

BOREAL FOREST FIRE ECOLOGY AND ARCHAEOLOGICAL SITE FORMATION: AN EXAMPLE FROM NORTHERN ONTARIO.

Andrew Hinshelwood

Forest fire is a major factor contributing to the collapsed stratigraphy observed on many boreal forest archaeological sites. Intense forest fire occurs in many boreal forest stand types on a sixty to eighty year cycle, with maximum stand age being approximately 250 years. During intense fire events most of the available fuel, including organics from the forest floor, is consumed. This results in the exposure of the mineral soil in large portions of the burned area and a clear discontinuity between the mineral and organic soil as the latter unit reforms. This periodic burning of sites means that any artifacts which are deposited on the surface, or are buried within the humus, will fall to the surface of the mineral soil. Excavations at Wunnumin Lake suggest that repeated fire episodes will result in the accumulation of artifacts at the surface of the mineral soil, and that some heat fracturing of lithics will occur. Artifact patterning at FfJh-1 suggests that, despite the collapsed stratigraphy, the basic spatial arrangement of the artifacts is preserved, although some heat spalled artifacts may become scattered over wider areas.

INTRODUCTION

The Wunnumin Lake site (FfJh-1) is located on the western end of a portage trail across a low section of an esker in Wunnumin Lake. Although the portage and the campsite were still in common use at the time of field work, the esker ridge had become the base for an access road to the community airport. The proposed upgrade of the airport access road by the Ontario Ministry of Transportation involved burial of the archaeological site under several metres of fill, which prompted salvage excavation of a portion of the site. Excavation of the site identified many features common to small sites in the Boreal Forest Region, particularly collapsed stratigraphy and expedient lithic implements manufactured of local chert.

The collapsed stratigraphy at FfJh-1 was brought into greater relief when it was observed that the twentieth century artifacts appeared to be sorted by depth in the leaf litter and humus, while the prehistoric artifacts were found together in a single level at the base of the organic soil. Detailed artifact and spatial analysis suggested that, while a broad span of time was likely represented in this level, only a few fire spalled lithic implements seemed out of place relative to inferred activity areas. This prompted the consideration that intense forest fire resulting in the removal of the organic soil may have been the cause of the accumulation of the prehistoric artifacts in the organic/mineral soil interface. From these observations a general model of the role of Boreal Forest fire ecology and archaeological site formation was devised.

Site Location

Wunnumin Lake is located between the Pipestone River, which drains Opapmiska Lake in the west, and the Winisk River, which flows southeasterly into Hudson Bay (Figure 1). Topographic mapping of the local area (N.T.S. sheets 53 A and 53 H), shows Wunnumin Lake on a topographic transition between low swampy land and an area of numerous small linear lakes oriented northeast to southwest. The orientation of the small, linear lakes to the north reflects the glacial scouring of the underlying bedrock. Although the low swampy land to the south of Wunnumin Lake is evocative of the landscape of the Hudson Bay Lowlands, mapping of the lowlands by other researchers (Julig 1988a: Figure 1; Pilon 1988: Figure 1), indicates that the actual boundary of the Lowlands lies some 200 km to the east.

Wunnumin Lake Indian Reserve 1 is bisected by a north-south trending esker. The crest of the esker is undulating and, at the village of Wunnumin, it dips below the level of the lake, only to surface as a line of small islands before

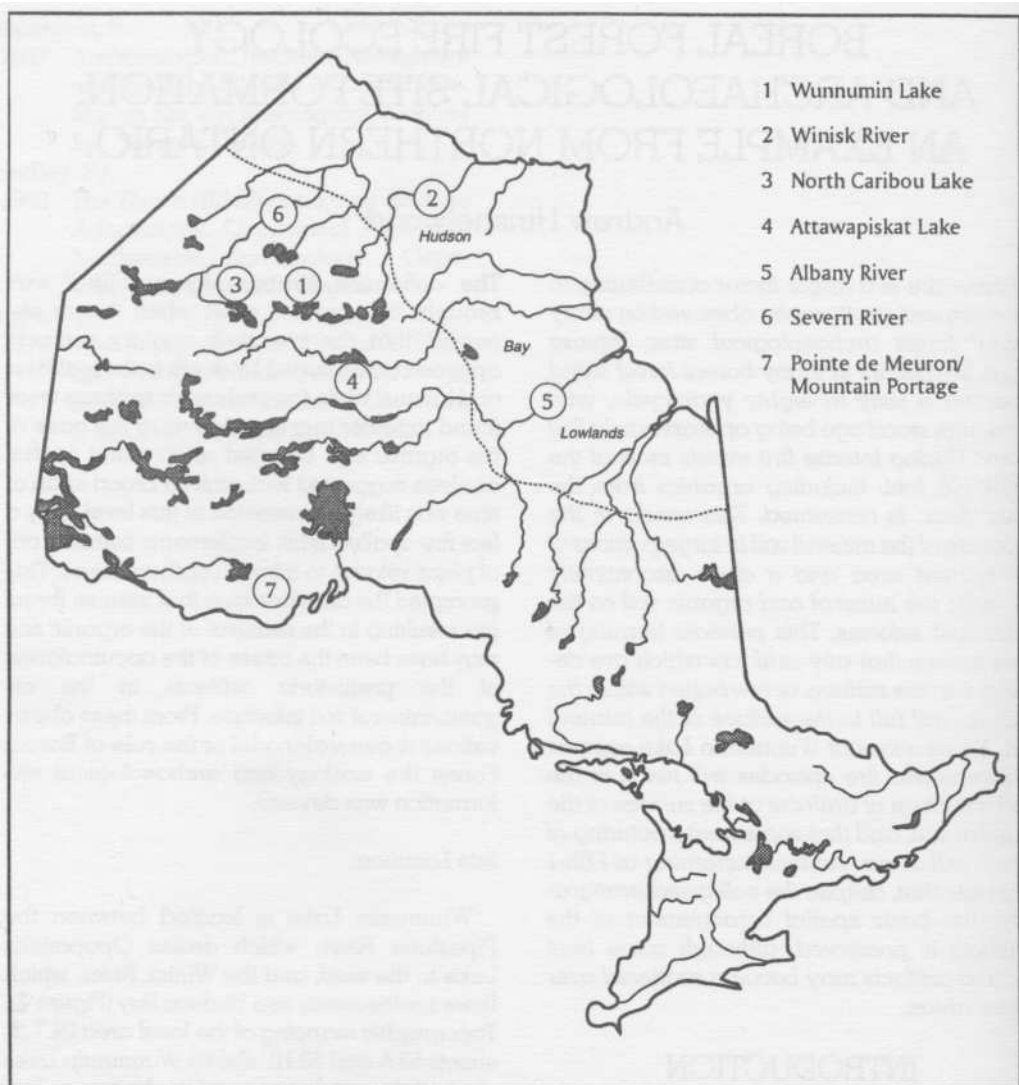


Figure 1. Map of Ontario Showing Principal Locations Mentioned in Text

re-emerging completely on the north shore. The esker has provided a solid base for the local airport and associated access road, and it would also have been a good north-south traverse for past human and animal populations in the region. Travel between the Winisk River to the east and the Pipestone River to the west would have required a detour north of the present village site or use of one of the several portages noted at low points along the esker. Two of these portages are associated with archaeological sites FfJh-1 and FfJh-2 (Figure 2).

FfJh-1 is positioned on a terrace associated

with a low saddle in the esker. The terrace, roughly two metres above and four metres back from the cobble beach, serves as the western end of a portage. The approximate surface area of the terrace was originally 100 square metres. About 20 square metres of this was buried beneath road fill prior to 1987. The eastern end of the portage is a gradual slope that opens onto a shallow marshy embayment. Limited examination of this part of the portage failed to identify any archaeological material or features. While unsuitable for camping, the marshy eastern end of the portage may have been used for hunting and fishing as this area

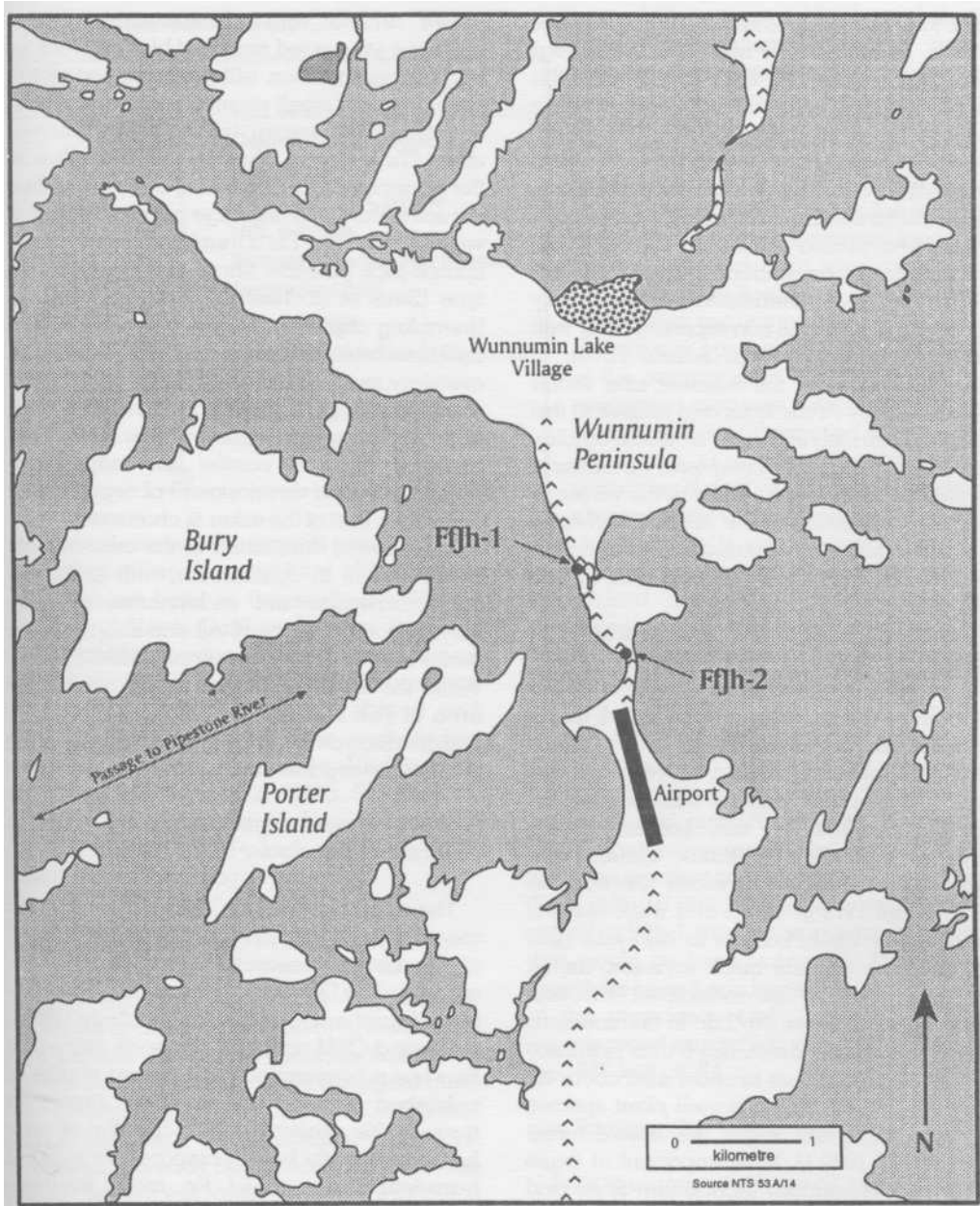


Figure 2. Map of Wunnumin Lake at FfJh-1

provides seasonal forage for moose, food and shelter for migrating waterfowl and spring spawning grounds for pike.

To the northeast of FfJh-1, at an elevation of about eight metres above the level of the lake, a recent grave site occupies the crest of the esker ridge. The grave was well maintained in 1989 and was not considered part of the ar

chaeological site. Visitors to the excavations had indicated that the grave was of a man who had lived near the portage.

The Boreal Forest

The boreal forest has been variously defined, and the boundaries of the forest, transi-

tional to adjacent ecological complexes, are unclear. Rowe (1972:6) identifies the boreal forest as a conifer rich zone distinct from the hardwood-rich Great Lakes-St. Lawrence forest to the south and tundra to the north. Deciduous species from the south decrease in frequency through the transitional forest, while forest structure changes, becoming more open in the forest-tundra transition. Bryson (1966) has analysed atmospheric complexes ("air masses") and has determined that seasonally stable frontal positions correspond closely with the forest boundary. The boreal forest, in effect, lies between the summer and winter positions of the Arctic front and relates to this climatic patterning in a state of "quasi-equilibrium" (Bryson 1966:257). Long-term variations in climatic patterning (i.e., shifts in the winter or summer positioning of the Arctic front) have repercussions on the expansion or contraction of the boreal forest region (Bryson 1966; Bryson et al. 1965).

The boreal forest is characterised by white (*Picea glauca*) and black spruce (*Picea mariana*), associated with jackpine (*Pinus banksiana*) on dry sites and tamarack (*Larix laricina*) on wet sites. There is a general admixture of hardy broad leaved species: birch varieties (*Betula spp.*), trembling aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*). Black spruce and tamarack abundance increase towards the north (Rowe 1972:6). Black and white spruce, tamarack or larch, balsam fir and jack pine are dominants, while birch varieties, aspen and balsam poplar are considered "successional" species (Rowe 1972:6). In the southern part of the boreal forest, red (*Pinus resinosa*) and white pine (*Pinus strobus*) also occur as local dominants. Non-arboreal plant species are also important within the boreal forest (Sims et al. 1989:1). Most important of these plants are sphagnum (*Sphagnum spp.*) and feather moss (such as *Pleurozium schreberi* and *Ptilium crista-castrensis*), ground lichens (*Cladonia spp.*), ericaceous shrubs such as labrador tea (*Ledum groenlandicum*), and woody shrubs such as mountain maple (*Acer spicatum*), beaked hazelnut (*Corylus cornuta*), and speckled alder (*Alnus rugosa*) (Sims et al. 1989:32-33).

Boreal Forest Environment at Wunnumin Lake. Wunnumin Lake lies within the northern coniferous section (B22.a) of the boreal forest

(Rowe 1972:43), which is characterised by extensive even-aged stands of black spruce in frequent association with jack pine on dryer sites and with small quantities of paper birch and trembling aspen in frequently burned areas (Viereck and Johnston 1990:233). Due to the presence on the terrace of a slightly different soil texture and drainage pattern, the forest vegetation at FfJh-1 is a trembling aspen-black spruce-jack pine/low shrub (V-10) vegetation type (Sims et al. 1989:43). Here, hardwoods (trembling aspen and some white birch) are mixed with black spruce and jack pine in the overstory, and broad leaved herbs and shrubs characterise a rich understory. The forest floor is largely covered in broadleaf litter, with small amounts of moss, conifer litter and wood, allowing a good development of organic soil. The larger part of the esker is characterised by mixed forests, dominated in the overstory by black spruce in combination with jack pine and hardwoods and understories showing varying combinations of tall and short shrubs, herbs and mosses (Sims et al. 1989:52,53,64). While the forest vegetation in the immediate area of FfJh-1 would be less prone to fire, a high intensity crown fire would consume much or all of the organic soil.

Previous Archaeological Work in Northern Ontario

There has been very little archaeological research done in remote northern Ontario. All of the known research reports to 1983 are contained in Dawson's exhaustive bibliography of northern Ontario archaeology (1984). Increased CRM activity in the north since that time has not generated a significant corpus of published literature. The data produced through the excavation of a handful of sites has consistently been compared to cultural frameworks developed for more southern regions or intensively surveyed areas to the west, such as South Indian Lake (Dickson 1980; Wright 1968).

Dewdney noted a report of a small pictograph site "near the west end of Wunnumin Lake...which I have not yet been able to pinpoint" (Dewdney and Kidd 1973:114). Other regional pictograph sites are recorded on the Sachigo River, the Severn River near Bearskin Lake, two sites on the Donnelley River, south of North Caribou Lake, the Ashweig River near

Table 1. Test pit recoveries 1987.

Provenance Number	Description
TP1	1 HBL biface fragment (midsection)
	1 Quartz scraper fragment
	5 HBLdebitage
	1 unmodified HBL pebble
TP2	1 HBLdebitage
	1 thermally altered chert fragment
	1 fire cracked rock
TP3	1 HBLdebitage
TP4	1 thermally altered chert fragment
	1 fire cracked rock
TP5	1 retouch flake fragment
	5 HBLdebitage
Total	20

Big Trout Lake and at various points around Sandy Lake (Dewdney and Kidd 1973:112-114). Attawapiskat Lake to the southeast (Riddle 1982), and North Caribou Lake to the west (Gordon 1985), are the bodies of water closest to Wunnumin that have received the attention of professional archaeologists. Survey and limited excavation has also been conducted on parts of the upper and lower Albany River (Dawson 1976; Julig 1982; 1988a; Riddle 1980; 1981; 1982), the lower Severn River (Pilon 1987), and the Winisk River (Pollock and Noble 1975; Tomenchuk and Irving 1974).

SITE INVESTIGATION

FfJh- 1 was first identified in August, 1987, during an archaeological survey of the airstrip and access road at Wunnumin Lake conducted by Paul Lennox, Archaeological Planner with the Ministry of Transportation, Ontario (MTO). Although the Wunnumin Lake First Nation had already begun construction of the airstrip and access road, MTO was planning to upgrade both in order to ensure year round air access to the community. Archaeological survey was directed towards identifying sites within the proposed upgrade area that would suffer impact from additional construction. The presence of the portage and the historic grave site identified FfJh-1 as a potential archaeological site location. Five test pits were excavated, all of which produced lithic artifacts (Table 1). The site was recorded as a prehistoric (aceramic) occupation of unknown age. Given that

part of the site would be buried during road improvements, Lennox recommended "intensive testing to determine [the site's] essential characteristics" (Lennox 1987:3). Excavation at FfJh-1 was undertaken between August 14 and 21, 1989 by the firm Old & In the Way, under the direction of the author who was assisted by a crew of five. Fieldwork was conducted under archaeological licence 89-114B. An excavation area measuring two metres by ten metres was opened adjacent to the base of the existing road bed (Figure 3). This excavation area was sufficiently large (25 percent of the total exposed surface area of the site), to obtain artifact and spatial patterning data that could be considered characteristic of the whole site. The decision to excavate a single contiguous area, rather than a series of smaller separate areas was based on Reid's (1989) observations regarding spatial patterning and superimposed occupations at other Northwestern Ontario sites. At DkKp-8, Reid observed that multiple occupations of a single site area could be spatially differentiated even where stratigraphy had collapsed by excavating beyond the areas of overlap between the superimposed artifact deposits, uncovering larger contiguous areas simultaneously and using the smallest possible vertical increments (Reid 1988:197-202). The area chosen for excavation at FfJh-1 was in the portion of the site that would be least accessible to future re-researchers once it was buried beneath the base of the upgraded road. An additional one square-metre excavation was opened around the 1987 test pit #4.

Site *Stratigraphy*

Prior to excavation, a soil pit was opened at the break in slope from the terrace to the erosional bank in order to view the general soil profile of the terrace (Figure 4). Within the upper part of the soil profile three grades of decomposed organic matter were present, which properly correspond to the L, F and H horizons (Ontario Institute of Pedology 1985). The boundary between the organic horizon and the underlying soil was abrupt and smooth, with transitional soil (Ah horizon) not present. The upper part of the mineral soil was

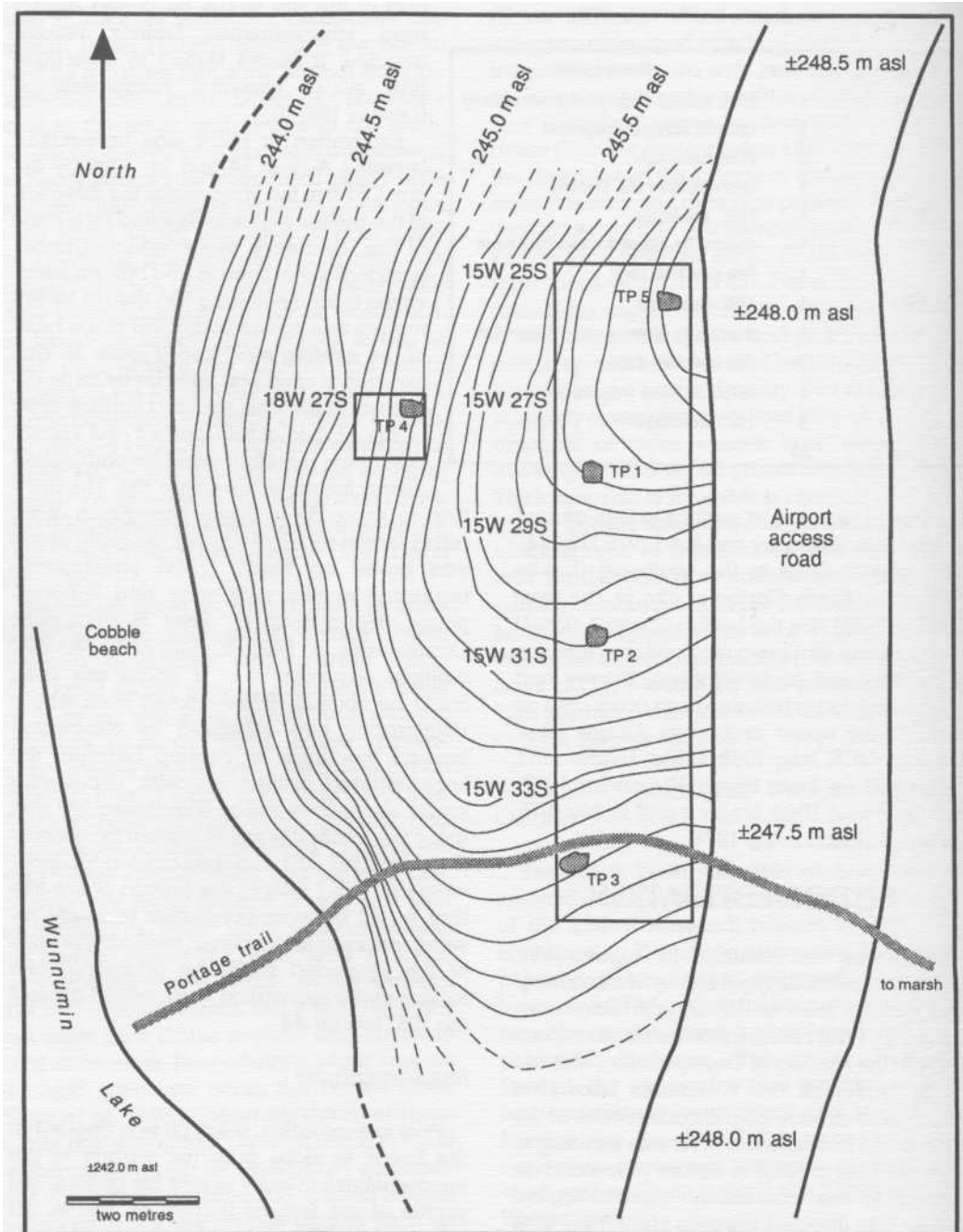


Figure 3. Plan of FfJh-1

a grey silt Ae horizon which graded into a light yellow or tan medium sand Bm horizon. The depth of each of the A and B horizons was variable; when combined they were under 10 centimetres. A diffuse boundary existed be-

tween the B horizon and the underlying parent material, which was a dark grey gravel between closely packed boulders. Although the abrupt boundary between the organic horizons and the underlying soil was noted in the profile

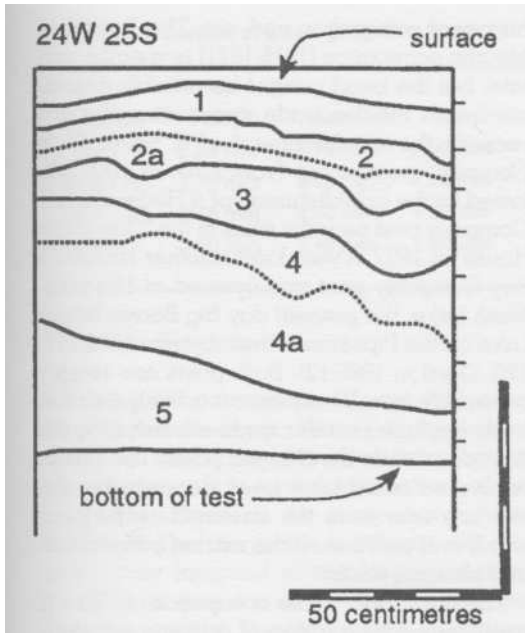


Figure 4. Soil Profile, FfJh-1

- (1) Organic soil; (2) AE grey silt; (2a) Yellow-tan silty sand; (3) Bm tan sand; (4) Orange-brown gravelly sand; (4a) Medium gravel, transitional; (5) Dark grey gravelly till.

of the soil pit, it was anticipated that this would mark a distinct surface from which to commence the excavation of subsequent levels and that artifacts would be distributed throughout the underlying soils to a depth of 15 to 20 centimetres.

Excavation commenced with the removal of the L and F horizons. Materials recovered from the surface or in the loose organic matter were collected as surface recoveries in one metre square units. Artifacts recovered from the H horizon were collected as Level I within 50 cm square quadrants. The surface of Level II was taken to be the organic/subsoil boundary. The excavation of Level II and subsequent levels proceeded in increments of three centimetres from this surface. Excavations were continued to one level below the last artifact producing level in each 50 cm quadrant. Material encountered *in situ*, primarily at the surface of the subsoil, was collected in 10 cm subunits, while 50 cm quadrant provenience was maintained for screen recoveries. Upon completion of each level in a two metre square, soils and

artifact concentrations were mapped, floors were photographed, and written summaries prepared by the excavators.

ARTIFACTS

A total of 634 artifacts was recovered through excavation, adding to the total of 18 artifacts (discounting fire cracked rock) from the original testing of the site. The inventory includes 9 historic, 32 prehistoric ceramic and 590 lithic artifacts, as well as 4 modified bone fragments (Table 2). Modern litter noted on the surface and in the loose organic soil is not included in the totals. Many of the lithic artifacts show evidence of heat fracture and, in several cases, fragments of finished implements have been refit. Heat fracture of finished implements points to unintentional heating rather than treatment of the chert during knapping.

The contemporary native occupation is represented by artifacts on the surface or within the organic soil horizon (Level I), and by the historic grave site 35 metres northeast of the site. Some subdivision of the contemporary (modern) occupation is possible on the basis of some of the artifacts present. Those recovered from the surface included shotgun shells (.410, 10 and 12 gauge), a range of fish, bird and mammal bone and the ubiquitous Carnation milk can. Four fragments of a spring ratchet screwdriver were recovered from the loose organic soil in unit 14W 31S. The bit has been modified by filing it into a four-sided awl, which now has a slightly asymmetrical cross section. It is suggested that the awl bit was modified in order to use the mechanical action of the ratchet to drive a simple drill. No evidence of rotary drilling was noted on the bit during microscopic examination, although oxidation and surface pitting may have obscured minor striations. The handle exhibits a light diamond pattern surface finish, as well as some numbers and words closer to the butt. One of the words, "MILLER...", is recognizable, and is most likely part of the firm name Miller Falls Company of Miller Falls, Massachusetts. A hand tool manufactured by this firm in the possession of the author bears marks indicating that the company was registering patents for hand tools in the early twentieth century. It appears to have been marketing these tools well into the mid-1950s, although the present

Table 2. Recoveries from FfJh-1, by artifact class

Artifacts from FfJh-1	N	%
ALL LITHICS	590	93.1
Debitage	553	87.2
Other lithic	23	3.6
Core	6	0.9
Uniface	5	0.8
Projectile point	1	0.2
Biface	1	0.2
Hammerstone	1	0.2
ALL CERAMICS	32	5.0
Rimsherds	12	1.9
Body sherds	20	3.2
DRAWN BEADS	5	0.8
SCREWDRIVER FRAGMENTS	4	0.6
MODIFIED BONE	3	0.5
Mammal	2	
Bird	1	
Total	634	100.0

status of the firm is not known.

An earlier occupation of the site during the late fur trade is indicated by the presence of five drawn glass beads recovered from level I of excavation unit 14W 26S. Four are small embroidery (seed) beads, two of which are white, one is robin's egg blue and one is aquamarine. The fifth is a drawn red tube bead similar in appearance to two specimens recovered in 1988 from the Mountain Portage (DcJj-7) excavations (Taylor and Glidon 1989), and one recovered from the Hudson's Bay Company Pointe de Meuron (DcJi-4) post (Hinshelwood 1989; 1991). The attributes of these beads are compared in Table 3. Drawn beads of these types are ubiquitous on late fur trade associated sites, and are not very useful in deriving temporal information. Nevertheless, it is useful to consider the dates for the regional sites and local trade posts. Mountain Portage has a long

history of occupation and use. The Pointe de Meuron occupation (1816-1821) is specific and late, but the bead cannot be reliably associated with the fur trade occupation. Lytwyn records the establishment of a North West Company post at Big Trout Lake in 1803, followed by the establishment of a Hudson's Bay Company post near the ruins of the "Canadian House" in 1807. A year later another Hudson's Bay Company post was opened at Misamikwash Lake, the present day Big Beaverhouse Lake on the Pipestone River (Lytwyn 1986:117-120; Gordon 1985:12). Both posts are readily accessible from Wunnumin; it is likely that this trade replaced earlier trade northeast to the Bay, or south to the Nipigon posts. The beads recovered could have been deposited at the site any time from the sixteenth century onward, and well before the ratchet screwdriver and shotgun shells.

The precontact native occupation of FfJh-1 is represented by a range of artifacts primarily situated at the organic soil/subsoil boundary. These artifacts appear to represent a mixed prehistoric component that cannot be subdivided into temporal subgroups. The presence of pseudo scalloped shell and dentate stamp impressed body sherds, typical of the Laurel culture, suggest that a considerable time depth of occupation in the precontact period is represented. Radiocarbon dates for Laurel in the boundary waters and Lake of the Woods area listed by Reid and Rajnovich (1991:202) range between 150± 165 BC (DIC-575) and AD 1270±55 (DIC-2885). Radiocarbon dated Laurel components listed by Reid and Rajnovich include dates of AD 620 ± 50 (DIC 1143) and AD 710±80 (I 10970) for Ejjd-6 (Riddle 1980:180), and AD 250±80 (S464) for the Attiwapiskat site (Dawson 1976:77). Pion (1987:173), reports a radiocarbon date of 870 ± 100 BP (Beta 7926) from GfJi-2 on the Sachigo River, a site which produced Laurel ceramics. Distribution maps of Laurel sites and associated dates by Reid and Rajnovich imply that Laurel ceramics were being produced in the northern interior of Ontario between the second and eighth century AD, the period of maximum Laurel expansion (1991:223; cf. Lenius and Olinyk 1990). The age of the Laurel sherds from FfJi-1, and consequently of the earliest occupation at the site may be estimated to fall within this range.

Table 3. Comparison of drawn glass tube beads.

<i>Artifact</i>	<i>length</i>	<i>diameter</i>	<i>bore</i>	<i>colour</i>
FfJh-1	2.35 mm	3.10 mm	0.90 mm	redwood over clear
DcJj-7 (1)	3.75 mm	3.40 mm	1.10 mm	redwood over apple green
DcJj-7 (2)	3.65 mm	3.40 mm	1.30 mm	redwood over apple green
DcJi-4	3.50 mm	3.45 mm	1.20 mm	redwood over apple green

Prehistoric Ceramics

At least two ceramic vessels are present in the FfJh-1 collections. Vessel 1 consists of twelve rim sherds and 5 body sherds. The rim sherds were refit to form three sections of the vessel rim (Figure 5). No body sherds have been refit. The rim profile is straight sided to moderately incurved in the largest section. There is no eversion of the lip on either the interior or exterior. The plane of the lip surface has a slight inslope. There is no decoration on the surface of the lip or on the interior of the rim. The exterior of the vessel is smooth, save for the slight impression of two roughly parallel, intermittent lines of simple twisted cordage. The impressions are within two centimetres of the lip on all of the rim sherds. On the exterior of one sherd is an irregularly shaped punctate. An impression taken of the punctate reveals that it was formed when a knot in the cordage was pressed into the wet clay of the unfired vessel (Figure 6). One body sherd has a clear coil break, confirming the observed "coil" cross-section in the rim sherds. Grit temper up to 4 mm in maximum dimension is evident in several sherds.

For vessel 1, the largest of the refit sections (five sherds) is sufficiently complete to allow orifice diameter and vessel volume to be estimated. The interior profile of the vessel and measurements are indicated in Figure 7a. Following the procedure outlined by Olinyk (1978), orifice diameter is calculated as:

$$(C^2/4A) + A = D$$

where C = chord length, A = arc length and D = diameter.

When applied to vessel 1, the diameter of the orifice is estimated at 101.0 mm with an error of uncertainty of .7 mm. In turn, the circumference of the vessel orifice is calculated

at 317.3 mm, with an error value of 2.1 mm. Calculations made using the two progressively smaller sections of the vessel rim produced orifice diameter values of 95.5 mm and 91.1 mm respectively. Vessel size can also be estimated (Figure 7b).

Vessel 1 meets two basic criteria — that the vessel orifice diameter can be measured, and that the reconstruction includes a section of the vessel wall from the rim to below the widest portion of the body (Lenius 1979). Volumetric estimates from a single sherd are possible only because the reconstructed rim section allowed for the correct orientation relative to the orifice. Referring to the numbering given in Figure 7b, the volume of the vessel is calculated as:

$$A_{hp} = ((A + I) / 2 + B + C + D + E + F + G + H) H, \\ \text{Volume} = \pi A_{hp}^2 / H_v$$

where A_{hp} = Area of the half profile, H_t = height of the trapezoid, and H_v = height of vessel.

The area of the half profile is calculated at 68.8 mm². Vessel size is estimated at slightly greater than .3 litres.

Vessel 2 (Figure 8) is represented by a collection of 13 body sherds, mostly exfoliated. Three of the sherds can be used to determine the cultural association of the vessel. One exfoliated sherd has four parallel rows of dentate stamp impressions on the exterior surface. A second sherd has pseudo scallop shell impressions and bears an interior boss. The application of decoration using a notched tool will produce either dentate or pseudo scalloped shell impressions depending on the angle at which the tool is impressed into the wet clay, making it difficult to argue that these sherds represent two different vessels. A third sherd is plain, but in profile reveals a clear coil break, and is probably a single coil. Both the decorative methods and coil construction are characteristic of Laurel ceramics.

Regional archaeological sites have produced limited quantities of prehistoric ceramics. At North Caribou Lake, Gordon identified three Laurel components, and at one

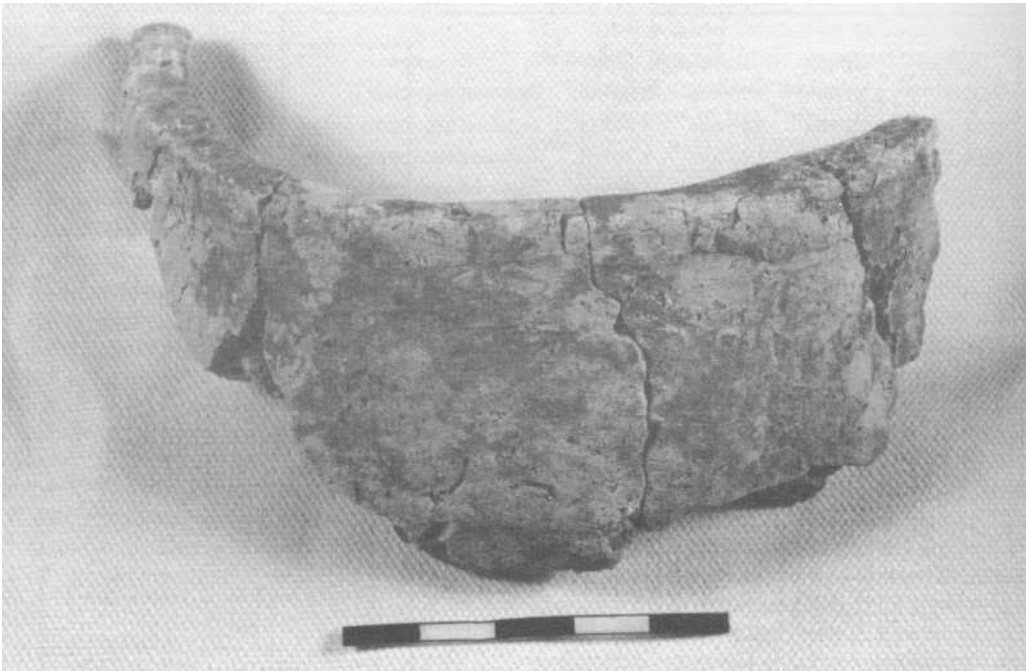
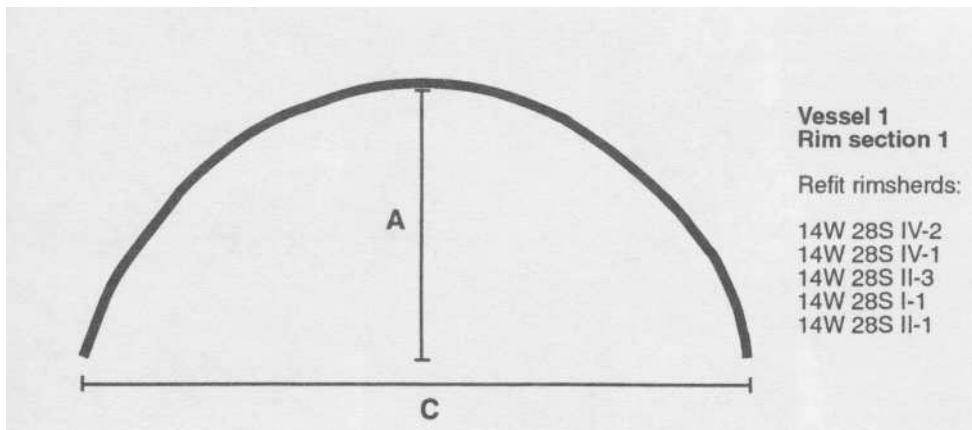


Figure 5. Refit Rimsherds, Vessel 1. From left: 14W 28S IV2, 14W 28S IV-1, 14W 28S 11-3, 14W 28S I-1



Figure 6. Plasticine Impression of Knot, Vessel 1, 14W 28S IV-1

Orifice Analysis (from Olinyk, 1978)



For Rim section one:

C = 99 mm
A = 41 mm

Calculated diameter = 101.1 mm
Calculated circumference = 317.3 mm

Volumetric measurement (from Lenius, 1979)

Section through 14W 28S II-3

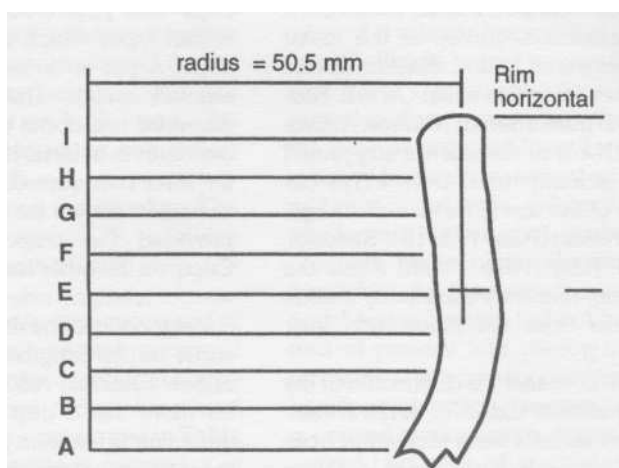


Figure 7. Calculation of Orifice Diameter and Volume, Vessel 1

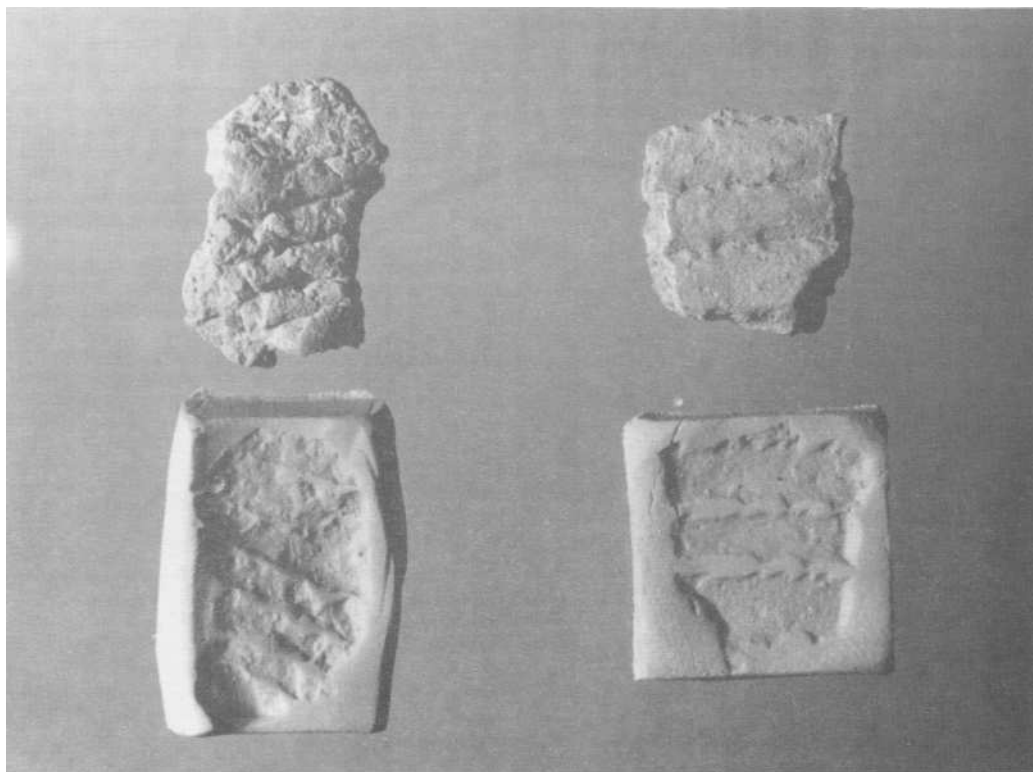


Figure 8. Decorated Body Sherds and Plasticine Impressions, Vessel 2
 left: Pseudo scallop-shell 18W 27S 111-2 right: Dentate
 stamp 18W 27S 11-2

recovered a dentate stamp tool (1985:32). No similarities were noted between the decorative motifs expressed on the North Caribou Lake ceramics and the stamped sherds from FfJh-1. Pilon, in his extensive survey of the lower Severn River recovered Laurel, Blackduck and Selkirk ceramics from two sites, Gllw-1, Feature B and GfJi-2. Instrumental Neutron Activation Analysis (INAA) of the sherds suggested that all were manufactured from clays obtained outside of the lower Severn drainage, perhaps in Manitoba (Pilon 1988:104; Stimmel, et al. 1991:50). Julig (1982; 1988a) notes the recovery of plain, relatively thick body sherds with coil breaks from the Muswabik River Mouth site (Eilg-1).

The small size of vessel 1 is duplicated at the Wenasaga Rapids site (EdKh-1), in northwestern Ontario. Two vessels were recovered from this site with exterior rim diameters of less than 9 cm (Hamilton 1981:82, 86). Decorative treatment of these vessels was typical of Middle Woodland ceramics with both dentate effect stamp and linear stamp impressions. At South

Indian Lake in Manitoba, Dickson notes the presence of a wide variety of Clearwater Lake Punctate ceramic objects, including plates, cups and pots (1980). Dickson defines two vessel types which are of interest: pots and cups. A pot is "a vessel with a slightly constricted mouth. The height and maximum diameter are about the same and the mouth diameter is at least half the maximum diameter" (Bruckner quoted in Dickson 1980:43). This definition allows for small or miniature pots, provided the proportions are recognized. Cups, on the other hand, "are deep bowls with vertical (straight) sides and a circular or nearly circular orifice. The depth is approximately the same as the length/width or diameter of the orifice" (Dickson 1980:45). Vessel 1 appears to be more like a cup than a pot if Dickson's definition is taken in more general terms. The vessel does not constrict between the plane of the widest diameter and the orifice, but without a better understanding of vessel depth this determination cannot be certain.

Lithics

Lithic artifacts from FfJh-I include a range of implements, as well as cores and debitage which allow a consideration of reduction practices. Almost all of the artifacts were produced from Hudson Bay Lowlands chert (HBL), a generic term for a wide range of locally available, glacially transported chert commonly recovered in the form of cobbles. Minor quantities of quartz were also knapped at FfJh-I.

Three bifaces are identified in the collections from Fflh-I. One is an untyped, side notched projectile point, while the others are fragmentary bifaces. Sketches of the bifaces are provided in Figure 9 and measurements are given in Table 4.

The projectile point exhibits random flaking on both faces, with discontinuous use-wear "nibbling" along both edges. In plan view, the point is generally well formed with the tip showing a possible impact fracture. In profile the point is slightly twisted and is curved along its length. The twist is possibly the result of expedient resharpening while hafted, while the curve could reflect the original flake blank. The suggested resharpening, tip fracture and the recovery of the artifact from a debitage concentration may indicate that it was discarded during retooling.

A fragmentary biface shows random, non-parallel flaking on both surfaces with discontinuous retouch along both edges. The biface was probably asymmetrical and semi-lunate in form. A third HBL biface was recovered during initial testing of the site by Lennox (1987). The latter is regularly flaked on both faces. The margins of the biface are irregular, suggesting that it was either a rough tool, was not complete, or was rejected during manufacture. The artifact was recovered from T. P. 1, which would place it in excavation unit 15W 27S (Figure 3).

Five unifacial implements were recovered at FfJh-I. One additional uniface was recovered by Lennox (1987). The unifaces differ in shape and finishing, which may reflect functional differences. Attributes are presented in Table 5. Three of the formal unifaces recovered at FfJh-I are discussed below, with regional comparisons made where possible.

Uniface Form 1. The most visually appealing of the lithic artifacts recovered is a unifacially

retouched flake of HBL chert (Figure 10). The flake is roughly triangular in outline with 90 percent of the dorsal surface covered by weathered pebble cortex. It has been reconstructed from four fragments originally fractured due to rapid heating. Retouch is confined to one margin of the flake, where 5.7 mm of retouch creates a working edge, including a 4.1 mm linear edge and an excurvate bit. In size, the flake (size grade 5.0) is at the upper end of the debitage size distribution and of the flake scar sizes on the cores.

Uniface Form 2. This scraper is represented only by the proximal end of a unifacially retouched flake. While fragmentary, the artifact is sufficiently complete to allow comparison with other combination end/side scrapers recovered in the region (Figure 11). The scraper is based on a relatively thick, steeply backed lamellar flake, with two primary flakes oriented along the long axis and creating a medial ridge and triangular cross-section. The sides of the flake are roughly parallel with slight unifacial retouch occurring to within 3.0 and 8.0 mm of the platform on either edge. The dorsal edge of the platform bears numerous step fractures, suggesting that a number of attempts were made to remove this flake.

Examples of this form were recovered by Riddle (1982:15, 21, 25) from sites Fblx-4, FbJa-7 and FbJa-14 on Attawapiskat Lake. Metrical attributes are presented in Table 5.

Uniface Form 3. A blocky side scraper has been formed through unifacial retouch of one edge of a tabular fragment of HBL chert (Figure 10). Ripple marks on one face of the artifact allow the identification of dorsal and ventral surfaces, as well as the orientation of the flake as removed from the core. Evidence of heavy battering is present on both the proximal and distal ends, although it is not clear whether this battering is a consequence of use, or represents the cortex element of the pebble from which the flake was removed. The artifact had been subjected to heat fracturing *in situ* and at present four pieces have been refit, including one fragment of a worked edge. This heat fracturing may have resulted in the loss of a second worked edge opposite the one observed. Artifacts of a similar form, termed double side scrapers, are recorded from the region (Smith 1980:93).

Two additional unifaces, both retouched flakes, were identified in the collection (Figure

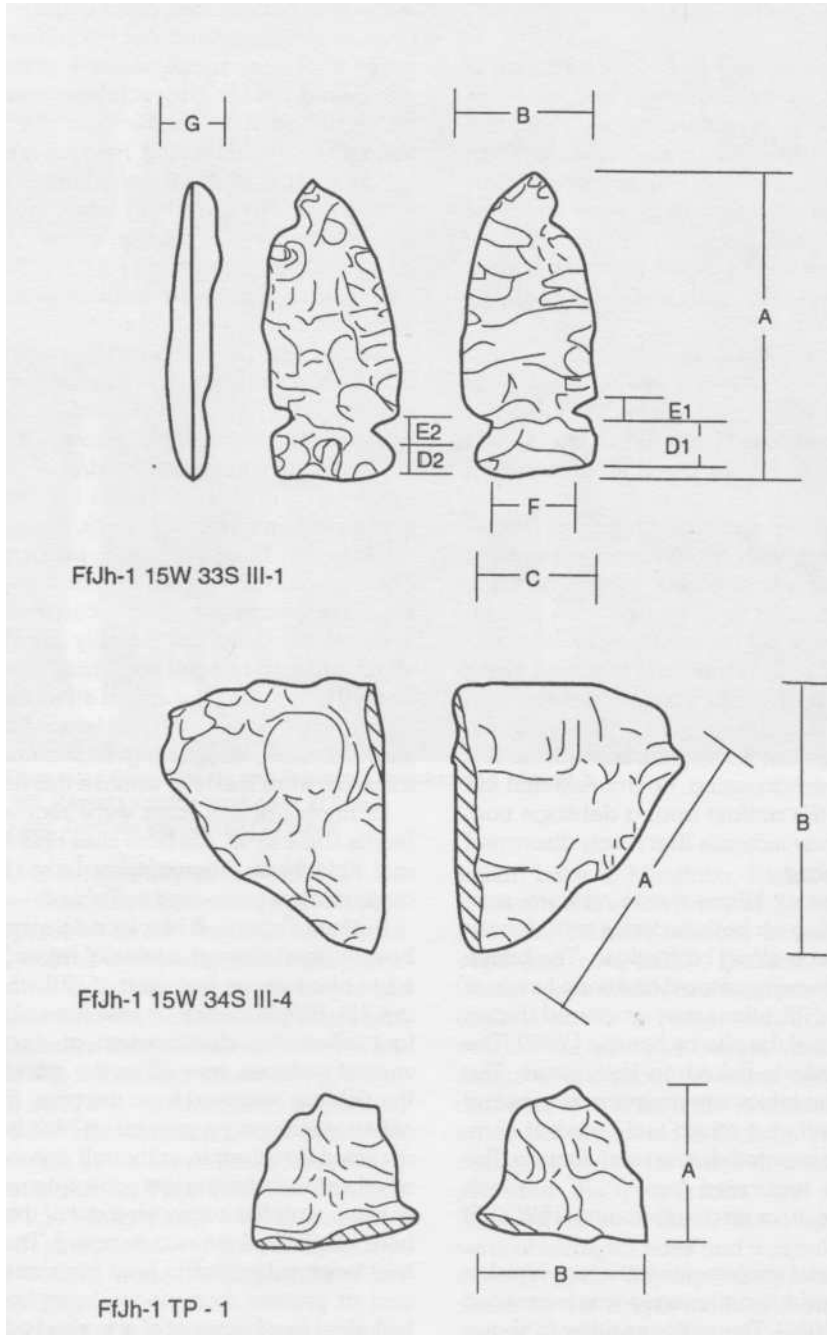


Figure 9. Line Drawings of Bifaces from FfJh-1

10). One is a complete, hinge terminated flake. Retouch is uniform for 1.7 mm along one edge. Slight use-wear is observed on the opposite edge. The artifact has evidence of having been

heated intensively subsequent to deposition on the site. A multiple uniface is noted on the distal end of a fragmentary flake. It is not possible to ascertain whether the flake was

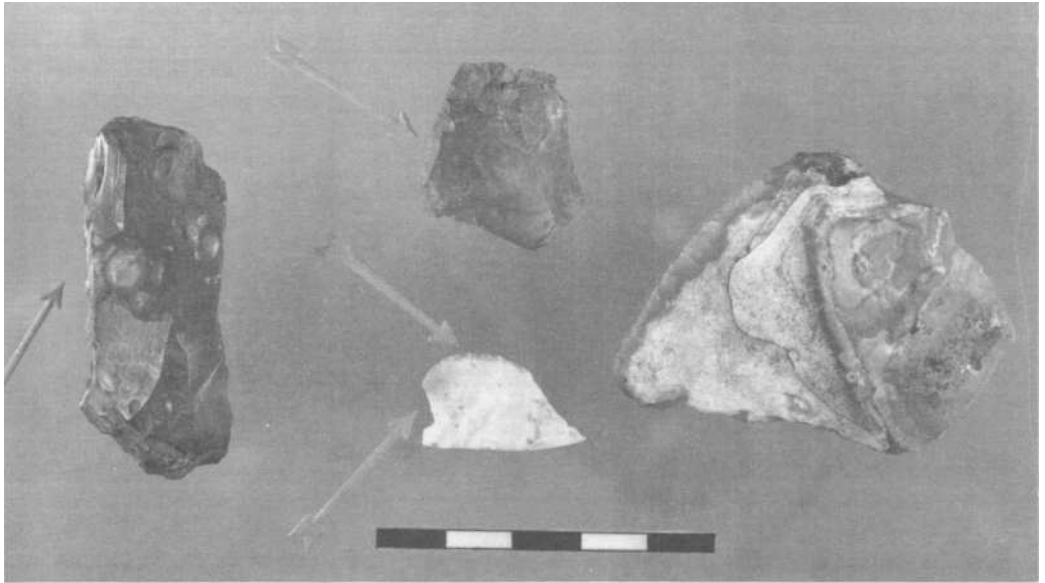


Figure 10. Unifaces from FfJh-1 (arrows indicate retouch on first three artifacts)
left: 15W 27S II-5, centre top: 15W 34S 11-8, centre bottom: 15W 32S I-10, right: 15W 27S I-1



Figure 11. Form 2 Unifaces
from left: FbJa-14; FbJa-7; Fblx-4; FfJh-1 14W 28S 11-5

Table 4. Biface metrical attributes.

		<i>Biface 1</i> 15W 33S III-1	<i>Biface 2</i> 15W 34S III-4	<i>Biface 3</i> TP3 (1987)
Max. length	A	4.49 cm	4.53 cm	2.22 cm
Max. width	B	2.02 cm	4.13 cm	2.52 cm
Basal width	C	1.78 cm		
Basal height	D1	0.59 cm		
	D2	0.31 cm		
Notch height	E1	0.37 cm		
	E2	0.52 cm		
Stem width	F	1.22 cm		
Max. thickness	G	0.65 cm		

Note: A-G refer to measurements described in Figure 9.

artifact, core and debitage samples from the site. Debitage and flakes scars on cores were

tabulated by size grade. Size grade was determined from the smallest square into which a piece of debitage fits. Grade intervals increase by .5 cm to size grade 4 (a side of 4.0 cm), and by 1.0 cm thereafter. The analysis of debitage assemblages using size grade frequencies has been widely discussed in the literature on debitage analysis. Fladmark (1982) in his microdebitage studies has graded debitage based on

standard soil sieve sizes, while Stahle and Dunn (1982) used a constant 4.5 mm interval. More recently

Ahler (1989) has proposed that only five size grades are necessary to conduct meaningful analysis.

broken prior to retouch; it is too small to use effectively in its present form. Two areas of retouch are present on alternate faces of the flake. One area of retouch is on the distal edge of the flake, producing an excurvate working surface. The other area accentuates a small notch (2 mm deep by 5 mm wide), which is present in the flake edge.

Examination of the debitage and cores from FfJh-1 identified a core reduction pattern emphasizing the production of flakes greater than size grade 2.5 for use as implement blanks, although use of smaller flakes as expedient implements is also likely. As is typically found in size grade analysis, larger quantities of debitage is in the form of smaller size grades.

Lithic reduction patterns

Lithic reduction patterns at FfJh-1 were discerned through a consideration of the

Table 5. Uniface metrical attributes.

	length	width	thickness	retouch length	height	edge angle
15W 278,1-1	4.16 cm	5.85 cm	1.17 cm	5.56 cm	0.54 cm	55°
14W 28S, II-5	2.11 cm F	2.63 cm F	1.04 cm F	1.84 / 1.26		85° / 80°
15W 27S, II-5	5.34 cm	2.21 cm	1.30 cm	3.60 cm	0.96 cm	80°
15W 34S, II-8	2.61 cm	2.50 cm	0.55 cm	1.72 cm	0.27 cm	60°
15W 32S, 1-10	2.55 cm F	1.43 cm F	0.21 cm F	1.48 / 0.69	0.20 / 0.07	50°
FfJh-1, T.P. 1	2.53 cm	1.77 cm	1.10 cm	2.65 cm	0.45 cm	70°
Fblx-4	5.03 cm	2.63 cm	0.95 cm	n/a	n/a	80°
FbJa-7	6.93 cm	2.28 cm	0.79 cm	n/a	n/a	65°
FbJa-14	6.22 cm	2.39 cm	0.73 cm	n/a	n/a	20°

Notes: "F" indicates measurement of fragmentary artifact
 Retouch measurements with two figures indicate that two edges are retouched.
 *Edge angle for 'notch' not available.

Table 6. Cores from FfJh-1.

Attribute	Core 1	Core 2	Core 3	Core 3a	Core 4	Core 5
1	HBL	HBL	HBL	HBL	HBL	HBL
2	none	none	none	later	none	later
3	cobble	cobble	cobble	cobble	cobble	cobble
7	6.49 cm	7.71 cm	7.37 cm	7.37 cm	5.41 cm	3.27 cm
8	131.2g	101.2	132.2g	172.8g	44.0g	19.5g
9	>67%	>67%	34 - 66%	<33%	34 - 66%	<33%
10	6	14	4	4	4	2
11	3.48 cm	2.52 cm	3.29 cm	3.25 cm	2.77 cm	2.24 cm
11(a)	L= 4.65 cm W= 4.74 cm	4.89 cm 2.40 cm°	4.37 cm 6.00 cm	4.76 cm 4.28 cm	5.25 cm 2.97 cm	2.35 cm 1.17 cm
12	1	1	1	1	2	2
13	4	9	2	1	2	0
14	108.3°	104.1°	112.5°	65°	65°	n/a
14(a)	110°	105°	105°	65°	70°	n/a
15	1	1	1	1	1	none
15(a)	no	no	no	no	yes	-

Attributes:

1	Raw material: HBL indicates Hudson Bay Lowlands chert.
2	Thermal modification
3	Material source, ie. bedrock or cobble.
7	Maximum dimension.
8	Weight
9	% of surface flaked. (three categories; <33%; 34 - 66%; >67%).
10	Number of flake scars (>1.0 cm).
11	Mean flake scar length.
11(a)	Dimensions of largest flake (Length and width).
12	Flake scar pattern.
13	Number of platforms.
14	Mean platform angle.
14(a)	Angle of largest flake platforms.
15	Crushed areas on platforms.
15(a)	Crushed areas on largest flake platforms

Notes:

Attribute 2	"Later" suggests that the thermal modification occurred after deposition.
Attribute 12	"1" stands for multiple non-parallel "2" stands for multiple parallel Core 2: a better shaped flake is L= 2.05 cm and W= 3.50 cm
Attribute 14	Opposite angle to angle on core is taken as a means of reflecting flake angle. (ie. core angle of 70° would equal an angle of 110° on the detached flake).

This reflects finishing (retouch) actions as well as the unintentional production of smaller debitage during knapping.

Six cores were recovered from FfJh-1. For the

purpose of this discussion, they have been assigned numbers 1 through 6. Core 3 was reanalysed as Core 3a following the refit of a large flake. Although it showed evidence of

having had several flakes removed, Core 6 was not analysed due to intensive heat fracturing of the surface. All of the cores were recovered from the south end of the excavation in the area of highest debitage density. Attributes recorded for the cores follow definitions in Julig (1988b:197-203) and are presented in Table 6.

All of the cores are formed on HBL cobbles. Cores appear to have been reduced through bipolar reduction; in other words, chert cobbles were split by percussion when they were supported on a stable platform or anvil. Two size groups are evident in the collection. The larger group (>100.0 grams) appear to be complete, exhausted cores. Between 4 and 14 flake scars (>1.0 cm) are present with at least two of the flake scars being size grade 4.0 or greater. The exception is the refitted core 3. Flake scars on the reconstructed core are size grade 3.0 and smaller. The two smaller cores show four or fewer flake scars, the largest of which is size grade 3.0. Core 4 is a split pebble core with a surface flake scar of size grade 4.0 defining one margin. Potential platforms generated along the edges of this flake scar have not been used in removing subsequent flakes. It would appear that this fracture was the final one prior to discard. Core 5 is too small and fragmentary to determine if similar conditions apply. An otherwise unworked HBL pebble recovered from the debitage concentration reflects similar characteristics. It was split mechanically to reveal a size grade 3.0 ventral surface.

Flake scar data from the cores indicates that at least two flakes of size grade 4.0 and larger have been removed from the large cores, although the cores are not capable of producing more than a few flakes in this size range. All but one of the formal artifacts present on the site could have been produced from flakes between size grades 4.0 and 6.0. The unifaces 15W 27S, II-5 and 15W 27S I-1, when reconstructed, are formed on flakes of size grade 5.0. The projectile point fits into size grade 4.0. Only the large biface fragment, 15W 34S, III-4 would have exceeded the size of flakes noted at FfJh-1. Production of this artifact would have required the reduction of a suitably sized flake or cobble to the finished bifacial form.

Notwithstanding the necessity of producing larger flakes for the more formal implements in use at the site, it seems likely that a large number of smaller flakes would have been

produced for various purposes. The small uniface is perhaps the more obvious examples of this requirement; a number of expedient flake tools may also have been used.

Size grade attributes of the flakes removed from the cores were recorded using the flake scars remaining on the cores. The flake scar size grade distribution will be skewed to smaller size grades due to overscarring from subsequent flake removals. This is superficially analogous to the distribution of debitage size grades, where unintentional flake removals increase the counts of smaller sized debitage. Only controlled testing will clarify the exact nature of this relationship. Flake scar size grade distributions for each of the cores are listed in Table 7. This distribution is compared with the size grade frequency distribution of all debitage, platform bearing flakes and flake scars listed in Table 8 and Figure 12. It seems clear that there is a marked difference in the distribution of flake scar size grades when compared to either the complete collection of debitage from the site, or the platform bearing flake sample. The size grade distribution of the debitage samples seem very similar, with minor differences showing up in the smaller size categories. This difference is perhaps the result of sample size and the inclusion of many flake fragments in smaller debitage size categories. Flake scar size grade frequencies peak at size grade category 3.0, while the debitage and platform flake samples peak at size grade 1.5. This suggests that larger sized flakes were produced, but are not present in the assemblage. It is possible that these larger flakes were selected by the knappers for further refinement or expedient use and removal from the knapping locus. The data suggests that core reduction was directed towards the production of larger flakes suitable for refinement and use as implements.

Spatial considerations

The distribution of recoveries from the main excavation at FfJh-1 may be considered in terms of vertical and horizontal space. The depth of artifact recoveries in most units was generally less than two levels (6 cm). The majority of the artifacts recovered were at or very close to the top of level II, which is the organic soil-subsoil horizon boundary. In

Table 7. Flake scar size grades from core:

Size Grade	Core 1	Core 2	Core 3	Core 3a	Core 4	Core 5	Total	%	
0.5	not recorded								
1.0							0	0.0	
1.5		1		1	2		4	11.8	
2.0		1			1	1	3	8.8	
2.5		4	2			1	7	20.6	
3.0	2	5		2	1		10	29.4	
3.5	1	1					2	5.9	
4.0	2	2					4	11.8	
5.0	2		1				3	8.8	
6.0			1				1	2.9	
<i>Total</i>	7	14	4	3	4	2	34		

certain areas, depth of recovery was greater than 6 cm, in some instances reaching depths of 20 cm. The localised pockets of deep deposits are thought to be the result of root action causing local mixing of the coarse esker matrix.

Figure 13 shows the horizontal distribution of precontact (subsoil) artifacts, excluding debitage. This distribution suggests that there are

two artifact clusters. Towards the north end of the excavation the area around unit 14W 27S may have been a locus of domestic activity or food preparation. Several large rocks in a roughly semicircular arrangement may represent a hearth area, although no charcoal was recovered (Figure 14). Most of the ceramic fragments and three refined unifaces, as well as a small patch of reddish sand suggestive of

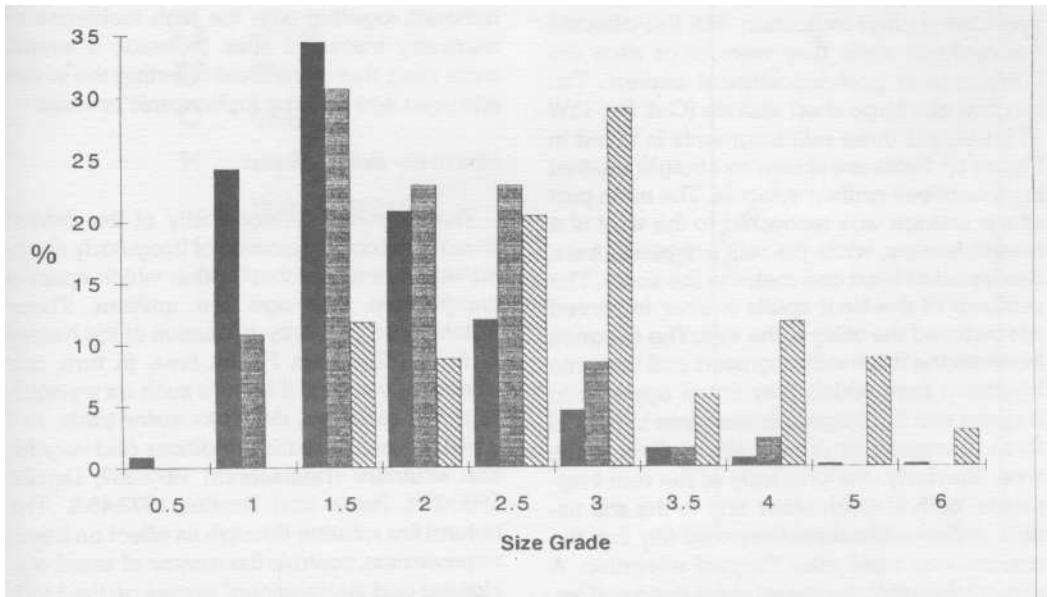


Figure 12. Comparison of Flake Scar to Debitage Size Grade Distribution

Table 8. Debitage or flake scar size grade frequency distribution

Size Grade	All debitage	Platform	Flake scars
0.5	0.9	0.0	0.0
1.0	24.3	10.8	0.0
1.5	34.6	30.8	11.8
2.0	21.0	23.1	8.8
2.5	12.0	23.1	20.6
3.0	4.6	8.5	29.4
3.5	1.5	1.5	5.9
4.0	0.7	2.3	11.8
5.0	0.2	0.0	8.8
6.0	0.2	0.0	2.9

concentrated heating were found in the vicinity of these rocks. The area surrounding this artifact concentration was mostly fine sand. Smaller rocks were generally absent from the upper parts of the subsoil in this area, and debitage recoveries were limited. At the south end of the excavation is an area which may be described as a lithic reduction or tool maintenance area. Here, the soil was generally coarse gravel and cobbles with a matrix of silt and clay. Abundant quantities of debitage were associated with cores, biface fragments and a hammerstone (Figure 13).

The refit of several heat fractured fragments provides a clear indication that fire affected the artifacts while they were at or near the surface in a post-depositional context. The location of a large chert uniface (Cat. No. 15W 27S I-1) and three refit fragments is noted in Figure 13. Refits are shown as straight dashed lines between artifact symbols. The main part of the uniface was recovered to the west of a hearth feature, while the refit fragments were recovered at least one metre to the south. The removal of the heat spalls neither improved nor reduced the utility of the tool. The distance between the three refit fragments and the main fragment from which they came appears to suggest that the fragments were free to fly and were, therefore, at or near the surface at the time. Similarly, the proximity of the refit fragments, both to each other and to the still usable uniface, discounts the possibility that the artifact was used after thermal alteration. A second thermally fractured chert uniface (Cat. No. 15W 27S II-5) also supports the hypothesis

that burning at the site was unintentional and post depositional. Here, the four refit fragments were found close to the main fragment. All of the refit fragments were superimposed "potlid" flakes and had caused one of the worked edges of the uniface to spall.

FIRE ECOLOGY AND SITE FORMATION

Three attributes of the site, the smooth, distinct horizon boundary between the organic soil and subsoil, the concentration of artifacts at or very close to this boundary and the high incidence of thermally fractured lithic material, suggest that fire events played an important role in site formation. While hearths or other human-initiated fire may account for the burning at the site, intense forest fire events, common in the boreal forest, are the most probable cause. Thermal fracture of both refined artifacts and unworked chert pebbles suggest that artifact burning was widespread. It is not possible to argue that the burning of completed artifacts is an aspect of thermal modification in the lithic reduction process. When the smooth, distinct horizon boundary between the organic soil and subsoil and the concentration of artifacts at or very close to this boundary is taken into account, together with the high incidence of thermally fractured lithic material, it seems more likely that a fire event affecting the entire site area was a major taphonomic process.

Fire in the Boreal Forest

The apparent homogeneity of the boreal forest is actually a mosaic of irregularly shaped vegetation "patches" within which species composition and age are uniform. These patches are primarily a function of the history of fire in the area. Forest fires, in turn, are affected by physical factors such as topography, soil moisture, depth to water table, soil development, climatic conditions and vegetation structure (Heinselman 1973:357; Larsen 1980:329; Rowe and Scotter 1973:453). The natural fire rotation through its effect on forest regeneration, controls the mosaic of stand age classes and successional stages on the landscape (Wright and Heinselman 1973:324). The irregular shape of forest patches is a reflection

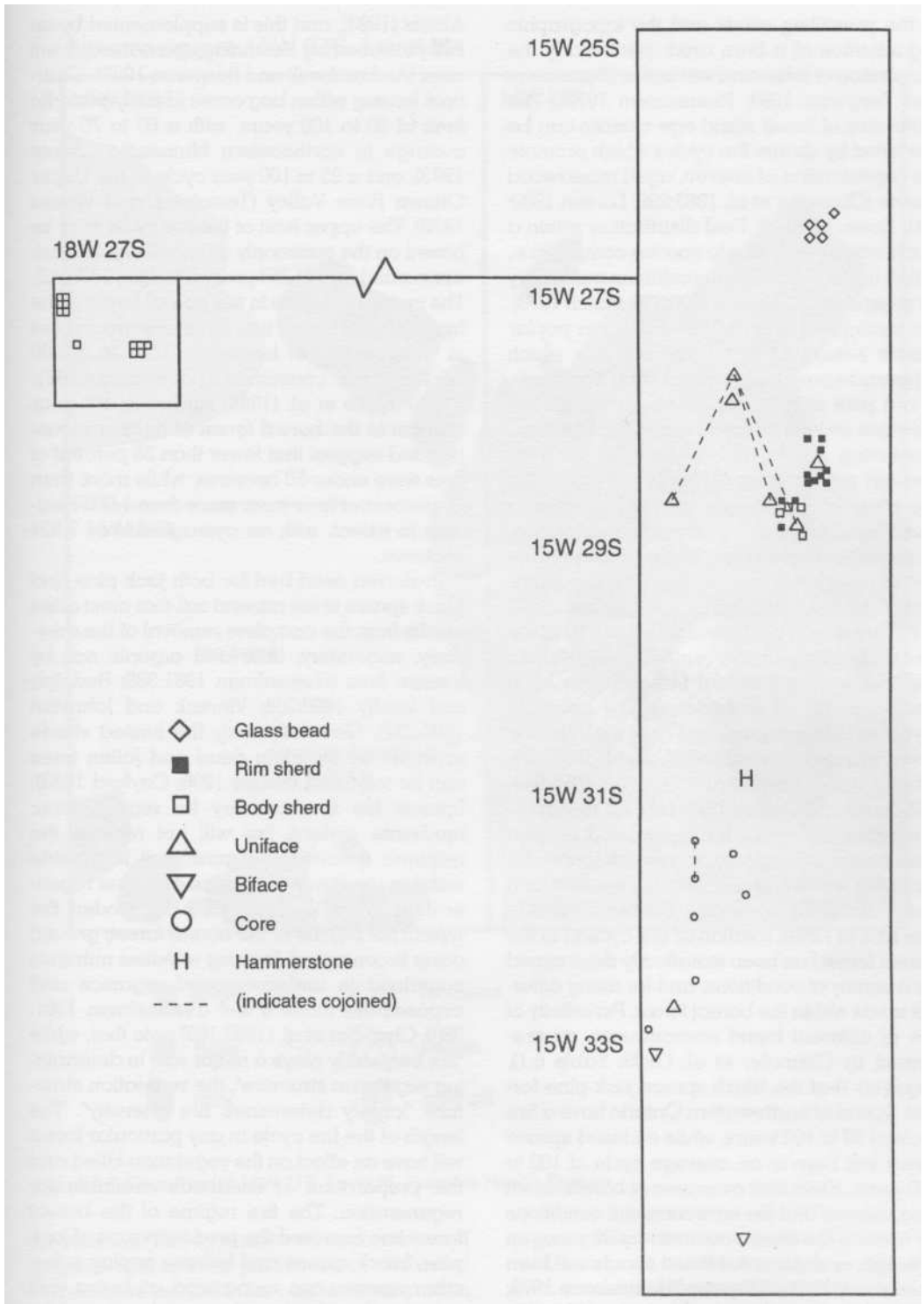


Figure 13. Plan of Excavation Showing Distribution of Artifacts Recovered, Excluding Debitage

of the prevailing winds and the topographic organization of a burn area, particularly the distribution of lakes and wet areas (Dansereau and Bergeron 1993; Heinselman 1973). The uniformity of forest stand age classes can be disrupted by shorter fire cycles which promote the regeneration of uneven, aged mixedwood stands (Chandler et al. 1983:299; Larsen 1980:330; Rowe 1972:42). Fuel distribution within a stand varies according to species composition, which in turn effects the conditions necessary for regeneration (Larsen 1980:330; Mutch 1970). For example, lower fuel availability in poplar stands results in lower intensity fire which supports regeneration by suckering from roots. In red pine stands, certain characteristics of the trees reduce the incidence of crown fires, preserving seeds and clearing seed beds through ground fires (Ahlgren 1974:200). On the other hand, the fire adapted species of black spruce and jack pine retain lower limbs, which encourages crown fires and the production of seed beds most suitable for regeneration of this species (Rudolph and Laidly 1990).

Research has demonstrated that most of the forests throughout the central United States and the southern boreal forest region have been burned, as is evidenced by charcoal layers within the organic soil or at the interface of organic and mineral soil (Ahlgren 1974:194-195, Figure 1; Payette and Gagnon 1985:570-572; Rowe and Scotter 1973:447). All researchers agree that while human-caused ignition does occur, the majority of fires are ignited by lightning strikes (Bell 1889; Dansereau and Bergeron 1993; Rowe and Scotter 1973:447). The rate of forest rotation or fire cycling in the boreal forest has been statistically determined for a variety of conditions, and for many different areas within the boreal forest. Periodicity of fire in different forest environments, as presented by Chandler et al. (1983: Table 6.1), suggests that the black spruce/jack pine forests typical of northwestern Ontario have a fire cycle of 60 to 100 years, while a closed spruce forest will burn at an average cycle of 100 to 120 years. Statistical overviews of boreal forest fires suggest that the environmental conditions for intense fire events occur every 30 years on average, and that most forest stands will burn once every 150 to 300 years (Heinselman 1973; 1981:375; Rowe and Scotter 1973:447). Dansereau and Bergeron have derived similar data for the area immediately south of Lake

Abitibi (1993), and this is supplemented by an 802-year tree-ring chronology from an adjacent area (Archambault and Bergeron 1992). Charcoal lensing within bog cores identify periodic fires of 20 to 100 years, with a 60 to 70 year average in northeastern Minnesota (Swain 1973), and a 95 to 100 year cycle in the Upper Ottawa River Valley (Terasmae and Weeks 1979). The upper limit of the fire cycle may be based on the commonly acknowledged maximum stand age of 250 years (Ritchie 1987:142). The main fire regime in the boreal forest is the high intensity crown fire, or severe ground fire in which areas of between 10,000 to 40,000 hectares are consumed (Heinselman 1981:375). Payette et al. (1989) support a 100 year rotation in the boreal forest of northern Quebec and suggest that fewer than 35 percent of fires were under 50 hectares, while more than 30 percent of fires were more than 1,000 hectares in extent, with an average size of 7,924 hectares.

Preferred seed bed for both jack pine and black spruce is the mineral soil that most often results from the complete removal of the overstory, understory, litter and organic soil by intense fires (Heinselman 1981:380; Rudolph and Laidly 1990:284; Viereck and Johnston 1990:231). Generally, only the limited shade provided by standing dead and fallen trees can be tolerated (Rouse 1986; Cayford 1963). Intense fire is necessary for regeneration; moderate surface fire will not remove the required quantity of organic soil to provide suitable seedbeds for spruce and pine regeneration (Van Wagner 1963:16). Under the typical fire regime of the boreal forest, ground cover is consumed. Burning releases nutrients contained in undecomposed organics and exposes the mineral soil (Heinselman 1981:380). Chandler et al. (1983:163) note that, while "fire frequently plays a major role in determining vegetation structure", the vegetation structure "largely determines fire intensity". The length of the fire cycle in any particular forest will have an effect on the vegetation killed and the preparation of seedbeds available for regeneration. The fire regime of the boreal forest has favoured the predominance of jack pine, black spruce and balsam poplar; a few other species are recognized as being well suited to invading territory newly opened by fire (Rowe and Scotter 1973:449). Longer periods between cycles ensure the accumulation

2 metre square 15W 27S, Level III

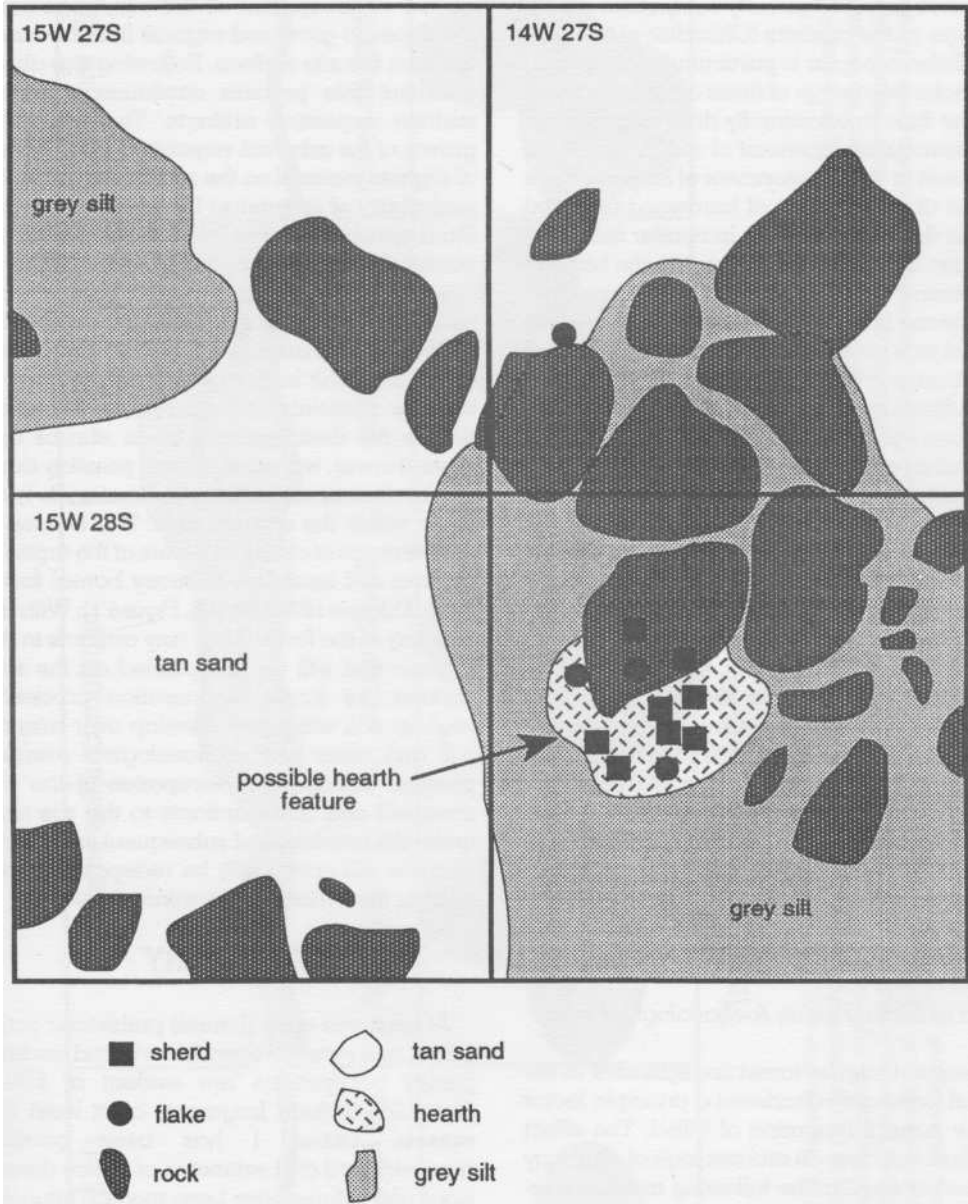


Figure 14. Floor Plan of 15W 27S, Level III. Probable Hearth Feature

of sufficient fuel to remove all vegetation and organic soil and the production of unshaded mineral soil seedbeds for conifer regeneration (Larsen 1980:329; Rouse 1986). The reduction in depth of organic matter depends generally on fire severity and is a critical factor because the

organic substrate that remains following fire makes a poor conifer seedbed. In general, even severe fires do not expose mineral soil on more than 40 or 50 percent of a burn and this area is usually distributed in small patches (Nienstaedt and Zasada 1990:216). Where

incomplete burning of the organic soil occurs, hardwood regeneration from suckering is likely and presents an early competitive disadvantage to the conifers (Chandler et al. 1983:158). Balsam poplar is particularly well adapted to take advantage of these conditions. More intense fires in abnormally dry years and the successional replacement of aspen by spruce will result in the development of larger spruce forests at the expense of hardwood or mixed stands (Larsen 1980:330). In conifer forests, a short fire cycle may be defined on the basis of the natural timing of maximum seed production among fire adapted boreal conifers. In the case of jack pine, maximum seed production is found among 40 to 60 year old trees (Rouse 1986). Black spruce dominates fire-prone areas because it produces seed at an early age and is noted as a "post-fire pioneer on both uplands and peatlands" (Viereck and Johnston 1990:233), largely because of its cone characteristics. The serotinous cones of the jack pine, and semi-serotinous cones of black spruce are effectively sealed against opening without the aid of fire or, in limited cases, prolonged hot and dry periods. Cones open when external temperatures rise above 50 to 60° C and can withstand peak temperatures of 370 to 540° C for short periods (Cayford 1963; Chandler et al. 1983:275; Rudolph and Laidly 1990:285). The trees themselves, however, are killed at temperatures above 65° C (Rouse 1986). Cones containing viable seed may survive up to twenty years on the trees or on dead limbs on the ground, allowing a rapid dense seed production in the post fire environment.

Effect of Forest Fire on Archaeological Sites

Frequent intense forest fire episodes in the boreal forest are considered a principle factor in the natural formation of FfJh-1. The effect that fires will have on archaeological sites may be summarized in the following manner (Figure 15). Site formation commences with the occupation of a locality at some time during the fire cycle of the particular forest stand. Occupation may take place in a recently burned area, where mineral soil is exposed in broad patches, or in a mature forest with an established organic soil component. During human occupation, artifacts are manufactured, used, broken and discarded, hearths are used and pits dug. For the most part,

activities involving the introduction of artifacts will occur on the active surface. During the period of occupation at the site, vegetation continues to grow and organic litter accumulates on the site surface. Following site abandonment this process continues, covering surface deposited artifacts. The continued growth of the arboreal vegetation and buildup of organic material on the surface increase the probability of an intense fire event occurring. Black spruce, the principle tree species of the boreal forest, and jack pine, a commonly associated species on dry sites, both support conditions of intense fire and regenerate most effectively in bare mineral soil. Intense forest fires that result in the ignition and burning of organic materials on the forest floor, in addition to the destruction of trees, shrubs and ground cover, will relocate and possibly damage or destroy archaeological materials lying on or within the organic soils. This is seen in the presence of charcoal lenses at the organic-mineral soil boundary in many boreal forest soils (Ahlgren 1974:194-195, Figure 1). With the burning of the forest floor, any artifacts in the organic soil will be redeposited on the new surface. As forest regeneration proceeds, organic soil will again develop over mineral soil and cover any archaeological remains present. Subsequent occupation of the site area will add more artifacts to the site and, under the conditions of subsequent fire events, artifacts will continually be redeposited, typically at the surface of the mineral soil.

SUMMARY

At least one early (Laurel) prehistoric occupation and several recent historic and contemporary occupations are evident at FfJh-1. Ceramics include fragments of at least two vessels. Vessel 1 has been partially reconstructed and estimates of orifice dimensions and volume have been made. This small vessel has a plain surface and, apart from two twisted fibre impressions, is undecorated. Although a typological identification of this vessel cannot be made, it is inappropriate to dismiss it as a "juvenile" vessel or as an aberrant form. Only one area, South Indian Lake in Manitoba, has produced vessels of this size in association with Late Woodland Clearwater Lake Punctate ceramics. While this vessel cannot be identified as Clearwater Lake Punc-

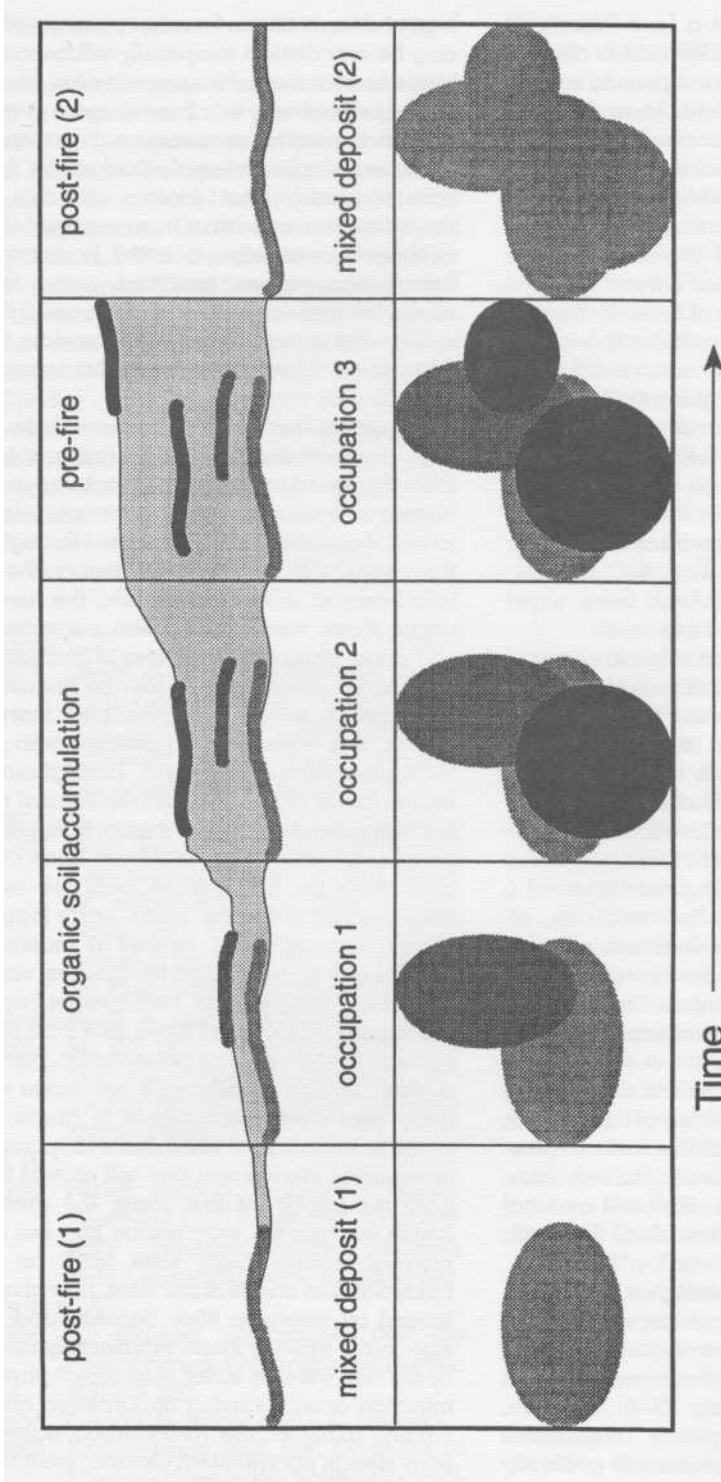


Figure 15. Forest Fire, Regeneration and Archaeological Site Formation
 Mixed deposit (1) represents the archaeological material exposed on the surface of the mineral soil following the previous fire event. As forest regeneration proceeds, organic soil accumulates. Three reoccupations of the site are represented between fire events, with the two earlier reoccupations becoming buried in accumulating organic soil. During the subsequent fire event, organic soil matrix is removed, resulting in the formation of mixed deposit (2). Intense fire events will reduce the number or condition of organic archaeological materials present in each subsequent mixed deposit.

tate, it does suggest that a Late Woodland occupation is represented. Vessel 2 is characterised by dentate stamp and pseudo scallop shell impressed body sherds manufactured using coil construction techniques considered typical of Middle Woodland Laurel ceramics. Lithic material from the site suggests pebble or cobble reduction, implement manufacture and use. Refined implements include one side notched projectile point and several end and side scrapers. While none of these artifacts fit into established "types", a similarity between an end-side scraper from Wunnumin Lake and scrapers from three Attawapiskat Lake sites is noted. The sample of cores and debitage recovered reflect core reduction patterns in which pebbles are split to produce larger flakes as blanks and smaller flakes for expedient use. Historic artifacts and faunal remains, possibly ranging in date from the late nineteenth century to the present, were noted throughout the organic soil at the site.

The most effective method of locating sites in interior regions of the boreal forest is through a post-forest fire survey when the majority of the organic cover has been removed naturally. At South Indian Lake, Dave Riddle (personal communication 1994) has identified surface artifact scatters at interior locations that have recently been burned. Hems (1981:174) reports locating several sites during a walkover of a recently burned area at Burrows Lake, although a 1994 survey was unable to relocate any of these sites due to dense regeneration (Dalla Bona 1994:80). Surface survey of a burned forest area in northwestern Saskatchewan led to the identification of over twenty artifact clusters at the Cummins site (GiOf-1) by Dale Russell in 1993. Testing at the site was conducted to determine if the surface presence indicated buried deposits, but only three of twelve test excavations produced material below the surface of the mineral soil (Finnigan et al. 1995).

Detailed cultural chronologies for boreal forest regions should be advanced with caution since fire contributes to the collapsed stratigraphy. Intense fire events are expected to occur at least once every 150 to 300 years, and often with greater frequency. This is much shorter than the temporal periods generally described for the archaeological cultures of the boreal forest region of northern Ontario. Through frequent, intense burning at archaeo-

logical sites, artifacts from occupations which may be very distinct temporally will become a single level at a site. Reoccupations of sites by a group once every two, three or more generations, and possibly on a seasonal rotation will become a single archaeological strata. Alternate approaches for dealing with this collapsed stratigraphy have been reported (Reid 1988), and are usually successful. Radiocarbon dating occupations identified using these methodologies may not be as successful if the researcher is not vigilant, for the date may relate to an old fire rather than a human occupation.

It appears that, at the Wunnumin Lake site (FfJh-1), all of the prehistoric artifacts have been displaced by fire in the past. More recent historic artifacts and organic materials relating to later occupations are distributed throughout the organic soil. If the next intrusion on the site had been an intense forest fire, the historic occupations would have been subjected to significant impact through loss of context and organic site components, while the prehistoric occupations would have remained more or less in their redeposited positions, with perhaps some thermal alteration. Throughout the boreal forest region, the archaeological sites that will suffer the greatest impact from intense forest fire will be those that have been occupied since the last intense local fire event. Sites related to the fur trade, early logging, mining and settlement, as well as recent Aboriginal history will contain the greatest variety of artifacts and features. Management action will require protection of these sites from fire to ensure cultural resource preservation. Perhaps of even greater significance are those relatively rare sites which occur in areas less prone to forest fire, or which have acquired an overburden of sediment that will protect them from the impact of fire. Here, the greatest cause for concern may not be fire, but suppression efforts. Early sites such as late Palaeo-Indian and Archaic sites, now characterised by extensive lithic deposits and little else, have already been significantly altered by fire and will only suffer from direct physical intrusion accompanying suppression efforts. Finally, many of the radiocarbon dates on early sites in northwestern Ontario, even those which are accepted by researchers, may be inaccurate since fire events often introduce carbon to sites after the original organic matrix

has been removed.

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