HOLOCENE ENVIRONMENT OF A FOSSIL BISON FROM KENORA, ONTARIO

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ABSTRACT

Sediment found within a buried bison skull has been radiocarbon dated at 4,850 ± 60 years B.P. Pollen and plant macrofossil analysis shows that the animal died in a shallow pond surrounded by a pine-poplar woodland. A dated pollen diagram from nearby Hayes Lake shows this Hypsithermal woodland habitat to have existed from 9,200 to 3,600 years B.P.

Although no artifacts were found with the skull or skeleton it is possible that bison was a prey animal of the late Paleo-Indian and Archaic people of northwestern Ontario.

INTRODUCTION

There is no historic record of bison in Ontario (Peterson 1966) and postglacial bison remains from Ontario are rare. There is a bison skull collected front the glacial Lake Iroquois beach in Toronto of late Pleistocene age (ca. 12,500 years ago), when forest-tundra provided an open, grassy habitat (McAndrews 1981). (The skull is with the Royal Ontario Museum, Department of Vertebrate Palaeontology, catalogue number 1198; the skull has been misplaced but a photo of it appeared in the Edmonton *Journal* of June II, 1932). Bison apparently disappeared from southern Ontario at the end of the Pleistocene because the dense Holocene forest (McAndrews 1981) was not a suitable habitat. The Holocene fossil record, confined to a horn core and small bones from archaeological sites (Wintemberg 1972; Moore 1975; Dawson 1976), probably represents imports from outside the province.

A bison skeleton without associated artifacts was recently reported from a 4.5 m deep peat bog near Kenora, Ontario (Fig. 1) (Rajnovich 1980). The specimen (Manitoba Museum of Man and Nature catalogue number V-780) was of an extinct form tentatively identified by G. Lammers and J. Dubois as Bison crassicornis, a late Pleistocene species that became extinct before 10,000 years ago (Kurten and Anderson 1980). However, the Kenora area would have been poor bison habitat during the late Pleistocene because the land was mostly inundated by glacial Lake Agassiz from between the time of deglaciation about 12,500 years ago and the beginning of the Holocene 10,000 years ago (Prest 1970). Thus it is more probable that the bison is of Holocene age. However, because bison is historically absent in the forest of northwestern Ontario it is possible that the Holocene environment of the Kenora bison resembled the normal bison habitat of prairie and woodland.

To better understand the age and environment of the Kenora bison, sediment associated with the bones was studied for its composition, radiocarbon age, fossil pollen and plant macrofossils.

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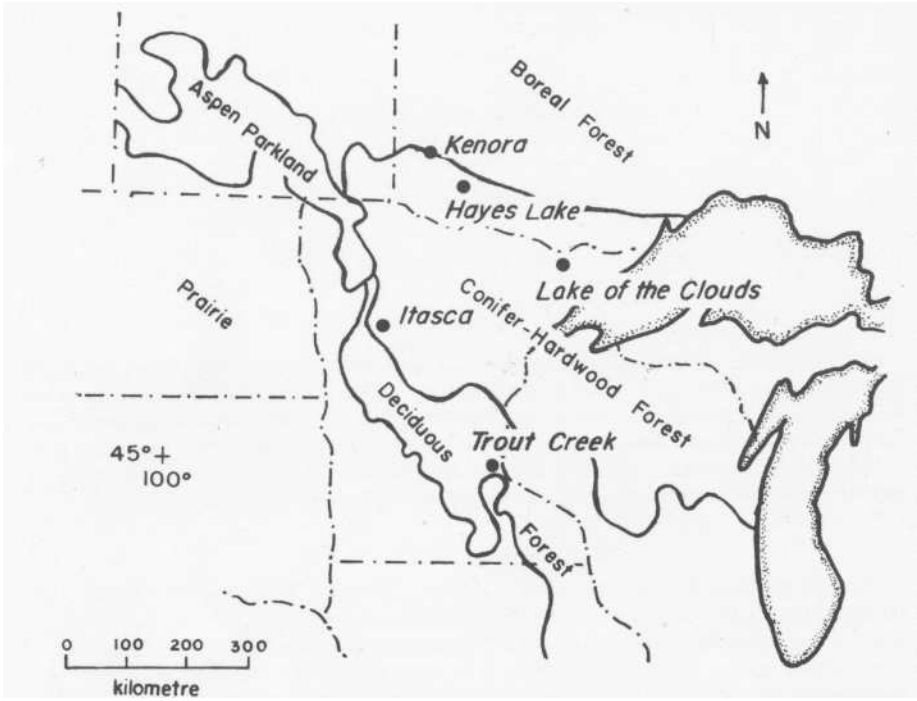

Fig. 1. Location of the Kenora bison site, Hayes Lake and other pollen analysis sites discussed in the text.

TABLE 1

PERCENTAGE FOREST COMPOSITION IN THE KENORA DISTRICT

BASED ON VOLUME OF PRIMARY GROWING STOCK
(DIXON 1963)

Conifers	
white pine *(Pinus strobus)*	1
red pine *(P. resinosa)*	1
jack pine (P. *banksiana)*	*28*
white spruce *(Picea glauca)*	*5*
black spruce (P. *mariana)*	*20*
balsam fir *(Abies balsamea)*	*6*
white cedar *(Thuja occidentalis)*	1
larch *(Larix laricina)*	«1
Hardwoods	
poplar *(Populus)*	30
white birch *(Betula papyrifera)*	*7*
ash *(Fraxinus)*	*«1*
soft maple *(Acer rubrum)*	*«1*

VEGETATION HISTORY

Northwestern Ontario is a region of rolling topography with many lakes and hills of crystalline bedrock partly covered with a shallow soil. The forest is dominated by poplar, jack pine and black spruce with lesser amounts of white birch, balsam fir and white spruce (Table 1). Exposed, windswept hilltops support sparse jack pine with a ground cover of herbs and depressed juniper *(Juniperus communis).* About 200 km to the west a zone of aspen (poplar) parkland separates the forest from the prairie grassland (Fig. 1), the historic bison habitat.

Unlike the Red River Lowland to the west, postglacial Lake Agassiz did not completely cover the Kenora area where local relief provided islands (Brunskill and Schindler 1971) that were habitats for pioneer plants and possibly bison.

Two radiocarbon-dated pollen diagrams record the regional postglacial vegetation; the hitherto unpublished Hayes Lake (Lake 240) near Kenora and Lake of the Clouds in northeastern Minnesota (Craig 1972). Hayes Lake lies below the level of Lake Agassiz. In 1969 we lifted an 820 cm long core from beneath 8 m of water. The upper 640 cm of sediment was organic mud typical of a small lake. Below the mud was the varved clay of Lake Agassiz—a radiocarbon date of 10,780 years B.P. lies several centimeters above the contact (Table 2).

TABLE 2

RADIOCARBON DATES

FROM SEDIMENT OF **HAYES LAKE** AND **KENORA BISON SKULL**

(All Samples Were Pretreated To Remove Carbonates)

Level (cm)	Radiocarbon Years B.P.	Laboratory Number
210-220	4685 ± 130	I-7267
410-420	6970 ± 115	I-7268
560-570	10780 ± 160	1-7269
skull 6	4850 ± 60	BETA-3779

The Hayes Lake pollen diagram (Fig. 2) was zoned with the computer-assisted constrained single-link clustering (CONSLINK) method (Birks and Birks 1980); three zones and four subzones were identified. The age of the zone boundaries was determined from regression of depth with three radiocarbon dates and the core surface.

Zone 1, confined to the Lake Agassiz varved clay, is dominated by herb pollen indicating tundra occupied the nearby windswept rocky islands.

Zone 2 begins with the local disappearance of Lake Agassiz about 11,900 years ago. Herb pollen abruptly declines and spruce pollen becomes dominant, an indication that spruce forest replaced tundra in response to climatic warming enhanced by an increase in local relief. This spruce forest was relatively diverse and included larch, birch, poplar and elm.

Zone 3 is dominated by jack/red pine and birch pollen—the contact between zones 2 and 3 at 10,000 years B.P. signals the beginning of the Holocene. The zone is divided into four subzones; 3a is distinguished by low alder *(Alnus)* and herbs, 3b and 3c have somewhat higher herb pollen and low spruce, whereas 3d has high spruce, fir and larch and low poplar and herbs. The distinction between subzones 3b and 3c is subtle—3b has relatively high herbs, cedar-juniper (Cupressaceae) and low pine while 3c has higher pine and oak. The 3a/3b boundary is 9,200 years B.P., 3b/3c is 6,400 years B.P. and 3c/3d is 3,600 years B.P.

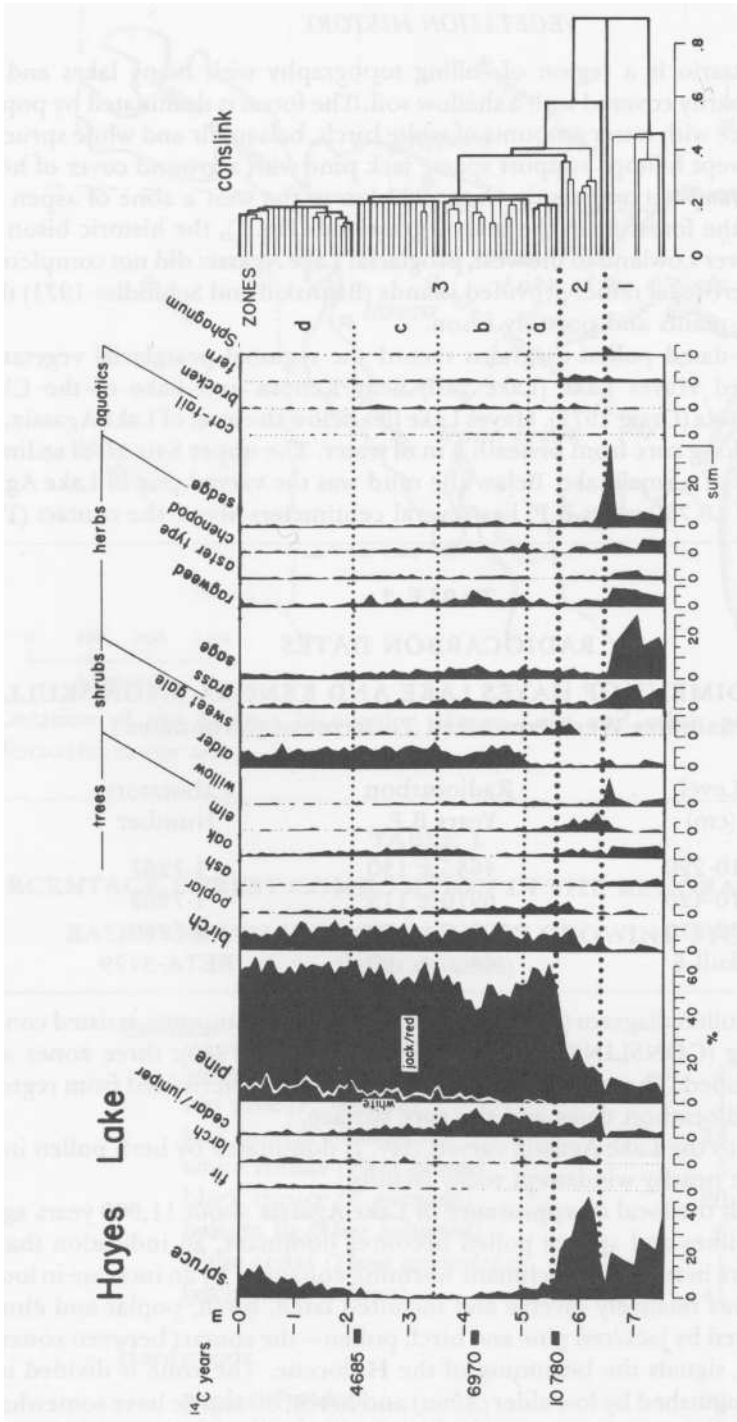

Fig. 2. Pollen diagram from Hayes Lake **(49°** 35' N, 93° 45' W). Pollen analysis by J. H. McAndrews

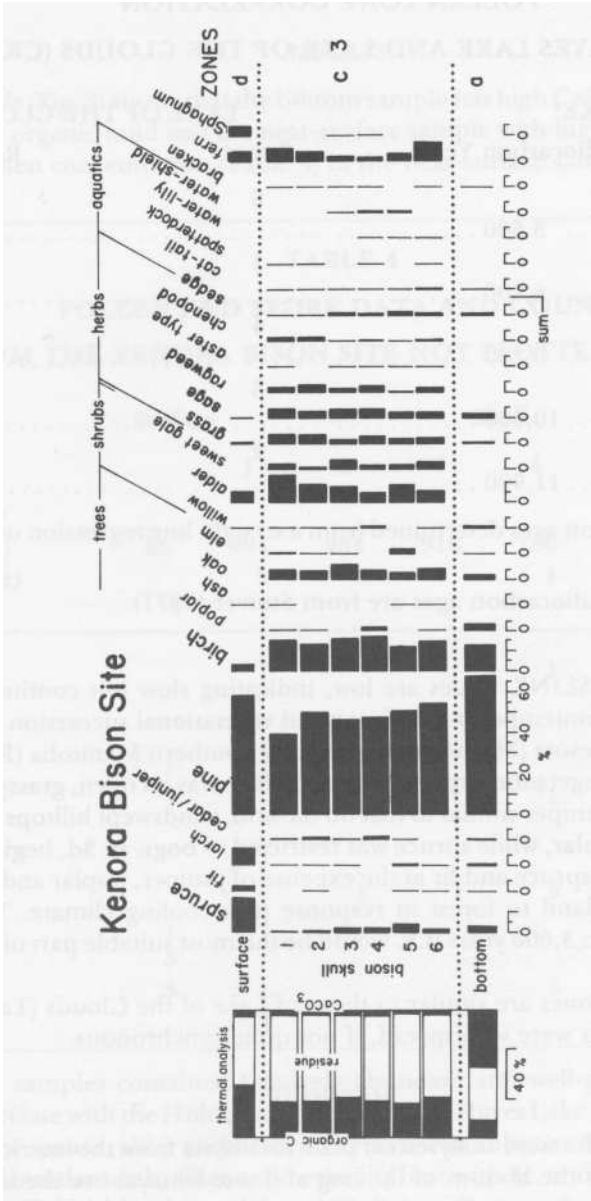

Fig. 3. Pollen diagram from the Kenora bison site. Miscellaneous pollen and spores not included on the diagram are given in Table **4.**

TABLE 3

POLLEN ZONE CORRELATION

BETWEEN HAYES LAKE AND LAKE OF THE CLOUDS (CRAIG 1972)

HAYES LAKE[1]		**LAKE OF THE CLOUDS[2]**	
Zones	Radiocarbon Years	Zones	Radiocarbon Years
3d	3,600	6	3,600
3c	6,400	5	6,600
3b	9,200	**4**	8,600
3a	10,000	3	9,400
2	11,900	2	

[1] Hayes Lake radiocarbon ages determined from a straight line regression using the dates and the sediment surface.

[2] Lake of the Clouds radiocarbon ages are from Stuiver (1971).

In zone 3 the CONSLINK values are low, indicating slow but continuous vegetational succession unlike the contemporaneous but rapid vegetational succession along the prairie-forest ecotone in Minnesota (McAndrews 1966) and southern Manitoba (Ritchie 1976). The Hypsithermal period vegetation expressed in 3b and 3c was an open, grassy jack pine-poplar woodland with much juniper similar to that on the arid, windswept hilltops today. Mesic sites were dominated by poplar, while spruce was restricted to bogs. In 3d, beginning 3,600 years B.P., the resurgence *of* spruce and fir at the expense *of* juniper, poplar and herbs indicates a succession from woodland to forest in response to a cooling climate. The open, mixed woodland from 9,200 to 3,600 years B.P. would be the most suitable part *of* the Holocene for bison.

Hayes Lake pollen zones are similar to those *of* Lake *of* the Clouds (Table 3), indicating vegetational successions were widespread, *if* not quite synchronous.

METHODS

Eight sediment samples were analysed for plant fossils, six from the interior *of* the skull, one from below the skull at the bottom *of* the bog and one from above the skull near the bog surface. The percentage organic C and $CaCo^3$ was determined by thermal analysis (Dean **1974);** the residue is largely silt and clay-sized quartz (Brunskill et al 1971). Pollen concentration per g dry sediment was estimated by adding a known number *of* ***Lycopodium*** spores to a weighed sediment sample (Stockmarr 1971). Sample preparation for pollen analysis included treatment with KOH, HCL, HF and acetolysis solution. In each sample 300 fossil pollen *of* upland plants were counted together with fossil pollen of aquatic plants, spores and introduced ***Lycopodium*** spores.

Seeds and needles were sieved from the bottom, skull and surface samples and identified by comparison with modern reference material.

A single radiocarbon date was obtained from sediment within the skull. After plant macrofossils were sieved and removed from skull sample 6, 25 g of dry residue was dated.

RESULTS

Thermal analysis (Fig. 3) shows that the bottom sample has high CaCo3 and is thus marl, the skull samples are organic mud and the near-surface sample with high organic C is peat. The relatively low pollen concentration (Table 4) in the near-surface sample is consistent with it being peat.

TABLE 4

POLLEN AND SPORE DATA AND COUNTS

FROM THE KENORA BISON SITE NOT PLOTTED IN FIG. 3

Level	Surface	Skull						Bottom
		1	2	3	4	5	6	
pollen per g dry sediment (X 10^3)	86	994	984	916	736	445	434	821
ironwood (Ostrya)		3			1			
basswood (Tilia)		1						
maple (Acer)				1				
hazel (Corylus)		1		1	1	3	1	1
Ephedra						1		
Xanthiurn						1		
Sarcobatus	1	1						
Iva ciliata			1	1	1			
Thalictrum				1				
Potamogeton		1						
Sparganium type			1	1	3			
Equisetum	1	1						1
Lycopodium	3							
indeterminable	3				3	1	2	2
unknown		1		2		1	1	

The sediment samples contained relatively abundant and well-preserved pollen (Fig. 3; Table 4) that correlate with the Holocene pollen zones of Hayes Lake. The bottom sample with high pine and low spruce, alder and herbs correlates with subzone 3a, the skull samples with low spruce and abundant oak, alder and herbs fits best with 3c, and the near-surface sample with high spruce, fir, pine and low oak and herbs correlates with subzone 3d.

Relatively abundant macrofossils of the wetland trees, fir, larch and spruce and the shrub swamp birch (Table 5), confirm the surface sample as zone 3d peat. The skull samples have seeds of a variety of marsh shrubs and herbs and pond plants, whereas macrofossils are relatively sparse in the bottom marl sample. This evidence suggests the bison died in a waterlily-covered pond one or two meters deep that was bordered with a marsh dominated by shrubs; wetland conifers (spruce, larch) grew nearby. The pond subsequently filled in and the

TABLE 5

PLANT MACROFOSSILS PER L OF SEDIMENT FROM THE KENORA BISON SITE

All are seeds except n= needle, c= cone and b= bract

Level	Surface	Skull	Bottom
Volume examined (L)	0.12	0.48	0.12
Trees			
fir *(Abies)*	92n	6n 2	
larch *(Larix)*	83n 8c 33	33n	25n
spruce *(Picea)*	58n	2n	
hemlock *(Tsuga)*	8n		
Shrubs			
swamp-birch *(Betula pumila)*	58	23 8b	17
gale *(Myrica gale)*		31	
blackberry *(Rubus)*		29	
red osier dogwood *(Cornus stolonifera)*		2	
Herbs			
violet *(Viola)*	*25*		
sedge *(Carex)*	17	10	
buck bean *(Menyanthes)*		4	
arrowhead *(Sagittaria)*		*2*	
spatterdock *(Nuphar)*		10	
water-lily *(Nymphaea)*		12	
water-shield *(Brasenia)*		*75*	
pondweed *(Potamogeton)*		*27*	
water-milfoil *(Myriophyllum)*		*2*	
naiad *(Najas flexilis)*		3000	133

site became the bog forest that occupies the site today. The hemlock needle in the surface sample is anomalous because the tree does not grow in northwestern Ontario today—the needle probably represents laboratory contamination.

The radiocarbon age of 4,850 ± 60 years B.P. on the skull sediment also places the bison in the mid-Holocene Hypsithermal zone 3c.

DISCUSSION

The bison is mid-Holocene in age and this is the first dated Ontario record for the Holocene or Recent epoch (Peterson 1966). Its identification as B. *crassicornis is* questionable because McDonald (1981) places this species in synonomy with *B. priscus.* Its mid-Holocene age suggests that it is ***B.*** *antiquus occidentalis,* but further study is needed before it can be firmly identified (G. Lammers, personal communication).

Two Holocene bison skulls from nearby Minnesota have been analysed for fossil pollen (Table 6). Their assemblages are dominated by herb pollen with relatively low tree pollen, particularly pine and birch. Unlike the Kenora bison, these animals inhabited prairie or

TABLE 6

POLLEN PERCENTAGES OF SEDIMENTS FROM INSIDE BISON SKULLS FROM KENORA, ITASCA (SHAY 1971) AND TROUT CREEK (ROWLEY 1957-58)

Taxa	Kenora	Itasca	Trout Creek
Trees			
spruce (Picea)	2	1	4
fir (Abies)	-	-	3
pine (Pinus)	47	19	13
birch (Betula)	13	2	2
oak (Quercus)	5	10	4
elm (Ulmus)	1	1	4
basswood (Tilia)	-	-	4
other trees	2	2	1
Shrubs			
willow (Salix)	1	17	3
alder (Alnus)	10	1	3
hazel (Corylus)	1	2	1
gale (Myrica)	3	-	-
Herbs			
grass (Gramineae)	4	7	16
sage (Artemisia)	4	17	10
ragweed (Ambrosia)	3	9	17
aster type (Tubuliflorae)	1	(5)*	2
chenopod (Chenopodiineae)	2	8	12
sedge (Cyperaceae)	2	(156)*	-
cat-tail (Typha)	(1) *	(5) *	(11)*
miscellaneous and unidentified	(1)*	(2)*	(2)*

* Values in parentheses are calculated outside the pollen sum.

savanna in areas that are now forested. Pollen diagrams from Lake of the Clouds (Craig *1972),* Ignace and Thunder Bay (McAndrews n.d.) suggest that the mid-Holocene woodland habitat of the Kenora bison extended eastward across the Shield to Lake Superior. However, bison density may well have been lower than in the more favorable prairie and savanna habitats to the south and west.

CONCLUSIONS

Bison occurred in northwestern Ontario *4,850* years ago and their occupation probably spanned the interval of the Hypsithermal woodland *9,200* to *3,600* years ago. The posthypsithermal succession to forest probably caused bison to withdraw to more favourable habitats to the west and south. The Kenora bison discovery indicates that this resource was available as prey species for the late Palaeo-Indian and Archaic hunters of northwestern Ontario.

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