

AN INVESTIGATION OF A LATE-GLACIAL DEPOSIT FROM THE
MISSOURI COTEAU IN SASKATCHEWAN

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Bernard De Vries

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ABSTRACT

A buried deposit of limnic sediment was excavated from a site in the Missouri Coteau, Saskatchewan. Carbon-14 determinations indicated that it is of late-glacial age, apparently deposited immediately before the Condie re-advance. On the basis of studies of the plant macrofossil remains and pollen an attempt is made to reconstruct the vegetation as follows: the lower sediment levels yielded a fossil flora suggesting a white spruce forest; this was followed by a flora containing a strong element of temperate species, suggesting a mixed boreal forest; the upper levels show a reversion to white spruce predominance. These suggestions are based on the interpretation of 80 entities of plant macrofossils and a pollen diagram.

I. INTRODUCTION

Studies of late-Pleistocene plant remains are of value both for elucidating the history and development of regional vegetation and flora, and for providing necessary information on the changing environment of the recent past. As Terasmae (1961) has pointed out in a recent review article, while there have been several investigations of late- and post-glacial vegetation in eastern Canada and the adjacent United States, and in the Pacific Northwest, west-central Canada is almost entirely unknown from this point of view.

The aim of the general investigation being conducted currently at the University of Manitoba*, of which this contribution forms a part, is to apply the established procedures of macrofossil studies and pollen analysis to suitable Holocene deposits, with the hope of reconstructing the sequences of vegetation change since deglaciation. From such a reconstruction it might then be possible to make

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palaeoecological inferences. While the number of studies in North America of plant macrofossils in Holocene deposits is small, such an approach has been used to great advantage in N.W. Europe, especially in elucidating the nature of late-glacial vegetation and flora (cf Jessen 1949, Godwin 1956, Iversen 1954). These investigations, and others in Europe, have demonstrated that inadequacies of the pollen record in late-glacial clays can be overcome in part by the macrofossil record. Further, the presence in late-glacial deposits of limnic origin of particular species and genera in the form of macrofossils provides almost unequivocal evidence of their presence at the site, while pollen spectra of late-glacial deposits in Europe have been difficult to interpret in some cases because of problems of over- and under-representation, poor preservation and secondary origin.

The specific objectives of this thesis are to make a thorough examination of the plant macrofossils in organic sediment from the Missouri Coteau of Saskatchewan. Attention was directed to this line of enquiry by several reports of organic sediments of late-glacial age in the region of the Missouri Coteau.

Kupsch (1960) reports on the botanical and zoological material associated with a Carbon-14 dated organic sediment near Herbert, Saskatchewan. This site was located on the east shore of a small saline lake on the bottom of former Glacial Lake Herbert, at an altitude of about 700 m. Kupsch (loc. cit.) describes the stratigraphy of the site as follows: (a) - below the 16.50 m. level, glacial till, (b) - from 16.50 to 6.90 m., sand and silt with no organic material, (c) - from 6.90 m. to the surface is a layer of calcareous silt, gyttja, marl and loam, with the 3.70-3.00 m. stratum particularly rich in organic remains. A sample of Salix wood from this level was dated by Carbon-14 measurement as $10,050 \pm 300$ years B.P. (McCallum and Dyck, 1960). On the basis of the somewhat limited macrofossils (Chara, Potamogeton, Picea and Salix), a pollen diagram prepared by Dr. J. Terasmae of the Geological Survey of Canada, Kupsch (l. cit.) concludes that the climate of the area at the time of deposition was considerably cooler and wetter than at present. Christiansen (1961) has revised Kupsch's (l. cit.) conclusion about the proximity of the glacier at the time, suggesting that "the glacier stood about 50 miles north of

the Herbert Site 10,000 years ago" (p. 43).

A second late-glacial deposit was discovered accidentally in 1958 (Dew, 1959) and a pollen diagram was prepared from samples by Terasmae (unpublished, personal communication from Dr. Terasmae). The site is located on the Scrimbit Farm, near Kayville, Saskatchewan. Upper and lower samples from a section of organic sediment, 2.5 m. thick and buried by about 2.5 m. of mineral material, indicate that the deposit was formed between 11,700 and 10,400 B.P. (personal comm. Terasmae). A further deposit has been reported (Anon. 1961) from Lillestrom, about 32 km. southwest of Moose Jaw, Saskatchewan. This account mentions several other deposits reported from southern Saskatchewan, apparently of a similar nature to the Herbert and Scrimbit sites, but neither these sites nor that at Lillestrom have been studied in detail.

These discoveries indicated the need for further, more intensive study of the plant macro- and microfossils. Accordingly, exploratory field work was begun in July 1962, with the intention of either examining in more detail the Scrimbit site material, or locating a new site in the same

vicinity. The Scrimbit site was examined, but it was found to be no longer suitable for study due to various landscaping and water-level changes. Several other sites were studied and finally the site of the present investigation, on the Hafichuk Ranch (northeast quarter of Section 2, Range 29, Township 16, west of Second Meridian) in the Missouri Coteau, was located and excavated. Preliminary examination of the sediment and associated plant remains suggested that the site was of late-glacial age, and subsequent dating of three samples has confirmed this opinion. The three samples of organic sediment, from upper, middle and lower levels, were dated at the laboratory for radiocarbon dating, University of Saskatchewan, by the courtesy of Dr. K. J. McCallum, Professor of Chemistry, University of Saskatchewan. The dates indicate that the deposit under study was laid down between 11,700 and 10,270 B.P.

This thesis reports on a detailed examination of the plant macrofossils extracted from bulk samples from the excavation, and incorporates the results of a concurrent study of the pollen and spores found in close-interval samples collected from the same excavation. (The pollen

analysis of these samples was conducted under the supervision of Dr. J. C. Ritchie and was made available for this thesis to facilitate interpretation of the findings).

Following a brief statement on the geographical features of the Hafichuk site region, and an account of the field and laboratory methods involved in the work, the main part of the thesis deals with the plant remains discovered in the deposit. The thesis is concluded with a section suggesting some interpretation of the results.

II. GEOGRAPHICAL FEATURES OF THE VICINITY OF THE HAFICHUK SITE

Geology and landforms

The site is located in the Missouri Coteau, an upland which runs from the vicinity of the Souris River in southeast Saskatchewan in a northwest direction to latitude 53° at the western boundary of the province. The following description has been abstracted from the map entitled "Physiographic Divisions of Saskatchewan" (Acton et al, 1960). The primary physiographic features of the Coteau - the escarpment which marks its eastern boundary and the major drainage valleys -

are the result of pre-glacial erosion of soft Cretaceous and Tertiary bedrock. The local prevalent landform of the Hafichuk area is glacial, described and mapped by Christiansen (1961) as Hummocky Moraine. He writes (p. 15-16) "the landscape is characterized by till knobs, kames, kettles, rimmed kettles, moraine plateaus, and small, rimmed depressions which contain lacustine silt and clay". The other main glacial landforms of the region have been mapped (Fig. 1) after Christiansen (l. cit.), showing the disposition of the major end moraines, the glacial channels, and adjacent till and lacustrine plains. The hummocky moraine shows the typical blocked drainage pattern of "dead-ice" or disintegration morainic deposits. The topography is strongly rolling, with the relief varying from 10 to 15 m. The maximum elevation of the hills in the immediate vicinity of the Hafichuk site is 660 m. (above sea level).

Christiansen (1956) concludes, in his discussion of the glacial history of the region, that the Missouri Coteau, a "preglacial topographical high" (p. 27), was one of the first areas in Saskatchewan from which the Wisconsin ice melted. In a later report (Christiansen, 1961) he outlines

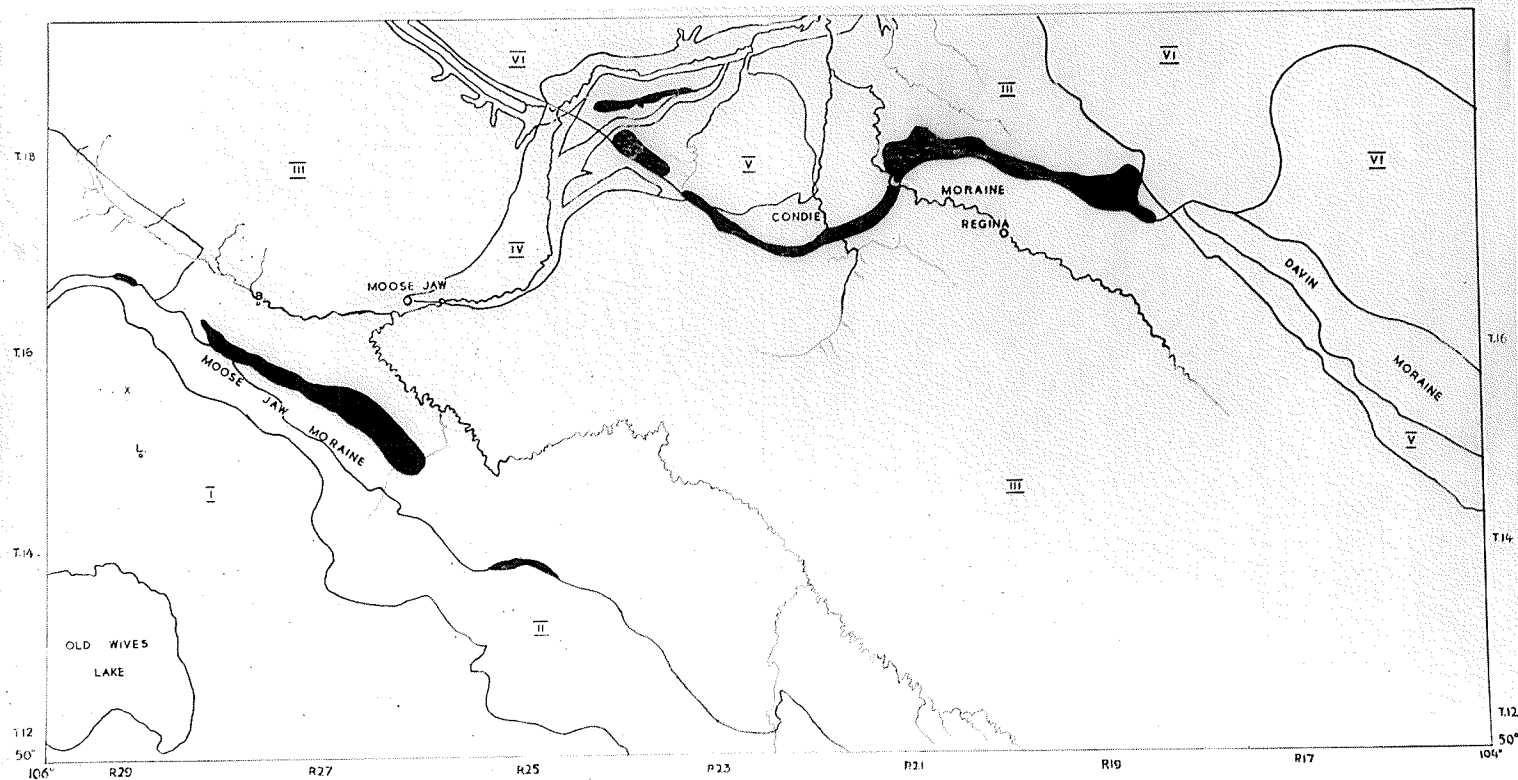


Fig. 1. The location of the Hafichuk site (x) in relation to the Moose Jaw and Condie moraine in south central Saskatchewan (modified version of Christiansen, 1960). I. Hummocky moraine, gentle to strongly rolling, having a knob and kettle topography, II. Ground moraine, undulating to gentle rolling, III. Glacial basin of lake Regina, flat to rolling, IV. Eroded till plains, flat to undulating, V. Fluvio-lacustrine plain, flat to undulating, VI. Wash-board moraine with sub-parallel, discontinuous and generally arcuate ridges.

the stages of the glacial history of the area. During his Phase No. 1 of the glacial history of the Regina area, the glacier had "retreated to a position north of the Moose Jaw and Davin Moraines" (p. 44) (Fig. 1 of thesis), exposing the hummocky moraine in which the Hafichuk site is situated. Following this the ice retreated to a position north of Regina and subsequently (Phase No. 3) advanced to the position of the Condie Moraine (Fig. 1). Christiansen (l. cit.) suggests that this advance is correlative with the Valdres advance of the Mid-Western United States, and throws doubt on the conclusion of Elson (1957) that the ice front stood at The Pas Moraine during the Valderan sub-age. Correlating the dates which Christiansen suggests for these events (1961 p. 43), it would appear that the Hafichuk deposit was formed in an episode between deglaciation and the re-advance of the ice to the Condie moraine. This problem of chronology will be discussed more fully in the concluding section of the thesis.

Climate

The following information on climate has been

abstracted from Mitchell et al, (1947), Thomas (1953), Kendrew and Currie (1955), and the Atlas of Canada (1958).

The climate of the prairie region in southern Saskatchewan, including the Missouri Coteau, is continental in character with extreme differences in temperature between summer and winter, and a comparatively low precipitation.

Frequent wide variations are noted between day and night temperatures. Amounts of precipitation vary considerably from year to year. Extremes from 17.5 to 62.5 cm have been recorded (Mitchell et al, 1947). Winters are long and cold, with short, warm to hot, and frequently bright sunny summers. Mitchell (l. cit.) lists as average, annual temperature for Caron, about 14 K.M. north of the Hafichuk site, as 1.46° C and an average precipitation of 34.38 cm. Regina, in the more humid eastern section of the mixed prairie zone, averages 0.67° C and 35.58 cm. Swift Current, in the drier western section of the mixed prairie zone, averages 3.4° C and 37.95 cm. The prevailing winds are westerly, with drying Chinook winds from the south-west, and dry, cold winds from the north-west being typical. These winds are less frequent during the warmer part of the year,

being replaced by winds from a north-westerly or north-easterly direction (Kendrew et al, l. cit.). Wind velocity is quite high in the prairie, with the highest in spring, and the lowest in mid-winter and late-summer.

Data obtained at various stations cannot be considered as indicative for a certain region, because of variation in height above soil surface at which measurements were taken. Evaporation from water and land surfaces are greatly influenced by drying winds and strong solar radiation.

Vegetation

The site under study lies well within the northern boundary of the grasslands vegetation zone. Its position in relation to the major vegetation zones of west-central Canada is shown in Fig. 2.

The following general and brief account of the plant communities of the Missouri Coteau has been abstracted from Coupland (1950 and 1961), supplemented by personal observations in the area.

By far the largest proportion of mixed prairie in

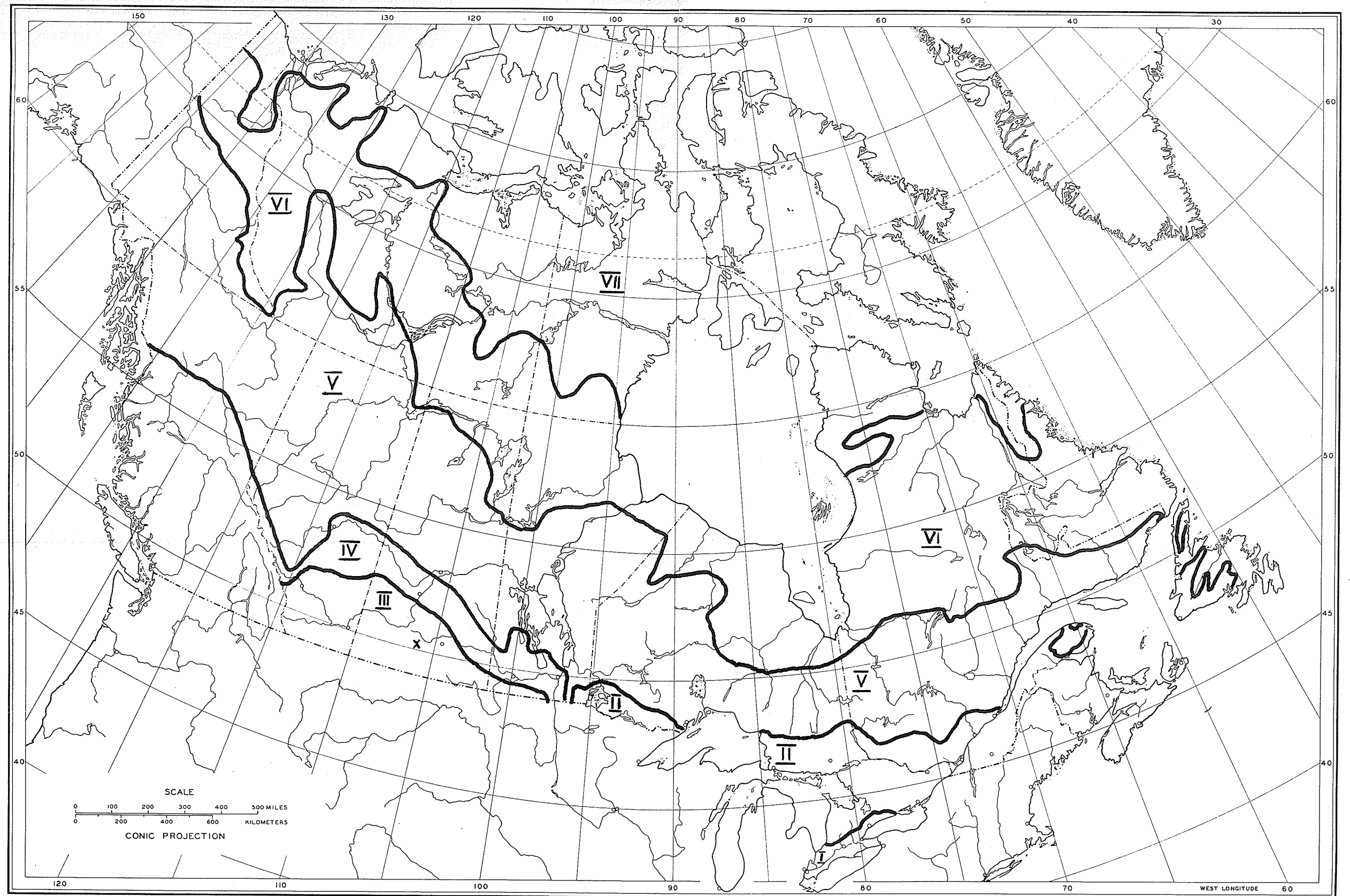


Fig. 2. The general location of the Hafichuk site (x) in relation to the main vegetation regions (modified version of Rowe, 1959). I. Deciduous Forest; II. Great Lakes - St. Lawrence Forest; III. Grasslands; IV. Aspen-Parkland; V. Boreal and Northern Coniferous Forest; VI. Northern transition - Subarctic-Forest and Barren; VII. Tundra.

southern Saskatchewan, including the Missouri Coteau, is occupied by a Stipa-Bouteloua faciation. This characteristic climax-type vegetation is developed on medium textured soils over glacial till in the moister brown, and drier dark-brown soil zone. This faciation is pre-climax to the Stipa-Agropyron community and post-climax to the Bouteloua-Stipa type. In the moister part of the brown soil zone, including the eastern zone of the Coteau, the Stipa-Bouteloua faciation, is mainly confined to the intermediate slopes. The upper slopes and top of knolls are occupied by a Bouteloua-Stipa type of vegetation, while lower slopes support a Stipa-Agropyron community. Local depressions are usually occupied by a mesic vegetation, depending on available soil moisture. Locations of faciation types varies with climatic conditions. Three vegetation strata can be recognized, (i) an upper layer consisting of medium-height grass-culms and flowering stems of various forbs, (ii) a middle layer of Bouteloua gracilis, Carex eleocharis and associated forbs such as Malvastrum coccineum, (iii) a lower layer consisting of Selaginella densa in places.

Trees and shrubs are not common in this community,