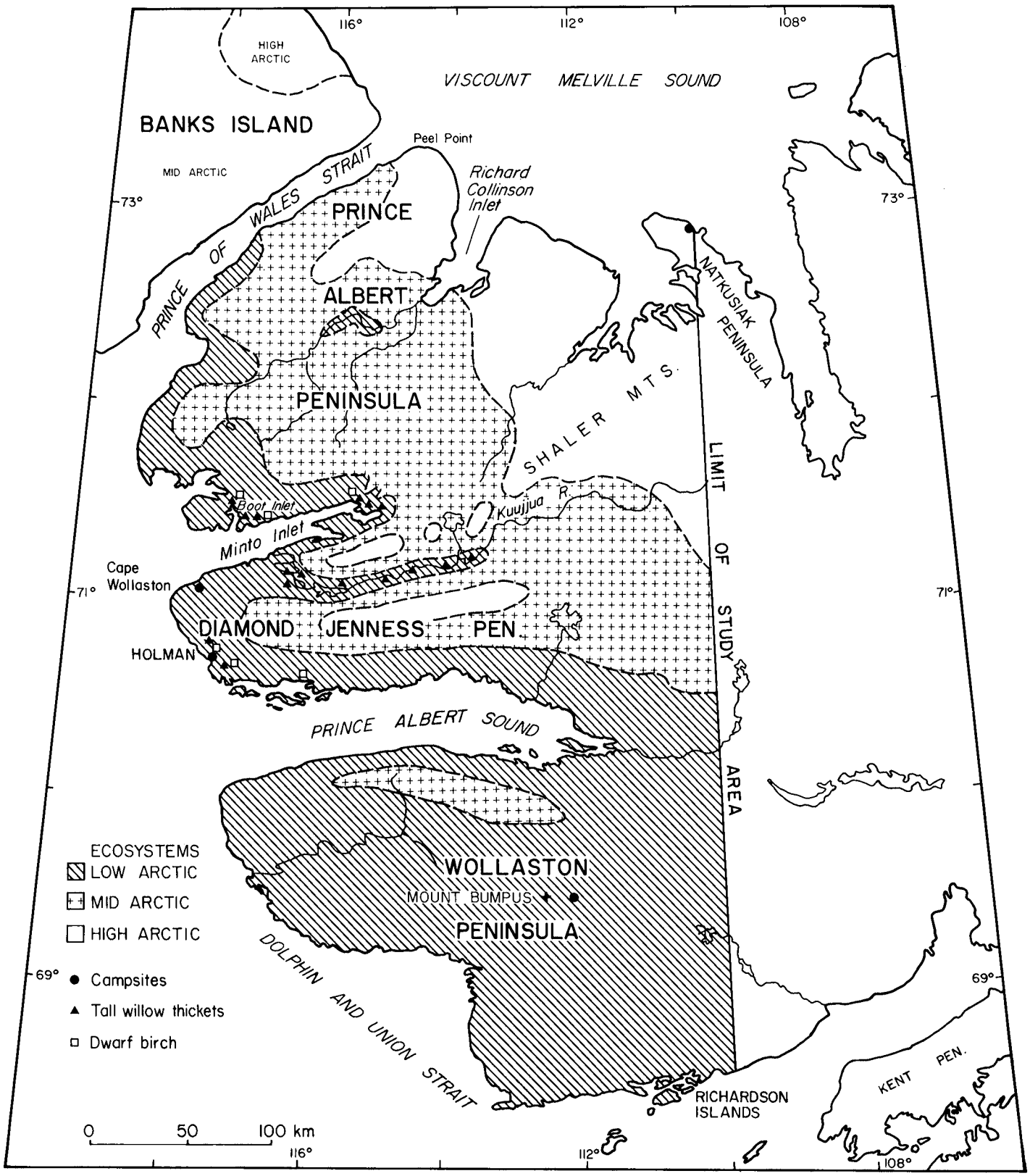

Figure 9.1. *Western Victoria Island showing arctic ecosystems, locations of campsites and of tree-size willows and dwarf birch.*

The progression from Low to High Arctic ecosystems is marked by a decrease in species diversity, major changes in the life form of the plant communities, and a decrease in the per cent plant cover (Fig. 9.2). In describing the ecosystems of western Victoria Island, the two extremes High and Low Arctic ecosystems – are compared and contrasted and then the intermediate Mid Arctic ecosystem is described.

High Arctic Ecosystem

The High Arctic ecosystem is dominant in the Queen Elizabeth Islands north of the map area (Edlund, 1983a). On western Victoria Island it occurs along the north coast and farther south at high elevations in Shaler Mountains, Prince Albert Peninsula, and Diamond Jenness Peninsula (Fig. 9.1). The flora and plant communities in these areas are comparable to those on southern Melville Island (Edlund, 1982b), southern Bathurst Island (Edlund, 1983b), Cornwallis Island (Edlund, 1982c), and Prince of Wales and northern Somerset Island (Woo and Zoltai, 1977). Flora of this ecosystem is the least diverse found on western Victoria Island (less than 100 vascular species), and continuous plant cover is restricted to lower slopes and wetlands.

The vascular component of the plant communities at all but the wettest sites is dominated by dwarf shrub communities which commonly have less than 25% cover but locally reach 50% cover. The calciphile **Dryas integrifolia** (mountain avens) is the most common dwarf shrub, although arctic willow (**Salix arctica**) is also common in many communites. Two of the most common herbaceous associates are purple saxifrage, **Saxifraga oppositofolia,** and the sedge **Carex rupestris,** both calciphiles.

Continuous vegetation is generally confined to moist lower slopes and lowlands found locally near the north coast. Sedge meadows with a large grass component are common on these wet areas but are relatively low in graminoid abundance and general diversity, as are other herbaceous species. Arctic willow is common on raised moss hummocks in these wet meadows.

Low Arctic Ecosystem

The Low Arctic ecosystem on western Victoria Island is found on Wollaston Peninsula and northwards along the coast, up Kuujjua River valley, to southwestern Prince Albert Peninsula (Fig. 9.1). The rich flora (from 150 to more than 200 vascular species) is found in communities that have a nearly continuous vegetation cover on all but the coarsest and driest materials. **Dryas,** including **D. integrifolia** and **D. punctata,** is again a major component of the vascular plant stratum of the plant communities on well to moderately drained materials, with arctic willow a common dwarf shrub associate. Herbaceous associates include a variety of legumes, such as **Oxytropis, Hedysarum,** and **Astragalus,** as well as **Artemisia, Potentilla, Kobresia, Carex,** and various grass species.

The wetlands are generally continuously vegetated with dense and diverse sedge meadows having an abundance of graminoid species and a substantial component of shrubs. The shrub component includes several dwarf shrubs as well as thickets of semi-erect and erect shrubs, commonly willows, which reach 25 to 50 cm in height and may form a nearly continuous low canopy. Heaths, such as **Cassiope tetragona** (arctic heather) and to a lesser extent **Vaccinium uliginosum** (blueberry), **Rhododendron lapponicum** (Lapland rosebay), **Arctostaphylos rubra,** and **A. alpina** (bear berry), occur with dwarf willow on raised hummocks in wet sedge meadows and on sheltered slopes. Dwarf birch (**Betula glandulosa**) occurs locally in this ecosystem as well, generally in sheltered locations (Fig. 9.1).

An unusual feature within this zone is the presence of sites with tree sized willows in the Minto Inlet area (Fig. 9.1). Willows as high as 1.5 m have been reported near Holman (Porsild, 1955; T. Washburn, personal communication, 1982); tall willows have been noted in a river valley near the head of Minto Inlet (Peterson et al., 1981). Nevertheless, it was surprising to see the size of the felt-leaved willow (**Salix alaxensis**) in many sheltered valleys around Minto Inlet, Boot Inlet, along terraces of Kuujjua River and dunes near its mouth (Fig. 9.3), as well as in extremely sheltered niches near Holman (Fig. 9.1). They form thickets, 1.5 to 5 m in height, with trunk diameters of 5 to 12 cm. Other erect willow species, such as **S. lanata** spp. **Richardsonii** (Porsild and Cody, 1980), which usually grow no higher than 0.25 m elsewhere on Victoria Island, also reach heights of up to 1 m in some of these sheltered valleys. The rich arctic herbaceous flora found nearby or as an understory to the thickets, is similar to the flora of communities near treeline, 400 km to the south.

The dense thickets have developed from shoots from a relatively few willows; preliminary tree ring analysis shows that the largest shoots are 50 years old. Numerous dead trunks, similar in size to the willow shoots sampled, were found within the thickets, but so too were new suckers. Thus, in some places, present day conditions are suitable for continued growth of the thickets.

The willow thickets represent vegetational and floristic oases. They probably form as a result of the special microclimatological conditions prevailing in some deep valleys where steep walls, composed of dark gabbro, absorb and reradiate heat into the valleys. One afternoon (August 1, 1982), at a site at the head of Minto Inlet, a temperature difference of more than 20°C existed between the plateau (1°C) and valley floor (22°C). Protection from winds, availability of nutrients and moisture, as well as deep snow conditions during winter probably also contribute to the unique flora at these special sites.

Mid Arctic Ecosystem

The Mid Arctic ecosystem occurs on central Prince Albert Peninsula, and at moderate elevations in Shaler Mountains and on Diamond Jenness Peninsula, and in a small area of northern Wollaston Peninsula (Fig. 9.1). As in the Low Arctic ecosystem, dwarf shrubs, particularly **Dryas** species, dominate all but the wettest areas. The diversity is less than 150 species, however, and fewer types of legumes are associated with these communities than is the case for the Low Arctic ecosystem. Common associates are several **Oxytropis, Kobresia,** and **Carex** species, **Pedicularis lanata,** and **Parrya arctica** – all of which are also common in the Low Arctic ecosystem. But the rich diversity of Low Arctic herbs is absent.

Wetlands are characterized by sedge meadows in which the woody component consists of prostrate shrubs, primarily **Salix arctica,** but do include other dwarf shrubs such as **S. reticulata** and **S. polaris. Cassiope** is the only heath species, growing in sheltered spots. Species of willow that are normally semi-erect and erect are present, but in this zone they usually take on a prostrate form. The exceptions occur locally where some gnarled individual branches of **Salix lanata** and **S. alaxensis** reach about 25 cm in height.

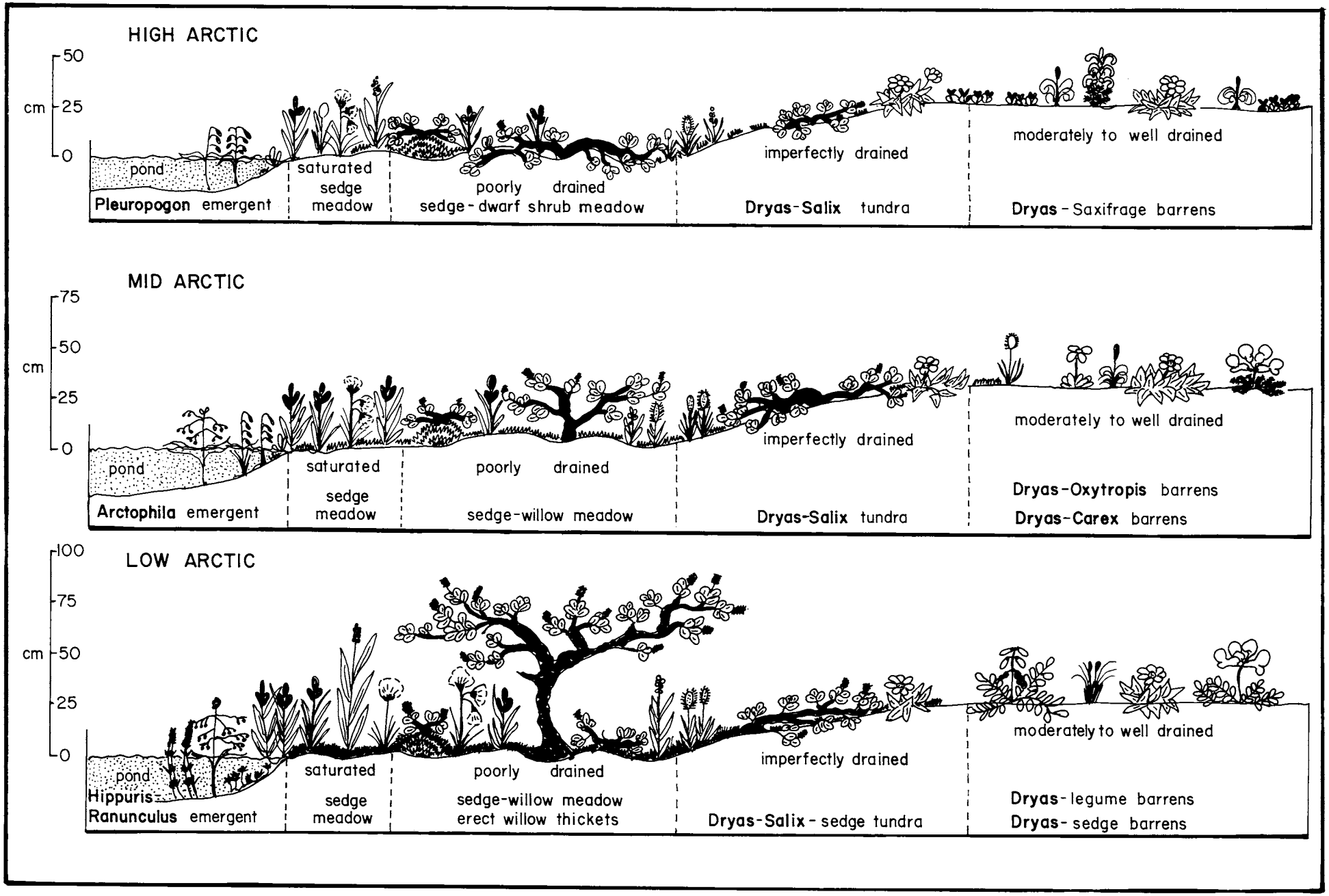

Figure 9.2. *Catena showing plant communities of the Low, Mid, and High Arctic ecosystems on the different moisture regimes of calcareous deposits of Victoria Island.*

Figure 9.3

*An erect willow (**Salix alaxensis**) thicket on deflated sands along the north bank of Kuujjua River, 20 km from its mouth, on Diamond Jenness Peninsula. (203642-D, courtesy of J-S. Vincent).*

Figure 9.4

Location of tall willows in northern Canada and their proximity to treeline.

Comparisons with other Areas in the Canadian Arctic (Fig. 9.4)

Western Victoria Island is floristically similar to Banks Island to the west. Banks Island, like Victoria Island, is largely blanketed by calcareous glacial deposits (Vincent, 1982), although on Banks till masks neutral to weakly acidic bedrock. Banks Island, therefore, is also vegetated by calciphilous plant communities, predominantly **Dryas integrifolia**, barrens, and wet sedge meadows (Vincent and Edlund, 1978), and is characterized by all three arctic ecosystems. On western Victoria Island, which extends farther south than Banks Island, the Low Arctic ecosystem is more extensive; on Banks Island, it occurs only in the southernmost part of the island and the only low willow thickets are found primarily in Masik River valley and De Salis Bay lowland (Fig. 9.4). Nowhere on Banks Island do willows attain heights seen in the Minto Inlet area, and while dwarf birch is locally common on Victoria Island, only one clump on a south-facing slope in Masik River valley has been reported on Banks Island (Kuc, 1970).

On Banks Island, the Mid Arctic ecosystem is dominant whereas on western Victoria Island Mid Arctic-type vegetation is much less common. The High Arctic ecosystem on Banks Island is confined to the northeastern plateau (Fig. 9.1) and the foggy, low lying northwest coast adjacent to the permanent ice pack whereas on western Victoria Island it occurs on the northern coast and in mountainous areas.

The High Arctic plant communities of northwestern Victoria Island are most similar to those of the southern part of Dundas Peninsula, Melville Island (Edlund, 1982b), north of the study area, which is also covered by calcareous till probably derived from materials from Victoria Island (Hodgson et al., in press). Similar plant communities also develop on Bathurst and Cornwallis islands on materials derived from local, moderately calcareous bedrock. Woo and Zoltai (1977) found similar communities on calcareous substrates on Prince of Wales Island and northern Somerset Island.

The flora and plant communities of western Victoria Island are quite different from those found on materials derived from noncalcareous rocks of the Canadian Shield. In north-central District of Keewatin, south of the study area, the Low Arctic communities are dominated by heath species such as **Cassiope tetragona** (heather) and **Ledum palustre** ssp. **decumbens**, (Labrador tea) and commonly possess a thick, nearly continuous carpet of foliose, squamulose, and fruiticose lichens, particularly **Cladonia** and **Alectoria** species, and mats of mosses such as **Rhacomitrium** and **Polytrichum** (Edlund, 1982a). A similar dense and diverse cryptogamic stratum is not present on the calcareous gravels of Victoria and Banks islands; neither are heath-dominated communities common, but species characteristic of heath are found locally in hummocky wetlands and in areas having wet, snowpatch conditions where the local reducing environment of the soil results in a lowered pH (6.8 to 7.2). In spite of these distinctions, which include a general lack of overlapping dominant species, physiognomic similarities exist between the plant communities on western Victoria Island and northern District of Keewatin. The Low Arctic ecosystem in both regions has nearly continuous vegetation, and the vascular plant stratum of all but the wettest soils is dominated by dwarf shrubs. For example, on the highest parts of Wager Plateau (Edlund, 1982a) of northern Keewatin (Fig. 9.4) the vascular plant stratum is dominated by dwarf shrubs, similar to that on Wollaston Peninsula, Victoria Island. At lower elevations surrounding Wager Plateau, semi-erect willows, particularly **Salix phylicifolia** and **S. alaxensis**, and dwarf birch (**Betula**) appear generally with less than 10% cover; in the southern part of the plateau around Tehek Lake (north of Baker Lake), dwarf shrubs are a major ground cover, and in sheltered valleys and along some river terraces, thickets of willow up to 80 cm in height are found. This physiognomy similar to that found in the Low Arctic ecosystem of Victoria Island.

Within the Low Arctic ecosystem, to find willow thickets of a comparable size to those in the Minto Inlet area, one must look farther afield (Fig. 9.4). The Bathurst Inlet and Tree River areas south of Victoria Island, not far from treeline, harbour such thickets in some sheltered valleys (W. Blake, Jr. and B.G. Craig, personal communication, 1983). Tree-sized willows are also found south of Baker Lake in the Kazan River area of Keewatin, between Ford Lake and Thirty Mile Lake (A.N. LeCheminant, personal communication, 1983). Maycock and Matthews (1966) described **Salix alaxensis** thickets reaching 4.6 m in height in northern Ungava Peninsula, Quebec and they refer to reports by J.D. Soper of 3.7 m-high willow (probably **S. plainfolia**) near Lake Harbour, southern Baffin Island. All such communities are extremely local and rare. It appears that the occurrence of the willow "forests" at Minto Inlet are the northernmost ones known in North America.

Bioclimatic Zones

Victoria Island has several zones of biogeographical and bioclimatological importance. The High Arctic ecosystem, which extends across the Queen Elizabeth Islands to the north, has its southern limit on Victoria Island. The High Arctic ecosystem on Victoria Island lies entirely within the richest subzones of the High Arctic, where dwarf shrubs are the major vascular plants (Edlund, 1983a). Farther north, in the Queen Elizabeth Islands, dwarf shrubs are no longer dominant. The boundary between the zone where dwarf shrubs are dominant and that where dwarf shrubs occur only locally may be thought of as a 'mini-forest line'. The northermost limit of dwarf woody species is the 'mini-treeline'.

All of Victoria Island lies well within the 'mini-forest zone'. Dwarf shrubs are dominant on moderately to well drained substrates. They are absent from plant communities only in areas where local snowbeds persist well into mid and late July; in such places, the communities are floristically similar to those seen farther north above the 'mini-treeline'.

This concept of broad bioclimatic zonation of the ecosystems can be applied to other parts of Victoria Island as well. The southern boundary of the High Arctic ecosystem is, in effect, the limit of erect and semi-erect shrubs – an 'erect shrub limit'. Throughout the Mid Arctic ecosystem, erect and semi-erect shrub species are locally present in poorly drained areas but are less than 25 cm high and have low percentages of cover. In the Low Arctic ecosystem, the semi-erect and erect shrubs of the low shrub forest zone generally reach 0.5 m high and commonly form thickets on poorly drained, sheltered sites; these represent a local erect shrub forest. The tree-sized willow thickets in valleys around Minto Inlet represent isolated tall willow-forest zones in an area far removed from treeline.

Further research may tie these biogeographical observations with climatological parameters, possibly coincident with isotherms such as the mean July isotherms, as suggested by Edlund (1983a) for the central Queen Elizabeth Islands.

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