A POPULATION HISTORY OF THE HURON-PETUN, A.D. 900 - 1650

by

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ABSTRACT

This study presents a population history of the Huron-Petun, Iroquoian-speaking agriculturalists who occupied south-central Ontario from A.D. 900 to A.D. 1650. Temporal change in the number, size, and residential density of prehistoric and contact village sites of the Huron-Petun are used to delineate population change. It is revealed that Huron-Petun population grew dramatically during the fourteenth century, attaining a maximum size of approximately 30,000 in the middle of the fifteenth century. This growth appears to have been intrinsic (1.2% per annum) and is best explained by colonization of new lands and increased production and consumption of corn. Population stabilized during the fifteenth century primarily because of an increased burden of density-dependent diseases (tuberculosis) arising from life in large nucleated villages. Huron-Petun population remained at 30,000 until A.D. 1634; there is no archaeological evidence for protohistoric epidemics of European origin. The historic depopulation of the Huron-Petun country, resulting from catastrophic first encounters with European diseases between 1634 and 1640, is substantiated by archaeological data.

RESUME

La présente étude retrace l'histoire des Hurons-Pétuns, peuple agricole de langue iroquoise qui vécut dans la région sud-centrale de l'Ontario à partir de l'an 900 jusqu'en 1650. Les variations successives du nombre de villages, de leur taille et de leur densité de population servent à cerner les changements démographiques. En effet, ces données, provenant à la fois des sites préhistoriques et des villages qui eurent des contacts avec les Européens, révèlent que la population des Hurons-Pétuns s'est multipliée de façon dramatique au cours du XIV^{e} siècle, atteignant environ 30 000 personnes à son apogée, soit vers le milieu du XV^{e} siècle. Cet essort semble avoir été intrinsèque (1,2 p. 100 par an) et s'explique en grande partie par la colonisation de nouvelles terres et par la production et la consommation accrues de mais. La population s'est stabilisée au cours du XV^{e} siècle, surtout en raison de la montée des maladies tributaires des conditions bondés (la tuberculose) qui caractérisait la vie dans les grands villages nucléaires. La population des Hurons-Pétuns s'est maintenue à 30 000 jusqu'en 1634. Il n'existe aucune preuve archéologique d'épidémies protohistoriques d'origine européenne. Les données archéologiques témoignent du dépeuplement du pays des Hurons-Pétuns que provoquèrent les premières rencontres désastreuses de ce peuple avec les maladies européennes entre 1634 et 1640.

PREFACE

This study began in 1984 and was originally designed to explore archaeologically the effects of depopulation among the seventeenth-century Petun of Southern Ontario. Two historical village sites threatened by subdivision development were selected for archaeological investigation and plans for lengthy excavations were drawn up. However, upon learning that both sites were no longer threatened with imminent destruction and, in fact, stood a good chance of long-term preservation by heritage designation, research plans were abandoned. I could not justify excavating for personal research the last two Petun villages ever occupied in Southern Ontario.

A week later, I scheduled a meeting with my supervisor, Professor Bruce Trigger, and informed him that my Petun research was cancelled. Instead of trying to convince me to continue, he actually welcomed my decision. He then asked how I felt about expanding the original research proposal. After a long afternoon of discussion, he convinced me to examine Huron-Petun population change from its prehistoric beginnings to its mid-seventeenth-century collapse. A feasibility study demonstrated to Professor Trigger and myself that the archaeological data were adequate to bring such a study to a successful conclusion. We also agreed, however, that field as well as archival research would be an essential part of this study.

Two summers of archaeological survey in Simcoe County, participation in graduate seminars at McGill University, numerous

discussions with archaeological colleagues and friends, attending conferences, and a lengthy period of site data compilation and library research produced this study. It is inductive and should be considered a first approximation of Huron-Petun population history. Yet, I believe that further archaeological research will not alter the two most significant findings of the study: a fourteenth-century population explosion and no protohistoric depopulation among the Huron-Petun. Before we can conclude, however, that these demographic trends characterize all interior native groups of northeastern North America, additional population histories must be compiled.

Fieldwork in 1985 and 1986 was generously supported by two consecutive Ontario Heritage Foundation Research Grants and by a McGill University Graduate Faculty Research Grant. Full-time academic research was made possible by a Max Bell Fellowship in Canadian Studies (1984-1985) and three years of a Social Sciences and Humanities Research Council of Canada Doctoral Fellowship (1985-1988). Laboratory facilities for analysis of archaeological materials were provided by the Department of Anthropology, McGill University (1985-1986) and the Archaeology Unit, Ministry of Culture and Communications, Toronto (1986-1988 and courtesy of William Fox, Roberta O'Brien and Allen Tyyska). Roberta O'Brien (Ministry of Culture and Communications) kindly loaned equipment for the 1985 and 1986 fieldwork.

The Southern Simcoe County Archaeological Project owes it success to the hardworking fieldcrews: Vince Gray, Jim Molnar, and Jim Shropshire in 1985, and Scott Cerjko and Jim Molnar in 1986. I would also like to thank several other individuals and institutions who assisted with fieldwork and analyses: Paul Lennox who provided the initial impetus for the project; Peter Carruthers, Jamie Hunter, Hugh Jackson, and Roberta O'Brien who supplied valuable information on Simcoe County prehistory; the City of Barrie for copies of detailed base maps; Jeff Bursey for his help with ceramic type analyses; and Bill Fox for his assistance in chert identification.

Compilation of Huron-Petun village site data would have been extremely difficult without the kind assistance of Kathy Gray (Data Co-ordinator, Archaeology Unit, Ministry of Culture and Communications) who permitted open access to Ontario's archaeological site database contained in paper and computer files, maps, and unpublished reports. A number of archaeological colleagues were most generous with advice, critical discussion, and unpublished data: Jeff Bursey, Peter Carruthers, Bill Finlayson, Bill Fox, Charles Garrad, Jamie Hunter, Ian Kenyon, Dean Knight, Paul Lennox, Rob MacDonald, Jim Molnar, Roberta O'Brien, Bob Pearce, Dana Poulton, Peter Ramsden, Dean Snow, Peter Timmins, and Ron Williamson.

Finally, I would like to thank my supervisory committee, Professor Michael Bisson, Professor Fumiko Ikawa-Smith, and Professor Bruce Trigger, for their guidance, patience, and genuine interest in my academic pursuits. Their constructive criticism and editorial assistance with rough drafts of the dissertation added immeasurably to the quality of this work. Professor Trigger's intellectual stimulation and unfailing support will be remembered always.

I dedicate this study to my family (Gail, Caitlin, Courtney, and Zachary) and to my parents for their enduring love, patience, and understanding.

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CHAPTER 1

INTRODUCTION

The European discovery of North America had a profound impact on the historical trajectory of its aboriginal peoples. Beginning in A.D. 1519, epidemics of European disease decimated the indigenous populations (Dobyns 1983; Ramenofsky 1987a). Yet it is far from certain how far and how fast these early epidemics spread from the primary centres of infection. The potential impact of sixteenth-century epidemics on native North Americans has received considerable attention in recent years (Dobyns 1983; Ramenofsky 1987a; Snow and Lanphear 1988; Snow and Starna 1989; Trigger 1985b:231-242; Upham 1986), but there have been few attempts to reconstruct the precontact population of a native group living far from the coastal areas and early landfalls of Europeans. Except perhaps for select regions of the American Southwest (Blake et al. 1986; Plog 1974) and the Valley of Mexico (Sanders et al. 1979), no scholar has written a population history of such a group from its prehistoric beginnings to the earliest recorded contact with Europeans. The Huron-Petun, an Iroquoian-speaking group who occupied Southern Ontario from approximately A.D. 900 - 1650 , offer a unique archaeological context for reconstructing the precontact demography of one part of interior North America. Thus, the purpose of this study is to ascertain and explain trends in Huron-Petun population from A.D. 900 to A.D. 1650.

There are several reasons why the study of Huron-Petun population is important. Population is an extremely important variable in models of culture change. Recent research in Iroquoian archaeology has attempted to trace and explain cultural change by studying key causal factors, such as subsistence (Williamson 1985) and sociopolitical organization (Pearce 1984; Warrick 1984). Unfortunately, virtually nothing is known about one of the potentially most important factors in Iroquoian culture change: alterations in population. The lack of research on demography seriously hampers our understanding of Iroquoian prehistory (Trigger 1985b:231-242). In particular, outstanding problems of Iroquoian prehistory include:

1) Did the adoption of agriculture in late Middle Woodland times result from population growth (Smith 1972), cause population growth (Stothers 1977:164-167), or not affect population to any remarkable degree (Trigger 1985b:86-87)?

2) Was there a "population explosion" during Middle Iroquoian times (Noble 1975b:44; Sykes 1981:29; Wright 1972:78)?

3) Did the rapid decline of Iroquoian populations begin in the sixteenth (Brasser 1978; Dobyns 1983:313-327; Dickinson 1980; Ramenofsky 1987a) or in the seventeenth century (Snow and Lanphear 1988) as a result of European diseases?

Another reason for undertaking this research relates to developing archaeological methods of investigation, or middle range theory. Reconstruction of past populations is a difficult methodological problem in archaeology (Ammerman et al. 1976:31-33; Schacht 1981). Certain features of Huron-Petun archaeology, however, reduce some of the difficulties of converting archaeological remains into population numbers. First, unlike the situation in most other regions of the world, Huron-Petun settlements were compact and occupied for only a brief period of time, thirty years or less. Consequently, the contemporaneity problem that plagues demographic archaeology (Schacht 1984), when population totals are inflated as a result of "double-counting" archaeological remains that are in fact not contemporary, is substantially reduced by the "snapshot" nature of Iroquoian occupations. Secondly, the Huron-Petun chronological sequence is well-understood; enabling the archaeologist, on the basis of ceramic or European trade item seriation, to assign prehistoric sites to fifty year periods and contact sites to ones whose lengths roughly correspond to actual village durations (Warrick 1988b). Finally, over a century of archaeological survey and excavations in the predominantly ploughed lands of south-central Ontario have located a substantial proportion of all the Huron-Petun villages that ever existed, one of the most conspicuous types of archaeological site in the agricultural areas of the Northeast. Therefore, a study of Huron-Petun population can make a significant contribution to middle-range theory in archaeology, particularly to the methodology for inferring demographic information from archaeological data for tribal societies that practice slash-and-burn agriculture. In contrast to the demography of early urban societies (e.g. Adams and Nissen 1972; Sanders et al. 1979; Smith and Young 1986; and Trigger 1965) for which modern analogs are readily available (e.g. Kramer 1979), there are few tribal or Neolithic societies left in the world from which the archaeologist can derive empirical generalizations and demographic analogies.

Finally, as a specific case study of the causes and consequences of population change, the results of this archaeological study can be used, like historical demographic studies (e.g. Skipp 1978), to test general theories of population change. Understanding human population change, especially growth, is one of the most pressing problems of the contemporary world (e.g. World Commission on Environment and Development (1987)). It is also a truly interdisciplinary topic, encouraging cooperation among archaeologists, anthropologists, demographers, economists, geographers, and historians (Jones 1981:161; Zubrow 1975:1-2). Because of its long-term perspective, archaeology can provide unique empirical insights into population change.

Middle-range theory in demographic archaeology can be defined as a set of empirically-tested generalizations that allow human demographic behaviour to be inferred from the material remains of that behaviour (Binford 1981:21-30). Empirical generalizations are developed, often inductively, from the archaeological data of one or more societies. While such statements may be applicable to other past societies, caution must be exercised in transferring empirical constants, such as Raoull Naroll's (1962) floor area per person generalization, to wider contexts (Fletcher 1981). The intent of this study is to develop an explicit methodology for drawing from the archaeological record as accurate a picture as possible of population change among the Huron-Petun, A.D. 900 - 1650. The resulting case study can then be tested by anthropologists and ethnologists for goodness of fit with high-level theories of population change. In fact, the major goal of archaeology, demographic or not, should be to compile historical case studies of human behaviour.

The presentation of the study follows a logical sequence. Chapter 2 sets the stage with a review of previous estimates of the precontact population of the Huron-Petun and other Iroquoian groups of the Northeast. Critical discussion of the seventeenth-century eyewitness accounts and their use and abuse by subsequent demographic researchers is highlighted in this chapter. This is followed (Chapter 3) by a presentation of the theoretical approach or orientation of the study. It is argued that a historial-ecological approach, similar to that employed by most historical demographers (Wrigley 1969), is perhaps the least biased theoretical stance to adopt for dealing with specific archaeological contexts. In Chapter 4, the archaeological methods available for estimating past population numbers are summarized. According to middle-range theory in archaeology, settlement patterns are the best preserved archaeological barometer of past population size and change. The Huron-Petun study area is defined in Chapter 5. Since the majority of Huron-Petun sites used in this study were not personally discovered or studied by the author, the representativeness of the site sample is examined in a comprehensive manner. Various estimates suggest that, for most of Huron-Petun prehistory, over 70% of all village sites ever occupied have been archaeologically located. The generation of population numbers is dealt with in Chapter 6. Empirical generalizations about site duration and residential density of Huron-Petun villages, adjusted for changes over time, are applied to the site data and a relative population curve is produced. Relative population numbers are then transformed into absolute numbers by estimating changes over time in Huron-Petun family size using burial populations and palaeodemographic inference. Chapter 7 presents a population history of the Huron-Petun, with special attention to causes of population growth in the fourteenth century, population movements in the sixteenth century, and the seventeenth century depopulation as a result of epidemics of European disease. The final chapter (Chapter 8) offers a set of conclusions and suggestions for further research.

CHAPTER 2

HISTORICAL REVIEW OF IROQUOIAN POPULATION RESEARCH

The purpose of this chapter is to place the present research into historical perspective by reviewing previous contributions to the study of Iroquoian population. The approach will be chronological, beginning with eyewitness observations of the early seventeenth century. Figure 1 depicts the approximate territories of the major Iroquoian groups of northeast North America in the early seventeenth century.

Seventeenth-Century Observations

At first contact in the early seventeenth century, the Huron population was reported to be approximately 30,000 persons (Biggar 1922-1936, 3:122; Wrong 1939:91). Similar population estimates were recorded by the Jesuit missionaries of the early 1630s (see Table 1). In the winter of 1639-1640, after a series of devastating epidemics of European disease, the Jesuits conducted an actual house by house census of the Huron and Petun, counting 32 villages, 700 longhouses, 2,000 hearths, and 12,000 people (Thwaites 1896-1901, 19:127). The Huron-Petun occupation of Southern Ontario ended A.D. 1650 with their dispersal by the Five Nations Iroquois. The few seventeenth-century estimates of Huron-Petun population are the foundation for much Iroquoian demography, including precontact population estimates. Thus, it is essential that they be evaluated for their accuracy and internal consistency.

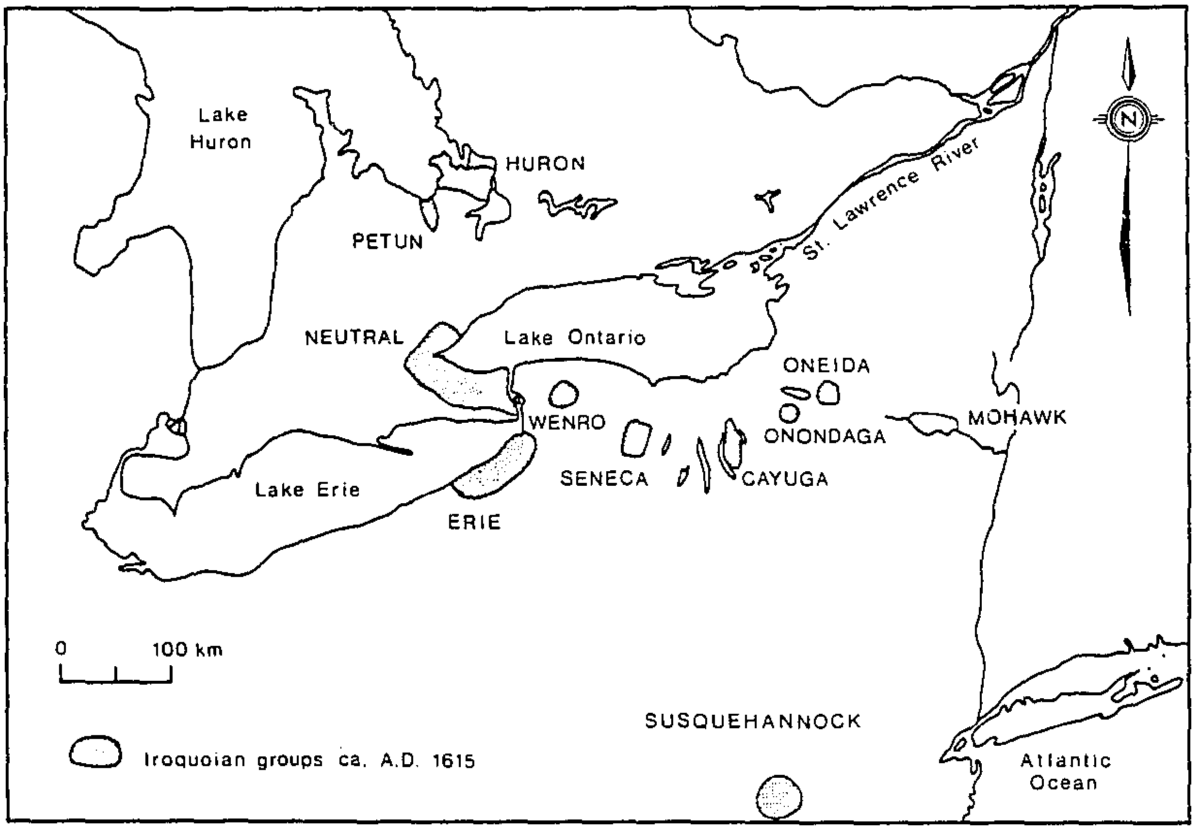

Figure 1. Distribution of Iroquoian groups in the early seventeenth century.

Samuel de Champlain, explorer and one of the founders of New France, sojourned with the Huron and visited the Petun country during the winter of 1615-1616. His original account of that winter, published in 1619, documents 18 villages (six palisaded) for the Huron (Attigouantan) country populated by "two thousand warriors, **not counting the common mass**, which amounts perhaps to thirty thousand souls"(i.e. 32,000 people in all) (Biggar 1922-1936, 3:121-122; emphasis added). A subsequent account of that same winter, published in 1632, reports 18 Huron (Attigouantan) villages (eight palisaded) but a population total of only 22,000 (including 2,000 warriors) (Biggar 1922-1936, 4:301-302). Both accounts of Champlain and LeCaron's visit to the Petun country in January of 1616 recorded seven villages and two additional ones under construction, the latter probably replacement villages (Biggar 1922-1936, 3:95-96, 4:278-284). No population estimates were given.

There are several problems with Champlain's estimates. First, they are not strictly his eyewitness observations. Champlain was quoted these figures by the Huron (Biggar 1922-1936, 3:95-96). Etienne Brule, a French youth who had lived among the Huron since 1610, or Savignon, a Huron youth whom Champlain had taken to France over the winter of 1610-1611, might have supplied reasonably accurate population estimates, yet Champlain does not specify that these young men were in fact his informants. It is possible, using a simple type of arithmetic, such as finger digit counting (common to certain native American groups on the Plains (Thompson 1971:192)), that any adult Huron would have been able to convey a rough estimate of the total number of villages and people. Without an interpreter, however, it seems unlikely that such information would have been sufficiently understood by either party (Trigger 1985b:233). Even if Champlain himself had attempted to conduct a hurried census during his visits to most of the principal Huron and Petun villages from 1615 to 1616, the obvious problems with some of his other numerical data, such as his overestimation of the east-west dimensions of the Huron country (Heidenreich 1971:25) and the house totals for the village of Cahiague (Trigger 1976:304), where he resided for several weeks and supposedly would have had ample time to count them, add further suspicion to the accuracy of his population figures.

Champlain's Huron warrior total is a serious internal inconsistency of his population estimate. As Bruce Trigger (1985b:233) notes, it is inconceivable that the number of adult males would have been less than 7% of the entire Huron population. Even doubling the warrior count to account for men who were away trading (Dickinson 1980:177) underrepresents adult males. The generally cited proportion of warriors in native societies of early contact North America is 25-35% (Aten 1983:45; Dobyns 1983:179; Mooney 1928; Snow and Lanphear 1988; Ubelaker 1974:69).

It is also uncertain to what proportion of the Huron-Petun these figures apply. Champlain referred to all the Huron as the **Attignawantan**, the name of the westernmost tribe of the Huron confederacy (Heidenreich 1971:81-82). Yet, he visited the entire Huron-Petun country and presumably would have attempted to provide an estimate for the entire region. The final problem is the clear discrepancy between Champlain's two accounts: in the later one the number of palisaded villages increases from six to eight and total population decreases by 10,000. It is not known whether these are editorial revisions made in light of improved knowledge of the Huron or merely typographical errors.

Despite numerous problems, Champlain's population total of 32,000 Hurons is substantiated by most other seventeenth century accounts.

Gabriel Sagard, a Recollet lay brother, lived among the Huron from August 1623 to May 1624 and published his observations of everyday Huron life (Wrong 1939) in what has been labelled one of the first book-length ethnographies (Trigger 1969:4). Sagard did not travel throughout the Huron-Petun heartland and seems to have relied on Huron informants and perhaps Champlain's writings for much information, including population size and number of villages (Heidenreich 1971:91; Trigger 1969:12). However, Sagard was more aware of Huron politics than Champlain because he recognized three tribal groups (i.e. the Attignawantan, Attigneenongnahac, and Arendarhonon) living in 25 villages "inhabited by two or three thousand warriors at the most, without reckoning the ordinary people who may number about thirty or forty thousand souls in all" (Wrong 1939:91-92). Sagard's population estimate shares some of the problems of Champlain's: no explicit account of how it was compiled and an unbelievably low warrior count. There is, however, a distinct difference between Sagard's and Champlain's estimates. Sagard recorded not 18, but 25 villages. While it is conceivable that three large Huron villages each fissioned into two or three smaller ones between 1616 and 1623, thus creating seven more villages (Heidenreich 1971:100), it seems

Table 1. Seventeenth-Century Estimates of Huron Population. ‡

Date Observed	Recorder	Population Estimate	Warrior Count	Village Count	Source
1615-1616	Champlain	32,000	2000+	18a	Biggar 1922-1936, 3:122
1615-1616	Champlain	22,000	2000+	18b	Biggar 1922-1936, 4:302
1623-1624	Sagard	30,000-40,000	2000-3000	25c	Wrong 1939:91
pre-1633	LeJeune	30,000	-	-	Thwaites 1896-1901, 6:59
1634-1635	Brebeuf	30,000	-	20	Thwaites 1896-1901, 7:225, 8:115, 10:313
pre-1633	Lalemant	30,000	-	-	Thwaites 1896-1901, 17:223
pre-1633	LeMercier	30,000-35,000	-	-	Thwaites 1896-1901, 42:221
pre-1633	Druillettes	30,000-35,000	-	-	Thwaites 1896-1901, 44:249
pre-1633	LeClerq	10,000	-	18	LeClerq 1881:96-97
1639-1640	Lalemant	10,000	-	-	Thwaites 1896-1901, 17:223
1639-1640	Lalemant	12,000d	-	32d	Thwaites 1896-1901, 19:127
post-1640	Lalemant	10,000-20,000	-	-	Thwaites 1896-1901, 28:67

‡ Table adapted from Heidenreich 1978:370

a Population estimate may refer to both Petun and Huron but village count refers only to Huron. In January of 1616 Champlain and Le Caron visited seven Petun villages, two under construction (Biggar 1922-1936, 3:95-101, 4:278-284).

b Population estimate may be a typographical error in this later (published 1632) account of Champlain's visit to the Huron and Petun country. There is a possibility, however, that it reflects a correction of the first account (published 1619) that may have combined both Huron and Petun populations but not village totals. If the latter explanation is correct, these figures would be for the Huron only.

c Population estimate and village total are probably for both the Huron and Petun (see Trigger 1985b:233).

d Population and village counts are for Huron and Petun combined. The population ratios were not recorded but the Petun lived in nine of the 32 villages.

more likely that Sagard's higher village and population totals reflect a combined Huron (18 villages) and Petun (seven villages) census (Trigger 1985b:233).

In 1633, Paul Le Jeune, head of the Jesuit mission in New France from 1633 to 1637, wrote that the Huron population was 30,000. Since Le Jeune had never been to the Huron country, this figure must have been obtained from either Champlain or two Jesuit missionaries, Anne de Noue and Jean de Brebeuf, who had lived with them between 1626 and 1628 (Heidenreich 1971:91).

Despite local depopulation from the first recorded epidemic of European disease, which struck the Huron in 1634 (Heidenreich 1987; Trigger 1981), 30,000 Huron living in twenty villages was the population figure consistently reported between 1634 and 1636 by Jean de Brebeuf, a Jesuit missionary to the Huron (Thwaites 1896-1901, 7:225; 8:115; 10:313). Although Brebeuf was perhaps the most knowledgeable European of his day about Huron culture, he probably had not personally visited every Huron-Petun village but had simply accepted the earlier population estimates as fact (Trigger 1969:12). Other Jesuits who worked in the Huron mission reported the same general pre-epidemic population of 30,000-35,000 Hurons (Thwaites 1896-1901, 42:221; 44:249).

In order to better manage the Huron mission, the Jesuit superior, Jerome Lalemant, directed a comprehensive census of the Huron and Petun from the late spring of 1639 to the winter of 1639-1640, at the same time that Ste Marie I was established (Dickinson 1980:178; Trigger 1976:578). Although no original tally sheets have ever surfaced, Lalemant (Thwaites 1896-1901, 19:127) summarized the results:

> . . . we have had means to take the census not only of the villages, large and small, but also of the cabins, the fires, and even very nearly of the persons in all the country, - there being no other way to preach the Gospel in these regions than at each family's hearth, whereof we tried to omit not one. In these five missions there are thirty-two hamlets and straggling villages, which comprise in all about seven hundred cabins, about two thousand fires, and about twelve thousand persons.

Certain features of the 1640 census require explanation. First, given that two families shared each central hearth in a Huron longhouse (Biggar 1922-1936, 3:123; Thwaites 1896-1901, 15:153; 16:234; 35:87; Wrong 1939:94), the census implies that there were only three persons per family, an unusually low average family size. The coincidence of the census with a major smallpox epidemic over the winter of 1639-1640 suggests that the Jesuits adjusted their population figures, but not the hearth counts of the previous summer, in the spring of 1640 (Trigger 1976:578; 1985b:234). Similarly, the overall drop in Huron population from 30,000 to 10,000 can be attributed to a series of epidemics of European disease that swept the Huron-Petun homeland from 1634 to 1640 (Thwaites 1896-1901, 19:127; Trigger 1981). Lastly, the census does not report separate tallies for the Huron and Petun. Conrad Heidenreich (1971:92-93), assuming equal proportionality for the number and size of Huron and Petun villages, calculated that in 1640 there were 9,000-10,000 Huron and 2,000-3,000 Petun.

The last contemporary estimate of Huron population was made by Jerome Lalemant in 1645: 10,000-20,000 persons (Thwaites 1896-1901, 28:67).

Another potential source of information from the seventeenth century about Huron population are four maps by Jesuit authors (Heidenreich 1966). The **Corographie du Pays des Hurons**, perhaps drawn by Jerome Lalemant from the 1640 census data (Heidenreich 1966:111-113), depicts the Huron country between 1639 and 1648 (Figure 2) (Trigger 1976:579). Excluding the mission of Ste Elizabeth to the Onontchatoronon, who were Algonkian visitors, 22 village sites are plotted, including three unnamed ones. Another map published by Du Creux in 1664 (Figure 3) is a crude copy of the **Corographie** and shows only 19 Huron village locations, the three unnamed ones having been omitted. A third map, the **Description du Pais des Hurons**, displays only 16 Huron villages and just two for the Petun (Figure 4). Brebeuf may have drawn the map outline in 1631 and labelled some villages, but an amended date and labels in different handwriting suggest that someone else revised this map in 1651 to portray the Huron country of the late 1640s (Heidenreich 1966:114). The final map, the **Huronum Explicata Tabula, 1657** inset from the map of New France authored by Francois Bressani, has essentially the same outline as the **Description** but depicts 15 Huron villages and five Petun ones (Figure 5). The "Bressani map" is actually the most problematic in terms of village chronology. For example, it depicts locations for Ihonatiria, Carhagouha, and Ste Marie II - non-contemporaneous settlements dating from as early as 1614 to as late as 1651 (see Heidenreich 1971:31-48). Unfortunately, no population estimates appear on any of these maps. However, as will become apparent in Chapter 7 of this study, these maps are invaluable aids in the

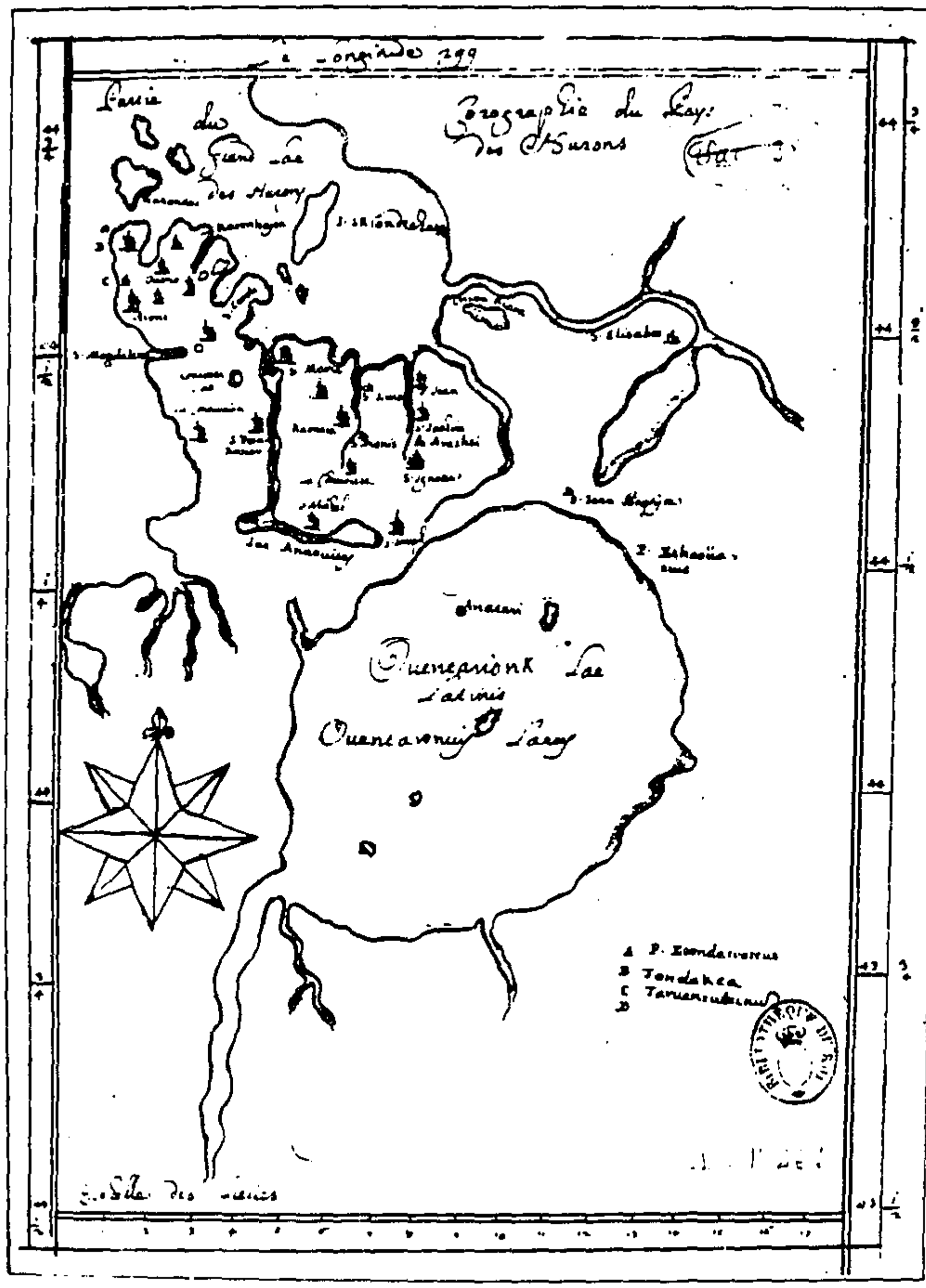

Figure 2. Corographie du Pays des Hurons, ca. A.D. 1639-1648. (reproduced from Trigger 1976:579; Public Archives of Canada, Ottawa)

Figure 3. Chorographia Regionis Huronum from Francois Du Creux's Historiae Canadensis 1664. (reproduced from Heidenreich 1971; Public Archives of Canada, Ottawa)

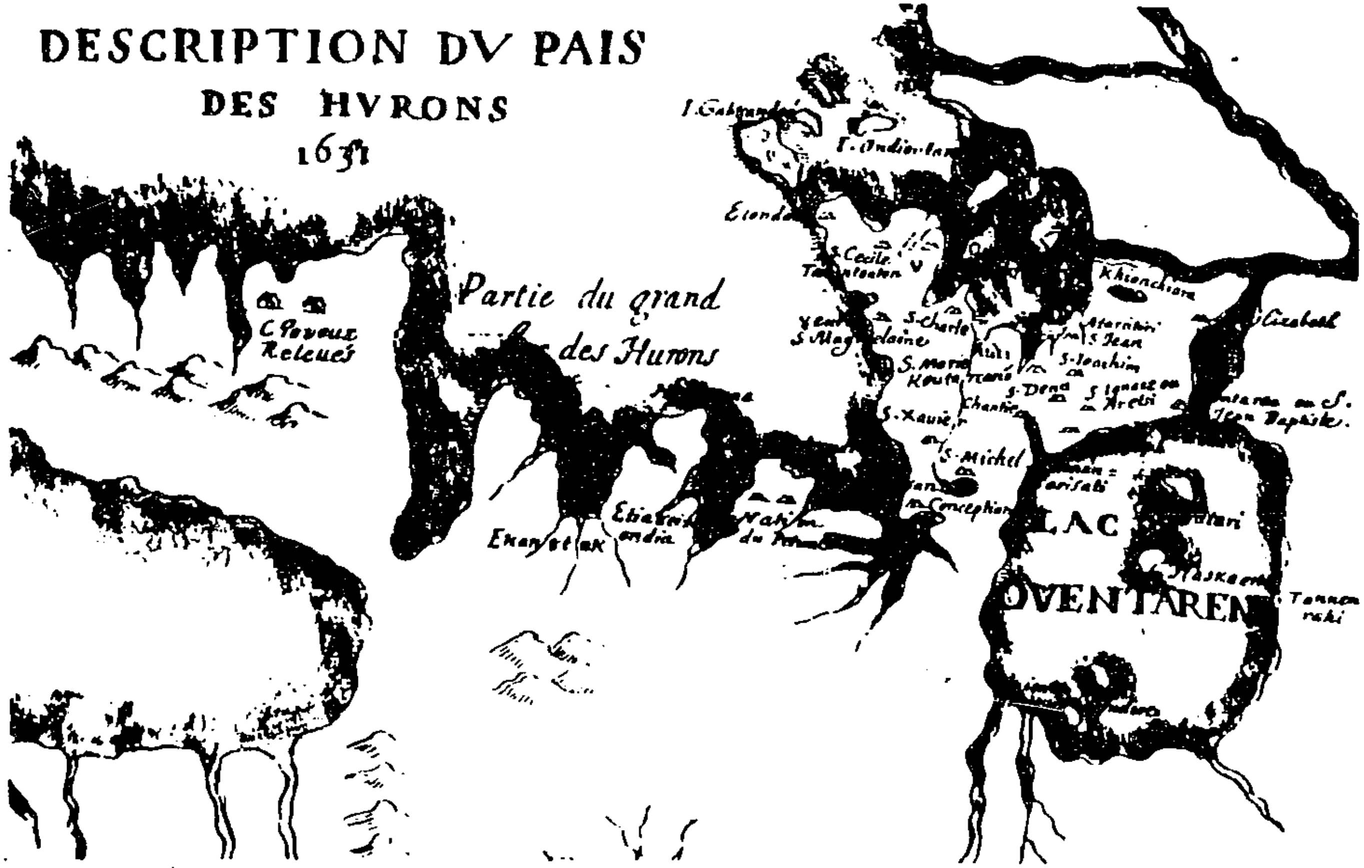

Figure 4. Portion of <u>Description du Pais des Hurons</u>, ca. A.D. 1631-1651. (reproduced from Heidenreich 1971; Public Archives of Canada, Ottawa)

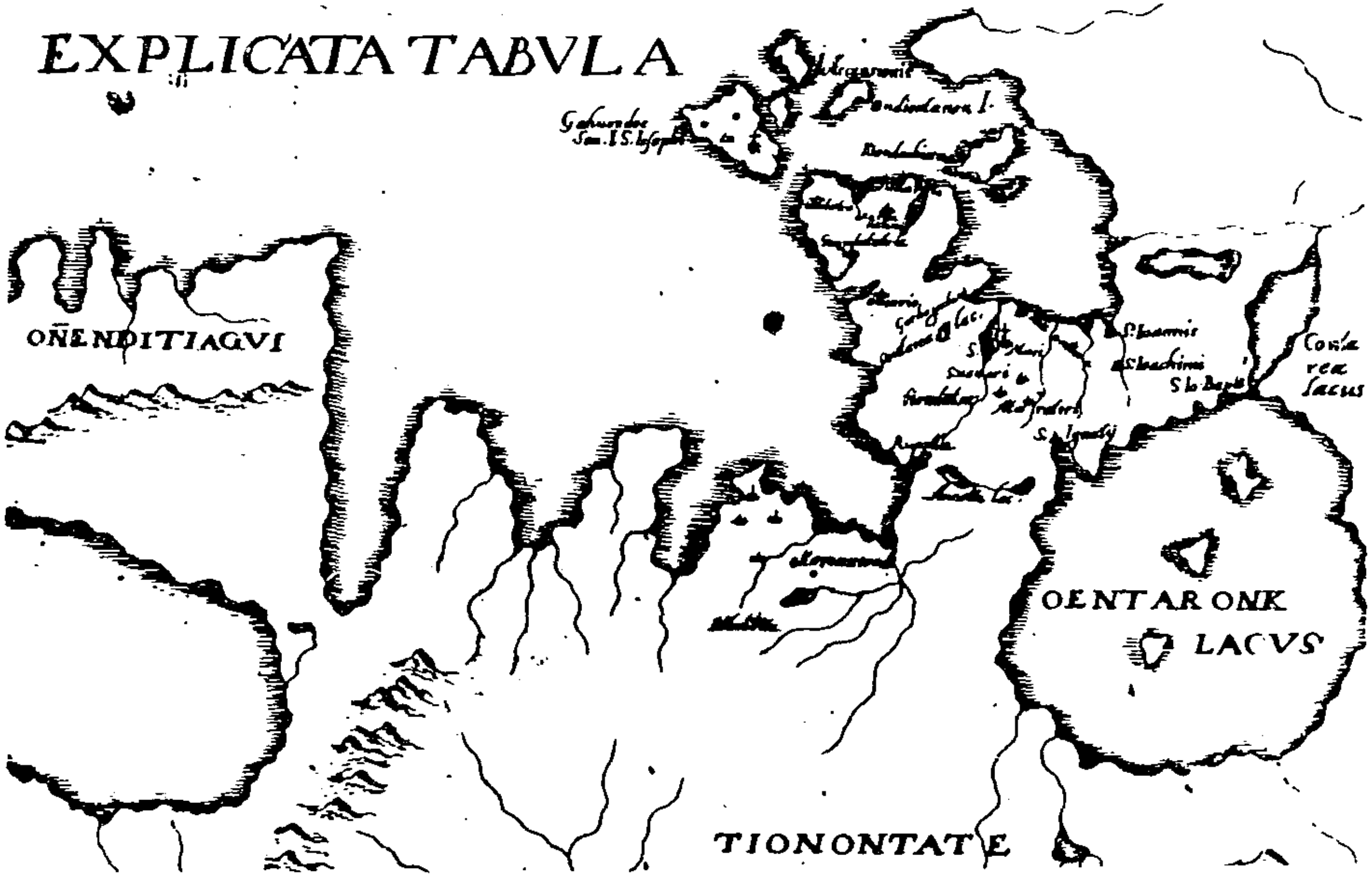

Figure 5. Portion of inset Huronum Explicata Tabulus, 1657 attributed to Francois-Joseph Bressani. (reproduced from Heidenreich 1971; Public Archives of Canada, Ottawa)

identification of archaeological sites with seventeenth century villages (see Latta 1985b for difficulties with this approach).

Seventeenth-century estimates for other Iroquoian groups, such as the Neutral and Five Nations Iroquois, are considerably fewer in number and less accurate than those for the Huron-Petun, but may shed light on population of the latter through comparative references. The Neutrals, according to Champlain in 1615, inhabited 40 villages and could field 4,000 warriors (Biggar 1922-1936, 3:99-100; 6:249). Sagard's warrior totals for the Neutral in 1623 were 5,000-6,000. In 1633, Le Jeune wrote that the Neutrals had a much larger population than the Huron (Thwaites 1896-1901, 7:225). Following the same series of epidemics that reduced Huron-Petun numbers from 1634-1640, Lalemant recorded in 1640 that there were only 12,000 Neutrals but that they still occupied 40 villages and could muster 4,000 warriors (Thwaites 1896-1901, 21:189-191). The obviously erroneous reports of a constant number of Neutral villages and warriors for pre-epidemic and post-epidemic periods emphasizes the limitations of the seventeenth century documents (see Dodd 1984:308-327 for an excellent explication of the disparities between seventeenth century accounts of longhouses and archaeological data for seventeenth-century houses).

Demographic information on the early seventeenth-century Iroquois is even more meagre than the Neutral record. Only inferential pre-epidemic population estimates can be made for two of the five Iroquois tribes - the Mohawk and the Oneida. In the winter of 1634-1635, Harmen van den Bogaert and two Dutch companions visited all the Mohawk villages and the single Oneida village, recording house totals for each (Jameson 1909). Correcting van den Bogaert's tallies to account for the abandonment and relocation of four original Mohawk villages following a devastating smallpox epidemic (Snow 1986:5-8), the total number of Mohawk houses occupied prior to 1634 would have been 125, not 180 as reported. The principal Oneida village appears to have contained 66 houses at the time the smallpox epidemic struck (Jameson 1909:149). In 1643, the Mohawk inhabited only three villages and could field 700-800 warriors (Thwaites 1896-1901, 24:271). Modern estimates of Mohawk population from these house numbers will be discussed in the next section of this chapter. Unfortunately, no pre-1650 population estimates are available for any of the Five Nations tribes. In fact, warrior counts made in 1660 (Thwaites 1896-1901, 45:207) for each tribe are the first seventeenth-century estimates reported (Table 2). They are not very informative about Iroquois numbers, however, because they include a large percentage of resettled Hurons, Neutrals, and other groups (Thwaites 1896-1901, 51:187; Trigger 1976:826-836).

This constitutes the entire written record of population totals for early seventeenth-century Iroquoians of the Northeast. Ethnohistoric interpretation of the early records and archaeology provide the sole means for accurately estimating precontact populations for the majority of northern Iroquoians.

Table 2. Population Estimates for Various Northern Iroquoian Groups.

Iroquoian Group	Pre-epidemic population estimate	Post-epidemic population estimate	Source
Huron	10,000		Mooney 1928:23-24
Huron	45,000-50,000	-	Popham 1950:87
Huron	18,000	9,000	Trigger 1969:11-13
Huron	23,500	9,000	Trigger 1985b:234
Huron	16,000-22,500 (21,000)	9,000	Heidenreich 1971:96-103
Huron	18,000-22,000 (20,000)	9,000	Heidenreich 1978
Huron	20,000	-	Heidenreich 1987
Huron	25,000-30,000	10,000	Dickinson 1980
Huron	30,000		Wright 1977:184, 1987
Huron	30,000	9,000-12,000	Johnston 1987:20-21
Huron	25,000-30,000	10,000	Clermont 1980
Petun	8,000		Mooney 1928:23-24
Petun	8,000	3,000	Trigger 1969:11-13
Petun	12,000	2,900	Garrad 1975
Petun	8,000	3,000	Garrad and Heidenreich 1978
Petun	5,000-10,000	3,500-4,000	Clermont 1980
Neutral	35,000-40,000	12,000-20,000	Noble 1984:17
Neutral	20,000-30,000	12,000	Clermont 1980
Iroquois	5,500		Mooney 1928
Iroquois	12,000		Tuck 1971
Iroquois	20,000		Trigger 1976:98
Iroquois	15,000-20,000	8,000	Clermont 1980
Seneca	<5,200-5,500>[a]		Vandrei 1987
Seneca		4,000	Tooker 1978:421
Cayuga		1,200	Tooker 1978:421
Oneida		400	Tooker 1978:421
Onondaga	<1,000-2,000>[a]		Bradley 1987
Onondaga		1,200	Tooker 1978:421
Mohawk	11,000	4,500	Starna 1980
Mohawk	8,100	2,000	Snow and Lanphear 1988

a Population estimates from village number and size (converting site area into population by multiplying total hectares by 500 people per hectare (see Wright 1987))

Iroquoian Population Research

Ethnohistory and its sister discipline prehistoric archaeology are the basic methodologies for writing Native American history (Trigger 1982:16; 1985b:166). Research on Iroquoian population history has been essentially ethnohistorical in orientation, with a heavy reliance on early seventeenth century writings of European explorers, missionaries, and colonists (e.g. Dickinson 1980; Heidenreich 1971; Johnston 1987; Starna 1980; Trigger 1969). Early contact population estimates for various native groups, roughly calculated from available seventeenth century observations and depopulation ratios (e.g. Johnston 1987), have even been projected into more remote prehistoric times on the assumption of population homeostasis (e.g. Heidenreich 1967:27; Engelbrecht 1987:24). In order to understand why there have been so few archaeological estimates of Iroquoian population and practically no studies of Iroquoian population change, it is necessary to review the history of Iroquoian demographic research.

Iroquoian archaeology in the late nineteenth and early twentieth centuries was based largely on ethnography. Archaeologists operated within a static, culture-area paradigm. While extensive regional surveys in Ontario (e.g. Hunter 1889) and New York (Beauchamp 1900) had located hundreds of Iroquoian sites and provided useful data for making regional population estimates, the goal of ethnographic archaeology was to recover artifacts and determine their manufacture and use (Trigger 1985b:61-62). Differences in site assemblages were attributed to Algonkian or Iroquoian occupations and the only mention of population change in Iroquoian prehistory was the use of migration to explain the location of specific Iroquoian tribal groups at the time of contact (Trigger 1985b:60-63).

Because of the static approach to Iroquoian history in the first half of the twentieth century, there was no incentive for archaeologists to deal with internal change, including demographic change (Trigger 1985b:60). Population estimates recorded by explorers and missionaries for historic Iroquoian tribes were simply projected into prehistoric times (e.g. Mooney 1928; Kroeber 1939; Fenton 1940). James Mooney's (1928) comprehensive study of native North American populations relied exclusively on historic estimates on a tribe-by-tribe basis or dead-reckoning. He lists 10,000 Huron, 8000 Petun, and 5500 Iroquois at the time of European contact, obviously post-epidemic figures. Alfred Kroeber (1939:140-150) agreed with Mooney's figures for the Huron-Petun, and justified their accuracy by calculating the maximum carrying capacity and population density of the Huron-Petun culture area. Errors in Kroeber's method and Mooney's use of post-epidemic census data, at least for the Huron, suggest that both anthropological population estimates are too low (Heidenreich 1971:94-95). Similarly, William Fenton's (1940) estimate of 10,000 Iroquois is too conservative (Starna 1980).

In the mid-twentieth century, Iroquoian archaeology developed a concern with culture change as an offshoot of developing site chronologies based on pottery seriations. Chronological archaeology was practiced first in New York by William Ritchie (1965), then in Ontario (Emerson 1954). While house and village plans were recovered for the Huron-Petun during the 1950s excavations of Wilfrid Jury and J. Norman Emerson, there was little concern with interpretation, particularly in terms of population estimates. Building culture chronologies was still the main goal of Iroquoian archaeology (Trigger 1985a:9-11).

In 1950, Robert Popham (1950) made the first attempt to estimate Huron-Petun population using archaeological data. Based on Andrew Hunter's (n.d.) unpublished notes of contact period site locations in Innisfil Township, he argued that the early seventeenth century reports of 30,000 Huron were an underestimate because they had failed to count the ten contact villages in Innisfil Township. Accepting the 30,000 value for northern Simcoe County, Popham (1950:86-87) calculated a population density for the Huron heartland and applied it to the whole area west of Lake Simcoe, arriving at an estimate of 45,000-50,000 Huron prior to European contact. This estimate is unacceptable for two reasons. First, it is extremely unlikely that Champlain, Sagard, and the Jesuits would have had no knowledge of an Iroquoian group in southern Simcoe County that supposedly rivalled the Petun in numbers (Heidenreich 1971:95). Secondly, Popham failed to take account of chronological differences in contact Huron sites. All Iroquoian sites thus far discovered in Innisfil Township were occupied prior to A.D. 1615 (Warrick 1988a).

A major change in Iroquoian archaeology occurred in 1952, when Richard MacNeish published **Iroquois Pottery Types**, in which he proposed an in situ development for northern Iroquoian groups. No longer were population movements and replacements adequate explanations for changes in prehistory. Thus the in situ theory invited processual explanations of Iroquoian culture change (Trigger 1985a:11). Soon, factors such as trade, warfare, and population growth were seen as important causes of Iroquoian cultural development (Noble 1969; Wright 1966).

In the mid-1960s, three publications altered the course of Iroquoian population research. In an attempt to expand MacNeish's in situ theory, James V. Wright published **The Ontario Iroquois Tradition** (1966) and William Ritchie published **The Archaeology of New York State** (1965). In these books, for the first time archaeological data were used to infer **prehistoric** Iroquoian population change. Both archaeologists proposed a marked population increase in the fourteenth century, based on a rise in the number of sites and an apparent increase in agricultural food remains. It is important to realize that such inferences were new for archaeology. Wright's and Ritchie's books appeared at the same time as Robert Adams' (1965) and Bruce Trigger's (1965) systematic studies of changes in past population sizes from archaeological settlement patterns in the Near East and Nubia respectively. The latter are considered pioneering attempts at both settlement and demographic archaeology (Hassan 1981:66; Parsons 1972:141). However, the former approaches are much less sophisticated than the latter.

The direction of Iroquoian demography was also changed in the 1960s by the publication of a paper by Henry Dobyns (1966). Following the lead of Woodrow Borah and Sherburne Cook (1963), Dobyns argued that previous estimates of the aboriginal population of the Americas were far too low because they did not consider the potential impact of protohistoric epidemics. Based on historical evidence, primarily from central Mexico, Peru, and California, Dobyns (1966:414) proposed that Native American population counts made 130 years after initial contact amount to only one twentieth of precontact population. He was, and remains, convinced that epidemics of European diseases, such as smallpox, measles, and influenza, were introduced to most indigenous peoples of the New World far in advance of actual physical contact with Europeans. Catastrophic reduction of population ensued because the European pathogens infected whole communities of non-immune Native Americans. Consequently, Dobyns believes (1966;1983) that, in most cases, the very first post-Columbian population counts reflect populations which had already experienced serious depopulation. A number of Iroquoian researchers, presumably having read Dobyns (1966), support the idea that the Huron-Petun may have experienced protohistoric epidemics (Brasser 1978; Crosby 1976; Dickinson 1980; Garrad 1980; Martin 1978:51-54,91; Ramenofsky 1987a). Others (Clermont 1980; Heidenreich 1971; Snow 1980:32-33; Snow and Lanphear 1988; Sullivan 1983; Trigger 1981a; 1985b:231-242) remain unconvinced and rightly look to archaeology to provide a definitive solution to the problem of sixteenth century epidemics in the Northeast.

Over the last two decades, archaeological research on Iroquoian population sizes can be characterized as synchronic or diachronic. Synchronic research includes all attempts to use historical data to establish Iroquoian population numbers as a basis for improving our understanding of historic Iroquoian populations and the magnitude of demographic collapse following European contact (e.g. for the Neutral

(Noble 1984:16-18) and Huron (Dickinson 1980; Heidenreich 1971:91-106; Johnston 1987; Trigger 1969:11-13; 1985b:234)) or to shed light on precontact populations when archaeological data are unavailable or inadequate (e.g. for the Mohawk (Snow 1980:34; Starna 1980) and Seneca (Dobyns 1983:313-327)).

Prior to the compilation of settlement pattern data, archaeologists who were interested in Iroquoian population were forced to rely on historical data. Bruce Trigger (1966; 1969:11-13), for example, put the precontact Huron population at 18,000. This figure assumed that the Champlain estimate of 30,000 Huron is inflated, that the 1640 Jesuit census is roughly accurate, that there were 9,000 Huron survivors, and that the mortality rate from the smallpox epidemic was 50%. A re-evaluation of his own work (Trigger 1985b:234), perhaps in response to criticism of his first estimate (Dickinson 1980), yielded a total of 23,500 Huron at A.D. 1615. Conrad Heidenreich (1971), a historical geographer, presented three independent estimates of early contact Huron numbers, ranging from a low of 14,000 to a high of 33,300. He accepted an average of the three medians: 21,000 Hurons prior to 1630. He has subsequently lowered this total to 20,000 (Heidenreich 1978; 1987). Heidenreich's (1971:98) first pre-epidemic estimate was calculated from two post-epidemic populations (8,700 and 10,000) and three depopulation ratios (50, 60, and 70%), resulting in a range of values 17,400-33,300. The second estimate (12,000-18,000) was made by multiplying warrior counts (2,000-3,000) by six (presumed Huron family size). His last estimate of precontact Huron population (1971:100-102) was derived from individual village populations by extrapolating from fragmentary records for two large villages occupied in the 1630s, Ossossane and Teanaustaye. Setting the largest villages at 1,500-2,400 people and the smallest at 300 people, the tally for 28 villages amounted to 20,400 pre-epidemic Huron.

The major criticisms of the Trigger-Heidenreich estimates are that they are too low in light of the seventeenth century documents (Dickinson 1980), that their depopulation ratios only considered the effects of the 1639-1640 smallpox epidemic (Johnston 1987), and that preliminary archaeological investigation of Huron population supports seventeenth century census data (Wright 1977:184). However, much of this criticism is unfounded. Dickinson's (1980) work has been questioned itself by palaeodemographic data from the Kleinburg ossuary (ca. A.D. 1600) which implies no population reduction prior to A.D. 1615. Johnston's (1987) estimates are predicated on estimated mortality rates for the Huron epidemics of 75-85% (cumulative depopulation of 62-69%). These may be too high and, anyway, there is simply no way to verify them using historical records. Finally, James Wright (1977) presents no empirical data to support his position, other than a few generalizations . In all fairness to Trigger and Heidenreich, both recognized that the ultimate answer to precontact Huron population size lies in archaeology (Heidenreich 1971:101; Trigger 1981b, 1985b:242).

Ethnohistorical estimates of contact Petun (Garrad 1975, 1980; Garrad and Heidenreich 1978), Neutral (Noble 1984), Mohawk (Snow 1980; Starna 1980) and Seneca (Dobyns 1983) population sizes are as tenuous as those for the Huron.

Petun population at A.D. 1615 has been estimated at 6,000-8,000 persons, by backwards extrapolation from the post-epidemic (A.D. 1640) census (Garrad and Heidenreich 1978; Trigger 1969:11-13). Charles Garrad (1975) calculated, from the number and size of archaeological ossuary and village sites, a pre-epidemic Petun population of 10,000-12,000. Garrad's estimates are suspect, however, since he merely borrowed Heidenreich's (1971) questionable empirical generalizations about residential density and family size for the Huron.

The precontact Neutral population has been approximated between 35,000 and 40,000 (Noble 1984:16-18), based on the archaeological verification of 40 contemporaneous Neutral villages that were occupied in the early 1630s. Unfortunately, Noble provides no archaeological data, such as total site areas and residential density values, in support of his estimate.

According to the ethnohistoric research of William Starna (1980) and Dean Snow (1980:34, 1986), there were 8,100-11,000 Mohawk prior to the smallpox epidemic of 1634-1635. Using a number of sources, including warrior counts, epidemic mortality rates, house tallies, residential density values inferred from archaeological sites (primarily from Heidenreich (1971) and Wright (1974)), both authors present convincing estimates. The ongoing Mohawk Valley Project (Snow 1987a,1987b; Snow and Starna 1989) will supply independent archaeological estimates.

Only indirect estimates are available for the population size of the early seventeenth-century Seneca and Onondaga, and no published ethnohistoric or archaeological estimates exist for the Oneida. Based on an assumed correlation between Wray and Schoff's (1953) Seneca village relocation sequence and supposed dates of disease pandemics during the sixteenth century, Dobyns (1983:313-327) has postulated that Seneca numbers were substantially reduced prior to the seventeenth century by a series of epidemics of European disease. There is little empirical evidence, however, for sixteenth-century Seneca depopulation. Wray and Schoff's (1953) chronology depends on untested assumptions of site duration and, in any event, may date the initial appearance of European trade goods in Seneca sites 25 years too early (Kenyon and Fitzgerald 1986). Archaeological data from the Seneca heartland indicate no substantial decline in total settlement area from A.D. 1580 to A.D. 1630 (Vandrei 1987). In fact, Charles Vandrei's (1987) archaeological estimate suggests at least 1,800-4,700 Seneca in A.D. 1600. He used Naroll's (1962) and Casselberry's (1974) formulae for converting the roofed area of a settlement into population, an approach that Ann Ramenofsky (1987a) also employed in her inconclusive efforts to determine if the New York Iroquois had experienced depopulation already in the sixteenth century.

No ethnohistoric estimates of early contact Onondaga population have appeared in print. Archaeologically, the Onondaga are relatively well-known (Tuck 1971; Bradley 1987). The village relocation sequence and approximate site sizes suggest that most of the Onondaga of the early 1600s lived in one large village (approximately 1.6 hectares in area) (Bradley 1987:116) but archaeologists have not attached population values to their settlement pattern data.

The most recent study of protohistoric Iroquoian population is Ann Ramenofsky's **Vectors of Death: The Archaeology of European Contact** (1987a). Her analyses of archaeological settlement data, at least for the southeastern United States, seem to support the Dobyns (1966,1983) hypothesis of protohistoric depopulation, but for the New York Iroquois, there is no certain evidence of a protohistoric decline in population. The issue of sixteenth-century epidemics in the Northeast is not resolved by Ramenofsky's (1987a) research because of a limited site sample (only 26 Iroquois sites were used, representing all five tribes and spanning at least three centuries) and imprecise periodization (i.e. the 80 year durations of Period III (A.D.1525-1613) and Period IV (A.D. 1613-1700) are too large to pinpoint the initial decline of Iroquois populations (Trigger 1985b:240)).

The diachronic approach to Iroquoian population research relies primarily on archaeological settlement data or on a combination of settlement and skeletal data (Pendergast 1983; Pfeiffer 1983, 1986) to estimate past population size and trace changes in population. Beginning in the early 1970s, Ontario Iroquoian population research assumed a more diachronic perspective, as a result of the rapid accumulation of settlement data from research and archaeological resource management projects. Following Wright's (1974) rescue excavation of the Nodwell site, relatively complete village excavations (e.g. Draper (Finlayson 1985), Ball (Knight and Cameron 1983), and Fonger (Warrick 1984)) have produced data for estimating village populations from house floor plans and house densities. In addition, intensive regional surveys (e.g. Penetang Peninsula (Latta

1973; O'Brien 1976b), Trent Valley (Ramsden 1977c, 1978a, 1981) and the greater Toronto area (Kapches 1981a; Konrad 1975; Poulton 1979)) have supplied a wealth of data for making Iroquoian population inferences for large geographical areas of Ontario and New York State Iroquoians (Tuck 1971; Snow 1985, 1987b).

Despite the accumulation of large bodies of settlement data, inferences about prehistoric Iroquoian population change remain grounded on inadequate data, overly-simplistic demographic models, and questionable assumptions. Key demographic questions still remain unanswered for Iroquoian prehistory. For instance, archaeologists have not determined whether the adoption of corn agriculture by Early Iroquoians was the result of population growth, the cause of population growth (Stothers 1977), or even related to population change (Trigger 1985b:86-87). Similarly, it is generally assumed that fourteenth-century Iroquoians experienced a dramatic population increase (Noble 1969:21-22, 1975b:44; Sykes 1981:29; Wright 1972:78). Yet, there is neither sufficient archaeological evidence for such an increase nor a sufficient explanation for one. The first introduction of beans to Ontario, originally proposed as the cause of the fourteenth-century population explosion (Wright 1966, 1972; Noble 1975b), is now known to have occurred as early as the twelfth century (Fecteau 1985). The final outstanding problem of Iroquoian population research is the major controversy over sixteenth-century epidemics, which has been addressed in the preceding sections of this chapter.

In the last few years, certain Northeastern archaeologists have stressed the importance of a demographic approach for Iroquoian prehistory (Schindler et al. 1981; Snow 1981; Trigger 1981b; Ubelaker 1981), yet no one has applied such an approach, except for the ongoing Mohawk Valley Project (Snow 1985,1986,1987a,1987b) and certain recent advances in Ontario Iroquoian archaeology. For example, Robert Pearce (1984) suggests that population may not have increased appreciably in Middle Iroquoian times, after tracing settlement relocations in a small geographic area near London, Ontario. Ron Williamson's (1985) reconstruction of Glen Meyer settlement-subsistence patterns on the Caradoc Sand Plain stresses the need for Iroquoian demographic archaeology to take account of subsistence and site seasonality. Yet even these studies lack the scope to permit reliable estimates of changes in Iroquoian population from one period to another. There is a pressing need to place Ontario Iroquoian demographic studies on firmer foundations.

CHAPTER 3

THEORETICAL APPROACH

The goals of this study are twofold: to ascertain trends in Huron-Petun population from A.D. 900-1650 and to explain these trends. Achieving each of these goals involves working at different levels of theoretical inference. The first goal requires middle-range theory for inferring population trends from archaeological data and the second a more general explanatory approach, independent of the one used to construct middle-range generalizations. This avoids the pitfalls of tautological argument in archaeological inference (Binford 1981:26). The purpose of this chapter is to explain and justify the various approaches that will be used to infer and interpret the population history of the Huron-Petun.

Theories of Population Change

General theories which purport to account for population change, as presently formulated, are inadequate for achieving the ultimate explanatory goal of this research. There are essentially two general explanations of human population change: Malthusian (population homeostasis) and Boserupian (population pressure). Malthusians believe that for most of human history population has been in equilibrium with available resources. Yet, occasionally there have been dramatic environmental or technological changes in human conditions, such as new methods of food production, that have greatly increased resource availability. This has allowed population to increase and then stabilize at a new equilibrium position by removing "positive" (famine, disease, war) and "preventive" (contraception, marriage practices) checks on population growth. Thus, population change is seen as a **consequence** of change in environmental or sociocultural conditions (Malthus 1959[1798]). On the other hand, Ester Boserup's (1965) theory of agricultural intensification has been modified by anthropologists and archaeologists to explain human population change (Binford 1968; Cohen 1977; Sanders et al. 1979; Smith 1972). The central argument is that because of humanity's innate tendency to increase in number, population pressure, or the imbalance between population and available resources, has **caused** most sociocultural change, from the origins of intensive food collection and agriculture (Cohen 1977; Cohen and Armelagos 1984) to the rise of stratified societies and civilizations (Smith and Young 1984).

While both population theories appear to have some explanatory potential, significant problems are encountered in applying either theory to actual historical or archaeological situations. Malthusians treat population as a dependent variable and Boserupians consider population an independent variable. Yet in real situations, population change is sometimes a direct cause and in other cases a clear result of culture change (Cowgill 1975b; Dumond 1975; Grigg 1980:283-285); population can be both a dependant and independent variable. In fact, Malthusian and Boserupian theories are not opposites but complements (Smith and Young 1984:153-154).

Another problem is that neither theory deals objectively with causes of population change. Malthusians assume that population remains in equilibrium with available resources until environmental or technological change increases the resource base (Wrigley 1969). Population increase is a **natural** outcome of this process. Population pressure advocates, on the other hand, assume that population growth is a natural human tendency and therefore a driving force behind culture change (Binford 1983:208-213; Cohen 1977; Smith 1972). Believing that population growth is inevitable or constant is an unproductive approach to past population change. Because of the long-term perspective provided by the archaeological record, archaeologists have a unique opportunity not only to document population changes but also to determine **why** they change. They can determine in specific contexts the conditions that preceded, accompanied, and followed population change. Furthermore, past population trends can and must be ascertained directly from archaeological data (e.g. burial and house counts), independently of other variables and of **a priori** assumptions derived from general theories. For example, Cohen's (1977:78-83) archaeological indices of population pressure (changes in diet, site distribution, and health of a population) have not been empirically demonstrated to measure population increase (Roosevelt 1984) and hence are not reliable for inferring population change in the past. Even more important, they are useless for measuring the extent of population change.

Carrying capacity, an integral concept for both population theories (Wrigley 1969; Zubrow 1975), creates still more difficulties in applying general or high-level theory to specific cases of prehistoric or historic population change. As critics have noted

(Bayliss-Smith 1978; Brush 1975:807-809; Cowgill 1975a; Harpending and Bertram 1975; Hassan 1981:166-167; Hayden 1975,1981), reconstructing environments and measuring what resources were available and used in what quantities in the past are extremely difficult, if not impossible. Consequently, several archaeologists have suggested an alternative, possibly more operational concept for measuring carrying capacity: the duration and frequency of periods of extreme resource scarcity - a variant of "Leibig's Law of the Minimum" (Hassan 1981:166-173; Hayden 1975,1981; Jochim 1981:181-182; Snow 1981:106-109). Unlike carrying capacity, this concept can (Hayden 1981:523) and has been measured (Cohen and Armelagos 1984) by looking at the health of past populations using their skeletal remains.

A final problem with both theories is that they are too deterministic about the causality of population or culture change (Ellen 1982:269-270; Hassan 1981:162-163). In historically-documented pre-industrial societies , such as Europe (Cowgill 1975b; Grigg 1980; Skipp 1978; Wrigley 1969), population change is often a function of the complex interaction between many connected variables, including the natural environment, human biology and health, subsistence, economic behaviour, sociopolitical organization, and ideology (Figure 6, see p. 46).

An alternative to using high-level theory both to reconstruct and explain past population trends is to utilize middle-range theory to reconstruct those trends and a cultural historical approach, similar to European historical demography (Grigg 1980; Skipp 1978), to explain them.

Middle-range Theory in Archaeology

"Middle-range theory" is a term introduced to archaeology by Lewis Binford (1977) to refer to a set of "'Rosetta stones' that permit accurate conversion from observation on statics to statement about dynamics" (Binford 1981:25). Binford (1981:21-30) rightly points out that, if archaeologists are to be taken seriously by other social scientists in trying to test general theories about human behaviour, they must first determine and make explicit how inferences about past human behaviour are constructed from observations about material remains.

Archaeological inference proceeds in a logical fashion from obser able (intrinsic) properties of material to unobservable (extrinsic) properties of the past (Gardin 1980:65-76). David Clarke (1973:16-17) provides the most comprehensive summary of the different types of archaeological theory which are used to transform material remains into "predictions about the directly unobservable ancient behavioural and environmental patterns." Clarke's (1973) predepositional, depositional, and postdepositional theories correspond to Michael Schiffer's (1976) site formation theory. His retrieval theory deals with recovery of material remains and analytical theory transforms material remains into archaeological data and patterns - i.e. material-material correlations. Finally, interpretive theory generalizes about the correlation between material remains and past sociocultural and environmental conditons. Interpretive theory is middle-range theory. Middle-range theory (material-behavioural correlations) bridges the gap in archaeology between low-level theory (material-material correlations) and high-level theory (behavioural-behavioural correlations) (Raab and Goodyear 1984:264; Trigger 1982b:33; Willey and Sabloff 1980:250-251).

Middle-range theory consists of generalizations about relations between material culture and human behaviour derived from observations in the modern world. Ethnoarchaeology, experimental archaeology, ethnology (Binford 1981:21-30), and ethnohistory (Hodder 1986:116-117; Timmins 1986:5) are important disciplines for deriving relevant correlations for middle-range theory. Middle-range theory also requires the results of site formation theory to factor out the "noise" in relationships between material remains and the behaviour that produced them (Clarke 1978:410-411). The main goal of middle-range theory in archaeology is to determine which archaeological data are the most direct or relevant correlates of key behavioural concepts or variables used in more general theories. Middle-range theory assembles empirically-tested statements about human behaviour derived from specific archaeological contexts which make general theory operational (Raab and Goodyear 1984:264).

It is recognized that this definition of middle-range theory may not be acceptable to all archaeologists. For example, in his most recent writings, Ian Hodder (1986:103-117), who has an anti-positivistic approach to archaeological inference, views both ethnoarchaeology and middle-range theory as producing irrelevant and ahistorical empirical generalizations. He does concede (1986:116-117), however, that ethnoarchaeology and middle-range research, if carried out on living descendants of a prehistoric society (i.e. use of direct historic analogy, such as Carol Kramer's (1982) work in Iranian rural villages), could provide valuable material-behavioural correlates for interpreting the prehistoric record. Hodder (1986) maintains that the most powerful material-behavioural correlates will be those that are idiographic, derived from ethnographic observation of historically-related groups or from historical ethnographies relating to the particular past society being studied.

To illustrate how the study of Huron-Petun population history is a contribution to middle-range theory in archaeology, the discussion will now turn to an examination of the logical relationship between archaeological settlement data and general theories of population change.

The first step in moving from archaeological settlement data to general population theory is to transform the data into a variable that is important to population theory, such as population size. Historical, ethnographic, and ethnoarchaeological data demonstrate a significant correlation between settlement size and site population size (Cook and Heizer 1968; LeBlanc 1971; Watson 1979). The correlation tends to be logarithmic (i.e. as site size increases, population density increases (Sanders et al. 1979:37-38; Sumner 1979:166-168)) and society-specific (Fletcher 1981). Also, it can change through time (Fletcher 1981; Turner and Lofgren 1986).

To establish a site size-population size relationship for a particular society, one must first acquire a sample of roughly contemporaneous sites of different sizes and then estimate the area and population for each site. In archaeological cases, a measure of population, such as number of houses, rooms, hearths, or burials, must be substituted for a direct head count. Direct historic or ethnographic analogy should be used to relate these measures to actual numbers of people for different periods. Site area is plotted on the abscissa and population on the ordinate for each site and the correlation determined. The correlation can then be used to predict population when one has only site area with which to work (Plog 1974). Thus, site size can serve as a direct archaeological measure of population size.

The next step is to determine if population in a specific archaeological context changed through time. This is accomplished by applying the appropriate correlation between site area and population size to assemblages of sites of different time periods in a society's history, keeping in mind site contemporaneity and function.

Once this is achieved, the population trends must be explained in terms of changes in variables, which may be climatic, biological, technological, or sociocultural in nature. Once again, archaeological correlates must be sought that most directly reflect change in these variables. Explanation at this level will be historical or idiographic. Therefore, research about Huron-Petun population trends will contribute to middle-range theory in Iroquoian archaeology by first seeking to discover the explicit logical principles (Gardin 1980) that are best suited for transforming Iroquoian archaeological data into statements about past population trends.

While general theories of population change cannot be tested directly using archaeological data, they can be built and verified by extracting regularities and patterns from a wide range of archaeological and historical case-studies of human population change. General theory can be tested only by means of repeated observations of expected relationships between key variables in particular contexts (Kuhn 1970). Social scientists working with living people can observe these variables directly. Archaeologists must observe them indirectly through their material correlates. Thus, archaeology must operate largely within middle-range theory.

Culture History and Population Change

Several theoretical approaches are available to archaeologists to help them explain cultural and population change in prehistoric times. The primary ones include cultural materialism and neo-evolutionism (processual or New Archaeology (Binford 1983; Harris 1979)), Marxism (Childe 1936; Leone 1982), historical-contextualism (Hodder 1986), and culture history (Trigger 1982b). The approach best suited to explain prehistoric population change is culture history.

In the 1960s, cultural historical archaeology was unfairly maligned for being too artifact-oriented, descriptive, and unconcerned about how cultures change and, with rare exceptions (Trigger 1973), was almost entirely replaced by the cultural materialism and neo-evolutionism of the New Archaeology (Binford 1968, 1983). Over the last few years, however, the culture history approach in American archaeology has regained popularity (Deetz 1988; Trigger 1980,1982a,1985b). The goals of cultural historical archaeology are "to explain individual situations in all of their complex reality"

(Trigger 1982b:32) and to compile culture histories (case-studies) of prehistoric and nonliterate human societies, similar to those provided by ethnographers and historians (Deetz 1988; Trigger 1982a). Archaeological culture histories can then be used by ethnologists to construct general theories of human behaviour (Deetz 1988:21). Ian Hodder's (1986) historical-contextual approach maintains that one of the principal aims of archaeology is to document unique or specific cultural contexts in past time. Cultural materialism and Marxism, like Malthusian and Boserupian demographic theory, carry too many untested presumptions about how populations and societies change to be applicable to specific prehistoric or historic cases.

The study of human population change in historic times is the domain of historical demography (Wrigley 1969) and in prehistoric times it is the domain of demographic archaeology (Hassan 1981; Schacht 1981). Demographic archaeology "is the study of human populations in an archaeological context" (Hassan 1981:1). Palaeodemography, an ancillary data source for demographic archaeology, is a term that should be restricted to the study of human skeletal populations in order to reconstruct the demographic profiles, health, and diets of prehistoric peoples (Buikstra and Mielke 1985; Hassan 1981:95). Cultural historical archaeology shares a remarkably similar explanatory framework with both historical demography and demographic archaeology. An ecological approach to demography and history, inductive reasoning, an idiographic (limited space-time) perspective, and, at least in the variant adopted here, a materialist bias constitute the essential features of all three disciplines

(Cook 1981; Grigg 1980; Hassan 1981; Rotberg and Raab 1985; Skipp 1978; Trigger 1973, 1984; Willigan and Lynch 1982; Wrigley 1969). There are certain advantages to explaining prehistoric population change within this type of framework as opposed to more general theoretical frameworks (Malthusian, Boserupian, Marxist).

One advantage is that an ecological approach to the study of human populations is holistic and realistic. Population change in real situations is often multicausal; multivariate flow-charts and computer simulations are common tools for presenting the complex explanatory models of demography (Katz 1987; Mahadevan 1986; Mosley 1978), historical demography (Grigg 1980; Willigan and Lynch 1982:295) and demographic archaeology (Ammerman and Cavalli-Sforza 1984; Black 1978; Hassan 1981; O'Shea 1978; Zubrow 1975). Referring to Figure 6, the fertility rate for each human population, for instance, is the result of complex interactions between the natural environment, biology, technology, and subsistence (Harrison and Boyce 1972; Hassan 1981; Katz 1972,1987; Wrigley 1969). In turn, fertility can be altered by sociocultural variables (contraceptive practices, marriage rules, family size norms, desires for children, economic and sociopolitical organization, warfare, religious beliefs (Bulatao and Lee 1983)). Changes in any of these variables can produce population change (Cowgill 1975a:129; Dumond 1975; Katz 1972; Willigan and Lynch 1982:390-391; Wrigley 1969). Since population change can in turn stimulate numerous cultural changes, treating population as only one of many variables in a human ecosystem with associated reciprocal causal loops realistically depicts population change as both a cause and consequence of culture change.

Another advantage is that an ecological approach provides a framework for testing implications of higher level theory against empirical data in specific contexts (Ellen 1982:74-78). Values for variables can be estimated from archaeological data (e.g. population size), direct historic analogies (e.g. family size), or crosscultural analogies (e.g. age at marriage, infant mortality rate).

An inductive, as opposed to a deductive, approach to general theories of population change makes no **a priori** assumptions about prime movers of population or culture change (Ellen 1982:267). Each archaeological situation can be considered a specific case study in which the relationship of variables is empirically examined. Rather than attempting to impose general theory on a specific case (deduction), an inductive approach generates specific case studies for

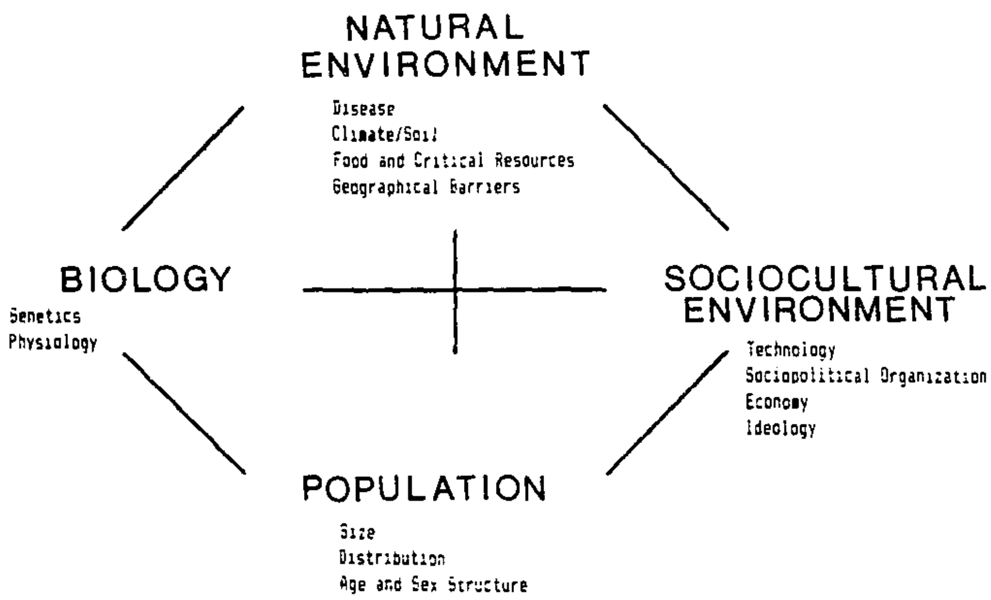

Figure 6. Ecological approach to human population change. (after Hardesty 1977; Katz 1972, 1987)

assessing the reliability of existing general theories and for formulating new theories of human population change. It simply is not possible, with available high-level demographic theory, to "retrodict" adequately the actual trajectory of population change for a specific historic or prehistoric society (see Trigger 1973).

A materialist orientation to the explanation of prehistoric population change is justified by historical evidence and is highly operational in archaeological contexts. It is becoming increasingly clear from historical and ethnographic data that populations waxed and waned, at least in pre-industrial societies, according to constraints imposed by the natural environment, biology, technology, subsistence-settlement, and socio-economic and socio-political systems (Grigg 1980; Skipp 1978; Wrigley 1969). While it is possible that the fertility rate in any society is the sum total of the decisions of individual families, partially influenced by cultural perceptions of affluence and the economic costs and benefits of children (Bender 1979:210-214; Cowgill 1975a:515-516; Handwerker 1986; Hayden 1986:189-192), it is extremely unlikely that such personal and ideological factors would have determined **long-term** historical trends in a **pre-industrial** society's population size to a greater extent than the interplay between biological (natural fertility and disease), environmental (crisis mortality), economic (absolute scarcity of food and other critical resources), and socio-political (war and peace) factors . In fact, prior to the eighteenth century , crisis mortality was probably the largest single determinant of worldwide trends in population growth (see Caldwell et al. 1987:30-31; Grigg 1980:283-285;

Handwerker 1983; Hayden 1975, 1981; McKeown 1985; McNeill 1976:199-200; Snow 1981; Wrigley 1969:89).

Fortunately for demographic archaeology, the more material components of human societies, which appear to have been the primary causes of most documented cases of pre-industrial population change, are highly visible in the archaeological record. Despite criticism (Binford 1972:93-94; Hodder 1986), Christopher Hawkes's (1954) hierarchy of inference in archaeology, which stipulates that prehistoric technology, economics, social organization, and ideology are increasingly more difficult to infer, has become a fundamental working assumption of most archaeologists (Smith 1987; Trigger 1984:282).

The idiographic emphasis of cultural historical archaeology is another benefit of using this approach to explain prehistoric population change. Reiterating some of the previous discussion, specific cases of human population change are often the result of a unique combination of multiple causes operating within a brief span of time on a local geographical scale. Population change, documented for specific prehistoric (Sanders et al. 1979) or historic (Wrigley 1969) populations, is best described by a saw-toothed curve (Figure 7), reflecting short-term fluctuations in birth, death, and migration rates. Mathematical or theoretical models of population change (e.g. logistic and exponential growth curves) lack the resolution for either predicting or explaining the actual population history of small-scale, regional populations (Ammerman et al. 1976; Bronson 1975; Hiorns 1972). In fact, the reliability of such general models cannot even be assessed without first comparing them to actual case studies of population change. Only cultural historical archaeology, with its focus on micro-regions, precise chronologies, and a materialist approach to prehistory, can hope "to explain individual situations in all of their complex reality" (Trigger 1982b:32). Thus, only cultural historical archaeololgy can compile a set of specific case studies for testing general theories and models of population change.

In summary, the culture history approach to prehistoric demography denies the primacy of Malthusian and Boserupian theory. It does not preclude the application of empirical generalizations; it simply insists that such generalizations be used to explain specific demographic situations, not as substitutes for demographic data.

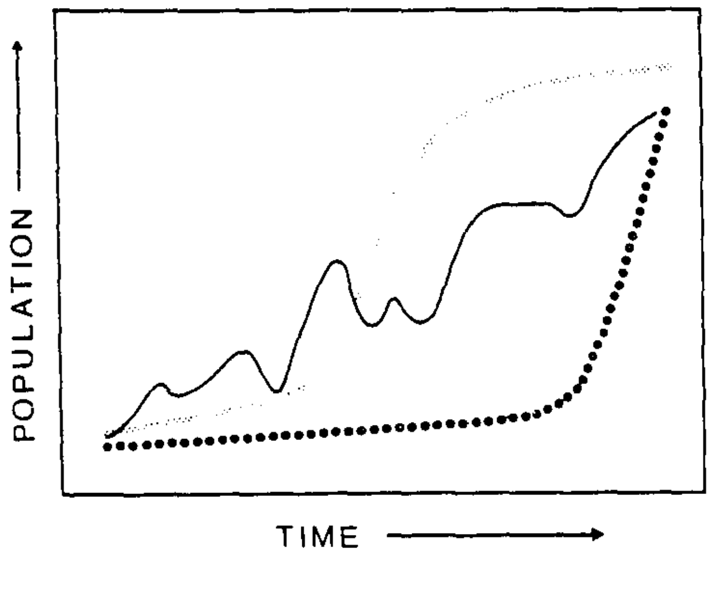

Figure 7. Theoretical and historical patterns of population growth.
(··········) Logistic growth (long-term/large region)
(●●●●●●) Exponential growth (global historical trend)
(———) Actual growth (short-term/small region)

Pre-industrial Demography

The Industrial Revolution in eighteenth century Europe coincided with the Demographic Transition, resulting in the permanent alteration of millennia-old constants in human demography that were rooted in patterns of fertility and mortality. While exact causes of the Demographic Transition are still somewhat obscure (Caldwell 1981; Wrigley 1969:146-202), it is certain that death rates, followed by birth rates, declined considerably. In the modern world, virtually every human society has either passed through or is still in the Demographic Transition. Consequently, vital rates of populations from developing nations are inappropriate for defining the demographic setting of pre-industrial and prehistoric societies, such as the Huron-Petun, a tribal-level society of swidden agriculturalists who occupied south-central Ontario between A.D. 900 and 1650. A general model of pre-industrial demography must necessarily be derived from ethnographic (Binford and Chasko 1976; Howell 1979), historic (Wrigley 1969), or prehistoric (palaeodemographic) data sources (Acsadi and Nemeskeri 1970; Weiss 1973).

Population change in any human society is governed by three factors: births, deaths, and migration. The best heuristic device for explaining the interaction of these factors is the "bathtub" analogy, where the level of water is population size, the tap inflow is births, the open drain deaths, and a ladle, for adding or removing water from the tub, represents in-migration and out-migration (see Wrigley 1969:62). According to demographic statistics for pre-industrial societies, inflow ranges from a low of 15 to an upper limit of 50 births per 1000 per annum (Bongaarts 1983; Handwerker 1983; Wrigley 1969:62). Outflow down the drain is far more variable; in normal years death rates average 30-40 deaths per 1000 per annum (Grigg 1980; Hassan 1981:117-123; Kunitz 1986; Weiss 1973). In crisis years, occurring about once every 10-20 years from disease epidemics or severe famines, death rates can soar to 60-80 deaths per 1000 per annum (Grigg 1980:44-47). Unusually high death rates of 200-400 deaths per 1000 per annum, though probably rare occurrences in regional populations (perhaps occurring once a century or more (Harpending and Bertram 1975; Hayden 1975; Snow 1981:106)) can cause such decline that recovery of a population to its former levels can take several generations (e.g. Black Death of fourteenth century Europe (Grigg 1980:54) and the sixteenth century depopulation of Mexico and Peru (Cook 1981; Dobyns 1966, 1983)). The level in the tub also can be quickly raised or lowered by adding extra water with a ladle or removing some of the bath water: in- and out-migration. Migration is the movement of people in or out of an existing regional population as the result of "pushes" (e.g. resource insufficiency (Hammel and Howell 1987:155), environmental deterioration, warfare, and persecution (Jones 1981:255-260) in the donor population) and "pulls" (e.g. uncontested land and resources and military security in the recipient area (Jones 1981)). Colonization of uninhabited lands is a special case of out-migration, if the colonizers relocate in distant lands; internal colonization simply redistributes a regional population, altering its population density. It is difficult to estimate pre-industrial rates of migration, but values of 10-20 per

1000 per annum are documented for rural out-migration in one region of early seventeenth-century England (Skipp 1978) and for urban in-migration in early eighteenth-century London (Wrigley 1969:148-150) and certain cities of sixteenth-century France (Grigg 1980:109). The growth of early cities, such as Teotihuacan and Uruk, appears to have been fueled by in-migration from the rural countryside at about 5 per 1000 per annum (Cowgill 1975a:511). Prior to urbanization, however, it is difficult to conceive of circumstances that would have triggered large-scale migrations in prehistory, other than climatic deterioration in marginal environments (e.g. Pueblo prehistory (Dean et al. 1985)), disease epidemics, or warfare.

In summary, pre-industrial population change seems to have been controlled primarily by changes in fertility and mortality. Fertility and mortality, in turn, are controlled by a number of proximate determinants.

Pre-industrial fertility

There is a growing consensus among demographers and anthropologists (Bongaarts 1980, 1983; Caldwell et al. 1987; Handwerker 1983; Howell 1986; Knodel 1977; Lee 1977; McKeown 1985; Wilmsen 1986) that "natural fertility theory" (lack of deliberate birth control) applies to most pre-industrial societies, particularly hunter-gatherers and early agriculturalists.

Marriage in modern pre-industrial societies is universal and occurs at a relatively young age, normally before 20 years of age (Nag 1962:163). Average age at menarche in such societies is 16 years (Hassan 1981:128), but human females characteristically display a three to four year period of adolescent sterility between first menses and regular ovulatory cycles (Bongaarts 1983). Thus, age at marriage normally coincides with age of fertility. The normal interval between live births in a natural fertility population is equal to the average duration of postpartum amenorrhea (10-13 months), plus the time elapsed before a new conception (6 months), plus 9 months from conception to birth, totalling 28 months (Bongaarts 1983; Hassan 1981:127).

John Bongaarts (1983) has defined four proximate determinants of natural marital fertility:

1) Postpartum infecundability period
2) Waiting time to conception
3) Intrauterine mortality (spontaneous abortion)
4) Permanent sterility

The ultimate determinants of these are the intensity, frequency, and duration of breastfeeding and the frequency of intercourse (the length of the fertile period during the menstrual cycle is a constant - two days). The specific values of proximate determinants (3) and (4) tend to be fixed by biological rather than cultural factors. Intrauterine mortality is roughly 15-20% of all conceptions. The average age of permanent sterility in females of developing societies varies little, ranging between 39 and 41 years (menopause occurring slightly later at 44-51 years of age). Sterile marriages account for only 3% of total marriages in such societies (Bongaarts 1983:122-127).

Proximate determinants (1) and (2) are influenced by a combination of biological and cultural factors (Figure 8). The duration of postpartum infecundability is primarily determined by breastfeeding practices. Nipple stimulation during breastfeeding increases prolactin in the mother's bloodstream which suppresses ovulation (Konner and Worthman 1980). In fact, if breastfeeding and suckling of an infant is frequent, intense, and of relatively long duration, postpartum infecundability can last up to 13 months on average (Bongaarts 1983). Postpartum infecundability can be extended even longer if the mother is poorly nourished. Malnourished mothers produce considerably less (40%) milk volume than adequately nourished ones (Wray 1978), causing the infant to suck longer, more frequently, and more intensely. Furthermore, in societies that are prone to seasonal food scarcity, such as the !Kung Bushmen (Howell 1979;1986) and presumably most prehistoric groups, age at weaning is often 2-3 years and infant diets are not heavily supplemented (Van Ginneken 1978). This would further increase breastfeeding duration and intensity, suppressing ovulation even longer. Thus, rather than a critical-level of maternal fat (22%) controlling ovulation (Frisch 1982), it is generally agreed (Bongaarts 1980,1983; Howell 1986; Knodel 1977; Menken and Bongaarts 1978; Scott and Johnston 1985; Tyson and Perez 1978; Wilmsen 1986) that the duration and intensity of breastfeeding is the predominant determinant of the duration of postpartum infecundability. Therefore, variation in birth spacing among natural fertility populations is due to variable breastfeeding patterns caused by differences primarily in maternal nutrition and supplemental feeding of infants.

The second proximate determinant identified by Bongaarts (1983), the waiting time to conception, is ultimately determined by the frequency of intercourse. Given that the length of the fertile "window" in human females is only two days (Bongaarts 1983:120-121), in order for a conception to occur, intercourse must either be timed perfectly to this fertility window, doubtful in pre-industrial situations, or it must be relatively frequent. Six to eight months is the average time to conception in natural fertility populations (Bongaarts 1983). Obviously, for societies that have high divorce rates, that live in overcrowded single-room dwellings, or that have large periods of spousal separation (e.g. Huron and New York Iroquois (Engelbrecht 1987)), the mean wait time to conception will be relatively long (Nag 1962).

In summary, it is entirely possible that pre-industrial populations were not forced to regulate their numbers, except under rare conditions of local Malthusian crashes. A combination of periodic food shortages and late age at weaning could have functioned as effective natural regulators, maintaining population levels in balance with food and other critical resources (Handwerker 1983:16-17). Nevertheless, a number of demographic researchers support the notion that past human societies attempted to limit population growth with cultural mechanisms. Population pressure advocates (Abernethy 1979; Binford 1968, 1983; Cohen 1977; Harris 1979; Sanders et al. 1979; Smith 1972) believe that past human populations practiced a variety of population regulating mechanisms, such as coitus interruptus, postpartum abstinence, abortion, and infanticide, but that these were applied ineffectively and did not curb population

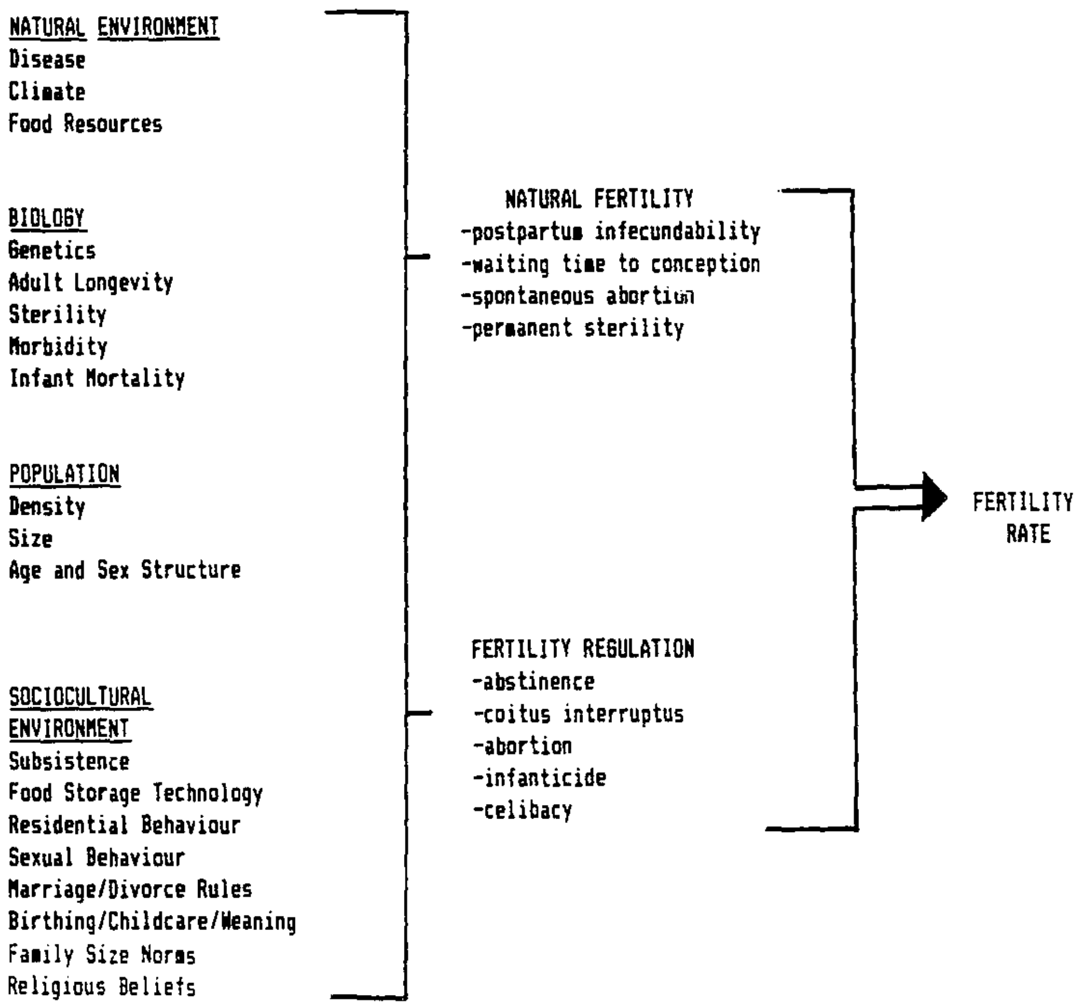

Figure 8. Pre-industrial fertility.
(after conceptual frameworks in Bongaarts 1983; Bulatao and Lee 1983; Hassan 1981; Mosley 1978)

growth over the long-term. Others (Birdsell 1968; Denham 1974; Hassan 1981; Hayden 1975, 1981), citing ethnographic data on human foragers such as the Australian Aborigines and Netsilik Eskimo, believe that for much of human prehistory population growth was effectively held in check by both a nomadic existence (Binford and Chasko 1976; Lee 1980; Sussman 1972) and a ruthless application of cultural mechanisms of population control, especially infanticide, during periods of severe resource stress. None of these positions are tenable, however, in light of recent re-evaluations of prehistoric population control.

First of all, the fertility patterns of human foraging populations, such as the !Kung Bushmen, Tiwi, and Australian Aborigines, conform entirely to natural fertility theory (Handwerker 1983:11-14). Furthermore, the life expectancy of foragers is typically low (30 years at birth (Howell 1979:116)), and consequently, moderate fertility and moderate mortality, except for crisis famine years (see below), would have been sufficient to limit population growth in ecologically-circumscribed foraging societies, without invoking deliberate population control mechanisms (Coale 1974). There is also no definite evidence that documented fertility increase and mortality decrease among settled hunter-gatherer groups (Roth 1985) is independent of increased access to Western medical aid and foodstuffs (Hayden 1981: 522).

Another reason why the theory of deliberate population control cannot be generalized to all of prehistory is the poor quality of ethnographic data on which it is based (Caldwell et al. 1987:30). For example, Birdsell's (1968) generalization about the prevalence of infanticide in prehistory (15-50% of Pleistocene births) is based on questionable statistics compiled from only a few ethnographic accounts of marginal foragers, such as Australian Aborigines, Eskimoes, and the !Kung. In fact, it is unlikely that either abortion (Benedict 1972:80; Scrimshaw 1983:257) or infanticide (Howell 1979,1986) were commonly used to control population growth. Abortion carries a 1% maternal mortality risk and a much higher risk of sterility and morbidity (David 1983:228). Ethnographically documented cases of infanticide for such groups as the !Kung indicate that infanticide is used infrequently (Denham 1974; Howell 1986:182) and mostly to eliminate **weak, malformed, sickly, or twin** babies (about 1% of all live births in theory (Hassan 1981:155)), who would probably die later anyway. Only among pre-industrial societies who lived in relatively harsh environments, where food shortages were frequent, would abortion and infanticide have been a common method of birth control (e.g. the Yanomamo, who inhabit an "ecological desert", have a 15-20% infanticide rate (Chagnon 1972; Neel 1977)).

Coitus interruptus and postpartum abstinence, particularly the latter, were probably the most common cultural mechanisms of pre-industrial birth control. Coitus interruptus, however, is not a very good method of contraception, just 15-30% effective (Hassan 1981:152). Postpartum abstinence, on the other hand, ought to prolong non-pregnancy as long as it is practiced. Abstinence was probably the most important factor, in addition to breastfeeding practices, contributing to inter-societal variability in fertility rates in prehistoric times. The seventeenth-century Huron, for example, practiced postpartum abstinence as a very effective means of contraception (Engelbrecht 1987). Huron women avoided intercourse for two to three years while nursing each child (Thwaites 1896-1901, 8:127), resulting in very low birth rates (Wrong 1939:127). It should be noted that postpartum abstinence may be an **unintentional** contraceptive; some pre-industrial populations practice abstinence in conjunction with prolonged breastfeeding in order to enhance the survival of each child (Van Ginneken 1978). Closely-spaced births lead to early weaning which in turn decreases infant survival through insufficient post-weaning nutrition (Solimano and Vine 1982; Winikoff 1982).

Three basic factors, breastfeeding duration and intensity, postpartum abstinence, and infant mortality rate (the latter a function of overall level of nutrition in society, frequency of food scarcity, and disease) perhaps can explain, at the proximate level, most cases of pre-industrial population change (Bongaarts and Menken 1983:34-35; Handwerker 1983).

In summary, pre-industrial fertility (i.e. prior to the modern Demographic Transition) is essentially described by natural fertility theory: universal marriage and fecund period at age 20 for females, age-specific fertility rate decreasing naturally with age, minimum live-birth spacing of 28 months, and permanent sterility in females at age 40. Estimating the most likely values for prehistoric adult female longevity (29-37 years), infant mortality rates (30-50%), and live-birth spacing (40 months), Fekri Hassan (1981:128-136) suggests that the total fertility rate in prehistoric times would have ranged from 3.3 to 5.7 live births per female. Table 3, adapted from similar tables in Bongaarts and Menken (1983:35); Dumond 1975:717; Hassan (1981:126-138); and Handwerker (1983:10) (ultimately derived from model life-tables in Coale and Demeny (1966)), presents a range of possible values of the average number of children surviving to age 20 and corresponding net reproduction rate (R0) for select adult life expectancies and total fertility rates for stable prehistoric populations. The most striking feature of this table is that the potential for population growth in pre-industrial societies is a function, not just of fertility, but of the interaction between fertility and mortality. Small changes in either (such as a raising of life expectancy from 20 to 25 years or an increase in total fertility by one child) can initiate dramatic population growth.

Pre-industrial mortality

According to studies of living hunter-gatherers (Howell 1979:116; Weiss 1973) and palaeodemographic populations (Acsadi and Nemeskeri 1970; Angel 1984; Hassan 1981:95-123; Weiss 1973), prehistoric hunter-gatherers and early agriculturalists had relatively short life expectancies (life expectancy at birth or e0 = 20-30 years; life expectancy at age 15 or e15 = 13-25 years). In prehistory, the average life expectancy at birth (e0) was about 25 years and the average length of life for an adult female probably fell between 29 and 37 years of age and for adult males between 33 and 41 years (Hassan 1981:128-129). Infant mortality rates averaged 30-50% (Hassan 1981:138; Weiss 1973:49) and are largely responsible for variability in pre-industrial life expectancy at birth figures.

Table 3. Average Number of Children Surviving to Age 20 and Net Reproduction Rates for Stable Populations with Different Fertility and Mortality Rates. *

Life Expectancy at Birth (e0)	Crude Death Rate (per 1000 per annum)	Total Fertility Rate: 3	4	5	6
20	50	1.0 (0.5)	1.5 (0.7)	2.0 (1.0)	2.4 (1.2)
25	40	1.3 (0.6)	1.8 (0.9)	2.3 (1.1)	2.8 (1.4)
30	33	1.6 (0.8)	2.1 (1.0)	2.6 (1.3)	3.2 (1.6)
35	29	1.8 (0.9)	2.4 (1.2)	3.0 (1.5)	3.6 (1.8)

* adapted from Bongaarts and Menken (1983:35), Dumond (1975:717)
Numbers in parentheses are Net Reproduction Rates (R0) where
R0 = Total Fertility Rate x 0.488 x (No. of Children Surviving to Age 20 / Total Fertility Rate)

R0 values greater than 1.0 indicate a growing population
(to convert R0 values into Rate of Potential Natural Increase (r)
r = ln R0/20 years)

Why were mortality rates so high in pre-industrial times?

There are two types of mortality rates in pre-industrial societies: normal and crisis. Normal mortality is characterized by death rates of 30-40 deaths per 1000 per annum (Grigg 1980; Hassan 1981:117-123; Kunitz 1986; Weiss 1973). Crisis mortality, occurring about once every 10-20 years from disease epidemics or severe famines, could double the normal death rate to 60-80 deaths per 1000 per annum (Grigg 1980:44-47). Extremely high death rates of 200-400 deaths per 1000 per annum, occurring every 100-500 years as the result of unique historical catastrophes (floods, earthquakes, disease epidemics) (Harpending and Bertram 1975; Hayden 1975; Snow 1981:106)) likely resulted in local population extinctions, perhaps represented by discontinuities in the archaeological record of a region (McGhee 1978:36; Snow 1981).

Referring to Figure 9, it is obvious that the normal level of mortality and the frequency of crisis years are directly related to determinants that would generally have been out of the control of pre-industrial peoples, particularly for those living in more marginal environments. Climate, environmental hazards, disease, and malnutrition are the primary determinants of prehistoric mortality. Each is discussed below with special reference to the Huron-Petun.

Prehistoric disease caused far more deaths in the Old World than in the New World. Acute crowd infections (e.g. smallpox, plague, and measles) require extremely large populations for endemicity (Armelagos and McArdle 1975; Black 1975). Measles, for example, requires 1.5 million people to be sustained endemically (Cockburn 1977).

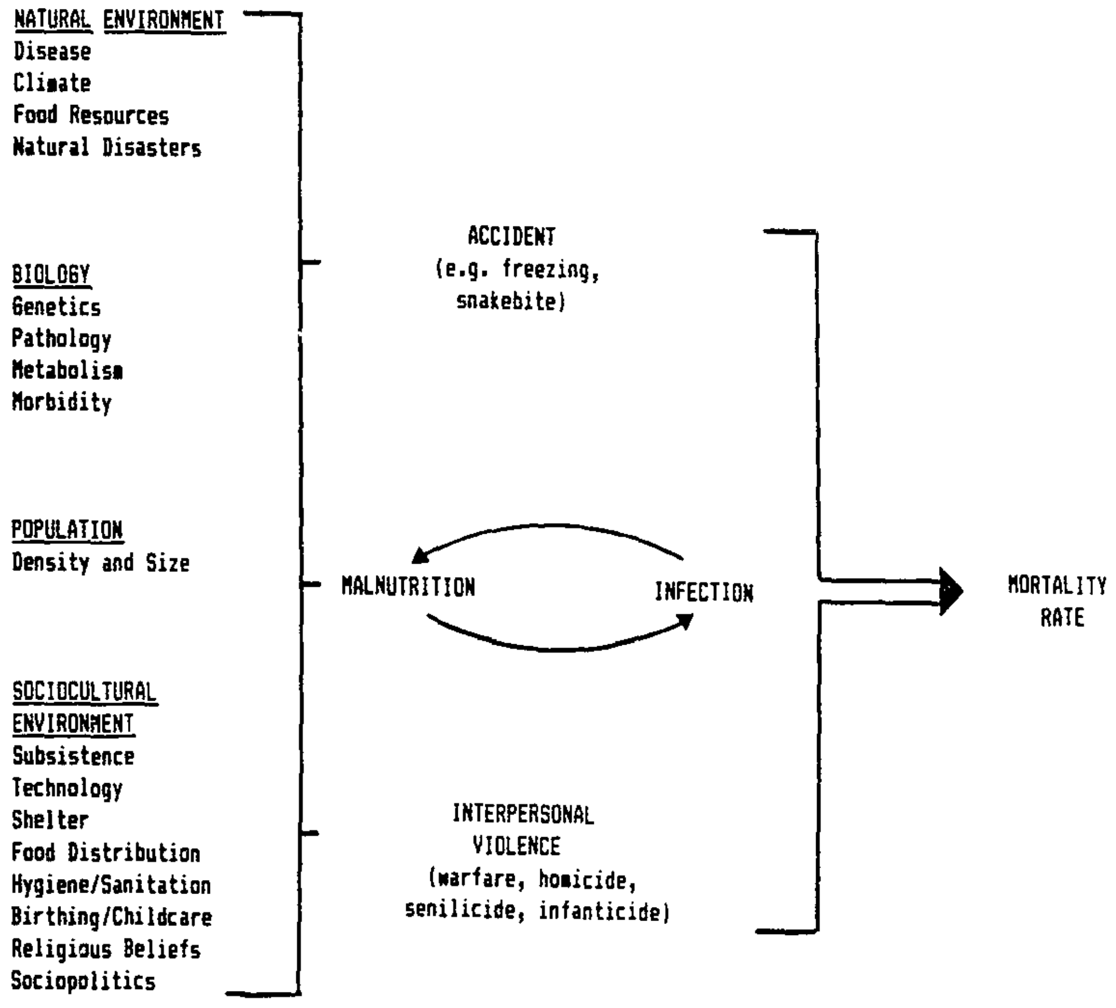

Figure 9. Pre-industrial mortality.
(after conceptual frameworks in Chen 1983; Katz 1987; Mahadevan 1986; Rotberg and Raab 1985)

Populations of the prehistoric New World were just too small and spread out to support acute crowd infections, except in Peru and central Mexico (Cook 1981; Sanders et al. 1979). It is possible that the lack of domestic animal vectors in the New World prevented the establishment of acute crowd infections among aboriginal populations (McNeill 1976:178). Palaeopathological data from prehistoric Native American skeletons and coprolites indicate robust and healthy populations; intestinal parasites (Cockburn 1977), osseous and periodontal disease (Pfeiffer 1986), tuberculosis (Buikstra 1981; Clark et al. 1987), and perhaps syphilis (Baker and Armelagos 1988) are the only diseases clearly documented for the prehistoric peoples of the Americas. Blood serum studies of Amazonian tribes suggest that hepatitis, herpes, staph and strep infections, and zoonotic diseases also would have been prevalent (Black et al. 1977). Except for syphilis (Armelagos and Baker 1988), the one-way transfer of disease between Europeans and Native Americans in the sixteenth century and its catastrophic consequences (Crosby 1976; McNeill 1976) support the hypothesis that acute crowd infections were unknown in the prehistoric Americas. Thus, it seems likely that epidemic disease did not have significant impacts on prehistoric mortality rates in the New World, particulary north of Mexico (Binford 1983:209; Kunstadter 1972:324-325).

In the absence of disease epidemics, environmental hazards and accidents would have caused most of the adult deaths in Native American societies. Environmental hazards would include respiratory and eye infections from spending all winter in cramped, smokey dwellings as well as interpersonal violence (i.e. homicide, senilicide, and warfare). Accidents, including burns, wounds, broken bones, drowning, hypothermia, snakebite, and starvation (resulting from being lost in the bush in winter), would have accounted for at least 25% of all adult deaths (Acsadi and Nemeskeri 1970:180-181; Chagnon 1972; Neel 1970; Steegman 1983). Childbirth complications would have killed 5-10% of adult females. Heart disease, stroke, and cancer are virtually unknown for living pre-industrial societies, being diseases of old age. Only 6% of pre-industrial peoples reach 60 years of age (Howell 1979).

Climate and malnutrition would have been closely linked causes of mortality in prehistoric northeastern North America, homeland of the Huron-Petun. Winters in the Northeast last generally 4 - 5 months and would have been a time of extreme food scarcity for hunter-gatherers (Clermont 1974; Rogers 1986:205-208; Snow 1981; Steegmann 1983). Very cold winters with high snowfalls, occurring about every 34 years in the Northeast (Snow 1981:106), would be particularly bad, since deer herds would be cut by half (Smith and Verkruysse 1983:26-28) and thick ice on the lakes would prevent fishing. Late spring break-up would have had dire consequences for small groups of hunter-gatherers on the edge of starvation, as country foods, stockpiled the previous fall, would have run out (Colson 1979:21-22) or would have lost most of their nutritional value from processing and prolonged storage (Keene 1981:139-141). Typically, infants, the old, and the sick are the first to die in famine situations (Dirks 1980). Early agriculturalists, such as the Huron-Petun, may not have fared much better over the lean winters than did their foraging neighbours, especially in winters subsequent to two consecutive crop failures. Those individuals not killed outright by starvation and exposure in a bad winter would have a high morbidity and might succumb to relatively minor illnesses because of their weakened physiological and psychological state of health (Steegmann 1983:249-251).

The frequency of periodic crashes in major food resources, such as deer and corn, would have created a state of chronic malnourishment among prehistoric Native Americans living in the Northeast. Referring to Table 4, the average periodicity of short-term scarcity cycles for key food resources in the prehistoric Northeast is 5-10 years. Short-term resource scarcity can be buffered by several strategies (food storage, exchange, and famine foods) (Colson 1979). Short-term resource stress usually does not kill healthy adults, but it does kill malnourished infants.

Table 4. Periodicity of Short-Term Resource Stress for Select Prehistoric Foods in Northeastern North America.

Food Resource	Periodicity (years)	Source
Nuts	3	Keene 1981:62-69
Wild Rice	3	Trigger 1985b:85
Deer	10-12	Smith and Verkruysse 1983 Snow 1981:106
Hare	7-10	Rogers 1986
Canada Geese	5-7	Rogers 1986
Corn	5	Heidenreich 1971:58

Protein-calorie malnutrition and the unavailability of sufficient and appropriate supplementary foods for infants and weanlings can dramatically increase infant mortality rates (Chen 1983; Solimano and Vine 1982; Wetterstrom 1986:115-123). Weanlings, children between six months and three years old, are particularly vulnerable to the synergism between malnutrition and infectious diseases, mainly diarrhoeas (Winikoff 1982). In fact, deaths of one to two year olds in pre-industrial societies constitute 25% of infant mortality statistics (Chen 1983:204-205; Winikoff 1982:115). The main causes of infant deaths are birthing trauma, infections (diaorrhea, respiratory infections, including tuberculosis), and protein-calorie malnutrition (Chen 1983:205), all linked in a positive-feedback or synergistic loop. Malnourished mothers have low birth weight babies, low birth weight leads to greater risk of infections, infections lead to malnourishment, and malnourishment increases the rate of infection and risk of death (Chen 1983:214; Rotberg and Raab 1985:305-308; Solimano and Vine 1982; Taylor 1985). Poor hygiene and sanitation conditions (lack of refrigeration, dirt floors, contaminated drinking water and eating utensils, sharing living quarters with animals, overcrowded houses) exacerbate the malnutrition-infection synergy (Chen 1983; Mosley 1982) . Thus, it is hardly surprising that infant mortality rates account for 50% of all deaths and for the low life expectancy at birth (e0 = 30 years) in pre-industrial and prehistoric societies (Chen 1983:199-201; Hassan 1981:138; Weiss 1973:26-29).

Long-term cycles of resource scarcity, with periodicities of 50-200 years or more, are unpredictable and would have caused catastrophic depopulation and perhaps actual extinction of small, isolated groups in prehistory (Hayden 1975, Jochim 1981:181-184; Rogers 1986;Snow 1981). While populations can recover in a mere 10-20 years from a severe mortality crisis (Weiss 1975), an equally likely outcome is population extinction from random fluctuations in sex ratios in a depleted popul^tion (Kunstadter 1972:319-320; Wobst 1974). The latter outcome, in fact, seems more likely, if it is true that prehistoric human populations were adjusted, according to "Liebig's Law of the Minimum", to short-term rather than long-term resource stress periods (Hayden 1975; Jochim 1981:181-182; Snow 1981).

Population Change

Prehistoric population change is the net outcome of fluctuating fertility and mortality rates. In- and out-migration only have a significant effect on population trends in small, local populations (Cowgill 1975a:509). Fertility rates fluctuate relatively little (realistic rates fall between 25 to 45 per 1000 per annum (Hassan 1981:140; Wrigley 1969)); mortality rates in normal years fall between 30-40 per 1000 per annum, but in crisis years they often double, and in exceptional years can approach 200-400 per 1000 per annum (Grigg 1980; Wrigley 1969). Regional population trends in prehistory often display a sawtcoth or step curve (Figure 7) with a trend over time to population growth (Ammerman et al. 1976:31; Bronson 1975:68-69; Grigg 1980:52; Sanders et al. 1979:183-219; Schacht 1984). The stepped pattern of regional population growth in prehistory is the result of fertility rates exceeding mortality rates by 1 to 5 per 1000 per annum (Cowgill 1975a:511; Hassan 1981:140) and the absence of extreme crisis mortality years. Of course the latter were inevitable but, if they did not exceed 60 deaths per 1000 per annum and a frequency of one per century, regional population could gradually increase in a "ratchet" manner (Snow 1981).

The potential limits to prehistoric population growth fall between a theoretical maximum of 30 per 1000 per annum (Ammerman et al. 1976; Cowgill 1975a) and historically-documented maximums of 10 to 17 per 1000 per annum (Grigg 1980; Wrigley 1969:54). Table 5 presents several pre-industrial population growth rates calculated from either archaeological or historical data. Excluding questionable values for Iron Age Britain and Ancient Greece, it is evident that prehistoric population growth seldom exceeded a rate of 10 per 1000 per annum.

Table 5. Pre-industrial Population Growth Rates.

Population	Annual Growth Rate (per 1000 per annum)	Reference
New World (10,000-5000 B.C.)	0.8-1.0	Hassan 1981
Old World Neolithic (800-4000 B.C.)	0.8-1.3	Carneiro and Hilse 1966
Linearbandkeramik (4500-4000 B.C.)		
Aldenhoven Platte, Germany	15	Ammerman and Cavalli-Sforza 1984
Uruk (3rd millenium B.C.)	6-7	Adams and Nissen 1972
Attica, Greece (8th century B.C.)	40	Snodgrass 1977,1980
Iron Age Britain (500 B.C.-A.D. 300)	30-40	Cunliffe 1978
Valley of Mexico (A.D. 1000-1519)	7	Sanders et al. 1979
Black Mesa, SW U.S. (A.D. 800-1100)	9	Swedlund and Sessions 1976
Mogollon-Mimbres, SW U.S.		
(A.D. 200-1450)	3-6	Blake et al. 1986
Hay Hollow Valley, SW U.S.		
(A.D. 700-1350)	7-10	Zubrow 1975
Mockingbird Mesa, SW U.S.		
(A.D. 900-1250)	11	Schlanger 1988
Western Europe (16th century)	6-11	Grigg 1980
France (17th century)	2-5	Grigg 1980
England (17th century)	1-6	Grigg 1980

CHAPTER 4

METHODS FOR ESTIMATING PREHISTORIC POPULATION SIZE

The estimation of prehistoric population from archaeological data is an exercise in middle-range theory. The unobservable entity is the **momentary population**, the actual number of people that lived in a particular house, settlement, or region at a certain time in prehistory. The observable entities are the environment and material remains of that prehistoric population, and, in the case of the New World and other portions of the nonliterate world that were contacted by Europeans between the sixteenth and nineteenth centuries, historical census data from first contact accounts. Referring to Figure 10, certain observable entities are better (i.e. more accurate) than others for estimating prehistoric population size. Assuming total preservation, burials (dead body counts) and settlement remains (number and size of houses and settlements) should display the highest correlation with momentary population. Other archaeological remains, such as the amount of accumulated artifacts, food and other refuse, are less directly correlated because, among other factors, they also covary with time (i.e. duration of occupation) (Tolstoy and Fish 1975; Warrick 1988b). Historical census data, regional carrying capacity, and population density exhibit the lowest correlation with prehistoric population size, primarily because of problems with uniformitarian assumptions.

Archaeologists have estimated the size of past populations from ecological (Jochim 1976; Zubrow 1975), historical (Dobyns 1966,1983; Heidenreich 1971; Snow 1980), burial (Angel 1972; Asch 1976; Howell

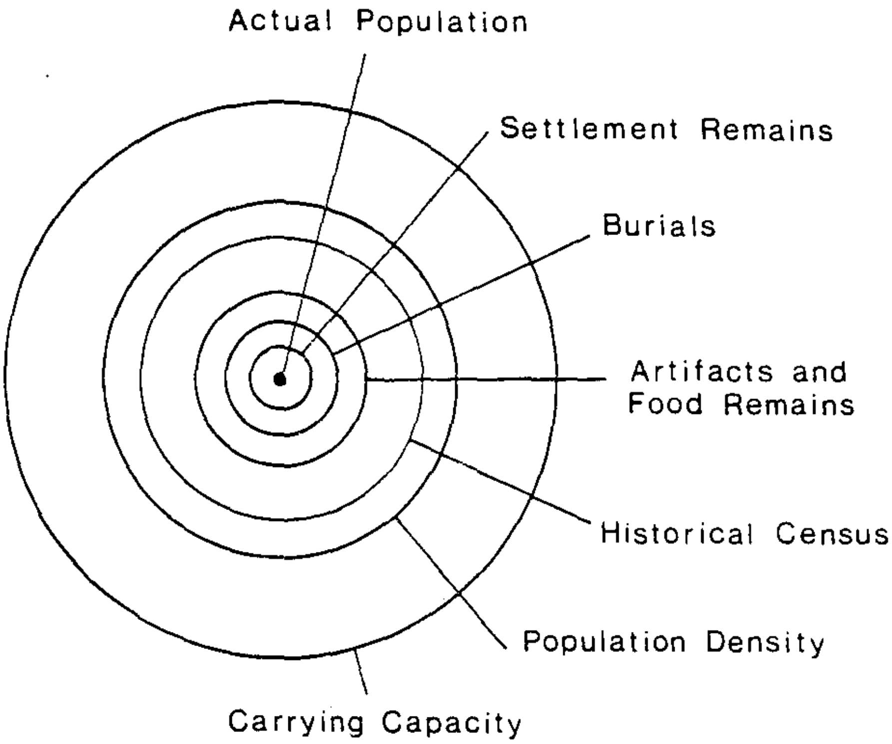

Figure 10. Methods for estimating prehistoric population size.

1982; Howells 1960), and archaeological data (Adams 1965; Ammerman et al. 1976; Blake et al. 1986; Cook 1972; Cook and Heizer 1968; Hassan 1981; Plog 1974; Renfrew 1972; Sanders et al. 1979; Smith and Young 1984; Trigger 1965; Turner and Lofgren 1966). Of these, archaeological data are the most appropriate estimators of population size for Iroquoian prehistory.

Carrying Capacity

Carrying capacity is a theoretical concept in biology that has been applied to human populations by anthropologists (Carneiro 1960; Rappaport 1968) and archaeologists (Bayliss-Smith 1974; Casteel 1972; Jochim 1976; Keene 1981; Kirby 1973; Sanders et al. 1979; Zubrow 1975) and refers to the **maximum population** that can be supported in a given environment with a given subsistence technology. In response to criticism (Brush 1975; Hayden 1975; Cowgill 1975a,b), archaeologists redefined carrying capacity to refer to the **maximum population** that can be supported during a short-term scarcity of any critical resource (essentially Liebig's Law of the Minimum) (Glassow 1978; Hassan 1981:161-175; Snow 1981).

Estimating carrying capacity of actual prehistoric agricultural societies, such as the Huron-Petun, has become intimately associated with catchment analysis (Vita-Finzi and Higgs 1970) and Robert Carneiro's (1960) formula:

$$\text{Population Size} = \frac{TY}{A(R + Y)}$$

where T is the total amount of arable land available in ha, Y is the cultivation period in years, R is the fallow period in years, and A is the area in ha required per capita to meet annual subsistence needs. Following Heidenreich's (1971:168-200) excellent study of Huron agriculture, Iroquoian archaeologists (Bond 1985; Horne 1987; Jamieson 1986; R. MacDonald 1986; Snow 1986; Sykes 1980; Vandrei 1987; Williamson 1985) have undertaken catchment analyses to arrive at a better understanding of village duration, relocation, and site ecology. However, despite comprehensive simulation models that relate site catchment radii to village duration and population (R. MacDonald 1986; Snow 1986; Sykes 1980), no researcher has successfully delineated the actual extent of cornfields around any Iroquoian village site, nor are precise estimates of village duration available for a specific site (except perhaps for Crawford Lake (Finlayson and Smith 1987) and certain historically identified seventeenth-century villages). Even if the two-kilometre average distance between successive Iroquoian villages (Bond 1985; Horne 1987; Jamieson 1986; Warrick and Molnar 1986) accurately reflects village catchment size and the distribution of mature pine stands around Late Prehistoric Huron villages defines former cornfields (Bowman 1979) (see Figure 11), other assumptions of the carrying capacity method seriously limit its ability to provide reliable population estimates.

The major problem with carrying capacity as a measure of past population is its static, uniformitarian approach to environmental reconstruction and subsistence (Asch 1976:17-18; Ellen 1982:42; Hayden 1975). Quantitative estimates of corn yields (1245-1880 kg/ha) for

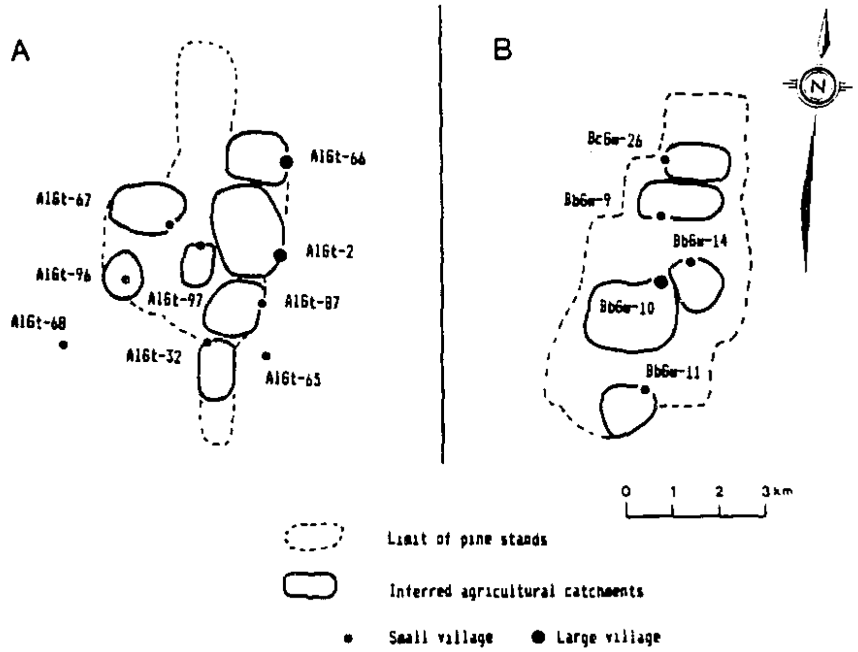

Figure 11. Inferred size of agricultural catchments for Late Prehistoric Huron village sites. A Pickering cluster (data from Poulton 1979 and Williamson 1983); B Barrie cluster (data from Lennox et al. 1986 and Warrick and Molnar 1986). Catchments defined by distance between successive villages and distribution of mature pine stands observed in the late 18th and early 19th century by land surveyors.

prehistoric Iroquoians are based on the triangulation of seventeenth-century Huron yields (Thwaites 1896-1901, 15:157), a study of one relict Petun cornfield (Heidenreich 1974), nineteenth-century agricultural census data for Eurocanadian farmers (Heidenreich 1971:189-193), and twentieth-century interviews of Iroquoian subsistence farmers (Fenton 1945). While these figures may accurately reflect seventeenth-century Huron-Petun yields, do they apply to prehistoric times? Moreover, the productive period for Iroquoian corn fields may have been substantially longer than the commonly cited 10 years. Empirical data suggest that Iroquoian corn fields could have been used indefinitely with no fallow period by intercropping corn with beans on alkaline soils (Hasenstab 1986).

The relative proportions of non-agricultural food and specific food species in the Iroquoian diet are also poorly known. Isotope study of Ontario Iroquoian skeletal remains suggests considerable chronological variation in the percentage of corn (or corn-eating animals) in the diet, ranging from 20 to over 50% (Schwarz et al. 1985). Even if the Iroquoian diet was precisely known, the problem of how to reconstruct the density of food species from measurements made in a modern environment that is substantially different from the prehistoric one would still remain. Further, gradual changes in the prehistoric environment caused by prolonged Iroquoian occupation of a region, such as forest succession (Bowman 1979) and local extirpation of preferred food species, have yet to be documented with good chronological control.

Another problem with carrying capacity , assuming it can be operationalized, concerns the **maximum population** estimate and its relationship to short-term scarcity. For example, Heidenreich (1971:197-199) calculated the maximum carrying capacity of the historic Huron territory at 60,000 people, but actual population is estimated at only 33% of this figure. Cross-cultural data reveal that actual population totals for most hunter-gatherers and simple agriculturalists are normally at 50% or less of carrying capacity (Bayliss-Smith 1978:131-133; Hassan 1981:49-50). This raises several questions. What scarce critical resource is limiting population size? Is population size limited by scarcity every 10, 25, or 100 years? Is population size limited by actual resource scarcity or perceived resource scarcity (see Bronson 1975)? To what degree does under-utilization of a region's carrying capacity reflect a society's emphasis on leisure time, an acceptable level of food energy output to labour energy input (Bayliss-Smith 1978), political proscriptions on land-use, or trade in foodstuffs (Ellen 1982:42)?

Carrying capacity is not a useful method of estimating prehistoric population size because it cannot deal with the dynamics of human ecosystems, many of its variables defy precise quantification, and it supplies an unrealistic maximum estimate of population.

Population density

Regional population size in prehistory can be approximated by back extrapolation from either carrying capacity or ethnographic data on population density. The general forumla is:

Population = population density x territorial area

where population density is the number of persons per 100 square kilometres and territorial area is the number of square kilometres.

The shortcomings of carrying capacity have already been addressed. The use of ethnographic analogy to retrodict the population density and ultimately the population size of a prehistoric group from historic observations of a similar group also has a number of serious problems. First, it is very difficult to reconstruct the size of prehistoric territories. While direct historic analogy permitted Dean Snow (1980) to reconstruct Eastern Algonkian cultural territories using drainage basins as the boundaries, how does one reconstruct territories in the absence of historic information? Another related problem concerns the applicability of early historic population density figures to prehistory. What about the possibility of protohistoric epidemics? Substantive uniformitarianism, assuming a constant population density for a certain region throughout prehistory, ignores the possibility of prehistoric change in the size of both population and sociopolitical territories. Such an approach also ignores the synchronic variability in population density within the same society. Different tribes of the historic Huron, for example, had remarkably different population densities, ranging from 6000 to 2000 people per 100 square kilometres of settled area (Heidenreich 1971:106). The Huron-Petun, assuming a population of 25,000-30,000 and a hunting territory of 17,000 square kilometres, had a population density of 147-176 people per 100 square kilometres. The historic Mohawk, despite a subsistence pattern and environment similar to the Huron-Petun, had a density of only 90-113 persons per 100 square kilometres of hunting territory (Snow 1980:33). Discrepancies like these suggest that back extrapolation of population density, particularly for prehistoric groups who lack historic analogs, should not be used as a method of population estimation. In fact, Fekri Hassan (1981:35-37) argues that, without independent empirical estimates of population size and density from archaeological settlement-subsistence data, application of a theoretical or average population density figure to regional prehistoric contexts necessarily carries a 50% error margin.

Historical Census

In certain respects, New World archaeologists are fortunate to have historical ethnographies and population estimates for most aboriginal groups at the time of first contact, dating from the early sixteenth to the late nineteenth centuries. It is highly unlikely, however, that historic accounts of first European-Native American contacts accurately portray aboriginal societies in a pristine state, untouched by European influence (Trigger 1982a:13; 1984:287; 1985b:114-118). This is especially true for Native American demography. Because of the possibility of substantial depopulation of Native American sociaties from epidemics of European disease that occurred prior to recorded contact with Europeans (Crosby 1976; Dobyns 1966, 1983; Ramenofsky 1987a, 1987b), the first historical censuses of most Native Americans may drastically underestimate precontact populations.

Historical population data for the Huron-Petun, although informative about seventeenth-century numbers (Dickinson 1980; Heidenreich 1971; Trigger 1985b and see Chapter 2), have little utility for reconstructing prehistoric population size. First, the historical records themselves may provide inaccurate estimates even of seventeenth-century aboriginal population, because of biased or inadequate census-taking and reporting (Trigger 1985b:232-240; Ubelaker 1981:176-178). Secondly, historically-recorded population sizes cannot be applied to prehistoric times because of the uncertain magnitude of demographic collapse caused by unreported or poorly reported disease epidemics of European origin (Trigger 1985b:242; Ubelaker 1981:177).

The accuracy of precontact population estimates produced by all of the methods commonly employed by historical demographers, such as depopulation ratios (Borah and Cook 1963; Dobyns 1966,1983), disease mortality models (Ramenofsky 1987b), and census projections (Cook 1981:75-107), rely almost exclusively on educated guesses concerning the type and number of diseases that could have afflicted protohistoric Native Americans and their associated mortality rates in a "virgin-soil" or non-immune population. The formula used is:

$$\text{Pre-epidemic Population} = \frac{\text{Post-epidemic population}}{1.0 - \text{Mortality or Depopulation Rate}}$$

However, documented mortality rates for virgin-soil smallpox epidemics, for example, range from 30% to 92% (Johnston 1987; Ramenofsky 1987a:146-148; Upham 1986). Because of the multiplier effect, selection of a particular mortality rate is crucial to precontact population estimates. To illustrate this point, mortality rates of 90% and 95% applied to post-epidemic populations of 1000 and 500 respectively produce the same pre-epidemic estimate of 10,000 people; however, using 90% for both yields a pre-epidemic population of only 5000 people for the 500 post-epidemic census figure (Snow 1980:35). Dobyns (1966:404) has stressed the need to use his 20:1 depopulation ratio cautiously and recommends that, where possible, precontact population size should be measured by independent means to cross-check the depopulation estimate, as exemplified by his study of Timucuan demography (Dobyns 1983). Even Noble Cook's (1981:114) exhaustive study of historical census data for sixteenth century Peru resulted in an acceptable pre-Columbian Peruvian population ranging from 5.5 million to 9.4 million. Such inaccuracy inspires little confidence in the ability of historical demography to estimate prehistoric population size. It is obvious that retrodicting pre-contact Native American population size from historical census data has serious difficulties, not to mention that such data are wholly inadequate for dealing with demographic change in prehistory.

Artifacts and Food Remains

The total amount or density of artifacts and food remains in or on the surface of an archaeological site has been used to estimate prehistoric population size (Clark 1954; Cook 1972a,1972b; Feinman et al. 1985; Jochim 1976:174-176; Parsons 1971,1972; Sanders et al. 1979; Schiffer 1976; Wheat 1972). Michael Schiffer (1976:60-63) provides the most comprehensive formula for calculating population from artifact numbers:

$$\text{Population} = \frac{TD \times L}{k \times t} \times \text{No. persons/household}$$

where TD is the total number of artifacts discarded at the site, L is the use-life of a particular artifact, k is the number of artifacts per household, and t is the occupation span of the site.

Food remains can be transformed into population with this formula, by substituting total edible meat weight or kilocalories for artifacts and human nutritional requirements (in kilocalories) for artifact requirements per unit of time. The underlying assumption relating artifact and food remains to the number of people is constant consumption rate. In addition, the number of persons per family or household must be supplied. Even if accurate values for consumption rates and family size can be derived from direct historic analogy, they should not be applied to prehistory as a uniformitarian constant. Both can vary through time (Turner and Lofgren 1966) and across space (Schacht 1981:123). The estimation of prehistoric population from artifacts and food remains suffers from several problems (Hassan 1981:79; Hirth 1978; Schacht 1981:123-124; Tolstoy and Fish 1975). Conversion formulae are virtually impossible to apply with any degree of certainty to a specific archaeological case because of unknown or unknowable variables, such as pot discard rate which requires determining the total number of pots broken by each household per year. No ethnographic data about this variable exist for the Huron-Petun, although archaeological approximations have been attempted (Warrick 1988b).

Another problem is that most artifact density measures, particularly sherd densities on the surface of ploughed archaeological sites, are correlated more with length of site occupation than site population (Kohler and Blinman 1987; Schlanger and Kohler 1984; Tolstoy and Fish 1975; Warrick 1986). Based on observations of modern rural villages in Mexico, certain Mesoamerican archaeologists (Feinman et al. 1985; Parsons 1971, 1972; Sanders et al. 1979) have posited that sherd density on the surface of an archaeological site is a direct reflection of former population density. The fundamental weaknesses of this measure are its subjectivity (Parsons 1971:23), the demonstrated variation of surface sherd density with both site duration (Kohler and Blinman 1987; Schlanger and Kohler 1984) and field conditions (Hirth 1978), and the uncontrollable effects of socioeconomic status on artifact consumption rates (DeBoer and Lathrap 1979; Hayden and Cannon 1982). Even one of the main proponents of using surface sherd density as an index of population density for prehistoric Mesoamerican settlements admits that "our equations of sherd density and population density remains (sic) the weakest link in our reasoning" (Sanders et al. 1979:40).

Differential preservation and recovery of artifacts is a further problem. For example, broken pots need not be discarded in a village site. Ethnoarchaeological data (Deal 1985; Longacre 1985) reveal that breakage of pots away from the settlement, their pulverization for use as temper, and lateral cycling can remove a substantial number of pots from habitation sites.

Problems of differential preservation are more acute when dealing with food remains. For instance, the ultimate location of discard for animal bones is a product of cultural (butchering and consumption patterns) and taphonomic processes which are usually unknown (Hassan 1981:79). The total amount of food remains in an Iroquoian village site probably represents only a small fraction of all food consumed by its inhabitants. Zooarchaeological data from the Wiacek village site near Barrie, Ontario indicate severe underrepresentation of deer and fish bones as a result of procurement and processing practices (Lennox et al. 1986:129-131). Seventeenth-century Huron hunted for deer over 100 kilometres away from their villages and lived in temporary camps while they fished (Heidenreich 1971:134-135,205). They did not carry unnecessary weight back to their settlements.

Site duration must be known precisely to convert artifact and food remain counts into people. With the exception of a handful of historic Huron villages, such as Ossossane II (see Chapter 6), exact occupation spans are unavailable for Iroquoian sites. Preliminary investigations (Warrick 1988b and Chapter 6) suggest considerable temporal variability in the duration of Iroquoian village occupations.

Lastly, few Iroquoian sites have been completely excavated or sampled in a way that would allow one to predict population size from specific artifact or food remain densities. The highly clustered pattern of artifact and refuse deposition in Iroquoian village sites seems to preclude archaeological sampling strategies for certain classes of artifacts and food remains (Bellhouse and Finlayson 1979; Lennox et al. 1986:31-33). Thus, without complete site excavation, artifacts and food remains have very limited utility for estimating prehistoric Huron-Petun population size.

Burials

Burial counts constitute a potential index of prehistoric population size, but results to date have been at best only moderately successful (e.g. Acsadi and Nemeskeri 1970; Angel 1972; Asch 1976;

Howell 1982; Howells 1960; Pfeiffer 1983; Sanders et al. 1979:46-51; Saunders 1987; Ubelaker 1974). Two methods exist for calculating population from skeletal remains. The first, developed by Acsadi and Nemeskeri (1970:65-66), is :

$$\text{Population} = K + \frac{De0}{T}$$

where K is a correction factor (0.1T), D is the total number of dead, e0 is life expectancy at birth, and T is the time interval in years. The other formula (Ubelaker 1974:66-68) removes the correction factor and substitutes life expectancy at birth (e0) for its reciprocal, crude mortality rate or number of deaths per 1000 per annum. It can be expressed as:

$$\text{Population} = \frac{1000N}{MT}$$

where N is the total number of dead, M is the crude mortality rate, and T is the time interval in years.

There are a number of problems involved in the application of these formulae to Huron-Petun burial populations. Ossuary burial was practiced by the Huron-Petun, at least from A.D. 1300 to A.D. 1650 (Johnston 1979; Trigger 1976). While ossuaries provide large skeletal samples for reconstructing past population size (Ubelaker 1981:186), there are various severe limits to Iroquoian ossuary samples. Palaeodemographic analyses of ossuaries (Jackes 1986; Pfeiffer 1983) and the common discovery of burials of infants and a few sickly, aged, or violently deceased adults in and around villages (Finlayson et al.

1986; Fitzgerald 1979; Kapches 1976; Melbye 1983; Ramsden and Saunders 1986; Saunders 1986; Saunders and Spence 1986; Williamson 1978) confirm historic Huron-Petun mortuary practices (Thwaites 1896-1901, 10:273; 39:31) and demonstrate that ossuaries contain a biased sample of the living population (Sutton 1988). Infant underrepresentation is especially a problem here since both formulae rely on life expectancy at birth values (e0), which are made notoriously unreliable by the underrepresentation of infants and children under five years of age in Huron-Petun burial populations (Asch 1976:41; Buikstra and Mielke 1985:365; Hassan 1981:96; Jackes 1986; Weiss 1973:48-50).

Another problem concerns the source of an Iroquoian ossuary population. A single ossuary may contain the dead of several neighbouring villages as well as kinsmen brought from elsewhere for burial (Thwaites 1896-1901, 10:279-281; Wrong 1939:211).

The uncertain time interval of ossuary or cemetery use is perhaps the primary weakness of this approach to reconstruction of prehistoric population size. Based on historical observations which suggest that ossuary burial events occurred when major villages were relocated (Thwaites 1896-1901, 10:275), palaeodemographers have simply assumed that Huron-Petun ossuaries represent an eight to twelve year accumulation of the dead (Katzenberg and White 1979:26; Pfeiffer 1986:24). However, empirical estimates of Huron-Petun village duration suggest that prehistoric and protohistoric villages were occupied on average for at least 25 years (Warrick 1988b). There is also the related problem of positive identification of a specific ossuary with a specific village site.

Finally, most ossuaries in Ontario were looted or destroyed in the nineteenth century (for numerous accounts refer to Hunter (1899, 1900, 1902)) and thus provide biased skeletal samples or are not available for study.

One example of the use of burial counts to reconstruct site population clearly demonstrates the inadequacy of this approach. The Adams village and cemetery in New York State were occupied by the Seneca ca. A.D. 1580-1600. Village area suggests a population of at least 1500 people (Vandrei 1987). However, the number of dead in the associated cemetery, which was completely excavated, indicates a village population of only 800-1000 (Saunders 1987), assuming an unrealistically short period of occupancy of only seven years. Increasing the time interval to a more realistic 10 or 15 years would lower the population estimates even further. Obviously, a large number of dead villagers did not end up in the cemetery. The use of burial populations in demographic archaeology should be restricted to calculating mortality rates; archaeological settlement data offer far more precision than burials for estimating prehistoric population size (Buikstra and Mielke 1985:361).

Settlement Remains

Of all archaeological data, settlements hold the most promise for estimating past population size (Ammerman et al. 1976; Cook 1972a:12-23; Hassan 1981:63-77; Plog 1974:94; Schacht 1981; Trigger 1965). However, deciding which class of settlement data best reflects past population numbers in a specific situation can be a problem. There are several measures for transforming archaeological settlement data into population counts: site number and size (Parsons 1972; Sanders et al. 1979; Schwartz 1956), house and room number (Plog 1974), hearth number (Hill 1970; Milisauskas 1986; Swedlund and Sessions 1976), site volume (Ammerman et al. 1976), roofed floor area (Cook and Heizer 1968; Naroll 1962), and site area (Adams 1965; Hassan 1981:66-72; Kramer 1982; Schacht 1981). In Iroquoian archaeology, site number and area (Snow 1986,1987a), roofed floor area (Casselberry 1974; Pearce 1984; Ramenofsky 1987a), house number (Heidenreich 1971:100-103; Starna 1980) and hearth counts (Finlayson 1985; Johnston and Jackson 1980; Ritchie and Funk 1973; Timmins 1987; Wright 1974) have been used to estimate population size. Since the Huron-Petun study area contains only a small proportion of excavated village sites, site number and area are the most appropriate population indices for deriving regional population estimates. But what archaeological settlement data offer the best estimate of the number of people per unit of site area? A review of the various archaeological indices relevant to the reconstruction of Huron-Petun population is in order.

<u>House and room count</u>

Perhaps the simplest way of estimating the population of an archaeological settlement is to total the number of free-standing houses or the number of rooms or room complexes in apartment-style settlements, such as the pueblo sites of the American Southwest, and then multiply by the average number of people per household:

$$\text{Settlement Population} = RP$$

where R is the number of houses or rooms per settlement and P is the number of persons per house or room. Not surprisingly, this approach has been employed primarily in regions which have direct ethnographic analogs, such as the American Southwest (Blake et al. 1986; Hill 1970; Lightfoot 1984; Longacre 1970,1976; Plog 1974; Powell 1983; Schlanger 1988; Swedlund and Sessions 1976), Mesoamerica (Maya) (Haviland 1972; Marcus 1976; Winter 1976), and California (Cook and Heizer 1968).

There are some fundamental problems with this approach. Identification of residential structures or rooms in a archaeological site is not always easy. Post mould patterns might be remnants of granaries or other non-residential structures (Hodder 1982) and the number of rooms per household can be confounded by room use and abandonment practices (Eighmy 1979; Graves 1983; Hassan 1981:75) and by socioeconomic factors (Kramer 1979; Skipp 1978:62-63). Closely related to the latter problem is contemporaneity of houses and rooms. It is estimated, for example, that only 30-80% of the total number of rooms in prehistoric pueblos were occupied at one time (Blake et al. 1986:454-455; Plog 1974:90-91 ; Watson et al. 1980). Similarly, only 5% of longhouses in Linearbandkeramik villages of Neolithic Europe appear to have been contemporaneous (Ammerman and Cavalli-Sforza 1984:74-75; Milisauskas 1986:220-222). In addition, the number of persons per household can vary through time (Turner and Lofgren 1966) and according to socioeconomic status (Kolb 1985). Uniformitarian assumptions, even from direct historic analogs, must be applied with considerable caution when estimating prehistoric family size. Careful use of palaeodemographic data, in conjunction with ethnographic and archaeological data, can provide insights into family size in prehistory (Warrick 1988c).

Dwelling or room number for unexcavated sites can also be estimated from the number of residential units per unit area of excavated settlement sites:

$$\text{Site population} = ARP$$

where A is site area, R is the number of houses or rooms per unit area of site, and P is the number of persons per house or room. However, in addition to all of the problems already mentioned, unexcavated sites with relatively lengthy histories of occupation may display a low correlation between predicted and actual numbers of residential units (Schacht 1981:127)

<u>Hearth number</u>

The number of hearths can be used to infer the number of households that occupied an archaeological site (Hill 1970:76; Lennox 1986:236-237; Milisauskas 1972; Swedlund and Sessions 1976; Yellen 1977:127). Total site population is given by:

$$\text{Population} = HP$$

where H is the total number of hearths and P is the number of people per hearth.

This method is limited by the same set of problems associated with residential unit counts. Not only can poor archaeological preservation of hearths be a potential problem, but also distinguishing commensal unit or everyday hearths from ancillary cooking and heating hearths used on a short-term basis can be difficult (Hill 1970). Demonstrating hearth contemporaneity, in the absence of stratigraphic evidence, poses another problem. Furthermore, the number of hearths may not be a true reflection of population. Change in household population is not always mirrored by change in hearth number. For example, during the late fifteenth to early sixteenth century, the population of Florence, Italy increased by 50% but the number of hearths remained constant (Herlihy 1977:157,162). Hearths can show relative inertia in the face of population change (Fletcher 1985). Further, in some pre-industrial societies like sixteenth-century England, hearth number can have a higher correlation with household status than population (Skipp 1978). Translating hearths into population also demands an average family size figure, ideally independent of ethnographic or modern analogues.

Despite these potential hazards, hearth counts offer the single best estimate of population size for Iroquoian archaeology (Trigger 1981b:32). Seventeenth-century Huron longhouses contained a central row of hearths, each hearth normally shared by two families (Thwaites 1896-1901, 15:153; Wrong 1939:94). Archaeological excavations in Southern Ontario have recovered floor plans of over 500 longhouses, most with well-preserved central hearths that tended to stay in the same place for the duration of the longhouse. Such a remarkably large database permits statistical generalization of hearth density for all periods of Huron-Petun archaeology (see detailed discussion of hearth count and density in Chapter 6).

Roofed floor area

Raoul Naroll's (1962) classic study was the first attempt in archaeology to find a normative allometric relationship between the area of a dwelling or roofed floor area and population. Generalizing from a sample of 18 societies, he suggested a cross-cultural constant of one person per 10 sq. m. of roofed floor area:

$$\text{Population of dwelling} = \text{Floor area} / 10 \text{ square metres}$$

where floor area is in square metres. Since its publication, Naroll's constant has been heavily criticized by archaeologists (Asch 1976; Casselberry 1974; Fletcher 1981; Kolb 1985; LeBlanc 1971; Schacht 1981; Shea 1985; Wiessner 1974). It is said to be unjustified on mathematical (Wiessner 1974) and statistical grounds (Schacht 1981:127; Shea 1985). Also, in over 50% of Naroll's original sample, the constant underestimates actual settlement population by 25-60% (Asch 1976:16; LeBlanc 1971), particularly for house floor areas of less than 1000 square metres (Hassan 1981:73). In fact, reanalysis of Naroll's empirical data indicates that the frequency distribution of floor area per person values is bimodal: 4 - 6 square metres per person and 19 square metres per person (Shea 1985; Wiessner 1974:334). The 10 square metres per person figure is a statistical illusion!

Cook and Heizer (1968:94-96) discovered a different allometric or log-log relationship between floor area and population in a sample of 30 aboriginal societies from California. Their formula is:

$$\text{Population} = 0.54994\ (\text{floor area})^{0.62284}$$

This formula means that as house floor area increases, the amount of floor area per person increases too: 2.32 square metres per person for the first six people and 9.29 square metres per person for each additional person (Hassan 1981:73). The correlation between roofed floor area and population is high for Cook and Heizer's (1968) entire sample.

Samuel Casselberry (1974) has proposed yet another formula specific to societies who live in multifamily dwellings, such as the Iroquoians. The relationship between roofed floor area and population that he suggests is:

Population of dwelling = Floor area / 6 square metres

However, application of this equation, which is itself based in part on estimates relating to archaeological data, to Ontario Iroquoian longhouses has yielded unacceptably low population estimates (Timmins 1987:47; Trigger 1981b:32; Warrick 1984:96-97). Ontario Iroquoian archaeological data suggest that prehistoric longhouses had a population density ranging from one person per 6.0 square metres of total floor area (assuming family size of six and two families per hearth (Finlayson 1985:415) to one person per 6.7 square metres (assuming a family size of five (data from Dodd 1984:272-274 and Wright 1974:71)). However, historic Iroquoian longhouses appear to have been more cramped, varying from one person per 4.2 square metres (Johnston and Jackson 1979:198) to one person per 4.8 square metres of total floor area (assuming family size of five (Dodd 1984:272-274)). Excluding end storage areas, the amount of roofed floor space per person falls between 2.6 square metres (Dodd 1984:272-274) and 3.4 square metres (Clermont et al. 1983:130; Lennox et al. 1986:16-27), assuming a family size of 4.5 to 6 members.

In summary, there are a number of difficulties in converting archaeological roofed floor area into population numbers. First, there is no normative cross-cultural relationship between floor area and population. While most societies seem to allot **on average** four to six square metres of dwelling space per person (Casselberry 1974; Cook and Heizer 1968; Kolb 1985; Shea 1985), there is considerable variability in the population density of dwellings both within (Kolb 1985; Kramer 1979) and between societies, as well as over time (Fletcher 1981). Wealth, sociopolitical organization, and proxemic factors may be partly responsible for this variability (Fletcher 1981). Another problem is that not all of a dwelling floor is necessarily habitable; at least 20% of the floor area of Huron longhouses was used to store firewood and corn (Dodd 1984:273). Calculation of population without regard for **habitable** floor area can produce totally unreliable estimates (Hassan 1981:74-75). Until more reliable quantitative models of the relationship between roofed floor area and population are available, it seems unwise to apply blindly some average constant based on modern pre-industrial societies. Thus, the danger of tautology or assuming "precisely what we should try to find out about the past" is avoided (Fletcher 1985:592).

Settlement area

Most societies display a high correlation between settlement size and population size. For instance, Cook and Treganza (1950) found that, for a sample of 16 Yurok villages, the logarithm of village size has a correlation (Pearson's r) of +0.896 with the logarithm of population size. Schacht (1981:130) reports a correlation of +0.94 between settlement size and population in a sample of 185 Iranian towns and villages, but Sumner (1979:165) for a sample of 110 Iranian villages found a lower correlation of +0.76. Casteel (1979), using data from Yellen (1977), discovered a correlation of +0.93 for his power curve relationship of Bushmen camp size and population.

The most important aspect of the settlement area-population size relationship, in addition to the high correlation, is the variability of population density with settlement size and type. The relationship is essentially curvilinear; in other words, as settlement size increases, population density decreases or increases depending on the type of settlement. Roland Fletcher (1981) analyzed population density data for a large number of societies that occupy **nucleated settlements** or settlements that display distinct concentrations of buildings and people. His findings indicate that hunter-gatherer settlements (10 - 50 people) have an amazingly wide range in population density (5000 people/ha - 25 people/ha) and that population density decreases markedly with an increase in settlement size. Small-scale agricultural settlements (100-1000 people) display a narrower range in population density (1000 people/ha - 50 people/ha), which increases as settlement size increases (Fletcher 1981:106-108). Independent studies of modern hunter-gatherer camps (Wiessner 1974; Yellen 1977) and agricultural villages in Iran (Sumner 1979) and Mesoamerica (De Roche 1983) substantiate the allometric nature of the relationship between settlement area and population.

The settlement area method is admirably-suited for reconstructing regional population size in prehistory (Ammerman et al. 1976; Blake et al. 1986; Feinman et al. 1985; Sanders et al. 1979; Schacht 1981; Zubrow 1975), mainly because completely excavated prehistoric settlements and house floors are in short supply for most regions of the world. Archaeological application of this method normally entails finding an appropriate population density constant or exponential expression, either by ethnographic analogy or statistical regression of archaeological settlement data, and then multiplying by site size:

$$\text{Settlement population} = b + (cA)^{n}$$

where A is site area (in ha), b is the minimum settlement size in people, c is the population density or mathematical constant, n is an exponential function (after Hassan 1981:66-72; Schacht 1981:130). Various applications of this formula have been tried by archaeologists. The simplest is to assume a constant population density irrespective of site size, thus:

$$\text{Settlement population} = \text{People/ha} \times \text{Site Area (in ha)}$$

For example, Robert Adams's (1965) study of Mesopotamian population history used a constant of 200 people/ha, derived from an average of modern settlements in the region. Despite the use of direct historic analogy, his population estimates are suspect because he failed to quantify the spatial and temporal variabilility in residential density

(Fletcher 1981; 1985). Data on modern Iranian settlements indicate substantial variability in population density (66 - 293 people/ha) (Sumner 1979). Furthermore, residential density of a single settlement can fluctuate dramatically over time, as exemplified by London, England: 125/ha (A.D.900); 250/ha (A.D. 1500); 225/ha (A.D. 1700); and 50 people/ha (A.D. 1900) (Fletcher 1981).

Rather than simply assuming a constant average residential density, a number of archaeologists have calculated linear regression equations (Kramer 1982; Plog 1974:89; Schacht 1981:130; Zubrow 1975:58) or log-log regressions (Cook and Heizer 1968; Hassan 1981:70-72; Wiessner 1974) either from modern analogs or directly from completely excavated archaeological settlements of the society in question. In the latter case, population is estimated from roofed floor area, house counts, or room counts for contemporaneous architectural features (e.g. Schlanger 1988). In order for this method to produce reliable population figures, however, the regression equation must be constructed from a large sample of settlements covering the entire range of settlement sizes and archaeological time periods. Judging from data presented in Cook and Heizer (1968) and Fletcher (1981), the most comprehensive settlement area-population equations will be specific to a certain settlement size (or type), at a certain time, and for a particular society. Other problems include calculating the proportion of site area taken up by contemporaneous residential structures (Ammerman and Cavalli-Sforza 1984; Plog 1974).

In Iroquoian archaeology, no regional estimates of prehistoric populations, calculated strictly from the number and size of archaeological settlements, are available. Site counts provided the first regional estimates of historic Huron (Popham 1950) and Middle Iroquoian (Wright 1966:59) populations. The trouble with site count estimates is that they ignore site size, which for Iroquoian villages can vary between 0.3 and 5.0 hectares (see Chapter 5). Heidenreich's (1971:100-103, 128-129) regional estimate of historic Huron population relied on both historic and archaeological inference. With an archaeological database of only three excavated Huron villages (actually just one **completely excavated village** (Forget) - MacKenzie was not entirely excavated (Johnson 1980) and Hunter's #36 (Hamilton site) is a highly atypical site (Latta 1988)), Heidenreich (1971:128) calculated that the average population density for Huron villages was 450-550 people/ha, assuming 12-15 longhouses per hectare and an average of 36 people per house. However, even Heidenreich (1971:129) acknowledged that his results were hypothetical and that "only years of archaeological research will allow one to accumulate data which will permit a refinement of longhouse site densities". James Wright's (1974) total excavation of the late fourteenth century Nodwell village site in Ontario led him to generalize (1977:184,1987) that the 18-25 historic Huron villages could have contained 30,000 people, assuming an average of 600 people per hectare (from Nodwell data) and 2.0 hectares per site (presumably derived from Heidenreich's (1971: Figure 5) admittedly biased sample of 47 Huron village sites). If this seems a disturbing over-generalization, pan-Iroquoianist assumptions about residential density, in apparent disregard for Fletcher's (1981) well-argued objections, have permitted New York Iroquoian archaeologists to use Heidenreich's (1971) limited generalization and the Nodwell site population density data to assist their estimations of Mohawk (Starna 1980; Snow 1986;1987a) and Seneca populations (Vandrei 1987). In the case of Dean Snow's Mohawk Valley Project (1985,1986,1987a,1987b), however, excavation and non-invasive remote sensing techniques are supplying independent residential density data for estimating regional trends in Mohawk population from the early fifteenth to late seventeenth centuries.

In summary, regional population estimates for the Huron-Petun are best achieved by employing archaeological settlement data (hearth density and site area) in conjunction with direct historic analogy. There are a number of logical steps and a standard set of problems associated with translating archaeological site area into regional estimates of population (Ammerman et al. 1976:32-45; Blake et al. 1986; Petersen 1975:231-232; Plog 1974:88; Ramenofsky 1987a:23-24; Roosevelt 1980:203-220; Schacht 1981:131-132, 1984; Schlanger 1988; Trigger 1965:42-52, 156-160). For each major period of Huron-Petun prehistory and history, the following algorithm will be used to estimate regional population:

$$\text{Regional Population} = \frac{\text{Total Site Area} \times \text{Hearths/ha} \times \text{Persons/hearth}}{\dfrac{\text{Average Site Duration}}{\text{Period Duration}}}$$

The standard set of problems with this kind of approach include:

1) acquiring the entire population of settlement sites or, at least, a representative sample of settlement sites,

2) establishing the correlation between maximum archaeological site area and maximum area of contemporaneous settlement,

3) distinguishing village (settlement) sites from special-purpose or seasonal sites,

4) estimating site durations for each chronological period that are independent of direct historic analogy,

5) calculating the density of contemporaneous hearths for each chronological period to control for potential change over time in residential density, and

6) estimating family size from palaeodemographic data (i.e. life tables for burial populations) and direct historical analogy (Ammerman et al. 1976; Plog 1974; Schacht 1984).

The method used in this study consists of the following steps:

1. Definition of the regional study area
2. Compilation of the total sample of reported village sites in the study area
3. Editing the site sample by removing:
   a) probable special-purpose sites
   b) sites not found by modern archaeological work, and
   c) a proportion of unverified sites based on the relative frequency of (a) and (b)
4. Assessment of the representativeness of the edited site sample
5. Dating and periodization of each site
6. Estimation of site size
7. Calculation of hearth density and correlation with site date and size for total number of excavated sites
8. Estimation of site duration
9. Correction for site contemporaneity
10. Summation of total site area and total hearths for each period
11. Estimation of family size for each period from palaeodemographic data and direct historic analogy
12. Conversion of hearth total into population using family size estimates
13. Plotting population curve
14. Calculating rates of population growth and decline

15. Writing a period by period population size history

Chapter 5 will address steps (1) to (4), Chapter 6 steps (5) to (14), and Chapter 7 step (15).

CHAPTER 5

STUDY AREA AND DATA

South-central Ontario, roughly a triangle bordered by the Canadian Shield to the north and east, Lake Ontario to the south, and the Niagara Escarpment to the west, is generally accepted by archaeologists to be the ancestral homeland of the Huron-Petun (Ramsden 1977a:66-67, Trigger 1976:148-150; Wright 1966:66-69). Evidence of archaeological continuity between Middle Woodland and the first recognizable Ontario Iroquoian sites in this geographical zone, for example in Prince Edward County (Fox 1982), and genetic continuity in skeletal remains from such sites (Molto 1983:256) argue strongly in favour of an in situ development for the Huron-Petun. Thus, based on the distribution of Iroquoian village sites and pottery styles in south-central Ontario, the prehistoric homeland of the Huron-Petun, constituting the study area of this research, is defined by the Frontenac Axis (the geological boundary between the Canadian Shield and Paleozoic sedimentary formations) to the north and east, Lake Ontario to the south, and the Credit Valley to the west (see Figure 12). The latter is the only "arbitrary" boundary to the study area, the others being natural barriers to Iroquoian settlement. Its definition requires explanation.

The first syntheses of Ontario Iroquoian prehistory were based on a handful of professionally-investigated sites separated from each other by vast distances (e.g. Emerson 1954; MacNeish 1952; Wright 1966). The discontinuous site distribution permitted clear boundaries to be drawn between prehistoric Neutral and Huron territories that approximated the seventeenth-century territories of these groups. More recent archaeological work has altered dramatically the map of the Iroquoian occupation of Southern Ontario. It is now obvious that the distribution of Iroquoian settlements is virtually continuous from central Lake Erie to eastern Lake Ontario. Consequently, the normative interpretation of Iroquoian sociopolitical development has been substituted for a clinal interpretation. Because the exact settlement relocation sequences associated with the formation of the historic Neutral and Huron-Petun confederacies have yet to be worked out, archaeologists have been reluctant to assign ethnic identity to prehistoric Ontario Iroquoian settlements, except for those situated in the Neutral and Huron-Petun heartlands. In light of what is known about Iroquoian village relocation and political evolution, however, it is possible to identify village clusters ancestral to either the Neutral or Huron-Petun (Pearce 1984; Ramsden 1977a; Smith 1987), except for a group of sites between the Niagara Escarpment and the Humber River, situated in the borderland between what most archaeologists would consider Neutral and Huron territories. The line of division, unfortunately, is rather fuzzy. Some authors place it at the edge of the Niagara Escarpment (Smith 1987), others at the Humber River (Noble 1984:23). Recent archaeological investigations of this "borderland" (e.g. Crawford 1984; Fox 1984a; Kenyon 1986; Ramsden 1977a; Smith 1987) suggest that the Credit River valley marks the western boundary of the Huron-Petun homeland .

Between the Niagara Escarpment and the Humber River, there are a number of Iroquoian sites seemingly ancestral to both the historical

Neutral and Huron-Petun confederacies (see Figure 12). Prehistoric territories are notoriously difficult to identify, but a brief examination of the archaeology of this region suggests that the Credit River valley is the best compromise as a boundary between "Neutral" and "Huron-Petun" territories.

As early as A.D. 800, it appears that the Credit River valley may have functioned as a boundary marker between ancestral Neutral and ancestral Huron-Petun peoples. The Maracle site, located on the east bank of the Credit River, is a Princess Point settlement - the most easterly one identified in the province (Fox 1982). The Princess Point culture is thought to be ancestral to Glen Meyer and ultimately Neutral culture (Fox 1982, 1984b; Noble 1975). It is apparent that this "boundary" persisted, with minor shifts, throughout Early Iroquoian times to A.D. 1320. No Glen Meyer site has been identified east of the Niagara Escarpment. From A.D. 1320 to A.D. 1500 (for chronology see chapter 6), the Crawford Lake region, on top of the Niagara Escarpment, and the Credit River valley were intensively occupied by Iroquoians. It is generally believed (Smith 1987) that the Crawford Lake sites are prehistoric Neutral, since there is demonstrable occupational continuity from Uren to the protohistoric Neutral period. The Credit River valley sites, at least the late prehistoric ones, have yielded typically Neutral ceramic assemblages (i.e. Dutch Hollow Notched, Lawson Incised, Niagara Collared rim types) (Jeff Bursey, personal communication 1988). However, there are a handful of very late prehistoric or early protohistoric village sites at the upper reaches of the Credit River

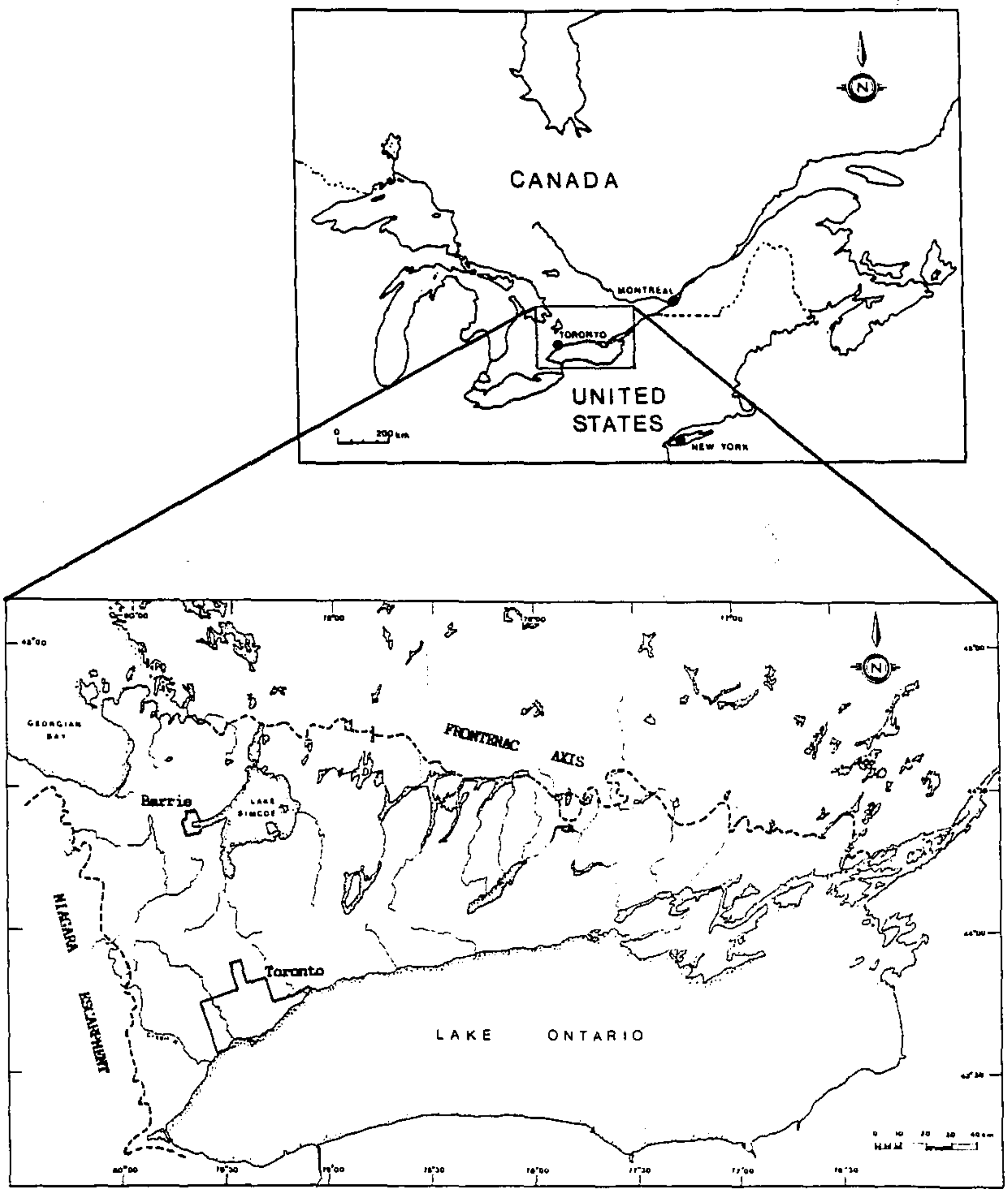

Figure 12. Study area.

(e.g. Emmerson Springs (Fox 1984a) and Wallace (Crawford 1984)) and on the east bank of the Humber River (e.g. Boyd and Seed (Ramsden 1977a:270-272)) that were apparently occupied by a mixed Neutral-Huron-Petun population, despite claims to the contrary (Noble 1984:23). Even skeletal data from the related Kleinburg ossuary imply only equivocal Neutral affinity (Molto 1983:244). In short, it is not clear whether these sites were frontier Neutral communities or primarily Huron-Petun ones that had experienced profound cultural change as a result of exchange and intermarriage with neighbouring Neutral peoples. Given that the Credit River valley was home to prehistoric and historic Neutral and Neutral peoples for seven centuries, that the Humber River sites are only a few kilometres from contemporaneous indisputable Huron-Petun sites (e.g. McKenzie-Woodbridge), and that the Credit River and Humber River site clusters are over 20 kilometres apart, with no intervening village sites, it seems reasonable to suggest that the Credit River valley can be considered the "boundary" between Neutral and Huron-Petun homelands.

Study Area

Geology, soils, and physiography

South-central Ontario lies in the St. Lawrence Lowlands physiographic zone. Its soils and landscape have been shaped by Pleistocene glaciation of underlying bedrock: Ordovician limestone and shales (approximately 435 - 455 million years old). The Ordovician beds cover the Precambrian Shield, ending at the Frontenac Axis which is the southern edge of an arch of Precambrian rock extending from Algonquin Park to the Adirondack Mountains (Chapman and Putnam 1984:2-3) (see Figure 13). The final retreat of the Wisconsin ice sheets about 13000 years B.P. left gravel, sand, and silt soils arranged in a complex topography of moraines (Oak Ridges and Dummer Moraine systems), drumlins (Peterborough Drumlin Field), till plains (Peel Plain) and glacial lake strandlines (Lake Iroquois beach ridge) (Chapman and Putnam 1984). Lyle Chapman and Donald Putnam, in their definitive work **The Physiography of Southern Ontario**, have divided Southern Ontario into fifty-two physiographic regions, twelve of which occur in south-central Ontario. Brief descriptions of each of the latter are provided in order to identify portions of the study area that would have been unsuitable for occupation by Iroquoian agriculturalists.

Referring to Figure 13 and proceeding from south to north, the Iroquois Plain is a narrow band (one to 15 km) of sandy soils bordering the north shore of Lake Ontario (76 - 152 metres asl). Prior to European clearance, it was covered by oak-hickory forest (Chapman and Putnam 1984:190-195).

The Prince Edward Peninsula, east of the Iroquois Plain, consists of a lowland (76 - 106 metres asl) of shallow clay loam soils with limestone bedrock outcrops. Drainage is imperfect, supporting large cedar swamps. The region is prone to summer drought because of irregular rainfall and shallow soils (Chapman and Putnam 1984:188-189).

The South Slope region is sandwiched between the Iroquois Plain and the Oak Ridges Moraine, running the length of Lake Ontario. It is a drumlinized till moraine (152 - 274 metres asl) containing silts, clay loam, and sandy loam soils that are moisture retentive and highly fertile. Maple, beech, and white pine forest covered the region at the beginning of the nineteenth century (Chapman and Putnam 1984:172-174).

The Peel Plain is an island in the South Slope that has very heavy clay soils and poor drainage (152 - 229 metres asl). Original forest cover was a mixture of maple, beech, oak, and hickory (Chapman and Putnam 1984:174-175).

The Oak Ridges Moraine is one of the highest landforms in Southern Ontario (304 - 396 metres asl) and acts as the watershed between Lake Ontario and the Georgian Bay-Trent River drainages. Composed predominantly of sand and gravel, this moraine has an almost total lack of surface water and summer droughts are common. In fact, its drought prone soils and short growing season (frosts occur earlier here than in surrounding lowlands) place serious constraints on the agricultural potential of the Oak Ridges. Pine and secondary associations of maple, beech, and oak constituted the pre-European forests of this region (Chapman and Putnam 1984:166-169).

Northeast of the Prince Edward Peninsula lies a flat region of limestone bedrock (106 metres asl) known as the Napanee Plain. Covered only by a thin veneer of clay or stoney clay loam soil (often only 10 centimetres in depth), this region is very poor for corn agriculture. Late eighteenth-century land surveyors reported that maple forest covered the region, with cedar and elm occurring in the low-lying swampy lands (Chapman and Putnam 1984:186-187).

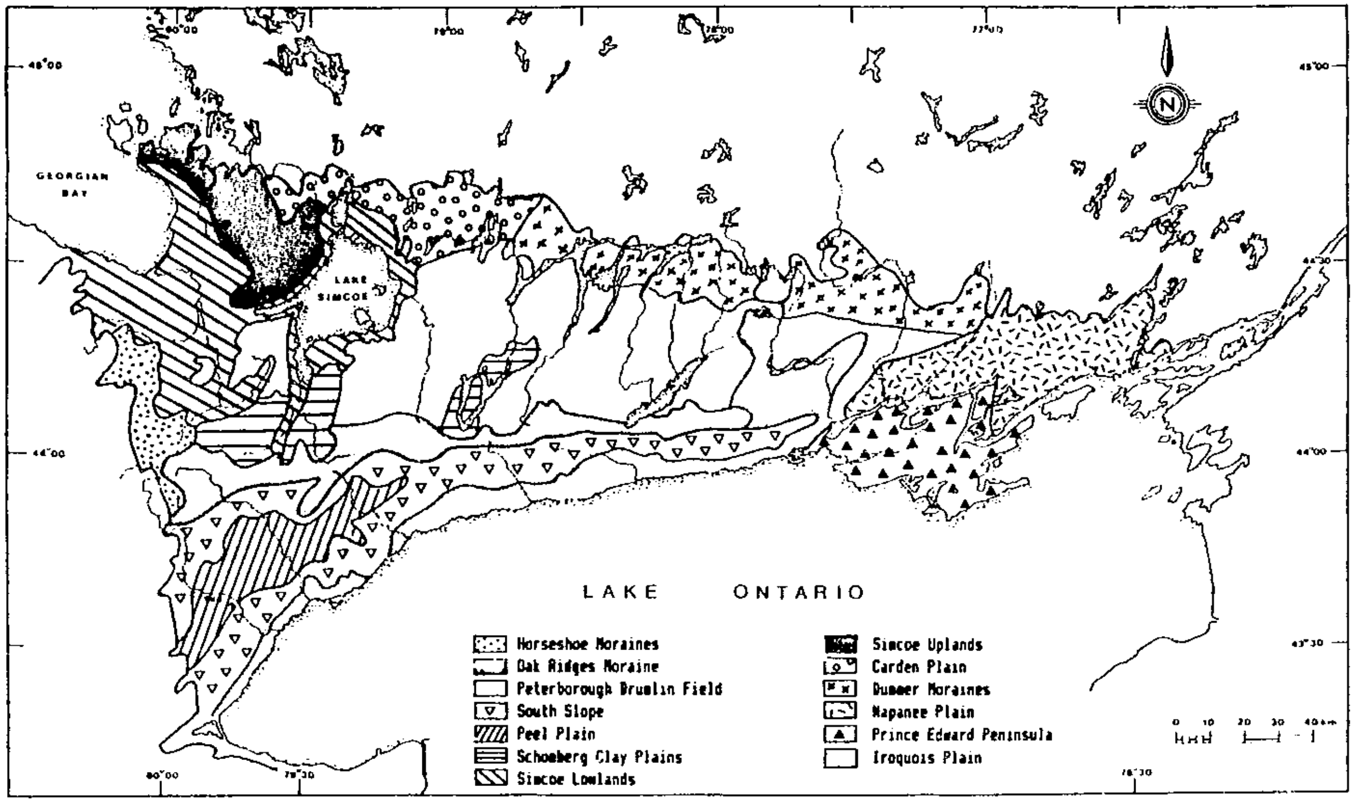

Figure 13. Physiography of south-central Ontario. (from Chapman and Putnam 1984)

The Schomberg Clay Plains are located north of the Oak Ridges and encompass the Holland River drainage and the lowlands of Lake Scugog (244 - 274 metres asl). Heavy silty clay loam soils predominate. However, prior to modern drainage control and tractor cultivation, the lowland portions of this region would have been waterlogged and not very well suited to corn agriculture. Prior to European settlement, maple-beech forests covered the uplands and cedar and elm groves dominated the imperfectly drained lowlands (Chapman and Putnam 1984:176-177).

The Peterborough Drumlin Field occupies 25% (about 4500 square kilometres) of the study area, extending from Lake Simcoe east to the Napanee Plain (183 - 244 metres asl). Drumlins composed of sand, gravel, and boulder till are separated by swampy clay flats and have the highest density in the Rice Lake area. Severe limitations to corn agriculture exist in the eastern half of this physiographic region because of the concentration of drought-prone drumlins (low moisture retention of coarse sand and gravel drumlin soils) and mucky bottomlands. Fine sandy loam soils are distributed throughout the western half of the region, overlapping with the southernmost segments of the Simcoe Uplands. The first EuroCanadian settlers encountered forests of maple, beech, and pine in the uplands and cedar swamps in the lowlands (Chapman and Putnam 1984:169-171).

The Simcoe Lowlands and the Simcoe Uplands, positioned between Georgian Bay and Lake Simcoe, are the physiographic regions of the historic Huron-Petun heartland. The lowlands (183 - 274 metres asl) include the Nottawasaga River and Lake Simcoe basins and are characterized by imperfectly drained sand, silt, and clay soils and organic muck in extensive marshes, swamps, and bogs, such as Holland Marsh and Minesing Swamp. Elm, ash, maple, and cedar were the predominant tree species of the original forests (Chapman and Putnam 1984: 177-180). The Simcoe Uplands (274 - 335 metres asl) are defined by a series of sandy and sandy loam ridges and intervening valleys of imperfectly drained sandy and silt loam soils. Upland soils are among the best in the study area for corn agriculture, although some portions, such as the Oro Hills just north of Kempenfelt Bay, are especially prone to summer drought because of coarse sandy soils (Heidenreich 1971:70-71). Prior to European land clearance, springs issuing from the sides of the sand ridges would have been major sources of water in the region (Chapman and Putnam 1984:181-184). Original forest cover of the uplands consisted primarily of maple, beech, pine, and oak, with concentrations of cedar and elm in the river and creek valleys (Heidenreich 1971:60-63).

At the northern edge of the study area, northwest of Lake Simcoe, there is a flat region of limestone bedrock overlain by very thin stony loam called the Carden Plain. The potential for corn agriculture is low in this region because of the droughty soil cover. Pine was the predominant tree species at the time of European settlement (Chapman and Putnam 1984:184-185).

The last physiographic region is the Dummer Moraine system which stretches from the Kawartha Lakes to the eastern boundary of the study area (183 - 244 metres asl). Soils are a boulder loam till and have a low potential for corn agriculture because of excessive stoniness.

Pre-European vegetation would have comprised maple forests and cedar wetlands (Chapman and Putnam 1984:185-186).

The various physiographic regions of south-central Ontario hold different potentials for supporting successful digging stick corn agriculture. The Huron-Petun had a distinct occupational preference for well-drained sandy loam or loamy sand soils (Heidenreich 1971:66-67; Konrad 1975:14-17; Warrick and Molnar 1986). Low-lying wetlands and steeply sloping landscapes (e.g. drumlin fields) seem to have been avoided, as well as drought-prone areas of sand or shallow soils (Konrad 1975:14-16). In addition, heavy loam soils were generally not settled by the Huron-Petun, unless they constituted more than 50% of a region's area (Konrad 1975:15). Based on modern land capability maps (Canada Land Inventory 1968) and Huron-Petun locational preferences, Figure 14 was constructed, which identifies areas unsuitable for Iroquoian occupation. Low potential zones in Figure 14 include drought-ridden sandy uplands, mucky bottomlands, limestone plains, and boulder till moraines (Class III - Class VII soils (Canada Land Inventory 1968)). Zones of moderate potential possess either steep topography (e.g. drumlin fields), shallow sandy loam soils, or heavy clay loam soils (Class I - III soils (Canada Land Inventory 1968)). Lands ideally suited to Iroquoian occupation (i.e. high potential zones) have sandy loam soils in combination with gently-rolling upland topography (primarily Class I and II soils (Canada Land Inventory 1968)). There is a remarkable correspondence between Figure 14 and the actual distribution of Iroquoian village sites (see Figures 17-23, pp. 148-154), corroborative evidence in

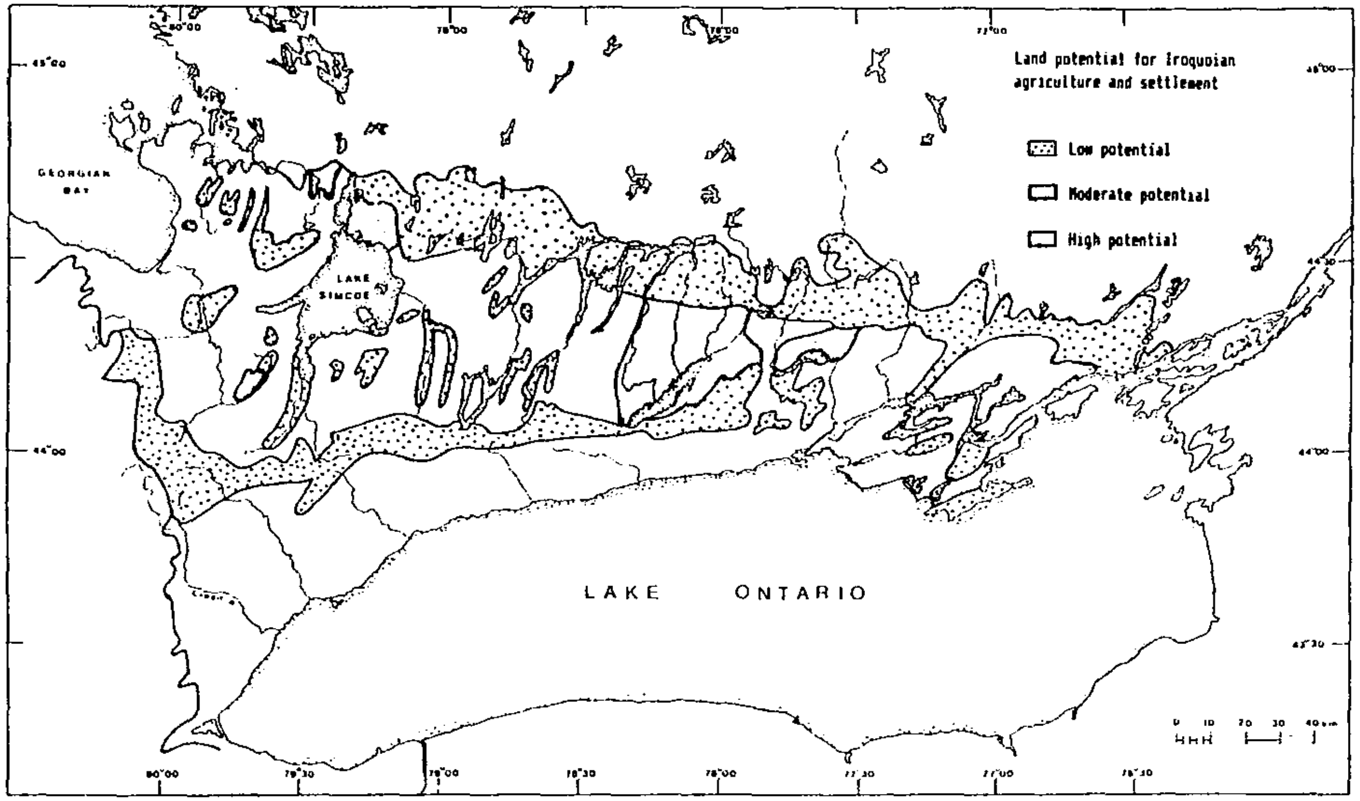

Figure 14. Areas of south-central Ontario unsuitable for Iroquoian occupation.

support of the claim that the archaeological distribution maps for Huron-Petun sites represent the real geographical pattern of Iroquoian settlement of south-central Ontario.

Climate

The present climate of south-central Ontario provides a completely adequate moisture-temperature-light regime for corn agriculture (Fecteau 1985:100-111). Table 6 summarizes relevant climatic statistics for the northern (Simcoe County) and southern (Toronto) portions of the study area (data from Brown et al. 1968). Considering that at least 50% of the Huron-Petun diet was based on corn (Schwarz et al. 1985), it is necessary to review the climatic history of Southern Ontario in order to identify any periods of prehistory when drastic climatic shifts might have occurred and put corn agriculture at risk.

From A.D. 500 - A.D. 1200, midcontinental North America, and presumably Southern Ontario, experienced a warmer and moister climate than at present (Bryson and Padoch 1980:591). It has been suggested (Williamson 1985:85) that increased precipitation may have encouraged Early Iroquoian experimentation with corn agriculture on the easily cultivated sandy soils of Southern Ontario.

During the thirteenth century, climates grew cooler and drier in interior North America (Baerris et al. 1976:52; Bryson and Padoch 1980:596). In Southern Ontario, palynological data indicate a cooling trend and reduced precipitation (Fecteau 1985:98; McAndrews 1976) between A.D. 1250 and 1450. It is possible that a drier climate was one of the causes for the fourteenth-century abandonment of the

Table 6. Climate of South-Central Ontario and Corn Agriculture Requirements.

Climatic Variable	Simcoe County	Toronto	Minimum Requirement for Corn
Mean Daily July Temperature (degrees Celsius)	19	21	16 - 21
Mean Daily Minimum Temperature in January (degrees Celsius)	-13.3	-10.0	n/a
Mean Annual Frost Free Period (Days)	138	145	120
Start of Growing Season	Apr. 20	Apr. 13	n/a
End of Growing Season	Oct. 28	Nov. 3	n/a
Mean Length of Growing Season (Days)	195	205	190
Mean Annual Growing Degree Days	3100	3600	3000
Available Corn Heat Units (CHU)	2400-2600	2800-3000	2500
Mean May - Sept. Precipitation (cm)	38.1	35.5	30 - 60
Mean Annual Snowfall (cm)	254	178	n/a

Note: Source for climatic data (Brown et al. 1968) and source for miniumum requirements for corn (Fecteau 1985:100-113).

drought-prone sand plains by certain groups of Ontario Iroquoians (Warrick 1984:65). However, the Great Lakes would have tended to maintain a relatively constant precipitation pattern in Southern Ontario (Bryson and Murray 1977). Cooler climates would have shortened the growing season and might have placed corn crops at greater risk of frost damage in the Georgian Bay - Kawartha Lakes region.

There appears to have been a brief return to more "normal" (i.e. warmer and moister) climatic conditions between A.D. 1450 and A.D. 1550 (Bryson and Padoch 1980:592-593). Then, cooler climates returned, lasting from A.D. 1550 to A.D. 1880 (the "Little Ice Age"). The growing season would have become shorter and less predictable

(Bryson and Murray 1977:83-88) in the northern areas of south-central Ontario. However, Heidenreich's (1971:57-59) compilation of historical data indicates that the Huron suffered serious droughts every five years during the 1630s and 1640s, a frequency that suggests a rainfall pattern similar to the present.

Flora and fauna

South-central Ontario is part of the Great Lakes-St. Lawrence Forest Province, an ecological region of mixed deciduous and coniferous forest (McAndrews and Manville 1987). Land surveys of the study area were carried out between A.D. 1784 and 1860, in order to facilitate European settlement. Forest associations were recorded along concession lines and permit reconstruction of pre-settlement vegetation (Ontario Ministry of Culture and Recreation, Historical Planning and Research Branch (MCR) 1981:85-87). Except for a narrow band of oak forest bordering the shore of Lake Ontario in the Toronto region, the pre-European forests were composed primarily of sugar maple, beech, basswood, elm, and hemlock. White pine and oak forest covered the dry sandy uplands and white cedar stands dominated the swampy lowlands of the region (Chapman and Putnam 1984; MCR 1981:337-38, Map 2; Heidenreich 1971:59-63). Stands of mature white pine (estimated to be 300 - 400 years old at the time of observation) were remarkable in certain areas, such as the Rouge-Duffin drainage (east of Toronto) and south of Kempenfelt Bay (Innisfil Township, Simcoe County). Subsequent archaeological research has demonstrated a high correlation between such pine stands and fifteenth-century Iroquoian villages and their associated corn fields (Figure 11 (after Bowman

1979; Lennox et al. 1986:153-154)). It would appear that Iroquoian agriculture affected the natural sequence of forest regeneration and hence altered the pre-Iroquoian forest associations in certain intensively occupied portions of south-central Ontario (Lennox et al. 1986:152-158). Edible plants, fruits, and nuts native to the study area include goosefoot (**Chenopodium** sp), Jerusalem artichoke, Solomon's seal, wild onion, wild strawberry, raspberry, blackberry, blueberry, cranberry, choke cherry, pin cherry, wild grape, wild plum, mayapple, butternut, bitternut, and acorn (Heidenreich 1971:60-61; Keene 1981:54-91; Lennox et al. 1986:138-143).

The fauna of south-central Ontario, prior to European settlement, can be inferred from zooarchaeological identification lists compiled for a representative sample of excavated Iroquoian village sites (Burns 1979; Hamalainen 1981; Lennox et al. 1986:101-131; Reid 1975:33-38; Savage 1971a,1971b). Wild mammals most commonly observed include white-tailed deer, woodchuck, beaver, black bear, chipmunk, red squirrel, muskrat, cottontail rabbit, snowshoe hare, raccoon, fox, and wolf. The only domestic animal known to prehistoric Iroquoians was the dog.

Birds include ruffed and spruce grouse, wild turkey (non-migratory) and migratory species such as duck, Canada goose, passenger pigeon, and sandhill crane (summer residents only).

Common fish species are catfish (i.e. bullhead), sucker, yellow perch, sunfish, bass, pickerel, lake trout, whitefish, freshwater drum, and bowfin. With the exception of trout and whitefish, most of these are spring spawners that inhabit shallow lakes, marshes, and warm, slow streams (Cleland 1982:766-767; Heidenreich 1971:208-212). Other potential food animals whose remains occur in Iroquoian sites include turtles, frogs, and freshwater mussels.

Brief History of Huron-Petun Archaeological Research

By integrating frameworks proposed by Bruce Trigger (1985b:56-75) and Gordon Willey and Jeremy Sabloff (1980) for organizing the history of American archaeology, the history of Huron-Petun archaeology can be divided into three major periods: Inventory (1840-1908); Site Excavation and Chronology (1909-1967); and Settlement Patterns and Archaeological Resource Management (1968-present). Each period encompasses a distinct style of archaeology that originated from a complex interaction between the personalities of individual archaeologists, shifts in archaeological paradigms, and society's changing attitudes toward native people and cultural heritage (Trigger 1985b:56-75).

Inventory (1840-1907)

Serious archaeological interest in the Huron-Petun began in the mid-nineteenth century as a result of Jesuit research into the seventeenth century Huron mission. French-Canadian nationalism motivated these investigations more than an interest in native heritage (Trigger 1985b:9). In 1842 Pierre Chazelle visited Simcoe County and discovered a historic Huron village site on the Sturgeon River. He identified it as St. Ignace (Hunter 1900:79-80). Two other Jesuits, Felix Martin in 1855 and Joseph-Charles Tache between 1860 and 1865, located and examined several more historic Huron villages and supervised the "excavation" of at least sixteen Huron ossuaries (Latta 1985b:162; Martijn 1978:13). Regrettably none of the survey notes or site data have been published.

The "Inventory Period" of Huron-Petun archaeology began in earnest with David Boyle's appointment as curator of the Provincial Museum and his establishment of The Annual Archaeological Report for Ontario in 1887. Between 1885 and 1907, Boyle conducted a number of surveys and site excavations throughout south-central Ontario, the main purpose of which was to acquire artifacts for the museum and to compile a comprehensive inventory of the province's native archaeological sites (Killan 1983). The driving force behind late nineteenth century Ontario archaeology was the same as nineteenth century ethnography, to acquire a record of native life as a means of preserving it forever (Trigger 1980). For its day, Boyle's work was first-rate and encouraged a few dedicated avocational archaeologists to undertake serious archaeological work in their local regions. In particular, Boyle's inventory of Petun sites (10 villages and 21 ossuaries) in Nottawasaga Township, Simcoe County (Boyle 1889), compiled through door-to-door interviews with local farmers and systematic fieldwalking, was emulated by two of his finest proteges - George Laidlaw and Andrew Hunter.

George E. Laidlaw's active archaeological career began in 1890 with a visit by Boyle to his ranch on the west shores of Balsam Lake, Victoria County. Laidlaw toured Boyle around three Huron village sites, including Coulter (BdGr-6), situated on his ranch (Killan 1983). Over the next three decades, Laidlaw combed Victoria

County, gathered artifacts and information from over 61 archaeological sites, many of them Huron-Petun settlements (see Appendix 2), and published relevant details and some site plans in a series of high-quality reports (Laidlaw 1898; 1900; 1912; 1917). Laidlaw, unlike Hunter, personally visited virtually every site that he reported and individual site descriptions reflect this. For most village sites, Laidlaw recorded the number of "ashbeds/ash heaps" (i.e. recently ploughed house floors and middens), general classes of artifacts, and a size estimate. In certain cases, he even attempted to date the village occupation by estimating the ages of large pine trees that were found growing on unploughed midden deposits . For example, pine stumps found on the middens and earthwork of the Jamieson site (BcGr-1) were judged to be over 400 years old, implying that it was abandoned ca. A.D. 1500 (Laidlaw 1900). On the basis of ceramic seriation the Jamieson village is dated ca. A.D. 1475-1500! Laidlaw ceased active fieldwork in 1917, but some of his interpretations, such as his correct identification of a relatively high incidence of St. Lawrence Iroquoian ceramics on many of the Victoria County sites, have been borne out by contemporary archaeology (Killan 1984:10).

Andrew F. Hunter personifies the "Inventory Period" of Huron-Petun archaeology. In 1885, as an undergraduate at the University of Toronto, Hunter met Sir Daniel Wilson and David Boyle, who encouraged his avocational pursuits in Huron archaeology (Killan 1983:120). Using contemporary archaeological survey methods (i.e. interviews with local collectors and farmers and systematic fieldwalking), by 1889 Hunter had recorded almost 400 Huron-Petun site locations in Simcoe, York, and Ontario Counties. Based on the geographical distribution of sites with French trade goods, Hunter concluded that the historic Huron confederacy was formed before 1615 by northward migration of Huron whose homeland had been the north shore of Lake Ontario (Hunter 1889) - a remarkable inference based entirely on archaeology! From his Barrie home, he continued his inventory of Huron sites by systematically scouring the various townships of Simcoe County, amassing a total of 637 sites by the end of his archaeological career in 1904. Hunter personally visited most sites or relied on verbal reports from respected collectors (e.g. J. Hugh Hammond, Orillia Township (Boyle 1904; Hammond 1905)) or at least two independent sources (Hunter 1907:20). The location, integrity, relative size and age, and associated artifacts of each site were recorded in pocket-sized notebooks and on scrap paper (Hunter n.d.) and are stored in the archives of the Ethnology Department of the Royal Ontario Museum. While certain sites remain unpublished (i.e. York and Ontario County and Innisfil Township, Simcoe County), the majority of Hunter's site descriptions were organized by township and published sequentially in <u>The Annual Archaeological Report for Ontario</u> (Hunter 1899, 1900, 1902, 1903, 1904, 1907) . Despite problems with imprecise size, age, and, in about 30% of the cases, location of sites, Andrew Hunter's archaeological work was an enormous achievement and "was the most comprehensive survey of a historical tribal area so far carried out in North America" (Trigger 1985b:61).

Archaeological fieldwork in south-central Ontario came to a virtual standstill with Hunter's "resignation" as Simcoe County's archaeologist in 1904 and Boyle's debilitating stroke in 1907 (Killan 1983). The task of interpreting the immense inventories compiled by Boyle and his co-workers was taken up by amateur historians. Arthur E. Jones integrated Hunter's archaeological data with the recently published Jesuit Relations and Allied Documents (Thwaites 1896-1901) in an attempt to identify the seventeenth century Huron mission sites (Jones 1908). Unfortunately, many of Jones's identifications are suspect, since he did no follow-up fieldwork to verify his selections. A similar study was carried out to identify Petun mission sites by members of the Huron Institute (Lawrence et al. 1909), using Boyle's Nottawasaga Township survey data. These were the first attempts in Huron-Petun archaeology to impose some form of chronological order on the vast amounts of site data that had been generated between 1880 and 1905 by a museum administrator and a few avocational archaeologists.

Site Excavation and Chronology (1908-1967)

After David Boyle's death in 1911, William J. Wintemberg became Ontario's most respected archaeologist. Trained by Boyle and employed by the National Museum of Canada in Ottawa, in 1912 Wintemberg initiated a series of Iroquoian site excavations across Southern Ontario, yet he excavated portions of only one Huron-Petun site - the Sidey-Mackay site - in 1926 (Wintemberg 1946). The primary aim of this research was to acquire artifacts for museum display and to intepret their function. In the tradition of a true "ethnographic" or museum archaeologist of the early 1900s, Wintemberg paid no attention to house patterns (although he recognized and mapped some post mould patterns), did not record artifact distributions, and made no serious attempt to develop site chronologies (Trigger 1985b:61,63). The emphasis of Wintemberg's archaeological career (1912-1940) on site excavation as opposed to site survey (except for a brief foray into Nottawasaga Township in 1923) and a heavy reliance on impressionable avocational archaeologists (e.g. Wilfrid Jury) for field crew delayed for nearly twenty years the introduction of culture chronology to Huron-Petun archaeology.

Contemporary with Wintemberg, a few avocational archaeologists continued to compile site inventories for select regions of south-central Ontario. Arthur J. Clark of Richmond Hill located, mapped, and recorded detailed descriptions of over 40 Iroquoian sites in York County between 1913 and 1932 (Dana Poulton, personal communication 1988), and from 1923-1961, Jay Blair added a number of Petun villages to the Boyle-Wintemberg list (Garrad 1982).

During the 1940s, Huron-Petun archaeology focused on the large-scale areal excavations of a number of Huron village sites directed by Wilfrid Jury (e.g. St. Louis/Newton, St. Joseph/Train, St. Ignace II/Hamilton, Flanagan (Latta 1985b:164;1988)) and the archaeological study of important historic sites, such as Cahiague (McIlwraith 1946,1947), Ste. Marie I (Kidd 1949), and the Ossossane ossuary (Kidd 1953). Unfortunately, much of Jury's work is either unpublished or described in a series of unscholarly preliminary reports filed with the University of Western Ontario. This partly explains the skepticism surrounding some of his village reconstructions and identifications (Heidenreich 1971:47-48; Latta 1988).

Culture chronology was introduced to Huron-Petun archaeology in 1952 by the publication of Richard MacNeish's **Iroquois Pottery Types**. Influenced heavily by James B. Griffin and William S. Ritchie, both strong proponents of the culture history or area synthesis approach in Northeastern archaeology (Trigger 1985b:66-67; Willey and Sabloff 1980:108-117), MacNeish demonstrated, using pottery typology and seriation, that the historic northern Iroquoian groups had evolved **in situ** from Middle Woodland populations. Based on rim samples from only six sites, he hypothesized that the historic Huron originated from an Ontario Owasco (i.e. Early Iroquoian) base, separated from the prehistoric Neutrals during Middleport times, and, throughout the Late Prehistoric period, gradually moved north from the Toronto region into Huronia (MacNeish 1952:31-32). Petun origins and their relationships to the Huron were not addressed because MacNeish (1952:29) felt that the two groups were archaeologically and, by implication, ethnically indistinguishable, based on the Sidey-Mackay (i.e. an early Petun site) rim sample. **Iroquois Pottery Types** put an end to blind empiricism in Huron-Petun archaeology by directing archaeological research toward building culture chronologies.

In the very year of its publication, the MacNeish **in situ** hypothesis (1952) was challenged by an entirely independent theory of Huron origins published by Frank Ridley (1952). Frank Ridley, perhaps the most dedicated and accomplished avocational archaeologist in the province since Andrew Hunter, commenced fieldwork in 1942 from his summer cottage at Bluewater Beach in Tiny Township, Simcoe County (Ridley and Ridley 1985). Ridley's early field surveys discovered several prehistoric Huron sites that yielded a style of high-collared pottery entirely different from the low-collared pottery that predominated on Late Prehistoric and Contact Huron sites. He named these high-collared sites the Lalonde Culture, after the Lalonde type site (BeGx-19). According to Ridley (1952), the historic Huron developed **in situ** in northern Simcoe County from the earlier Lalonde Culture. Toronto region Iroquoian sites were explained by a **southward** migration of late prehistoric Huron (Ridley 1952, 1958). While most of his interpretations were eventually proven false (Wright 1966), Ridley's temporal and geographical definition of Lalonde pottery and his comprehensive inventory of Huron sites in Simcoe County made significant contributions to Huron-Petun archaeology. He re-investigated over 148 of Andrew Hunter's site locations and, mainly between 1966 and 1975, recorded 110 Huron-Petun village sites in Simcoe County, describing the location, integrity, size, age, and artifacts recovered by surface collection or test excavation for each in a series of reports that are now on file with the Public Archives of Ontario and the Ontario Ministry of Culture and Communications, Toronto (Ridley 1958, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975). Because Ridley's archaeological surveys identified biases and systematic errors in Andrew Hunter's site data, it was possible, after making appropriate corrections and eliminating certain sites, to include most of Hunter's unverified site locations in the present study.

Verification and refinement of MacNeish's preliminary framework for Huron-Petun prehistory was accomplished by J. Norman Emerson and his academic and avocational students. In 1946, Emerson became the first professionally-trained prehistoric archaeologist to be hired by a Canadian university - in the Department of Anthropology, University of Toronto. Between 1947 and 1962, Emerson and his students test excavated a number of prehistoric Huron-Petun sites in the Toronto region, including McKenzie-Woodbridge (AkGv-2), Black Creek (AkGv-11), Seed (AkGv-1), Downsview (AkGu-13), Aurora (BaGu-2), Draper (AlGt-2), and Parsons (AkGv-8) . Rim sherd samples, predominantly from middens, provided the raw data for both MacNeish's (MacNeish 1952:29) and Emerson's (1954) dissertations, which contained interpretations of Huron origins (Emerson 1961; Emerson and Popham 1952) that were opposed to Ridley's (1952,1958). Emerson helped to found, in 1951, the Ontario Archaeological Society, whose purpose was to promote avocational archaeology in the province. Several Huron-Petun sites, such as Draper (AlGt-2), Elliot (AkGt-2), Robb (AlGt-4), Milroy (AlGt-1), Fairty Ossuary (AlGt-3) (Donaldson 1962a), MacMurchy (BcHb-26), Graham-Rogers (BbGw-2), Bosomworth (BaGv-1) (Emerson 1961), and Cleary (BbGw-10) (Warrick 1988a), were discovered and test excavated in the 1950s and early 1960s by society members, working in collaboration with the University of Toronto.

In 1966, James V. Wright published **The Ontario Iroquois Tradition**, which reconciled the MacNeish-Emerson and Ridley interpretations of Huron-Petun culture history. Data from over 30 sites in south-central Ontario were synthesized into a culture historical framework that, despite limited modifications (cf. Ramsden 1977a), is an indispensable tool in contemporary Huron-Petun archaeology. Wright (1966:74-79) postulated that the historic Huron and Petun resulted from a sixteenth-century fusion of the Northern (i.e. Lalonde) and Southern Division (i.e. Toronto region) Huron. With a reliable chronological framework established, Ontario archaeologists turned to examine the spatial aspect of Huron-Petun prehistory (Trigger 1985a:11).

Settlement Patterns and Archaeological Resource Management (1968-present)

The salvage excavation of the Miller site, directed by Walter Kenyon of the Royal Ontario Museum between 1958 and 1961, uncovered the virtually complete ground plan of an Early Iroquoian (Pickering) village, prior to its destruction by a gravel pit (Kenyon 1968). It was the first application, albeit unintentional, of settlement pattern archaeology in an archaeological resource management context in Ontario and anticipated the style of contemporary Huron-Petun archaeology by almost 30 years.

In 1966, Huron-Petun archaeology adopted a settlement pattern orientation in response to J.V. Wright's (1966:100-101) explicit recommendation to concentrate on the spatial dimension in Ontario Iroquoian research and a growing interest among American archaeologists in settlement patterns (i.e. site distributions, village organization, and house plans) (Trigger 1965,1968).

Patterns in Huron-Petun site distribution were elucidated considerably by a number of regional site surveys that were completed between 1966 and 1974. In Simcoe County, Frank Ridley's massive inventory of Huron sites (1966-1975) was complemented by more intensive surveys of the Penetang Peninsula (Tyyska 1969; Latta 1973) and Awenda Provincial Park (Tiny Township) (O'Brien 1976b). The Penetang project, a joint effort by several graduate archaeology students in the Deparment of Anthropology, University of Toronto (Hurley and Heidenreich 1969), was designed to produce an inventory of Huron sites for research and archaeological resource management purposes (Latta 1973:3). In the summer of 1969, 20 sites, representative of the entire span of Huron occupation of the Penetang Peninsula, were sampled for artifacts and, at the Maurice (BeHa-2) and Robitaille (BeHa-3) villages, two unploughed house floors were entirely excavated (Tyyska 1969; Latta 1973). The survey of Awenda Provincial Park, one of many archaeological inventories of the province's provincial parks undertaken in the early 1970s, was carried out between 1972 and 1973 by Roberta O'Brien and discovered eight Huron-Petun village sites and several special-purpose camps, mostly situated in forest contexts (O'Brien 1976b). The Penetang Peninsula, because of three complementary surveys and a low rate of site destruction, is perhaps the archaeologically best-documented region of the Huron-Petun heartland.

Beginning in 1966, Charles Garrad conducted exhaustive investigations of every reported Petun site in Nottawasaga Township and surrounds. The culmination of his work, "Project The Petun 1974", a two-volume report (Garrad 1975), summarizes location, size, age, and other pertinent details for 18 village sites, 18 special-purpose sites, and 21 ossuaries. Artifact samples, primarily ceramic rim sherds, pipes, and European glass beads, provided the basis for chronologically ordering the villages and associating over half of them with documented seventeenth-century Jesuit missions (Garrad and Heidenreich 1978; Garrad 1980).

In the Toronto region, extensive archaeological survey between 1971 and 1973, directed by Victor Konrad of York University, recorded 102 Iroquoian village sites in the Metro Toronto Planning Area and North Pickering Project region (Konrad 1973; Konrad and Ross 1974). The intent of these inventories was to confirm and register previously reported sites and to locate new sites on lands slated for development or urbanization. These studies played a prominent role in the widespread adoption of archaeological resource management in Ontario, because they presented alarming statistics on the actual and potential loss of archaeological sites as a result of urban development. In fact, they were the precursors of the New Toronto International Airport archaeological survey.

The New Toronto International (Pickering) Airport survey, which involved fieldwalking close to 5300 hectares of contiguous lands in Pickering Township, between 1976 and 1978, is probably the most intensive archaeological survey ever accomplished in Huron-Petun archaeology (Poulton 1979). Undertaken by the Museum of Indian Archaeology, and directed by William Finlayson and Dana Poulton in conjunction with the complete salvage excavation of the Draper village site (AlGt-2), the survey discovered 14 previously unknown Iroquoian sites, all part of a local developmental sequence of village removals (Finlayson 1985).

Also in the 1970s, several problem-oriented regional surveys made a substantial contribution to our understanding of Huron-Petun site distributions. Archaeological surveys of Prince Edward County, primarily designed to field-verify reported sites, were completed in 1972 (Sweetman 1972) and 1973 (Swayze 1973) and added several Early Iroquoian and Middle Iroquoian settlements to an earlier inventory of this region (Pendergast 1964; Emerson 1966). In 1977, Mima Kapches relocated and tested six Middle Iroquoian settlements in the Town of Markham (i.e. AlGt-1, 4, 14, 18, 35, and 36) for her Ph.D. dissertation at the University of Toronto (Kapches 1981a). Arthur Roberts conducted an extensive archaeological survey of the Regional Municipality of Durham and southeast Northumberland County in 1978 and 1979 to provide data on the Archaic occupation of the north shore of Lake Ontario for a Ph.D. dissertation in the Department of Geography, York University (Roberts 1985). Based on informant reports, field verifications, and random fieldwalking, Roberts documented almost 350 sites, including 26 Iroquoian villages (Roberts 1978, 1985:52). This project filled in a crucial data gap between the Toronto region and Prince Edward County and also resulted in the salvage excavation, in 1979, of the early Pickering Auda site (AlGo-29) (Kapches 1981b). Finally, Victoria County, particularly the Balsam Lake region, received intensive archaeological attention from 1976 to 1978. Directed by Peter Ramsden of McMaster University, the Trent Valley Archaeological Project relocated many of Laidlaw's sites and carried out large-scale excavations of three village sites: Benson (BdGr-1), Coulter (BdGr-6), and Kirche (BcGr-4) (Damkjar 1982; Nasmith 1981; Ramsden 1977b, 1977c, 1978a, 1981).

Concomitant with regional surveys, the areal excavation of longhouse and village plans became commonplace in the Huron-Petun archaeology of the 1970s. Reasons for such excavations include pure research (e.g. unploughed houses at Maurice [BeHa-2] and Robitaille [BeHa-3] (Tyyska 1969) and definition of village plans by slit-trenching at Benson [BdGr-1] (Ramsden 1977b,1977c), Coulter [BdGr-6] (Damkjar 1982), and Kirche [BcGr-4] (Nasmith 1981)), field school instruction (Le Caron [BeGx-15] (Johnston and Jackson 1980), Ball [BdGv-3] (Knight 1976), Warminster [BdGv-1] (Sykes 1983), Seed [AkGv-1] (Snow 1978)), and salvage archaeology (e.g. Draper [AlGt-2] (Finlayson 1985; Hayden 1979), Robin Hood [AlGt-96](Williamson 1983), White [AlGt-32](Finlayson 1985), Alonzo [BeGw-15] (Roberta O'Brien, personal communication 1987), and Auda [AlGo-29] (Kapches 1981b)).

Archaeological resource management and salvage archaeology have come to dominate Huron-Petun archaeology in the 1980s. Maturation to adulthood of the "Baby Boom Generation" by 1980 created a tremendous demand for housing and industrial expansion, particularly in Metro Toronto and outlying communities, such as Vaughan, Richmond Hill, Markham, Scarborough, and Barrie. Realizing the potential threat to archaeological resources in these urban centres, the provincial government (Ontario Heritage Foundation and Ministry of Culture and Communications) provided grants to municipalities, developers, and private archaeological consultants for archaeological inventory and mitigation. In Metro Toronto, for example, archaeological inventories for municipal planning use (i.e. archaeological masterplans) were carried out between 1986 and 1988 for Vaughan (Mayer, Pihl, Poulton and Associates Incorporated (MPP) 1986b), Richmond Hill (Archaeological Services Inc. (ASI) 1988), Markham (MPP 1986a), and Northeast Scarborough (MPP 1988b). The masterplans involved fieldchecks of known sites and the search for new ones by means of intensive fieldwalking. On average, two previously unreported Iroquoian villages were added to the inventories of each municipality by this process. In 1985, salvage excavations at the Keffer site (AkGv-14) uncovered an almost complete village plan and associated cemetery (Finlayson et al. 1987). In Barrie, archaeological resource inventory was combined with research. Building on earlier survey work (Hunter 1976,1978) and the salvage excavation of the Wiacek site (BcGw-26) (Lennox et al. 1986), Barrie (Lennox 1984c) and Innisfil and West Gwillimbury Townships (south of Barrie) (Warrick 1988a) were extensively surveyed from 1984 to 1986. These surveys relocated 11 Iroquoian village sites, the majority of which had been pinpointed by Andrew Hunter in the late 1890s (Hunter n.d.). Salvage excavation of the protohistoric Molson site (BcGw-27), situated on a future industrial park in Barrie, and intensive surface collections of the other sites have provided reliable rim samples for reconstructing a local village sequence in southern Barrie (Warrick and Molnar 1986) as well as identifying sites threatened by development.

Site Data

Over a century of archaeological work in south-central Ontario has amassed a large inventory of registered or Bordenized sites (Borden 1952) and unregistered sites, totalling approximately 1600. Prior to the **Ontario Heritage Act (1974)**, few archaeologists formally registered site location, type, age, and size. Standardized Borden forms, although available by the late 1960s, were not regularly submitted to the provincial site database, housed in the Toronto office of the Ontario Ministry of Culture and Communications, until the early 1970s. Consequently, sites discovered and investigated prior to 1967 are not registered, unless they were subsequently visited by a licenced avocational or professional archaeologist. Thus, the vast majority of Andrew Hunter's Simcoe County sites, George Laidlaw's Victoria County sites, A.J. Clark's York County sites, and even some of Frank Ridley's and Wilfrid Jury's sites have never been registered (see Appendix 1 and 2).

In theory, a registered site description should be more complete and reliable than that for an unregistered site. In actual fact, however, this is not always the case. For example, descriptions and maps of village sites by Laidlaw (1898), Clark (MPP 1986a,1986b), and Ridley (1966-1975) are superior in quality to those supplied by some "modern" archaeologists, such as Konrad (1973) and Roberts (1978). In terms of reliability, the archaeological inventory surveys of the Towns of Vaughan and Markham, Regional Municipality of York (MPP 1986a,1986b), have had a relatively equal success rate in the rediscovery of Iroquoian village sites recorded by "pre-modern" and early modern (i.e. late 1960s and early 1970s) archaeologists.

The total inventory of Iroquoian village sites in south-central Ontario was compiled from documentary sources and fieldwork. The bulk of the documentary sources are stored on computer and in a library at the Ontario Ministry of Culture and Communications, Toronto. The computer contains data on over 10,000 archaeological sites throughout the province. In addition, original Borden forms are also on file, permitting cross-checking and editing of the computer data. The ministry library contains over 1500 unpublished licence reports, spanning about 20 years of archaeological activity in the province, as well as a set of National Topographic System 1:50,000 scale maps with plotted site locations. Including published reports, the essential references on Huron-Petun village sites are:

1. Simcoe County - Hunter (1899,1900,1902,1903,1904, 1907, n.d.); O'Brien (1976b); Ridley (1966,1967,1968, 1969,1970,1971,1972,1973,1974,1975); Tyyska (1969); Warrick (1988a)

2. Victoria County - Laidlaw (1891,1898,1900,1902,1904, 1912,1917); Ramsden (1977c,1978a,1981)

3. Prince Edward County - Swayze (1973); Sweetman (1972)

4. North Shore of Lake Ontario - Roberts (1978)

5. Toronto Region - ASI (1988); Dibb (1979); Kapches (1981a); Konrad (1973); Konrad and Ross (1974); MPP (1986a, 1986b,1988b); Poulton (1979); Ramsden (1977a); Wright (1966)

6. Petun Country - Garrad (1975,1980,1981,1987).

A preliminary coverage of previous research revealed an obvious gap in Huron-Petun site distribution: southern Simcoe County. The area between northern Toronto and Barrie was virtually devoid of known

Huron-Petun sites in 1983. Yet, according to accepted hypotheses of Huron-Petun cultural evolution (Ramsden 1977a; Wright 1966), there should be abundant evidence for Huron-Petun occupation between Toronto and northern Simcoe County. Consequently, the Southern Simcoe County Archaeological Project was organized and directed by the author. The goals were to find as many Huron-Petun village sites as possible in two (1985 and 1986) two-month field surveys of Innisfil and West Gwillimbury Townships, Simcoe County (see Figure 15). With the assistance of Andrew Hunter's unpublished field notes from the late 1890s (Hunter n.d.) and a fieldwalking strategy, approximately 1200 hectares of ploughed fields were surveyed (200 person days of work) and 14 village sites were sampled by intensive surface collection, employing a combination of five-metre rope grids and rod and stadia measurements. Nine of the 14 sites were previously unregistered. Surface collections provided precise site size and adequate ceramic rim sherd samples for seriation dating (Warrick and Molnar 1986; Warrick 1988a and Appendix 1 and 2). The fieldwork succeeded in filling an extremely crucial gap in the Huron-Petun occupation of Southern Ontario. Without this fieldwork, the reliability of the regional population estimates in this study would have been questionable and the evidence for the Iroquoian colonization of southern Simcoe County in the early fourteenth century would not have been discovered (see Chapter 7).

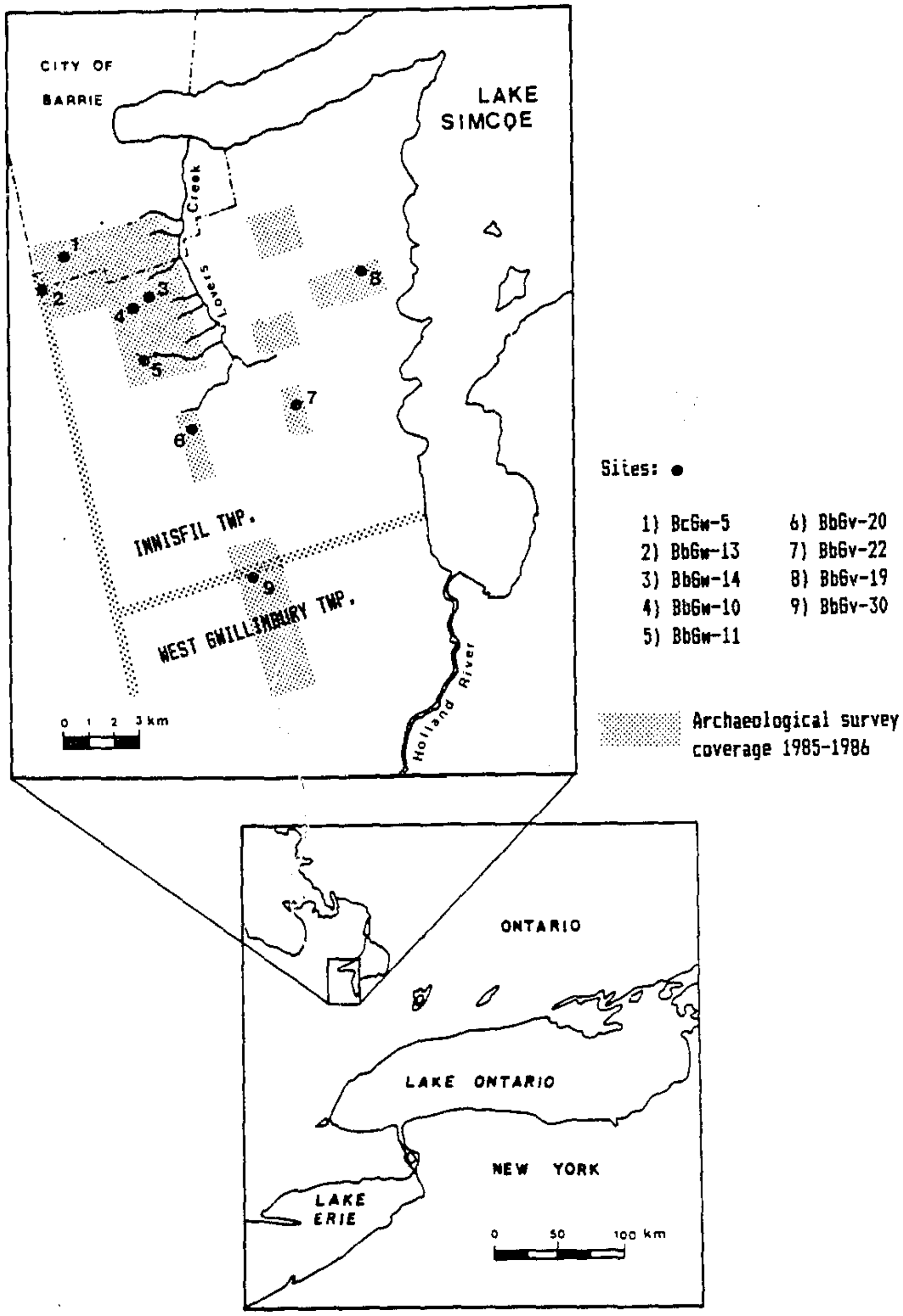

Figure 15. Archaeological survey coverage and Iroquoian village site discoveries in Innisfil and West Gwillimbury Townships, Simcoe County (1985-1988). (from Warrick 1988a)

Data Compilation

In anticipation of computer-aided statistical manipulations, standardized coding forms were designed and filled out for each site (Appendix 1). Site name, location, mode of discovery, age, size, history of investigation, rim sherd sample and other pertinent details were recorded for each site and the data entered into a database management file on an IBM PC compatible computer.

Data were recorded only for verified or probable **village sites**. For registered sites, the identification of Huron-Petun village sites was based on the following criteria:

1) Huron-Petun artifact assemblage
2) Total site size greater than 0.2 ha
3) Two or more middens
4) Moderate to high surface sherd density (at least 5 rimsherds per hectare of site area) (see Chapter 6 for derivation of these numbers).

For unregistered sites, because descriptions were somewhat more vague and incomplete, a polythetic set of criteria for identifying Huron-Petun village sites was adopted:

1) Huron-Petun artifact assemblage
    a) Presence of pottery,pipes,stone axes
    b) Size of artifact collection
2) Site size greater than 0.4 ha
3) Two or more "ashbeds" or middens
4) Water source within 150 metres

The criteria for identification of registered site data, applied in a strict manner, easily distinguished Huron-Petun village sites from other types of archaeological sites. The total number of registered or Bordenized Huron-Petun village sites is 334. When discrepancies existed between pre-modern and modern estimates of site size, the modern estimates were accepted as more precise. In the case of two or more different size estimates by modern archaeologists, a median site size value was recorded, except where there were obvious differences in the quality of field techniques used to estimate site limits. Complete or partially excavated sites have more precise size estimates than intensively surface collected ones, and the latter, in turn, provide more precise size estimates than eyeball observations. Application of the same criteria to unregistered site data produces less confident assignments of site type. Some examples might help to illustrate the special problems involved in identifying Huron-Petun village sites from pre-modern site survey data, mainly that collected by Andrew Hunter and George Laidlaw.

1) Artifact assemblage

In late nineteenth and early twentieth century Ontario, as outlined earlier in this chapter, Iroquoian sites and artifacts were the primary focus of archaeological inquiry. The sites were conspicuous in the newly cleared and ploughed landscape (many portions of northern Simcoe County were not cleared until the 1870s and 1880s) and the densities of ceramic sherds in village sites were high. Decorations on ceramic pot rims and especially those on pipes were attractive and easy to spot in freshly ploughed fields; local farmers with sites on their properties acquired small collections of the most complete and aesthetically-pleasing specimens in the course of their daily activities on the land. Such finds attracted the archaeological interest of Boyle, Hunter, Laidlaw, and Wintemberg (Killan 1983). Through personal visits and informants (at least two corroborative ones per site in Hunter's case (Hunter 1907:20)), Andrew Hunter recorded 425 archaeological site locations in Simcoe County and George Laidlaw recorded 61 in Victoria County (Appendix 2). Both men were well aware that their respective inventories exhibited considerable variability in site function and age. Sites were classified as isolated burial (e.g. Hunter's North Orillia #1 (1904)), cemetery (Hunter's South Orillia #10 (1904)), ossuary (e.g. Hunter's Medonte #21, (1902); Hunter's Vespra #52 and 53 (1907); Hunter's Tiny #6,#7,#32 (1899)), hunting or fishing camp (e.g. Hunter's Medonte #56,#58 (1902); Hunter's Vespra #29 (1907); Hunter's Oro #14, #66 (1903); Laidlaw's #17 (1898) , or village (e.g. Hunter's Tay #4 [St. Louis], #18 [BdGw-25A/25B] (1900); Hunter's Oro #38 [BdGv-8] (1903); Hunter's Tiny #37 [BeGx-10] (1899); Laidlaw's #7 [BdGr-1], #26 [BcGr-1] (1898)). Site dating was based on artifact assemblages. Hunter's (1907) chronological scheme, from earliest to latest, was: pre-Huron (Gouge-using People, Hunter's Flos #2 (1907); Hunter's Oro #33 (1903) - i.e. Archaic and Initial Woodland), pre-Early Huron (Hunter's Vespra #27-42 (1907) - i.e. Middle Iroquoian), Early Huron (Hunter's Vespra #45-49 (1907) - i.e. Late Prehistoric), early Historic (Hunter's Tay #32 (1900); Hunter's Tiny #45 [BeGx-22] (1899) - i.e. protohistoric and early historic), Historic or Jesuit Period (Hunter's Tiny #30 [BeGx-15]; Hunter's Tay #31 [BeGw-3] - i.e. middle and late historic), and 18th or 19th century Algonkian (Hunter's #85 (n.d.)). Chipped lithic and ceramic attributes were used to distinguish the prehistoric sites and the quantity of iron trade axes and diversity of other metal and glass items (particularly glass beads, brass kettles, scissors, and Jesuit rings) allowed Hunter to separate early historic from later historic sites.

Both Hunter's and Laidlaw's standard list of artifacts from a Huron village site is "pottery, pipes, and stone axes". Quantities of artifacts are sometimes reported in terms of large or small, small being often associated with camp sites. Thus, relative quantity of artifacts can help separate village from "special-purpose" sites in these inventories.

2) Site size

Precise size estimates are seldom provided in either Hunter's or Laidlaw's reports. When they are, a range in acres is given, such as 1.5 - 2.5 acres. More common are relative measures (large and small) or the number of lodge markings, camps, or middens. Comparison of relative size measures and actual sizes of some of Hunter's and Laidlaw's sites, the latter provided by modern archaeologists who rediscovered them (e.g. Frank Ridley (1966-1975) or Peter Ramsden (1977c,1978a,1981)), suggest that a large village site averages 2.10 hectares (n=21) and a small one 0.44 hectares (n=8). Thus, relative size estimates of unverified Hunter or Laidlaw sites are useful for determining approximate size and which ones might have been villages (see Chapter 6 for a definition of Iroquoian village size).

3) Ashbed or midden number

Andrew Hunter (1902:65-66) identified the characteristics of a ploughed village site as an area strewn with "fragments of relics" and "the ashbeds and blackened patches where the cabins stood". In individual site descriptions, distinctions are made between "camp fires" (Hunter 1903:179; 1907:52), "camps"(Hunter 1903), or "blackened patches"(Hunter 1907:54) and "ashbeds" (Hunter 1903:181; 1907:54) or "ash heaps" (Hunter 1904:115). The obvious inference is that Hunter was describing ploughed house floors as "blackened patches", ploughed hearths as "camps", and ploughed middens or refuse heaps as "ashbeds". It is important to remember that Hunter was describing village sites that had been ploughed only by horse, and sometimes after only the first ploughing, such as Hunter's Oro #26, where he could actually trace the outlines of house floors:

> marks of about twenty Huron lodges, having in nearly every case three fires for each lodge, were to be seen over an area of about three acres (not more) . . . the Huron lodge form was more discernible on the ground here than at any other place seen in my archaeological visits (Hunter 1903:170).

In contrast to descriptions of **village** sites, Hunter also discovered small camps or cabin sites, such as Hunter's Oro #58 (1903:181), where he:

> found some pottery fragments, a stone axe . . . but . . . there were few in comparison with other sites. And the evidences have been obliterated by cultivation, as the present occupant . . . has observed no signs of ashbeds or pottery fragments (Hunter 1903:181).

Such descriptions are repeated for other small sites (Hunter 1903:179; Hunter 1907:51; Hunter #172 (n.d.)). Laidlaw referred to ploughed house floors as "ash beds" or "those that were created by the floors of dwellings or habitations and are distinguished by the discoloration of the soil" (1898:51) and called ploughed middens "ash heaps or ash pits" or "those refuse heaps which occur generally on the outskirts of the village, and which were created by dumping the refuse of the village " (1898:52). Thus, any of Hunter's or Laidlaw's sites possessing two or more ash heaps was considered a tentative village site.

4) Distance to water source

Studies of the geographical location of Huron-Petun village sites (Konrad 1975:14) and archaeological site prediction models (Peters 1986; Pihl 1986) indicate that 85% are situated within 150 metres of a permanent water source. Any of Hunter's or Laidlaw's sites that lie beyond this threshold were not accepted as villages.

Adherence to these criteria identified 149 of Hunter's, Boyle's (1904), Hammond's (1905), Ridley's (1966-1975), W. Jury's and A.J. Clark's unregistered (i.e. unverified) sites and 18 of Laidlaw's as potential Huron-Petun villages (see Appendix 2). Thus, the combined total of registered and unregistered sites gives a total Huron-Petun village site inventory of 501. Referring to Figure 16, however, this should be considered a **potential** not an **actual** inventory of known Huron-Petun village sites. The potential inventory requires some editing. A proportion of the potential sites are probably not actual villages sites, based on the results of modern archaeological work designed specifically to relocate Hunter's and Laidlaw's unverified and unregistered sites (Ramsden 1977c, 1978a, 1981; Ridley 1966-1975; Warrick 1988a).

Table 7 summarizes the proportion of Huron-Petun sites, found prior to 1930 in Simcoe and Victoria Counties, that either have failed to be relocated by modern archaeological survey or else have been identified as special-purpose sites rather than villages. The overall percentage of verified non-village or non-existing village

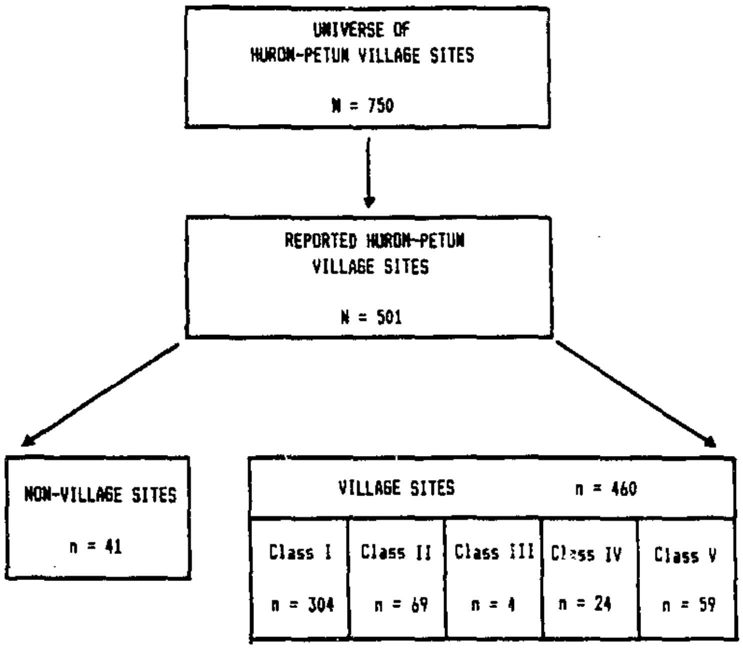

Figure 16. Information classes of Huron-Petun site data.

sites is 31 %. It is likely that a similar proportion of unverified or outstanding Hunter and Laidlaw sites are not actual villages. Thus, by random selection, proportional samples of unverified sites were removed from each township of Simcoe County and from Victoria County, a total of 41 sites (see Table 8 for list of sites removed by this process). Consequently, the actual inventory of Huron-Petun village sites totals 460 (see Figure 16).

The inventory of probable Huron-Petun village sites (n = 460) consists of several different types or classes of site data, ranging from those sites for which precise age and size are known (e.g. completely excavated sites) to those for which neither age nor size is available. Site class frequencies are provided in Figure 16. Class I sites (precise age and size) total 304. This is an important class of

Table 7. Current Archaeological Status of Premodern Reported Huron-Petun Village Sites in Simcoe and Victoria Counties.

County	Pre-Modern Survey Village Site Total**	Modern Verified Village Site	Modern Verified Non-Village Site	Not Found by Modern Survey	Outstanding Potential Village Site	Percentage of Verified Sites Non-Village/ Not Found
<u>SIMCOE</u>						
Tiny Twp.	29	17	1	2	9	15
Tay Twp.	34	15	1	6	12	32
Medonte Twp.	66	29	4	15	18	40
Flos Twp.	24	7	3	2	12	42
Oro Twp.	39	12	1	6	20	42
S. Orillia Twp.	13	5	-	1	7	17
N. Orillia Twp.	8	-	-	-	8	0
Vespra Twp.	39	14	3	-	22	18
Innisfil Twp.	35	18	1	6	10	28
<u>VICTORIA</u>	35	11	5	4	15	45
TOTALS	322	128	19	42	133	n/a

*Premodern data sources: Simcoe County (Boyle 1904; Hammond 1905; Hunter 1899,1900,1902,1903,1904,1907; Hugh Jackson, personal communication 1985) Victoria County (Laidlaw 1898,1900,1912,1917)

**Totals exclude non-Huron-Petun sites (i.e. Archaic,18th century), burials and ossuaries, and camps as identified by premodern archaeologist or according to criteria previously discussed. For grand totals for premodern archaeological surveys refer to Appendix 2 or original sources.

Table 8. List of Unverified Sites Removed from Total Inventory of Potential Huron-Petun Villages. *

Victoria County	Simcoe County	Simcoe County
BeGr-C	Tay	Oro
BdGr-B	BeGw-C	BdGw-K
BdGr-A	BeGw-I	BdGv-N
BcGp-A	BeGw-K	BdGv-T
BcGr-A	BeGw-N	BdGv-U
		BdGv-V
Simcoe County	Tiny	BdGu-A
	BeHa-A	
Flos	BeGx-K	S. Orillia
BdGx-C		BdGu-F
BdGw-M	Vespra	BdGu-I
BdGw-P	BcGw-A	
BdGw-T	BcGw-B	N. Orillia
	BcGw-C	BdGv-Y
Medonte	BcGw-L	BdGu-P
BdGw-D	BcGv-D	
BdGw-F	BcGw-N	Innisfil
BeGw-B	BcGw-T	BcGv-J
BdGv-F		BcGv-K
BdGv-I		BcGv-M
BdGv-K		

* See text for rationale and Appendix 1 and 2 for specific information on removed sites. These sites are excluded from further consideration in this study.

sites, since size and age estimates for the poorer known sites will be assigned by proportionality from the Class I sample (see Trigger 1965:157-160 for similar use of proportionality in demographic archaeology). Class II sites (approximate age and precise size) number 69. Sites in this class can be assigned only to the gross periods of Ontario Iroquoian prehistory (i.e. Early Iroquoian, Middle Iroquoian, Late Prehistoric, Contact - see Chapter 6 for detailed discussion of Ontario Iroquoian chronology). There are only 4 Class III sites, or sites for which only an approximate age and no size estimate are available. Class IV sites total 24 and include all sites for which no age estimate (other than a prehistoric/contact distinction) is available but which do have a precise size estimate. Finally, Class V sites , numbering 59, have no age or size estimates, other than a prehistoric or contact age designation and sometimes a relative size indication (e.g. large or small site). Prior to using these 460 sites to estimate Huron-Petun population, however, one further problem must be addressed - is this site sample a representative one?

Representativeness of Site Sample

It is widely recognized in the archaeological literature that regional population estimates from settlement data must be based on either the total population of settlements or on a statistically representative sample of that population (Adams 1965:119-125; Blake et al. 1986:448; Cunliffe 1978:4; Hodder 1977; Kruk 1980:1-12; Ramenofsky 1987a:27; Roosevelt 1980:203; Sanders et al. 1979:14-20; Schacht 1981:131-132; Schiffer and McGuire 1982:226; Starling 1983; Swedlund and Sessions 1976: Trigger 1985b:109; Zubrow 1975:57). In the absence of a total or representative sample of regional settlements, the reliability of reconstructed population change is seriously jeopardized because fluctuations in population may simply be a function of over or under-representation of sites from certain time periods.

The sample of 460 Huron-Petun village sites was not derived from probabalistic (Nance 1983; Plog et al. 1978) or 100% intensive (e.g.

Adams and Nissen 1972; Sanders et al. 1979) regional survey. It is the net accumulation of over 100 years of diverse archaeological activity in south-central Ontario (see earlier sections in this chapter). Reliable regional population estimates can still be made from distribution maps of settlement sites which have not been compiled from probabalistic or complete surveys (Blake et al. 1986), as long as we control for certain factors. Clive Orton (1980:179) summarizes these:

> if on the map there is no site of the type we are studying in a certain area, this could mean either (a) there never was a site of that type there, (b) there was once such a site in the area, but it has since been destroyed, (c) there is a site there, but it has not been found. . . There are basically two problems - differential survival and differential detection.

In other words, the demographic archaeologist working with settlement distributions has to be fairly certain that gaps in archaeological site distribution maps for a particular time period are not the result of site destruction or inadequate survey but real gaps or "black holes" (Groube 1981). In summary, the following factors can produce gaps in archaeological settlement pattern maps:

1) Site destruction
2) Site invisibility
3) Biased archaeological survey
4) Ecological or topographical constraints on settlement
5) Demographic or political constraints on settlement

The first three cause "apparent" gaps, the latter two produce "real" gaps (Groube 1981). Except for the last one, which is the subject of Chapter 7, each cause will be evaluated for its potential effect on the spatial-temporal distribution of known Huron-Petun village sites.

Figures 17 through 23 present the geographical distribution of the total inventory of Huron-Petun village sites (n = 501). Sites have been assigned, where possible, to four gross periods of Ontario Iroquoian history: Early Iroquoian, Middle Iroquoian, Late Prehistoric, Contact. Sites of unknown age are also plotted. Individual site numbers refer to the Borden designation and are cross-referenced to Appendix 1 and 2. For readers unfamiliar with the Borden system of site location, a brief description of its use is provided. In 1952, Charles Borden (1952) proposed a scheme for locating Canadian archaeological sites. Based on the National Topographic Series of maps (published by the Federal Department of Energy, Mines, and Resources), a Borden block (for example BeHa in Figure 22) occupies 10′ of longitude and 10′ of latitude. The area of the blocks decreases northward because of meridional convergence toward the pole. The first two letters of the Borden designation refer to latitude, the next two letters to longitude, and the number identifies a specific site. The latitude letters change east to west (i.e. from "a" to "x") and the longitude ones south to north (i.e. from "a" to "l").

1) Site destruction

South-central Ontario is still primarily a rural landscape, except for the urban areas of the Regional Municipalities of York and Durham, and the cities of Toronto, Barrie, and Peterborough (see Figure 12). While the effects of site destruction have been particularly severe in these areas (Konrad 1973; Konrad and Ross 1974;

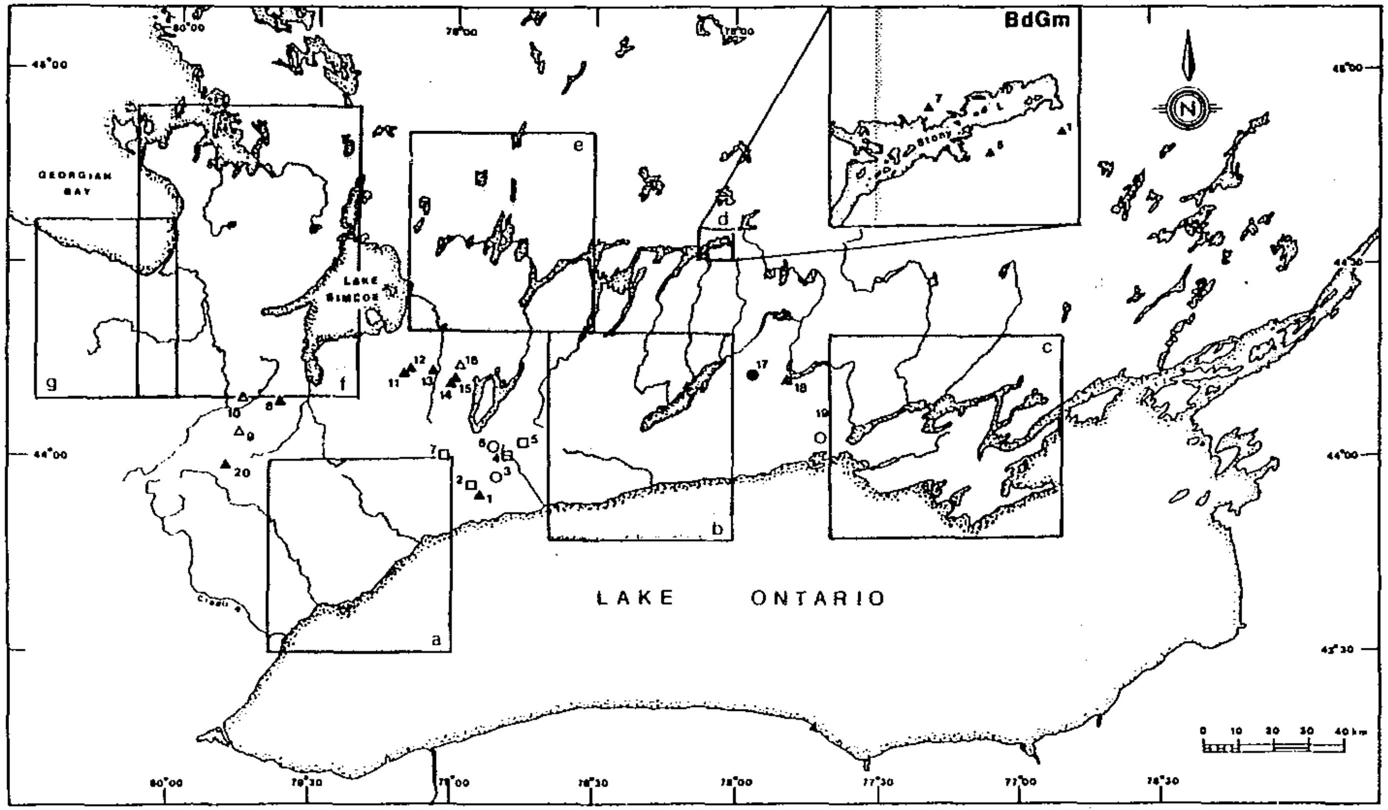

Figure 17. Key map showing concentrations of Iroquoian settlement in south-central Ontario. Sites distributed within any of the shaded boxes marked with a letter can be found in inset maps (Figures 18-23). Sites located outside the shaded boxes are included in this study. (Key to site symbols - see Figures 18-23; key to site numbers (see Appendix 1 for site data): (1) AlGr-41; (2) AlGr-9; (3) AlGr-10; (4) BaGq-9; (5) BaGq-2; (6) BaGr-1; (7) BaGs-1; (8) BaGv-1; (9) BaGw-1; (10) BaGw-2; (11) BbGt-2; (12) BbGs-10; (13) BbGs-11; (14) BbGs-1; (15) BbGr-2; (16) BbGr-3; (17) BbGl-4; (18) BbGk-7; (19) BaGk-2; (20) BlGw-1

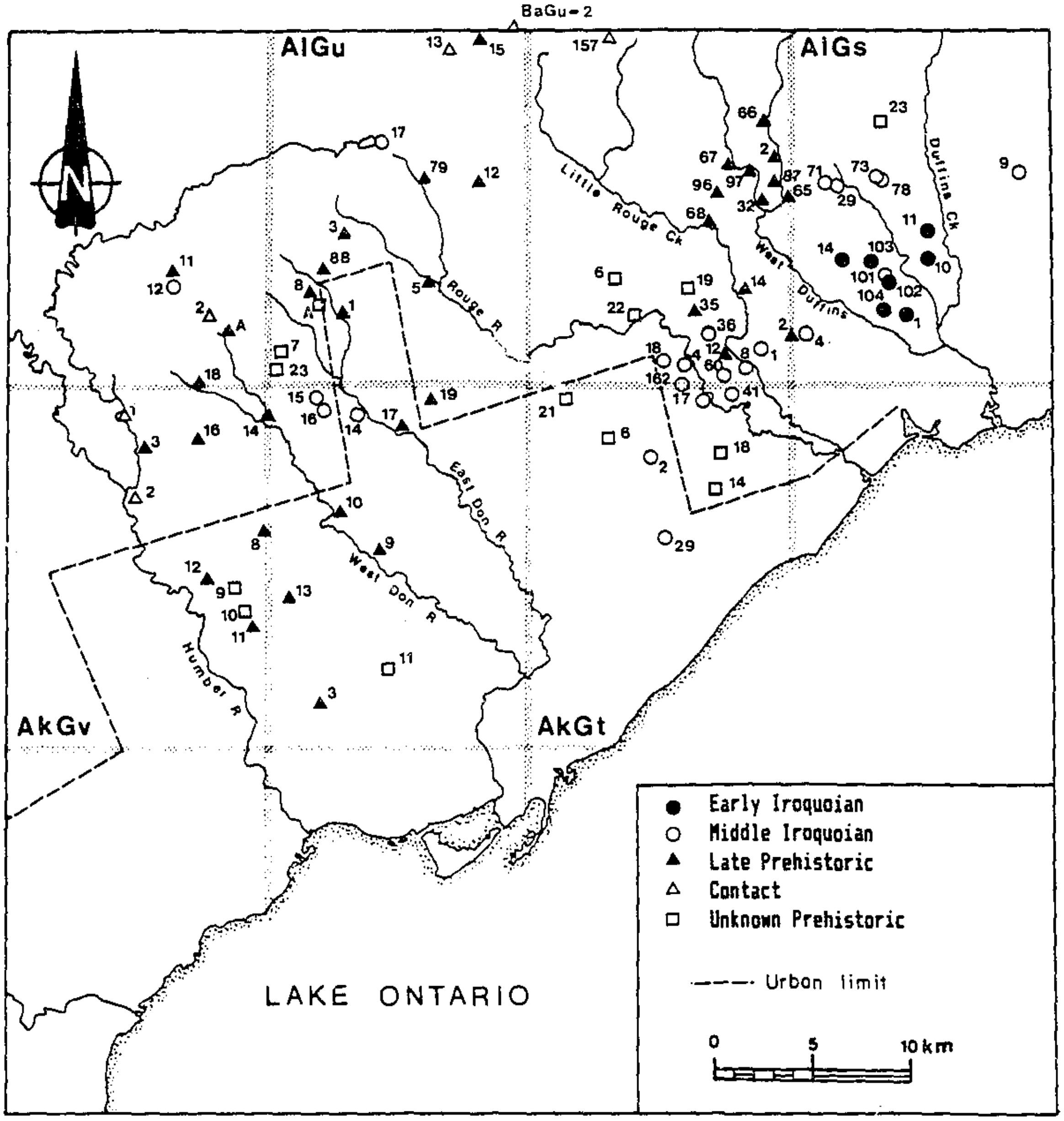

Figure 18. Toronto cluster of Huron-Petun village sites. (Inset a in Figure 17). Site numbers are the Borden registration numbers. To identify a particular site, read the four letter Borden block designation (marked on the map and delineated by shaded lines), then attach the site number. Refer to Appendix 1 for a description of each site.

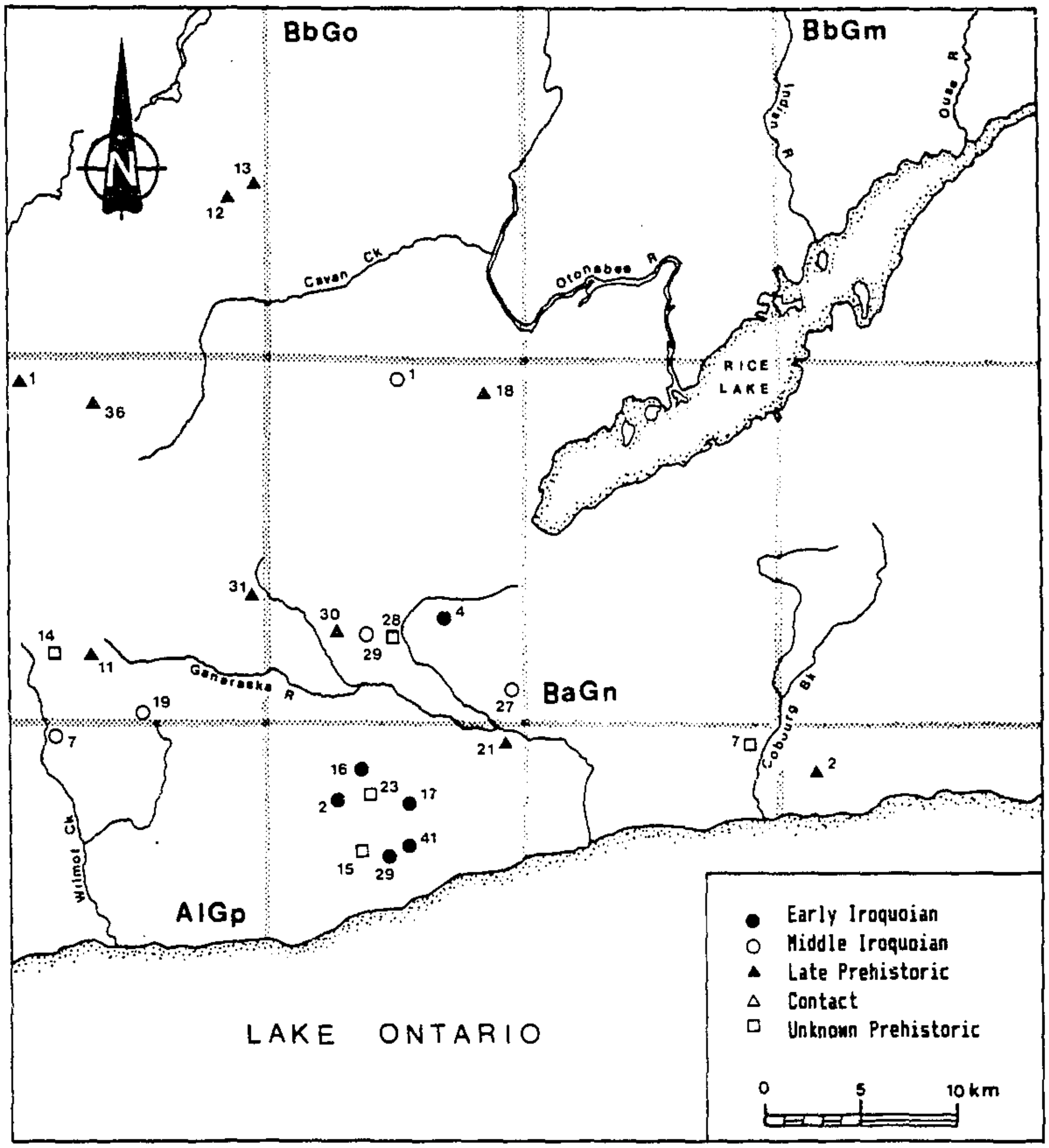

Figure 18. North shore of Lake Ontario cluster of Huron-Petun village sites. (Inset b in Figure 17). Site numbers are the Borden registration numbers. Refer to Appendix 1 for a description of each site.

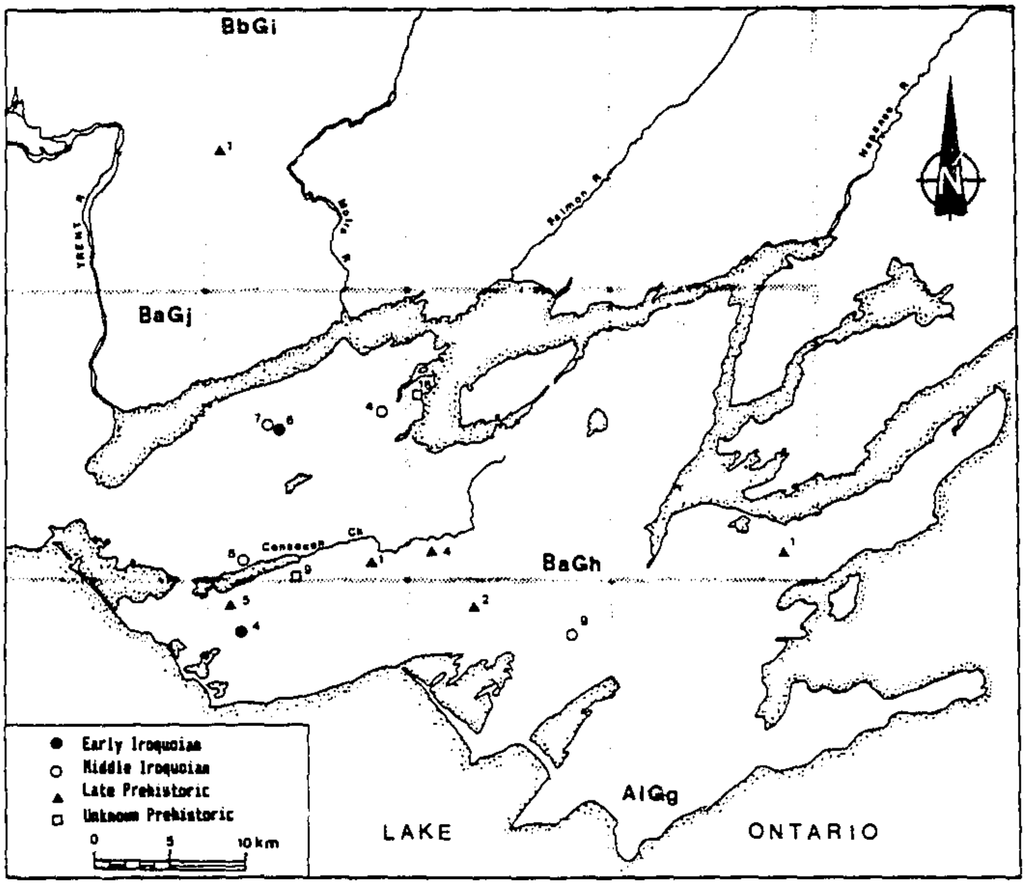

Figure 20. Prince Edward County cluster of Huron-Petun village sites. (Inset c in Figure 17). Site numbers are the Borden registration numbers. Refer to Appendix 1 for a description of each site.

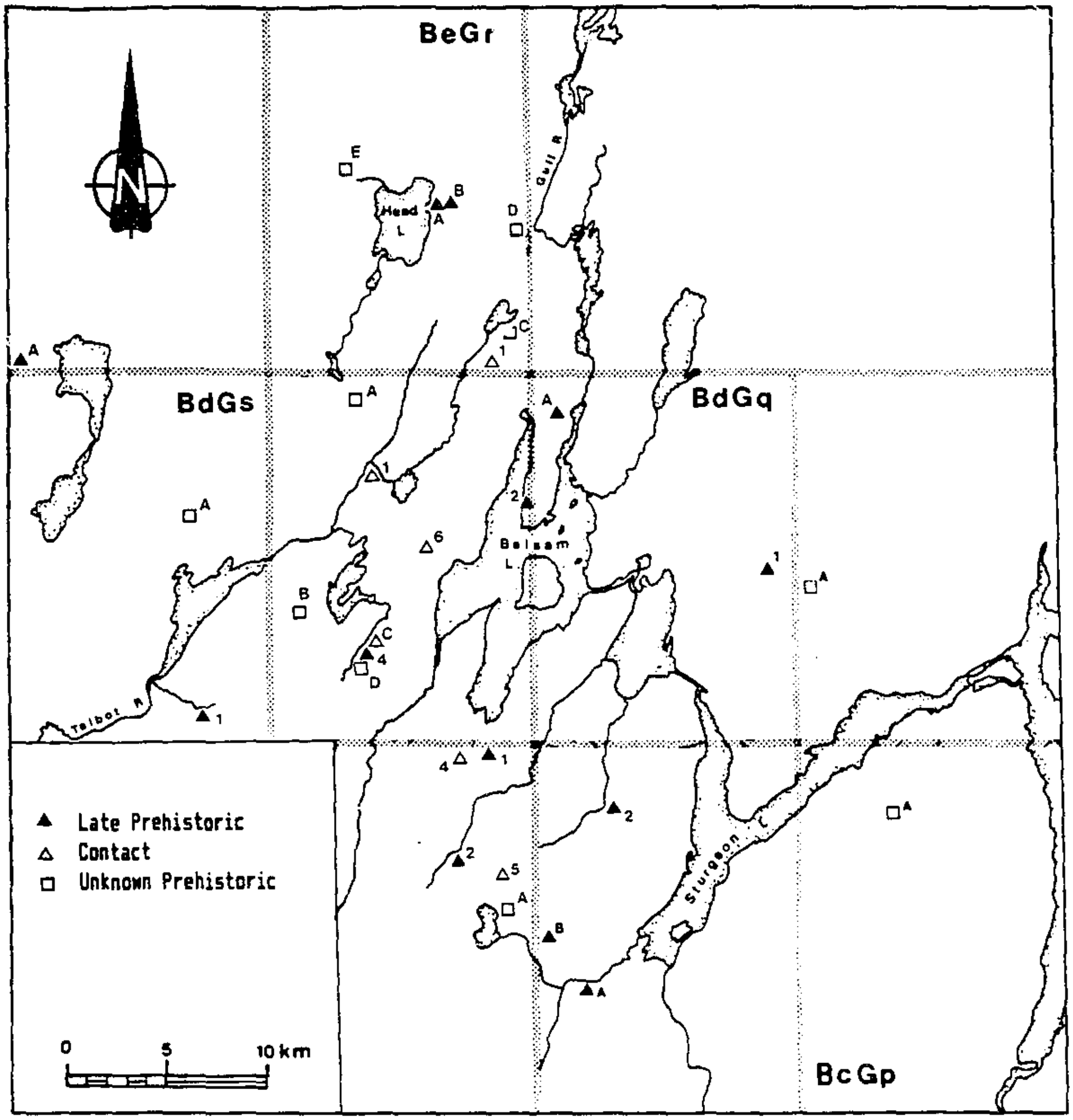

Figure 21. Victoria County cluster of Huron-Petun village sites. (Inset e in Figure 17). Site numbers are the Borden registration numbers. Refer to Appendix 1 for a description of each site.

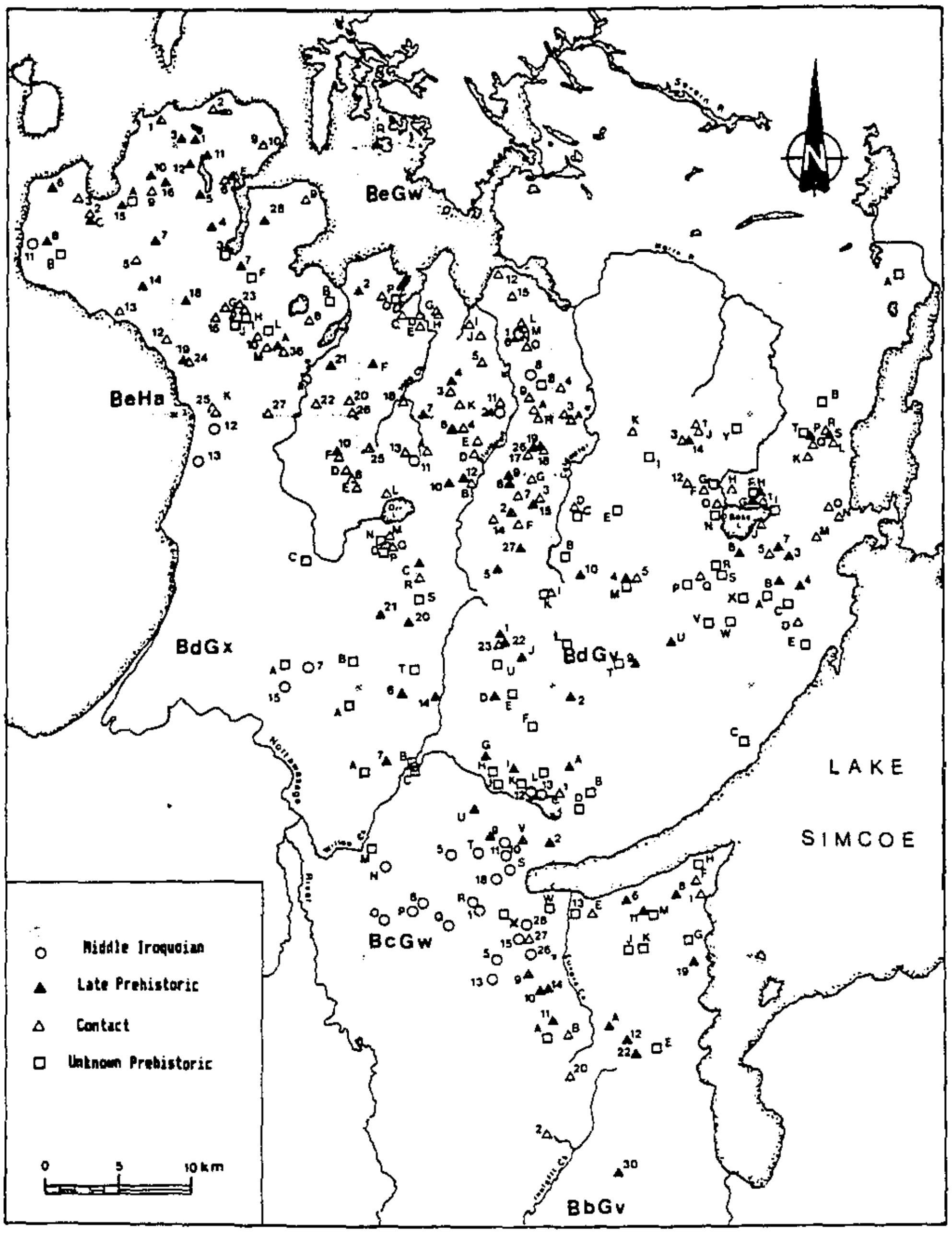

Figure 22. Simcoe County cluster of Huron-Petun village sites. (Inset f in Figure 17). Site numbers are the Borden registration numbers. Refer to Appendix 1 for a description of each site.

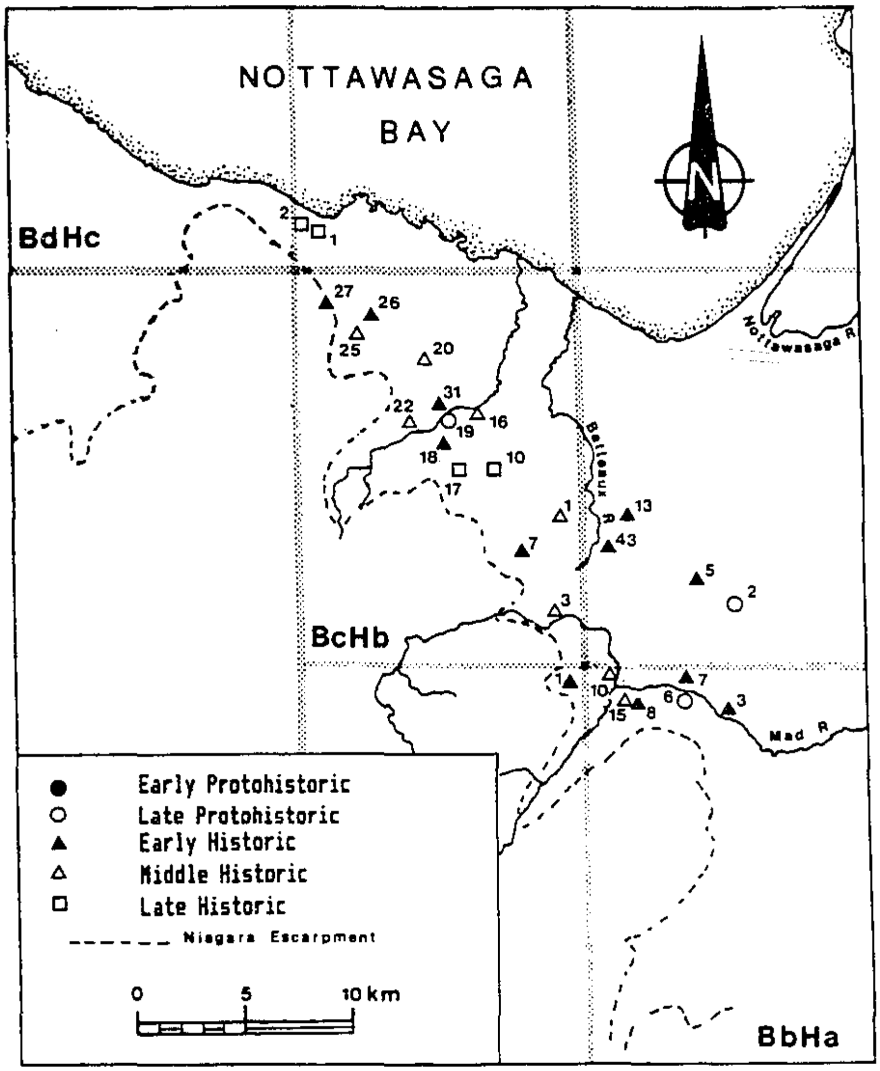

Figure 23. Petun village sites. (Inset g in Figure 17). Site numbers are the Borden registration numbers. Refer to Appendix 1 for a description of each site.

MPP 1986a,1986b,1988; Warrick 1988a), the overall attrition of Huron-Petun archaeological sites appears to have been minor. While pit and quarry activity has damaged a considerable number of **Early Iroquoian** sites east of Toronto (Ambrose 1981; Kenyon 1968; Reid 1975) and highway corridors have posed a threat to sites in more northern areas (Lennox et al. 1986), most Huron-Petun sites are situated on active farmland, in fallow pastures, and in woodlots and are reasonably safe from destructive forces. The relatively recent age of most sites and the moderate climate of south-central Ontario has prevented their destruction by erosion and deep burial by alluviation.

2) Site invisibility

Unlike other Neolithic settlements in the American Southwest (Blake et al. 1986), Mesoamerica (Sanders et al. 1979), Britain (Orton 1980:179-186), Egypt (Trigger 1965), and the Middle East (Adams and Nissen 1972; Smith and Young 1984), Huron-Petun settlements were each occupied for only a brief span of time, 10 - 40 years (Warrick 1988b), and are not deeply buried under sterile or cultural overburden. Faced with the typical constraints of swidden agriculture (Ellen 1982; Harris 1972), such as exhaustion of cultivable land, firewood, building supplies, and game within a reasonable walk of the village, the Huron-Petun were compelled to relocate their villages rather frequently. However, superimposed village occupations are rare; only eight of 306 well-documented ones are multicomponent (see Appendix 1). In effect, the Huron-Petun settlement distribution represents a series of "snapshots" left on the Southern Ontario landscape (Snow 1985). Consequently, the danger of earlier settlements being hidden under later ones is not a serious issue in Huron-Petun archaeology. Furthermore, Huron-Petun village sites are highly visible on the landscape, being relatively large (several acres), having high artifact densities, and tending to be situated on active agricultural land (only 5% of Huron-Petun sites are in bushlots; bushlots in Southern Ontario tend to occupy land unsuitable for corn agriculture (i.e. poor soils, poor drainage, and steep slopes)). Difficult for farmers, casual collectors, or professional archaeologists to overlook, Huron-Petun settlements are the most conspicuous type of archaeological site in the province.

3) Biased archaeological survey

It is something of a truism in archaeology that in regions which have not been subjected to complete survey coverage, the distribution of archaeological sites will tend to reflect the distribution of archaeologists (Brown and Taylor 1978:78-80; Hamond 1980; Orton 1980:183; Schiffer and Wells 1982:363). Unfortunately, data are insufficient for mapping the distribution of archaeological activity in south-central Ontario. Records for both professional and avocational archaeologists often lack information on number, size, and location of survey units. Thus, there is no direct way of empirically assessing the correlation between the amount of land surveyed and the number of sites found for a particular region of south-central Ontario. Nevertheless, there are indirect statistical tests which can identify holes, resulting from biased archaeological survey, in the current distribution map of Huron-Petun village sites.

At a gross level, the historical pattern of Huron-Petun site finds from 1880-1988 conforms to a saturation or logistic curve. Figure 24 depicts two curves. The exponential one (A) represents the expected pattern of archaeological discovery for a region with only a brief history of archaeological investigation. Most sites of a particular period remain unknown and thus the curve increases without apparent end. The logistic curve (B), on the other hand, describes the pattern of archaeological discovery for a region with a long history of archaeological fieldwork. Most sites of a particular period have been found, few remain outstanding, and the law of diminishing returns would hold true for any archaeological survey. Superimposed on the theoretical curves is the cumulative frequency of Huron-Petun village site finds (n = 460). It conforms more closely to the saturation curve.

If the historical pattern of Huron-Petun site discovery is best described by a saturation curve, then it follows that the known inventory of Huron-Petun sites is not overly biased. Two questions remain: what proportion of all Huron-Petun villages ever built have been discovered and is the known sample of Class I Huron-Petun sites (n = 304) representative of the Huron-Petun occupational history of Southern Ontario?

The total number of Huron-Petun villages ever occupied (i.e. the universe of Huron-Petun villages) can be estimated by simple arithmetic. Using an average of 25 Huron-Petun villages per quarter century (Warrick 1988b) from A.D. 1650 to A.D. 900 (based on the modal number of villages reported in the early seventeenth century (Biggar 1922-1936, 3:122; Thwaites 1896-1901, 8:115; 10:313) the universe of

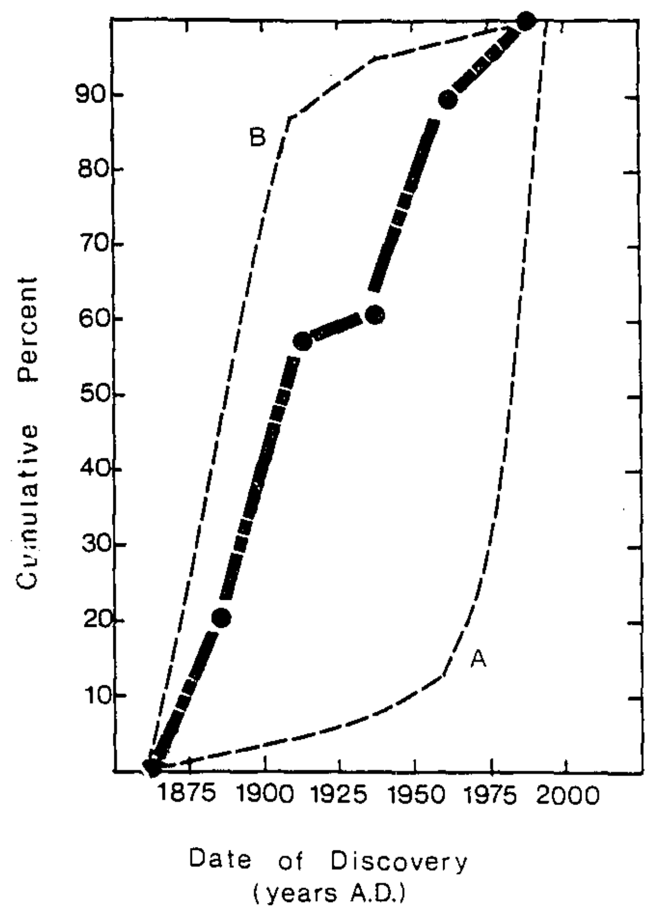

Figure 24. Historical pattern of Huron-Petun village site discoveries (A.D. 1880-1988). (A) Exponential curve; (B) Logistic curve; ▬▬ Cumulative frequency of Huron-Petun site discoveries (n = 480).

Huron-Petun archaeological villages would be 750 (400 Early Iroquoian and 350 Middle Iroquoian, Late Prehistoric, and Contact sites). This figure is only a rough approximation, however, since it ignores temporal variability in village duration, village size, and regional population size. Early Iroquoian villages were occupied about 40 years and historic villages were occupied only 10-15 years (Warrick 1988b). Also, Early Iroquoian villages were only 25-33% the size of later villages (Dodd 1984) and, thus, possibly more numerous. Finally, it is generally acknowledged that Early Iroquoian population was less than half the historic Huron-Petun population (Clermont 1980; Noble 1975; Wright 1966). Taking all these factors into account results in a maximum universe of 975 village sites (600 Early Iroquoian and 375 Middle Iroquoian, Late Prehistoric, and Contact sites). Reducing Early Iroquoian population to an eighth of historic Huron-Petun population, more in conformity with Middle Woodland population estimates (see Chapter 7), results in a minimum universe of 525 Huron-Petun village sites (150 Early Iroquoian and 375 Middle Iroquoian, Late Prehistoric, and Contact sites). The actual sum of all Huron-Petun villages probably lies somewhere between 975 and 525. The original figure of 750, identical to the arithmetic mean of the maximum and minimum values, is considered the best estimate for the universe of Huron-Petun village sites (i.e. 200 Early Iroquoian, 150 Middle Iroquoian, 250 Late Prehistoric, and 150 Contact sites).

A universe of 750 Huron-Petun villages is not a very large statistical population. A total of 460 villages are known. Before meaningful inferences can be drawn from village site data about Huron-Petun population change, it must be demonstrated that the sample of known villages accurately represents the chronological and spatial distributions of villages in the universe or target population.

The "Law of Large Numbers" in statistics dictates that as the size of a sample of a target population approaches population size, the variability between the sample and target popu[illegible] will become trivial. In other words, the larger the sample, the more representative it should be of the population (Thomas 1976:181-202). Various experiments in regional sampling of archaeological sites suggest that a sampling fraction of 40-60% is sufficient for predicting the population proportions of different site types and ages with a standard error of +/- 3% ($p < 0.05$) (Blake et al. 1986:448; Chenhall 1975:20-22; Plog et al. 1978:396; Sanders et al. 1979:499-511). Given that N = 750 (N is a finite target population), either n = 304 (Class I sample size) or n = 460 (total sample) are above the minimum 40% sample size required.

Determination of the critical sample size required to ensure that sample proportions are representative of population proportions can be calculated from:

$$n = [\ 1.96/\text{Desired s.e.}\ ]^2 \ pq$$

and correcting for finite population

$$n = n \ / \ 1 + (n \ /N)$$

where n is the required sample size, 1.96 is the Z-score value for a 95% confidence limit, Desired s.e. is the desired standard error (+/- 5% is the usual value), p is the proportion of items with a certain characteristic, q is the proportion of items without the characteristic, and N is the finite population size (see Blalock 1972:211-215). Applying this formula to the age distribution of Huron-Petun village sites in the target population that was estimated earlier by simple arithmetic (i.e. 200 Early Iroquoian, 150 Middle

Iroquoian, 250 Late Prehistoric, and 150 Contact sites), Table 9 presents the sample sizes required to ensure that the proportional breakdown of site age in the sample is representative of the population proportions. In most social science research, desired precision is +/- 5%. In theory, both the total (n = 460 or 61% of the target population) and Class I (n = 304 or 41% of the population) site samples exceed the minimum size required to guarantee representativeness at a 5% precision level. A quick comparison of estimated and actual proportions of site age, however, reveals some glaring discrepancies. The Class I sample grossly underestimates the proportion of Early Iroquoian sites and tends to overestimate the proportions of Late Prehistoric and Contact sites in the population.

Table 9. Sample Size Required for Reliable Estimates of the Age Distribution for Finite Population of 750 Huron-Petun Village Sites.

Site Age	Estimated Proportions in Population (N=750)	Actual Proportions in Sample (n=304)*	Sample Size Required (s.e. = 5%)
Early Iroquoian	27%	3%	215
Middle Iroquoian	20%	18%	185
Late Prehistoric	33%	42%	233
Contact	20%	37%	185

*Actual proportions derived from Table 28 in Chapter 6.

The underrepresentation of Early Iroquoian sites in the Class I sample is due to their size and geographic distribution. Early Iroquoian village sites average 0.45 ha in size (Table 28) and they often contain only a couple of artifact-impoverished middens. Consequently, they are inconspicuous archaeological sites and might be easily overlooked in traditional archaeological survey. Furthermore, Early Iroquoian sites in south-central Ontario tend to occur in compact clusters, on the sandy soils north of Lake Ontario. This peculiar geographical distribution has resulted in considerable site loss from urbanization and aggregate extraction. Downtown Toronto has almost certainly consumed an entire cluster of Early Iroquoian sites (see Figure 18). Sand extraction (i.e. wayside pits) has damaged several and destroyed an indeterminate number of Early Iroquoian sites in the Pickering cluster, at the eastern edge of the Greater Toronto Area (Ambrose 1981; Konrad and Ross 1974). Thus, modern destructive forces combined with low site visibility have hampered the archaeological discovery of Early Iroquoian sites in south-central Ontario.

The overrepresentation of Late Prehistoric and Contact sites in the Class I sample is a function of their relatively large size, high visibility, and history of research interests in Ontario archaeology. Late Prehistoric and Contact Huron-Petun sites are highly visible because they cover large areas and contain dense concentrations of artifacts. On average, Late Prehistoric and Contact sites are four times the size of Early Iroquoian sites (Table 28). In a ploughed context, their archaeological discovery is a certainty.

A positive relationship between site size and probability of archaeological discovery is demonstrated for Huron-Petun villages. Based on the conformity of Huron-Petun village site discovery with a saturation or logistic curve and on the assumption that the probability of site discovery is influenced considerably by relative site size, one would expect that most of the large and medium-sized Huron-Petun village sites (i.e. Late Prehistoric and Contact) have already been found. Referring to Table 10, there is a highly significant inverse relationship (G=19.26, $p < 0.005$) between date of

Table 10. Relationship between Site Size and Date of Site Discovery.

Date of Site Discovery	Frequency of Site Size (n) Small (0.2-1.2 ha)	Medium (1.3-2.4 ha)	Large (>2.4 ha)	Medium + Large
1850-1907 (n = 126)	46	55	25	80
1908-1967 (n = 74)	37	22	15	37
1968-1988 (n = 104)	68	21	15	36
Total sample	151	98	55	153

G-test (Sokal and Rohlf 1969:599-600)
(for Small vs. Medium + Large Size Sites only)
G = 19.26, df = 2, $p < .005$

discovery (measured by archaeological fieldwork phase) and site size. In simple terms, most of the large village sites (greater than 2.4 ha) were found by the early twentieth century; small village sites (about 1.0 ha in size) have been the predominant archaeological discoveries since the 1960s. This trend is particularly well-illustrated by the master plan inventories of municipalities that were conducted in the 1980s (ASI 1988; MPP 1986b;1988). In each case, involving extensive regional survey and intensive surface collection, only one new Iroquoian village site was added to the total inventory and it ranged in size from 0.9 to 1.2 hectares. One serious implication of the historical trend favouring the discovery of large Huron-Petun sites is that many small sites, such as Early Iroquoian villages, remain undiscovered.

Historical change in research interests of Ontario archaeologists has influenced the age distribution of known Huron-Petun village sites. Given that prehistoric swidden settlement in other regions of the world tends to be clustered on the landscape, such as the Linearbandkeramik of Central Europe (Hodder 1977; Kruk 1980; Sherrat 1982,1983) where "areas devoid of settlement in some periods have considerable settlement in others" (Starling 1983:2)), do the major phases of Huron-Petun archaeology reflect a pseudo-random coverage of the region or a biased coverage? With a pseudo-random coverage, the frequency distribution of the proportion of site time periods should remain constant throughout the history of archaeological fieldwork in the region because all areas and time periods should be equally represented from one fieldwork phase to the next, assuming constant site visibility and equal probability of site discovery. With reference to Table 11, there are no significant differences between the 1850-1907 and 1908-1967 fieldwork phases of Huron-Petun archaeology with respect to relative frequencies of site age. However, there is a significant difference between the 1908-1967 and 1968-1988 phases of archaeological field activity, especially in the frequency of Early and Middle Iroquoian and historic sites. This difference is partly related to the difference in archaeololgical visibility of early prehistoric and historic village sites. Early and Middle Iroquoian sites are considerably smaller and less visible than historic ones (see Table 28). However, the main reason for observed differences relates to changing research interests of Ontario archaeologists. As pointed out earlier in this chapter, the 1968-1988 phase of Huron-Petun archaeology concentrated on prehistoric sites and the two earlier phases emphasized historic sites. So, although geographical coverage was similar from one phase of archaeological fieldwork to the next, archaeologists' interests led to the discovery of large, artifact-rich prehistoric and historic villages prior to 1968, and, after 1968, to the discovery of small, artifact-impoverished prehistoric sites.

Over a century of accidental finds, casual collecting, and avocational and professional archaeological survey have discovered 60% of all Huron-Petun village sites that ever existed. However, historical trends toward the discovery of large, contact sites at the expense of small, prehistoric ones paint a biased picture of the Huron-Petun occupation of Ontario. Fortunately, the bias is definable and can be corrected for.

Table 11. Distribution of Site Age for the Major Phases of Huron-Petun Archaeology.

Archaeological Fieldwork Phase	Distribution of Site Age (number of sites) E. Iroq.	Mid. Iroq.	L.Pre.	Proto.	Hist.
1850-1907 (n = 126)	0	19	46	23	38
1908-1967 (n = 74)	3	7	34	8	22
1968-1988 (n = 104)	7	28	48	13	8
Total sample (N = 304)	10	54	128	44	68

G-test: (see Sokal and Rohlf 1969:599-600)
(1) (1850-1907) and (1908-1967) G = 2.90 ; df=3; 0.1 < p < 0.5
(2) (1908-1967) and (1968-1988) G =19.76 ; df=4; p < .005

4) Ecological constraints to Iroquoian settlement

Figures 13 and 14 depict the physiographic zones and prime agricultural lands of south-central Ontario. The Huron-Petun displayed a marked preference for sandy loam soils, both in the Huron heartland (Heidenreich 1971:67) and in the Toronto region (Konrad 1975). Other resources that would have been essential to the prehistoric Huron-Petun include fish, deer, firewood, building supplies, chert, and clay. With the exception of pebble cherts and clay, which tend to be ubiquitous throughout south-central Ontario, resources critical to the survival of the Huron-Petun would have been clustered in south-central Ontario. Regions dominated by climax maple-beech forest uplands, for instance, might contain sandy loam soil in abundance but deer, fish, and suitable building materials would have been scarce (Lennox et al. 1986). In contrast, deer and fish would have been abundant in the lowlying cedar swamps and wetlands of the Peterborough drumlin field but level fields of sandy loam soil would have been scarce in such a region. Elevated regions, such as the Oak Ridges Moraine, are characterized by early frosts and droughtiness because of coarse-textured soils and little surface drainage. Huron-Petun farmers would have avoided such areas given the choice. By simply overlaying Figure 14 with any of the site inventory maps (Figures 17-23), the correlation between areas of high potential for Iroquoian settlement and the actual distribution of Iroquoian settlements is striking. Intensive archaeological surveys of areas outside the main Huron-Petun site concentrations, on somewhat marginal lands, such as Tecumseth, Essa, and West Gwillimbury Townships in Simcoe County (Spittal 1977; Warrick 1988a), the Oak Ridges Moraine and east shore of Lake Simcoe (Dibb 1979), and the Peterborough Drumlin Field and north shore of Lake Ontario (Roberts 1978), have failed to locate comparable concentrations of village sites. In fact, most of the surveys failed to locate any Iroquoian sites at all (e.g. Dibb 1979; Spittal 1977; Warrick 1988a). This lends further support to the pattern of ecological constraints imposed on Huron-Petun settlement in south-central Ontario.

CHAPTER 6

ESTIMATION OF HURON-PETUN POPULATION SIZE

Diachronic trends in Huron-Petun population size are best generated from archaeological settlement remains. The methodology follows a logical sequence:

1) Acquire a representative sample of archaeological settlement sites
2) Develop a regional chronology and periodize each site
3) Determine site size
4) Estimate hearth density for each time period
5) Estimate site duration and correct total site area per period for contemporaneity
6) Multiply hearth density and total corrected site area for each period
7) Estimate the number of persons per family for each period from palaeodemographic data and direct historic analogy
8) Convert hearth totals per period into number of families by multiplying hearths by two
9) Estimate absolute population per period by multiplying family totals by number of persons per family
10) Plot the population totals for each time period and interpolate a trend curve

The inventory of 460 Huron-Petun village sites is a slightly biased sample of the target population of Huron-Petun villages; there are too few Early Iroquoian and too many Contact period sites in the sample. A further shortcoming is that 156 sites have poorly known or entirely unknown age and size. The direction and magnitude of sample bias is fortunately known and therefore can be corrected for, but it could be argued that only those sites with known age and size should be used to reconstruct Huron-Petun population size. However, excluding 156 village sites (an estimated 20% of the universe of

Huron-Petun villages) simply because there are doubts about precise age and size would reduce the accuracy and reliability of absolute population estimates. Bruce Trigger's (1965:158-160) population estimates for prehistoric Nubia would not have been possible without including by apportionment a large sample of poorly dated sites. Similar solutions are the norm in palaeodemography. When confronted with ambiguous age and sex data for certain individuals in their skeletal populations, palaeodemographers normally opt to include rather than exclude them from abridged life tables, by proportionally distributing them in the table using statistical averaging techniques (Asch 1976; Buikstra and Mielke 1985:397; Weiss 1973:15). Thus, the poorly known Huron-Petun sites will be assigned age and size according to age and size distributions for known sites.

Site Dating

Previous attempts at estimating change in regional prehistoric populations from site counts and areas, have tended to rely on rather imprecise chronologies composed of long time periods (Adams 1965; Sanders et al. 1979; Smith and Young 1984). Furthermore, the lack of attention given to site duration in most regional population studies has led to insurmountable site contemporaneity problems (Schacht 1984). Ammerman et al. (1976:32) point out the importance of good chronological control to demographic archaeology:

> In modern census practice, the aim is to count all of those people living over a brief period of time or even ideally at a given point in time. In contrast, the archaeologist normally has to deal with material remains that from a

> census point of view have accumulated over a substantial time period. An estimate of the length of period of accumulation as well as information on rates of accumulation are needed if useful statements are to be made about the number of objects in circulation (and, by extension, the number of people living) at a given point in time. In this respect, estimates of population size and chronological control are very closely linked.

In short, the closer that a chronological framework approximates reality (i.e. the ability of the chronology to date particular site occupations to actual calendar years or, at least, to time periods that roughly equal average site duration), the greater the likelihood that a population curve, inferred from site counts and areas, will approximate reality (Ammerman et al. 1976; Schacht 1984). The key problems associated with dating sites in a regional context include constructing a chronological framework, developing criteria for accurately periodizing sites, and estimating site duration.

Ontario Iroquoian Chronology

Prior to the discovery of radiocarbon dating in 1949, Iroquoian sites could be dated only by relative means, with a heavy reliance on pottery seriation. As early as 1907, Andrew Hunter was able to distinguish four chronological types of Huron village sites, on the basis of presence/absence of European trade goods and pottery styles. Hunter (1907) classified sites as historic, early historic, late prehistoric, and "early Huron". Pottery recovered from a series of excavations, conducted between 1912 and 1930, enabled W.J. Wintemberg (1948:v, 40-41) to seriate a small number of prehistoric Ontario

Iroquoian sites. Wintemberg (1948) correctly identified the Middleport site as intermediate in time between the Uren and the Southwold and Lawson sites. While he made no attempt to assign calendrical ages to any of them, he did suggest (1939:60) that Lawson, Southwold, Roebuck, and certain Huron sites represented late "pre-European" occupations.

The first attempt to build a calendrical-based Iroquoian chronology was made by Richard S. MacNeish. In **Iroquois Pottery Types** (1952), he outlined the **in situ** hypothesis for the development of Northern Iroquoian culture from Middle Woodland (i.e. Point Peninsula) antecedents. Using pottery type seriations and guess dates, he (1952:86) proposed six periods of Iroquoian prehistory: Early Owasco (A.D. 600-900), Late Owasco (A.D. 900-1100), Transitional Iroquois (A.D. 1100-1350), Prehistoric Iroquois (A.D. 1350-1500), Late Prehistoric Iroquois (A.D. 1500-1610) and Historic Iroquois (A.D. 1610-1687). A similar independent chronology, restricted to Ontario Iroquoian sites, was outlined in J. Norman Emerson's Ph.D. dissertation (1954).

As radiocarbon dates accumulated for archaeological sites in the Northeast, James Wright (1966) was able to refine the earlier site chronologies for Ontario. He divided Ontario Iroquoian culture history into five periods: Early Ontario Iroquois (A.D. 1000-1300), Middle Ontario Iroquois (Uren Substage A.D. 1300-1350; Middleport Substage A.D. 1350-1400), Late Ontario Iroquois (A.D. 1400-1600), and Historic (A.D. 1600-1650). Despite some controversy among archaeologists over the calendrical ages for the beginning and end of each period (cf. Kapches 1981a; Lennox et al. 1986; Poulton 1985 for dating of the Middle Iroquoian period), Wright's chronological framework became widely accepted. Furthermore, because Wright's (1966) work vindicated MacNeish's (1952) pottery types as true temporal indicators, pot type seriation has become the most accepted technique for dating Ontario Iroquoian sites (Dodd et al. 1988; Lennox et al. 1986).

Controversial chronologies are unacceptable to demographic archaeology. If a population curve is to have any basis in reality, the time scale over which the population varies must be as precise and real as possible. Otherwise, the population curve will be merely a heuristic exercise, worthless to serious scholars. Figure 25 summarizes the most recent formulations of Iroquoian chronology for southcentral Ontario. Key sites act as reference points to emphasize the differences between the various chronological frameworks. For ease of organization, the discrepancies in dating each of the major time periods will be outlined and the most reasonable dates for each summarized.

Princess Point

The transition from the Middle Woodland to the Early Iroquoian period of Ontario prehistory, referred to as the Princess Point Complex (Stothers 1977), is defined by the appearance of corn and a distinctive style of cord-wrapped-stick-impressed pottery in the archaeological record, between A.D. 500 and A.D. 900 (Fecteau 1985; Fox 1982, 1984; Jackson 1983; J. MacDonald 1986:20; Spence and Fox

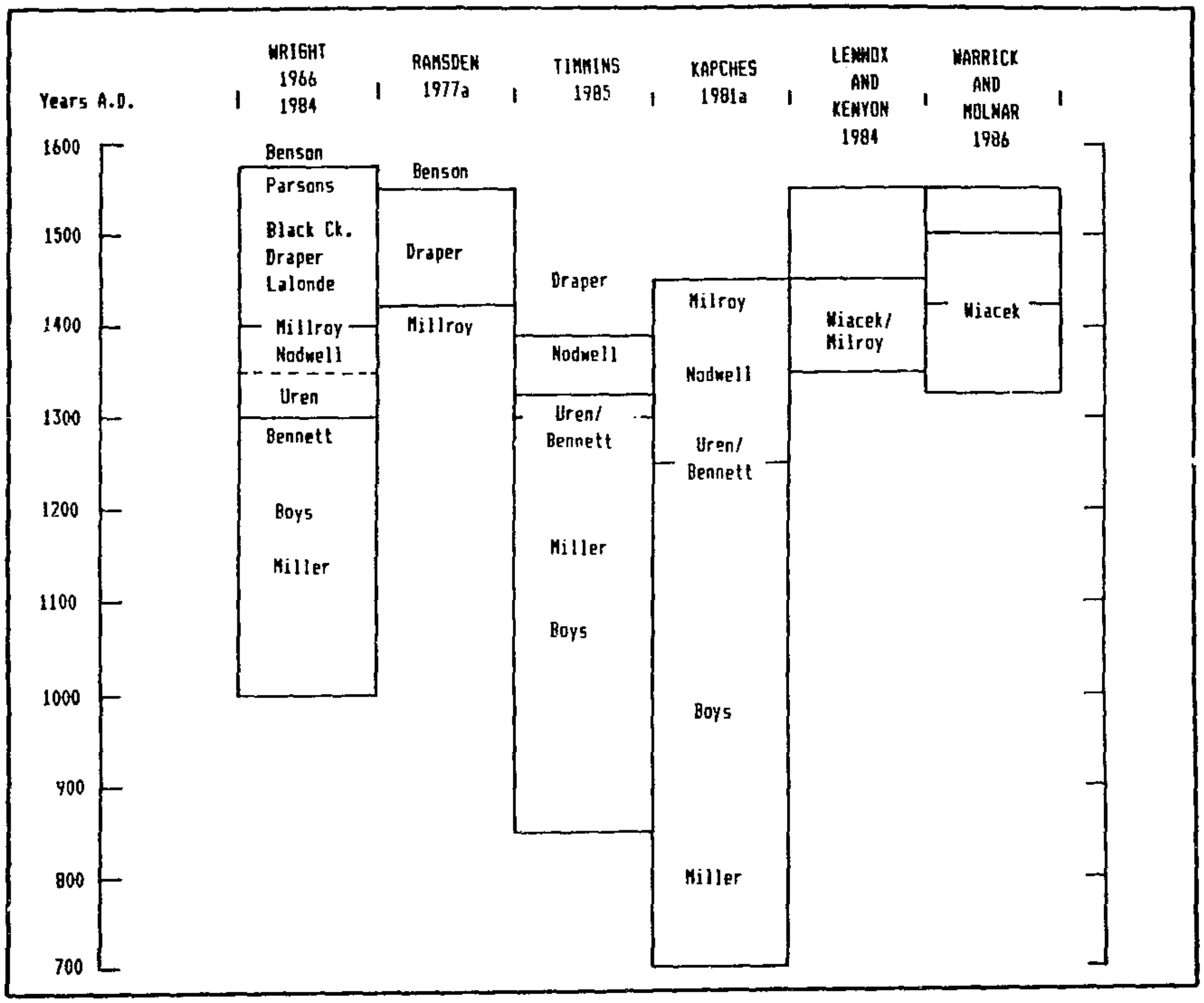

Figure 25. Chronological schemes for Huron-Petun archaeology.

1986:38; Spence and Pihl 1984:40; Stothers 1977). The earliest appearance of corn north of Lake Ontario is at the Dawson Creek site, with a calibrated radiocarbon date of A.D. 615 +/- 25 years (Jackson 1983; Timmins 1985). Unfortunately, this date is not associated with diagnostic artifacts. In southwestern Ontario, the earliest evidence of corn has come to light at the Princess Point site , dating ca. A.D. 750 on the basis of ceramic similarity to other radiocarbon-dated Princess Point components (J. MacDonald 1986:20; Stothers 1977:109-113; Timmins 1985: 79). The "surprisingly early" radiocarbon date from the Mohawk Chapel (Princess Point) site (calibrated to A.D. 505 +/- 55) is most certainly too early, probably an "old wood" date (William Fox, personal communication 1988; J. MacDonald 1986:20; Timmins 1985:66). In fact, excluding the Mohawk Chapel date, the earliest Princess Point component with an acceptable radiocarbon date is Varden (calibrated to A.D. 675 +/- 118 (J. MacDonald 1986:12)). Other radiocarbon-dated Princess Point sites appear to have been occupied ca. A.D. 875 +/- 100 (Ferris 1988:6; Timmins 1985:80).

Princess Point terminates about A.D. 900. Recent radiocarbon dates from the Varden site, on Long Point in Lake Erie, argue in favour of David Stother's (1977) ca. A.D. 900 date for the Porteous site, transitional between Princess Point and Glen Meyer (i.e. Early Iroquoian). Consequently, available radiocarbon dates, although somewhat inadequate, indicate that the Princess Point Complex lasted from A.D. 700 - A.D. 900 in southwestern Ontario, creating a 200 year chronological hiatus between Middle Woodland (i.e. Saugeen) and Princess Point.

In south-central Ontario, the hiatus between terminal Middle Woodland and Early Iroquoian is larger still. No authentic Princess Point components have been found north of Lake Ontario, east of the Credit River Valley. A few sites yielding cord-wrapped stick ceramics **similar** to Princess Point ware have been discovered in south-central Ontario (Sandbanks Provincial Park, Charleston Lake, St. Lawrence Islands National Park) (Spence and Pihl 1984:40-41), but none has produced evidence of corn and only one has a radiocarbon date. The Lakeshore Lodge site, in Sandbanks Provincial Park, Prince Edward County, contained a component that produced Princess Point-like ceramics (Fox 1982:20) and a calibrated radiocarbon date of A.D. 915 +/- 60 (Timmins 1985: 85). Considering that Auda, an early Pickering site, has a generally-accepted radiocarbon date calibrated to A.D. 905 (Fox 1980; J. MacDonald 1986; Timmins 1985:85-86), the Lakeshore Lodge date suggests that the transition from Princess Point or "Transitional Woodland" (Spence and Pihl 1984) to Early Iroquoian times was roughly coeval in southwestern and south-central Ontario.

The discontinuity between Middle Woodland and Princess Point sites in southwestern Ontario (200 years) and between Middle Woodland and Early Iroquoian sites in south-central Ontario (400 years) is probably more apparent than real. Although archaeological discontinuity can be caused by actual population extinction or emigration on a regional scale (Snow 1981), the Middle Woodland/Early Iroquoian discontinuity more likely reflects the failure of archaeologists to find and identify relevant sites that would fill the gap. The Middle Woodland is widely recognized (Ferris 1988:4-5;

Poulton 1985:126; Spence and Fox 1986:36; Spence and Pihl 1984) as one of the most poorly dated periods of Ontario prehistory. Furthermore, skeletal (Molto 1983:253) evidence indicates continuous occupation of Southern Ontario by an Iroquoian population at least since Middle Woodland times. Contrary to earlier hypotheses (Stothers 1977), cultural and population continuity between Middle Woodland and Early Iroquoian times seems likely.

Early Iroquoian

The appearance of upland corn agriculture and semi-permanent village life in Ontario ends the Princess Point ("Transitional Woodland" (Spence and Pihl 1984)) period of prehistory and signals the beginning of the Early Iroquoian period (Wright 1966). Pickering is the regional expression of Early Iroquoian culture in south-central Ontario. The earliest Pickering site with an **acceptable** calibrated radiocarbon date is Auda (A.D. 905 +/- 125) (Timmins 1985:86). Although an earlier radiocarbon date exists for the Richardson site (calibrated to A.D. 850 +/- 105 (Timmins 1985:85)), ceramic seriation dates Richardson to the end of the Pickering sequence, even later than the Boys site (see Table 12). In agreement with William Fox (1980), the calibrated radiocarbon date for Miller (A.D. 1160 +/- 55) and the lower range of the youngest date for Boys (A.D. 1295 +/- 60) are considered accurate age estimates and are consistent with the ceramic seriation (Figure 26). Thus, Richardson must have been occupied towards the end of the thirteenth century. In fact, this dating is substantiated by another radiocarbon date from Richardson (A.D. 1315 +/- 80

Table 12. Exterior Rim Attributes for a Sample of Pickering Village Sites. (a)

Site	Rim (n)	Dentate Stamp	Push-Pull	Linear Stamp	Horizontal Motif (b)	Reference
Auda (AlGo-29)	30	34	p	51	10	Kapches 1981b
Miller (AlGs-1)	7490	67	9	6	10	Kenyon 1968
Ginger (AlGs-104)	43	56	12	12	12	Spittal 1978
Eldorado (AlGo-41)	27	27	9	32	23	Kapches 1983a, 1988
Bolitho (AlGs-102)	126	45	16	20	20	Ambrose 1981; Spittal 1978
Winnifred (AlGs-103)	31	40	40	11	40	Ambrose 1981; Spittal 1978
Boys (AlGs-10)	257	29	21	20	22	Reid 1975
Breeze (BaGk-2)	63	10	28	13	30	Pearce 1977, 1978
Richardson (BbGl-4)	347	31	53	6	57	Pearce 1977, 1978
Delancey (AlGs-101)	29	8	28	36	50	Ambrose 1981; Spittal 1978
Bennett (AiGx-1)	543	3	55	18	56	Wright and Anderson 1969

(a) all attribute frequencies in percentages
(b) total horizontal motif (push-pull and incised)

uncalibrated) that was deemed unacceptably late by the excavator, Robert Pearce (Timmins 1985:85). The central tendency of this date agrees with the inferred date of occupation for Richardson based on ceramic seriation.

Radiocarbon dates and refined pottery seriations have pushed Pickering further back in time, beyond Wright's (1966) original A.D. 1000 estimate. At one extreme, Kapches (1981b) rejects the radiocarbon dates for sites like Auda and Miller in favour of pottery seriation dates derived from presumed, but erroneous, dates of A.D. 700 and A.D. 800 for the Porteous and Miller sites respectively. Other

YEARS A.D.	PICKERING CLUSTER	EASTERN LAKE ONTARIO
1300	Delancey Boys	Richardson Breeze
1200	Winnifred Bolitho	
	Ginger	Eldorado
1100	Miller	
1000		
900		Auda

Figure 26. Pickering site chronology.

archaeologists (Fox 1980; J. MacDonald 1986; Timmins 1985), including this author, accept the calibrated radiocarbon dates for Porteous and the Pickering sites at face value. The eagerness of Kapches (1981b) and others (Noble 1975; Pearce 1978; Reid 1975) to accept a ninth century or earlier date for the origin of Pickering stems from a desire to fill in the obvious hiatus between the terminal Middle Woodland (i.e. latest accepted date ca. A.D. 500 (Spence and Pihl 1984)) and early Pickering (i.e. earliest accepted date of A.D. 905). As discussed earlier, instead of stretching existing chronologies, this time gap will be better resolved by acquiring a larger sample of radiocarbon-dated Middle Woodland components. For the time being, A.D. 900 is considered the best estimate for the beginning of an Early Iroquoian presence in south-central Ontario (J. MacDonald 1986:20).

Pickering ceramic decoration evolved over time, essentially from early dentate-stamped motifs to late push-pull horizontal ones. Assisted by radiocarbon dates, estimated Pickering site durations of 40 to 50 years (Warrick 1988b), and a local site sequence in Pickering Township (see Finlayson 1985:432 and Figure 46), a chronology for Pickering sites can be constructed from ceramic seriation. Temporally-sensitive decorative attributes have been identified for Pickering ceramics (Fox 1980; Kapches 1981b:44-57; Pearce 1977:91-98; Reid 1975:55; Spittal 1978:55-58) and are summarized for relevant sites in Table 12. The ceramic seriation that is most consistent with radiocarbon dates and the inferred sequence of village relocation in Pickering Township, based primarily on the relative frequency of dentate stamp, push-pull, and horizontal motifs, is presented in

Figure 26. For analytic purposes, three phases of Pickering development are distinguished: early (A.D. 900-1050), middle (A.D. 1050-1200), and late (A.D. 1200-1300). The relative frequency of horizontal motifs (i.e. Iroquois Linear, Ontario Horizontal, and other pottery types (see MacNeish 1952)) in the ceramic assemblage of a Pickering site is sufficient for periodizing it to a particular phase: early (<10% horizontal motifs), middle (10-20%), and late (>20%).

Middle Iroquoian

Establishing precise boundaries for the Middle Ontario Iroquoian period is crucial to understanding and explaining the "dramatic revolution in Iroquoian life" that occurred in the fourteenth century (Trigger 1985b:91). In recent years, archaeologists have recognized that the Middle Iroquoian period was one of rapid and perhaps unprecedented change in Iroquoian prehistory (Timmins 1985:121; Trigger 1985b:91-96; Warrick 1984:65-66). Two subperiods have been recognized: Uren followed by Middleport (Dodd et al. 1988; Wright 1966:54-65).

Uren

At the end of the thirteenth century in Southern Ontario, there was a rapid replacement of the intricate Pickering pot styles (i.e. pots decorated with bands of dentate-stamped and impressed obliques and push-pull horizontal motifs) by much simpler styles (i.e. trailed horizontal motifs). James Wright (1966:54-59) named this the "Uren Substage" of Ontario Iroquoian prehistory, after the Uren type site in southwestern Ontario (Wintemberg 1928; M. Wright 1986). Calibrated radiocarbon dates from Uren, and similar sites in other parts of Ontario, clearly demonstrate that the initial transformation occurred in a relatively short interval of time, between A.D. 1290 and 1330 (Poulton 1985:82-86; Timmins 1985:162-164), and along a sloping time horizon from west to east. Any Ontario Iroquoian site possessing a combination of 10-50% Ontario Oblique, 10 - 50% Iroquois Linear, 10 - 30% Ontario Horizontal, and virtually no Middleport Oblique pottery types (see MacNeish 1952 for definitions) was certainly occupied during the Uren subperiod (Dodd et al. 1988; M. Wright 1986:36).

Middleport

It is fairly certain that, by A.D. 1330, most Ontario Iroquoian pot rims were decorated with trailed horizontal motifs. The consolidation of this ceramic change was named the "Middleport Substage" of the Middle Iroquoian period (Wright 1966:59-64). Middleport sites are characterized by certain pottery rim types: virtually no Iroquois Linear, 25-30% Ontario Horizontal, 25-50% Middleport Oblique, 20-25% combined Pound Necked and Black Necked, and less than 10% Huron and Lawson Incised (Dodd et al. 1988:15-16; Lennox and Kenyon 1984; Warrick and Molnar 1986). Sites transitional between Middle Iroquoian and Late Prehistoric Huron-Petun tend to have more Pound/Black Necked pottery than Ontario Horizontal and Middleport Oblique combined (Dodd et al. 1988:16).

There are various estimates for the duration of the Middle Iroquoian period, as depicted in Figure 25. At one extreme, Mima Kapches (1981a) extends the Middle Iroquoian from A.D. 1250 to A.D.

1450. On the other hand, Peter Timmins's (1985) calibration of radiocarbon dates suggests an A.D. 1330-1380 range for this period. In light of calibrated radiocarbon dates (Timmins 1985) and most ceramic seriations, it seems likely that the Middle Iroquoian period in south-central Ontario lasted almost a century, dating A.D. 1330-1420 (Timmins 1985; Warrick and Molnar 1986). It should be noted that the latter dates include the short transition phase between the Middle Iroquoian and Late Prehistoric periods. In south-central Ontario, at least in the northern portions, this transition is clearly demarcated by the appearance of Lalonde High Collar pottery in sites that would otherwise be periodized as late Middle Iroquoian. Recent archaeological work in southern Simcoe County (Lennox et al.1986; Warrick and Molnar 1986) dates the Middle Iroquoian-Late Prehistoric transition, exemplified by the Wiacek site (BcGw-26), ca. A.D. 1390 - 1420.

The basic ceramic changes that mark the termination of Middle Iroquoian times have different expressions in the southern and northern regions of south-central Ontario. In the south, along the north shore of Lake Ontario, pots with horizontal rim decoration and virtually no neck decoration were replaced by pots with oblique rim decoration and abundant neck decoration (i.e. Black Necked pottery type (MacNeish 1952:36)). In the north (i.e. Simcoe County), rim collar height increased dramatically, in association with the introduction of a unique set of decorative motifs (opposed triangles of trailed lines). The latter is referred to as Lalonde High Collar pottery (Ridley 1952). By A.D. 1420, Black Necked and Lalonde High

Collar pottery had become the most popular ceramic styles manufactured by prehistoric Huron-Petun potters, constituting 40-60% of the ceramic assemblage in most early fifteenth century sites (Table 13).

Late Prehistoric

Ceramic differences between Late Prehistoric sites along the north shore of Lake Ontario ("Southern Division Huron") and those in Simcoe County ("Northern Division Huron" or "Lalonde") have been interpreted as different political groups of prehistoric Huron-Petun (Wright 1966:68-74). Fusion of the two groups supposedly occurred sometime in the early sixteenth century (Trigger 1985b:157). The virtual absence of Lalonde pottery in Simcoe County village sites post-dating A.D. 1500 and the abandonment of Huron-Petun villages on the north shore of Lake Ontario by A.D. 1550 support the political fusion hypothesis (Ramsden 1977a). Reasons for the coalescence are uncertain, but formation of the Huron confederacy to increase political and economic security seems likely (Trigger 1985b:157-158).

Providing bracket dates and internal divisions for the Late Prehistoric is far easier than for preceding periods, because of an excellent ceramic seriation developed through years of intensive site survey in small regions (O'Brien 1976b; Poulton 1979; Ramsden 1977a; Warrick and Molnar 1986). Although available radiocarbon dates for Huron-Petun sites seem to suffer from problems with single dates, "old wood", and kinks in the calibration curve (Timmins 1985), dovetailing ceramic seriation and radiocarbon age estimates for certain sites (see

Table 13. Relative Frequencies of Huron-Petun Pottery Types from a Select Sample of Late Prehistoric Sites. (a)

Site	Date (Yrs. A.D.)	OH/MO	BN	LHC	HI
Milroy (AlGt-1)	1380-1410	41	6	-	5
Wiacek (BcGw-26)	1390-1420	19	15	5	5
Lalonde (BeGx-19)	1420-1450	5	7	39	8
Doncaster (AkGu-17)	1430-1460	5	56	3	4
MacDonald (BcGv-11)	1430-1460	1	20	53	4
Deschambault (BeGx-4)	1440-1470	4	13	30	20
Copeland (BdGw-J)	1460-1490	2	21	25	21
Black Creek (AkGv-11)	1470-1500	15	30	p	23
Draper (AlGt-2)	1470-1510	2	35	3	17
Parsons (AkGv-8)	1500-1530	-	8	3	16
Pinery (BeGx-12)	1510-1540	-	7	11	29
Bosomworth (BaGv-1)	1490-1530	-	19	12	16
Lucas (BbGv-22)	1530-1560	-	11	-	24
Seed (AkGv-1)	1540-1570	1	4	p	30

(a) Key: all numbers are percentages except for p (less than 1%)
OH/MO = Ontario Horizontal/Middleport Oblique
BN = Black Necked
LHC = Lalonde High Collar
HI = Huron Incised

Figure 25 and Table 13) suggests that the Late Prehistoric period can be divided into three subperiods: early ("Classic Lalonde" and Southern Division ("Black Creek")) (A.D 1420-1450), middle (late Lalonde and Southern Division) (A.D. 1450-1500), and late (A.D. 1500-1550). With reference to Table 13, each subperiod can be distinguished on the basis of relative frequencies of key pottery types. Early Late Prehistoric sites generally contain small quantities of Middle Iroquoian-style pottery (5% Ontario Horizontal/Middleport Oblique) and a combination of 40-70% Black

Necked/High Collar and less than 10% Huron Incised pottery. Middle Late Prehistoric sites are characterized by ceramic assemblages with virtually no Middle Iroquoian-style pottery, 40-60% Black Necked/High Collar, and 10-20% Huron Incised pottery. The ceramic assemblages of late Late Prehistoric sites are dominated by Huron Incised pottery (20-50%); Black Necked/High Collar pottery appear only as minority types (10-20%).

Contact

Contact Huron-Petun sites contain items of European manufacture. The Sopher site ossuary, with a calibrated radiocarbon date on tree bark of A.D. 1485 +/- 75 years (Timmins 1985:113), yielded an iron bar celt (Noble 1971), the earliest reliable calendar date for a European item in good context from a Huron site. Considering the standard error of this date, the ca. A.D. 1600 pottery seriation age estimate for the associated Sopher village site (Ramsden 1977a:263), and the lack of glass beads in either the ossuary or village, Sopher was probably occupied sometime in the mid-sixteenth century, certainly prior to A.D. 1580 (Fitzgerald 1983; Kenyon and Fitzgerald 1986:12; Kenyon and Kenyon 1983). Other mid-sixteenth century Huron sites in the Trent Valley have yielded small quantities of European trade metal (Damkjar 1982:146; Fitzgerald and Ramsden 1988). While it is possible that some European trade goods were already reaching Huron-Petun villages in the early sixteenth century, archaeological research has failed to discover, in indisputable context, a single item of European manufacture from any village site that was occupied prior to A.D.

1530. On historical grounds, only a few handfuls of European items, obtained along the Atlantic coast, can be expected to have ended up in Huron villages prior to A.D. 1550, and more likely prior to A.D. 1580 (Trigger 1985b:151-152). In other words, before A.D. 1550, European items would have been so rare in Ontario (i.e. only a few tiny scraps of metal and glass) that the probability of their archaeological recovery from a village site would be almost nil. Consequently, A.D. 1550 is perhaps the best cut-off date between the Late Prehistoric and Contact periods.

European glass beads have not been found in any Ontario Iroquoian site that pre-dates A.D. 1580, according to ceramic seriation. Sites that post-date A.D. 1580 are rarely without glass beads (Fitzgerald 1983). Recent work on glass beads from Ontario Iroquoian sites has produced a glass bead chronology based on archaeological dating and historical inference (Fitzgerald 1983; Kenyon and Fitzgerald 1986; Kenyon and Kenyon 1983).

Period I in the glass bead chronology is characterized by bead assemblages dominated by various frit core and light blue round bead types. It is bracketed by A.D. 1580-1600 dates (Fitzgerald 1983; Kenyon and Kenyon 1983).

Period II sites (A.D. 1600-1624 (Kenyon 1984; Kenyon and Kenyon 1983) or A.D. 1600-1632 (Fitzgerald 1983)) contain predominantly tubular and oval glass beads coloured white and dark blue. The controversy surrounding the end of Period II rests on the interpretation of the timing of European events in the Northeast (Trigger 1985b:211-212). Several pieces of archaeological evidence, however, appear to support an A.D. 1624 terminal date for glass bead Period II in Ontario.

The archaeological identification of the Cahiague village, where Champlain wintered in A.D. 1615, provides the first indication that period II ended ca. A.D. 1624. William Fitzgerald's (1986) analysis of glass bead assemblages from the Ball and Warminster sites, both candidates for Champlain's Cahiague, indicate that Ball was occupied for both Periods I and II, but Warminster for only Period II. Since Cahiague relocated sometime between A.D. 1616 and 1623, Fitzgerald (1986) concludes that the Ball site is probably Cahiague and would date A.D. 1590-1620. Ian and Tom Kenyon's (1983) analysis of the same sites, however, places both Ball and Warminster in Period II. Even allowing for some bead identification error, a glance at the bead frequencies shows that the Ball site must have been occupied much earlier than Warminster, and therefore, in agreement with Fitzgerald (1986), we conclude that Ball probably was occupied mostly in Period I.

Estimated site durations for both sites, based on house wall post densities (Warrick 1988b:47), suggest that the Ball and Warminster sites were occupied for comparable lengths of time, about 15-20 years. If either Ball or Warminster has to be Cahiague and **if** they were occupied serially rather than overlapping in time, it is likely that Ball dates ca. A.D. 1585-1605 and Warminster A.D. 1605-1623. Consequently, Period II appears to have ended no later than A.D. 1625.

Additional support for a 1620s terminal date for Period II derives from the historical events that caused differences in glass bead assemblages between Ontario and New York Iroquoian sites. Glass bead assemblages from New York Iroquois and Ontario Iroquoian sites display a pronounced divergence in types after Period II. Kenyon and Fitzgerald (1986) attribute this to the developing Dutch trade which would have effectively monopolized the supply of beads to the Iroquois, especially after the construction of Fort Orange in 1624.

A final piece of evidence supporting a ca. A.D. 1625 end date for Period II is Gabriel Sagard's 1623 observation that the Ontario Iroquoians preferred red glass beads. Period III is characterized by red glass bead assemblages, but not Period II, which suggests that French suppliers had become aware of this colour preference as early as A.D. 1623 (Kenyon 1984).

In summary, existing archaeological and historical data point to a ca. A.D. 1600-1625 duration for glass bead Period II.

Glass bead Period III is marked by red round and red tubular beads. Although Fitzgerald (1983,1986) treats the entire period as a single temporal unit, Kenyon and Kenyon (1983) subdivide it into early (IIIa) and late (IIIb) phases, on the basis of the relative frequency of red tubular beads. Period III phases are substantiated by a grave lot seriation of the historic Neutral Grimsby cemetery, which demonstrates a clear spatial clustering of Period IIIa and IIIb burials (Kenyon and Fox 1982). Glass bead assemblages, from Period III sites that are associated with known historic events (e.g. Angoutenc, Ossossane, Ste. Marie I), imply that bead Period IIIa dates ca. A.D. 1625-1639 and Period IIIb to the 1640s (Kenyon and

Table 14. Ontario Iroquoian Chronology for South-Central Ontario.

PERIOD	PHASE	YEARS A.D.	PHASE DURATION IN YEARS	AVERAGE SITE DURATION IN YEARS (a)
CONTACT	Late Historic	1639-1650	11	10
	Middle Historic	1625-1639	14	15
	Early Historic	1609-1625	16	15
	Late Protohistoric	1580-1609	29	25
	Early Protohistoric	1550-1580	30	35
LATE PREHISTORIC	Late	1500-1550	50	30
	Middle	1450-1500	50	30
	Early	1420-1450	30	30
MIDDLEPORT	Late	1370-1420	50	25
	Early	1330-1370	40	25
UREN		1300-1330	30	25
EARLY IROQUOIAN	Late	1200-1300	100	40
	Middle	1050-1200	150	40
	Early	900-1050	150	40
MIDDLE WOODLAND		300 B.C. - A.D. 500	800	

(a) Village site duration averages are from Warrick (1988b) and derived from house post densities. The brevity of the middle historic phase is the result of rebuilding of villages after the 1630s epidemics and the brevity of the late historic phase is because of the 1648-49 destruction of newly rebuilt villages. The shortness of the early historic phase cannot be attributed to any known cause, but volatile sociopolitical arrangements within the newly-created Huron and Petun confederacies may have resulted in a brief period of unprecedented village fission and fusion.

Kenyon 1983).

In summary, there are five distinct phases to the Contact Period for the Huron-Petun: Early Protohistoric (A.D. 1550-1580); Late Protohistoric (A.D. 1580-1600); Early Historic (A.D. 1600-1625); Middle Historic (A.D. 1625-1639); and Late Historic (A.D. 1639-1650).

Site Periodization

Assigning a site to a precise time period will depend on the amount known about that site. As outlined in Chapter 5, the quality of the data used in this study ranges from sites for which neither age nor size is known to sites for which positive historical identifications have been made. Previous age estimates for registered sites were re-evaluated against the regional chronology proposed earlier (Table 14) and appropriate ages reassigned where necessary. Contact sites that have been identified with historical Huron villages or ones that possess excavated European trade item inventories (e.g. Cahiague (BdGv-1), Ossossane II (BeGx-25), Toanche (BfGx-2), Ihonatiria (BfHa-1)) and prehistoric sites that have yielded representative ceramic samples (i.e. 20 rim sherds for small sites and 50 rim sherds for large ones (Ramsden 1977a)) or acceptable radiocarbon dates (refer to Timmins 1985 for reliability of radiocarbon dates) comprise the easiest group of sites to periodize. Contact Period sites with representative European inventories can be assigned to one of the five phases outlined earlier, by comparing glass bead types and the relative frequency of trade items. For example, a site with no glass beads and only a few rolled brass beads would be dated A.D. 1550-1580, whereas a site that produced mostly Period II glass beads would be assigned an A.D. 1600-1625 date. In the absence of radiocarbon age estimates, a prehistoric site can be periodized on the basis of pottery seriation. Pottery seriation dates supplied by original investigators of each site in the sample have been adjusted to the chronological scheme outlined in this study (Table 14). Except for some sites in Innisfil Township, Simcoe County, this author was spared the arduous task of typing immense quantities of Iroquoian pottery. Archaeologists who have provided age estimates for sites, from the seriation of pottery and European trade goods, are duly acknowledged in Appendix 1. Jeff Bursey's (personal communication 1989) ongoing reanalysis of rimsherd collections from over 50 of Frank Ridley's Simcoe County sites was particularly helpful.

Sites with less certain dates include ones that have received only limited test excavation or surface collection and, consequently, have artifact collections that are too small to permit the application of formal site seriation techniques. Nevertheless, there are a number of artifact traits, primarily ceramic, that act as "index fossils" for particular periods of Huron prehistory (Wright 1966). While admittedly subject to error, "index fossils" of Ontario Iroquoian prehistory can provide a fairly precise periodization of sites.

For the Early Iroquoian period, sites without carbon dates or representative ceramic samples can still be assigned to early or late phases on the basis of relatively limited ceramic inventories. Late Early Iroquoian sites characteristically yield rim sherds that are decorated with fewer exterior punctates and more horizontal motifs than earlier ones (Wright 1966:49). In addition, even small artifact collections from late sites tend to include pipe fragments and cup-and-pin game deer phalanges (Wright 1966:51).

In the Middle Iroquoian Period, early sites display minor amounts of Pickering pottery (e.g. Iroquois Linear type). Late sites, on the other hand, contain small percentages of Lalonde High Collar or Black Necked style pottery (Lennox and Kenyon 1984). Pipe styles are informative about site age as well. Pipe bowl form appears to have evolved throughout the Middle Iroquoian Period, from predominantly plain, straight-sided Iroquois Ring types to plain and decorated conical types (Emerson 1954; Warrick and Molnar 1986).

Artifact trends that separate early from late Late Prehistoric Period sites include the relative frequencies of Lalonde High Collar or Black Necked pottery (which decrease through time), acorn and effigy pipe forms (which increase through time), and St. Lawrence Iroquoian style pottery (which increases through time) (Ramsden 1977a; Wright 1966).

Contact Period sites for which there are only very small samples of European material can still be periodized with considerable confidence to protohistoric and early, middle, and late historic phases. The simple presence or absence of certain types of European trade goods constitutes the grounds for age determination of poorly investigated contact sites. Protohistoric settlements are expected to contain only a few scraps of copper, brass, and iron and virtually no complete iron axes or knives (Fitzgerald 1982,1983; Warrick 1982).

Although late prehistoric sites with native copper artifacts may be indistinguishable from early protohistoric sites with European copper artifacts (Fitzgerald and Ramsden 1988), the number of misidentified sites is expected to be small. Sites that have produced mostly brass scraps and a few complete iron axes and knives would date A.D. 1600-1630. Sites yielding several iron axes, knives, and brass kettle parts appear to have been occupied ca. A.D. 1630-1650. A Jesuit ring, medallion, or gunflint recovered from a Huron site implies an A.D. 1635-1650 date (Fitzgerald 1982:246,1983).

There is a special group of sites, namely Andrew Hunter's (1899-1907) contact sites in Simcoe County, that can be assigned with reasonable precision to late protohistoric, early historic, middle historic, or late historic phases as defined previously. From his earliest surveys, Hunter distinguished prehistoric from contact sites on the basis of the presence or absence of European items on the site's surface. The relative quantity of iron axes was the commonest measure that he cited in specific site descriptions. In fact, in the heart of historic Huron territory, Medonte Township, Simcoe County, Hunter remarked that in the late nineteenth century, French trade axes were:

> frequently found on almost all the farms in this neighbourhood, and are generally turned to various uses by the farmers. Since the advance in the price of iron, they are sometimes even sold to the scrap-iron dealers, who make regular visits to all the houses. The quality of the iron is first-class, belonging as it does to the period of French rule, 1615-1650 (Hunter 1902:73).

When data permitted, Hunter recorded the relative number of iron axes that had been found at each site, as well as any other artifacts of European origin. Sites were categorized as having either no axes, or one (Hunter's Medonte #66 [BdGv-H] (1902)), "a few" or "some" (Hunter's Tiny #45 [BeGx-22] (1899), Hunter's Oro #38 [BdGv-8] (1903)), "several"(Hunter's Medonte #46 [BdGv-3] (1902)), "numerous" (Hunter's Oro #61 [BdGu-D] (1903)), or "a great number of" iron axes (Hunter's Medonte #69 [BdGv-J] (1902)). Sometimes even 50 or 200 for a single site are reported (e.g. Hunter's Medonte #28, Hunter's Medonte #48 [BeGv-4] (1902)). Most often, however, the simple term "iron axes" was used which is interpreted in this study to mean several.

Problems arise when attempting to use Hunter's iron axe quantities to date contact Huron sites precisely. The first was recognized by Hunter himself - the possibility that European artifacts found on the surface of a village site may not date to the time of that site's actual occupation. Superimposition of European artifacts on prehistoric Huron village sites could result from nineteenth century homesteading, undocumented eighteenth and early nineteenth century Ojibway camps, or Huron losses on older sites (Hunter 1903:9; 1907:44). In the Huron heartland, the latter factor was perhaps most pervasive.

In the center of the historic Huron territory, for example the Mount St. Louis Ridge (mostly in Medonte Township), the density of known village sites is on the order of one per 3.3 square kilometres. Assuming an average agricultural catchment radius of 1.5 km (Snow 1986; R. MacDonald 1986; Warrick and Molnar 1986), each village would have exploited 7.7 square kilometres of the landscape. Even with a somewhat unrealistic catchment radius of one kilometre, 3.4 square kilometres would be utilized by each village. Two centuries of village relocation in such an area would inevitably produce palimpsests of villages and cornfields; old villages would eventually be incorporated into new cornfields. In fact, utilization of relict villages and cornfields would have been ecologically preferred by the Huron-Petun (Heidenreich 1971:151-153,175). Among contemporary groups who practice swidden agriculture, cutting new fields out of the forest is an ongoing task and results in a substantial breakage and loss of tree-felling axes. It has been estimated for at least one group, the Duna of Highland New Guinea, that approximately 80% of all axes in circulation enter the archaeological record as losses in agricultural fields (White and Modjeska 1978:282-283). Thus, if the agricultural fields of a seventeenth century Huron village overlapped a prehistoric village site, a number of iron axes would be deposited by loss on the prehistoric site. It is precisely this mechanism that accounts for reports of iron axes on demonstrably prehistoric Huron village sites.

Frank Ridley (1966-1975) relocated 106 of Andrew Hunter's village sites in Simcoe County. Table 15 compares the age estimates of both investigators for this sample of sites. For the most part, Hunter and Ridley agree **except** for a small but disturbing proportion of sites. Five sites that Hunter aged as prehistoric are in fact contact and 16 sites that Hunter aged as contact are actually prehistoric. Of the former, four of the five are protohistoric sites that do not normally yield large quantities of European artifacts even with full-scale excavation (Fitzgerald 1982,1983). It is hardly surprising, given the cursory examination of sites by Hunter, that this type of mistake occurred. A more serious problem is the misidentification of prehistoric sites as contact ones. In light of the previous discussion about axes lost in cornfields, the proportion of the 16 misidentified villages that yielded only one iron axe (BdGw-5 and BdGw-1) or that are situated within two kilometres of a known historic

Table 15. Comparison of Ridley and Hunter Site Age Estimates.

Hunter Age Estimate	Ridley Age Estimate (a)	Site Frequency
Prehistoric	Prehistoric	52
Contact	Contact	33
Prehistoric	Contact	5
Contact	Prehistoric	16
TOTAL SITES		106

(a) Ridley's estimates are actual site ages

village site (BeGx-A, BeHa-A, BdGw-11, BdGw-10, BdGw-24, BdGw-8, BdGw-15, BdGw-19, BdGu-3, BdGw-1) were tabulated. The resulting frequencies were then statistically compared with correctly identified contact village sites (Table 16). It was found that the prehistoric sites misidentified as contact ones have a significant tendency

(.01 < p < .025) to be within two kilometres of an actual contact village site. In other words, reported finds of iron axes from the

Table 16. Association between Age Misidentification and Distance to Nearest Contact Village for Prehistoric Huron Village Sites.

		Distance to Nearest Contact Village: Within 2 km	> than 2 km
Age Identification	C=C	12	21
	C=P	11	5

C=C = Hunter's contact sites that are in fact contact in age
C=P = Hunter's contact sites that are in fact prehistoric in age

Chi-square = 5.93; df = 1 $.01 < p < .025$

Note: The percentage of "contact" sites within 2 km of a contact village that are in fact prehistoric = 11/23 = 48%

surface of prehistoric sites is probably due to superimposition of historic Huron fields on prehistoric settlements. This suggests that a percentage of other Hunter sites tentatively identified as contact and that occur within two kilometres of a known contact site are probably misidentified prehistoric sites. A search of the site database revealed only 16 unverified Hunter sites that satisfy these conditions. In keeping with the proportion of misidentified prehistoric sites (see note in Table 16), a random sample of 50% of these were changed from contact to prehistoric. The list of sites is provided in Table 17 (see Appendix 1 for further details).

Table 17. List of Huron-Petun Village Sites Recorded by Hunter Corrected from a Contact to Prehistoric Age. (a)

BdGw-E	BeGw-A	BeGw-G	BeGw-H
BeGw-M	BeGx-H	BdGx-D	BdGu-K

(a) see text, Table 16, and Appendix 1 for rationale behind selection of these sites

The other problem with using Hunter's observations on iron axe abundance to phase contact period sites is correlating relative measures with a precise contact phase. Data from excavated Huron-Petun and Neutral village sites which have been dated by glass bead seriation (Fitzgerald 1983; Kenyon and Kenyon 1983, 1987) to a particular phase of the contact period provide a solution. Table 18 summarizes the absolute frequencies of complete or near complete iron axes that have been acquired through subsurface excavation of village sites. While areas of excavation are not equal from one site to the next, areas are roughly comparable (except for the sample of late protohistoric sites, almost all of which have been completely excavated). Simple visual inspection of Table 18 reveals that Andrew Hunter's relative abundance scale for iron axes can be used to date

Table 18. Iron Axe Frequencies for Excavated Ontario Iroquoian Village Sites, ca. A.D. 1580-1650.

Contact Period Phase	Site	Iron Axe (n)	Reference
LATE PROTOHISTORIC (A.D. 1580-1600)	Fonger	-	Warrick 1982
	Ball	2	Knight and Cameron 1983
	Carlisle	-	Kenyon 1986
	Molson	-	Molnar 1986
EARLY HISTORIC (A.D. 1600-1625)	Christianson	1	Fitzgerald 1982
	Bidmead	2	O'Brien,pc 1987
	Alonzo	1	O'Brien,pc 1987
MIDDLE HISTORIC (A.D. 1625-1638)	Walker	8	Wright 1981
	Le Caron	5	Johnston and Jackson 1980
	Robitaille	1	Tyyska 1969
LATE HISTORIC (A.D. 1639-1650)	Hood	9	Lennox 1984a
	Hamilton	8	Lennox 1981
	Freelton	14+	Kenyon and Kenyon 1987

Iron axe frequencies are for excavated specimens only and include only complete or near-complete axes (i.e. missing only part of the eye or blade). The relatively low axe frequencies reflect minimal loss of axes in villages, collection of axes by farmers and looters, and partial site excavation. The almost complete excavations of Sainte-Marie I, contemporaneous with late historic Iroquoian villages, produced only 38 iron axes.

his contact period sites to a specific phase: single axe sites are late protohistoric; sites reported to have produced two or a few axes are early historic; sites with several axes or simply "iron axes" are middle historic; and late historic sites contain numerous or abundant iron axes. The presence and diversity of other European items from Hunter's contact sites, especially Jesuit material and glass bead varieties, helped to substantiate the "iron axe chronology".

Periodization and size estimates for poorly known sites

A relatively large number of Huron-Petun settlement sites (n=156 or 33.9% of the total inventory of 460 sites) either have completely unknown ages (except for a prehistoric or contact designation) or can be assigned only to one of the four general periods: Contact, Late Prehistoric, Middle Iroquoian , and Early Iroquoian. The majority of Andrew Hunter's prehistoric archaeological sites in Simcoe County (1889-1907) and George Laidlaw's (1917) Victoria County sites fall into this category. When confronted with a sample of sites that possess less than precise age estimates, most demographic archaeologists have attempted to integrate them into their study by proportionality calculations (Blake et al. 1986; Sanders et al. 1979; Trigger 1965). One simply assumes that the chronological distribution of sites with known age is representative and then distributes the less precisely aged sites according to the same proportions. It has already been demonstrated (Chapter 5) that the distribution of precisely-aged Huron-Petun sites is slightly biased, primarily towards the underrepresentation of Early Iroquoian sites.

Corrections for this bias, however, are best made later, during estimation of absolute Huron-Petun population.

The principle of proportionality between sites of known age and those of less certain or unknown age will be used here as a working assumption. A similar assumption will be made for dealing with sites of unknown size. In Chapter 5, the geographical locations of Huron-Petun village sites employed in this study were plotted on a set of six regional maps and one key map (Figures 17-23). The regional maps are more than just a convenient way of partitioning south-central Ontario. Each one essentially encompasses a prehistoric Huron-Petun tribal homeland: Petun Region, Simcoe County, Victoria County, Prince Edward County, North Shore of Lake Ontario, and Toronto Region. Sites that occur outside of these regions appear on the key map. Because of their "historical" nature, homogeneity of site age is maximized within each regional map. Thus, the regional maps of Huron-Petun village distribution are natural units from which to make proportional estimates of the age of poorly known sites. Utilizing an entire region, rather than a smaller spatial unit, such as a Borden block, to assign an age to unknown Huron-Petun village sites by proportionality, reduces the boundary effect associated with small-scale site distributions (Hodder and Orton 1976:41-42), and results in age estimates that are more representative of reality. For example, in the Simcoe County region there are no known Early Iroquoian sites. Consequently, no poorly aged site in this region was assigned an Early Iroquoian age. Similarly in the Victoria County region, poorly aged sites were assigned either to Late Prehistoric or early Contact periods; there are no Early or Middle Iroquoian sites documented for this region.

The proportionality method can be enhanced in cases of demonstrable unidirectional movement of sites, as in the budding-off process associated with a growing population of swidden agriculturalists (Ammerman and Cavalli-Sforza 1984). The oldest sites will be in or closest to the core of original settlement; the youngest farthest away. A cursory examination of the Huron-Petun settlement inventory maps (Figures 17-23) discloses certain regions that illustrate progressive directional movements in village locations over time. Isochrons can be interpolated for site distributions in southern Simcoe County (with Barrie as the center) and the Toronto and North Shore of Lake Ontario regions. The former pattern is bidirectional (north and south movement) and the latter is clearly unidirectional (northward movement). An explanation for these temporal trends in Huron-Petun settlement distribution is offered in Chapter 7.

Sites with approximate ages (i.e. aged to gross time period) were periodized differently from those with unknown ages. For example, one site in the Toronto region could only be dated to the Early Iroquoian period. Three middle Early Iroquoian (50%) and three late Early Iroquoian (50%) sites are documented for this region. Thus, the approximately-aged site was split in half and 0.5 of a site was assigned to either of the Early Iroquoian phases. Site size, if known, was adjusted accordingly. Completely undated sites were assigned to a precise period in the Huron-Petun chronology by distributing them in the same proportion as precisely-aged sites. Thus, returning to the Toronto region, 15 prehistoric sites are undated and were periodized proportionally: 0.8 sites to middle Early Iroquoian, 0.8 to late Early Iroquoian, 1.2 to Uren, 1.6 to early Middleport, 2.2 to late Middleport, 2.2 to early Late Prehistoric, 1.8 to middle Late Prehistoric, and 4.4 to late Late Prehistoric (see Table 19). The totals for each temporal phase were obtained by adding the approximately-aged sites and unaged sites that were assigned by proportionality to the same phase. A grand total for each phase in each region was calculated as the sum of known and proportionally-aged sites. Tables 19-24 summarize the statistics and results for each of the six regions. For this exercise, Simcoe County was divided into north and south subregions, using the City of Barrie as the boundary. This division, based on demonstrable isochrons for sites with known age, effectively separated the main cluster of early prehistoric sites in Simcoe County (south) from clusters of later prehistoric and contact period sites (north). The creation of two temporally-homogeneous subregions permitted a more accurate periodization of poorly aged sites in Simcoe County. Sites outside the major regions (Figure 17) were included in the closest region. Those sites north and west of the Toronto region were added to the south Simcoe County subregion; sites surrounding Lake Scugog and those east of the North Shore cluster, including those in Prince Edward County, were arbitrarily assigned to the North Shore of Lake Ontario region; and sites around Stony Lake (i.e. the "Quackenbush cluster") were placed in the Victoria County region.

Table 19. Toronto Region Village Site and Size Totals.

Phase of Occupation	Known Sites n	Known Sites %	Known Sites ha	Poorly Known Sites n	Poorly Known Sites ha	Total Sites n	Total Sites ha
E. Early Iroq.	-	-	-	-	-	-	-
M. Early Iroq.	3	5.3	1.4	1.4	0.6	4.4	2.0
L. Early Iroq.	3	5.3	2.0	1.5	0.6	4.5	2.6
Uren	4	7.0	3.0	4.3	3.9	8.3	6.9
E. Middleport	5	8.8	6.3	4.9	5.2	9.9	11.5
L. Middleport	7	12.3	11.0	3.5	4.0	10.5	15.0
E. Late Prehist.	7	11.7	11.4	3.9	6.9	10.9	18.3
M. Late Prehist.	6	10.5	15.3	3.3	5.8	9.3	21.1
L. Late Prehist.	14	24.6	26.3	6.0	11.8	20.0	38.1
E. Protohistoric	6	10.5	17.1	-	-	6.0	17.1
L. Protohistoric	2	3.5	4.0	-	-	2.0	4.0
TOTALS	57	100.0	97.8	29	38.8	86	136.6

Poorly Known Sites: n = 29 (Age: 1 = Early Iroq.; 7 = Middle Iroq.; 6 = Late Prehist.; 15 = prehistoric)
(Size: 22 = size estimate in ha that was adjusted up or down to match median value for period, once the site was periodized)

See text for method used to assign ages to poorly known sites by proportion

Table 20. North Shore of Lake Ontario Region Village Site and Size Totals.

Phase of Occupation	Known Sites n	Known Sites %	Known Sites ha	Poorly Known Sites n	Poorly Known Sites ha	Total Sites n	Total Sites ha
E. Early Iroq.	2	6.4	0.6	3.1	1.6	5.1	2.2
M. Early Iroq.	1	3.2	0.2	1.5	1.3	2.5	1.5
L. Early Iroq.	1	3.2	0.4	1.5	1.3	2.5	1.7
Uren	2	6.4	2.8	1.9	1.5	3.9	4.3
E. Middleport	2	6.4	2.5	3.2	2.8	5.2	5.3
L. Middleport	3	9.7	3.5	3.2	2.8	6.2	6.3
E. Late Prehist.	6	19.4	12.0	2.1	3.0	8.1	15.0
M. Late Prehist.	10	32.2	13.0	4.8	6.8	14.8	19.8
L. Late Prehist.	3	9.7	3.3	3.7	5.0	6.7	8.3
E. Protohistoric	1	3.2	0.8	-	-	1.0	0.8
TOTALS	31	100.0	39.1	25	28.7	56	65.2

Poorly Known Sites: n = 25 (Age: 5 = Early Iroq.; 5 = Middle Iroq.; 4 = Late Prehist.; 11 = prehistoric)
(Size: 8 = size estimate in ha that was adjusted up or down to match median value for period, once the site was periodized)

See text for method used to assign ages to poorly known sites by proportion

Table 21. Victoria County Village Site and Size Totals.

Phase of Occupation	Known Sites n	Known Sites %	Known Sites ha	Poorly Known Sites n	Poorly Known Sites ha	Total Sites n	Total Sites ha
M. Late Prehist.	6	37.5	9.4	5.7	8.5	11.7	17.9
L. Late Prehist.	5	31.2	8.0	4.3	6.1	9.3	14.1
E. Protohistoric	4	25.0	7.5	1.0	1.5	5.0	9.0
L. Protohistoric	1	6.3	3.2	-	-	1.0	3.2
TOTALS	**16**	**100.0**	**28.1**	**11**	**16.1**	**27**	**44.2**

Poorly Known Sites: n = 11 (Age: 10 = Late Prehist.; 1 = Contact)
(Size: 2 = size estimate in ha that was adjusted up or down to match median value for period, once the site was periodized)
See text for method used to assign ages to poorly known sites by proportion

Table 22. Southern Simcoe County Village Site and Size Totals.

Phase of Occupation	Known Sites n	Known Sites %	Known Sites ha	Poorly Known Sites n	Poorly Known Sites ha	Total Sites n	Total Sites ha
Uren	1	2.5	1.0	1.0	0.8	2.0	1.8
E. Middleport	7	17.5	6.1	5.8	6.0	12.8	12.1
L. Middleport	6	15.0	7.0	4.9	5.0	10.8	12.0
E. Late Prehist.	3	7.5	10.2	2.2	3.2	5.2	13.4
M. Late Prehist.	9	25.0	14.7	8.5	15.6	17.5	30.3
L. Late Prehist.	4	12.5	6.0	4.7	7.5	8.7	13.5
E. Protohistoric	1	5.0	1.6	1.0	1.5	2.0	3.1
L. Protohistoric	3	12.5	5.4	2.0	3.0	5.0	8.4
E. Historic	1	2.5	1.6	-	-	1.0	1.6
TOTALS	**35**	**100.0**	**53.6**	**30**	**42.6**	**65**	**96.2**

Poorly Known Sites: n = 30 (Age: 5 = Middle Iroq.; 7 = Late Prehist.; 3 = Contact; 15 = prehistoric)
(Size: 7 = size estimate in ha that was adjusted up or down to match median value for period, once the site was periodized)
See text for method used to assign ages to poorly known sites by proportion

Table 23. Northern Simcoe County Village Site and Size Totals.

Phase of Occupation	Known Sites n	Known Sites %	Known Sites ha	Poorly Known Sites n	Poorly Known Sites ha	Total Sites n	Total Sites ha
L. Middleport	9	6.9	17.4	5.2	4.9	14.2	22.3
E. Late Prehist.	13	10.0	14.7	8.0	12.2	21.0	26.9
M. Late Prehist.	27	20.8	49.0	16.5	26.4	43.5	74.0
L. Late Prehist.	16	12.3	23.6	11.4	16.2	27.4	39.8
E. Protohistoric	12	9.2	18.5	0.6	0.4	12.6	18.9
L. Protohistoric	9	6.9	15.3	4.7	4.5	13.7	19.8
E. Historic	18	13.8	29.4	4.0	4.1	22.0	33.5
M. Historic	15	11.5	31.7	8.1	9.3	23.1	41.0
L. Historic	11	8.5	22.1	2.6	4.1	13.6	26.2
TOTALS	130	100.0	221.7	61	82.1	191	303.8

Poorly Known Sites: n = 61 (Age: 3 = Late Prehist.; 4 = Contact; 4 = L. Protohistoric; 3 = E. Historic; 7 = M. Historic; 2 = L. Historic; 38 = prehistoric)
(Size: 9 = size estimate in ha that was adjusted up or down to match median value for period, once the site was periodized)

See text for method used to assign ages to poorly known sites by proportion

Table 24. Petun Region Village Site and Size Totals.

Phase of Occupation	Known Sites n	Known Sites %	Known Sites ha
L. Late Prehist.	4	12.9	3.4
E. Protohistoric	-	-	-
L. Protohistoric	3	9.7	4.1
E. Historic	12	38.7	12.9
M. Historic	8	25.8	14.8
L. Historic	4	12.9	9.6
TOTALS	31	100.0	44.8

It is appropriate at this time to mention how sites with unknown sizes were assigned a particular size. Because site size varies from one time period to the next (see Table 28 and Figure 28), assigning size to unknown sites is best achieved after assigning age. An examination of the histograms of site size for each period (Figure 28) reveals that all the distributions are left skewed (i.e. smaller sites constitute the majority of the sample). Median site size instead of the mean provides a more accurate picture of the central tendency of such skewed size distributions (Thomas 1976:70-71). For sites of uncertain ages but with an actual size estimate in hectares, the size estimate was accepted verbatim. For sites with a relative size designation (i.e. small or large), small sites were multiplied by 0.45 ha and large ones by 2.1 ha. These specific values were derived by comparing Hunter's and Laidlaw's relative size estimates with actual size estimates as recorded by modern archaeologists. A sample of 21 "large" sites (mean of 2.1 ha and range of 0.8 to 4.3 ha) and 8 "small" sites (mean of 0.45 ha, range of 0.2 to 0.6 ha) was used to generate these statistics. Total size estimates for each phase for totally unsized sites were calculated by multiplying site frequency by the period-specific median site size (Early Iroquoian - 0.45 ha; Middle Iroquoian - 1.0 ha; Late Prehistoric - 1.6 ha; protohistoric - 1.5 ha; historic - 1.4 ha). Tables 19-24 summarize the results of these statistical manipulations.

Site Size and Village Size

The archaeological study of regional populations normally relies on site counts and sizes as proxies for head counts because **unexcavated** sites comprise well over 90% of the data, precluding the use of indices such as roofed floor area or artifact densities. Site size is estimated from the extent of surface remains (i.e. visible structural remains and debris scatter (Adams 1965; Ammerman et al. 1976; Blake et al. 1986; Sanders et al. 1979)) or less frequently by testpitting (Redman and Anzalone 1980; Roosevelt 1980). However, one rarely finds in the literature any examination of the relationship between site size, as estimated by archaeological techniques, and the variable of real interest, settlement size. In order to deal with this relationship, it is first necessary to define settlement limits or limits of residential space for actual settlement sites.

Archaeological excavation has confirmed the historical observation (Biggar 1922-1936, 3:48-49; Thwaites 1896-1901, 38:247; Wrong 1939:91-92) that only the larger Huron villages were fortified with multiple row palisades (e.g. Knight 1987; Latta 1985a; Sykes 1983) Establishing the limits of a palisaded Iroquoian village from archaeological excavation is relatively straightforward. Normally, longhouses and middens abutt the interior row of palisade but do not extend beyond it (Warrick 1984:143). Furthermore, the spacing between outer and inner rows of the palisade is so close, often only a few metres, that the difference between the site areas enclosed by the outer and inner palisade, at least for large villages, is negligible. Thus, palisades appear to have set real spatial limits to residential activities associated with everyday life in an Iroquoian village. Excavations beyond palisade lines, such as those conducted at the prehistoric Keffer site (Pearce 1986), have encountered little evidence of aboriginal use, except for village cemeteries. Thus, the limits of a palisaded village are generally considered to be the outermost row of palisade posts.

There are some Ontario Iroquoian sites, however, that do not fit the convenient palisaded village model. For example, the Nodwell and Uren sites were surrounded by stockades, the outermost row of which had been constructed a considerable distance from the nucleus of settlement and residential activity. The outermost palisade row at Nodwell extends 18 metres (Wright 1974) and that at Uren 25 metres (M. Wright 1986) beyond the inner row that encloses the houses. Occasionally, isolated houses and midden areas occur exterior to village palisades, such as at Nodwell (Wright 1974), Calvert (Timmins 1987), Kirche [BcGr-1] (Nasmith 1981), and Benson [BdGr-1] , although it is believed that in most cases such houses were occupied only by seasonal residents (Ramsden 1988:181). Completely unpalisaded Iroquoian villages, such as Molson [BcGw-27] (Molnar 1986), are another type of site that deviates from the palisaded village model. Yet, their layout is similar to palisaded sites (Warrick 1984:30-32). Consequently, the limits of unpalisaded or open Iroquoian villages can be defined by inscribing an arc that joins the outermost edges of middens and longhouses, effectively creating an imaginary palisade.

Taking into account abnormal village layouts and that it is impossible to locate palisades from surface survey, the limits of an Iroquoian village should be broadly defined as the "nimbus of debris and activity areas associated with the built area of a settlement" (Fletcher 1986:74). This corresponds to John Yellen's (1977:103) "LNAT (limit of nuclear area, total)" concept that he developed to measure the size of Bushman camps. LNAT includes "all huts, their associated hearths, and the debris surrounding the hearth" (Yellen 1977:103) and is highly correlated with population size in Bushman camps (Yellen 1977:127-129). The LNAT of an Iroquoian village would include all longhouses and associated open areas and middens. Application of the LNAT measure to Huron archaeology offers an accurate definition of village size, for population reconstruction purposes (Yellen 1977:127-129), and accommodates both excavated (i.e. palisaded and unpalisaded) and unexcavated sites.

One potential problem that could seriously bias village size estimation, employing the LNAT measure, is the effect of ploughing on the size of surface sites. Research on ploughzone archaeology has discovered that the size of ploughed sites will tend to be overestimated for small ones and underestimated for large ones (Lewarch and O'Brien 1981). Experiments have confirmed that artifacts are displaced horizontally by ploughing by an average of 4-5 metres from their original location, in a random walk fashion (Ammerman 1985; Roper 1976; Trubowitz 1978). In an attempt to quantify the change in the size of Iroquoian village sites as a result of ploughing, a series of hypothetical villages were increased in size by five metres on all sides, to approximate the average horizontal movement of artifacts originally located at site edges (Table 25). As expected, increasing the original (i.e. pre-plough) LNAT by five metres in all directions effectively results in an overestimation of original village area. The size of small sites, less than 1 ha, will be overestimated after ploughing by 25%; village sites of 4 ha or more will cover 10% more area.

Table 25. Effect of Ploughing on Archaeological Site Area.

Original Site Area (ha)	Ploughed Site Area (ha)	% Increase in Site Area
0.31	0.43	27.3
0.63	0.78	19.2
0.94	1.12	16.1
1.26	1.47	14.5
1.89	2.16	12.8
2.83	3.20	11.6
3.28	3.68	10.7
4.40	4.83	9.9

In theory, reconstructing past populations from the surface area of habitation sites that have been ploughed will tend to overestimate population numbers by 10 - 25%. In practice, however, a demographic archaeologist can safely ignore this effect for several reasons. First of all, a recent set of ploughzone experiments documents that, **on average**, the increase in site size caused by ploughing is only half the expected increase (Odell and Cowan 1987:467-468). Second, with reference to Ontario Iroquoian archaeology, estimates of ploughed site size from controlled surface pickups generally exclude outlier artifacts, meaning those that are located 8 to 10 metres beyond the next closest artifact in the direction of the site centre (Mayer Pihl Poulton 1988b; Poulton 1979; Warrick 1988a). If this criterion has been applied to most ploughed Iroquoian sites in Ontario, the entire problem of site overestimation is eliminated. Lastly, past estimates of the size of archaeological sites in Ontario are often approximated to the nearest 0.2 ha class. Such imprecision in recording and reporting archaeological site size is compounded by inter-observer error (see Table 29), as illustrated by fluctuations in the size estimates for the prehistoric Draper village site during the history of its investigation (3.42 ha [Finlayson 1985:430]; 3.2-4.0 ha [Hayden 1979:7]; 2.3 ha [Ramsden 1968]; 2.8 ha [Wright 1966:69]). The potential effects of ploughing bias on Iroquoian size estimates, although real, are minimized by archaeological practice in Ontario. Consequently, size data for Ontario Iroquoian village sites will be taken at face value as representative of original village limits.

Village Site Definition

To use the number of sites per time period as an accurate index of past population size, one must ensure that the sites that are being counted for each unit of time constituted the settlements where most of the people lived year round. Counting special-purpose sites, such as seasonally-occupied camps and cabins, will inflate actual population figures. To prevent this, archaeologists must develop a set of criteria for distinguishing year-round settlements from seasonal ones.

Ethnographic accounts of seventeenth-century Huron and Neutral settlements document a definite size hierarchy comprised of massive villages containing 50 - 200 longhouses (LeClerq 1973, 2:265-266; Thwaites 1896-1901, 10:211; Wrong 1939:92), small hamlets of seven to eight houses (LeClerq 1973, 2:265-266), and isolated cabins (Thwaites 1896-1901, 8:143; 14:45). Governed by the Huron seasonal round, the entire population concentrated in the villages for the winter, while hunters, fishermen, and women working in the fields occupied highly dispersed campsites and cabins during the spring, summer, and autumn (Thwaites 1896-1901, 8:143; 10:51-53). Although villages were sometimes almost deserted in the summer (Thwaites 1896-1901, 8:143; 10:53), village counts are obviously much better indicators of actual Huron population size than seasonally-occupied hamlets or cabins. It is no accident that the 1639-1640 Huron census, taken by the Jesuits by counting each family in every village, was conducted over the winter months (Trigger 1976:578).

There are no historic observations of hamlet and cabin site layout or duration. Large Huron villages had organized plans, with houses laid out in street-like rows (Warrick 1984:46). Villages were occupied for 10, 20, or 30 years and only the most populous villages, or those most exposed to enemy raids, were palisaded (Biggar 1922-1936, 3:48-49; Thwaites 1896-1901, 10:275; 38:247; Wrong 1939: 91-92).

Archaeological excavation and survey in Ontario has turned up evidence of Iroquoian hamlets, field cabins, and temporary camp sites, as well as villages. While exhaustive criteria have been proposed for determining the function and seasonality of Iroquoian habitation sites (Finlayson 1985:483-485; Lennox 1984b:264-273; Molnar 1986; Pearce 1983a,1983b; Poulton 1985; Timmins 1983; Tripp 1978; Williamson 1983:11-12), such criteria (e.g. artifact densities, faunal assemblages, and house plan details) are applicable only to excavated sites. Unfortunately, almost all Iroquoian sites in Ontario are known only from surface remains in ploughed fields. Consequently, it seems that the best factors for disclosing site function and permanence, in this study, are site size, midden number, and relative density of surface artifacts.

Archaeologists have linked site permanence with site size: the smaller the site, the shorter its occupation and the greater the likelihood that it functioned as a seasonal, special-purpose habitation (Powell 1983:85; Sanders et al. 1979:54-59; Schlanger and Orcutt 1986). In Iroquoian archaeology, site typologies exhibit considerable overlap, particularly between what are called hamlets and villages in the 0.25 to 0.8 ha size range (Finlayson 1985; Molnar 1986; Noble 1975; Warrick 1984:8). Table 26 and Figure 27 present data on the estimated size, and in some cases actual size, midden number, and inferred function of a select sample of Ontario Iroquoian sites. The confusion between hamlets and villages is clearly portrayed in Figure 27. However, this confusion between inferred hamlet and village sites stems from a confusion between **site seasonality** and **site duration**. The term "hamlet" has been used by Iroquoian archaeologists to mean seasonal site (e.g. Robin Hood site (Williamson 1983)), small year-round village (e.g. Bogle sites (Lennox

Table 26. Site Size, Midden Number, and Surface Sherd Density for a Select Sample of Ontario Iroquoian Settlement Site Types.

Site	Settlement Type	Size (ha)*	Midden (n)	Surface Sherd Density (rims/ha)	Reference
Magrath	camp	0.1*	-	n/a	Poulton 1985
Pennock II	camp	0.01	-	0	Poulton 1979
AfHi-45	camp	0.05	-	0	Timmins 1983
BeGx-14	camp	0.005	-	n/a	O'Brien 1976b
BfHa-3	camp	0.07	-	n/a	O'Brien 1976b
BfHa-5	camp	0.003	-	n/a	O'Brien 1976b
Mystery	camp	0.06*	-	0	Warrick 1988a
Caitlin	camp	0.003	-	0	Warrick 1988a
Pincombe 5	camp	0.01*	2	0	Pearce and Catsburg 1985
Horner Creek	camp	0.03*	-	n/a	Lennox 1987
Colony	camp	0.09	-	0	Poulton 1982
Birch	camp/cabin	0.08	-	10	Warrick 1988a
Huronia Road	camp/cabin	0.1	-	0	Warrick 1988a
Tollendale Ck.	camp/cabin	0.1	1	40	Warrick 1988a
Poltree	camp/cabin	0.06	-	0	Warrick 1988a
Hunter	camp/cabin	0.06	-	0	Warrick 1988a
Blubeetle	camp/cabin	0.06	-	17	Warrick 1988a
Willcock	cabin	0.1*	3	n/a	Poulton 1985
AfHi-47	cabin	0.1	-	10	Timmins 1983
Pincombe 2	cabin(2)	0.35*	2	3	Pearce and Catsburg 1985; Timmins 1983
Pincombe 6	cabin	0.13*	1	0	Pearce and Catsburg 1985
Black Kat	cabin	0.2*	1	0	Arnold and Pearce 1983
Woodholme	cabin	0.2	1	n/a	Arnold and Pearce 1983
Windermere	cabin	0.2*	1	n/a	Pearce 1983b
Ronto	cabin	0.2*	1	n/a	Pearce 1983b
Smallman	cabin	0.2*	2	n/a	Pearce 1983b
AlGt-7	cabin	0.2	1	n/a	MPP 1988b
Reiss	cabin(2)	0.6	2	2	MPP 1989
Sewell	cabin(2)	0.95	-	1	MPP 1988b
Sewell II	cabin	0.3	-	3	MPP 1988b
Bogle I	hamlet	0.3	1	28	Lennox 1984b
Bogle II	hamlet	0.3	1	0	Lennox 1984b
Robin Hood	hamlet	0.6*	2	n/a	Williamson 1983
White(Lower)	hamlet	0.6*	n/a	n/a	Tripp 1978
Draper South Field	hamlet	0.85*	2	n/a	Finlayson 1985
Auda	village	0.25	-	n/a	Kapches 1981b

Table 26. Continued.

Site	Settlement Type	Size (ha)‡	Midden (n)	Surface Sherd Density (rims/ha)	Reference
Miller	village	0.4	-	n/a	Kenyon 1968
Archie Little II	village	0.4	2	5	MPP 1988b
Little II	village	0.5	3	56	Warrick 1988a
Dykstra	village	0.3	2	10	Warrick 1988a
Blu Meanie	village	0.8	1	10	Warrick 1988a

‡ Excavated sites but site size estimate from initial surface collection

1984b)), or a confusing mix of the two (Finlayson 1985:485-487). While it is true that supposed hamlets, such as Robin Hood (Williamson 1983) and the Bogle sites (Lennox 1984b), have somewhat shorter occupation spans than contemporary villages, based on house wall post densities (less than 10 years for both (for Bogle I see Warrick [1988b:47] and for Robin Hood (based on House 2 post density of 3.2 posts/m)), there is no definitive evidence that the population of these hamlets abandoned them each winter to relocate in a neighbouring village. In the absence of detailed analyses of site seasonality, using rigorous zooarchaeological criteria, such as growth lines in teeth and shell (Monks 1981), which have not been carried out in any Iroquoian hamlet study, it is unreasonable to infer a lack of winter occupation from such notoriously unreliable or inappropriate indices as shallow hearths, presence of exterior hearths, low post densities in house ends, and relatively low frequency of storage pits (Finlayson

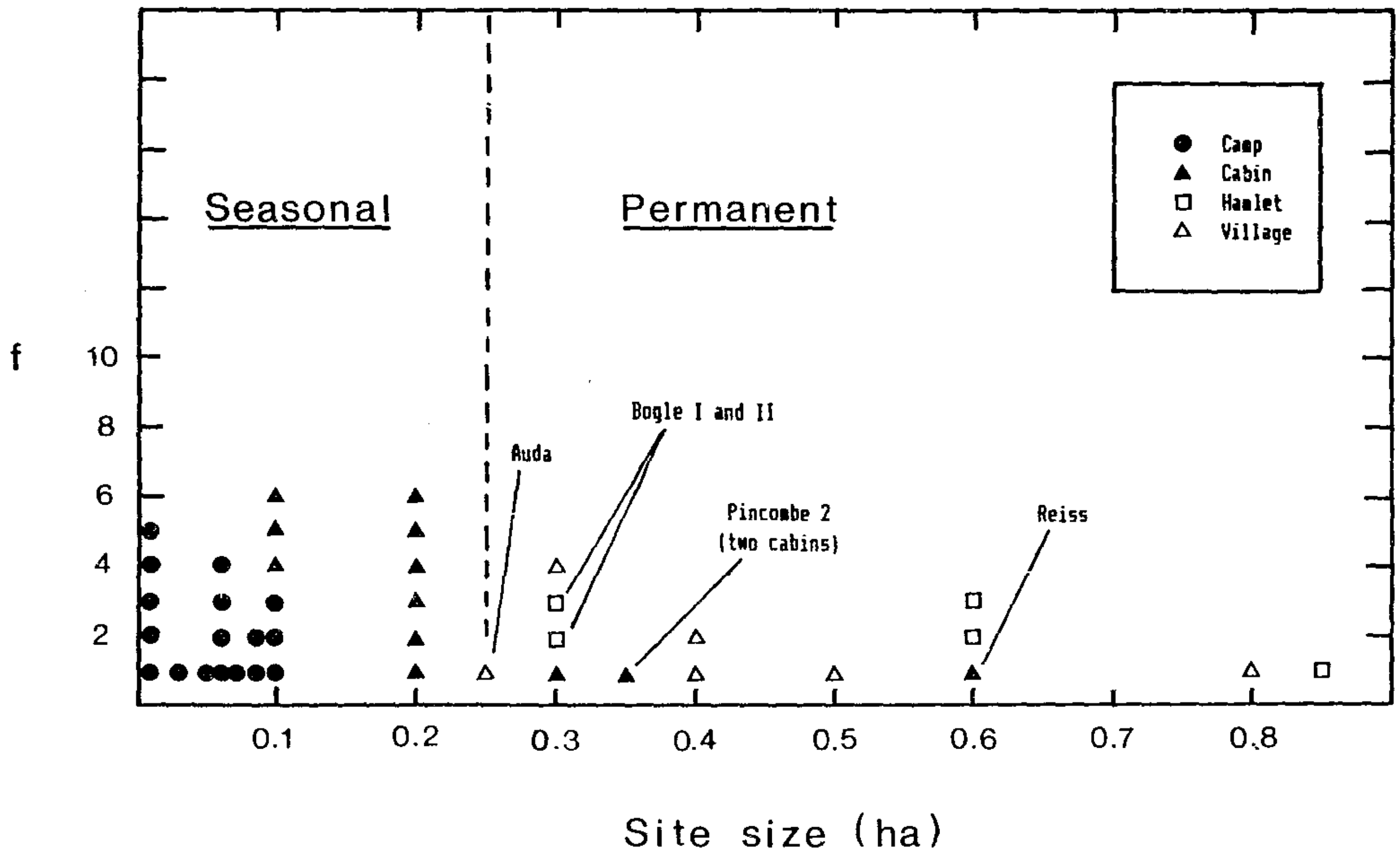

Figure 27. Size of various Ontario Iroquoian site types.

1985:483-485). Village sites that have experienced exceptionally deep ploughing, eradicating many hearths and shallow post molds (Dodd 1984:250; Finlayson 1985:484; Molnar 1986), might be misinterpreted as short-term hamlets, if occupational duration were the only criterion for determining site seasonality. In summary, since there is no conclusive evidence for differences between hamlets (Lennox 1984b; Williamson 1983), satellite villages (Finlayson 1985:485-487), and villages, with regards to their season of occupation, each of these site types can be considered permanent or year-round habitations. As there is no single cabin or temporary camp larger than 0.25 ha (see Figure 28), for the purposes of this study, all unexcavated Iroquoian sites in south-central Ontario that are equal to or greater than 0.25 ha in area and excavated sites that cover at least 0.2 ha and contain two or more discrete houses will be considered to have been permanent settlements.

For unexcavated sites, strict adherence to a 0.25 ha cut-off will eliminate any very small permanent settlements. However, only a small fraction of the sedentary Huron-Petun population lived in such settlements (see Figure 27). A 0.25 ha value will guarantee that virtually no unexcavated, non-permanent sites are added to population totals.

The 0.2 - 0.25 ha minimum size threshold for an Iroquoian village is a slight refinement of an earlier 0.4 ha definition (Warrick 1984:8). Anthropological theory supports the former figure. Anthony Forge (1972) discovered in an analysis of Highland New Guinea community size that 300 people was the normative size and hypothesized that this critical threshold value represented the maximum group size within which informal decision-making could effectively occur. Larger communities must be organized into politically-manageable and roughly equivalent-sized social units, which in the Iroquoian case would be clan segments. Minimum group size for a viable agricultural village would lie between 175 and 475 persons (Wobst 1974). Summaries of empirical data on minimum village population for Neolithic (Johnson 1977) and contemporary small-scale agricultural societies (Fletcher 1981) indicate a lower value of 100-150 persons. Based on an average value of 50 hearths per ha and 10 people per hearth (see next section in this chapter), a prehistoric Huron-Petun settlement of 0.25 ha would have contained approximately 125 people. Thus, according to theory and the empirical evidence for Neolithic village populations, a value of 0.2 - 0.25 ha for the minimum size of a Huron-Petun permanent village is indicated.

Village Size Data

Precise size estimates are available for 373 Huron-Petun village sites, ranging from 0.2 ha to 5.4 ha. Raw frequency distributions for each class of site size are presented in Table 27 for Class I sites (i.e. precise age and size known). Histograms of site size for each major time period of Huron-Petun archaeology appear in Figure 28 and pertinent statistics are compiled in Table 28.

It is important to realize that, prior to the late 1970s, size estimates for unexcavated Iroquoian village sites were often approximations made by eyeball observations or hastily measured by drawing an imaginary line around the outer edges of the outermost

Table 27. Raw Frequency Distribution of Site Size for a Sample of 304 Huron-Petun Village Sites.

Site Size (ha)	f	Site Size (ha)	f	Site Size (ha)	f
0.2	3	1.7	1	3.3	1
0.3	1	1.8	15	3.4	6
0.4	17	1.9	2	3.5	1
0.5	7	2.0	23	3.6	2
0.6	16	2.1	2	3.8	3
0.7	4	2.2	7	4.0	2
0.8	41	2.4	10	4.2	2
0.9	3	2.5	2	4.3	2
1.0	29	2.6	3	4.4	1
1.1	2	2.8	8	4.6	1
1.2	27	3.0	9	4.8	3
1.4	10	3.1	3	5.4	1
1.5	10	3.2	4		
1.6	20				

Table 28. Huron-Petun Site Size for Major Time Periods.

		SITE SIZE STATISTICS (in ha)					
Time Period	n*	Mean	S.D.	Median	Mode	Min.	Max.
Early Iroquoian	10	0.46	0.27	0.4	0.4	0.2	1.2
Middle Iroquoian	53	1.19	0.69	1	1	0.2	3.0
Late Prehistoric	130	1.74	1.02	1.6	1.2	0.4	5.4
Protohistoric	43	1.80	1.00	1.5	0.8	0.5	4.3
Historic	68	1.76	1.14	1.4	0.8	0.4	4.8

*Number of sites: N=304

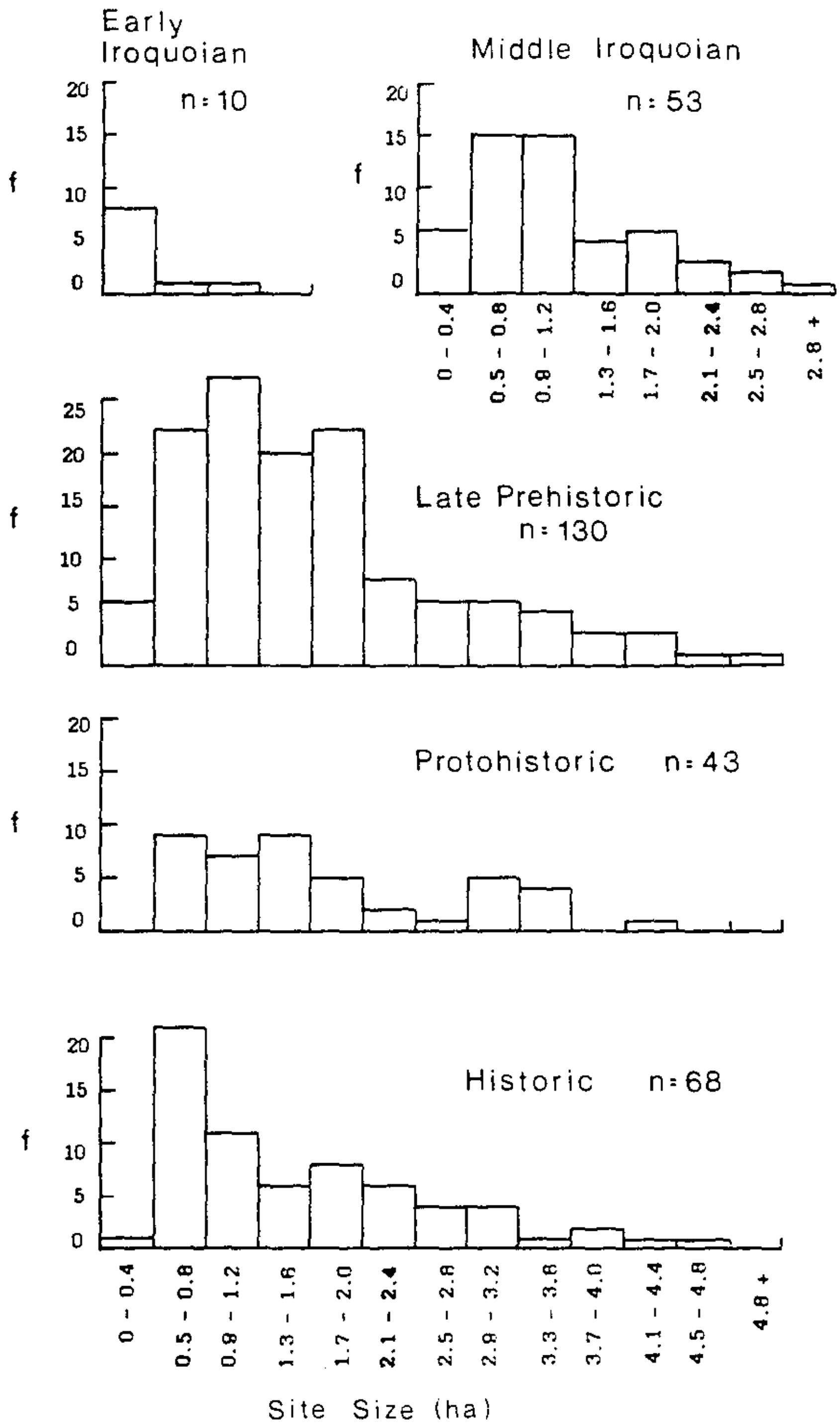

Figure 28. Distribution of site size for Early Iroquoian, Middle Iroquoian, Late Prehistoric, protohistoric, and historic periods.

midden scatters. Precise site size estimates from intensive surface collections did not become common until the 1980s in Ontario Iroquoian archaeology (Poulton 1979; Warrick 1986; 1988a). Nevertheless, early eyeball estimates of the size of Huron-Petun village sites are not significantly larger or smaller than later, more precise size estimates for the same sites (see Table 29). Site sizes recorded prior to 1975 are usually rounded to the nearest acre and were converted into hectares by multiplying by 0.4.

Six major size modes are visible in Table 27, occurring at acre or half acre intervals (e.g. 0.4 ha (1 acre); 0.8 ha (2 acres); 1.0 ha (2.5 acres); 1.2 ha (3 acres); 1.6 ha (4 acres); 2.0 ha (5 acres)). Although the modes are partly a function of rounding site size to the nearest acre, it is interesting that the upper limit of 4.8 ha (ignoring the 5.4 ha estimate since it is actually a combined total for possibly two discrete occupations of the Lalonde site) corresponds to a population of 2400 persons or six social units of 400 people apiece or eight social units of 300 people each (see the next sections for absolute population estimates based on hearth density). Because the most common village size is 0.8 ha (400 people) and because this is the modal size residential unit from which very large villages were assembled (e.g. Draper site (Finlayson 1985:422-431), it is tempting to conclude that the basic socio-demographic unit of the Huron-Petun consisted of 400 people, the uppermost size limit of informal decision-making communities (Forge 1972).

Table 29. **Comparison of Size Estimates for a Sample of Huron-Petun Village Sites.**

Site	Eyeball Size Estimate (a) (in ha)	Precise Size Estimate (b) (in ha)
AkGu-15 (Baker)	0.8	1.0
AlGt-2 (Draper)	2.3	3.4
AlGu-3 (Murphy-Goulding)	1.8	1.0
AlGu-5 (Watford)	1.8	2.4
AlGu-17 (Wilcox Lake)	0.8	0.6
BbGv-19 (Brassington)	2.2	3.1
BbGw-13 (Lougheed)	0.4	0.6
BcGv-11 (McDonald)	1.8	3.4
BcGw-9 (Carson)	2.0	1.8
BcGw-10 (Dunsmore)	0.8	2.0
BcGw-15 (Little)	2.0	1.5
BdGw-3 (Auger-Yates)	2.5	2.8
BeGv-4 (Bidmead)	2.0	2.8
BeGx-15 (Le Caron)	2.2	1.6

(a) Eyeball estimates comprise a select few of Andrew Hunter (1890s) and 1950-1970 estimates made without the aid of controlled surface collection
(b) Precise estimates include those made from controlled surface collection data or actual measurement of site size from excavated settlement pattern data

Matched pair t-test:

t = 1.53, df = 13, two-tailed test p = 0.15 (i.e. no significant difference between eyeball and precise size estimates)

Wilcoxen t = 25.5 ; p > 0.05 (i.e. no significant difference)

Hearth Counts

The typical historical Huron longhouse is said to have contained a row of four to five central hearths, spaced every two to three paces. Each such hearth was used by two families, living on either side of the central corridor of the house, for cooking, heating, and lighting (Biggar 1922-1936, 3:123; Thwaites 1896-1901, 15:153; 16:243; 19:127; 35:87; Wrong 1939:94). The Huron word for hearth ("te onatsanhiaj") connotes bilateral use (Steckley 1987:26). Fortunately, central hearths are relatively well-preserved in Iroquoian sites, even ploughed ones, enabling archaeologists to estimate site population by counting them (Finlayson 1985; Heidenreich 1971:114-120; Johnston and Jackson 1980; Wright 1974:69,75).

Unfortunately, only 3% of all Huron-Petun village sites have received total or partial excavation of house floors. With the exception of sites that have been ploughed for the first time (e.g. Eldorado [AlGo-41] (Kapches 1983a,1988)) or that have been subjected to intensive magnetometer survey (Snow 1986,1987a), it is impossible to count directly the number of hearths from the surface of an unexcavated village. Consequently, we must develop, from excavated sites with a known density of hearths, approximate measures of hearth density that can be applied to unexcavated sites. Such density measures must be sensitive to variations resulting from changes in time and settlement size (Fletcher 1981). We cannot simply assume a priori that Huron-Petun hearth density is some normative constant; it must be established empirically.

The conversion of hearth counts into number of families or people, also, presents some problems. Hearth preservation varies site to site, but is poorest for deeply ploughed sites (Dodd 1984:250). Central hearths in Iroquoian sites are relatively shallow features (i.e. 15 centimetres or less), often recognizable as a thin veneer of compact white ash and charcoal flecks, on top of a deeper zone of fire-reddened soil (Hayden 1979:4). Considering that the ploughzone depth averages 30 cm across Southern Ontario, ploughed Iroquoian villages contain few intact hearths. Nevertheless, numerous house plans appear to contain evidence of their full original complement of hearths.

Another problem associated with using hearth counts concerns "hearth drift" and contemporaneity. Walter Kenyon (1968) noted that House 5 at the Miller site displayed a continuous band of fire-reddened soil along its central corridor. Other sites (e.g. Molson (Molnar 1986), Boys (Reid 1975), and Draper (Finlayson 1985)) contain houses with hearths that appear to have migrated or drifted over time and that grew in size over their 10-30 year lifespans. In general, however, the archaeological evidence suggests remarkable stability in hearth locations throughout the lifetime of longhouses.

The number of central hearths in poorly preserved house floors can be accurately predicted using empirical generalizations developed by Christine Dodd (1984:274) from a sample of Ontario Iroquoian longhouses with full hearth counts. Dodd's (1984) generalizations are supplied in Table 30 and are particular to each major time period of Ontario Iroquoian prehistory. It is important to note here that Jerome Lalemant's (Thwaites 1896-1901, 17:177) observation of

Table 30. Ontario Iroquoian Central Hearth Statistics.*

Time Period	n	Hearth Spacing (m)	Hearth- N End (m)	Hearth- S End (m)
Early Iroquoian (A.D. 900-1300)	24	1.9	4.6	3.1
Middle Iroquoian (A.D. 1300-1450)	14	5.3	5.5	5.8
Late Prehistoric - Protohistoric (A.D. 1450-1609)	21	3.6	4.9	4.9
Historic (A.D. 1609-1650)	35	2.9	4.2	4.7

*from Dodd (1984:274)
n = Number of houses used to calculate hearth spacing
Hearth Spacing = Mean distance between the closest lateral margins of two adjacent central hearths in metres
Hearth - N End = Mean distance between the northernmost central hearth and the north end wall of the house in metres
Hearth - S End = Same as above only for south end

seventeenth century Huron longhouses documented a hearth spacing of two to three paces (2 - 3 metres (Dodd 1984:323)), the upper limit of which is virtually identical to archaeologically-derived values. This supports the underlying assumption that consistently-spaced archaeological central hearths are in fact contemporaneous. Although not compiled for Dodd's (1984) study, the average length of central hearths in Ontario Iroquoian houses is about one metre +/- 25 centimetres (for examples, refer to Finlayson (1985) and Lennox et al. (1986)). Occasionally small hearths occur peripheral to the central

2.0 m wide corridor where the central hearths occur (Lennox et al. 1986:16-17). These are normally interpreted as auxiliary cooking fires used primarily in the winter (Heidenreich 1971:117-118). In summary, Dodd's (1984) generalizations were applied to longhouse plans that possessed only partial preservation of central hearths. Missing hearths were interpolated from existing hearths using both hearth spacing generalizations and central corridor post clusters that may be the remnants of sweat lodges constructed **between** central hearths (MacDonald 1988:19). In fact, from Middle Iroquoian times on, sweat lodge post clusters are often better preserved and less mobile than neighbouring hearths. Figure 29 presents two examples of interpolating missing hearth floors for Ontario Iroquoian longhouses using inter-hearth distance measures and the position of sweat lodge post clusters. Extra hearths, resulting from hearth drift, can be factored out as non-contemporaneous on the basis of contemporaneous hearth spacing.

The total number of hearths for each partially or completely excavated Huron-Petun site was calculated by direct counting of preserved hearths and interpolation of missing hearths in longhouse floors. Hearth density was calculated by dividing the number of hearths by total site area or total area of excavation (see Table 32). Because partially excavated villages might yield hearth densities that are biased, especially in situations where the excavated area is less than 25% of total site area, a sampling experiment was conducted. Referring to Table 31, several village plans were gridded off into 0.25 ha blocks for which hearth densities were calculated. A

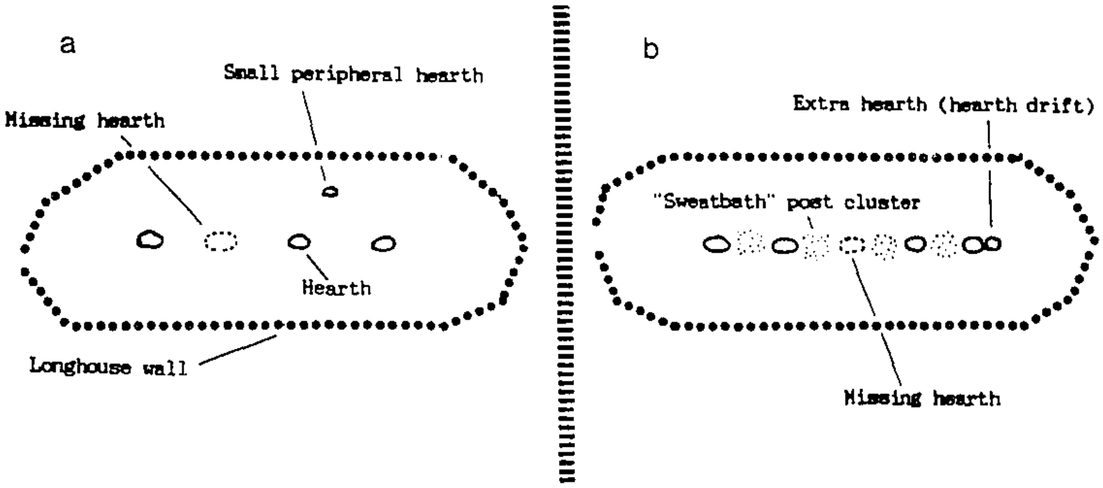

Figure 29. Interpolation of missing hearths in Huron-Petun longhouses.

comparison of hearth densities for the 0.25 ha village portions with those for entire villages reveals that partial block excavations of Huron-Petun village sites consistently overestimate overall hearth density by a factor of 1.4. Consequently, this figure was used as a correction factor for village sites in the study that have been less than 25% excavated (i.e. Warminster, Le Caron, and Bidmead).

Because of the paucity of historic Huron and Petun archaeological village plans, historic data were used to estimate hearth density for

Table 31. Difference in Hearth Density Estimates between Partial and Total Village Site Plans. (a)

Site	(1) Average Hearth Density for Partial Village Site Plans (hearths/ha)	(2) Actual Hearth Density for Total Village Site Plan (hearths/ha)	Ratio of (1):(2)
Draper	64 (n=8)	44	+1.45
Ball	87 (n=5)	63	+1.38
Benson	68 (n=4)	56	+1.21
Keffer	52 (n=4)	33	+1.58
Kirche **(b)**	76 (n=2)	52	+1.46

(a) Average hearth density for partial village plans based on 0.25 ha blocks arbitrarily placed on village site plans so as to maximize interior village area. Numbers in parentheses are the number of blocks employed for each site. The ratio column shows that partial village hearth density overestimates actual village hearth density by an average of 1.42 times.

(b) calculated for palisaded portion of site only

two Huron and two Petun villages. The late historic village of Teanaustaye has been identified with the Fitzgerald-Train site (BdGw-2A) on the basis of age (Kenyon and Kenyon 1983), Jesuit material, size, and geographical location (Ridley 1971). Teanaustaye was said to be populated by 400 families (Thwaites 1896-1901, 34:87) living in 80 cabins (Thwaites 1896-1901, 15:153) or a total of 200 hearths (2.5 hearths/house). Dividing the hearth total by site size (approximately 4.0 ha) yields 50 hearths/ha. The Ossossane village of the 1630s is tentatively identified with the Angoutenc site (BeGx-24) on the basis of age (Kenyon and Kenyon 1983), Jesuit material , size (2.4 ha), and geographical location (Ridley 1968). It was occupied by 200-240 families living in 40 cabins (Thwaites 1896-1901, 15:153), totalling 100-120 hearths. Taking the average of these values and dividing by site size yields 46 hearths/ha. The Petun village of Ehwae has been convincingly identified with the Hamilton-Lougheed site (BbHa-10) on the basis of age (Kenyon and Kenyon 1983), Jesuit material, size (4.8 ha), and geographical location (Garrad 1975; Garrad and Heidenreich 1978). Ehwae is reported to have contained 45-50 houses in the year A.D. 1639 (Thwaites 1896-1901, 20:45-47). Unfortunately, no historic Petun house floors have been archaeologically excavated. Nevertheless, assuming that average house length (20.4 metres) was the same for the historic Petun and Huron (Dodd 1984:321,414), the average number of central hearths per house would have been three. Multiplying average hearth number by documented houses in Ehwae (i.e. 135-150 hearths) and then dividing by site size yields 28-31 hearths/ha. Hearth density can also be estimated for another historic Petun village, Etharita. Etharita was the southernmost village of the Petun in A.D. 1649 and was occupied by 500-600 families (Thwaites 1896-1901, 35:107). It has been identified with considerable confidence as the Kelly-Campbell site [BcHb-10] on the basis of age (Kenyon and Kenyon 1983), size (4.8 ha), Jesuit material, and geographical location (Garrad 1975,1980; Garrad and Heidenreich 1978). Estimated hearth densities range from 52 to 62 hearths/ha, with a median value of 57 hearths/ha.

Table 32 and Figure 30 summarize hearth density data for Ontario Iroquoian and St. Lawrence Iroquoian village sites that have been partially or completely excavated. The number of hearths/ha is

Table 32. Hearth Densities for Excavated Iroquoian Villages in Ontario.

Site	Date (yrs A.D.)	Total Site Area (ha)	Excavated Area (ha)	Hearth n	Hearth Density (hearths/ha)	Reference
EARLY IROQUOIAN						
Porteous	850-900	0.1	0.1	5	50	Stothers 1977
Miller	1100-1140	0.4	0.33	19-20	54-60	Kenyon 1968
Calvert(3)	1180-1200	0.28	0.28	11	39	Timmins 1987
MIDDLE IROQUOIAN						
Gunby	1300-1330	1.1	0.3	16	53	Rozel 1979
Uren	1300-1330	1.1	1.1	50	45	Wright 1986
Nodwell	1380-1410	0.62 (a)	0.62	31	50	Wright 1974
Roebuck	1350-1400	2.5	2.5	110	44	Wright 1979
LATE PREHISTORIC						
Boyle-Atkinson	1450-1480	1.0	1.0	60	60	MPP 1987a
Draper	1470-1510	3.42	3.42	152	44-47	Finlayson 1985
White (Lower)	1470-1490	0.58	0.58	14	24	Finlayson 1985
Robin Hood (E)	1470-1480	0.61	0.61	16	26	Finlayson 1985
South Field	1500-1510	0.85	0.85	21	25	Finlayson 1985
Forget	1500-1530	0.72	0.72	47	65	Heidenreich 1971
Raymond Reid	1500-1520	0.5	0.5	28	56	Fitzgerald 1984
Keffer	1490-1520	2.0	1.6	52	33	Finlayson et al. 1987
Maynard-McKeown	1500-1530	1.6	0.45	28	62	Pendergast 1988
PROTOHISTORIC						
Kirche	1540-1570	1.3 (a)	1.3	67	52	Nasmith 1981
Benson	1550-1590	1.9	1.9	107	56	Ramsden 1977b
Fonger	1580-1600	0.8	0.8	36	45	Warrick 1984
Ball	1590-1605	3.5	3.0	188	63	Knight 1987
Molson	1580-1600	1.8	0.85	34	40	Molnar 1986
EARLY HISTORIC						
Warminster(N)	1605-1620	3.4	0.32	39	121 (86) (b)	Sykes 1983
Le Caron	1610-1635	1.6	0.2	19	95 (71) (b)	Johnston and Jackson 1980
Alonzo	1600-1625	0.8	0.24	11	46	R. O'Brien, pc 1987
Bidmead	1600-1625	2.1	0.34	29	86 (61) (b)	R. O'Brien, pc 1986

Table 32. Continued.

Site	Date (yrs A.D.)	Total Site Area (ha)	Excavated Area (ha)	Hearth n	Hearth Density (hearths/ha)	Reference
MIDDLE AND LATE HISTORIC						
Teanaustaye [BdGw-2A]	1630-1650	4.0	-	200	50	see text
Ossossane I [BeGx-24]	1610-1635	2.4	-	100-120	42-50	see text
Ehwae [BbHa-10]	1620-1641	4.8	-	135-150	28-31	see text
Etharita [BcHb-10]	1639-1649	4.8	-	250-300	52-62	see text

(a) Village size estimated from innermost palisade and excludes houses outside palisade
(b) Adjusted hearth density to correct for overestimation in large sites with small area of excavation (raw hearth density/1.4)
Underlined sites are unpalisaded

remarkably constant for most of Iroquoian prehistory, averaging 50 +/- 6 hearths/ha. Hearth density jumps dramatically, however, about A.D. 1600 but falls again to prehistoric values by A.D. 1630. Even adjusting for sampling error for the three Huron sites that fall into this time period, hearth density still averages 73 hearths/ha. Independent estimates of the Le Caron site (BeGx-15) hearth density are of the same magnitude: 65 hearths/ha (Johnston and Jackson 1980:198). Interestingly, Dean Snow (1987a) found a high density of hearths at the early protohistoric (ca. A.D. 1550-1580 (Ritchie and Funk 1973:314-315)) Mohawk village of Garoga - ranging from 70 - 90 hearths/ha - but, in the A.D. 1650 Caughnawaga village, hearth density was calculated at just 50 hearths/ha. This parallels the

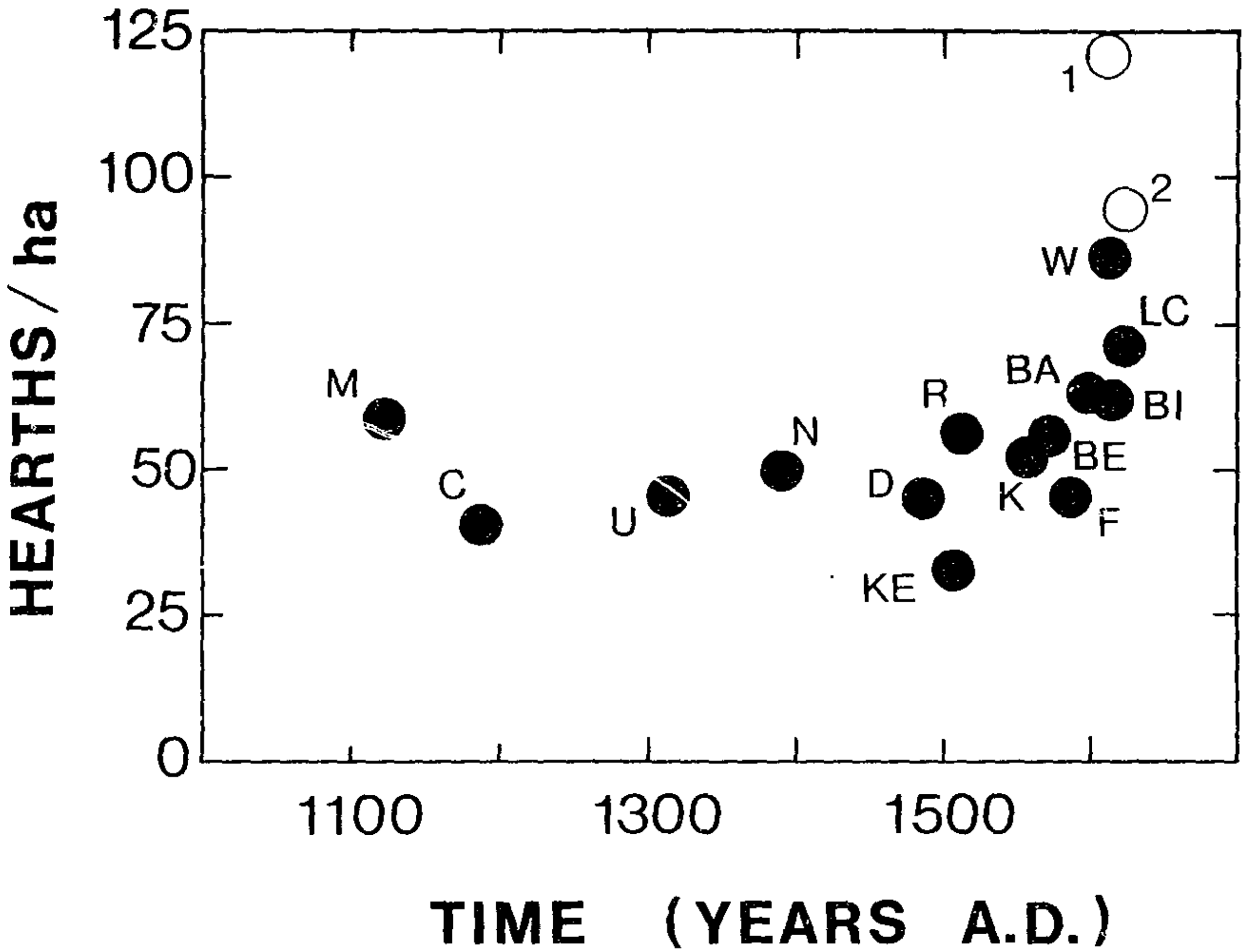

Figure 30. Ontario Iroquoian hearth densities. (Key to sites: M - Miller; C - Calvert (3); U - Uren; N - Nodwell; D - Draper; R - Raymond Reid; KE - Keffer; K - Kirche; BE - Benson; F - Fonger; BA - Ball; W - Warminster (N); LC - Le Caron; BI - Bidmead; 1 - Warminster (N)-uncorrected; 2 - Le Caron-uncorrected). See Table 32 for data.

chronological trends in hearth density for Ontario Iroquoians.

The relationship between hearth density and site size was also examined. Previous research into the population density of small-scale agricultural communities suggests an allometric relationship between these two variables - as site size increases, population and hearth density increase. As clearly depicted in Figure 31, however, there is no allometric or any other relationship between site size and the density of central hearths in Ontario Iroquoian villages. But there is a relationship between palisaded and unpalisaded village sites.

Refuting Heidenreich's (1971:128) prediction, palisaded villages tend to have higher hearth densities than their unpalisaded contemporaries. For instance, Molson and Alonzo, both unpalisaded contact sites, average 43 hearths/ha in contrast to an average of 64 hearths/ha for six contemporaneous palisaded sites. Similarly, from data supplied in Finlayson (1985:486), it was calculated that the unpalisaded small villages surrounding the contemporary Draper village averaged only 25 hearths/ha in contrast to the 50 hearths/ha average for palisaded prehistoric villages (see Table 32). Thus, while hearth density is essentially independent of both site size and time (except for a brief period of unprecedented overcrowding in early historic (A.D. 1600-1630) villages), palisaded villages have substantially higher hearth densities than unpalisaded ones of the same period. In the early seventeenth century, 10 or 12 of 18 Huron villages (i.e. 56-67%) were unpalisaded (Biggar 1922-1936, 3:122; 4:301). Only large villages, or those situated on the frontiers,

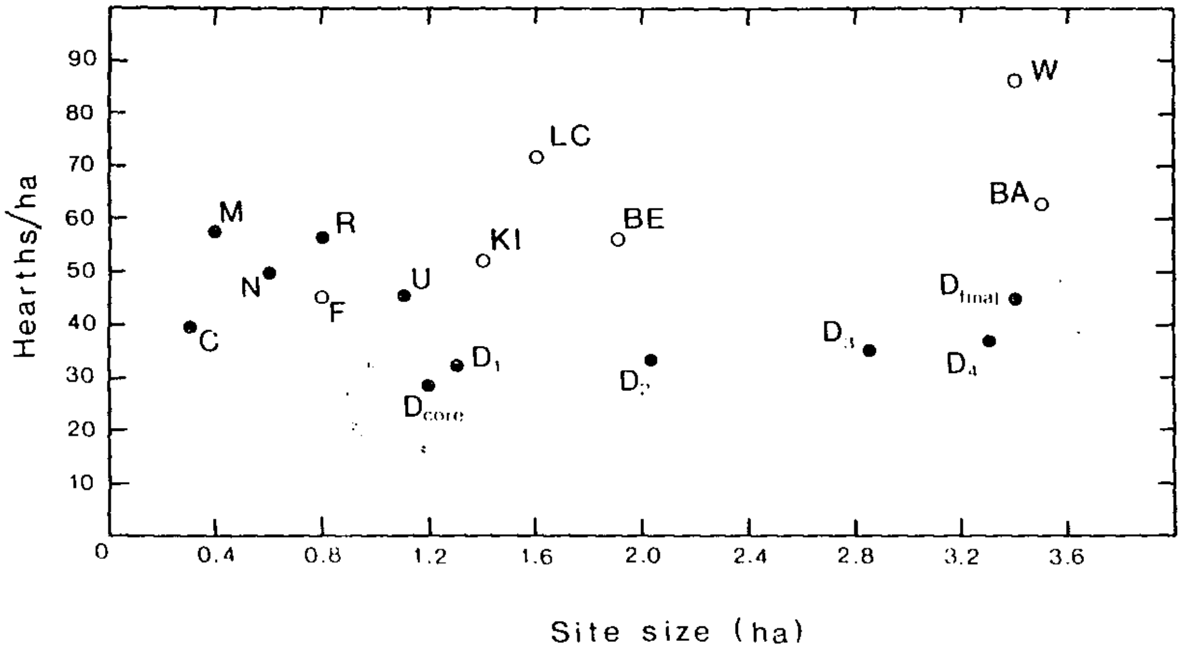

Figure 31. Relationship between Ontario Iroquoian hearth density and site size. (Key to sites: C - Calvert; M - Miller; F - Fonger; RR - Raymond Reid; K - Kirche; U - Uren; KE - Keffer; D(Core), D1, D2, D3, D4, D(Final) - Draper (village segments); LC - Le Caron; BI - Bidmead; BA - Ball; W - Warminster). See Tables 32 and 34 for data.

frontiers, appear to have been fortified; when under enemy attack the residents of small unpalisaded villages abandoned them and hid in the woods or sought refuge in the closest palisaded settlement (Thwaites 1896-1901, 10:51). Only 7/27 or approximatley 26% of archaeologically excavated Ontario Iroquoian settlements are unpalisaded and most are Late Prehistoric or Contact in age and less than 1.0 ha in size (Table 32). Thus, prior to calculating absolute population totals for the Late Prehistoric and Contact periods, hearth counts for 25% of the small (< 1.0 ha) sites will be calculated using the lower hearth densities of unpalisaded villages.

Site Growth and Contemporaneity

The "contemporaneity problem" in demographic archaeology is "the practice of counting as contemporary populations (or their remains) that in fact are not strictly contemporaneous" (Schacht 1984:678). In regional population reconstructions, it must be demonstrated that the settlement units being counted, that is settlement sites, houses, rooms, hearths, and storage pits, were being used at the same point in time. The density of longhouse wall posts provides an approximate estimate of Iroquoian settlement duration (Warrick 1988b) which, in turn, can be used to determine settlement contemporaneity by partitioning relatively long chronological periods into a number of shorter periods equal in length to average settlement duration. While this avoids "double counting" (Wright and Johnson 1975:274) entire settlements, it does not tell us how many of the longhouses of an archaeological village plan were occupied at the same time.

In the absence of superimposition of house floors by other house floors, palisades, or middens, Iroquoian archaeologists have boldly assumed that all non-overlapping houses were occupied from the first to the last day of a village's occupational history (Damkjar 1982; Finlayson 1985; Wright 1974). In other parts of the world, archaeologists have adopted a more realistic growth and decline model for dealing with the occupational history of prehistoric settlements, where the number of contemporaneous rooms or dwellings is a fraction (5-80%) of the cumulative totals for the archaeological site (Ammerman and Cavalli-Sforza 1984:73-75; Blake et al. 1986; Hassan 1981:74-77; O'Shea 1978; Plog 1974:90-91; Schacht 1984). These models assume that the use-life of a room or dwelling is considerably less than the occupation span of the settlement and that replacement structures are not superimposed on demolished ones. As will be argued in the next section, the potential lifespan of an Iroquoian longhouse was commensurate with the lifespan of a village and, in the case of house abandonment and demolition, the new house was invariably built directly on top of the old one, with a slightly different axial orientation (e.g. Fonger (Warrick 1984); Calvert (Timmins 1987)). In fact, the combined duration of superimposed longhouses in village sites like Fonger (Warrick 1984:96-97,150) are approximately equal to the duration of non-rebuilt longhouses, as calculated from wall post densities. Furthermore, except for a few unusually large Huron-Petun villages of the Late Prehistoric period and early protohistoric phase of the Contact period, wall post densities for single component village sites, such as Nodwell (Wright 1974), Raymond Reid (Fitzgerald

1984) Auger (Latta 1985a), Ball (Knight 1987), and Warminster (Sykes 1983), are remarkably constant house to house (Warrick 1988b). Thus, archaeological data imply that the number of contemporaneous houses in an Iroquoian village can actually be considered the sum of non-overlapped houses plus one house for each pair of overlapped houses. Further, the maximum momentary population of an Iroquoian village occurred at abandonment. No archaeological examples have come to light of any large Iroquoian village that declined in size during its lifespan; based on sequences of house construction and abandonment, we have only cases of relatively constant or growing village populations for the Huron-Petun.

Certain Huron-Petun villages grew substantially over the course of their short lives by the episodic addition of groups of longhouses or village segments. Examples include Draper (Finlayson 1985), Keffer (Finlayson et al. 1987), Coulter (Damkjar 1982), Kirche (Nasmith 1981), and Cleary (Warrick 1986). Table 33 summarizes growth statistics for these villages. The Draper site's growth history is the best understood because of the completeness of regional site surveys that have located the various smaller villages that combined to form the large Draper community (Poulton 1979). Archaeological data suggest that Draper grew throughout its lifespan, perhaps as a defensive coalition, by the sequential addition of smaller neighbouring settlements (Finlayson 1985:439). Figure 32 and Table 34 present the most likely scenario of Draper's settlement history and reveal the complex dynamics of exceptionally large Iroquoian settlements. Relatively consistent wall post densities of houses

Table 33. Growth Sequences for Large Huron-Petun Village Sites.

Village Site	Core Size (ha)	Final Size (ha)	Size of Village Expansions from First to Last (ha)	Reference
Draper [AlGt-2]	1.2	3.42	0.1/0.8/0.8/0.2/0.4/0.8	Finlayson 1985
Coulter [BdGr-6]	0.65	3.3	0.2/0.5/0.1/1.8	Damkjar 1982
Keffer [AkGv-14]	1.2	2.1	0.9	Finlayson et al. 1987
Cleary [BbGw-10]	1.2	4.6	n/a	Warrick 1986

belonging to a particular growth phase (Finlayson 1985) suggest that the smaller villages joined Draper as whole communities and not on a house-by-house basis. A similar pattern, albeit far less complete than Draper, is documented archaeologically for the Coulter site (Damkjar 1982). Village growth by immigration, if unrecognized in the archaeological record, can produce substantial overestimation of local population because of the "double counting" effect. The White site, for example, coexisted with the early occupational phases of the Draper site and joined Draper, probably as Expansion #3 (Table 34). By counting both White and Draper Expansion #3 in regional population totals, one would be committing a "double counting" error. Similarly, we must exclude Best, Carruthers, and Robin Hood from middle Late Prehistoric population estimates, since they have already been counted at Draper.

Unfortunately, the exact proportion of large Huron-Petun village sites that grew like the Draper site is unknown and extremely difficult to estimate. Precise regional site relocation sequences have yet to be developed for Coulter, Cleary and other large villages

Table 34. Hypothetical Sequence of Village Additions to the Draper Site. (a)

Years A.D.	Draper Village Segment	Size (ha) of Segment	Village Added	Size of Village (ha)
1470	Core	1.2	Pugh (AlGt-87)	1.2(2.8) (b)
1480	Expansion 1	0.1	?	?
1485	Expansion 2	0.8	Robin Hood (AlGt-96)	0.61
1490	Expansion 3	0.8	White (AlGt-32)	0.8
1500	Expansion 4/5	0.6	Carruthers (AlGt-97)	0.6
1500	South Field	0.85	Best (AlGt-67)	0.8(1.8) (b)

(a) Data for Draper village growth see Finlayson (1985)
Approximate calendar dates for village expansions see Warrick (1988b)
Village addition sequence see Poulton (1979) and Timmins (1981)

(b) Pugh (originally 2.8 ha in size) fissioned upon relocation into three daughter settlements: Draper Core (1.2 ha), Carruthers (0.6 ha), and White (0.8 ha) (see Poulton (1979) and Timmins (1981) for ceramic evidence supporting this settlement history for the Pugh site).

Best appears to have fissioned several years before abandonment, creating the Robin Hood site and leaving behind only 1.0 ha of the original 1.8 ha Best village (see Figure 32).

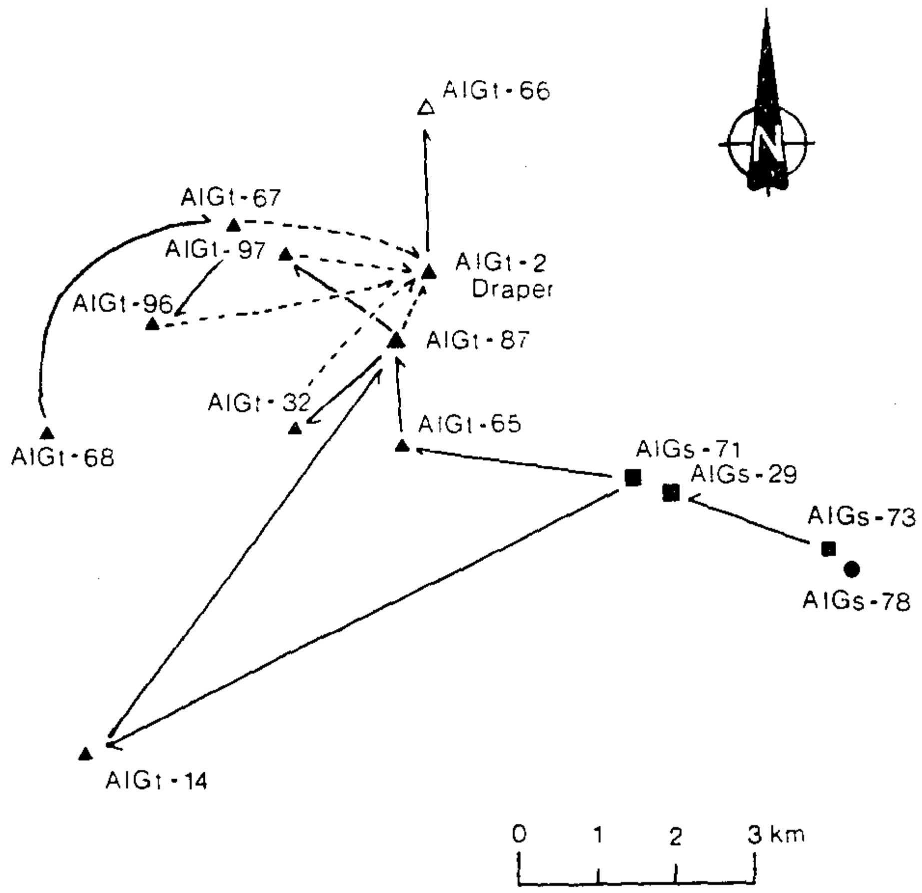

Figure 32. Settlement history of the Draper site (AlGt-2). Key to symbols: (————>) Village relocation; (------>) Draper village additions; (△) Protohistoric; (▲) Late Prehistoric; (■) Middle Iroquoian; (●) Early Iroquoian.

that appear to have grown by immigration as opposed to natural population increase (see Chapter 7). Furthermore, the growth of early protohistoric villages, such as Coulter and Kirche in Victoria County, was partially fueled (5-15% - see Table 50 in Chapter 7) by the immigration of St. Lawrence Iroquoian refugees (Damkjar 1982; Nasmith 1981; Ramsden 1988). Another problem with deriving a correction factor for accretionary village growth, is that such a model is probably applicable to an unknown but small percentage of the largest village sites occupied in Late Prehistoric and early protohistoric times. Although extremely large villages may have tended to fission more often than smaller ones, because of the inadequate dispute-resolution mechanisms of Huron-Petun sociopolitcal organization (Hayden 1978; Heidenreich 1971:129-134), there are archaeological examples, such as the relocation of the entire Draper village to the Spang site (Finlayson 1985), which indicate that once large villages were created, they might sustain themselves as a single socio-political community. Furthermore, the creation of very large Huron-Petun villages need not have proceeded by gradual accretionary growth. In the early 1630s, five northern Attignawantan villages of the Huron were making plans to combine all at the same time into one large village (Thwaites 1896-1901, 10:241).

Summarizing this evidence, in Huron-Petun prehistory large villages may have been created gradually as a result of the accretion of small neighbouring villages or instantly as a result of village amalgamation. Only in the former case does this cause problems of double counting in regional demographic estimates. Because it is impossible to ascertain which process produced a particularly large site in the absence of excavated village plans (Damkjar 1982; Finlayson 1985) or intensive surface collection (Warrick 1986), corrections for double counting will be applied only to those large Huron-Petun sites for which there is demonstrable archaeological evidence of gradual growth by accretion. For each of the latter sites, total site size less the size of the founding core village will be deducted from site size totals for the appropriate phase of Huron-Petun prehistory. It is recognized that, until the developmental histories of all large Huron-Petun village sites are known, there is a strong possibility that population estimates, particularly for the fifteenth and sixteenth centuries, will be slightly inflated due to double counting of large villages and the smaller contemporary settlements from which they were built.

Estimating Site Duration

The contemporaneity problem is one of the great methodological hurdles in demographic archaeology. Except for village sites of the Southwest United States where tree ring dating allows the construction of detailed histories of occupation for individual villages, archaeology has yet to develop a methodology for dating a site, not to a pigeonhole period, but to "its own dates of occupation, with its beginning, maximum, and ending dates defined in terms of its own history" (Schacht 1984:692).

Iroquoian demographic archaeology suffers from the contemporaneity problem. Regional site chronologies, based on pottery seriation and a sprinkling of radiocarbon dates, are divided into periods that are several decades long. The occupation of an Iroquoian village site is dated by assigning it to a chronological period. Site duration is estimated by arbitrarily assuming that all Iroquoian villages were occupied 10-30 years, based on seventeenth-century accounts of Huron village life.

While the historic estimates of Iroquoian village duration may be accurate, no one has bothered to verify them empirically. Instead, archaeologists have simply assumed that the historical estimates are accurate and that they are constants throughout Iroquoian prehistory. Regional population estimates from archaeological settlement data are becoming increasingly important to the interpretation of Iroquoian prehistory and history (Ramenofsky 1987a; Snow 1986; Snow and Starna 1989; Starna 1980; Trigger 1985b:231-242; Warrick 1986; Warrick et al. 1987). Yet, unless village duration can be empirically measured, estimates of Iroquoian population from settlement patterns will be heuristic exercises, having little credibility and little historical reality. In order to ameliorate the contemporaneity problem in Iroquoian archaeology, a method must be developed to estimate village duration and history of occupation from purely archaeological data, independent of time periods and the direct historic approach.

This section, which closely follows a published study (Warrick 1988b), proposes a method for estimating Iroquoian village duration from archaeological data. A review of historical, ethnohistorical, and ecological estimates of village duration reveals variability ranging from 8-100 years. Such estimates are too imprecise to be applied to real prehistoric situations. Consequently, several archaeological indices of site duration are evaluated in light of the Iroquoian case.

There are several methods for estimating Iroquoian village site duration. Historic observations made by seventeenth-century missionaries and explorers provide eyewitness estimates of Huron village duration. Ethnohistoric inference has been used to refine the raw historic estimates. Another method, the ecological approach, uses a mix of ecological theory and archaeological data to set a maximum limit on length of village occupation. Lastly, certain classes of archaeological data can be used as indices of village duration.

Historical observations

Explorers and missionaries who visited the Huron country were struck by the periodic relocation of Huron villages. Except in the latter period of European-Huron contact, no European lived long enough among the Huron to witness the entire life cycle of a village, from its construction to its abandonment and relocation. Nevertheless, several estimates of village duration, probably provided by Huron informants, were recorded. For A.D. 1615-1624 two estimates of village duration are available: Champlain noted a 10, 20, or 30 year duration (Biggar 1922-1936, 3:124) and Sagard documents a 10, 15, 30 (Wrong 1939:92-93), or 40 year duration (Sagard 1866, 1:197). During the 1630s and 1640s, Jesuits living and working among the Huron noted that villages were occupied for only 6-12 years, with a mode of 8-9 years (Thwaites 1896-1901, 10:275, 15:153, 19:133).

There are two major weaknesses in applying historical site durations to individual prehistoric villages. First, one is instantly struck by the temporal disparity between the pre-Jesuit and Jesuit accounts of village duration. It seems that the Jesuit period Huron villages were occupied only half as long as early contact ones. Furthermore, how does one determine which estimate is appropriate for a certain prehistoric case? It would be untenable simply to assume a constant site duration value for all of Iroquoian prehistory.

Ethnohistorical estimates

Based on evaluations of seventeenth-century eyewitness accounts, archaeologists and ethnohistorians have arrived at estimates of Iroquoian village duration. Like the historical observations, the ethnohistorical estimates are bimodal. The lower estimates range from 8-15 years, with a mean of 10-12 years (Fenton 1978:302; Heidenreich 1971:213; Trigger 1976:87); the higher ones average over 50 years (range of 26-70 years), and are based on historical (late seventeenth and eighteenth century) Mohawk village occupations, such as Caughnawaga (26 years) and Schoharie (70 years) (Guldenzopf 1984:89; Starna 1980:378; Tuck 1971).

In light of early seventeenth-century Huron village durations, ethnohistorical estimates seem flawed at both the upper and lower ends. Despite Heidenreich's (1971:213-215) ecological arguments concerning soil exhaustion and village relocation, an 8-12 year occupation seems too brief for most Iroquoian villages, especially in light of the 20-30 year estimates supplied by both Champlain and Sagard. At the upper end, more than a 50 year occupation seems too long, considering the ecological limitations of swidden settlement in temperate forests (Heidenreich 1971:213-215; Snow 1986). One should bear in mind that the latter estimate is based almost entirely on eighteenth-century accounts of the Mohawk, when floodplain plow agriculture and the horse permitted relatively permanent settlement (Guldenzopf 1984). Thus, while ethnohistorical inference can set gross parameters of Iroquoian village duration, like the historical data, it is virtually useless for elucidating the occupation spans of prehistoric village sites.

Ecological estimates

The size of agricultural catchments can provide rough estimates of village duration. Following a model developed by Heidenreich (1971), Sykes (1980) estimated the duration of several Huron village sites from data on the size, soil capability, and annual corn requirements of each site. Using a 3 km catchment radius, Sykes (1980:51) determined that villages of 1000 people could have been occupied 20-30 years. Villages of 600 could have lasted in one location for 55 years. Thus, the ecology of Iroquoian agriculture appears to offer a solution to dating the spans of individual village sites.

Recent applications of Heidenreich's (1971) and Sykes's (1980) models, however, have revealed several problems when attempting to use them to reconstruct the duration of individual village sites (Bond 1985:26-28; Crawford 1985:72-75; Horne 1987; Jamieson 1986; Snow 1986; Warrick and Molnar 1986). First of all, it seems likely that Iroquoian villages were relocated for reasons other than soil exhaustion within agricultural catchments. Factors such as depletion of firewood and game, sociopolitical realignment, insect infestation (Starna et al. 1984) and disease may have prompted village relocation before available soils had been used up. Another weakness of current ecological approaches concerns the size of agricultural catchments. Empirical evidence from regional archaeological surveys demonstrates that Iroquoian villages had catchment radii that averaged only 1.5 km

(Bond 1985; Horne 1987; Warrick and Molnar 1986), not the 3 km of earlier studies. Furthermore, the average amount of wasteland that surrounded most Iroquoian villages was about 30% (Crawford 1985:72-75). Dean Snow's (1986, 1987a) work with Mohawk demography and settlement patterns has estimated that villages of 1500 people could have endured for no more than 30 years with an agricultural catchment of 2 km radius and 33% wasteland.

The ecological estimates of village duration are interesting and provocative but cannot be applied to particular archaeological cases. Except for some special cases of data preservation (Bowman 1979; Heidenreich 1974), actual corn field sizes and village catchments elude archaeological detection. Thus, it appears unlikely that the precise life span of an Iroquoian village can ever be reconstructed from ecological data.

Historical, ethnohistorical, and ecological estimates of Iroquoian village duration can set upper and lower limits. However, such estimates are broad generalizations and thus are not very helpful for determining the duration of individual village sites. Archaeological measures provide the only means for determining actual site durations in prehistory. Measures that hold the most promise for estimating the occupation span of Iroquoian village sites include dating techniques, microseriation, village relocation sequences, burial counts, thickness of refuse deposits, microstratigraphy, artifact density, and house post density.

Dating techniques

Dating techniques, such as radiocarbon, are too imprecise for estimating Iroquoian site durations. Even with corn dates, direct counting, and date averaging, standard errors of radiocarbon dates are still about 30-40 years and hence exceed most recorded Huron village occupations. Dendrochronology is not very useful either. The virtual lack of preserved or charred timbers in Iroquoian sites poses a serious obstacle to its application. Varve dating has identified 25 year occupation spans for three Iroquoian village occupations in the vicinity of Crawford Lake (Finlayson and Smith 1987). Crawford Lake is meromictic, thus permitting calendar year estimates of village duration from corn pollen in the varves. However, Crawford Lake is an anomaly; there are no other reported associations of meromictic lakes with Iroquoian sites in the Northeast. In summary, current archaeological dating techniques are inadequate for estimating Iroquoian village duration because of either associated standard errors in excess of expected village durations or lack of suitable dating materials in or near most Iroquoian sites.

Microseriation

Seriation of artifact styles is used extensively in Iroquoian archaeology to construct relative site chronologies. There is a growing consensus among Iroquoian archaeologists that artifact seriation produces the most precise temporal ordering of sites, particularly in areas that were occupied by a single political group (Finlayson and Smith 1987; Pearce 1984; Ramsden 1977a; Smith 1987;

Warrick and Molnar 1986).

Prehistoric sites are seriated according to attributes or types of pottery decoration. Although there is a controversy over which is better (Smith 1987), pottery seriation provides fairly precise site sequences when coupled with radiometric age determinations. In reality, however, the precision associated with a pottery seriation date is on the order of +/- 25 years. This imprecision suggests that the popularity of certain Iroquoian pottery styles was probably determined by several factors, in addition to time. In fact, within most Iroquoian villages, pottery assemblages from midden deposits vary more spatially than they do stratigraphically (Bellhouse and Finlayson 1979; Wright 1974:241). Unfortunately, very little is known about rates of ceramic style change and the reasons for that change among prehistoric Iroquoians.

Historical or contact sites can be seriated and their durations estimated with far more precision than can prehistoric sites. Detailed chronologies have been constructed for contact Iroquoian sites using European glass bead types (Fitzgerald 1983; Kenyon and Kenyon 1983). By comparing frequencies of certain bead types, Iroquoian villages can be dated to a 20 year period. While this is a considerable improvement over prehistoric ceramic seriation, glass bead periods are still too long for dealing with sites that had actual durations of less than 20 years. For example, the Huron village of Ossossane, which moved twice within a single glass bead period (Heidenreich 1971:36), would be counted twice in a population study, unless there was an independent means of estimating the duration of the mother and daughter villages.

Village relocation sequences

Intensive regional surveys have been undertaken in several areas of southern Ontario (Finlayson and Smith 1987; O'Brien 1976b; Pearce 1984; Poulton 1979; Warrick and Molnar 1986; Williamson 1985). As a result, credible village relocation sequences have been constructed from survey data on site age, size, relative location, and soil capabilities. Unfortunately, this method assumes rather than generates village duration estimates for individual sites.

Burial counts

Counting the total number of burials associated with a village provides a potential archaeological measure for the length of occupation of that village (Asch 1976). The calculation is simple arithmetic. All one needs is total burial count, the annual mortality rate (or crude death rate), and the population size of the village. Finding values for each of these variables in Iroquoian prehistory, however, poses serious problems.

One problem with burial counts is that Iroquoians did not bury everyone in the same spot. It is clear that some of the chronically ill and the old were not buried in ossuaries, while infants were not even buried in cemeteries (Fitzgerald 1979; Kapches 1976; Melbye 1983; Spence 1986; Sutton 1988). Also, warriors who died far from home may help to account for the highly skewed sex ratios in some burial populations (e.g. Roebuck village burials [Pendergast 1983]).

The annual mortality rate for Iroquoians is unknown. While it has been estimated at about 4.0% (Pendergast 1983; Spence 1986), constant mortality rates, like this one, are objectionable on historical and paleodemographic grounds (see Chapter 3).

Another problem is that the population size of an Iroquoian village was not necessarily constant for the entire life of the village. Only a maximum or average population can be specified. Detailed examination of village site histories, particularly of late prehistorical ones such as Draper (Finlayson 1985), Coulter (Damkjar 1982), and Keffer (Finlayson et al. 1986), suggests that population waxed and waned in some villages, probably due to fluctuations in food availability, disease, warfare intensity, and sociopolitical arrangements. This problem is further compounded by the imprecision of archaeological population estimates in terms of actual head counts. Archaeology can only expect to provide population totals for a village site that are within 20% of the actual total (Sanders et al. 1979:38).

The problem becomes even more serious with Ontario Iroquoians who interred most of their dead in ossuaries. There is simply no way to tell how many villages contributed to a single ossuary. Historical accounts of the Attignawantan tribe of the Huron indicate that an ossuary could contain bones from a number of villages situated several kilometers apart (Thwaites 1896-1901, 10:279-281).

While burial counts can be used to set realistic parameters, it is obvious that they suffer from severe limitations when used as a measurement of Iroquoian village duration.

Thickness of refuse deposits

Based on the simple assumption that long-lived habitation sites will tend to have deeper deposits than short-lived ones, archaeologists have attempted to convert midden deposit thickness into years of occupation (Ammerman et al. 1976; Roosevelt 1980). Warren DeBoer (1974:342), for example, calculated that middens would have accumulated in prehistoric Shipibo villages in Peru at the rate of 7.5-15 cm per 50 year period. With specific reference to Iroquoian archaeology, Eric Damkjar (1982:123-124) has discovered a correlation at the early protohistoric Coulter site between mean midden thickness and postulated sequence of village expansions--that is, the oldest parts of the village have the thickest middens. Yet, because sociocultural variables can distort the exact relationship between time and the thickness of archaeological deposits (Schiffer 1983), and there is no experimental data on the formation and deformation processes of Iroquoian middens, the thickness of refuse deposits is a relatively insensitive measure of Iroquoian site duration.

Microstratigraphy

Microstratigraphy or layering in a single component site can provide clues to its duration. If the layers had a constant periodicity, similar to tree rings, then site duration can be calculated by simply totalling the number of layers. For example, Robert McGhee (1984:78-79) provides a very convincing argument for an annual periodicity to superimposed house floors in Thule winter houses at the Brooman Point site in Arctic Canada. However, the fundamental problem that plagues this method of inferring site duration is demonstrating, rather than assuming, actual periodicity of the layers. Were they deposited once a month, once a year, or once a decade?

Microstratigraphy occurs in the refuse pits and middens of Iroquoian village sites, but Iroquoian archaeologists have yet to devise methods for inferring the periodicity to the layers in those deposits. Peter Timmins's (1986:14, 1987:16-17) ongoing experimental research in Iroquoian feature formation and filling will hopefully shed new light on this problem.

Density of archaeological remains

Density measures of certain archaeological remains provide the most reliable estimates of site duration because they are essentially time dependent. While both surface and subsurface remains are useful, densities of subsurface remains are preferred because they are less prone to the distortion and sampling biases that are inherent in surface assemblages (Kohler and Blinman 1987; Schlanger and Kohler 1984; Warrick 1986). Density of food remains (Smith 1978), chipped lithic tools (Schiffer 1976; Odell 1980), pots (David 1972; DeBoer 1974), features, and post molds (Johnston and Jackson 1980) constitute the most promising and universal indices of site duration in archaeology.

The underlying principle for converting the density of archaeological remains into length of site occupation involves defining a number of variables and solving an equation. Basically, if the total number of remains of interest and households can be estimated with some precision, then a standard equation can be applied to calculate the number of years or seasons that a site has been occupied. The most parsimonious equation has been formulated by Michael Schiffer (1976:60-63):

$$TD = \frac{k\ c\ t}{L} \qquad (1)$$

where TD is the total number of a particular item discarded at a site, k is the quantity of the item in use in each household, c is the number of households, t is the occupation span of the site, and L is the use-life of the item. The most elusive variable in all this is k (i.e., number of items used by one household). In prehistoric situations, archaeological data must be manipulated in novel ways to produce accurate values for k. Furthermore, unless the number of households is calculated independently, Schiffer's formula becomes an inescapable tautology - one can calculate population from site duration, but one must know population to estimate site duration. The archaeologist rarely knows either.

Food remains

The amount of food remains per person or unit of area in a site can provide a rough estimate of length of occupation. For example, a quantitative analysis of deer bone and other food refuse from the Gypsy Joint site in the southeastern United States led Bruce Smith (1978:192-195) to conclude that the site was occupied for less than three years. Nevertheless, there are fundamental problems with estimating site duration from the density of food remains. For every site, an unknown amount of food will have been processed, eaten, and the refuse discarded off site. Furthermore, under normal circumstances, certain foods (e.g., fleshy fruits and starchy plants) leave little evidence in the archaeological record (Hally 1981).

Chipped lithic tools

In recent years , chipped lithic tool densities have been utilized as potential indices of site duration (Milisauskas 1986:176-178; Odell 1980). The major drawbacks of this measure stem from inadequacies of archaeological method for determining specific functions of chipped lithic tools and use-life (Cotterell and Kamminga 1987). Unlike domestic pottery, there are no longer any human groups in the world who manufacture and use a sophisticated chipped stone tool inventory for everyday tasks. Thus, there are no modern analogs for calculating stone tool use-lives, other than replication and use-wear experiments (Keeley 1980; Odell 1980). To complicate matters further, the vast majority of flaked stone tools, particularly for agricultural groups such as Iroquoians, are often unhafted, expedient, task-specific items that tend to be discarded or abandoned at the task locus, not at the base camp or village (Keeley 1982:802-803). These difficulties seriously hamper the ability of chipped stone tool densities to provide information about archaeological site duration.

Pots

The amount of pottery in a site is a more powerful indicator of length of site occupation than either food remains or lithic tools.

Unlike the latter, pottery is relatively nonportable, yet predictably breakable. Ethnoarchaeological studies of contemporary domestic pottery, in less developed regions of the world, document relatively consistent values for the number of average-sized cooking pots per household and pot use-lives (David 1972; DeBoer 1974; Foster 1960; Hagstrum 1987; Longacre 1985; Pastron 1974).

Ethnoarchaeological research by Nicholas David (1972) and Warren DeBoer (1974) laid the groundwork for estimating a site's occupation span from the amount of broken pottery that it contains. DeBoer (1974) dealt explicitly with prehistoric Shipibo village duration, extrapolating from his ethnoarchaeological findings among contemporary Shipibo villagers. Empirical formulae have been developed by Nicholas David (1972) and Michael Schiffer (1976) to estimate the duration of site occupation from pot frequency. David's (1972) formula assumes that all pots ever used at the site enter the archaeological record:

$$NT = NO + \frac{NO\,[T]}{2\ MEDIAN} \qquad (2)$$

where NT is the total number of pots in a site, NO is the number of pots in circulation at any one time, T is the occupation span of the site (in years), and MEDIAN is the median pot use-life (in years). Schiffer's formula (equation (1)), on the other hand, is more realistic, particularly for swidden agriculturalists such as Iroquoians. It implies that unbroken pots were transported to the next village site at the time of relocation. Rearranging equation (1) to fit the terminology of equation (2), one can solve for T by substituting values for the other variables:

$$T = \frac{2NTMedian}{NO} \qquad (3)$$

Calculation of Iroquoian village duration using a pot frequency formula encounters certain operational difficulties. First, it is impossible to recover archaeologically every pot that was used and broken by the inhabitants of an Iroquoian village. Breakage away from the village, pulverization of broken pots for use as temper, and lateral cycling would remove some broken pots from the village site. Furthermore, postdepositional processes, such as plowing, casual collecting, archaeological sampling, and partial site destruction, have impacted practically every Iroquoian site in Ontario. This has resulted in a further loss of broken pots from virtually every site. Consequently, the total number of pots in a site (NT) is an approximation, the accuracy of which decreases in direct proportion to the size and degree of disturbance of the site. Another problem with the pot frequency formula is that the use-life of an Iroquoian pot (MEDIAN) is unknown. Gabriel Sagard, a Recollet priest who lived among the Huron during the winter of 1623-1624, noted only that Huron pots rapidly deteriorated when water was stored in them (Wrong 1939:109). Similarly, the number of pots owned by each Iroquoian family (NO) was not recorded by Europeans.

Fortunately, there are enough archaeological data to permit at least a rough approximation of pot use-life and number of pots per family for prehistoric Iroquoians. Recent excavations in southwestern

Ontario have yielded a number of special-purpose prehistoric Neutral sites (Pearce 1983a, 1983b, 1984; Pearce and Catsburg 1985; Poulton 1985). Certain features of some of these sites, such as small size (<0.2 hectare surface area), single house associated with a single midden, and indications of primarily warm season use, have led to the interpretation that they were agricultural field cabins (Pearce 1983b). Field cabins sheltered historic Huron women and their children from late spring to early fall, while they planted, tended, and harvested the crops (Thwaites 1896-1901, 8:143, 14:45). Assuming that maize was the predominant cultigen grown by Iroquoians, agricultural fields and related cabins would have had use-lives of 6-8 years on loamy sands and 8-12 years on sandy loams (Heidenreich 1971:186-187). Excavated field cabin sites in southwestern Ontario are all situated on sandy loams or loams. Thus, it seems reasonable to estimate that each cabin site was occupied every summer for 8-12 years, by one to two related women and their children. It should be noted that adult males appear to have occupied these sites as well, but probably in late fall, during the deer hunting season (Pearce 1983a, 1983b) or while guarding their families against enemy raiders.

By selecting a typical Iroquoian cabin site and applying equat. (3), it should be possible, by substituting empirical values for NT and T, to produce a matrix of most likely values for pot use-life and number of pots per family. The Windermere cabin site was selected for this exercise. It consisted of a large, well-preserved cabin floor with one central hearth and associated midden, and yielded a total of 14 pottery vessels (Pearce 1983b). The site was probably occupied by two families each growing season, for several years in succession. Based on knowledge of Huron agriculture and field cabins (Heidenreich 1971:186-187; Pearce 1983b), the most likely values of the Windermere site duration correspond with 4-5 pots per family and a pot use-life of two or three seasons (see Figure 33).

Pot Use-life (Years or Seasons)	Number of Pots per Family: 2	3	4	5
1	(7.0)	4.7	3.5	2.8
2	14.0	(9.3)	(7.0)	(5.6)
3	21.0	14.0	(10.5)	(8.4)
4	-	18.0	14.0	11.2
5	-	-	-	14.0

Figure 33. Matrix of potential values for Windermere site duration (in years). (Values estimated from pot use-life and number of pots per family, using site duration equation (3) in text. Most likely values are circled).

The average number of pots used by a prehistoric Iroquoian family was probably four. According to ethnoarchaeology, the modal number of average-sized, utilitarian cooking and water storage pots per preindustrial household is four or less (see Table 35), even among groups who make different-sized vessels. Iroquoian potters fashioned only one form of vessel for everyday use, in two or three modal sizes (Clermont et al. 1983:70-71; Warrick 1984:114-115). Thus, it would be unreasonable to suggest that the average Iroquoian family owned more than three cooking pots (each of a different size) plus a water pot. In late contact times, Iroquoian families would have had probably only half as many clay pots as their prehistoric ancestors because of the introduction of relatively durable European copper and brass kettles. As early as 1650 among the Onondaga (Bradley 1987:121), domestic pottery had been virtually replaced by European metal containers. In late historic Iroquoian sites, therefore, it is estimated that the average family possessed only two clay pots. It is acknowledged that the relative frequency of metal kettles would vary directly with the distance between an Iroquoian group and its source of European goods.

The use-life of Iroquoian pots can be reduced to a single approximation. Using data from other field cabin sites (Table 36) and substituting values in equation (3) for total number of pots (i.e., 4) and site duration (8 seasons or years), one can solve for median use-life of Iroquoian pottery. As shown in Table 36, a median use-life of 3 seasons produces the most credible site durations, ranging from 6-10 seasons. Considering that pots in a cabin site would have been used for only 6 months of the year at maximum, it appears that the average pot broke after only 1.5 years of continual use.

Table 35. Ethnoarchaeological Data on the Use-life of Domestic Pottery. (a)

Cultural Group	Modal Number of Cooking and Water Pots per Family	Use-life (years) Cooking Pot (b)	Water Pot	Source
Tarascan (Mexico)	N/A	1	N/A	Foster 1960
Fulani (Africa)	N/A	2.6	10-13	David 1972
Shipibo-Conibo (Peru)	3-4	1-1.5	2.25	DeBoer & Lathrap 1979
Tarahumara (Mexico)	4	2-3	3-5	Pastron 1974
Kalinga (Philippines)	4	4.5	7-8	Longacre 1985
Wanka (Peru)	7	2	6	Hagstrum 1967

(a) values for small to medium-sized (average-sized) pots
(b) Kalinga values for "average rice cooking pots" only. According to historic documents (Biggar 1922-1936, 3:126-127; Wrong 1939:107), the Hurons did not use separate cooking pots for corn and meat.

While 1.5 years is well within the range of cooking pot use-lives in other societies, the data from cabin sites probably underestimate Iroquoian pot use-life because of the higher rate of ceramic breakage in cabins as opposed to villages. Cabin sites were located further from water sources than villages (Pearce 1983a, 1983b). Consequently, more distance would be travelled to fetch water in a pot at a cabin site than at a village site. One of the most common causes of pot breakage in preindustrial contexts is water fetching (Deal 1985; DeBoer and Lathrap 1979:129; Longacre 1985). In addition, cabin sites would have contained a number of poorly supervised children. Child's play is a recognized force in the formation of the archaeological

Table 36. Iroquoian Site Duration Estimates from Pot Densities. (a)

Site	Pots Recov.	% Site Excav.	NT (b)	Total Fam.	NO (c)	Site Duration (years)	Source
CABINS							
Windermere	14	100	14	2	8	10	Pearce 1983b
Smallman	26	100	26	4	16	10	Pearce 1983b
Ronto	8	100	8	2	8	6	Pearce 1983b
Black Kat	11	100	11	2	8	8	Pearce 1984
Pincombe 6	4	100	4	1	4	6	Pearce and Catsburg 1985
Pincombe 2-H2	12	100	12	2	8	9	Pearce and Catsburg 1985
VILLAGES							
Fonger	169	25	676	72	216	19	Warrick 1983
Christianson	726	12	908	[illegible]	[illegible]	17	Fitzgerald 1982
Bogle I	23	35	70	40	80	5	Lennox 1984b
Hood	119	25	476	[illegible]	[illegible]	5	Lennox 1984a

(a) In all cases the average pot use-life equals three years. The number of pots per family varies: four for prehistoric sites, three for protohistoric, and two for historic (see text for detailed explanations of these values).

(b) Total pots in site estimated by multiplying the number of recovered pots by the proportion of site excavated, except for the Christianson site. About 90% of the pots recovered from the Fonger site were from middens. At Christianson, about 80% of the middens were excavated (although only about 12% of the site area was excavated). Therefore, it is estimated that only 25% of the total pots in Christianson remain undiscovered.

(c) The number of families was estimated for cabins and longhouses using a constant of two families per hearth, except in the very small cabin at the Pincombe 6 site. Village populations were estimated by applying a constant of 50 hearths per hectare of village space.

record (Hayden and Cannon 1983:132-133). Lastly, cabin sites appear to have been used primarily for outdoor activities (Pearce 1983b). However, occasional inclement weather would have required that pots be moved back and forth between the cabin and outdoor activity area. Villages, on the other hand, were primarily cold weather settlements;

pots in village longhouses would have tended to stay put. High portability and frequent movement increase the probability of pot breakage (DeBoer 1985). Consequently, one would expect a higher breakage rate of pots at Iroquoian cabin sites than in villages. In light of this discussion and ethnoarchaeological data, it is felt that three years is the best estimate for the use-life of an Iroquoian pot. Employing the best fit values for total pot number, number of pots per family, and median pot use-life, the duration of several Ontario Iroquoian villages sites was calculated, according to equation (3). The results are presented in Table 36 and Figure 34.

Pot frequencies can provide rough approximations of the duration of Iroquoian village sites, but lack of precision concerning such important variables as median pot use-life and number of pots per family pose serious obstacles to estimating "actual" site durations. The pot frequency index is an inextricable product of both time and culture. What is needed is an index of site duration that is virtually independent of culture.

House wall post density

Post molds are almost as common as potsherds in Iroquoian village sites and longhouse structures contain most of them. Walter Kenyon (1968:20) was the first archaeologist to suggest that the density of wall posts in an Iroquoian longhouse could be used as an index of the duration of its occupancy. Subsequent archaeological research has considered the relationship between the number of posts in house walls

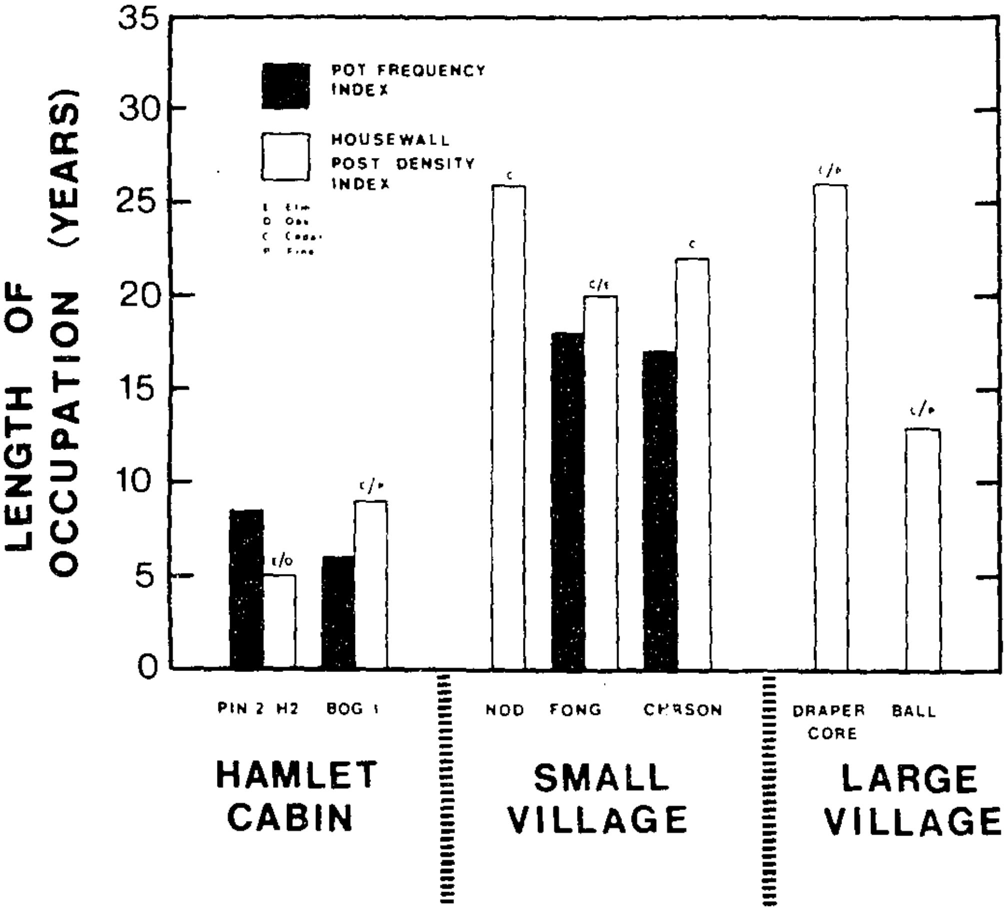

Figure 34. Comparison of pot frequency and house wall post density indices of Iroquoian village duration. See Tables 36 and 43 for data.

and house longevity. As Johnston and Jackson (1980:197) stated, "the evidence . . . is that the average number of posts per linear foot of wall is primarily a measure of the amount of rebuilding and therefore an indirect indication of the relative age and length of occupation of houses". Christine Dodd (1984:250, 284-285) refined this relationship and concluded that high wall post and interior post and feature densities in a longhouse indicate long-term occupation or high intensity of use. Yet it was not until the publication of **The 1975 and 1978 Rescue Excavations at the Draper Site: Introduction and Settlement Patterns** (Finlayson 1985) that longhouse wall post densities were truly demonstrated to be time-dependent.

Finlayson's (1985:406-408) hypothetical reconstruction of the sequence of village growth for the Draper site, based on ceramic seriation and palisade realignments, posits a core village that was added onto by five separate expansions, supposedly resulting from the immigration of small villages over time. The ranked order of the average and maximum house wall post densities for each village segment displays a perfect fit with the model of village growth (see Table 37). Likewise, several Draper houses (Houses 4, 6, 10, 11, and 15), which experienced two or more contractions or expansions over their life spans, display a perfect linear relationship between post densities and the reconstructed sequence of wall construction (see Finlayson 1985 for data). In other words, the number of posts per meter of wall length increases with time in a perfectly linear fashion. While these results are intriguing, Finlayson (1985) made no attempt to translate wall post density into actual time.

Wall post density and time

The density of wall posts in an Iroquoian longhouse is perhaps the best archaeological index of its life span and, by extension, the life span of an Iroquoian site. In short, the density of wall posts in an Iroquoian longhouse is the sum of the original number of posts and the number of repair posts that were added throughout its history. Assuming that the time between post failure and repair was negligible, it follows that wall post densities are virtually time-dependent.

Table 37. Longhouse Wall Post Densities for Village Segments of the Draper Site. (a)

Village Segment (earliest to latest)	Maximum Wall Post Density (posts/m)	Mean Wall Post Density (posts/m)
Core	7.5	6.2
1st Expansion	4.9	4.5
2nd Expansion	4.8	4.0
3rd Expansion	4.3	3.9
4th Expansion	4.1	3.5
5th Expansion	3.3	3.0

(a) from Finlayson 1985

Alternative measures of longhouse duration, such as the density of isolated posts, "sweatbath" posts, and features inside longhouses, have been proposed (Dodd 1984:296; Finlayson 1985:417-418). However, they are very difficult to operationalize because they are functions of both time (i.e., house duration) and culture (i.e., the amount and intensity of feasting and ritual activity engaged in by the longhouse occupants). It is noteworthy that, in at least two Huron village sites (Draper and Ball), it tends to be the largest coeval houses that display the densest concentrations of sweatbath posts and features (Dodd 1984:283, 370; Finlayson 1985:409-410). The largest houses in Iroquoian villages were probably occupied by chiefly lineages that would have hosted considerably more feasts and ritual events, including sweatings, than the houses of the ordinary folk (Hayden 1979:23-25).

Statistics demonstrate that alternatives to the wall post density index of longhouse duration have weaker relationships with time. Using a sample of 32 longhouses from the Draper site (data from Finlayson 1985), and assuming that wall post density is entirely time-dependent, correlation coefficients show a low relationship (r = +0.41) between wall post and sweatbath post densities and only a moderate relationship (r = +0.72) between wall post and feature densities. Much lower correlations were found by Christine Dodd (1984:347) for a larger sample of Ontario Iroquoian longhouses. This suggests that other factors in addition to time account for the number of sweatb[illegible] and features in a longhouse. Consequently, they will not be as useful as wall post density for estimating the duration or use-life of an Iroquoian village.

In order to convert house wall post density into an ordinal time scale, the archaeologist must supply several crucial pieces of information:

1. post wood type
2. wood decay rates and post use-life
3. the pattern and speed of post replacement after decay
4. the original number of posts per linear unit of house wall

Post wood type

The Iroquoians of Southern Ontario occupied two different forest zones: the Huron and Petun lived in a mixed deciduous forest (maple-beech with pine and cedar) and the Neutral inhabited a southern deciduous forest (oak-hickory). Obviously, architectural preferences for certain wood types had to be tailored to availability. Historical accounts and archaeological data provide a list of woods that the Huron and Neutral used for constructing the pole framework of longhouses and their palisades. According to Jesuit accounts (Thwaites 1896-1901, 8:105, 13:45, 14:43), the Huron preferred cedar wood for house construction, especially cedar bark for covering the house. Pine was used for palisade posts that surrounded the Huron village of St. Ignace II (Thwaites 1896-1901, 34:123-125). According to charred wood identifications from Huron archaeological sites, cedar posts predominate in longhouses at LeCaron (Johnston and Jackson 1980:193) and in the palisade at Warminster (Heidenreich 1971:154). In south-central Ontario, abandoned Iroquoian villages and corn fields would have regenerated into pine forests (Bowman 1979), and cedar swamps were abundant throughout the region. At the height of Huron occupation, pine and cedar would have been the predominant tree species available in south-central Ontario, in just the right modal size (i.e., trunk diameters of 7-9 cm at chest height) for house and palisade poles. In southwestern Ontario, on the other hand, the Neutral appear to have preferred cedar for house wall and palisade posts (Lennox 1984a:130-131), but other archaeological data suggest that red oak, elm, and pine also were used (Robert Pearce, personal communication 1987; Warrick 1982). Cedar or elm bark probably clad most Neutral houses (Thwaites 1896-1901, 8:105).

In summary, cedar and pine appear to have been the preferred woods of Ontario Iroquoian builders. As will be demonstrated shortly, this preference has a sound scientific basis.

Wood decay rates and post use-life

In the temperate forests of eastern North America, wood decay is caused primarily by fungi. Fungi consume wood fibre when supplied with sufficient oxygen and a suitable temperature and moisture regime. Fungi do the most damage to wood that is lying on the surface of the ground. Thus, wood posts placed in the ground decay first at the ground line (Krzyzewski et al. 1980:2).

Fortunately for archaeology, wood decay specialists and fence post manufacturers are interested in the decay rates of various untreated woods. For the past 40 years, untreated fence posts have been planted in closely monitored plots. Data from test plots at Chalk River, Ontario (Krzyzewski and Spicer 1974; Krzyzewski et al. 1980), Madison, Wisconsin (Blew and Kulp 1964), and southern England (Purslow 1976) were used to construct decay or half-life curves for untreated posts of North American eastern cedar, white pine, red oak, elm, and hickory. Relevant data are summarized in Tables 38 and 39 and Figure 35.

Table 38. Use-Life Data for Untreated Fence Posts of Various Northeastern Wood Types.

Wood type	Average Use-life (years)			
	S. England (a)		Chalk River, Ont. (b)	Madison,WI (c)
	Loam	Sand	Loamy sand	N/A
Eastern White Cedar			26.9	
White Pine	11	9	5.7	6.0
Red Oak	5-10		4.4	7.2
Elm			8.3	
Hickory				3.8
Hard Maple	4	3	4.5	
Beech			4.6	
White Birch	3	5	3.3	
Ash			6.5	4.0
Ironwood			4.9	
Tamarack			6.2	
Eastern Hemlock			4.4	

(a) Purslow 1976
(b) Krzyzewski et al. 198[illegible]
(c) Blew and Kulp 1964

Table 39. Average Use-life of Select Untreated Wood Fence Posts.

Wood Type	Average Use-life (years)
Eastern White Cedar	26.9
White Pine	7.9
Elm	8.3
Red Oak	5.8
Hickory	3.8
Maple	4.0

The untreated fence post data are nearly perfect for simulating decay rates of Iroquoian house posts. Each study used essentially the same techniques for measuring the use-life of untreated posts.

1) Untreated fence posts ranging 5-18 cm in diameter were debarked and planted 30-40 cm in the ground, in cleared forest plots. (In comparison, the average wall post in an Ontario Iroquoian longhouse was 7-9 cm in diameter and was inserted 40-55 cm below original ground surface (Dodd 1984:272)).

2) Sample size of untreated posts varied from study to study, but ranged from 10-50 specimens per wood type.

3) The average use-life was calculated directly for completed tests. For incomplete tests, it was estimated by the point on the decay curve at which 60% of the posts in a particular sample had failed (Blew and Kulp 1964:3; Purslow 1976:3-4). Post failure occurred when a post broke after being pushed with a 23 kg (50 lb) thrust, 1.2 m above ground line.

4) The onset of decay varies with wood use-life. According to test data in Purslow (1976), for woods with use-lives from 3-8 years, the first decay occurred in less than a year. For woods with use-lives of 8-12 years, the first decay happened at about 3 years. And for woods with use-lives greater than 20 years, the first decay was between the 10-15 year mark.

5) Soil conditions (i.e., sand vs. loam) did not appreciably affect post use-life. For example, Purslow (1976:6) reports that white pine has an average use-life in sand of 9 years and in loam of 11 years. For archaeological purposes, this difference is negligible.

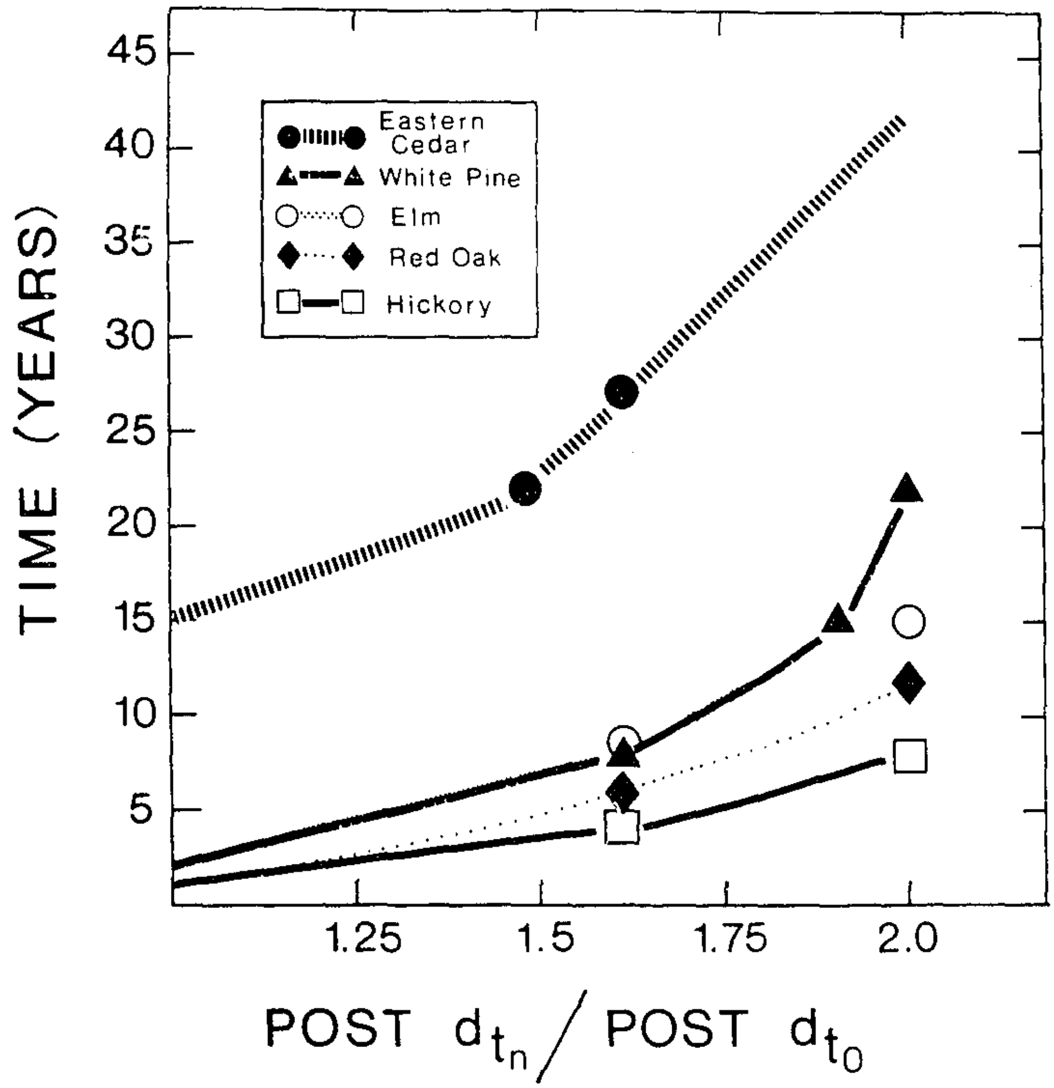

Figure 35. Use-life curves for untreated posts of various Northeast woods. To convert Iroquoian wall post densities into house duration in years, the ratio of archaeological wall post density (POST dtn) to original wall post density (POST dto) (see Table 42) is plotted on the abcissa and the corresponding time read off the ordinate (sources: Blew and Kulp 1964; Krzyzewski et al. 1980; Purslow 1976).

Unfortunately, raw data are not reported in any of the studies. Thus, the wood decay curves in Figure 35 were estimated from longitudinal data accompanying some of the test results. Onset of decay was approximated from data in Purslow (1976) and termination of decay was read directly from completed tests. Decay curves were constructed only for wood types that archaeological evidence shows were used in Iroquoian house construction (i.e., cedar, pine, oak, elm, and hickory).

One final consideration, prior to employing wood use-life curves to estimate Iroquoian longhouse duration, is to ensure that Iroquoian house posts were untreated. There is no evidence that Iroquoians attempted to prolong the life of their house posts by treating them with preservatives. However, it is widely believed that Iroquoians charred the butts of house posts, perhaps to increase post life. The ubiquity of charcoal flecks in house post molds in Iroquoian sites argues for some carbonization treatment of posts. In theory, charring wood creates a natural creosote by depositing tars and oils in the carbonized layer. In practice, however, there appears to be no significant difference between charred and uncharred fence posts in experimental tests. It seems that the surface fissuring associated with carbonization of wood allows fungi to enter the heartwood of the post. Also, carbonization does a very poor job of creosote deposition (Paul Cooper, personal communication 1987).

Post replacement

The density of wall posts in most Iroquoian longhouses is the cumulative total of original posts plus replacement posts. This hypothesis is based on three underlying assumptions. First, it is assumed (and will be demonstrated in the next section) that there was an architectural template in the minds of Iroquoian builders that standardized the original number of posts per linear unit of longhouse wall. Folk architecture is characterized by conservatism, particularly in its rules and measures governing the placement of structural elements (Deetz 1977:109). Another assumption is that decayed posts were replaced almost immediately. In addition to providing the structural framework of a longhouse, wall posts served as attachment sites for the bark sheets that formed the outer covering of the house. The sheets were interwoven between post uprights and were presumably held in place by tension and cordage (Biggar 1929:123; JR 8:105; Wrong 1939:93). In order to prevent a loss of thermal efficiency in a longhouse, holes in the bark covering, caused primarily by post breakage and a resultant loss of tension and slippage of bark sheets, would have required patching by post replacement. A final assumption is that the butts of rotted posts were not removed. Thus, replacement posts would appear as obvious additions to the original complement of wall posts in a longhouse. The archaeological record displays a clear difference in the patterning of wall posts between longhouses that have a high post density and those with a low post density. High post density longhouse walls exhibit a thick, irregular line of posts and low post density houses exhibit walls composed of a thin line of staggered posts. There is no evidence whatsoever for the excavation of a decayed post butt and the insertion of a new post in the same hole. Although wall trenches, occasionally found in Iroquoian sites, could be interpreted as the repair of entire sections of a house wall by excavation of decayed post butts, their shallow depth, seldom exceeding 35 cm below ground surface, argues that they functioned as insulation features (Kapches 1980).

If decayed wall posts in Iroquoian longhouses were replaced almost immediately and in a cumulative fashion, the length of occupation of a longhouse could be calculated by simply tallying the number of replaced posts and fitting the tally to the relevant use-life curve.

Original wall post density

Establishing the original number of posts that composed a given longhouse wall is essential to calculating how many replacement posts have been added to that wall. Once the original wall post density has been established, the duration of any longhouse can be estimated by counting replacement posts and fitting the appropriate wood decay curve.

There are two methods for establishing the original wall post density of Iroquoian longhouses. The first method assumes a highly consistent pattern of wall post spacing. At least for late prehistoric and contact period (i.e., A.D. 1400-1650) longhouses in Ontario, wall posts appear to have been placed in a highly regular, staggered or zigzag pattern (see Figure 36). As mentioned earlier, a staggered post pattern presumably facilitated attachment of the cross-brace poles and bark covering. This peculiar post pattern is best displayed in Neutral cabin sites that were probably occupied less than 10 years (see Pearce 1983b). It is also easily recognized in village houses. Simple visual inspection of archaeological house plans permits rapid detection of replacement posts that interrupt the extremely regular staggered post pattern.

The other method is less reliable, but is the only way to deal with prehistoric Iroquoian longhouse walls that do not possess an obvious staggered post pattern. Generally, longhouses earlier than A.D. 1400 display a simple linear arrangement of wall posts. In such cases, the house with the lowest post density, or houses that on the basis of independent evidence (e.g., Draper site village expansions) were the last ones constructed in a village, should be used to estimate the original density of wall posts.

Methods of estimating original wall post densities in Iroquoian longhouses were applied to a sample of 96 longhouses from 31 Ontario sites, ranging in age from A.D. 900 to A.D. 1650. An effort was made to collect data equally from sites in southwestern Ontario (i.e., Neutral) and south-central Ontario (i.e., Huron) (see Figure 37). Houses were grouped into six classes for calculation of descriptive statistics. The results are presented in Tables 40, 41, and 42.

The average wall post densities in Table 42 have a dual significance for understanding architectural standards in the minds of Iroquoian builders. First, variability in the construction density of house posts does not appear to have been influenced by type of wood used. Except for the values for protohistoric Neutral houses, which

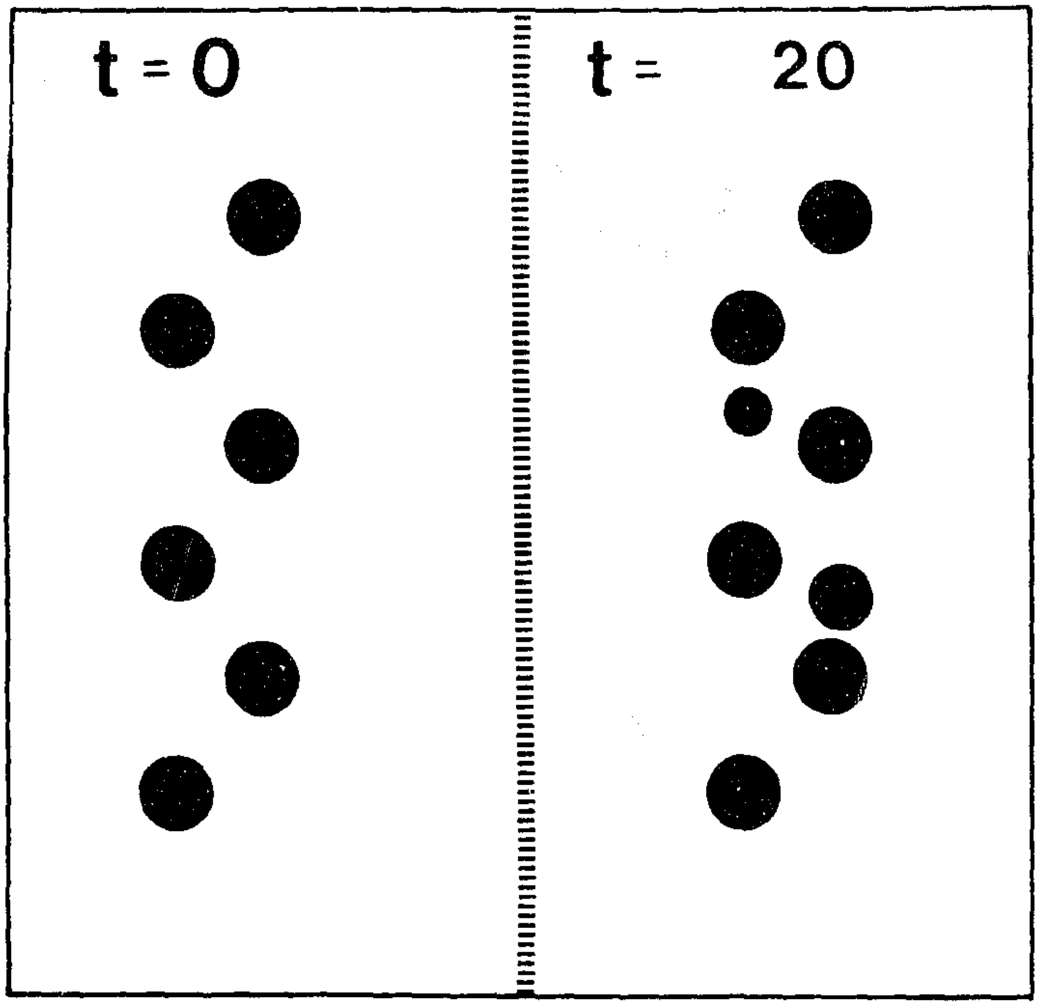

Figure 36. Temporal change in the wall post patterns of an Iroquoian house. The original wall post density pattern (t=0) is given on the left and the post density pattern after 20 years (t=20) is on the right, assuming cedar post construction.

probably are anomalous because of low sample size, there was no significant difference between original wall post densities of Huron and Neutral longhouses, despite the use of different woods. The prehistoric Neutral house sample is derived from sites in southwestern

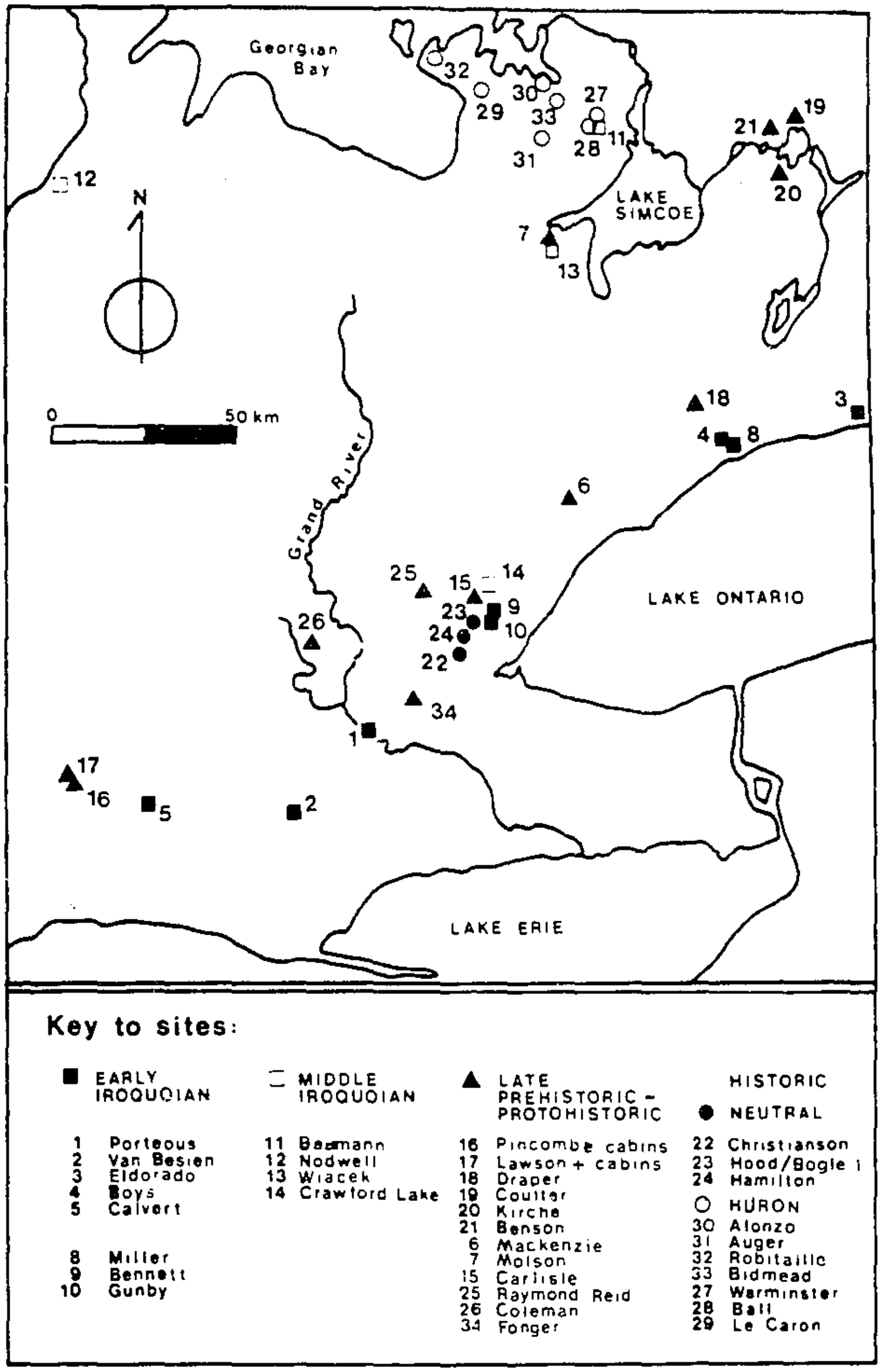

Figure 37. Location of Ontario Iroquoian sites cited in the text.

Table 40. Original Wall Post Densities for Neutral Longhouses.

Site	Date (years A.D)	House No. (a)	d (b)	Source
PREHISTORIC				
Porteous	850	1	3.3	Stothers 1977
Van Besien	1050	3	3.3	Noble 1975
Calvert	1100	7	3.2	Timmins 1987
	1160	6	4.0	Timmins 1987
	1240	4	3.4	Timmins 1987
		8	3.3	Timmins 1987
Bennett	1315	2	4.2	Wright and Anderson 1969
Gunby	1330	1	3.4	Rozel 1979
Pincombe 2	1500	1	4.1	Pearce and Catsburg 1985
		2	3.9	Pearce and Catsburg 1985
Windermere	1500	1	3.7	Pearce 1983b
Coleman	1500	1	3.6	R. MacDonald 1986
Raymond Reid	1530	1	4.0	Fitzgerald 1984
PROTOHISTORIC				
Fonger	1590	6	2.4	Warrick 1982
		9	2.6	Warrick 1982
		11	1.8	Warrick 1982
		12	2.6	Warrick 1982
Carlisle	1590	1	2.2	Kenyon 1986
		2	2.9	Kenyon 1986
HISTORIC				
Christianson	1615	4W	2.6	Fitzgerald 1982
		4E	2.9	Fitzgerald 1982
Hood	1640	2	3.6	Lennox 1984a
		3	3.4	Lennox 1984a
		6	3.7	Lennox 1984a
		7	2.9	Lennox 1984a
		10	3.6	Lennox 1984a
		11	3.9	Lennox 1984a
		13	3.7	Lennox 1984a
Hamilton	1640	2	3.4	Lennox 1981
		4	3.5	Lennox 1981
Bogle I	1640	3	3.5	Lennox 1984b
		5	3.2	Lennox 1984b

(a) House No. = the house number assigned by the researcher
(b) d = wall post density (posts/m)

Table 41. Original Wall Post Densities for Huron Longhouses.

Site	Date (years A.D)	House No. (a)	d (b)	Source
PREHISTORIC				
Eldorado	900	1	4.1	Kapches 1983a
Boys	1075	1	3.4	Reid 1975
Miller	1125	1	3.8	Kenyon 1968
		2	3.9	Kenyon 1968
		5	3.4	Kenyon 1968
Nodwell		2	4.2	Wright 1974
		3	3.6	Wright 1974
Baumann	1420	1	4.0	Stopp 1985
Draper	1480	8	4.0	Finlayson 1985
		15	3.3	Finlayson 1985
		19	3.3	Finlayson 1985
		23	3.0	Finlayson 1985
		25	3.6	Finlayson 1985
		28	2.9	Finlayson 1985
		35	3.3	Finlayson 1985
		41	3.4	Finlayson 1985
		43	3.2	Finlayson 1985
		45	2.9	Finlayson 1985
PROTOHISTORIC				
Mackenzie	1550	5	3.6	Kapches 1982a
Kirche	1550	2	3.2	Nasmith 1981
		18	3.5	Nasmith 1981
		22	3.7	Nasmith 1981
		25	3.3	Nasmith 1981
		27	3.7	Nasmith 1981
		28	3.2	Nasmith 1981
Benson	1565	15	3.5	Ramsden 1977c
Molson	1590	4	3.2	Molnar 1986
		6	3.4	Molnar 1986
		9	3.1	Molnar 1986
		10	3.1	Molnar 1986
Ball	1590	1	3.2	Knight and Cameron 1983
		2	2.9	Knight and Cameron 1983
		6	3.2	Knight and Cameron 1983
		7	3.5	Knight and Cameron 1983
		11	4.0	Knight and Cameron 1983
		13	3.5	Knight and Cameron 1983
		14	3.2	Knight and Cameron 1983
		18	3.2	Knight and Cameron 1983
		20	3.2	Knight and Cameron 1983
		22	3.8	Knight and Cameron 1983
		23	3.4	Knight and Cameron 1983
		25	3.2	Knight and Cameron 1983
		29	3.4	Knight and Cameron 1983

Table 41. Continued.

Site	Date (years A.D)	House No. (a)	d (b)	Source
Ball	1590	40	3.1	Knight and Cameron 1983
		43	3.0	Knight and Cameron 1983
HISTORIC				
Warminster	1615	6	3.4	Tyyska, pers. comm. 1987
		8	4.0	Tyyska, pers. comm. 1987
		9A	2.9	Tyyska, pers. comm. 1987
		9B	3.0	Tyyska, pers. comm. 1987
		10	3.7	Tyyska, pers. comm. 1987
		14	3.8	Tyyska, pers. comm. 1987
		19	3.4	Tyyska, pers. comm. 1987
Bidmead	1615	5	3.2	O'Brien, pers. comm. 1986
		6	3.9	O'Brien, pers. comm. 1986
		7	3.1	O'Brien, pers. comm. 1986
Alonzo	1615	1	3.1	O'Brien, pers. comm. 1987
		2	2.8	O'Brien, pers. comm. 1987
Robitaille	1630	1	3.5	Tyyska 1969
LeCaron	1630	2	2.8	Johnston and Jackson 1980

(a) House No. = the house number assigned by the researcher
(b) d = wall post density (posts/m)

Table 42. Average Original Wall Post Densities for Ontario Iroquoian Longhouses.

Ontario Iroquoian Group	Average Density	n (a)
NEUTRAL		
Prehistoric	3.6 +/- 0.3	16
Protohistoric	2.4 +/- 0.4	6
Historic	3.4 +/- 0.4	13
HURON		
Prehistoric	3.5 +/- 0.4	18
Protohistoric	3.3 +/- 0.3	27
Historic	3.3 +/- 0.4	16

(a) sample size of longhouse segments (each wall segment measured greater than or equal to 3 m)

Ontario, mostly in the London area, where cedar and pine were not available in large quantities prehistorically (Robert Pearce, personal communication 1987). In fact, oak and elm posts were used in the construction of at least three prehistoric Neutral houses in the London area (Robert Pearce, personal communication 1987). In contrast, the sample of Huron and contact Neutral houses were located in regions where cedar and pine were widely available (Bowman 1979; Heidenreich 1971). Identification of archaeological wood from posts in these sites indicates almost exclusive use of cedar and pine for house and palisade construction (Heidenreich 1971:154; Lennox 1984a:130-131). Thus, type of wood does not seem to have affected the frame design of an Ontario Iroquoian longhouse.

The other significant finding is the very low standard deviations associated with the mean post densities for each time period. Given the different methods of estimation and relatively low sample sizes, the observed standardization in the construction density of Iroquoian house wall posts is probably quite real. Standardized structural measures characterize vernacular or folk architecture (Deetz 1977:109).

Estimating the duration of an Iroquoian village site from densities of longhouse wall posts is straightforward. Assuming that the construction and abandonment dates for the oldest houses in an Iroquoian village effectively bracket the life span of that village, then the maximum duration of a village site can be estimated by averaging the life spans of those houses in the site that have the highest post densities. This average is then divided by the appropriate basal or original post density. The resulting quotient, greater than or equal to 1.0, is actually a ratio measure of the number of wall posts that decayed and were replaced in a longhouse. For example, a prehistoric Huron house with a density of 5.2 posts per metre of linear wall would have a mean ratio of 1.5 (i.e., replacement of 50% of its wall posts). Referring to Figure 35, one simply reads off the elapsed time (ordinate) on the appropriate wood decay curve that corresponds to the calculated ratio (abcissa). Thus, if constructed entirely of cedar, our hypothetical Huron house would have been occupied for approximately 25 years.

Certain factors complicate the estimation of village site duration from house post densities. Different sections of a house may have decayed at different rates. Because the end walls of Ontario Iroquoian houses were removed during house expansion or possibly dismantled each summer to improve ventilation (Latta 1985:48-49), they would tend to look younger, in terms of post density, than the rest of the house. This phenomenon is clearly demonstrated by post densities of historic Huron and Neutral houses (Dodd 1984:271-272). Consequently, end walls, defined as those sections of an Iroquoian house that are normally demarcated by a pronounced taper or curve in the side walls (Dodd 1984:239-241), were excluded from analyses. Furthermore, great care was taken to avoid counting posts that were not part of a house's side walls. Posts that were part of an overlapping house or palisade line as well as posts that were off the wall alignment by more than 50 cm were not counted.

Another factor complicating the use of post densities to estimate site duration is that one cannot be certain that the pole framework of a longhouse was fashioned entirely from one type of wood. While cedar was preferred, most sites probably contained houses that were built of mixtures of cedar, pine, oak, and elm. Nevertheless, given the remarkable longevity of cedar, as opposed to other woods, and that approximately 20,000 poles would have been required to build an average sized Iroquoian village (Finlayson 1985:398, 408; Heidenreich 1971:152), prehistoric Iroquoians probably expended considerable effort to construct their villages of cedar, in order to minimize the need to repair rotting house posts. This would have been especially true for prehistoric Iroquoians who met their woodworking requirements with relatively inefficient stone axes and chisels.

Variability in the original wall post densities of Iroquoian longhouses is another factor affecting the calculation of site duration from house longevity. Referring to Table 42, the 68% confidence intervals about the mean for original house post densities for each period have a range of about 0.6 posts per metre. Thus, it would be statistically unsound to offer precise estimates of longhouse and site duration, without considering the standard error values. Consequently, Table 43 provides upper, lower, and average values for the duration of each site. Three values for site duration appear in Table 43: a range based on cedar, another range based on either pine, elm or oak, and an average based on a 50:50 mix of cedar and pine.

Finally, in order to ensure that estimates of site duration from house post density are as accurate as possible, archaeologists must be careful to identify and use only those houses or house portions that have excellent post preservation and that were occupied for the entire life span of the village site. Poor archaeological preservation of house posts in Iroquoian sites is usually caused by eradication of posts by deep plowing (Dodd 1984:249) or by excavating house patterns that occur in dry sand or clay soils, making posts virtually invisible (Lennox et al. 1986:4-5). Because the actual age of poorly preserved longhouses would be underestimated by the post density index, one must identify and eliminate them. When not explicitly stated in an archaeological report, poor post preservation is suspect in an Iroquoian house plan that displays huge gaps in its side walls. Lack of end walls in an Iroquoian house may be real, suggesting temporary, and primarily warm season, occupation (Williamson 1983:57).

In contrast to houses with poor post preservation, post densities from houses that were substantially remodeled or totally rebuilt will overestimate actual house age. Historical and archaeological (Warrick 1983) evidence indicates that house posts were commonly destroyed by fire or removed during intentional remodelling of a house. Obviously, such events would have removed considerable numbers of undecayed posts. Thus, if one did not know that such an event had befallen a particular house, its life span, as estimated from wall post densities, would be biased upward. Fortunately, burned and rebuilt longhouses leave clear archaeological evidence (Warrick 1984:94-95). Completely burned houses were often rebuilt along somewhat different orientations from the originals; partially burned houses contained

Table 43. Iroquoian Site Duration Estimates from House Post Densities.

Site	Date (A.D.)	House n (a)	Post d (b)	Site Duration (Years) Cedar	Pine	Cedar + Pine (c)
NEUTRAL						
Porteous	850	3	4.9	18-23	5-7(Elm) (d) 3-5(Oak)	N/A
Calvert	1100	3	5.8	19-31	5-11	16
Windermere	1500	1	3.7	N/A	2-4(Elm) 1-2(Oak)	N/A
Pincombe 2	1500	1	5.0	N/A	4-7(Elm) 3-5(Oak)	N/A
Fonger	1590	4	4.2	22-45	7-17(Elm) 5-15(Oak)	N/A
Christianson	1615	2	3.2	11-17	2-5	10
Bogle I	1640	2	3.6	15-18	2-5	10
Hood	1640	6	4.0	15-20	2-6	11
HURON						
Miller	1125	4	4.0	15-19	2-5	10
Nodwell	1380	2	6.1	20-31	5-11	17
Wiacek	1400	1	6.9	30-45	10-25	28
Draper-core	1450	5	6.7	27-42	8-25	26
Coulter	1550	7	7.1	40-50	22-34	36
Kirche	1550	3	6.9	38-50	16-32	34
Benson	1570	4	5.8	27-38	8-16	22
Ball	1590	6	4.2	19-21	5-6	13
Warminster	1615	6	4.9	19-31	5-10	17
Bidmead	1615	8	4.1	19-21	5-6	13
Auger	1630	2	3.9	15-21	2-6	10
LeCaron	1630	3	5.3	21-32	6-12	18

(a) Number of oldest or "core" houses in sample, excluding burned or completely rebuilt (double-walled) houses.

(b) Post density measured by counting total number of posts along both side walls (excluding entrances and gaps due to poor post preservation) and then dividing by the linear distance in metres.

(c) Cedar + pine site duration estimate calculated by taking the median values for both cedar and pine and averaging them (assuming a 50:50 wood use ratio).

(d) Neutral sites (except northern ones) are situated in oak-hickory forest, thus cedar and pine use-life curves are probably inappropriate, unless the site is within a couple of kilometres of a cedar or tamarack swamp (e.g., Calvert village and Dorchester Swamp association).

short sections of wall composed of double rows of paired posts, with one post in each pair often filled with ash and charcoal (Warrick 1983). Rebuilding associated with longhouse renovation is more difficult to detect, but frequently resulted in double-walled house plans. Expansion and contraction of a longhouse usually affected only its ends. In this case, the true age of the house would be given by the density of posts only in that segment that had been occupied continuously.

Excluding longhouse plans that were poorly preserved, burned, entirely rebuilt, or obviously not occupied for the entire duration of the village, a sample of 73 houses from 20 Ontario Iroquoian sites were selected and their wall post densities calculated. The post density value for a house was calculated by counting the total number of side wall posts and then dividing by the total length of wall in metres. For sites with more than one house, post densities were averaged. The duration of each site was estimated by using Figure 35 to convert the average post density into years of occupation. Table 43 presents the results.

Density measures are perhaps the best indices of the duration of archaeological sites. In Iroquoian archaeology, the most useful site duration indices appear to be the density of pots and posts. Figure 34 illustrates the duration of various Ontario Iroquoian sites as estimated by pottery and house post densities. While there is a close correspondence between the two, the post density index is probably the more accurate. This is because the density of house posts in an

Iroquoian site is virtually a function of time. The density of pots, on the other hand, is a function of both time and culture. The amount of pottery that ultimately ended up in the refuse heaps of an Iroquoian village depended not only on time, but on the continually changing size and social status of its constituent households. Ethnoarchaeology shows a clear association between the amount of pottery used and broken in a household and the size, wealth, and sociopolitical importance of that household (DeBoer and Lathrap 1979). Thus, it is clear that house post density is the best archaeological index of the duration of Iroquoian village sites.

There is good reason to believe that the values for Iroquoian village duration reported in Table 43 are authentic. Independent estimates of village duration, from historical observations, varve dating, and experimental reconstructions, suggest that the average precontact Iroquoian village was relocated every 25 years, and that structural decay coupled with local environmental degradation, including depletion of soils, firewood, and building supplies, regulated the frequency of village relocation. Historical accounts of early seventeenth-century Huron villages suggest an average occupation of 20-30 years (Biggar 1922-1936, 3:124; Wrong 1939:92-93). Varve dates for the Crawford Lake village imply a 24-25 year occupation (Finlayson and Smith 1987). According to the wall post density of the only available house plan from that site (House 5) (William Finlayson, personal communication 1987), and assuming predominantly cedar poles, the Crawford Lake site was occupied 19-27 years, with an average of 23 years - a remarkable correspondence with actual village duration.

Experimental reconstructions of Iroquoian villages provide information on potential site duration. Villages constructed of mixed hardwoods (i.e., maple, beech, oak) have very short use-lives. For example, mixed hardwood palisades at the Crawford Lake and Lawson reconstructed villages decayed rapidly and blew down in windstorms only 3 years after construction (Wayne Hagerty, personal communication 1988; David Smith, personal communication 1987). Similarly, longhouses built of maple and beech saplings lasted only 3-4 years at the Lawson village. Conversely, village reconstructions of cedar have much longer use-lives. Untreated cedar posts were used to reconstruct Iroquoian villages at Longwoods Conservation Area (Mt. Brydges, Ontario) and Huronia Museum (Midland, Ontario). The Longwoods village receives annual maintenance (i.e., replacement of unsound posts). It is now 16 years old and in an excellent state of repair (Ronald Williamson, personal communication 1987). The Huronia village, on the other hand, has not been regularly maintained. After 29 years of service, its palisade had to be entirely replaced, and its longhouses, built of creosote-treated cedar posts, need total replacement after 32 years (Jamie Hunter, personal communication 1987). Lastly, a reconstructed village at Cayuga Lake, New York, built of pine and cedar, was literally falling to pieces after 22 years, needing replacement of over 90% of its posts (Ronald Williamson, personal communication 1987). In summary, triangulation of historical, experimental, and archaeological data show that the densities of longhouse wall posts are a reliable index of Iroquoian village duration.

Summarizing the results in Table 43, generalizations about

Iroquoian village site duration can be offered. Early Iroquoian village sites (A.D. 900-1300) often contain evidence of multiple occupations. Superimposed houses and palisades, resulting from rebuilding episodes, are commonplace in both Ontario (Warrick 1984:54-55) and New York (Tuck 1971:58). Total duration of an Early Iroquoian village can be estimated by adding the duration of each occupation. For example, the Calvert site had three distinct occupations (Timmins 1987), totaling 50 years (i.e., Phase I-20 years, Phase II-15 years, and Phase III-15 years or less). Middle Iroquoian sites (A.D. 1300-1400) appear to have been occupied for about 20-30 years. Prehistoric and protohistoric sites (A.D. 1400-1615) experienced the longest single occupations, ranging from 20-40 years. Historic Ontario Iroquoian sites had the shortest occupations, averaging only 15 years or less.

Theoretical consideration of Iroquoian village duration has concentrated on the relationship between length of occupation and the size and ecological requirements of a village. On purely ecological grounds, it is expected that small villages were occupied longer than large ones (Snow 1986; Trigger 1981b:16). The results of this study, however, do not support this expectation. In fact, there is no apparent relationship between the size and duration of seventeenth-century Huron villages (Figure 38). Perhaps structural decay of the village, which would have proceeded, irrespective of village size, at a constant rate for villages that were built of similar wood and surrounded by similar forest cover, might have been a significant determinant of the timing of Iroquoian village relocation.

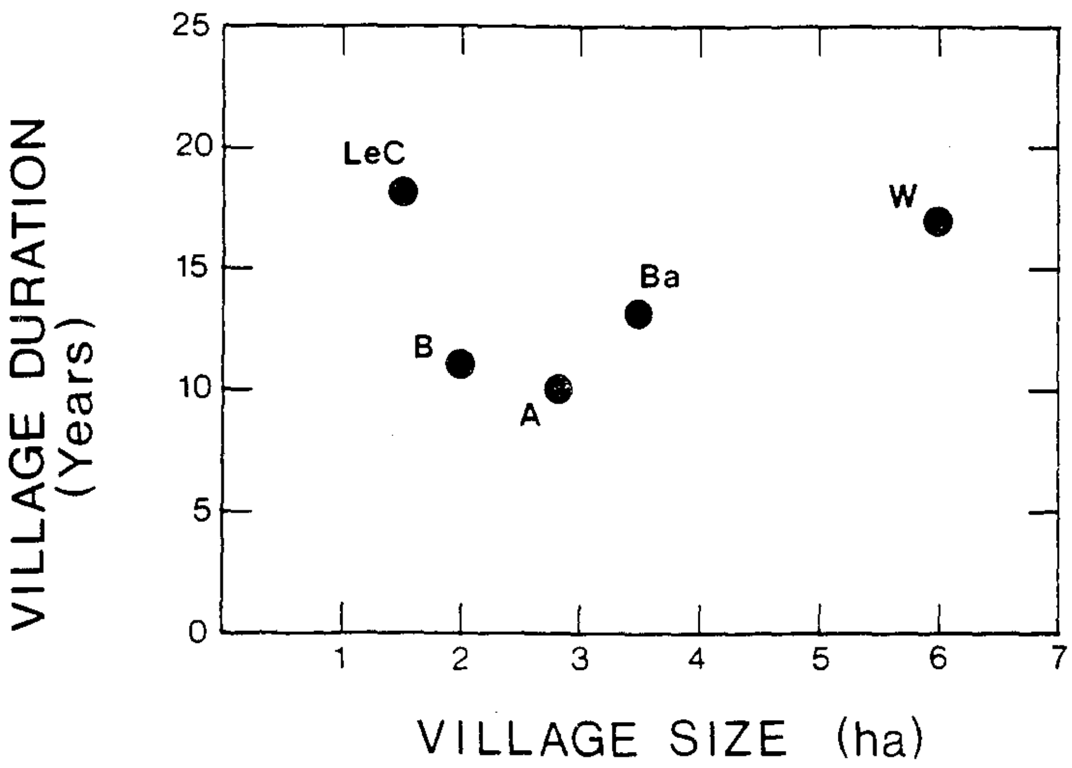

Figure 38. Relationship between estimated duration (based on house wall post densities) and size of seventeenth-century Huron village sites. Data from Table 43. (KEY: LeC=LeCaron, B=Bidmead, A=Auger, Ba=Ball, W=Warminster).

One final consideration is that the house post density index of archaeological site duration can be applied to other prehistoric contexts where people lived in semipermanent villages constructed of wooden posts. The prehistory of New Zealand, the Northwest Coast, Mesoamerica, and Central Europe, in addition to eastern North America, would benefit from original applications of the post density approach to site duration.

Summary

It has been demonstrated that house wall post mould densities hold the most promise for estimating the duration of Iroquoian village sites. According to post densities, Ontario Iroquoian villages were occupied approximately 10-40 years. This finding has important implications for Huron-Petun archaeology.

1) First contact observations of Huron village duration (i.e., 10-30 years by Champlain and 10-40 years by Sagard) are essentially accurate and can be used in analogical fashion to estimate prehistoric Huron-Petun village durations. Contrary to ethnohistoric and ecological arguments, it is unlikely that any single village occupation exceeded 40 years. Multiple occupations of village sites, common in Early Iroquoian times, have total cumulative spans of about 40 years.

2) There is no apparent difference in length of occupation between large and small villages, but the average duration of Ontario Iroquoian villages did decrease dramatically after 1615, from 25 years to 15 years or less. This may explain the discrepancy between estimates of Huron village duration reported prior to 1630 by Champlain and Sagard (10-30 years) and those reported after 1630 by the Jesuits (8-12 years).

3) Late prehistoric and protohistoric village sites display considerable variability in wall post densities. A great deal of this variability is real. Thus, in the absence of superposition, one cannot simply assume that all longhouses in an Iroquoian village are

contemporaneous. We must abandon our snapshot notions of Iroquoian site occupation and begin to construct life histories for individual villages. William Finlayson's (1985; Finlayson et al. 1986) excavations of the Draper and Keffer prehistoric Huron villages and Peter Timmins's (1986, 1987) investigation of the Early Iroquoian Calvert village are laudable first steps towards writing village histories. It is time for archaeologists to adopt a more realistic view of the complexity of Iroquoian village occupation.

Relative Huron-Petun Population Estimates

Relative trends in Huron-Petun population can be delineated by: totalling village area for each time period, time-standardizing the area total by multiplying by the ratio of site duration/period length, multiplying the time-standardized area total by period-specific hearth density, and adjusting the hearth total by subtracting a proportion of hearths to account for the lower hearth densities of unpalisaded villages. Table 44 details the results of this arithmetical procedure for each time period of Huron-Petun archaeology. The final column in Table 44, adjusted hearth total, is plotted in Figure 38 and provides the basis for the raw absolute population estimates in Table 47.

The total sample of Huron-Petun sites used in making relative population estimates is 456. Only 300 have precise size and age values; the remaining 156 sites were assigned size and age by proportionality on a region-by-region basis. Because Huron-Petun village sites of a particular age tend to be clustered in discrete regions (see Figures 17-23), relatively accurate age assignments for poorly known sites can be made with considerable confidence (see Chapter 5). Total village area for each time period in Table 44 equals the sum of known and assigned site areas. Median site area for each time period was calculated (Table 28) and assigned to sites with unknown area.

Raw village area totals are not comparable from one period to the next because the lengths of time periods vary, as do the lengths of village occupations. Consequently, village area totals must be time-standardized (see Blake et al. (1986) for similar approach). The simplest method of time-standardizing Huron-Petun village area totals is to multiply each by the quotient of site duration divided by period length. This calculation standardizes the total village area for each period to the average amount of village area occupied during any single year of that period.

Time-standardized village area is not the best relative index of Huron-Petun population, however, since village population density varied over time (Table 32). For example, late prehistoric villages had approximately 50 hearths/ha and late protohistoric villages had about 70 hearths/ha. Thus, total hearths provide a better relative population estimate than total village area.

Total hearths per time period is a good index of Huron-Petun population. Yet it ignores the potential effect of village palisades on residential density. Unpalisaded villages appear to have had considerably lower hearth densities than palisaded ones (see Table 32). It is estimated that, at least for the Late Prehistoric and

Contact periods, 25% of villages less than 1.0 ha in size were not palisaded. Therefore, total hearths calculated on the basis of average hearth density need to be slightly reduced to adjust for the much lower hearth densities of unpalisaded villages. For instance, the total area of middle historic Huron sites less than 1.0 ha is 9.8 ha. Multiplying this by 25% yields 2.4 ha. At 50 hearths/ha, there are 122 hearths; at 40 hearths/ha (for unpalisaded sites) there are only 98 hearths. The difference of 24 hearths was subtracted from the overall hearth total for the middle historic period because it was calculated using 50 hearths/ha.

Adjusted hearth totals (Figure 39) demonstrate clearly that Huron population experienced a rapid growth spurt (greater than 2% annual increase) in the fourteenth century and a catastrophic crash in the mid-seventeenth century (9% annual decrease). Yet relative change in Huron-Petun population, considered a methodological achievement by some archaeologists (Ammerman et al. 1976:38-39; Plog 1974:93-94), is not very satisfying to a historical demographer. Without some estimate of **absolute** change in population over time, it is very difficult to construct a credible historical explanation of population change.

Absolute Huron-Petun Population Estimates

Ignoring absolute population in demographic archaeology involves the tenuous assumption that family or household size remained constant from one period to the next (Schacht 1981:125-126). Actual population numbers and demographic vital rates of prehistoric societies are best supplied by palaeodemographic reconstruction of family size.

Table 44. Relative Population Totals for the Huron-Petun.

Time Period (years A.D.)	Duration Period (years)	Duration Site (years)	Known Sites n	Known Sites ha	Assigned Sites n (a)	Assigned Sites ha (a)	Total Sites n	Total Sites ha	TS Total n (b)	TS Total ha (b)	Hearth Density (c)	Hearth Total	Adj. Hearth Total (d)
E. Early Iroq.	150	40	2	0.6	3	1.6	5	2.2	1	0.6	50	30	30
(900-1050)													
M. Early Iroq.	150	40	4	1.6	3	1.9	7	3.5	2	0.9	50	45	45
(1050-1200)													
L. Early Iroq.	100	40	4	2.4	3	1.9	7	4.3	3	1.7	50	85	85
(1200-1300)													
Uren	30	25	7	6.8	7	6.2	14	13.0	12	10.8	50	540	540
(1300-1330)													
E. Middleport	40	25	14	14.9	14	14.0	28	28.9	18	18.0	50	900	900
(1330-1370)													
L. Middleport	50	25	25	38.9	17	16.7	42	55.6	21	27.8	50	1390	1390
(1370-1420)													
E. Late Prehist.	30	30	29	48.3	16	25.3	45	73.6	45	73.6	50	3680	
(1420-1450)											(25)	(-31)	3649
M. Late Prehist.	50	30	58	101.4	39	57.9	97	159.3	48	79.6	50	3982	
(1450-1500)											(25)	(-95)	3887
L. Late Prehist.	50	30	42	67.2	30	46.6	72	113.8	43	68.3	50	3414	
(1500-1550)											(25)	(-70)	3344
			4	**3.4**			**4**	**3.4**	**2**	**2.0**	**50**	**100**	
											(25)	**(-15)**	**85**
E. Protohistoric	30	35	24	45.5	3	3.4	27	48.9	27	48.9	60	2934	
(1550-1580)											(40)	(-27)	2907
L. Protohistoric	29	25	15	27.9	7	7.5	22	35.4	22	35.4	70	2478	
(1580-1609)											(40)	(-27)	2451
			3	**4.1**			**3**	**4.1**	**3**	**4.1**	**70**	**287**	
											(40)	**(- 6)**	**281**

(Continued)

Table 44. Continued.

Time Period (years A.D.)	Duration Period (years)	Duration Site (years)	Known Sites n	Known Sites ha	Assigned Sites n (a)	Assigned Sites ha (a)	Total Sites n	Total Sites ha	TS Total n (b)	TS Total ha (b)	Hearth Density (c)	Hearth Total	Adj. Hearth Total (d)
E. Historic	16	15	19	31.0	4	4.1	23	35.1	23	35.1	70	2457	
(1609-1625)											(40)	(-90)	2367
			12	**12.9**			**12**	**12.9**	**12**	**12.9**	**70**	**903**	
											(40)	**(-36)**	**867**
M. Historic	14	15	15	31.7	8	9.3	23	41.0	23	41.0	50	2050	
(1625-1639)											(40)	(-24)	2026
			8	**14.8**			**8**	**14.8**	**8**	**14.8**	**50**	**740**	
											(40)	**(-10)**	**730**
L. Historic	11	11	11	22.1	3	4.1	14	26.1	14	26.1	50	1305	
(1639-1650)											(40)	(- 5)	1300
			4	**9.6**			**4**	**9.6**	**4**	**9.6**	**50**	**480**	**480**

Note: Petun totals are in bold type

(a) Assigned sites are those sites for which age and/or size are either poorly defined or unknown (see Chapter 5 for procedure for assigning age and size).

(b) TS Total = Time-Standardized site number and size totals. Total site number and size for each time period were standardized to duration of period and average site duration as estimated in Warrick (1988b). In each case, total site number and size were multiplied by the ratio of site duration/period length. Site number was rounded to the nearest whole number. Eg. Total site number and size for E. Early Iroquoian (5 and 2.2 ha respectively) were multiplied by 40/150 or 0.267) yielding a time-standardized totals of 1 site and 0.6 ha.

(c) Hearth Density = average density of hearths in villages of each period. Hearth density is higher in L. Protohistoric and E. Historic villages and higher in large palisaded villages; measured in hearths/ha.

(d) Adjusted Hearth Totals = Total hearths calculated by average density of hearths was adjusted for much lower average hearth density of unpalisaded small sites (25% of total number of sites less than 1.0 ha for Late Prehistoric, protohistoric, and historic time periods (see text of Chapter 6)). Thus, the difference between hearth density sub-totals using the high overall density and the lower unpalisaded village density for 25% of small sites per time period was subtracted from the total hearth count for the period. For example, for the Middle Historic Huron, the total size of sites less than 1.0 ha is 9.8 ha. Multiplying this by 25% yields 2.4 ha. At 50 hearths/ha , there are 122 hearths; at 40 hearths/ha (for unpalisaded sites) there are only 98 hearths. The difference (24 hearths) was subtracted from the grand total since it was calculated using 50 hearths/ha.

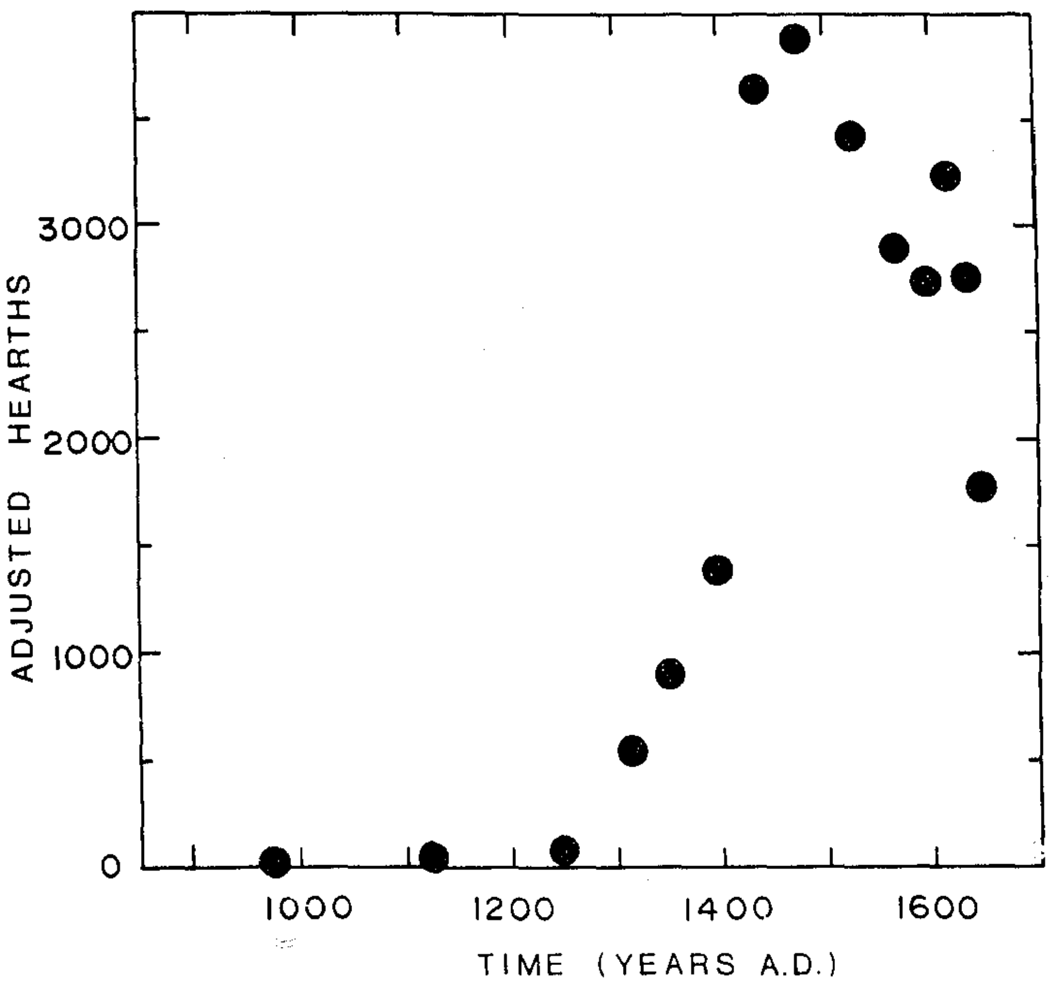

Figure 39. Temporal trend for adjusted hearth totals.
(see Table 44 for data)

Family size

Most archaeological indices of family size, such as house floor area, density of artifacts and food refuse, and pot size, are too unreliable. The problems with house floor area have already been addressed (see Chapter 4). The density of artifacts and food refuse assume steady rates of deposition per person - quite unrealistic for most archaeological contexts. Archaeological reconstructions of pot size are notoriously inaccurate (Bull 1987), and even if accurate pot sizes were available, recent ethnoarchaeological work, contrary to Turner and Lofgren (1966), has found virtually no relationship between mean pot size and family size (Nelson 1981).

Cross-cultural analogy sheds some light on the **average** size of the pre-industrial family. A brief survey of pre-industrial agriculturalists reveals that the average size of the **nuclear** family is 5.5 persons (see Table 45). Treated as a normative constant, this could be applied to prehistoric contexts. Likewise, estimates of family size observed in first contact situations could be applied to the prehistory of the same group. However, family size in any society changes over time, sometimes dramatically for prolonged periods. One cannot simply apply the "ethnographic present" to the past when dealing with demography. Moreover, palaeodemography (i.e demographic inference from human skeletal remains) can provide reliable estimates of prehistoric family size (Buikstra et al. 1986; Hassan 1981).

Table 45. Pre-industrial Family Size .

Group	Family size (range)	Family size (mean)	Reference
Indian Mexico[20th C]	3.5-9.5	6	De Roche 1983:191
Guatemala Maya[20th C]	3.2-9.8	6	Nelson 1981:117
Mesoamerica [20th C]		5.5	Kolb 1985:588
Guatemala Maya [20th C]		4.6	Haviland 1972:138
" " [15th C]		4.9	" "
Southwest US [20th C]	4.5-7	5.25	Cook 1972a:13
Hopi [20th C]		5.55	Turner & Lofgren 1966
California [18th C]		6	Cook & Heizer 1968:89
Hawaii [18th C]		6	Cordy 1981:91
Maori [18th C]		7	Sutton 1986
Tahiti [18th C]		6	MacArthur 1970
Huron [17th C]	4-8	6	Heidenreich 1971:99
Huron [17th C]		5	Trigger 1976:46-47
Huron [prehistoric]		6	Finlayson 1985:109
Huron [prehistoric]		8	Wright 1974:69,71
Mohawk [17th C]		5	Snow 1987a
NY Iroquois [17th C]		5	Engelbrecht 1987
NY Iroquois [prehistoric]		5	Ritchie and Funk 1973

The fundamental analytic tool of palaeodemographers is the abridged life table, an adapted version of model life tables used by demographers (Johannson and Horowitz 1986; Coale and Demeny 1966). An abridged life table can be used to generate valid vital statistics for a skeletal population that:

1) conforms to stable population theory

2) contains a representative sample of the living population, and

3) can be accurately aged and sexed (Buikstra and Mielke 1985; Ubelaker 1974).

Small pre-industrial populations, like the Huron-Petun, so long as they have not experienced prolonged and rapid growth or decline, conform to a stable population model (Buikstra and Mielke 1985:364). Huron-Petun ossuaries do not contain an entirely representative sample of the living population (Sutton 1988). Infants are under-represented, since a large number were buried in and around the villages (Kapches 1976; Saunders and Spence 1986). Nevertheless, adjustments can be made to ameliorate the effects of infant under-representation on life table statistics (Jackes 1986; Buikstra et al. 1986). Similarly, errors in ageing and sexing individuals in a burial population do not seriously affect gross estimates of mortality and fertility rates (Buikstra et al. 1986).

Fertility rates can be gleaned indirectly from skeletal data. Direct parity estimates from the extent of pitting on the os pubis (Angel 1969; Sutton 1986) are unreliable, since the relationship between pubic bone remodelling and number of births has yet to be demonstrated in modern skeletal populations (Buikstra and Mielke 1985:391). While the crude birth rate of a prehistoric population is equal to the inverse of its mean age at death (Sattenspiel and Harpending 1983), mean age at death statistics are difficult to estimate for skeletal samples (Buikstra et al. 1986:531-533; Johansson and Horowitz 1986). Recent palaeodemographic work (Buikstra et al. 1986; Jackes 1986) has produced relative measures of fertility and juvenile mortality from abridged life tables. Two proportions are required: (1) number of dead over age 30 divided by number of dead over age 5, and (2) number of dead aged between one and five years divided by number of dead aged 1 - 10 years. These provide relative estimates of fertility and juvenile mortality respectively. Applying these measures to the Fairty, Uxbridge, and Kleinburg ossuary life tables suggests a decline in both fertility and juvenile mortality from A.D. 1350 to A.D. 1600 (Table 46).

About A.D. 1330, the Huron-Petun began to inter their dead in large ossuaries. It is believed that Huron ossuaries represent the accumulated dead over the life of the contributing village (Pfeiffer 1983). Based on our knowledge of sociopolitical evolution among the Ontario Iroquoians (Warrick 1984), the latter assumption is probably true for most of Huron prehistory. There are only four Huron ossuaries that have been professionally excavated, analyzed, and accurately dated (see Figure 40 for location and Table 46 and Jackes (1986) for data). Fairty is the earliest and is likely associated with the Robb village (A.D. 1320-1350). Uxbridge is probably associated with the Balthazar village site (A.D. 1460-1490). Kleinburg dates approximately A.D. 1570-1600 and the Ossossane ossuary has been historically identified with the Feast of the Dead observed by Jean de Brebeuf in May of 1636 (Thwaites 1896-1901, 10:293-303). Relevant palaeodemographic statistics were compiled for each ossuary (Table 46).

Based on summary tables provided in Bongaarts and Menken (1983:35) and Ken Weiss's (1973) model life tables, the average number of children surviving to adulthood (i.e. 15-20 years) was calculated for each ossuary from life expectancy at birth (e0) values: Fairty (3.4), Uxbridge (2.9), Kleinburg (2.7), and Ossossane (4.8). Adding

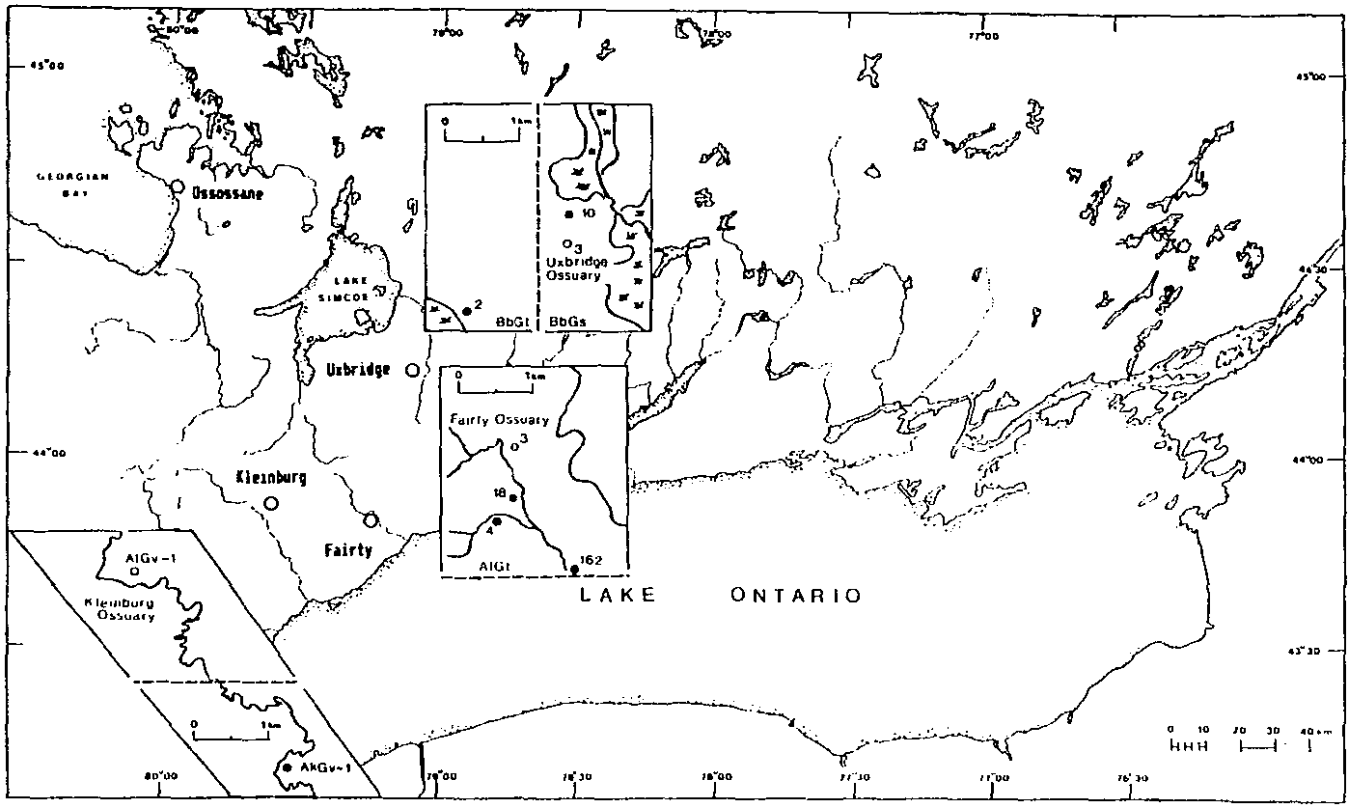

Figure 40. Location of excavated Huron ossuaries.

Table 46. Huron Ossuary Data.

Ossuary	Date (years A.D.)	e(o)	CBR	CDR	r	l(15)	TFR	Kids	D30+/D5+	D1-5/D1-10
Fairty	1320-1350	23	45	33	+.011	0.6	5.8	3.4	0.54	0.75
Uxbridge	1450-1480	30	33	33	0	0.7	4.3	2.9	0.68	0.59
Kleinburg	1570-1600	30	31	33	-.002	0.7	4.0	2.7	0.77	0.66
Ossossane	1623-1636	21	33	43	-.010	0.4	4.4	1.8	0.54	0.70

Key to column headings:

e(0) = life expectancy at birth (adjusted for 0-5 year child underrepresentation (see Jackes 1986)

CBR = Crude Birth Rate (inverse of e(0) and adjusted when appropriate for D30+/D5+ - e.g. Kleinburg CBR adjusted down because it was a lower fertility population than Uxbridge; Ossossane adjusted down to conform to historical evidence for low fertility among seventeenth-century Huron)

CDR = Crude Death Rate (estimated from historical data and held constant from A.D. 1300-1620 (Ossossane CDR derived from Sullivan and Katzenberg (1981))

r = population growth/decline rate = CBR - CDR

l(15) = proportion of children surviving to age 15 (see Jackes 1986)

TFR = Total Fertility Rate (estimated from model life tables (Weiss 1973))

Kids = Average number of children per family surviving to age 15 (average of TFR x l(15) and Weiss (1973))

D30+/D5+ = relative measure of fertility (lower proportion indicates higher fertility) (Buikstra et al. 1986; data from Jackes (1986))

D1-5/D1-10 = relative measure of juvenile mortality (higher value indicates higher juvenile mortality) (Buikstra et al. 1986; data from Jackes (1986)) two parents gives the following mean nuclear family sizes for the Huron-Petun: A.D. 1350 (5.4); 1480 (4.9); 1590 (4.7); and 1635 (6.8) (Figure 41).

Rates of population change implied by palaeodemographic data mirror rates based on archaeological data (compare Tables 46 and 47), except for the historic period. Vital rates based on palaeodemographic data from the Ossossane ossuary cannot possibly reflect reality because Gabriel Sagard reported in 1623 that Huron families were smaller than French ones (Wrong 1939:127). Including parents, early seventeenth century French families averaged only 4.4 members (Grigg 1980:55-59). Mary Jackes's (1986) re-evaluation of Ontario Iroquoian palaeodemography clearly demonstrates that the Ossossane ossuary has unusually high juvenile mortality and crude death rates, characteristic of a "virgin-soil" epidemic burial population. Assuming the Ossossane ossuary was constructed A.D. 1636, it would have contained an unusually high proportion of infants, children, and young adults killed by the first epidemic of European disease to visit the Huron (probably measles from June of 1634 to spring of 1635 (Trigger 1981a; Heidenreich 1987). In other words, the relatively low mean age at death (e(0)=21) reported for Ossossane reflects a high mortality rate instead of a high birth rate as at Fairty. If the 1634-35 epidemic killed 20% of Ossossane's inhabitants and if it was as virulent in other Huron villages (Johnston 1987), then the average family size of the Hurons **after** the epidemic would have been only 3.8 members - i.e. a drop from A.D. 1600 of about one person per family.

Absolute family size can now be applied to the archaeological

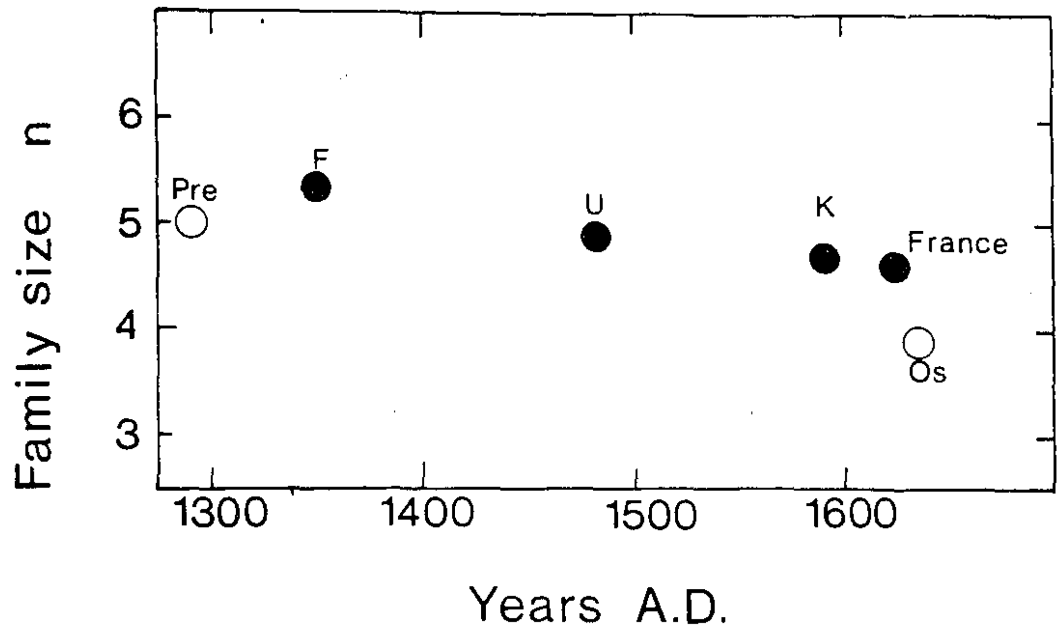

Figure 41. Trend in Huron-Petun family size. Key: Pre = estimated family size from Middle Woodland and Archaic burial populations (see Chapter 7 for references); F = Fairty; U = Uxbridge; K = Kleinburg; France = estimate from Grigg (1980:55-59) and Jackes (1986); O = Ossossane.

index of Huron household and community size - the central hearth. Taking into account that about 10% of all nuclear families would have contained one unmarried sibling or grandparent (Wrigley 1969) and that two nuclear families normally used a single hearth, the number of people around each central hearth in a Huron longhouse appears to have decreased over time : A.D. 1350 (11.0); 1480 (10.0); 1590 (9.6); 1635

(7.8). Because these values are based on relatively good skeletal populations, because they agree with relative estimates of Huron population growth/decline rates and historical estimates of pre-epidemic Huron family size, and because they are substantiated by a large sample of non-Western ethnographic and palaeodemographic vital statistics (Hassan 1981; Weiss 1973; Cohen and Armelagos 1984), it seems reasonable to believe that they are accurate to within 0.5 persons of true values.

Household size

Based on the actual number of people per hearth for various periods of Huron prehistory, the absolute population of the average household can now be reconstructed. The size of the Huron longhouse began to increase after A.D. 1300, reached a maximum length about A.D. 1500, and then decreased to its original prehistoric size by A.D. 1630 (Dodd 1984; Warrick 1984). Based on average distance between central hearths and average house length (Dodd 1984), average household size, in absolute terms, can be calculated by applying the actual hearth population values. Using a hypothetical value of 10 people per hearth for the Early Iroquoian period (A.D. 900-1300), Huron household size increased from 30 people per house in the tenth century to a maximum of about 70 people per house in the mid-fifteenth century. Thereafter, household size declined to about 50 people in the sixteenth and early seventeenth centuries, and, following the epidemics of European diseases in the 1630s, to only 15 people per house (Figure 42).

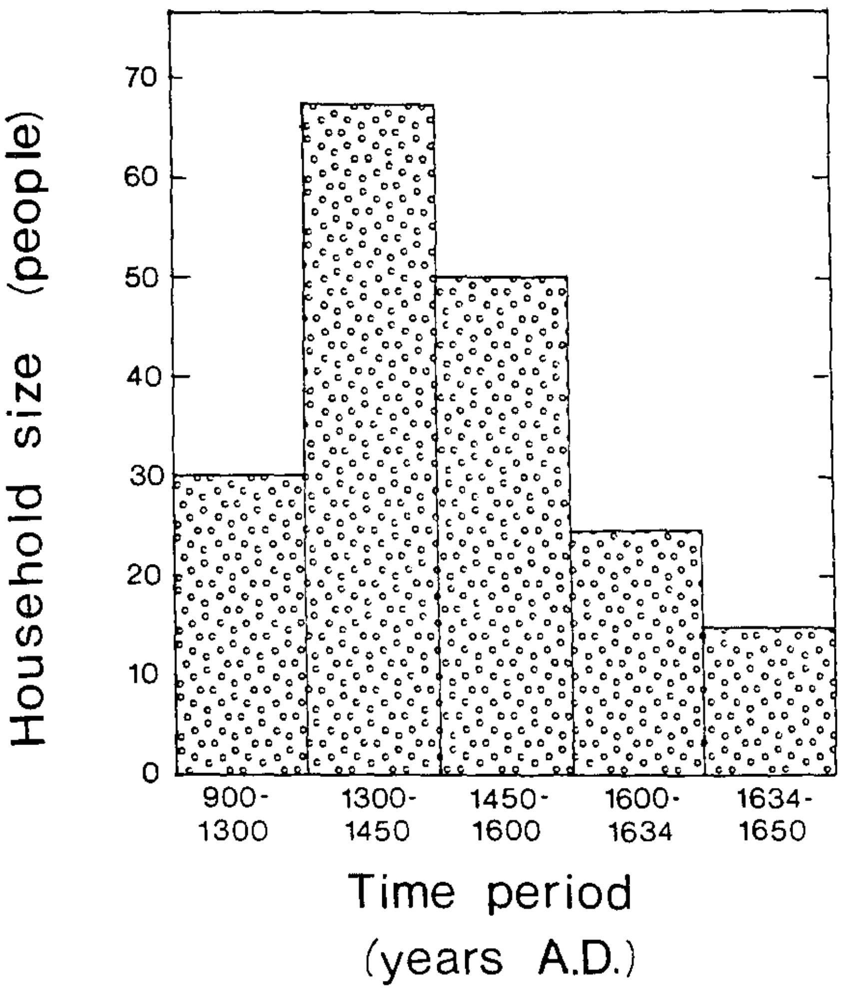

Figure 42. Trend in Huron-Petun household size.

Absolute estimates of Huron-Petun population

Absolute population estimates for the Huron-Petun can be made by three methods: adjusted hearth counts, population growth rates, and historical identification of archaeological settlements.

1) Adjusted hearth population estimates

One set of absolute population estimates is provided by converting adjusted hearth totals into number of persons by multiplying them by the period-specific hearth populations. The results are presented in Table 47 and graphically in Figure 43.

The population figures resulting from a direct conversion of adjusted hearth totals, however, have certain problems. Adjusted hearth counts are a biased and incomplete sample of the total number of hearths ever constructed. As discussed in Chapter 5, Early Iroquoian hearth counts are gross underestimates. Earlier in this chapter, it was argued that Late Prehistoric hearth counts are likely overestimates because of double-counting problems caused by the creation of very large villages as a result of the coalescence of several small villages within the span of a single village occupation. Thus, absolute population estimates for Early Iroquoian and Late Prehistoric periods calculated from adjusted hearth counts will be unrealistically low and high respectively.

Another problem with population estimates made from adjusted hearth counts is the unrealistic rates of population change. In light of Huron-Petun palaeodemography (Table 46) and pre-industrial population growth rates (Table 5), rates over 2.0% per annum are much too high for pre-modern intrinsic population growth. Referring to Table 47, Middle Iroquoian population, according to adjusted hearth counts, grew at rates in excess of 2.0% per annum. This result reflects the biased nature of the sample of Huron-Petun village sites.

2) Growth rate population estimates

Absolute population estimates for the Huron-Petun can be generated from another set of data - population growth rates derived from palaeodemography. Palaeodemography provides some approximate growth rates for various periods of Huron-Petun prehistory (Table 46). For temporal periods lacking palaeodemographic data, growth rates can be interpolated (e.g. the early Late Prehistoric growth rate is estimated at + 0.6% per annum, an average of known rates for late Middleport (+ 1.2% p.a.) and middle Late Prehistoric (0% p.a.)). For the Early Iroquoian period, absolute population growth rates were assumed to be more or less equal to the relative population growth rates. Furthermore, the Middle Woodland population for south-central Ontario, estimated at about 2000 persons (Chapter 7), was used to establish the initial Early Iroquoian population at A.D. 900. Absolute population was calculated for each time period according to the following formula (see Blake et al. 1986:454):

$$Nt = N0e^{rt}$$

where Nt is the population at time t, N0 is the initial population, r is the growth rate per annum, and t is the time span in years. Results appear in Table 47 and Figure 43.

Table 47. Absolute Population Totals for the Huron-Petun.

Time Period	Adjusted Hearth No. (a)	Rate of Annual Increase (%) (b)	Avg. No. Persons/ Hearth (c)	Adjusted Hearth Population (d)	Palaeodemog. Rate of Annual Increase (%) (e)	Growth Rate Population (f)
Middle Woodland (g)						2,000
E. Early Iroquoian	30	-	10	300	0	2,000
M. Early Iroquoian	45	+0.18	10	450	+0.18	3,000
L. Early Iroquoian	85	+0.51	10.5	890	+0.51	5,680
Uren	540	+2.31	11	5,940	+0.80	10,770
E. Middleport	900	+2.55	11	9,900	+1.20	13,690
L. Middleport	1,390	+0.96	11	15,290	+1.20	23,500
E. Late Prehist.	3,649	+2.41	10.5	38,314	+0.60	29,870
M. Late Prehist.	3,887	+0.16	10	38,870	0.0	29,870
L. Late Prehist.	3,429	-0.44	10	34,290	0.0	29,870
E. Protohistoric	2,907	-0.44	10	29,070	0.0	29,870
L. Protohistoric						
Huron	2,451			24,510		
Petun	281			2,810		
Total	2,732	-0.21	10	27,320	-0.20	28,180
E. Historic						
Huron	2,367			23,670		21,080
Petun	867			8,670		8,300
Total	3,234	+1.06	10	32,340	-	29,380

(Continued)

Table 47. Continued.

Time Period	**Adjusted Hearth No. (a)**	**Rate of Annual Increase (%) (b)**	**Avg. No. Persons/ Hearth (c)**	**Adjusted Hearth Population (d)**	**Palaeodemog. Rate of Annual Increase (%) (e)**	**Growth Rate Population (f)**
M. Historic (A.D. 1634)						
Huron	2,026			20,260		**21,210**
Petun	730			7,300		**8,200**
Total	2,756	-1.60	10	27,560	-	**29,410**
L. Historic (A.D. 1640)						
Huron	1,300			7,800		**8,630**
Petun	480			2,880		**2,880**
Total	1,780	-8.70	6	10,680	-	**11,510**

(a) from Table 44
(b) calculated following formula in Hassan (1981:139):

$$r = \frac{\ln (Nt / N0)}{t}$$

where r = annual growth rate; Nt = hearth total at time t; N0 = hearth total at time 0

Calculated from hearth totals at midpoint of each time period except for periods where the duration matches site duration (e.g. Uren period). In latter case, r was calculated from end point hearth totals of time period .

(c) Average number of persons per hearth is estimated from palaeodemographic data (Table 46) and historical data

(d) Adjusted Hearth Population = Adjusted hearths x persons per hearth

(e) Palaeodemographic rates of annual increase or decrease (from Table 46). Figures in bold type are those derived from actual data; all others are interpolated.

(f) Growth Rate Population = population estimate based on palaeodemographic rates of increase or decrease and a base population of 2,000 persons

(g) Middle Woodland population of 2,000 persons based on archaeological inference (see Chapter 7)

Table 48. Momentary Population Totals for the Huron-Petun.

Time Period	Adjusted Hearth No. (a)	Momentary Hearth No. (b)	Momentary Village No. (c)	Period/ Village Duration (d)	Universe of Sites (e)	Site Sample (f)	Sampling Fraction (g)	Avg. No. Persons/ Hearth (h)	Momentary Population (i)
Middle Woodland (j)									2,000
E. Early Iroquoian	30	200	9(@0.45 ha)	3.8	34	5	0.15	10	2,000
M. Early Iroquoian	45	300	12(@0.5 ha)	3.8	45	7	0.16	10	2,810
L. Early Iroquoian	85	480	18(@0.6 ha)	2.5	45	7	0.16	10.5	5,580
Uren	540	960	24(@0.8 ha)	1.2	24	14	0.58	11	10,240
E. Middleport	900	1,200	25(@1.0 ha)	1.6	40	28	0.7	11	14,150
L. Middleport	1,390	2,145	33(@1.3 ha)	2.0	66	42	0.64	11	23,890
E. Late Prehist.	3,649	2,880	32(@1.8 ha)	1.0	32	45	1.41	10.5	27,170
M. Late Prehist.	3,887	2,980	35(@1.7 ha)	1.7	70	97	1.39	10	27,960
L. Late Prehist.	3,429	2,960	37(@1.6 ha)	1.7	74	76	1.03	10	33,290
E. Protohistoric	2,907	3,020	28(@1.8 ha)	0.9	28	27	0.96	10	30,280
L. Protohistoric									
Huron	2,451					22			
Petun	281					3			
Total	2,732	2,820	31(@1.3 ha)	1.2	31	25	0.81	10	33,730

Table 48. Continued.

Time Period	Adjusted Hearth No. (a)	Momentary Hearth No. (b)	Momentary Village No. (c)	Period/ Village Duration (d)	Universe of Sites (e)	Site Sample (f)	Sampling Fraction (g)	Avg. No. Persons/ Hearth (h)	Momentary Population (i)
E. Historic **(k)**									
Huron	2,367	2,073-2,143	18		29	23			
Petun	867	655-1,006	7		12	12			
Total	3,234	2,938	25	1.1	41	35	0.85	10	29,380
M. Historic (A.D. 1634) **(l)**									
Huron	2,026	2,121	21		32	23			
Petun	730	820	9		14	8			
Total	2,756	2,941	30	0.9	46	31	0.67	10	29,410
L. Historic (A.D. 1640) **(m)**									
Huron	1,300	1,439	19		25	14			
Petun	480	480	4		4	4			
Total	1,780	1,919	23	1.0	29	18	0.62	6	11,510

(a) see Table 44 and text

(b) Momentary hearth number calculated by dividing the population totals derived from palaeodemographic growth rates (Table 47) by the number of persons per hearth.

(c) Momentary village number calculated by dividing the momentary hearth number by the number of hearths in an average-sized village for each period.

(d) Period duration divided by village duration

(e) Universe of sites or the total number of village sites ever occupied per time period. It is the product of momentary village number multiplied by the period/village duration ratio.

(f) Site sample = total number of village sites (n = 456)

(g) Sampling fraction = (f) divided by (e)

Table 48. Continued.

(h) Average number of persons/hearth (see text)

(i) Momentary population = (Adjusted hearth number/Sampling fraction) x persons/hearth

(j) Middle Woodland population set at 2,000 persons (see Chapter 7 for derivation).

(k) Early Historic momentary population based on an average momentary hearth number (two values reported for the Huron and Petun are A.D. 1615 and A.D. 1623 figures based on historical identification of archaeological sites and identifying missing sites using seventeenth-century documents and maps. Missing sites or those villages that appear in seventeenth-century records but not yet archaeologically discovered were added to archaeological hearth totals. Small or minor villages were arbitrarily assigned a size of 0.8 ha and large villages 2.0 ha.

(l) Middle Historic momentary population based on historical identification of archaeological sites that were occupied ca. A.D. 1634 (before the 1630s epidemics) and identifying missing sites using seventeenth-century documents and maps.

(m) Late Historic momentary population based on historical identification of archaeological sites occupied ca. A.D. 1640 (immediately after the 1630s epidemics but before the 1640s abandonments) and identifying missing sites using seventeeth-century documents and maps.

3) Ethnohistorical population estimates

Glass trade bead frequencies (Kenyon and Kenyon 1983), in conjunction with house post density estimates of village duration (Warrick 1988b), were used to compile village site totals for four temporal phases of the Contact period: 1615, 1623, 1634-39, and 1640-1650. These are summarized in the keys for Figures 69-76 for both the Huron and Petun (Chapter 7). Identifications of archaeological sites with historically-named villages supplied by Garrad (1975, 1980), Heidenreich (1971:22-48), Latta (1985b), and Trigger (1976) were incorporated with the author's own identifications based on site age, duration, size, and geographical proximity of the site to an actual village location on one of the four seventeenth century maps (see Chapter 2 and Heidenreich (1971), Latta (1985b), and Trigger (1976) for summaries on the authenticity and accuracy of these maps). Population totals were calculated for each of the temporal phases by totalling known and identified village sizes, then adding villages documented but archaeologically undiscovered (small village estimated at 0.8 ha and large village estimated at 2.0 ha), and finally multiplying by the appropriate hearth and family size values. The historic population totals are presented in Table 47. There is remarkable agreement between seventeenth-century observations of Huron-Petun numbers and calculated ethnohistorical estimates. Prior to the epidemics of the 1630s, Huron-Petun population is reported at 30,000-40,000 (Biggar 1922-1936, 3:122; Thwaites 1896-1901, 7:225, 8:115, 10:313; Wrong 1939:91). Calculated estimates based on ethnohistorical interpretation place seventeenth-century Huron-Petun

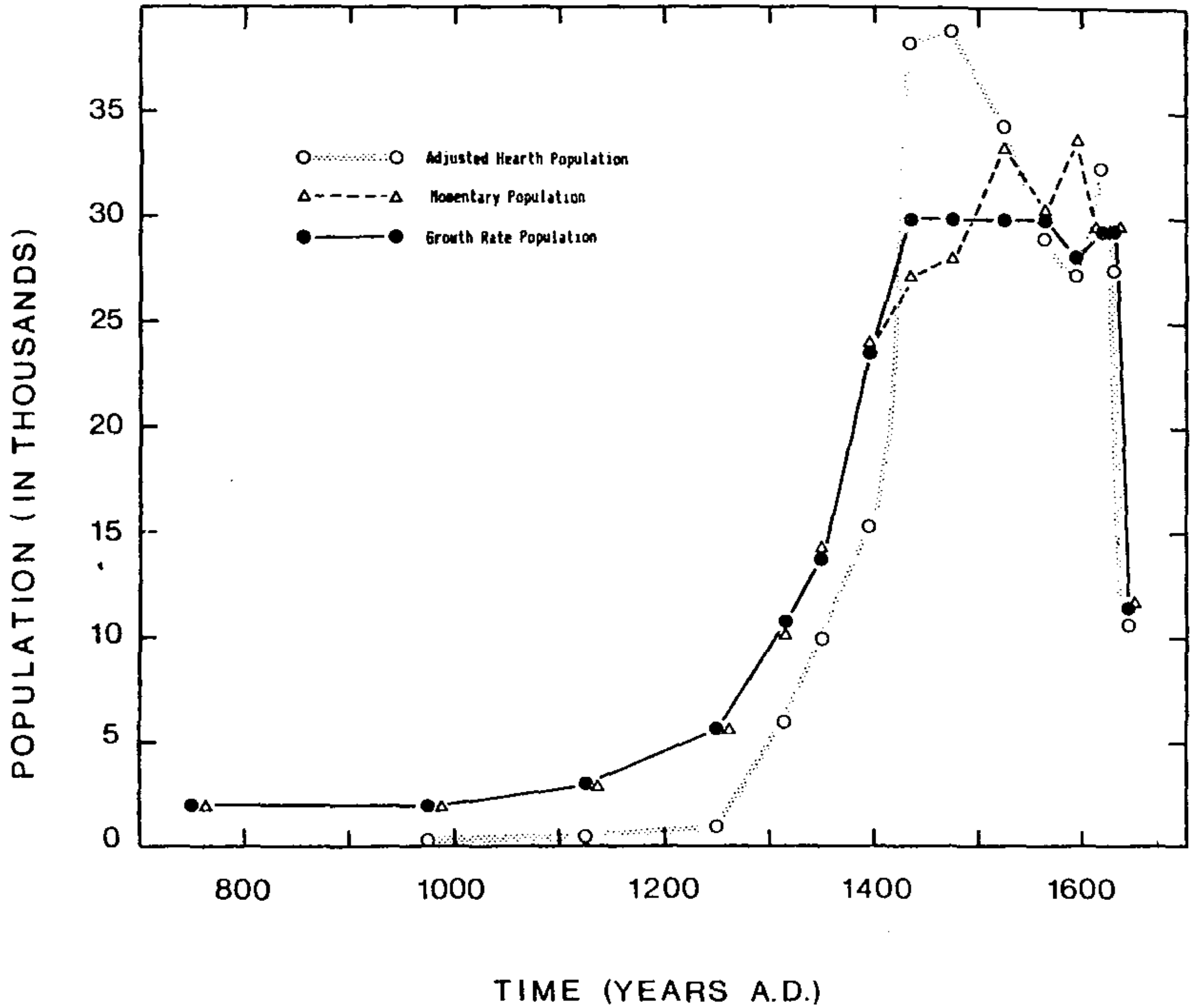

Figure 43. Huron-Petun population growth curves.

population at 29,500.

In summary, three independent estimates of absolute Huron-Petun population were made. The adjusted hearth estimates are the least acceptable since they are derived from a biased, incomplete sample of Huron-Petun village sites. Prehistoric estimates and associated growth rates are particularly suspect. The ethnohistorical and growth rate estimates form a mutually-supportive set. Late protohistoric Huron-Petun population is estimated at 28,000 by growth rates and early historic population is estimated ethnohistorically at 29,000. The congruence between seventeenth-century population estimates (i.e. 30,000-32,000) and the ethnohistorical ones and the agreement between the ethnohistorical and growth rate estimates suggest that the latter figures are an accurate reflection of reality.

Although the growth rate estimates provide a realistic picture of trends in prehistoric Huron-Petun population, they are based on palaeodemographic data, not on archaeological data (i.e. adjusted hearth counts). The archaeological data collected for this study, despite obvious biases, provide the best basis for estimating actual numbers of Huron-Petun through time. Biases inherent in the adjusted hearth totals, primarily the underrepresentation of Early Iroquoian and Middle Iroquoian hearths and the overrepresentation of Late Prehistoric hearths, can be corrected by converting absolute population, provided by growth rate estimates, into the number of momentary hearths or the actual number of hearths that would have been in service during the midpoint or endpoint year of a particular period. Momentary villages, simple transformation of momentary hearths, multiplied by the ratio of period duration divided by site duration results in the universe of villages (i.e. the total number of villages occupied during a time period) for each period. A sampling fraction can then be calculated by dividing the number of village sites known archaeologically by the number of villages in the universe for each time period. Absolute population estimates can be recalculated from adjusted hearth totals by dividing the latter by the sampling fraction and then multiplying by the appropriate number of people per hearth. The results appear in Table 48. Comparing the population totals in Table 48 with those in Table 47 reveals a close similarity between the growth rate estimates and the "corrected" adjusted hearth estimates.

CHAPTER 7

HURON-PETUN POPULATION HISTORY

Population history is generally thought to be the private domain of historical demographers (Skipp 1978; Wrigley 1969). In the absence of written records, certain historical demographers are extremely skeptical of and reticent to use archaeological data to generate population history (Cook 1981:40; Hollingsworth 1969:43). Others (Willigan and Lynch 1982:40, 379-400) are more optimistic about the potential contribution of demographic archaeology to a history of human population and correctly emphasize that archaeology is the only means of investigating population change for prehistoric and non-literate societies. Furthermore, prior to the eighteenth century, the historical record for population size and other demographic characteristics is generally as fragmentary as the archaeological record (Grigg 1980:51-53; McNeill 1976:212-213; Petersen 1975:227). In the New World, the only way to write the demographic histories of particular native groups is from archaeological and palaeodemographic data. A brief demographic history of the Huron-Petun is presented in this chapter written from an archaeological and ethnohistorical perspective.

Middle Woodland Baseline

The Middle Woodland period in south-central Ontario lasted almost a millennium, according to radiocarbon chronology (ca. 400 B.C. - A.D. 500 (Spence and Fox 1986; Spence and Pihl 1984). Point Peninsula is the regional manifestation of Middle Woodland culture in south-central

Ontario, although ceramic attributes suggest that the Nottawasaga cluster has both Saugeen and Point Peninsula affiliations (Spence and Fox 1986:34-36). Osteological (Molto 1983) and archaeological evidence (Snow 1984) demonstrate demographic and cultural continuity between Middle Woodland and Early Iroquoian times, tending to support the **in situ** origins of Ontario Iroquoian society (MacNeish 1952; Wright 1966). Middle Woodland archaeology can be used to establish a demographic baseline with which subsequent change in Iroquoian population can be compared. Moreover, because the Middle Woodland was pre-agricultural (Fecteau 1985; Schwarz et al. 1985), delineation of its demographic parameters is essential for assessing the role of demography in the transition to corn agriculture in Southern Ontario.

Middle Woodland peoples were generalized hunter-gatherers whose subsistence revolved around spring-spawning fish, deer, nuts, freshwater mussels, waterfowl, and, when locally available, wild rice (Pihl 1978; Spence et al. 1984). Isotopic studies of human skeletal remains confirm the absence of corn and the emphasis on meat, fish, nuts, and molluscs in Middle Woodland diets (Katzenberg and Schwarz 1986; Schwarz et al. 1985). Archaeological sites are concentrated along the banks of large rivers and the shores of inland lakes (Figure 44). These represent spring-summer aggregation camps that were occupied intermittently, some for several centuries (Spence and Fox 1986:36). At Rice Lake and the Moira River farther east, Middle Woodland burial mounds occur adjacent to the large aggregation campsites (Spence et al. 1984). Fall and winter campsites of the Middle Woodland period are rare in Ontario's archaeological inventory, presumably because they were small (i.e. one or two nuclear families) and of short duration. Using anthropological theory (Wobst 1974), burial counts, average site size, and inferred labour requirements for moundbuilding, Spence et al. (1984:124-125) estimate that 50 - 100 people comprised the local bands that occupied each of three main spring-summer aggregation camps at Rice Lake. The Rice Lake territorial band, thus, would have consisted of 150-250 people. Given that the Rice Lake band and the LeVesconte band, located about 30 km east of Rice Lake (see Figure 44), appear from osteological evidence to have been a single breeding population, the regional Rice Lake Middle Woodland population would have been approximately 350-500 people (Spence et al. 1984:128). Wobst's (1974) theoretical minimum hunter-gatherer band size of 475 persons, which is required to maintain demographic equilibrium in such populations, falls within this range.

Unfortunately, it is not possible to reconstruct the size of the entire Middle Woodland population of south-central Ontario from archaeological settlement or burial data. Settlement sites are horizontal palimpsests created by centuries of successive occupation. The relatively large size of Middle Woodland sites (maximum of 4-10 ha - see Table 49) reflects length of occupation span rather than momentary population size. David Asch (1976:18-19) encountered this same problem in his estimates of Middle Woodland populations in Illinois. In addition, no examples of Middle Woodland house structures have been unearthed in south-central Ontario. Previous archaeological excavations of Middle Woodland sites have tended to concentrate on

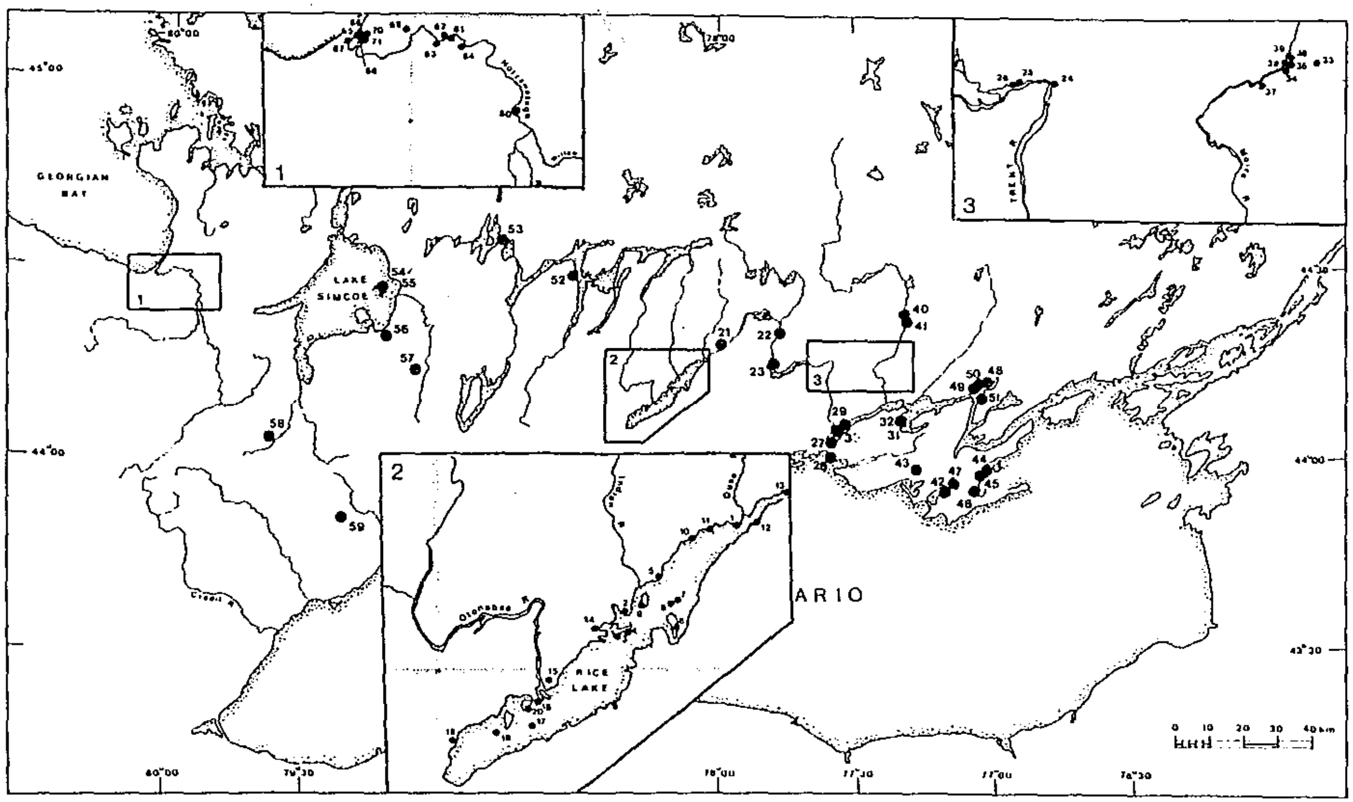

Figure 44. Middle Woodland settlement sites in south-central Ontario.
(see Table 49 for key to site numbers)

Table 48. Middle Woodland Settlement Sites in South-Central Ontario.

No.	Borden No.	Site	Site Type	Size (ha)
1	BbGm-1	Cameron's Pt.	village	n/a
2	BbGm-2	Serpent Mounds	village	n/a
3	BbGm-3	Harris Is.	camp	n/a
4	BbGm-4	Rainy Pt.	camp	0.05
5	BbGm-6	Loucks	village	1.2-1.6
6	BbGm-7	White Is.	camp?	n/a
7	BbGm-8	Hickory Is.	camp	0.4
8	BbGm-9	East Grape Is.	camp	n/a
9	BbGm-11	East Sugar Is.	camp	n/a
10	BbGm-12	Godfrey	village	2.8-4.0
11	BbGm-13	Spillsbury Bay	camp	1.2
12	BbGm-15	Exit River	camp	n/a
13	BbGm-24	Scriver Is.	camp	n/a
14	BbGn-2	McIntyre	village	n/a
15	BaGn-2	Miller Mound	village	3.7
16	BaGn-3	Jubille Point	village	n/a
17	BaGn-5	West Sugar Is.	camp?	n/a
18	BaGn-6	MacMahon	camp	< 1.6
19	BaGn-7	West Grape Is.	camp	1.2
20	BaGn-10	Cow Point	camp	n/a
21	BbGl-3	Shaw	camp	n/a
22	BcGk-2	Trent Is. #2	camp	0.8
23	BbGk-4	Percy Boom	village	10.0
24	BbGj-1	Morrow	camp	n/a
25	BbGj-4	MacFarlane 1	camp	n/a
26	BbGj-5	MacFarlane 2	camp	n/a
27	BaGj-2	Lattour	camp	n/a
28	BaGj-5	Smoke Point	camp	n/a
29	BaGj-6	Baker Is.	camp	n/a
30	BaGj-7	Indian Is.	camp	n/a
31	BaGh-1	Barber #1	village	0.6
32	BaGh-19	Barber #6	camp	n/a
33	BbGh-2	Smith-1	camp	n/a
34	BbGi-9	Frink	camp	n/a
35	BbGi-10	Eliot	camp	n/a
36	BbGi-11	Plainfield Rapids	camp	n/a
37	BbGi-12	Foster	winter camp	n/a
38	BbGi-14	Plainfield-1	camp	n/a
39	BbGi-17	Plainfield-4	camp	n/a
40	BcGh-5	Vanderwater Rapids	camp	n/a
41	BcGh-8	Vanderwater-2	camp	n/a
42	AlGh-7	Attersley	camp	n/a
43	AlGh-50	K. Kidd	camp	n/a
44	AlGg-1	Goodman	camp	n/a
45	AlGg-2	Bartman	camp	n/a

Table 48. Continued.

No.	Borden No.	Site	Site Type	Size (ha)
46	AlGg-3	Duetta Mound	camp	n/a
47	AlGg-4	Cherry Valley	camp	1.0
48	BbGg-2	Martin	camp	n/a
49	BbGg-4	Martin	camp	n/a
50	BbGg-6	Alkenbach	camp	n/a
51	BbGg-10	Embry	camp	n/a
52	BcGp-1	Lawrie	camp	n/a
53	BdGq-1	Cottage of the Year	camp	n/a
54	BcGt-2	Corin's	village	n/a
55	BcGt-1	Bristow	camp	n/a
56	BbGt-1	Pefferlaw	camp	n/a
57	BbGs-11	Markson/Nessim	camp	n/a
58	BaGv-8	McMillan	camp	n/a
59	AlGt-11	Brookwoods	camp	n/a
60	BcGx-1	Johnston #1	camp	0.8-1.2
61	BcGx-4	Bridge	camp	n/a
62	BcGx-5	Dominici	camp	n/a
63	BcGx-6	Fisherman	camp	0.8
64	BcGx-8	New Flos	camp	0.25
65	BcHa-20	Wasaga Beach II	camp	0.12
66	BcHa-23	Blueberry Field	camp	0.02
67	BcHa-27	Hitching Post	camp	n/a
68	BcHa-32	Jacques Rousseau	camp	n/a
69	BcHa-36	Klondike Park	camp	n/a
70	BcHa-37	Racetrack	camp	n/a
71	BcHa-46	Blueberry Field Two	camp	n/a

No. refers to Figure 44 site locations. This table is the key for Figure 44. Data from registered site files, Ministry of Culture and Communications, Toronto.

burial mounds and shell middens (Spence and Pihl 1984).

Burial counts cannot provide Middle Woodland census data either. Middle Woodland burial mounds generally grew by accretion over several centuries and contain the total dead from an unknown population that accumulated over an unknown span of time (Spence et al. 1984:124).

There are three potential methods for approximating the maximum momentary population for the Middle Woodland of south-central Ontario:

1) Carrying capacity
2) Regional population density
3) Archaeological site cluster counts.

Carrying capacity for Middle Woodland south-central Ontario is best calculated with reference to the supply of white-tailed deer. Deer were extremely important to the prehistoric peoples of the Northeast because they constituted the main source of animal protein and were almost exclusively the source of hides for winter clothing (Gramly 1977; Keene 1981). The density of white-tailed deer in Southern Ontario varies from 4 to 11 deer per square kilometre (Starna and Relethford 1985). Prior to European land clearance, however, deer densities would have been less - from 4 to 7.6 deer per square kilometre (Starna and Relethford 1985). With an annual per person requirement of 3.5 hides (Gramly 1977:602-603), a regional Middle Woodland band of 450 people would require 1,575 deer per year. At a 50% cull rate, the band's hunting territory would have been 400-800 square kilometres in size. Thus, the maximum number of Middle Woodland people that the deer resources of south-central Ontario (18,875 square kilometres) could have sustained are 9,450 - 18,900. These are ridiculous totals as they imply a population density five to ten times higher than any other hunting-gathering group in eastern North America (Asch 1976:57-59; Clermont 1980; Snow 1981:113). They also presume that the total population was near the maximum carrying capacity of the region which, as we have already argued, rarely, if ever, happens.

Hunter-gatherer population densities in the Northeast have been estimated by Dean Snow (1980; 1981:113) for the early seventeenth century : 0.1 - 0.15 persons per square kilometre. Norman Clermont (1980), in his study of Iroquoian population growth, used a value of 0.14 persons per sq. km. for Middle Woodland times. Applying these densities to the area of south-central Ontario (16,875 square kilometres) yields 1,680 - 2,360 persons - a far more satisfying result than the carrying capacity totals.

The distribution of known Middle Woodland archaeological sites suggests 5-6 regional band clusters west to east: Nottawasaga, Toronto, Eastern Lake Simcoe and Victoria County, Rice Lake, Moira River, and Prince Edward County (see Figure 44). Simple multiplication of the number of regional bands (5.5) by average band size (450 persons (Wobst 1974)) yields a total of 2,475 persons, independently supporting the population density estimates. In summary, the most likely estimate of the late Middle Woodland (i.e. A.D. 200-500) population of south-central Ontario is 2,000-2,500 persons.

Obviously, such estimates ignore the possibility of population growth during Middle Woodland times. Norman Clermont (1978, 1980) has proposed that Early and Middle Woodland populations in Quebec grew continuously at a very slow rate, about 0.08% per annum. Michael Spence and William Fox (1986:38) suggest that Ontario Middle Woodland population also grew. The evidence for such growth, however, is tenuous. Clermont's inference is based on demographic rates of increase and population pressure assumptions. The inference of Spence and Fox proceeds from archaeological data - the number, size, and distribution of Middle Woodland sites in Southern Ontario are greater than those for Early Woodland sites. However, Spence and Fox (1986) admit that population growth may have been only one of several factors contributing to the greater number, size, and visibility of Middle Woodland sites. The relatively long duration of the Middle Woodland period and subsistence and sociopolitical reorientation to larger and more sedentary settlements could have produced an archaeological illusion of substantial population growth. While it is entirely possible that the Middle Woodland population of south-central Ontario was increasing, accurate estimates of regional population size for Early and Middle Woodland await the results of more intensive regional surveys and more precise site dating.

Palaeodemographic data do not indicate any substantial change in demographic rates from the Late Archaic (3000 B.C. - 1000 B.C.) to the end of the Middle Woodland period (A.D. 500). Late Archaic skeletal populations are characterized by low life expectancy (e0=19 years; e15=18-24), high infant and juvenile mortality (43-45% of burial populations less than age 15), frequent episodic (annual) stress (average 8-11 Harris lines in young adults with lines), and a low rate of dental caries (0.4-2.5%) but a high incidence of periodontal disease (Cassidy 1984:324-326; Cook 1984:250,257; Hartney 1978:108-109; Patterson 1984:70; Perzigian et al. 1984; Pfeiffer 1985; Sciulli and Aument 1987). Early and Middle Woodland skeletal populations exhibit similar characteristics: low life expectancy (e0=18-25 years), high infant and juvenile mortality (40% of burials less than age 15), moderate annual stress (average of only 3.5 Harris lines in young adults with lines), and a relatively low rate of dental caries (2.5-13%) (Asch 1976; Buikstra et al. 1986; Cook 1984:250,257; Patterson 1984:176,313; Perzigian et al. 1984; Spence et al. 1984).

Although prehistoric fertility rates cannot be known with any precision, a relative measure of a skeletal population's fertility, developed by Buikstra et al. (1986) and utilized in this study (see Table 46), reveals a low fertility rate for Middle Woodland populations in Ohio, for which Asch (1976:40) has estimated an average family size of 4.5 members. Family size for early nineteenth-century hunting-gathering Ojibwa groups in Ontario averaged about 4.2 members, including 0.4 grandparents per family (Neal Ferris, personal communication, 1989; Hurlich 1983).

Very low growth rates (0.003-0.01% per annum) would have characterized prehistoric hunting-gathering populations that were geographically-circumscribed (Hassan 1981:193-208; Handwerker 1983; Hayden 1981; Snow 1981). Hunter-gatherers typically have low life expectancies at birth (e0=19-34), very high infant and child mortality rates (40-60%), relatively low adult life expectancy (e15=17-30 for prehistoric groups and e15=19-34 for modern groups), and moderate fertility rates (average completed family size of 4-5 children per adult female) (Handwerker 1983; Hassan 1981:118,134-136; Howell 1979; Weiss 1973:21,50). Prehistoric hunter-gatherers of Southern Ontario would have conformed to such demographic parameters. In addition, crisis mortality would have tended to suppress population growth over the long term. Periodic starvation from late winter famine would have been a fact of life for all hunter-gatherers in the Northeast, particularly when two staple foods, such as deer and wild rice, experienced population crashes in the same year (Clermont 1974; Snow 1981; Steegmann 1983). "The winter hunting season was the time of greatest hardship, danger, and mortality for the whole society" (Trigger 1985b:78). The high frequency of Harris lines in the bones of young adults in Middle Woodland times probably reflects annual late winter famine episodes (Cassidy 1984; Cook 1984). Epidemic disease does not appear to have been prevalent among Middle Woodland groups (Hartney 1978; Pfeiffer 1985), so the predominant causes of death would have been winter starvation (and related deleterious effects of acute starvation (Steegman 1983:249-251)), accidents (Pfeiffer 1985), interpersonal violence, and respiratory and eye infections from winter-life in small, smokey dwellings.

Princess Point and Corn Agriculture

Corn agriculture was introduced to Southern Ontario about A.D. 700, entering via southwestern Ontario or the Niagara Peninsula (Fecteau 1985, 1986). The earliest evidence of corn in south-central Ontario is from the Dawson Creek site near Rice Lake and has a calibrated radiocarbon date of A.D. 615 +/- 25 years (Jackson 1983; Timmins 1985:85). Unfortunately, no diagnostic artifacts were associated with this corn. In light of similar accepted dates (i.e. A.D. 600-800) for the adoption of corn agriculture in neighbouring regions, such as southwestern Ontario (Stothers 1977) and west-central Illinois (Asch and Asch 1985:198-199), an A.D. 700 date for south-central Ontario seems reasonable (Trigger 1985b:83-85).

Eight-rowed Northern Flint (**Zea mays indurata**) was the variety of corn first grown in Southern Ontario. It evolved from cold-tolerant types in the American Southwest and Midwest (Galinat 1985:266). Its peculiar traits were ideally suited to climates of the Northeastern Woodlands: its flinty endosperm acted to buffer it from early frosts and enhanced year-round storage and its loose husks prevented spoilage on the stalk in the rainy autumns (Fecteau 1985:20; Galinat 1985:267). Nutritionally, corn is inferior to wild rice (Adams 1975) and most nut species (Keene 1981:138), particulary with respect to overall protein, calories, calcium, lysine, and tryptophan content. Treatment of corn with lime can ameliorate some of its inherent amino-acid deficiencies (Katz et al. 1975). Alternatively, consuming beans with corn provides a full protein complement (Katz 1987). The fundamental advantages that corn as a staple food source has over "wild" plants are that it can be buffered significantly from unpredictable crashes in productivity, it is easily and efficiently harvested because it can be grown immediately adjacent to settlements, and it can be stored in a dried, shelled state for up to two years (Fecteau 1985:20-22; Heidenreich 1971:195; Trigger 1985b:85). Depending on the favourability of soils and weather, estimated yields of Huron corn agriculture are 910-1,820 kg/ha (15-30 bushels per acre) (Fenton 1945; Heidenreich 1971:189-195, 1974; Sykes 1980).

Beans (**Phaseolus vulgaris**), on the basis of currently available archaeobotanical and isotopic data, did not accompany the introduction of corn to Southern Ontario (Fecteau 1985,1986; Katzenberg and Schwarz

1986). The first archaeologically documented beans in Southern Ontario are at the Dick Farm site in Essex County, in the extreme southwestern part of the province. This is a Younge Tradition (non-Iroquoian) settlement dating ca. A.D. 1020 (Fecteau 1986:10). In south-central Ontario, beans do not appear in Iroquoian sites until the late fourteenth century, for example at the Wiacek site (Lennox et al. 1986). In the absence of beans, corn could only have been consumed as a dietary supplement; a corn-based diet being too deficient in calcium, niacin, and tryptophan and leading to deficiency diseases like pellagra and childhood cortical bone loss (Heidenreich 1971:165-168; Pfeiffer and King 1983). While no terminal Middle Woodland skeletal remains have been subjected to carbon isotope analyses, Early Iroquoian and contemporary remains from New York and the Mississippi Valley indicate that corn comprised on average 20-35% of the diet ca. A.D. 900-1200 (Schwarz et al. 1985:199-200) and meat and fish the remainder (Katzenberg and Schwarz 1986).

In southwestern Ontario, corn agriculture was grafted on to an essentially Middle Woodland settlement-subsistence culture, the result being labelled the Princess Point Complex (ca. A.D. 500-900) (Fox 1982, 1984b; Stothers 1977). No Princess Point components have been discovered in south-central Ontario, but the Lakeshore Lodge site, Prince Edward County (ca. A.D. 915 +/- 60 years (Timmins 1985:85)), has produced ceramics that are transitional between Point Peninsula (Middle Woodland) and Pickering (Early Iroquoian) (Fox 1982:20) wares. Apart from this site, the conditions surrounding the adoption of corn agriculture in this region remain archaeologically unknown. In southwestern Ontario, Princess Point settlements are located on the banks and floodplains of major rivers and sheltered bays of Lakes Erie and Ontario. Deep burial by alluviation prevents accurate size estimates for most Princess Point sites and no house floor plans are extant. Nevertheless, it has been inferred from zooarchaeological and archaeobotanical data that most Princess Point sites represent spring-summer aggregation camps of territorial bands, which were each composed of approximately 100 members (Fox 1984b; Stothers 1977:123-124). According to David Stothers (1977:161-162), a gradual increase in site size and in the quantity of cultural material in each site could either reflect population growth or the coalescence of territorial bands. Unfortunately, the lack of both settlement plans and burial populations precludes resolution of Princess Point population size and growth. On inferential grounds, the absence of full-time agriculture and the continuation of winter dispersal would not have been conducive to large-scale population growth during Princess Point times (Stothers 1977).

The transition to agriculture in Southern Ontario ca. A.D. 500-900 does not appear to have been caused by population pressure. As argued earlier, the Middle Woodland population of south-central Ontario was at only 15-25% of carrying capacity (i.e. using white-tailed deer as the critical resource), hardly a Boserupian situation. Bruce Trigger (1985b:109) proposes that the:

> main reason for adopting a horticultural economy may have been to reduce and finally to eliminate the need to disperse in small hunting groups during the winter.

As mentioned earlier, winter was the most dangerous time of year for Northeast hunter-gatherers. The relatively elaborate burial ceremonialism at spring-summer aggregation camps (assisted by participation in the Hopewellian exchange network) demonstrates that social interaction was highly valued among Middle Woodland peoples (Spence et al. 1984). Yet, each year inadequate quantities of local, storable foods demanded the breakup of spring-summer bands into small extended nuclear families, who then had to fend for themselves in winter bush camps. Each year, winter starvation would have claimed the lives of several band members. Consequently, any storable food that could have reduced the number of winter deaths from starvation and related illness would have been readily adopted. Because it was dependable, storable, and a good source of carbohydrates over long cold winters, corn gradually replaced less reliable wild rice and nuts and eventually permitted year-round settlement (Trigger 1985b:85-86). Thus, the first semi-permanent agricultural settlements of the tenth century A.D. in Ontario probably each consisted of a territorial patrilineal band, ranging in size from 50 - 150 persons (Spence et al. 1984; Trigger 1976:134).

Early Iroquoian Population Growth

The Auda site (A.D. 905 +/- 125 (Timmins 1985:86)) is the earliest dated Iroquoian settlement in south-central Ontario. Rescue-excavated in 1979 (Kapches 1981b), it was a 0.24 ha unpalisaded village containing 10 poorly-preserved houses, averaging seven metres long, with two hearths per house. Assuming contemporaneity of all houses and two families per hearth (10 persons per hearth) yields a site population of about 200. Kapches (1981b:73-75), however, proposes a population of only 92 persons, arguing that roofed floor areas are more similar to Middle Woodland values than Iroquoian ones and that each hearth was used by only a single family of four people. Extremely poor preservation and confusing arrays of post molds prevent an assessment of the contemporaneity of houses and of the actual population of the Auda village. Nevertheless, the range in population estimates includes the expected size of a Middle Woodland patrilineal band (i.e. 150 persons), suggesting that the first agricultural settlements in south-central Ontario were merely year-round aggregations of earlier territorial hunting bands (Spence et al. 1984), i.e. macrobands of 150-250 people (Kapches 1981b:82-83; Trigger 1976:134; 1985b:86).

Early Iroquoian or Pickering villages had an average size of only 0.46 ha (Table 28). The average house was 12.4 metres long and contained 2-3 central hearths (Dodd et al. 1988:19,22). Known sites are arranged in three clusters that occupy the sands and sandy loam soils bordering the north shore of Lake Ontario (see Figures 45-48). As argued in Chapters 5 and 6, however, the distribution of Pickering sites is biased by irregular archaeological coverage and preferential site destruction. Archaeological survey between Toronto and Prince Edward County, along the shore of Lake Ontario, has been haphazard (Roberts 1978). Further, urbanization and sand and gravel pit operations have destroyed a substantial, but unknown, number of Pickering village sites. The north shore of Lake Ontario was the

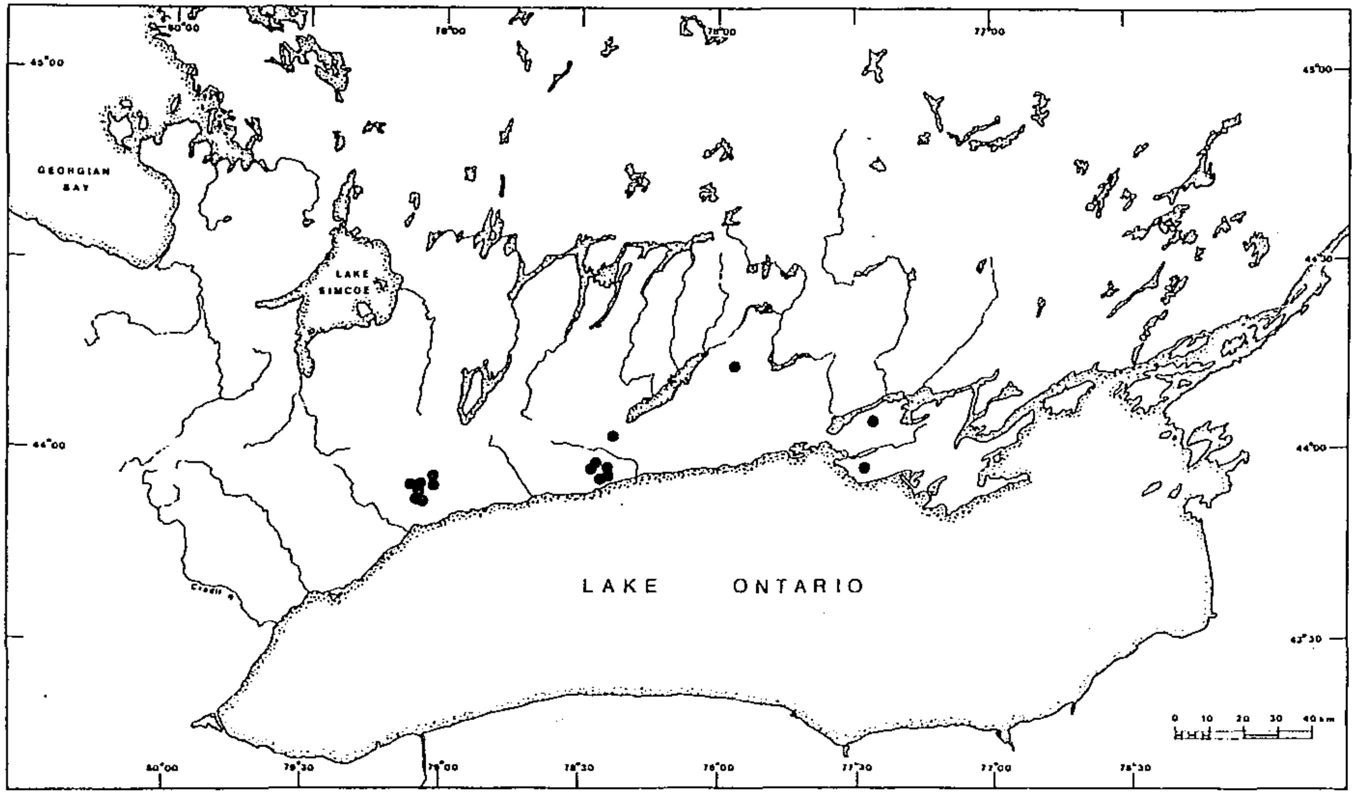

Figure 45. Location of Early Iroquoian village sites in south-central Ontario.

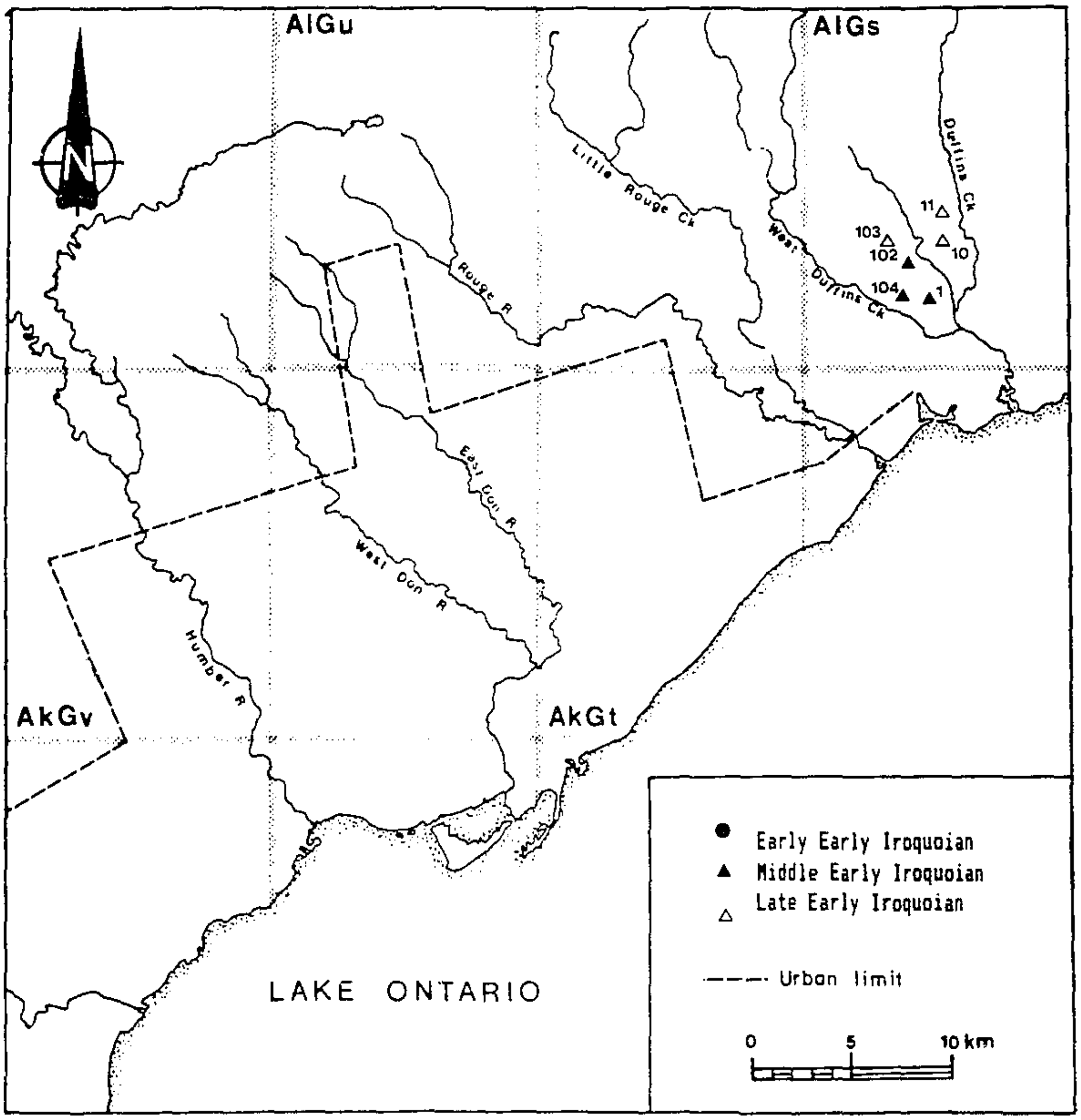

Figure 46. Confirmed Early Iroquoian village sites in the Toronto region.

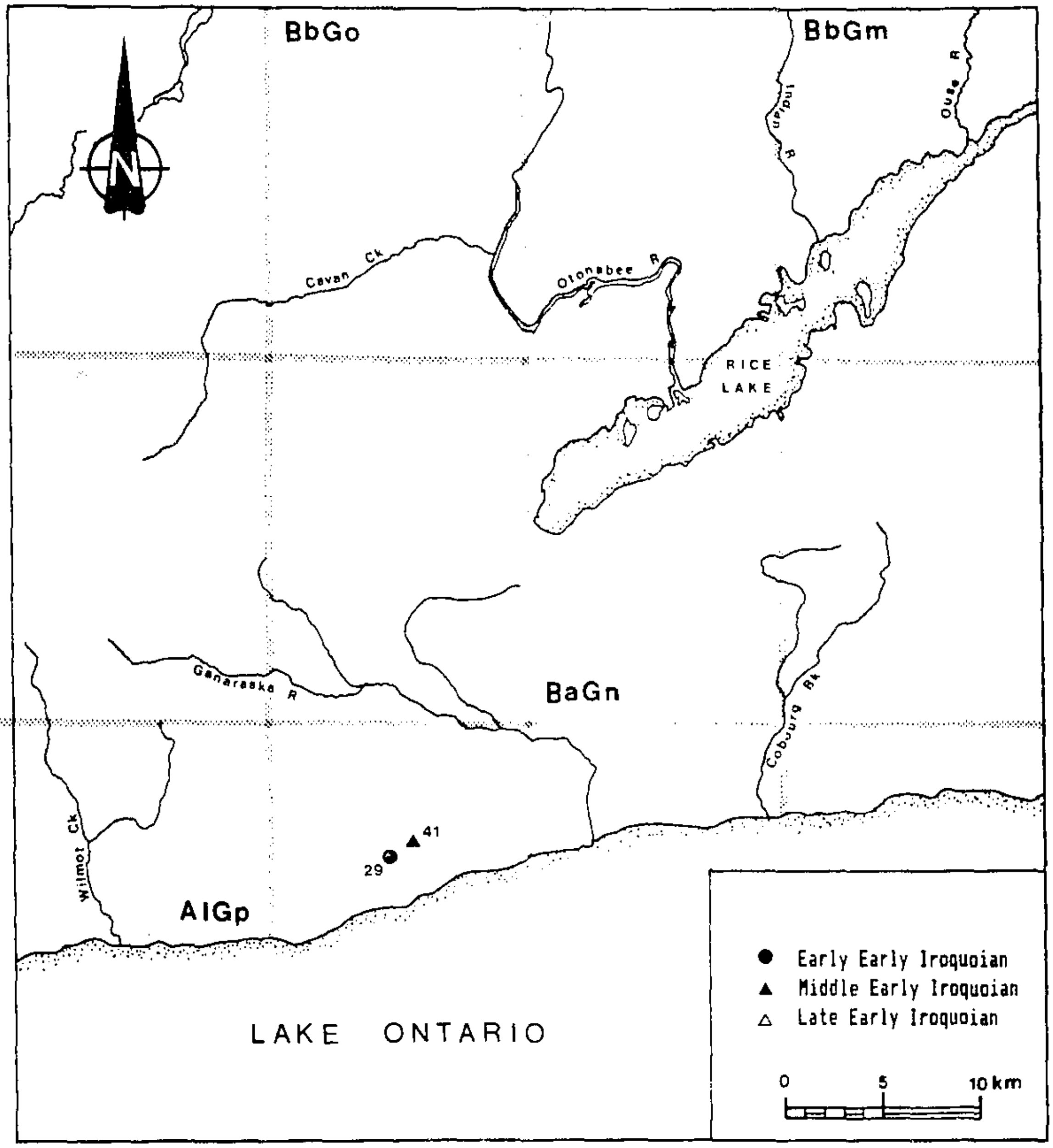

Figure 47. Confirmed Early Iroquoian village sites on the North Shore of Lake Ontario.

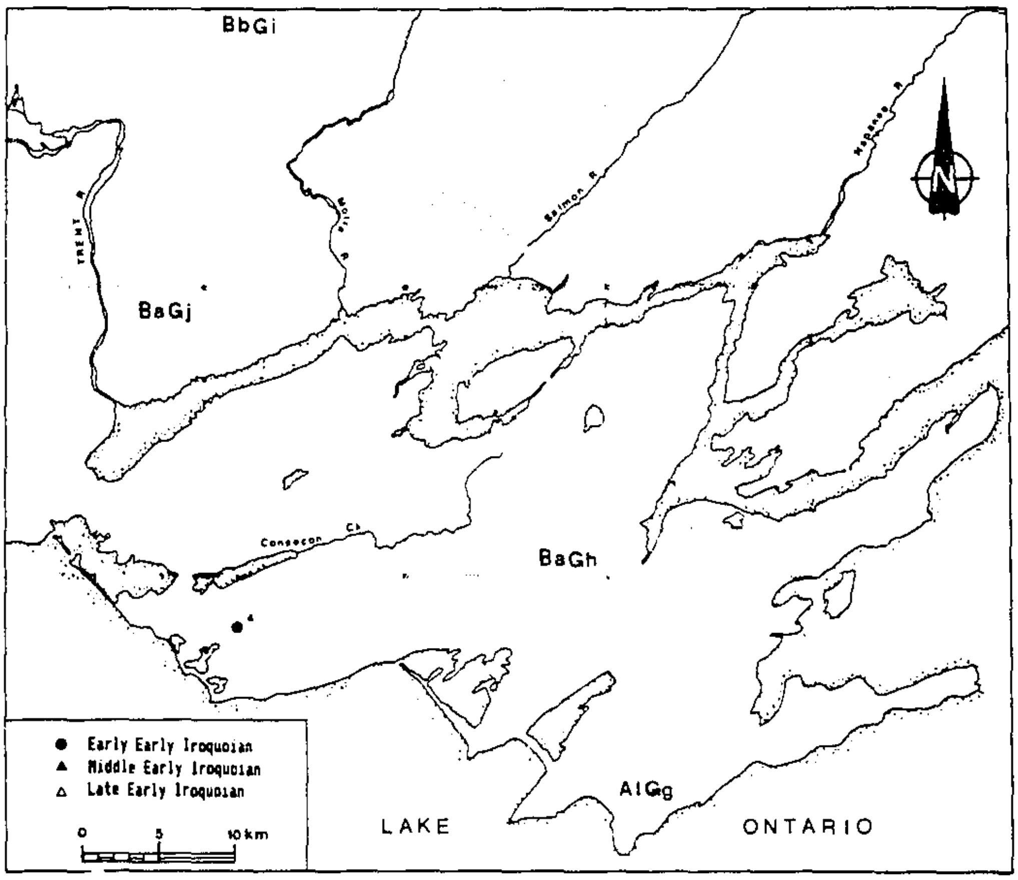

Figure 48. Confirmed Early Iroquoian village sites in Prince Edward County.

first area settled in the early nineteenth century and subsequent urbanization has probably destroyed at least one cluster of Pickering villages in what is now downtown Toronto. Quarry operations led to the accidental discovery of most of the Early Iroquoian sites in Pickering Township, east of Toronto (Ambrose 1981; Kenyon 1968; Reid 1975). Nevertheless, the overall geographical distribution of known Pickering sites essentially reflects reality; in over a century of archaeological survey no Pickering village site has ever been discovered north of the Oak Ridges Moraine.

Pickering village plans are palimpsests of several overlapping longhouses (e.g. Auda [AlGo-29]) and most are surrounded by a palisade (Richardson [BbGl-4]; Miller [AlGs-1]; Boys [AlGs-10]). Longhouses are positioned without apparent concern for conservation of interior village space and a rather loose-knit sociopolitcal organization has been inferred for Pickering communities, possibly already revolving around autonomous matrilocal and matrilineal households (Trigger 1981:25,1985b:88-90; Warrick 1984:59-62). Average community size is estimated at about 200 persons (i.e. 25-30 people per house and 6-8 houses per village).

Population growth is demonstrated throughout the Early Iroquoian period. Pickering population grew steadily from approximately 2,000 to 8,000 persons between A.D. 900 and A.D. 1300. The A.D. 1300 population figure was interpolated from an A.D. 1250 value of 5680 persons and a growth rate of 0.65% per annum (average of 0.51% and 0.80% p.a. rates (see Table 47)). This represents a mean annual growth rate of 0.35 % and a doubling time of 200 years (see Hassan

1981:139-140 for formulae for calculating population growth rates and doubling-times). This is an overall rate, however; from A.D. 900 to A.D. 1125, population increased at a slower pace of 0.18% per annum (Table 47). Population growth occurred between A.D. 1125 and A.D. 1300 at a rapid rate of 0.55 % per annum.

The ultimate cause of population growth in Early Iroquoian times is the adoption and increasing reliance on corn agriculture after A.D. 900. Despite intense debate over the causes of the agricultural revolution (cf. Boserup 1965; Bronson 1975; Cohen 1977; Cohen and Armelagos 1984; Hassan 1981:209-229; Hayden 1981; Smith 1976), it is generally agreed that increasing reliance on agriculture resulted in a dramatic growth in human population. It is also generally agreed (and supported by "natural fertility theory" (Bongaarts 1980)) that, at least in its initial stages, such growth was fueled by increased fertility and decreased juvenile mortality. Increased maternal health was the result of a more reliable food base and decreased birth spacing the result of reduced breastfeeding caused by supplementing infant diets with cereal porridges (Binford and Chasko 1976:137-140; Buikstra et al. 1986; Dumond 1975; Hassan 1981:223-224; Howell 1986:181-184; Kolata 1974; Roosevelt 1984:573-576). Juvenile mortality decreased because stored agricultural food would have reduced the frequency of annual starvation episodes, trimming the peaks off crisis mortality years (Acsadi and Nemeskeri 1970:180-181,187; Angel 1984:62; Bender 1979:210-214; Bronson 1975:68-69; Handwerker 1983; Hayden 1981; Kunstadter 1972; McKeown 1985:42-45 ; Sanders et al. 1979:364-365; Testart 1982:524; Weiss 1973:55). Also, when properly cooked through prolonged boiling, domestic plant foods mixed with small amounts of meat would have ameliorated weanling malnutrition in lean seasons (Buikstra et al. 1986). Prior to accumulating substantial disease loads because of high population density in relatively permanent villages, early agriculturalists enjoyed remarkable health and a high potential for population growth (Roosevelt 1984). This growth would have been especially pronounced among agricultural societies that were not geographically circumscribed and permitted or encouraged economic competition (Hayden 1986). The demand for children is high in such societies (Cowgill 1975a).

The transition to corn agriculture in south-central Ontario was gradual and the result of diffusion. Corn, followed by beans and squash, was imported from southwestern Ontario by the mid-eleventh century A.D., presumably through exchange networks that involved Central Algonkians (Younge Tradition) and Glen Meyer Iroquoians (Fecteau 1986:20). The agricultural revolution in south-central Ontario happened during a climatic episode (ca. A.D. 500-1200) that was slightly warmer and moister than the present (Bryson and Padoch 1980), perhaps explaining why the first agricultural settlements were located on sand plains, which were easy to till but normally prone to drought (Williamson 1985:85). Isotopic analyses of human bone indicate that the amount of corn in the Early Iroquoian diet averaged 30% or less prior to A.D. 1100 but rose dramatically to 50% by A.D. 1300 (Schwarz et al. 1985). An increase in corn consumption after A.D. 1100 is substantiated by a concomitant increase in dental caries (e.g. Serpent Pits (A.D. 1000) skeletons have only 11% caries but those from the Miller site (A.D. 1125) exhibit a 26% caries rate) (Patterson 1984:313). Trends in strontium and nitrogen isotope levels in the same skeletal samples indicate that beans, if they were being cultivated at all, were less important than meat and fish as a dietary source of protein prior to A.D. 1400 (Katzenberg and Schwarz 1986; Schwarz et al. 1985:202-203). Zooarchaeological data, albeit woefully inadequate because of poor collection techniques (i.e. lack of fine sieving and flotation), suggest that Pickering peoples consumed a large proportion of fish, as opposed to other animal protein (Kapches 1981b:84; Pearce 1978:19; Reid 1975:56).

Increased reliance on corn in the course of the twelfth century would have substantially lowered infant and juvenile mortality. Late winter famine deaths, presumably one of the main killers of prehistoric hunter-gatherers in Ontario (Snow 1981), would have been virtually eliminated by stored corn surplus. Moreover, corn mush **in addition to the meat and fish** already being fed to weanlings would have helped to reduce the risk of weanling death from the synergy between malnutrition and infection (Wetterstrom 1986). Weaning infants on corn mush would also have enhanced fertility by decreasing the duration of breastfeeding. Given the correlation between duration of breastfeeding and postpartum ammenorrhea (Bongaarts 1983), and assuming that Early Iroquoians behaved reproductively like their hunter-gatherer ancestors (i.e. a brief period of postpartum abstinence), beginning in the twelfth century, prehistoric Huron-Petun women would have had slightly more children due to closer birth spacing. One further possibility is that the intensification of corn agriculture in the twelfth century may have promoted larger families because of the obvious economic advantages of child labour in agricultural societies (Cleveland 1986:277; Cowgill 1975a).

The virtual lack of Pickering burial populations precludes any palaeodemogaphic inference concerning mortality, fertility, and overall health status. Based on resorptive vertebral lesions on 2/69 (3%) skeletal individuals from Serpent Pits (A.D. 1175) and 1/32 (3%) from the Miller burials (A.D. 1125), there is a distinct possibility that tuberculosis, and presumably other density-dependent infectious diseases, established themselves among late Pickering populations (Hartney 1981). The estimated 40 year duration and year-round occupation of Early Iroquoian villages (Warrick 1988b) would have encouraged the endemicity of faecally-transmitted parasites and related diseases. However, disease loads do not seem to have reached critical levels among the Huron-Petun until the mid-fifteenth century (Pfeiffer 1984).

Uren Colonization

Pickering material culture underwent rapid transformation between A.D. 1300-1330, the Uren phase of Ontario Iroquoian prehistory (Dodd et al. 1988; Poulton 1985; Timmins 1985; Wright 1966:54-59; M. Wright 1986). In particular, horizontal pottery decoration became universal among Iroquoian groups in Southern Ontario (Dodd et al. 1988; Wright 1966:57) and the average size of both houses and villages increased dramatically (Dodd et al. 1988). While no excavated village or house plans are available for south-central Ontario, data on Uren settlement sites (e.g. Bennett (Wright and Anderson 1969), Gunby (Rozel 1979), Uren (M. Wright 1986), and Willcock (Poulton 1985)) indicate a mean longhouse length of 28 metres (range of 6-45 metres) (Dodd et al. 1988:19). Average village size for south-central Ontario is 1.0 ha (n=7 and range of 0.2-2.0 ha). In less than half a century late Early Iroquoian settlements (n=4 with mean size of 0.6 ha (range 0.4-1.2)) and houses doubled in size. By A.D. 1330, the Uren population numbered almost 11,000 people, representing an increase of 0.80% per year from A.D. 1250 totals (Table 47). Population growth alone, however, does not account for the doubling of settlement and house size. Instead, the archaeological reconstruction of regional site sequences in southwestern Ontario suggests that increased house and village size during the Uren period occurred primarily as a result of the accretion of two or more smaller villages (Pearce 1984; Williamson 1985), supplemented by the addition of new family units due to natural increase.

Population growth in the early fourteenth century was simply a continuation of thirteenth century trends towards lower crisis mortality and higher fertility, both consequences of increased reliance on corn agriculture as explained in the previous section and by other researchers (Noble 1975; Pearce 1984:285-290). Archaeological plans of Uren villages, however, reveal a fundamental difference in sociopolitical organization. Unlike Early Iroquoian sites, which often display several longhouses overlapped by other houses and palisade lines, and sometimes the superimposition of entire village occupations (e.g. Glen Meyer sites like Calvert (Timmins 1987) and Elliott (Fox 1986)), Uren village sites are single-component, appear to have shorter occupation spans than Early Iroquoian sites (30 years as opposed to 40 years or more (Warrick 1988b)), and contain a number of non-overlapping longhouses of highly variable length arranged in two or more clusters with parallel alignment (e.g. M. Wright 1986). The relatively large size and aligned longhouses of early fourteenth century Iroquoian villages have been interpreted as the crystallization of formal matrilineages and the beginnings of clan organization in both Ontario (Pearce 1984:299; Trigger 1985b:92-94; Warrick 1984:66; M. Wright 1986:63) and New York (Engelbrecht 1985:16; Niemczycki 1984:85-89).

Community size during the Uren phase would have averaged 400-500 people and begun to strain the sociopolitical mechanisms that govern egalitarian communities below a normative size of 350 to 450 people (Forge 1972:370-375). Village fission, a common occurrence among tribal societies experiencing growth, now appears to have been the safety valve used by the prehistoric Huron-Petun to relieve the pressure of over-sized communities, beginning about A.D. 1300. Because of geographical constraints imposed by Lake Ontario and the poor agricultural soils of the Oak Ridges Moraine (Chapman and Putnam 1984), sociopolitical constraints imposed by the hunting territories of neighbouring Iroquoian groups to the east and west, and ecological constraints imposed by deer densities (assuming deer hides were the primary source of winter clothing (Gramly 1977)), newly-created Uren communities were forced to hop over the Oak Ridges Moraine and

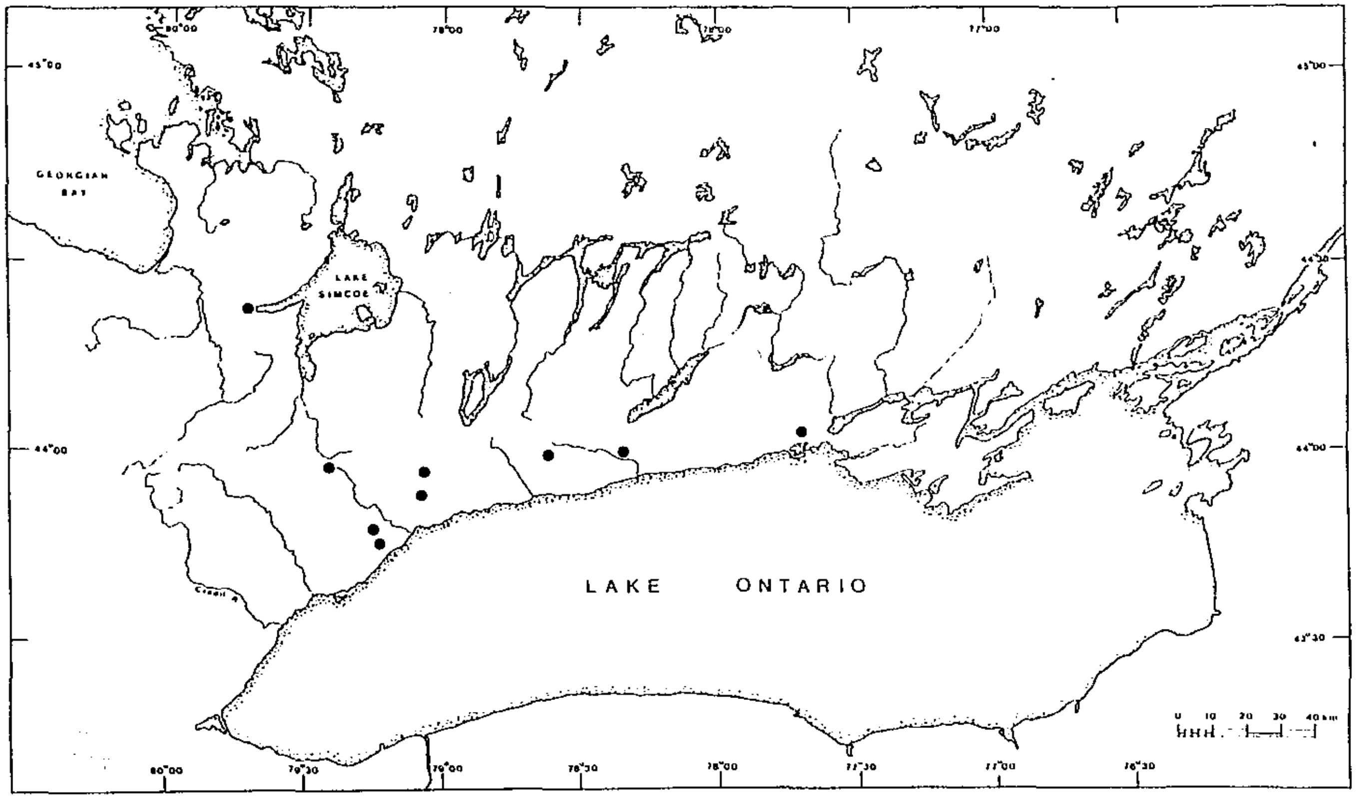

Figure 49. Location of Uren village sites in south-central Ontario.

colonize climax forest in the sandy uplands of southern Simcoe County (Warrick and Molnar 1986). With densities of 4-7.6 deer per square kilometre, the north shore of Lake Ontario, bounded by the Oak Ridges Moraine, the Credit River, and eastern margin of Prince Edward County (approximately 6000 square kilometres in total area), could have supported enough deer for only 3300-6300 people dependent on the herds for clothing, assuming a 50% kill rate and a demand for 3.6 hides/person (Gramly 1977; Starna and Relethford 1985). Sometime between A.D. 1250 and A.D. 1300, the Huron-Petun population exceeded this critical threshold. The low frequency of deer bone (<10% (Kapches 1981a)) in settlement sites such as Thomson [AkGt-20] and Elliot [AkGt-2] indicates that deer were becoming locally scarce in the Toronto region by the early fourteenth century. Local extirpation of deer herds would have exacerbated this situation, forcing certain communities to hunt for deer at great distance from their settlements or to relocate farther north. The Wilcox Lake site [AlGu-17], on the southern edge of the Oak Ridges Moraine, is probably one of the Uren communities that adopted the latter option. Only after A.D. 1300, however, did Uren phase communities relocate beyond the Oak Ridges Moraine. Over a century of archaeological research has failed to discover any **village** site in Simcoe County dating earlier than A.D. 1275. In fact, the Barrie site [BcGw-18], a 1.0 ha village situated at the terminus of Kempenfelt Bay (Figures 49 and 54), is the only documented Uren phase village north of the Oak Ridges Moraine (Ridley 1958). Thus, the historic heartland of the Huron-Petun, Simcoe County, was not permanently settled by Iroquoians until the early fourteenth century, 400 years after the initial adoption of corn agriculture.

Alternative explanations for the amalgamation and long-distance migration of certain Uren communities are warfare (Trigger 1985b:96-99; Wright 1966; Wright and Anderson 1969), trade (Hayden 1978), and climatic change (Warrick 1984:65). However, none of these is supported by archaeological evidence. Rather than the result of a bloody conquest of Glen Meyer by Pickering peoples (Wright and Anderson 1969), the Uren phase transition appears to have occurred relatively peacefully (Pearce 1984; M. Wright 1986). Furthermore, a re-evaluation of the origins of Ontario Iroquoian tribal warfare reports no clear archaeological evidence for cannibalism, defensive fortifications or defensive siting of villages during the fourteenth century (Warrick et al. 1987). There is also little material evidence for exchange during the early fourteenth century, except for the importation of Onondaga chert blanks into south-central Ontario (Bill Fox, personal communication 1989). Trade in perishables, such as corn, fish, hides, and nets, between Iroquoians and northern hunter-gatherers (Trigger 1976:165-168) is inferred to have begun in Early Iroquoian times, perhaps as early as the eleventh century A.D. (Wright 1966:101). Pickering and Uren-style pottery has been recovered from the Frank Bay site on Lake Nipissing, probably a Nipissing summer aggregation camp (Trigger 1976:170). Several other Algonkian sites in Northern Ontario have yielded Iroquoian pottery (Trigger 1976:170-171). The presence of Iroquoian pottery in Northern Algonkian sites indicates direct contact between the two groups, probably trade. Just where the actual trading occurred is not known, although t[illegible]overy of short-term camps occupied indisputably by late Pickerin[illegible] Uren people, such as the Methodist Point site on Georgian Bay (Smith 1979) and the Mystery site (Warrick 1988a) in Barrie, suggest that trade may have been initiated in Simcoe County. Nevertheless, it is difficult to see how low volume exchange in consumables rather than rare wealth items would have promoted economically-competitive Iroquoian households and lineages, ultimately resulting in long-distance migration and the emergence of large communities (cf. Hayden 1978,1979; Hayden and Cannon 1982).

The onset of a cooler and perhaps drier climate ca. A.D. 1200-1300 (Bryson and Padoch 1980) in the Great Lakes region has been invoked as a potential cause of the abandonment of sandy soils and the northward movement of Uren villages (Warrick 1984:65). However, 75% of all Uren phase sites are situated on loamy sands or sandy loams (Dodd et al. 1988), hardly an abandonment of such soil groups. Moreover, if the climate truly had become cooler and drier after A.D. 1300, the migration of an entire Uren community in the Toronto region 60 km **north** and its reestablishment on **sandy soils** near Barrie defies explanation.

Palaeodemography and palaeopathology are poorly documented for Uren times because of inadequate burial populations. The Tabor Hill ossuary [AlGt-5], believed to have been associated with the Uren phase Thomson [AlGt-20] village, was excavated in the early 1950s and yielded 523 individuals from two pits (Churcher and Kenyon 1960). Unfortunately, the palaeodemographic analyses are so incomplete that life table construction and estimation of vital rates are not possible (Jackes 1986:35).

Middleport Population Explosion

The Middleport phase of Huron-Petun developmental history, A.D. 1330-1420 (Dodd et al. 1988; Warrick and Molnar 1986), witnessed a veritable population explosion; in less than a century population jumped from 11,000 to 29,000 persons (Table 47), representing a growth rate of 1.07% per annum, which has rarely been equalled for Neolithic societies (see Table 5). Earlier researchers (Noble 1975:44; Fecteau 1986; Trigger 1976:143; Warrick 1984:62-63; Wright 1966:59), based on disparate types of data, had suspected that the Ontario Iroquoian population grew in the fourteenth century but no one had anticipated such **rapid** growth. Norman Clermont (1980:162), for example, proposed a constant rate for Iroquoian population increase between A.D. 1250 and A.D. 1500 of only 0.08% per annum. Moreover, suggested economic causes of Middleport population growth, such as increased reliance on corn (Wright 1966) or the introduction of beans (Noble 1975), are not borne out by palaeodietary (Schwarz et al. 1985) or archaeobotanical (Fecteau 1985,1986) data. The Middleport people occupied almost every habitable niche of south-central Ontario, except for Victoria County and the historic Petun region (see Figures 50-54). Only 53% of Middleport village sites are situated on sandy loam soils, the remainder occupy heavier loams (Dodd et al. 1988:21). The average village covered an area of 1.2 ha (n=53, range 0.3-3.0 ha) and contained a dozen or so longhouses with a mean length of 33.1 metres (n=18, range 12-45 metres (Dodd et al. 1988:22)). Thus, Middleport houses were only seven metres longer than those of Uren times, implying that burgeoning matrilineages were accommodated in a greater number of houses, not in increasingly larger ones. Likewise, Middleport and Uren community size is roughly equivalent, except that a few sites exceed 2.0 ha, particularly in the Late Middleport phase. This would translate into a village population of over 1,000 people, implying that late Middleport communities must have been governed by a council composed of representative leaders from constituent clan segments (Trigger 1985b:93).

Why did Middleport population increase at such a rapid pace? The potential of small groups of young, healthy humans to rapidly colonize virgin land is well-known to demographers and archaeologists (Ammerman and Cavalli-Sforza 1984; Hammel and Howell 1987:146; Hassan 1981:193-208). Referring to Figure 54, Middleport population growth occurred primarily in Simcoe County. The prehistory of Simcoe County displays a marked hiatus in human occupation between A.D. 500 and A.D. 1300. Although this might be only an apparent hiatus, reflecting the tendency of previous archaeological work to concentrate on large agricultural village sites, it is unlikely that the low density of large mammals in the prehistoric climax forest uplands of Simcoe County could have supported large bands of hunter-gatherers (Lennox et al. 1986:165-166). While short-term exploitation by local Algonkian hunter-gatherers or by seasonal long-distance forays to the interior and lakeshores of Simcoe County by Early Iroquoian hunters and fishermen from the sixth to fourteenth centuries A.D. is not

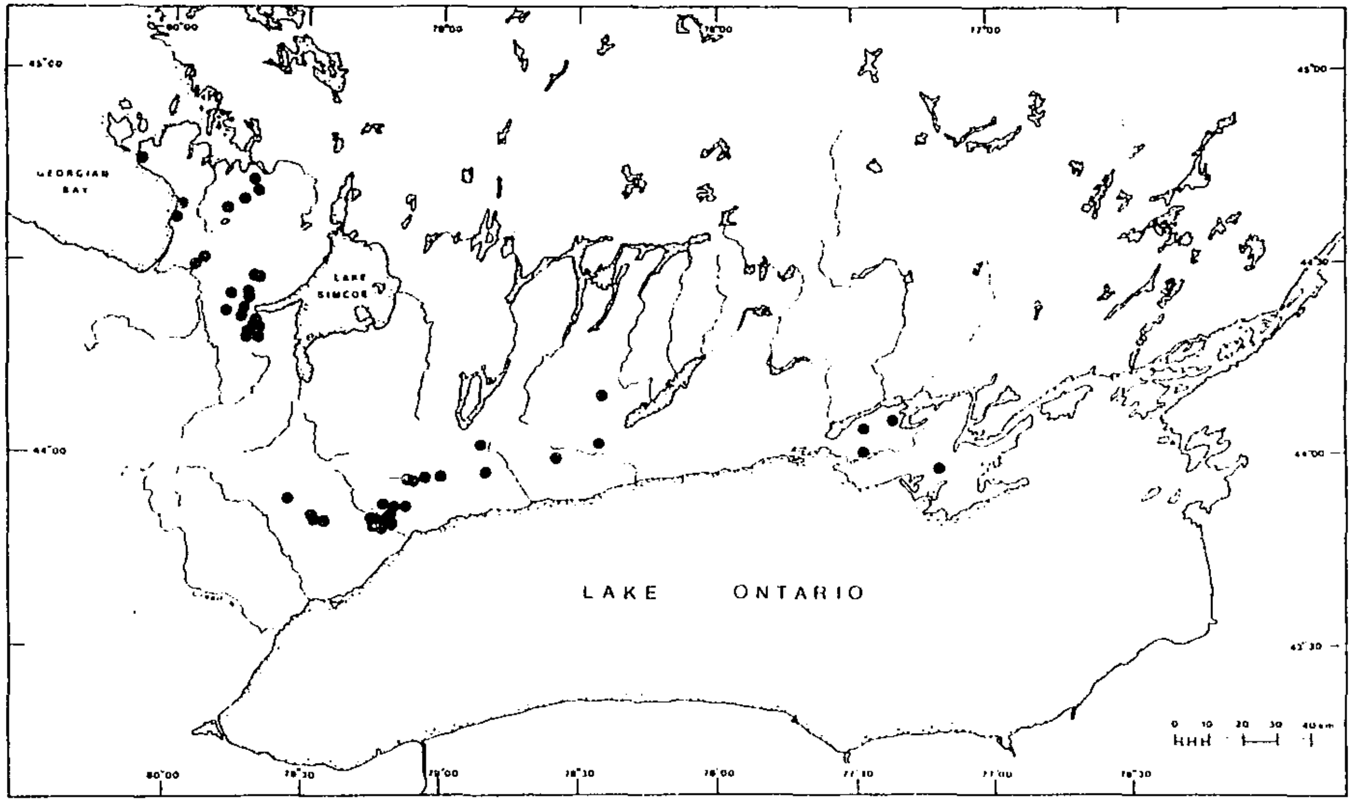

Figure 50. Location of Middleport village sites in south-central Ontario.

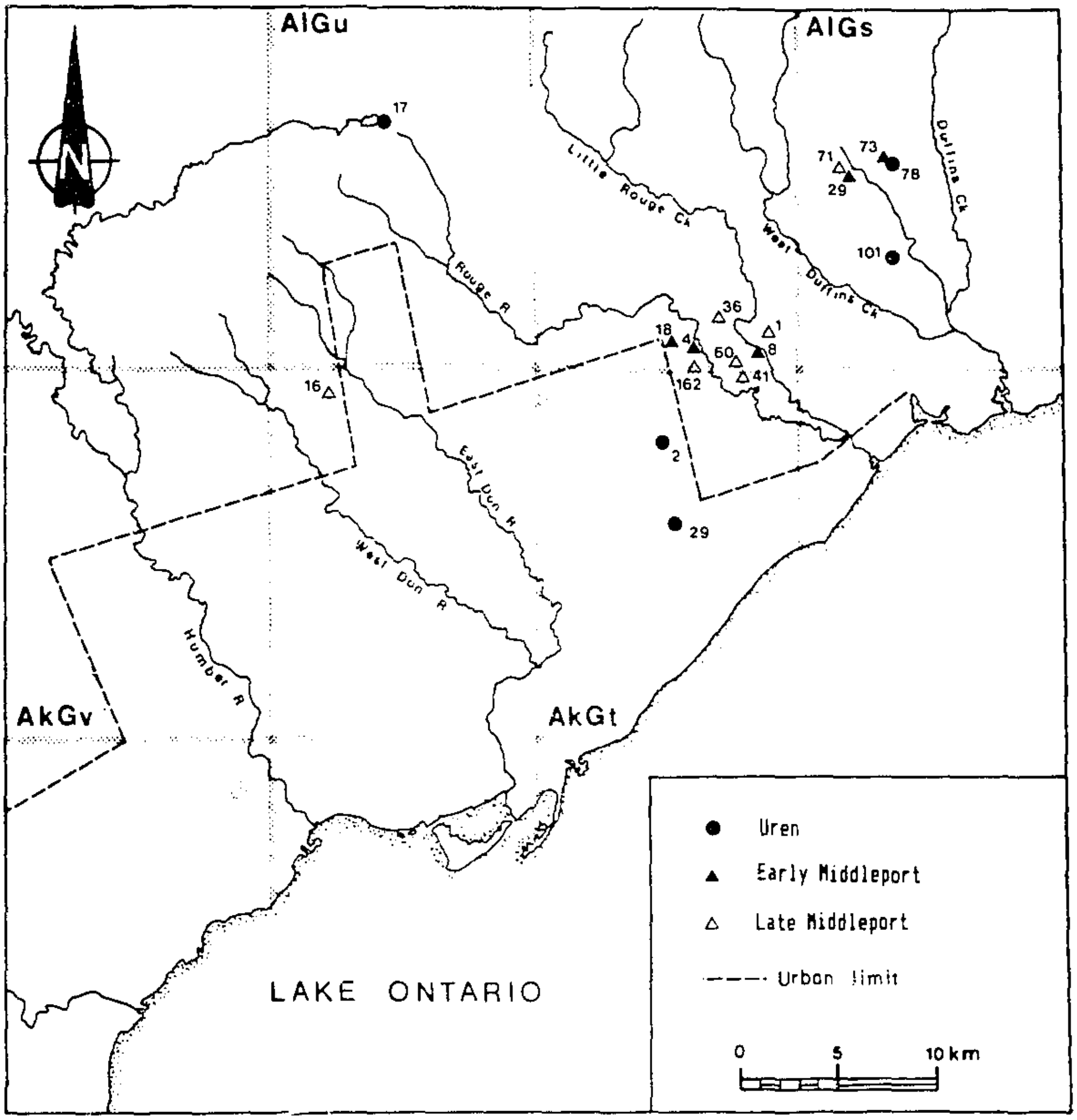

Figure 51. Confirmed Middle Iroquoian village sites in the Toronto region.

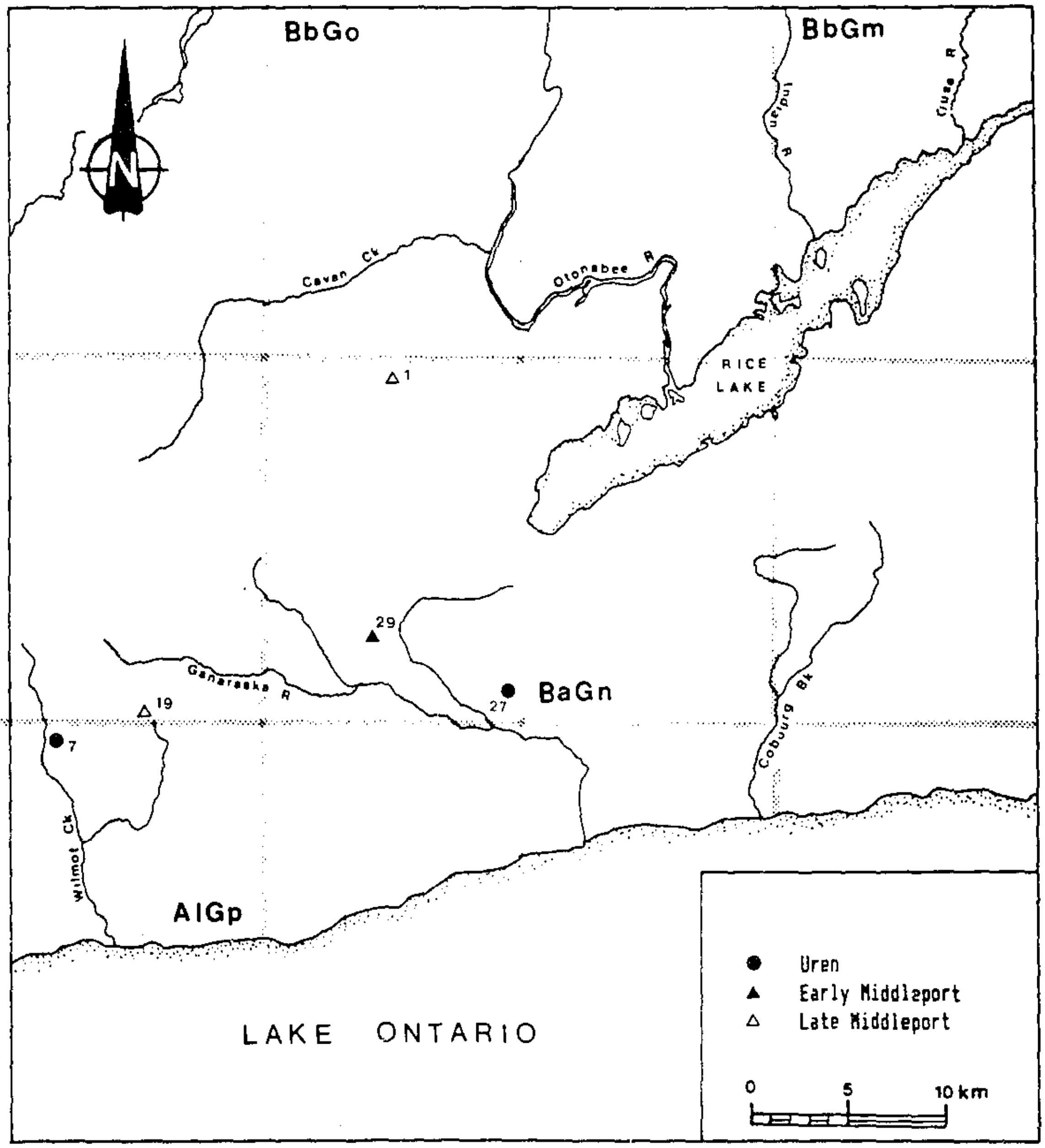

Figure 52. Confirmed Middle Iroquoian village sites on the North Shore of Lake Ontario.

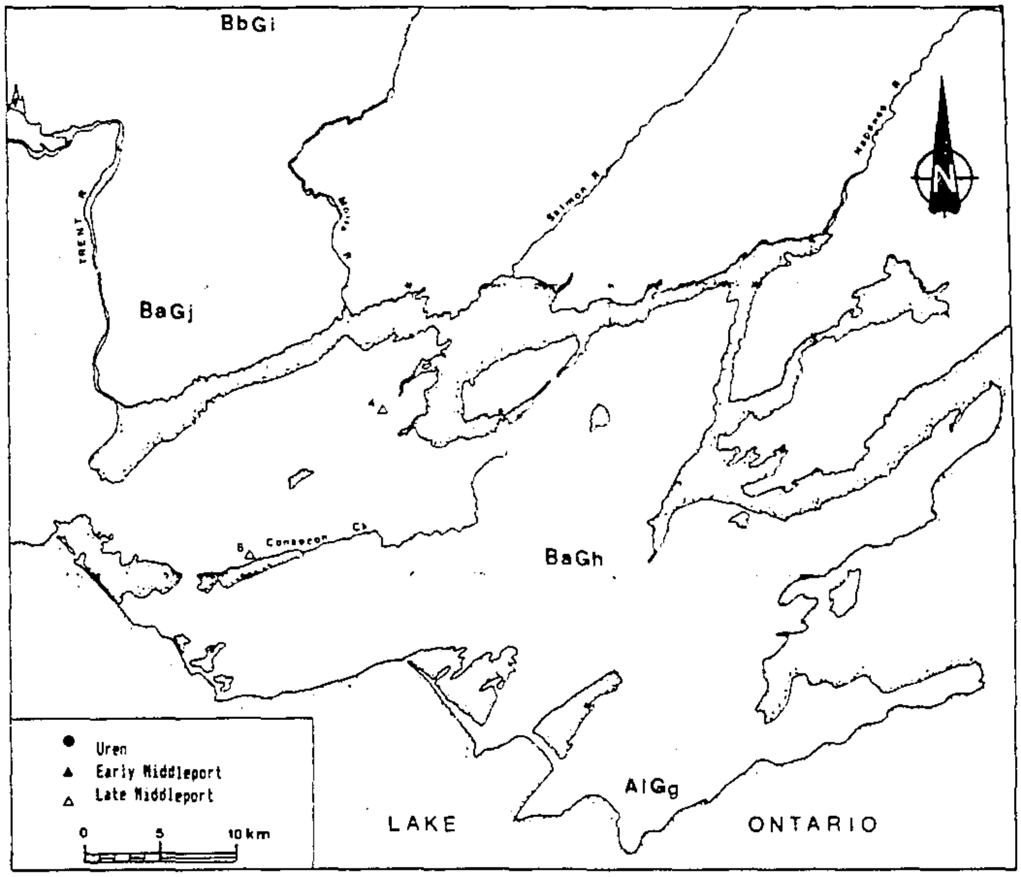

Figure 53. Confirmed Middle Iroquoian village sites in Prince Edward County.

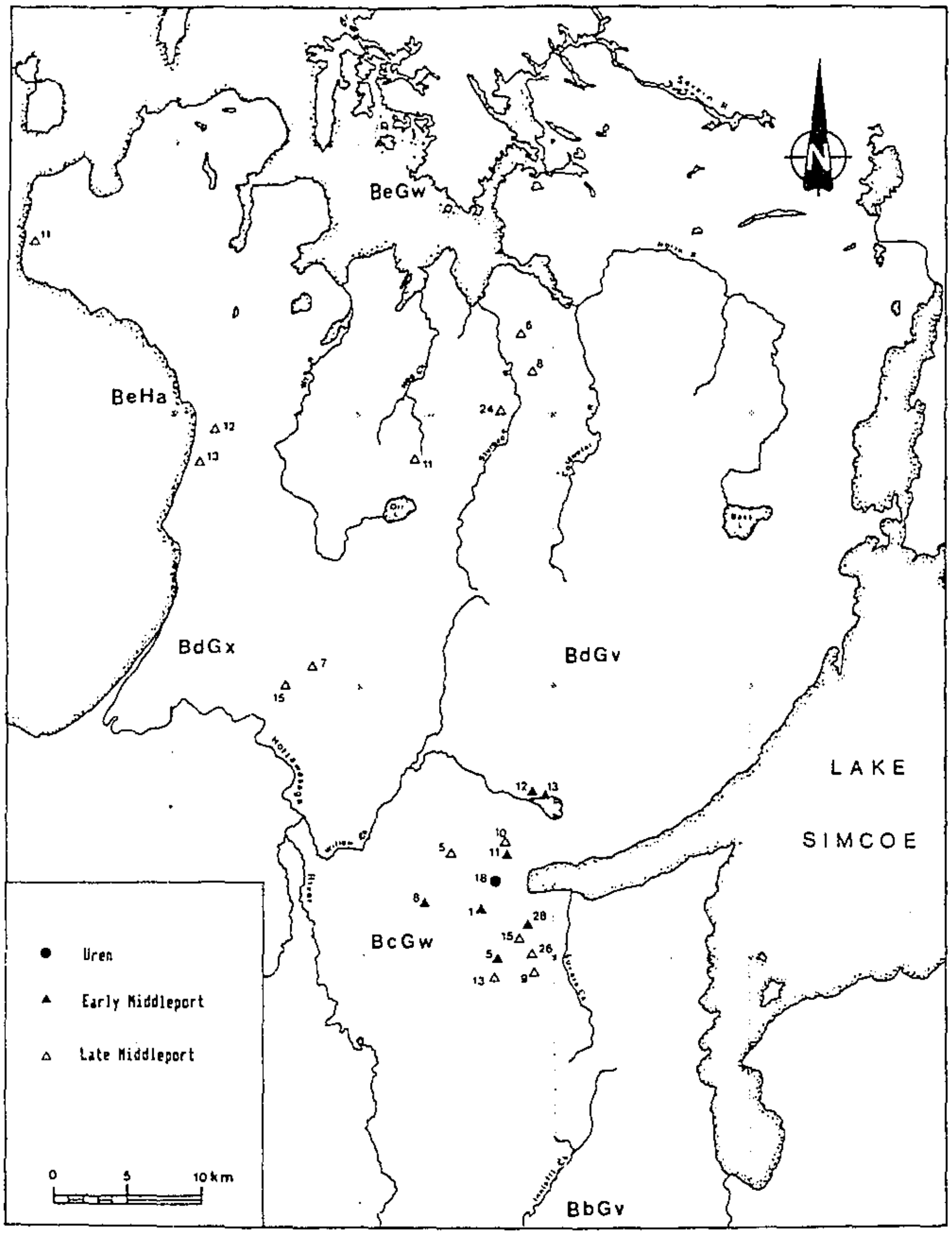

Figure 54. Confirmed Middle Iroquoian village sites in Simcoe County.

ruled out, palaeoenvironmental evidence from the Wiacek site [BcGw-26], a late Middleport village in southern Simcoe County, indicates that Middleport settlers were forced to clear fields out of mature maple-beech forest (Lennox et al. 1986). Thus, the first Uren villages (e.g. Barrie [BcGw-18] and Little II [BcGw-28]) in Simcoe County were true agricultural colonies.

The temporal-spatial distribution of Middleport settlements in Simcoe County represents a bidirectional expansion from a centre near present-day Barrie, at the end of Kempenfelt Bay, Lake Simcoe (see Figure 54). In southern Simcoe County, the relocation distances of Middle Iroquoian villages averaged 2.4 km/generation or only 0.1 km/year. In northern Simcoe County, however, the mean generational movement of early Middle Iroquoian villages was 27 km (five village relocations ranging 20-36 km [see Figure 54]) or about 1 km/year - conforming perfectly with a "Wave of Advance" model of population growth and expansion into a new environment (Ammerman and Cavalli-Sforza 1984). In fact, the similarity between the Middle Iroquoian settlement of northern Simcoe County and the Linearbandkeramik settlement of Central Europe is striking. Both were swidden agriculturalists in temperate forests; both populations were expanding rapidly (1.1 - 1.5 % per annum); and new villages were established each generation about 25 km from the old ones (Ammerman and Cavalli-Sforza 1984:57,72-78,155). Moreover, the Middle Iroquoian population explosion is best described by a logistic or S-shaped saturation growth curve (Figure 43), the type predicted by the "Wave of Advance" model. In summary, archaeological evidence (i.e. the sudden appearance of agriculture, Iroquoian material culture, and village settlement, and a rapid population growth rate favours a demic diffusion (Iroquoian migration) as opposed to a cultural diffusion (Iroquoianization of local hunter-gatherers) model for the Middle Iroquoian settlement of Simcoe County.

In addition to rapid population growth, the fourteenth century in south-central Ontario was a time of rapid culture change. The appearance of ossuary burial, an elaborate smoking pipe complex (Smith 1987), sweatbaths (MacDonald 1988), large longhouses clustered in aligned groups in large communities, and a new universal horizontal decorative motif on pottery suggest that fourteenth century Huron-Petun as well as their Neutral neighbours were developing more complex sociopolitical units, such as clans, in an effort to integrate large unwieldy communities (Engelbrecht 1985; Trigger 1985b:93-94).

Palaeodemographic data suggest that high fertility and declining infant and juvenile mortality was responsible for the Middleport population explosion. Recent palaeodemographic work (Buikstra et al. 1986; Jackes 1986) has formulated relative measures of fertility and juvenile mortality from abridged life tables. Applying these measures to the Fairty, Uxbridge, and Kleinburg ossuary life tables suggests a decline in both fertility and juvenile mortality from A.D. 1350 - A.D. 1600 (Table 46). In other words, the early fourteenth century Fairty population, a growing one, possessed relatively high fertility and declining juvenile mortality rates. The Fairty people (ca. A.D. 1350) were characterized by a life expectancy at birth of 24 years, average adult lifespan of 37 years and 40% of those born reached adolescence. Palaeopathological analyses have identified a 2-3% skeletal incidence of tuberculosis (Hartney 1981), a 14-26% rate of dental caries, a low incidence of trauma (4% healed fractures), and a relatively high rate of osteoarthritis and other degenerative bone disease (20-40%) (Anderson 1963; Patterson 1984).

Late Prehistoric Population Nucleation and Sociopolitical Change

By A.D.1450, the fourteenth century surge in population had slowed to a trickle (annual growth rate of less than 0.4 % per annum), and by A.D. 1475 it had stopped altogether. Huron-Petun population peaked and stabilized at 30,000 people in the fifteenth century (Table 47 and Figure 43). Demographic stability among the prehistoric Huron-Petun was accompanied by a series of interrelated historical events: unprecedented settlement nucleation at both the community and regional level, spread of density-dependent diseases such as tuberculosis, development of trade networks with the Shield Algonkians, formation of tribes, chronic inter-tribal warfare, and the immigration of refugee St. Lawrence Iroquoian communities.

Late Prehistoric communities were substantially larger than Middle Iroquoian ones. On average, Late Prehistoric villages covered 1.7 ha (n=130; range from 0.4-5.4 ha). The largest villages, such as Lalonde [BeGx-19] at a remarkable 5.4 ha and Cleary [BbGw-10] at 4.6 ha, would have held close to 2,500 people apiece! Late Prehistoric longhouses attained incredible sizes too; while there are no fully excavated examples from south-central Ontario, early to mid-fifteenth century Neutral longhouses commonly exceeded 50 metres in length (average 47.8 metres (Dodd et al. 1988:22)), and some reached monstrous proportions, such as the 90 metre Slack-Caswell house (Jamieson 1986), a 93 metre dwelling at the Moyer site (Wagner et al. 1973), and a 124 metre longhouse at the Coleman site (R. MacDonald 1986). Extremely large houses appear to have grown over time by periodic extensions of one or both ends, accommodating two to four new nuclear families per expansion (R. MacDonald 1986:60-63). In certain cases, such as House 1 of the Coleman village site in southwestern Ontario, house extensions doubled original house size (R. MacDonald 1986:32). Over 30% of all fifteenth century houses show at least one extension; in contrast only 8% of Early Iroquoian and historic Huron longhouses exhibit extensions (Dodd 1984:358). In light of the Middleport growth rate of 1.1% per annum, a series of "baby boom" generations would have been created throughout the fourteenth and in the early fifteenth century. Upon reaching maturity and marriage, each "baby boom" generation would have required a large number of new compartments to be added to existing longhouses **within the 30 year lifespan** of each house. Although population growth had ceased by A.D. 1450, demographic inertia (i.e. a bottom-heavy age pyramid characteristic of rapidly-growing populations (Wrigley 1969)) would have continued the trend in house extensions until the early sixteenth century. If martilocal and matrilineage rules were strictly followed in Late Prehistoric times, originally large households in a village would be expected to exhibit the highest number of end extensions. This expectation is borne out in the archaeological record (Dodd

1984:267). Consequently, household immigration or the amalgamation of two or more existing houses need not be invoked to explain Late Prehistoric house extensions (Hayden 1979; R. MacDonald 1986:63).

Concomitant with the growth of longhouses, Late Prehistoric sites expanded to cover areas of 4.0 ha or more. Unlike longhouse growth, which was primarily driven by intrinsic population growth and correspondingly high rates of nuclear family formation, the sudden appearance of massive villages in mid-fifteenth century south-central Ontario probably resulted from the amalgamation of several smaller neighbouring settlements. The Draper village [AlGt-2], for instance, grew from an original core of 1.2 ha to a total size of 4.2 ha (including Draper South Field expansion) by the accretion of five separate settlements during its estimated 35 year lifespan (Finlayson 1985; Warrick 1988b; see Chapter 6 and Figure 32). A similar developmental history is inferred for the early fifteenth century Cleary site [BbGw-10] (Warrick 1986). Based on the appearance ca. A.D. 1400-1450 of the defensive siting of settlements on high ground by forks in streams, as well as multiple-row palisades, scattered human bone in village middens (Warrick et al. 1987), and osteological evidence for death by interpersonal violence (Williamson 1978) in Ontario Iroquoian and St. Lawrence Iroquoian sites, warfare was probably the motivating factor behind such unprecedented growth in settlement size (Finlayson 1985:439; Pearce 1984; Trigger 1985b:98-103). A Huron-Petun population of 30,000 would have seriously impaired the regenerative capacity of deer herds in south-central Ontario (Gramly 1977; Starna and Relethford 1985; cf. Trigger

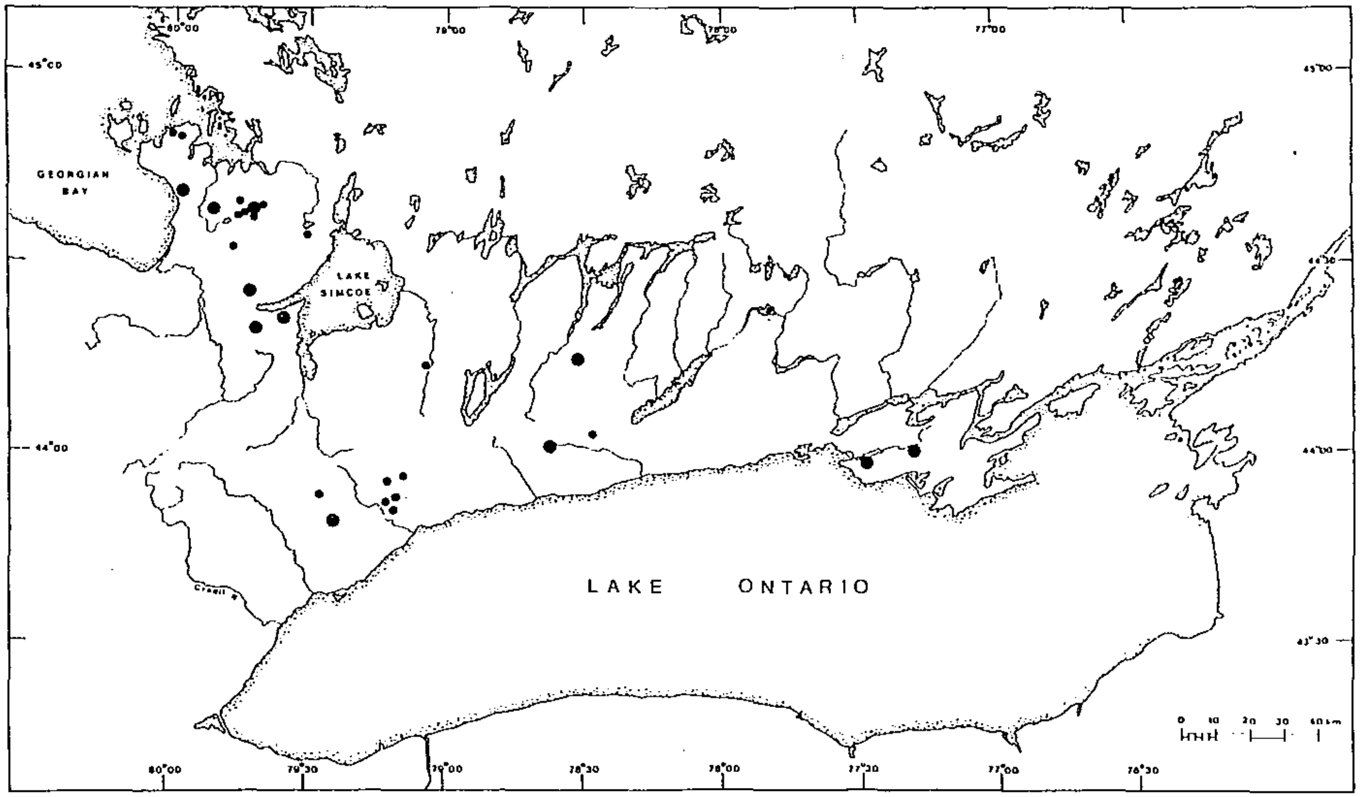

Figure 55. Location of early Late Prehistoric village sites in south-central Ontario. (Key: • site < 2.0 ha; ● site ≥ 2.0 ha)

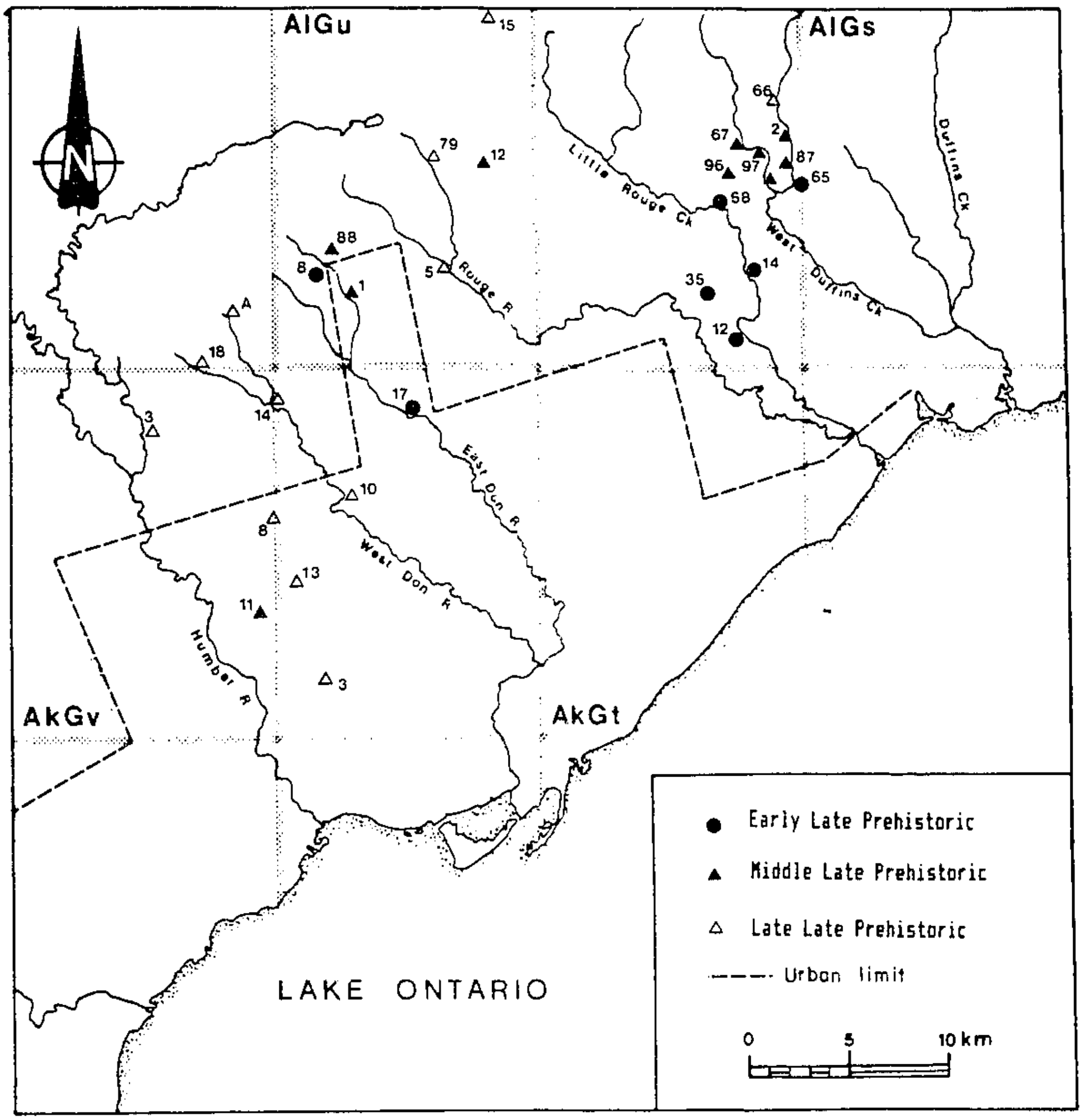

Figure 58. Confirmed Late Prehistoric village sites in the Toronto region.

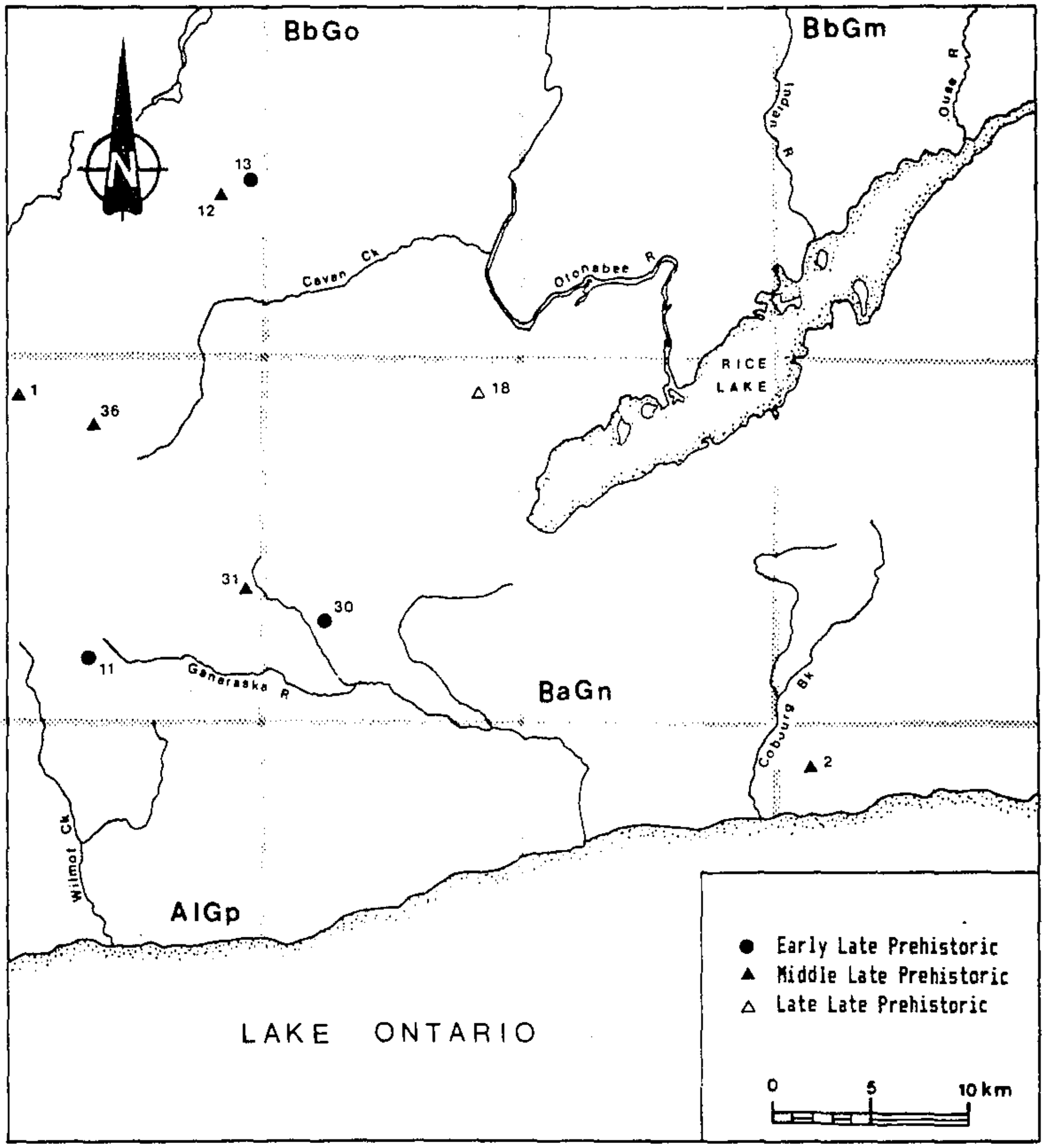

Figure 57. Confirmed Late Prehistoric village sites on the North Shore of Lake Ontario.

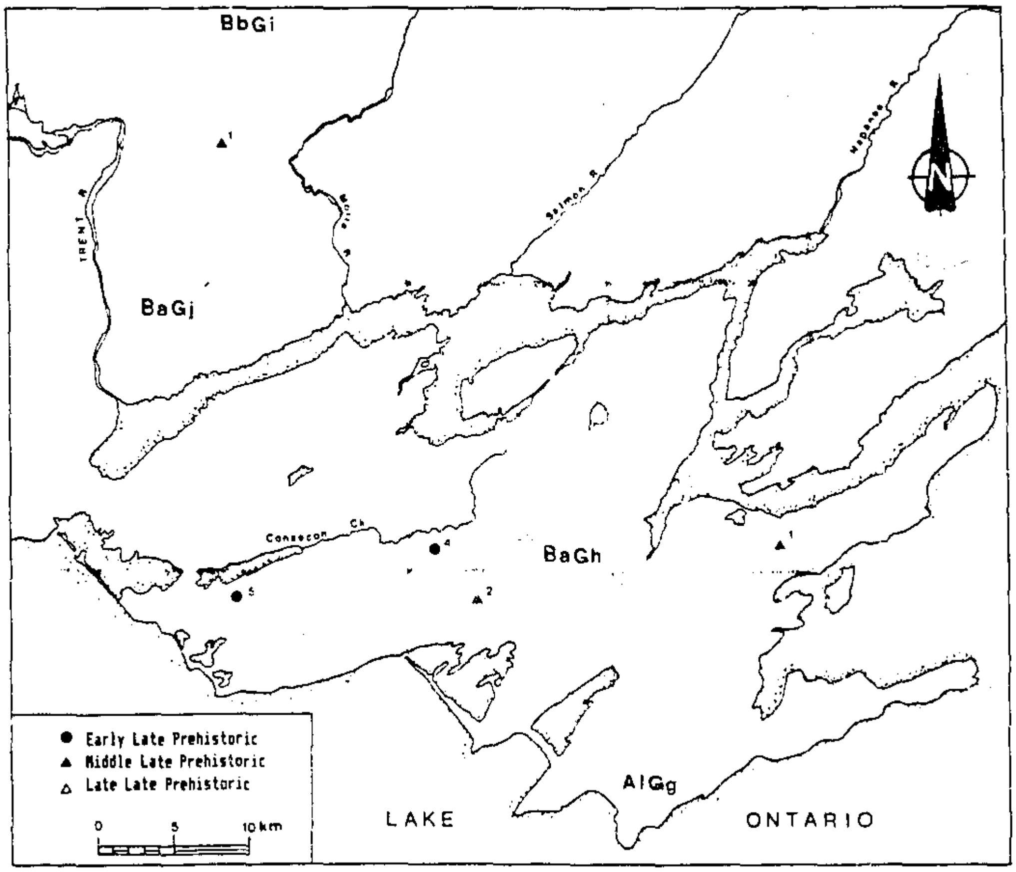

Figure 58. Confirmed Late Prehistoric village sites in Prince Edward County.

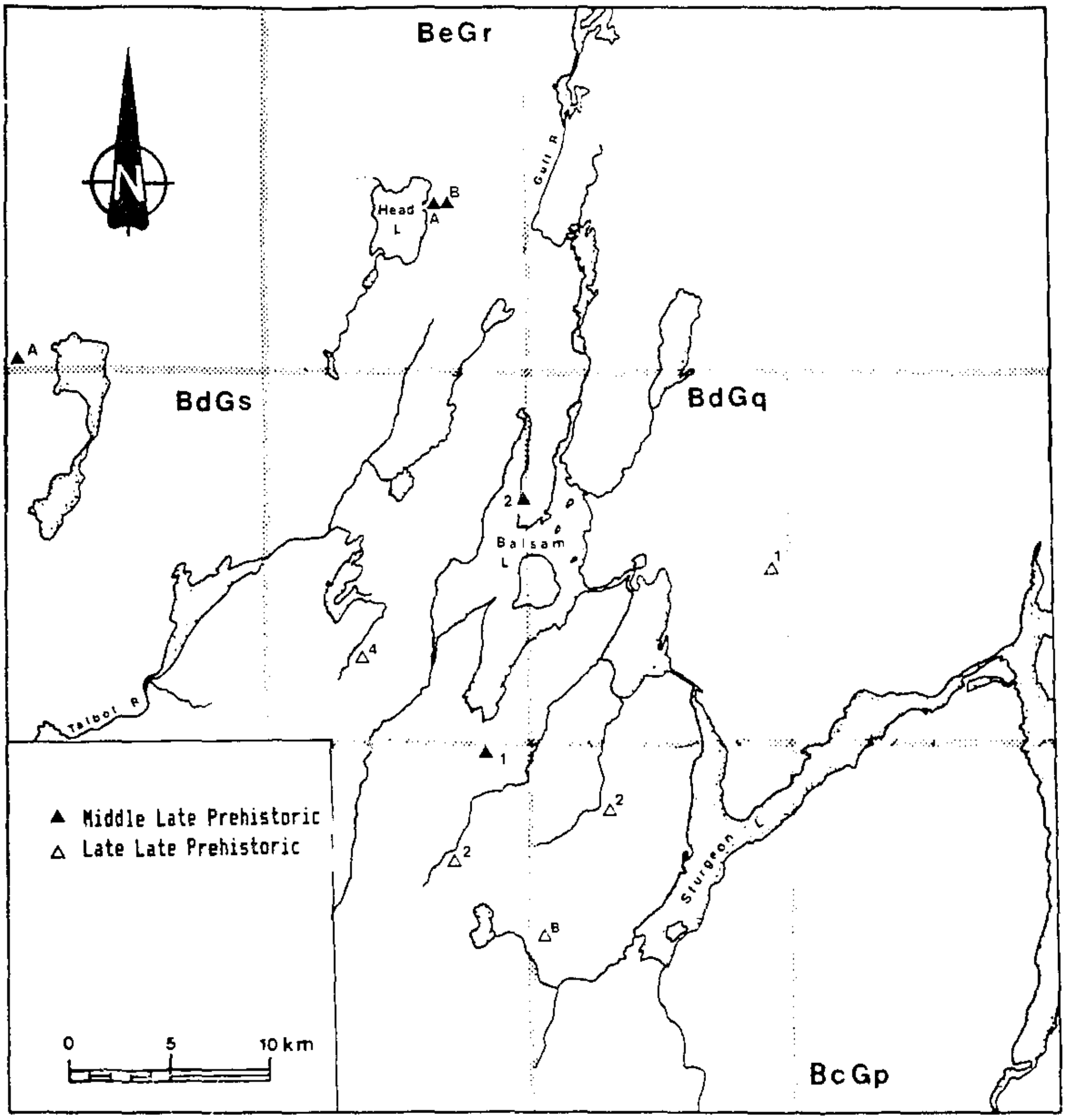

Figure 59. Confirmed Late Prehistoric village sites in Victoria County.

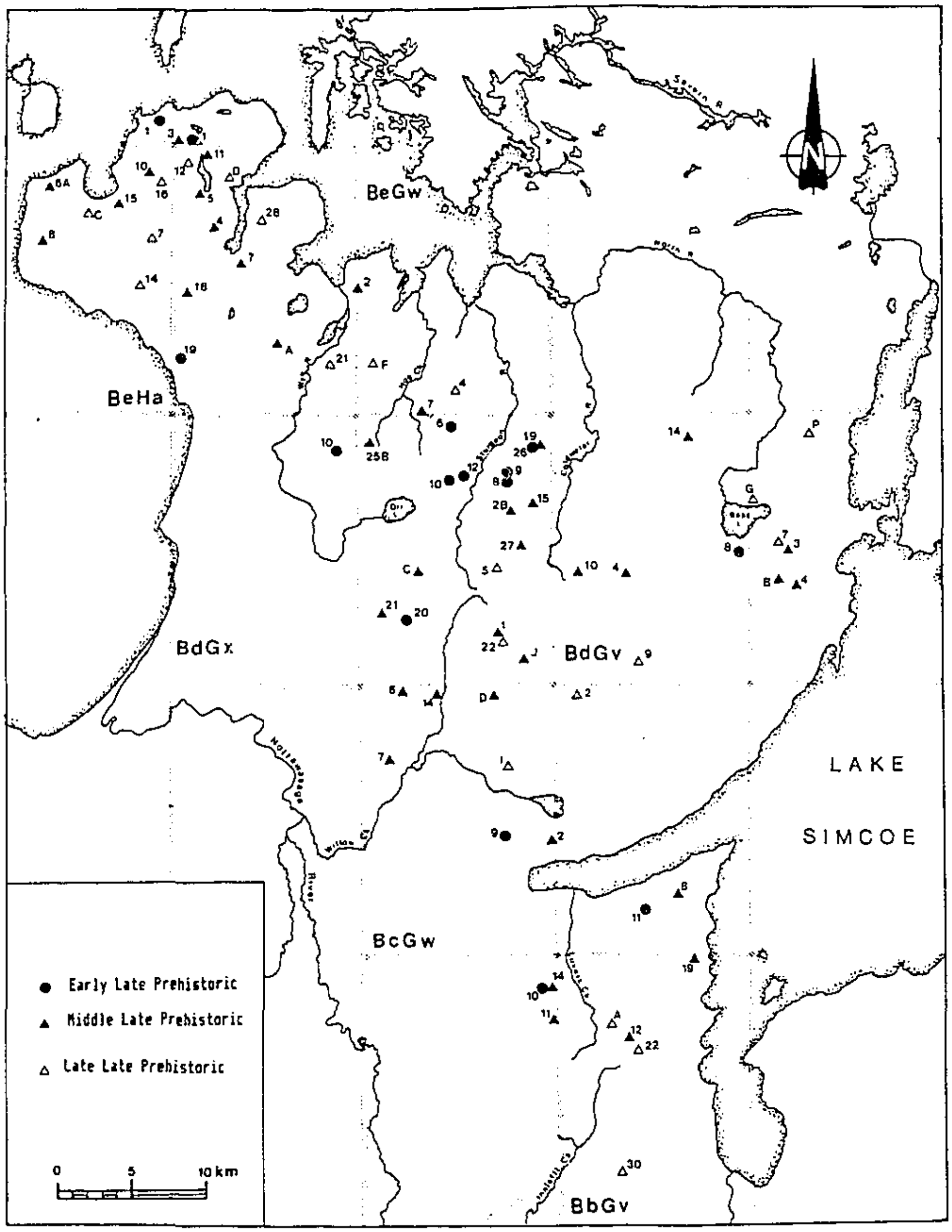

Figure 80. Confirmed Late Prehistoric village sites in Simcoe County.

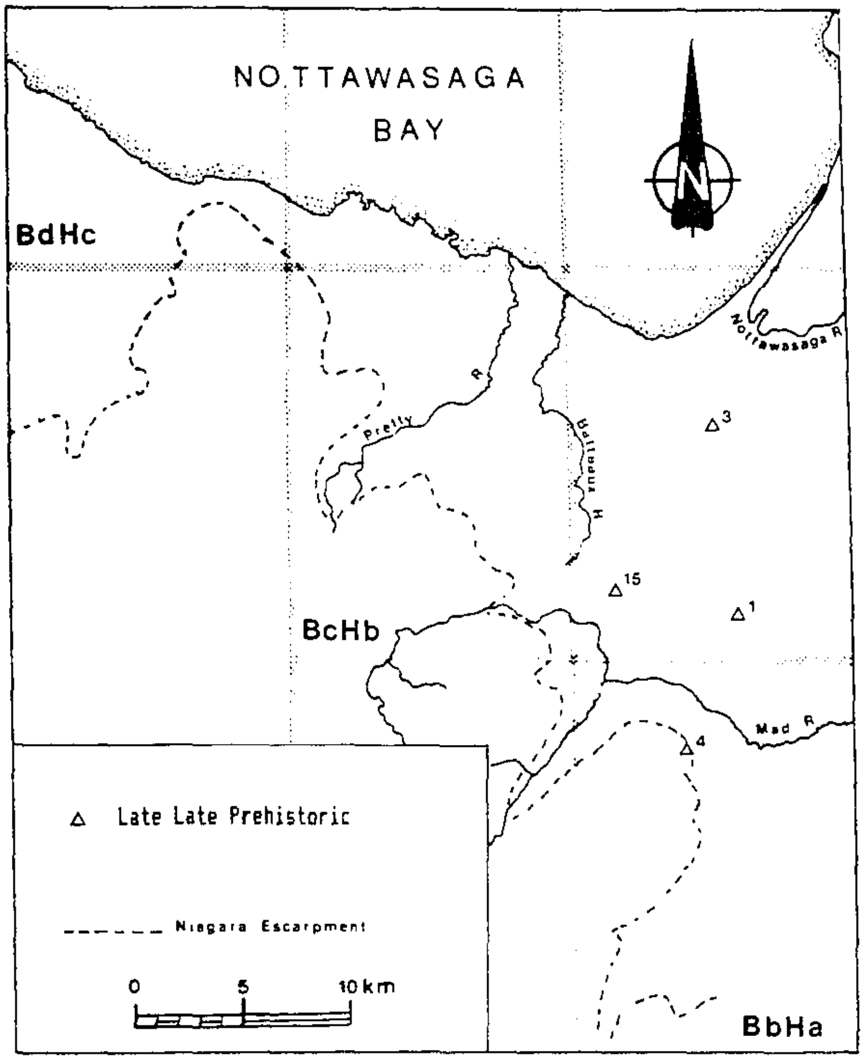

Figure 61. Confirmed Late Prehistoric village sites in the Petun homeland.

1976:132-133, 1985b:98). Local extermination of deer herds and fierce competition over rights to hunt diminished remaining ones may have led to outright warfare between emergent, non-allied Huron-Petun tribes.

Increased trade between the Huron-Petun and Shield Algonkians beginning ca. A.D. 1450 can be inferred from village site distributions. Prior to this date, Huron-Petun settlement was concentrated far south of the Frontenac Axis (Figure 55), with its relatively short growing season and extremely shallow, stoney soils (Chapman and Putnam 1984). During the mid-fifteenth century a number of Iroquoian settlements were established along the southern margins of the Shield (Figures 59 and 62). While it is possible that some of the smaller and most northerly sites were in fact occupied by Iroquoianized Algonkians (similar to the Ottawa and Nipissing of the seventeenth century) (Peter Ramsden, personal communication 1988), it is generally believed that the Jamieson earthwork village [BcGr-1] and the Quackenbush site [BdGm-1] are **bona fide** Huron-Petun settlements (Ramsden 1977a,1981). Based on excavated finds of literally hundreds of stone axe fragments in various stages of manufacture from Quackenbush, it has been postulated that this village controlled a major portion of the stone axe trade in Late Prehistoric south-central Ontario (Peter Carruthers, personal communication 1988). Neighbouring Algonkian hunters probably supplied foodstuffs (dried fish and meat), furs, and deer hides to the Iroquoian inhabitants in exchange for dried corn, tobacco, nets, pottery, and axes (Trigger 1976:166-174). The gradual northwesterly movement of Huron-Petun population throughout the Late Prehistoric period (Figures 56-61) is perhaps a

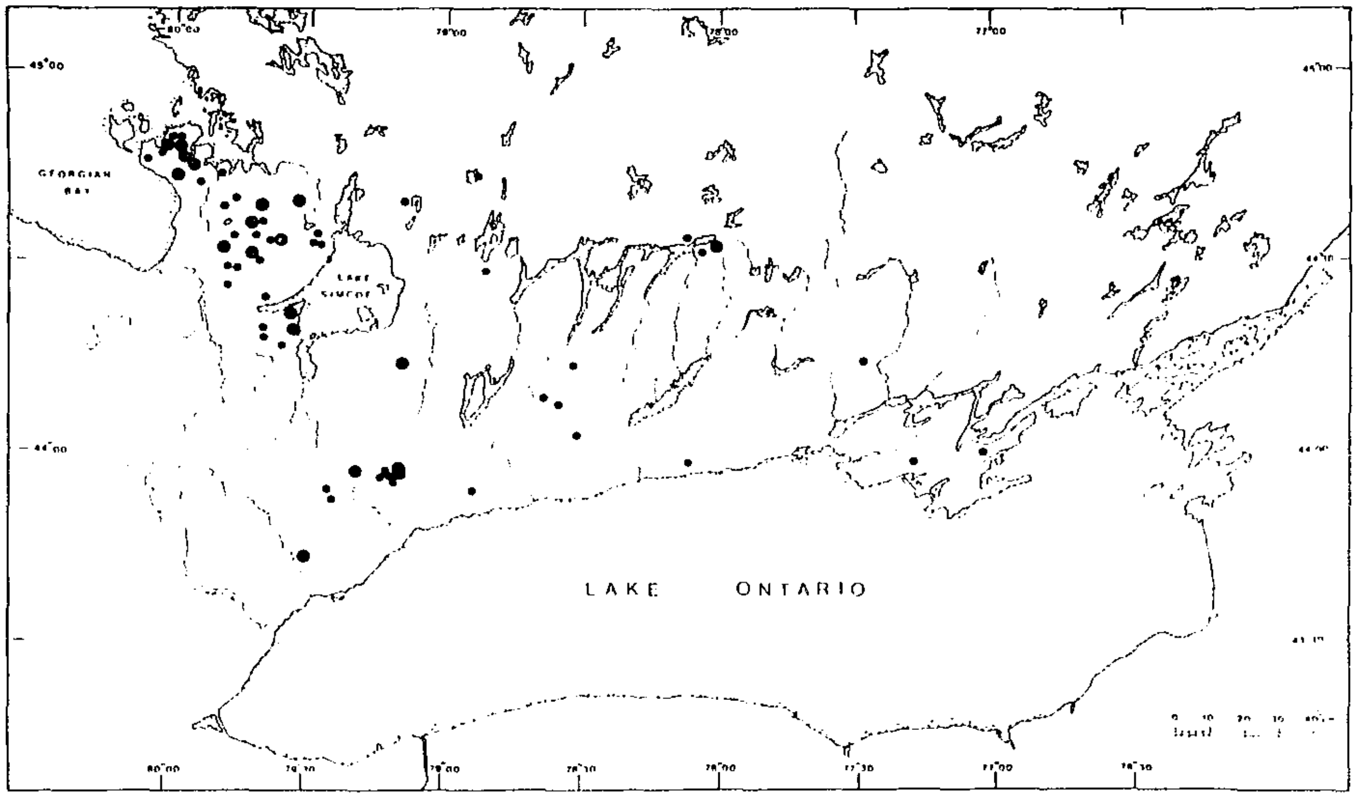

Figure 62. Location of middle Late Prehistoric village sites in south-central Ontario. (Key: • site < 2.0 ha; ● site ≥ 2.0 ha)

result of intensification of these exchange networks between Algonkian hunters and Iroquoian farmers (Trigger 1976:166-174; 1985b:160).

Clusters of Huron-Petun settlements appear in the sixteenth century (Figure 63), likely indicating the formation of tribal groupings. House size declined dramatically (mean length only 29 metres (Dodd 1984:270)) in the sixteenth century but village size remained large (mean 1.7 ha); late Late Prehistoric villages were composed of smaller but more numerous households. The formation of tribal alliances, integrated and sustained by clans, sodalities, sweatbathing, smoking, feasting, trade in exotic goods and ossuary burial (Warrick 1984:67-68), replaced strong matrilineages with more flexible clan segments (Engelbrecht 1985:15-17). It is tempting to identify the archaeological site clusters in Figure 63 with prototypes of the historical Huron tribes: Attignawantan (Penetang Peninsula); Attigneenongnahac (central Simcoe County); Arendarhonon (Victoria County); Tahontaenrat (one or two villages of the Toronto cluster); and Petun (bulk of the Toronto cluster). The reputed (Thwaites 1896-1901, 16:227-229) two hundred year antiquity of the Attignawantan and Attigneenongnahac tribes is demonstrated archaeologically. Likewise the association of the Arendarhonon tribe with the cluster of Late Prehistoric sites in Victoria County seems fairly certain (Trigger 1976:156). As the historic Tahontaenrat tribe could all fit into one village, four of the five large Late Prehistoric Toronto villages must have been ancestral to the Petun. Petun pottery styles (e.g. Blue Mountain Punctate) occur in collections from some of the early protohistoric sites of the Toronto region (William Fox, personal

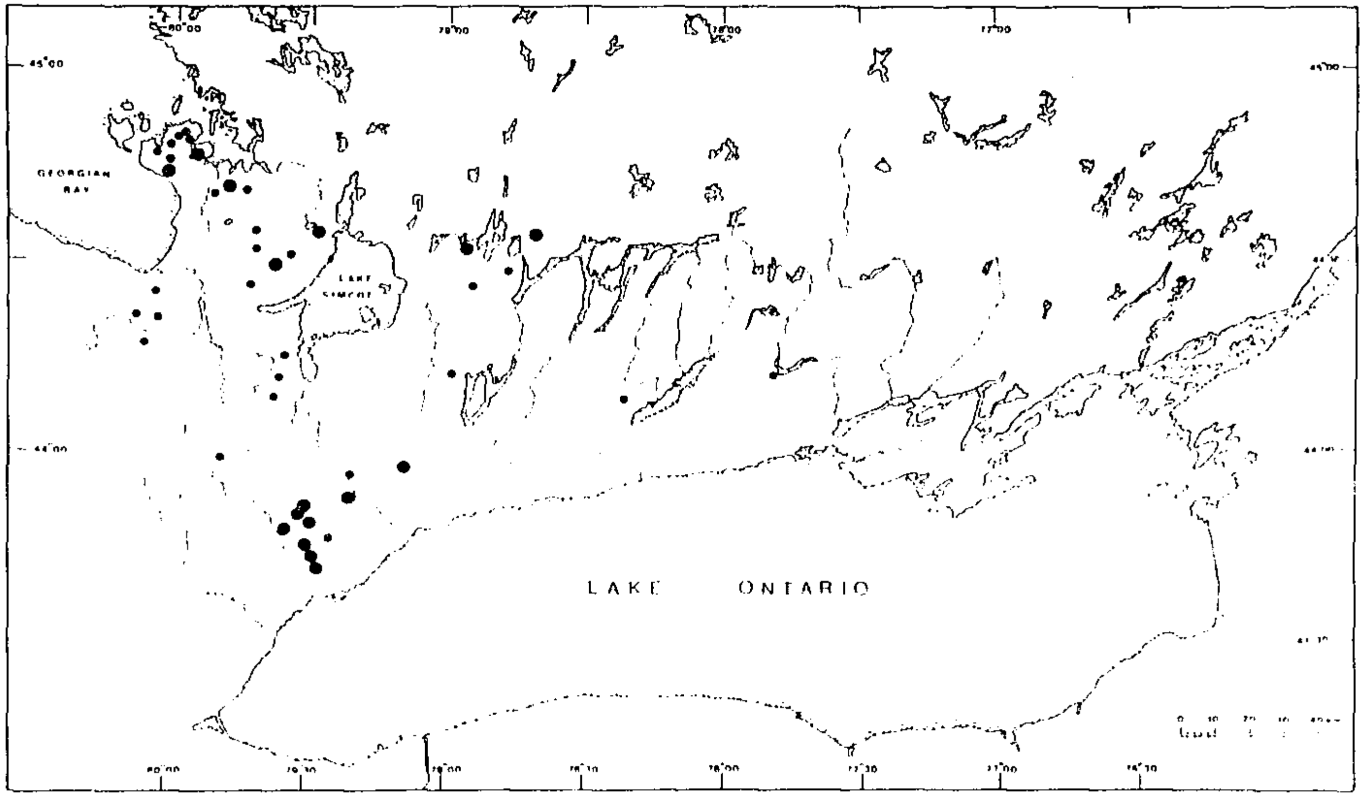

Figure 63. Location of late Late Prehistoric village sites in south-central Ontario. (Key: • site < 2.0 ha; ● site ≥ 2.0 ha)

communication 1989).

Immigration of St. Lawrence Iroquoians to the south-central Ontario Iroquoian villages in the final decade of the fifteenth century and possibly over the course of the sixteenth century is inferred from the presence of small quantities of St. Lawrence Iroquoian pottery in Late Prehistoric Huron-Petun village sites (Damkjar 1982; Nasmith 1981; Pendergast 1985; Ramsden 1988; Trigger 1985b). The westernmost St. Lawrence Iroquoians occupied two major areas in prehistoric times: Jefferson County in New York State and Grenville County in eastern Ontario (Pendergast 1975, 1985), with still other groups living along the St. Lawrence River as far downstream as the Quebec City area. Although St. Lawrence Iroquoian site chronology is problematic (Timmins 1985), both of the western areas appear to have been abandoned by ca. A.D. 1500 (Bradley 1987:84-87; Pendergast 1985). Fortunately, St. Lawrence Iroquoian pot decorative styles are highly distinctive and different from Huron-Petun ones. Locally made St. Lawrence Iroquoian pottery (Trigger et al. 1980) occurs in small percentages in a number of Late Prehistoric and early protohistoric Huron-Petun village sites, the majority of which are located in Victoria County (see Table 50).

Assuming that the proportion of St. Lawrence Iroquoian pots in Huron-Petun villages was roughly equivalent to the proportion of St. Lawrence Iroquoian potters (and their families) resident in those villages, a sizeable group of St. Lawrence Iroquoian immigrants appear to have settled in the Trent Valley ca. A.D. 1500 (Table 50). Taking into account total populations of relevant villages, this migration involved approximately 650 St. Lawrence Iroquoians, distributed in six or seven villages. Consistently small percentages of St. Lawrence Iroquoian pottery in sixteenth century Huron-Petun sites indicate either a constant trickle of St. Lawrence Iroquoian refugees or simply second and third generation St. Lawrence Iroquoian potters, descendants of the first immigrants. Unfortunately, other than the estimates provided from ceramic evidence, the sixteenth century St. Lawrence Iroquoian immigrations are not visible in archaeological settlement remains (see Table 44).

Table 50. Relative Frequency of St. Lawrence Iroquoian Pottery in Huron-Petun Village Sites.

Site	Date (years A.D.)	% St. Lawrence Iroquoian rims	Reference
Hillier [AlGi-5]	1420-1450	p	Ramsden 1977a
Hardrock [BdGr-2]	1460-1490	0.4	Ramsden 1977a
Payne [AlGh-2]	1460-1490	p	Ramsden 1977a
Lite [BbGi-1]	1470-1500	0.6	Pendergast 1972
Waupoos [BaGg-1]	1470-1500	p	Ramsden 1977a
Draper [AlGt-2]	1470-1510	5.0	Ramsden 1977a
Black Creek [AkGv-11]	1470-1500	1.5	Ramsden 1977a
Thomas [BbGr-2]	1490-1520	6.0	Donaldson 1962
Jackes [AkGu-3]	1490-1520	5.0	Noble 1974
Keffer [AkGv-14]	1495-1530	3.0	J. Bursey pc 1988
Dawn [BdGq-1]	1500-1540	16.0	Ramsden 1981
Lean [BcGq-2]	1510-1540	20.0	Ramsden 1977c
Parsons [AkGv-8]	1520-1550	4.4	Ramsden 1977a
Lucas [BbGv-22]	1530-1560	12.0	Warrick 1988a
Coulter [BdGr-6]	1530-1560	3.0	Damkjar 1982
Kirche [BcGr-4]	1525-1560	6.0	Nasmith 1981
Hunter's Oro #17 [BcGv-2]	1530-1560	5.0	Ridley 1966
Forget [BeGx-21]	1530-1560	7.0	Ridley 1973
Sopher [BdGu-1]	1530-1560	0.6	Ramsden 1977a
McKenzie-Woodbridge [AkGv-2]	1540-1570	2.8	Ramsden 1977a
Ward [BbGr-3]	1540-1570	14.0	Ramsden 1981
Benson [BdGr-2]	1550-1580	6.0	Ramsden 1977c
Sidey-Mackay [BbHa-6]	1570-1590	2.0	Ramsden 1977a
Aurora [BaGu-2]	1570-1600	1.0	Ramsden 1977a
Trent [BcGr-5]	1580-1600	13 - 25	Ramsden 1981; G. Dibb pc 1988
MacMurchy [BcHb-26]	1600-1625	0.1	Ramsden 1977a

Intense debate surrounds the relationship between the Huron-Petun and St. Lawrence Iroquoians(see Trigger 1985b:144-148), but there is a growing consensus that the St. Lawrence Iroquoians sought refuge among the Huron-Petun to escape constant raiding and harassment by the New York Iroquois (Bradley 1987:84-87; Ramsden 1988; Trigger 1987). The Iroquois or Five Nations Confederacy, according to a reanalysis of oral tradition and solar eclipse chronologies for the Northeast, seems to have originated ca. A.D. 1536 (Snow 1987b). With the cessation of intertribal hostilities, Five Nations warriors would have directed their status-seeking energies farther afield. The coincidence of the crystallization of the Five Nations confederacy and abandonment of traditional St. Lawrence Iroquoian homelands in the first decades of the sixteenth century are causally linked. Reasons for the final disappearance of the Hochelagan and Stadaconan St. Lawrence Iroquoians remain a mystery (Trigger 1985b:106-107,144-148, 1987), but at least one village in Victoria County, the Trent site [BcGr-5], which has yielded over 35% St. Lawrence Iroquoian pottery and Period I glass beads (A.D. 1580-1600) (Gordon Dibb, personal communication 1988), may represent the last remnants of this once populous Iroquoian group. The possibility that the Hochelagans and Stadaconans were also ravaged by epidemics of European disease in the sixteenth century (Snow and Lanphear 1988) should not be ruled out. Jacques Cartier (Biggar 1924:204) observed in December, 1535 that over 50 Stadaconans (about 10% of the village population) had died from an unknown disease (Trigger 1985b:237)

Stabilization of the Late Prehistoric Huron-Petun population at about 30,000 was the result of a lower fertility rate, not increased infant mortality (Jackes 1986). Skeletal analyses of the Uxbridge population, dating ca. A.D. 1460-1490, have revealed a rather unhealthy picture of fifteenth century Huron life: chronic protein-calorie malnutrition, a very high incidence of tuberculosis(at least 4% skeletal involvement (Pfeiffer 1986)) (and presumably other density-dependent diseases and parasites), and a large number of deaths and injuries caused by interpersonal violence (i.e. tribal warfare) (Pfeiffer 1984; Pfeiffer 1986; Pfeiffer and King 1983; Pfeiffer et al. 1986). Despite a high morbidity, however, the Uxbridge population had a lower juvenile mortality (only 32% of the burial population under 15 years of age) and a slightly higher adult life expectancy (average length of life 37 years (e0=25)) than the fourteenth century Fairty population. Uxbridge women were having fewer children (see Table 46 for relative fertility estimates), at least partly as a result of declining health. Malnourished mothers are more prone to infection and tend to produce less breast milk when lactating. Infants of such mothers suckle more because they get less milk per feeding. Since the frequency and intensity of suckling (i.e. nipple stimulation) is the major factor responsible for postpartum amenorrhea, malnourished mothers will have longer birth spacing, hence lower fertility, than adequately nourished ones (Tyson and Perez 1978). In addition, malnourished women tend to have shorter reproductive lives, irregular ovulation, and a higher probability of miscarriage (Frisch 1978). In summary, chronic malnutrition, high disease loads, overcrowded house life, and stress caused by endemic tribal warfare would have effectively lowered the fertility of fifteenth century Huron-Petun women. It is also possible that at this time the Huron-Petun began to avoid intercourse while nursing to ensure an adequate supply of breastmilk. This would have contributed to a lower birth rate (Winikoff 1982).

Protohistoric Huron-Petun Population

Approximately A.D. 1550, European metal items began entering Huron-Petun villages and ossuaries (Fitzgerald 1983; Trigger 1985b:151-152), signalling the end of the prehistoric period. The population of the Huron-Petun hovered at 30,000-28,000 from A.D. 1550 to A.D. 1609 (Table 47). Contrary to popular opinion (Brasser 1978; Dickinson 1980; Dobyns 1983; Garrad 1980; Martin 1978; Ramenofsky 1987a,1987b), there is no archaeological evidence for catastrophic depopulation of the protohistoric Huron and Petun from European disease epidemics. While a slight reduction in population during late protohistoric times from 30,000 to 28,000 persons could be due to limited protohistoric epidemics, this reduction is more likely the result of either the standard error of +/- 10% inherent in making regional population estimates from settlement area (De Roche 1983:190) or a consequence of the declining birth rate in Late Prehistoric times. Perhaps the most significant demographic event of the late sixteenth and first decade of the seventeenth century in south-central Ontario was the regional contraction of settlements that culminated in the formation of the Huron and Petun tribal confederacies (Garrad 1980; Trigger 1976:156-163).

Protohistoric Huron and Petun villages averaged 1.8 ha in size and contained longhouses with mean lengths of 25.6 metres (Warrick 1984:137). In spite of these similarities to Late Prehistoric sites, protohistoric villages exhibited slightly higher residential densities: 60 hearths/ha, exemplified by sites such as Seed [AkGv-1], McKenzie-Woodbridge [AkGv-2], and Ball [BdGv-2]. A brief period of intense hostilities was probably the cause of increased residential density among the protohistoric Huron. In the 1630s, the Huron informed the Jesuits that they had waged "cruel wars" with the Petun just before the arrival of the French (Thwaites 1896-1901, 20:43), or ca. A.D. 1580-1609. The large Huron villages of this time not only were constructed in highly defensible locations (often with ravine edges on three sides) but were surrounded by massive palisades, averaging three to four rows thick (Burgar 1988; Johnson 1980; Knight 1987; Ramsden 1977b). In addition to this evidence for the existence of intense warfare in late sixteenth century Ontario, there is a pronounced and rapid regional contraction of settlement about A.D. 1580-1600, indicating the formation of the Huron and Petun confederacies. From information that the Huron relayed to the Jesuits (Thwaites 1896-1901, 16:227) in 1639, the Arendarhonon, the easternmost tribe of the confederacy, moved into Huronia ca. A.D. 1590, and the Tahontaenrat joined the Huron confederacy about A.D. 1610. The abandonment of Victoria County about A.D. 1580 suggests that the Arendarhonon moved into Huronia from the east. The derivation of the single Tahontaenrat village is slightly more problematical, although the Early Historic (ca. A.D. 1590-1610)

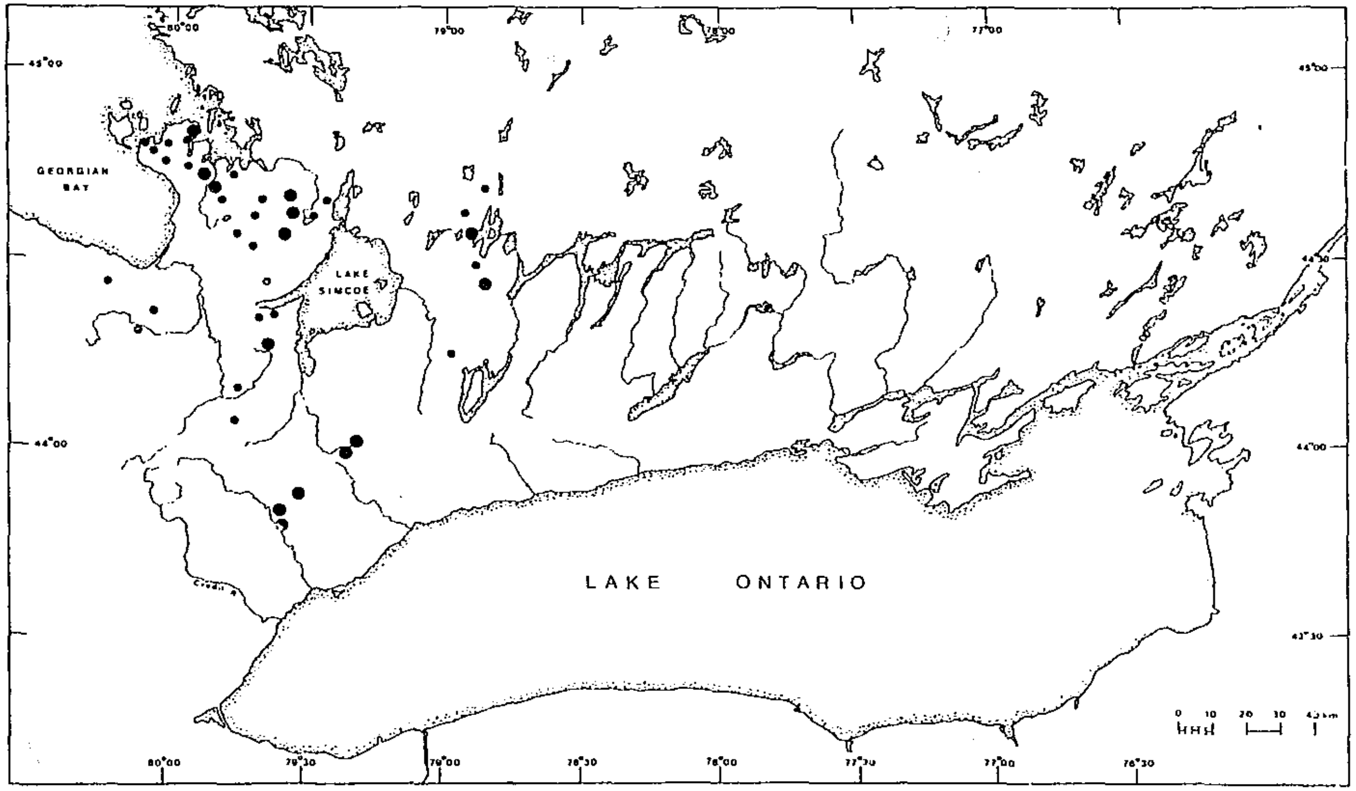

Figure 64. Location of protohistoric Huron-Petun village sites in south-central Ontario. (Key: • site < 2.0 ha; ● site $\geq$ 2.0 ha)

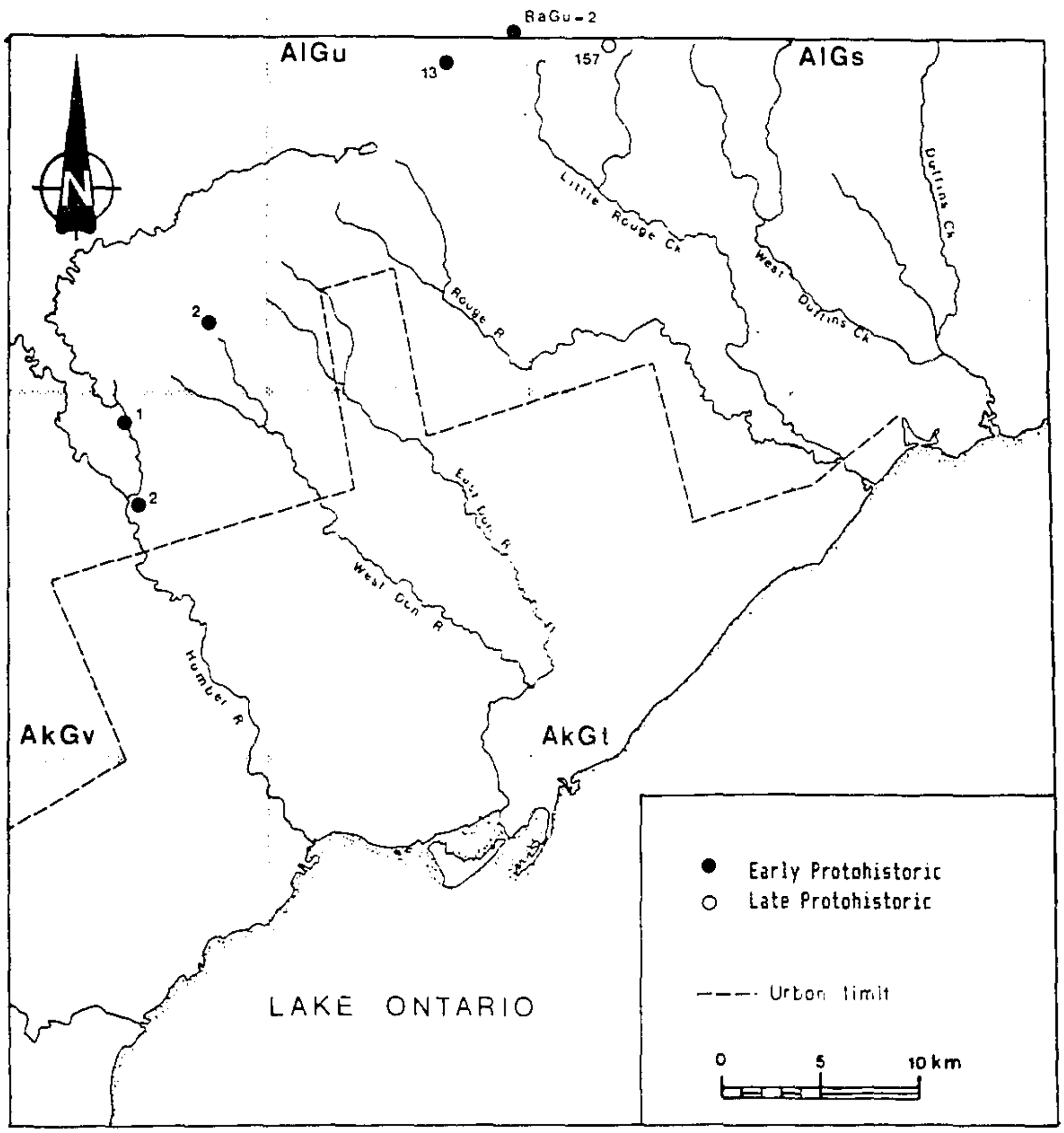

Figure 65. Confirmed protohistoric village sites in the Toronto region.

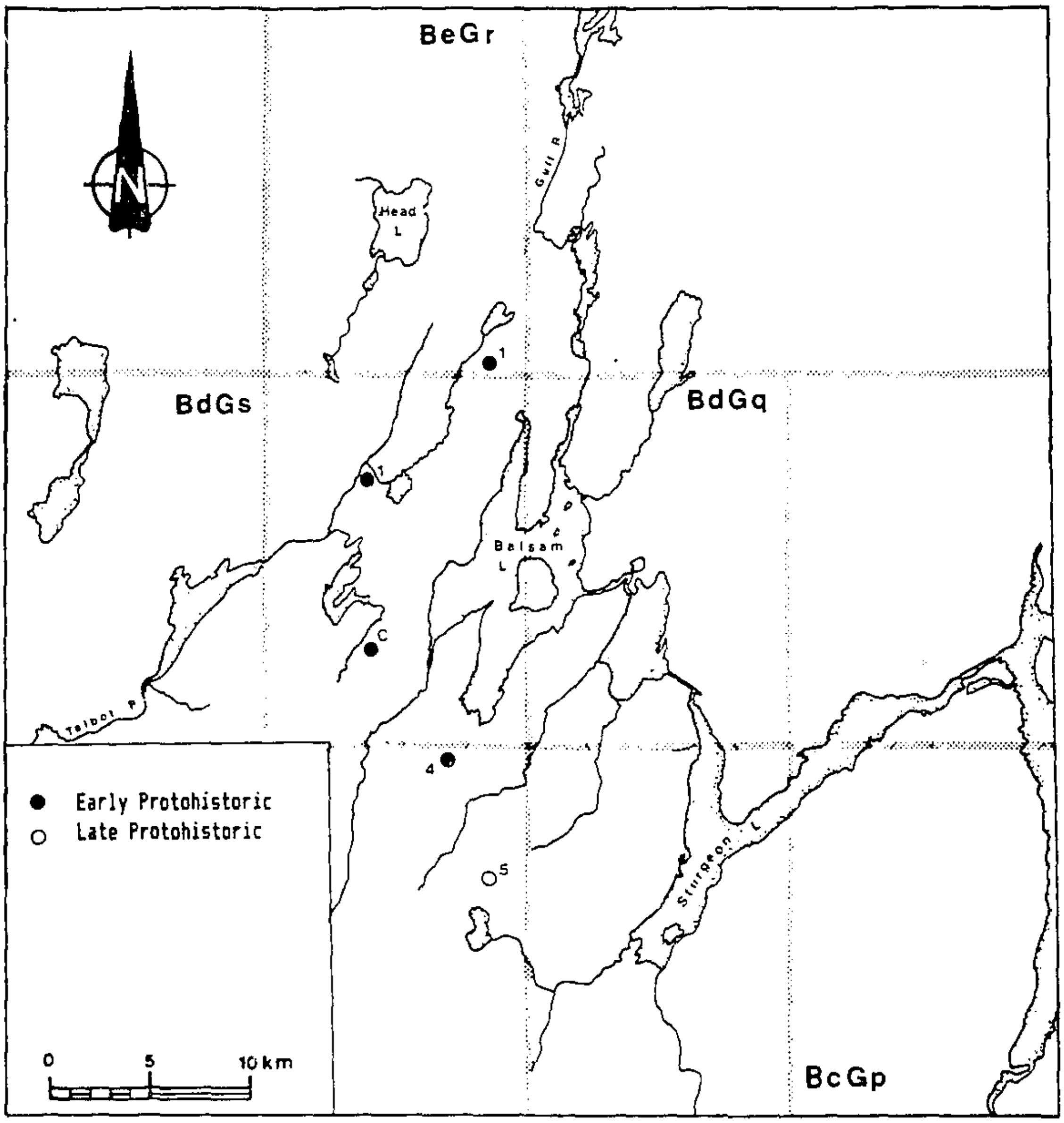

Figure 88. Confirmed protohistoric village sites in Victoria County.

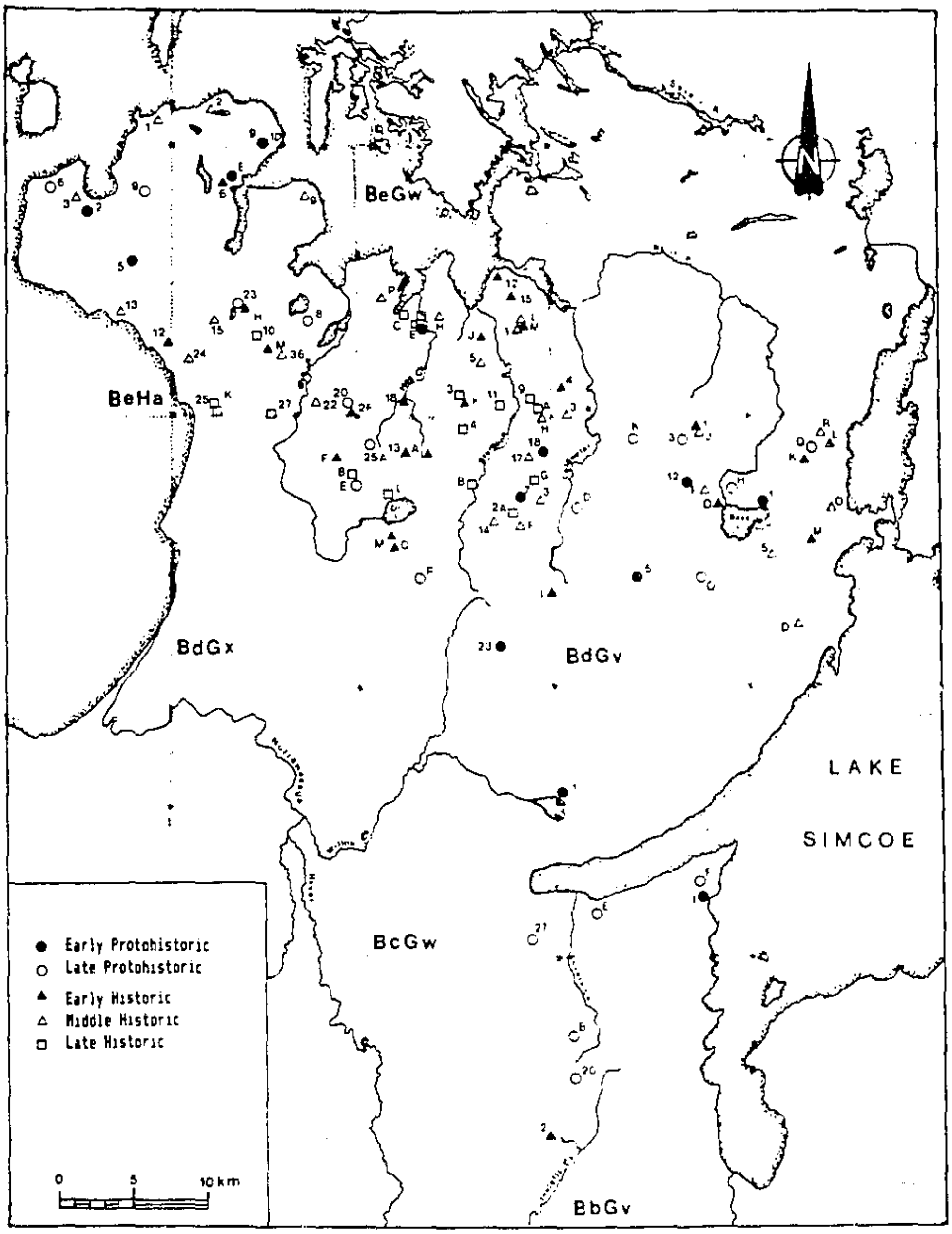

Figure 87. Confirmed protohistoric village sites in Simcoe County.

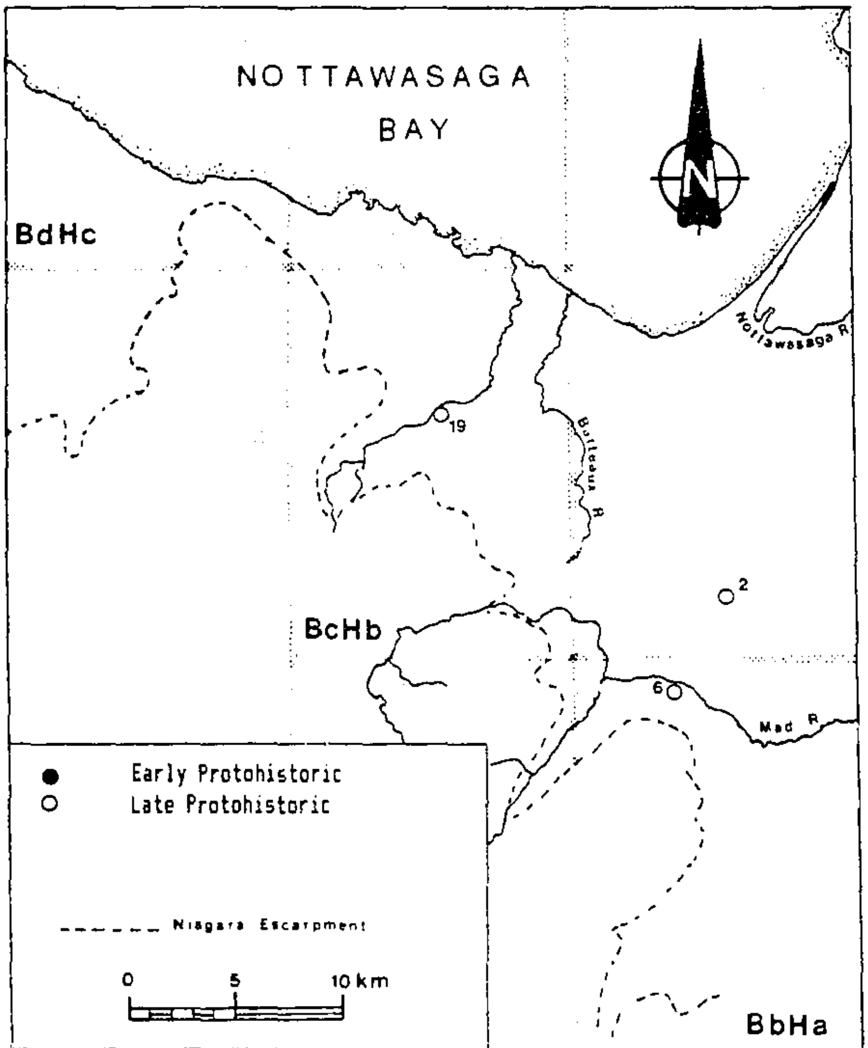

Figure 88. Confirmed protohistoric village sites in the Petun homeland.

Graham-Rogers [BbGw-2] village site from Innisfil Township seems the best candidate (Ramsden 1977a).

The protohistoric Petun consisted of only two villages (Sidey-Mackay [BbHa-6] and Young-McQueen [BcHb-17]) and perhaps a third smaller settlement (White-Coyle [BcHa-2]), amounting to only 2,000 people (Table 47, Figure 68). Based on pottery type similarities, especially the relatively high frequency of Neutral pottery (e.g. Lawson Incised) and Seed Incised pottery, it is probable that the first Petun settlements were long-distance relocations of villages formerly sited in the Humber River drainage of the Toronto region, such as Seed [AkGv-1] and McKenzie-Woodbridge [AkGv-2] (Garrad 1980; Ramsden 1977a). The sudden growth of Petun population to a total of about 6,200 people by A.D. 1620 (Table 47) is the result of large-scale immigration, primarily from Innisfil Township in southern Simcoe County. At least four large Late Protohistoric villages (e.g. Molson [BcGw-27] and Cooper [BbGv-20]), yielding 75-85% Sidey Notched pottery, the ceramic hallmark of the historic Petun (Garrad 1980), have been discovered in Innisfil Township (Hunter n.d.; Warrick 1988a). Innisfil Township was abandoned by the Iroquoians ca. A.D. 1610.

Palaeodemographic analysis of the Kleinburg ossuary (A.D. 1580-1600 (Kenyon and Kenyon 1983)), situated in the Humber River cluster of early protohistoric sites (Figure 40), reveals a reasonably high life expectancy at birth (e0=25), a low juvenile mortality rate (only 28% of the burial population less than 15 years old), a long adult lifespan (average of 42 years), but a low fertility rate (estimated

Total Fertility Rate of 4.0 children) (see Table 46; Jackes 1986; Pfeiffer 1983). An extremely high rate of dental caries (41% (Patterson 1984)) is substantiated by palaeodietary analyses suggesting a diet composed of 50% corn, 25% fish, and lesser amounts of meat and beans (Katzenberg and Schwarz 1986; Schwarz et al. 1985). Lack of palaeopathological data preclude inferences about the health of protohistoric Huron and Petun groups, but vital rates suggest not much difference between the Uxbridge and Kleinburg populations, except that the Kleinburg population probably did not have as high an incidence of tuberculosis (Pfeiffer and King 1983).

Seventeenth Century Huron-Petun Population

Prior to A.D. 1634, when the first recorded epidemics of European disease struck the Huron, the combined Huron-Petun population totalled 30,000-35,000, according to seventeenth century accounts (Biggar 1922-1936, 3:122; Thwaites 1896-1901, 6:59; 7:225; 8:115; 10:313; Wrong 1939:91), archaeological data (see Table 47 in Chapter 6), and ethnohistorical identification of villages (Figures 69-74). Except for the St. Lawrence Iroquoian immigrants of the late sixteenth century who added about 1,000 people, Huron-Petun population size remained remarkably stable from A.D. 1450 to A.D. 1633.

Several factors contributed to demographic stability among the late prehistoric and historic Huron-Petun. In A.D. 1623, Gabriel Sagard, a Recollet missionary living with the Huron, observed that Huron families were smaller than those in France (Wrong 1939:127). Including parents, early seventeenth century French families averaged only 4.4 members (Grigg 1980:55-59 and Figure 41). An abridged life table for the Kleinburg ossuary (A.D. 1590) suggests a low fertility rate (Total Fertility Rate = 4.0) (Table 46), completely in line with that expected for seventeenth century Huron-Petun marriage, birthing, and breastfeeding practices.

Early and universal marriage appears to have been the norm among the historic Huron-Petun and often occurred after the first signs of pregnancy in a young woman (Biggar 1922-1936, 3:139-140). Huron marriage was monogamous but divorce was very common (Thwaites 1896-1901, 8:119-121, 15:79; 28:51-53). Societies with high divorce rates tend to have lower fertility rates (Bongaarts 1983; Nag 1975:23), but the effect of high divorce rates on fertility may not have been pronounced because of relaxed Huron attitudes to youthful sexual intercourse outside of marriage (Biggar 1922-1936, 3:137-139; Wrong 1939:124).

Huron births were not normally attended by a midwife (Wrong 1939:130). Birthing complications (about 10-20% of births) in the absence of a midwife may have contributed to a rather high perinatal mortality rate and lowered Huron fertility (Trigger 1976:133). Infant and juvenile mortality rates were high (Jackes 1986), presumably due to unhygienic conditions of longhouse life (Thwaites 1896-1901, 10:91-93, 17:13-15; Wrong 1939:93-95), protein-calorie malnutrition from a predominantly corn diet (Pfeiffer et al. 1986; Wetterstrom 1986), and periodic famines (Heidenreich 1971:168).

Perhaps the single most important cause of low Huron fertility was the two to three year period of breastfeeding and post-partum sexual abstinence documented for the seventeenth century (Thwaites 1896-1901, 8:127). Prolonged (at least three years for early twentieth-century Five Nations Iroquois (Shimony 1961:209)) and intense breastfeeding is directly responsible for long post-partum ammenorrhea and a 2-3 year birth-spacing (Bongaarts 1980,1983). Postpartum abstinence for the duration of prolonged breastfeeding can ensure births that are spaced 3-4 years apart (Bongaarts 1983). Spousal separation, in intervals totalling up to six months each year for the Huron (men went hunting, fishing, trading, and warring from the late spring to the early fall (Heidenreich 1971; Trigger 1969)), would have augmented the spacing between births (Engelbrecht 1987:19).

Abortion and infanticide, although documented for the eighteenth century Five Nations Iroquois (Engelbrecht 1987), were not noted as being practiced to any noticeable extent by the seventeenth century Huron. In fact, they highly welcomed births, particularly those of girls (Thwaites 1896-1901, 15:181-183; Wrong 1939:127). Spontaneous abortions may have been frequent, given the heavy workload of a Huron woman (Engelbrecht 1987:16-17).

In summary, the stagnation of Huron-Petun population from A.D. 1450-1650 was the result of low fertility produced by both environmental factors, including constraints imposed by the density of deer herds (Gramly 1977), corn agriculture, and tuberculosis and other density-dependent diseases, and by cultural factors, including the long duration of breastfeeding and post-partum sexual abstinence.

The demographic history of the seventeenth century Huron and

Petun is best summarized in four chronological periods: A.D. 1615, 1623, 1634-39, and 1640-1650. These correspond to historical counts that were made of Huron-Petun population and settlements. As explained in Chapter 6, villages plotted in Figures 69-76 are based on historical identifications of archaeological sites that were made by matching the age, duration, size, and geographical location of each archaeological site with a documented seventeenth-century village. Villages not yet discovered by archaeology appear in the figures as open circles.

Early historic demography (A.D. 1609-1625)

The average early historic Huron village was 1.8 ha in size and contained 30-40 longhouses (mean length 20.4 metres (Dodd 1984:414)) and a population of 1,000. Residential density , as in protohistoric times, averaged 70 hearths/ha, exemplified by the LeCaron (Johnston and Jackson 1980), Bidmead (R. O'Brien , personal communication, 1987), and Warminster village sites (Sykes 1983).

In A.D. 1615, 18 Huron villages (Biggar 1922-1936, 3:122, 4:302) and seven Petun villages (Biggar 1922-1936, 3:95-101, 4:278-284) were recorded. Archaeologically , 12 Huron and seven Petun villages have been identified (Figures 69-70). Adding the "missing" village sites, five small and one large (i.e. Carhagouha is outstanding) produces a Huron population total of 21,000; the Petun population of A.D. 1615 would have been about 6,500 (assuming 70 hearths/ha for sites over 1.0 ha in size, 40 hearths/ha for 25% of sites less than 1.0 ha in size, and 10 persons per hearth). Thus, there would have been at least 27,500 Huron-Petun in A.D. 1615. While this number is 3,000-5,000

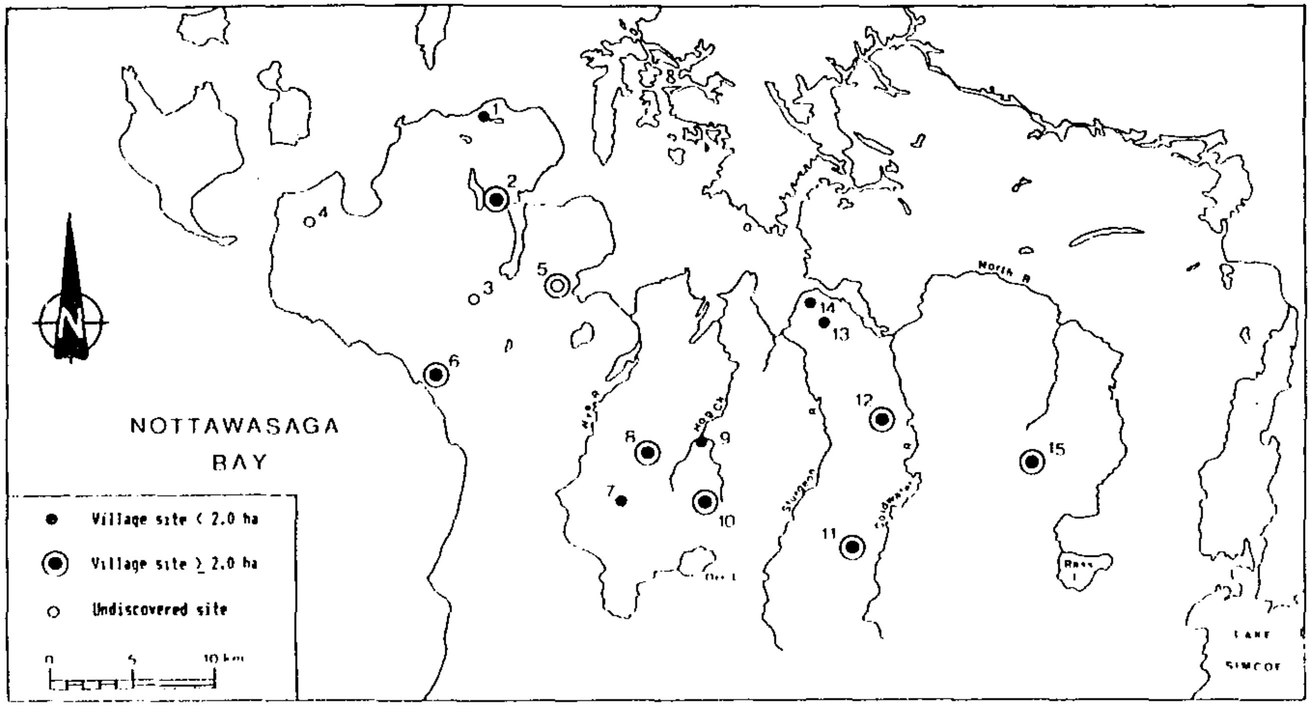

Figure 69. Huron villages ca. A.D. 1615.

Key:

1) Toanche (Otouacha) - [BfGx-2 - 1.2 ha]
2) Karenhassa (Carmaron) - [BeGx-6 - 2.4 ha]
3) Touaguainchain - ? [Small - 0.8 ha]
4) Unnamed village - ? [Small - 0.8 ha]
5) Carhagouha - ? [Large - 2.2 ha]
6) Tequenonquiaye (Ossossane) - [BeHa-12 - 2.0 ha]
7) Unnamed village - [BdGx-F - 0.8 ha]
8) Unnamed village - [BeGx-26 - 2.4 ha]
9) Unnamed village - [BeGw-18 - 1.0 ha]
10) Scanonaenrat - [BdGw-13 - 2.4 ha]
11) Teanaostaiae - [BdGw-3 - 2.8 ha]
12) Taenhatentaron - [BeGv-4 - 2.1 ha]
13) Unnamed village - [BeGw-15 - 0.8 ha]
14) Unnamed village - [BeGw-12 - 0.8 ha]
15) Cahiague - [BdGv-1
   - North (Huron) Village - 3.6 ha
   - South (Algonkian) Village - 2.4 ha]

+ 3 other unnamed villages

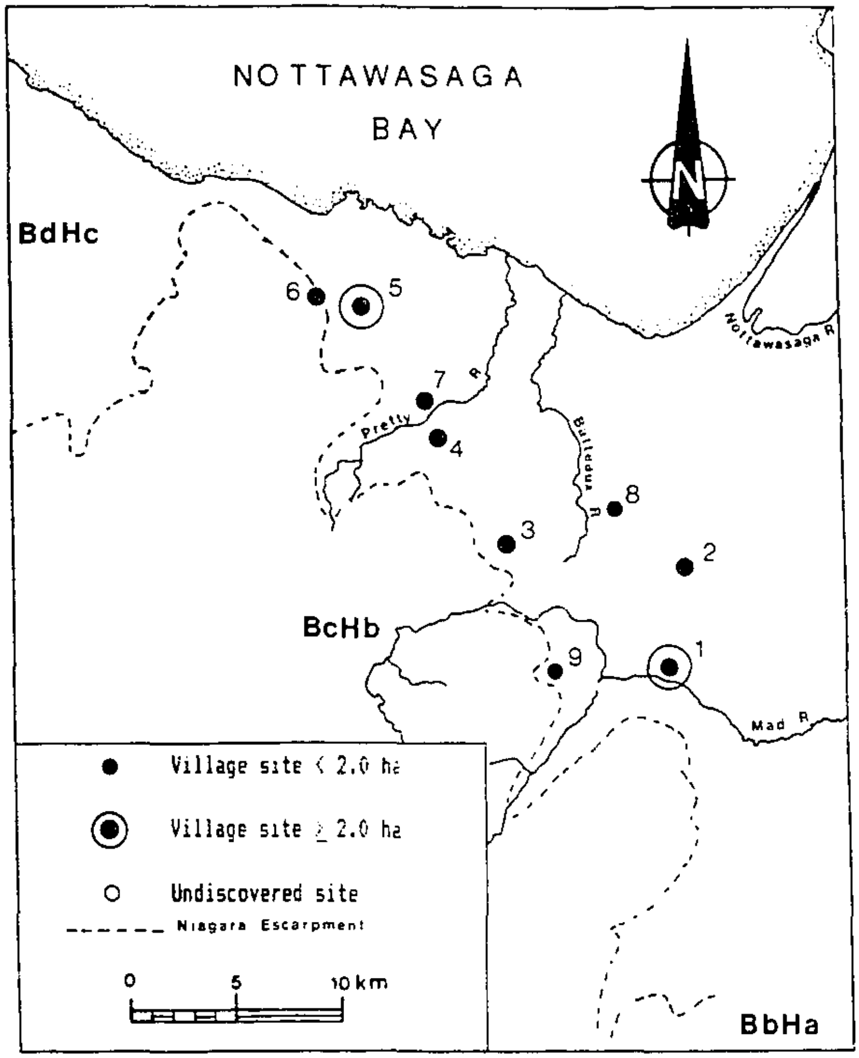

Figure 70. Petun villages ca. A.D. 1615.

Key:

1) Unnamed - [BbHa-7 - 2.0 ha]
2) " - [BcHa-5 - 0.9 ha]
3) " - [BcHb-7 - 0.8 ha]
4) " - [BcHb-18 - 0.8 ha]
5) " - [BcHb-26 - 2.8 ha]
6) " - [BcHb-27 - 1.6 ha]
7) " - [BcHb-31 - 0.8 ha]

8) Unnamed - [BcHa-13 - 0.8 ha] - **under construction 1615**
9) " - [BbHb- 1 - 0.8 ha] - **under construction 1615**

people less than seventeenth-century estimates, population estimates from settlement remains tend to **underestimate** actual regional population totals by 10-20% (De Roche 1983:190; Sanders et al. 1979:51).

In A.D. 1623, Gabriel Sagard remarked that 30,000-40,000 Huron occupied 25 villages (Wrong 1939:91). As argued in Chapter 2, the discrepancy between documented village and population totals for the Huron in 1623 and those in 1615 is probably due to Petun totals being included in Sagard's "Huron" totals (Trigger 1985b:233). There are 18 archaeological sites in Simcoe County that were occupied ca. A.D. 1623 (Figure 71). Assuming that Sagard's census data are actually combined Huron **and** Petun totals, the full complement of 1623 Huron villages are archaeologically known. Using the same conversion factors (e.g. 70 hearths/ha) as were used to calculate 1615 population values, the Huron population of 1623 would have been approximately 21,500 and the Petun population would have numbered about 10,000. The rise in Petun population from the A.D. 1615 level of 6,500 is largely the result of the sudden materialization of the large (4.8 ha) Pretty River [BcHb-22] site in the early 1620s. The poor artifact sample from the site defies ethnic classification, but it is possibly connected with the migration of a Neutral group (Garrad 1981). At 70 hearths/ha, the Pretty River village would have contained over 3,000 people, accounting almost completely for the overall increase in Petun population in the early 1620s.

Another possible source of Petun population increase during the early historic period is groups of wintering Ottawa (Cheveux Releves).

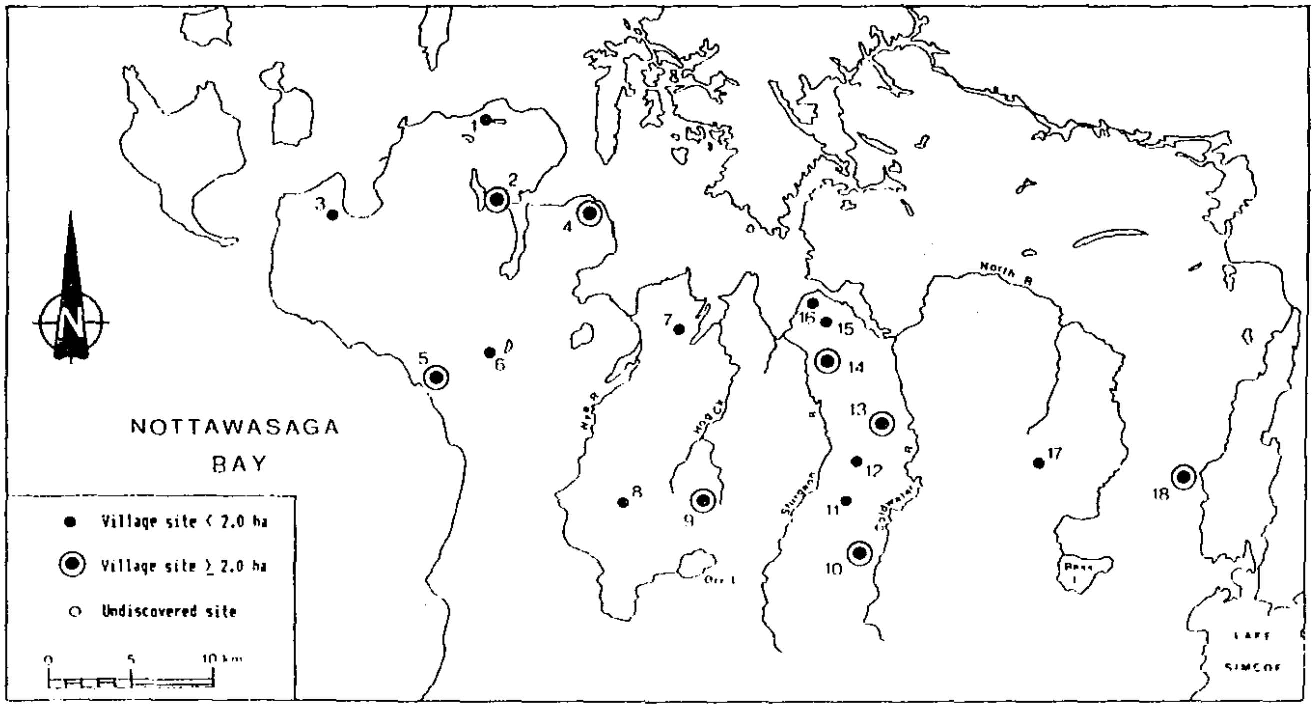

Figure 71. Huron villages ca. A.D. 1623.

Key:

1) Toanche - [BfGx-2 - 1.2 ha]
2) Karenhassa - [BeGx-6 - 2.4 ha]
3) Unnamed village - [BeHa-3 - 0.9 ha]
4) Quieunonascaran - [BeGx-9 - 3.2 ha]
5) Tequenonquiaye (Ossossane) - [BeHa-12 - 2.0 ha]
6) Unnamed village - [BeGx-15 - 1.6 ha]
7) Unnamed village - [BeGw-P - 1.6 ha]
8) Unnamed village - [BdGx-F - 0.8 ha]
9) Scanonaenrat - [BdGw-13 - 2.4 ha]
10) Teanaustaye - [BdGw-3 - 2.8 ha]
11) Unnamed village - [BdGw-17 - 1.5 ha]
12) Unnamed village - [BdGw-H - 0.8 ha]
13) Taenhatentaron - [BeGv-4 - 2.1 ha]
14) Unnamed village - [BeGw-1 - 2.0 ha]
15) Unnamed village - [BeGw-15 - 0.8 ha]
16) Unnamed village - [BeGw-12 - 0.8 ha]
17) Unnamed village - [BdGv-J - < 2.0 ha]
18) Contarea - [BdGu-L - 3.0 ha]

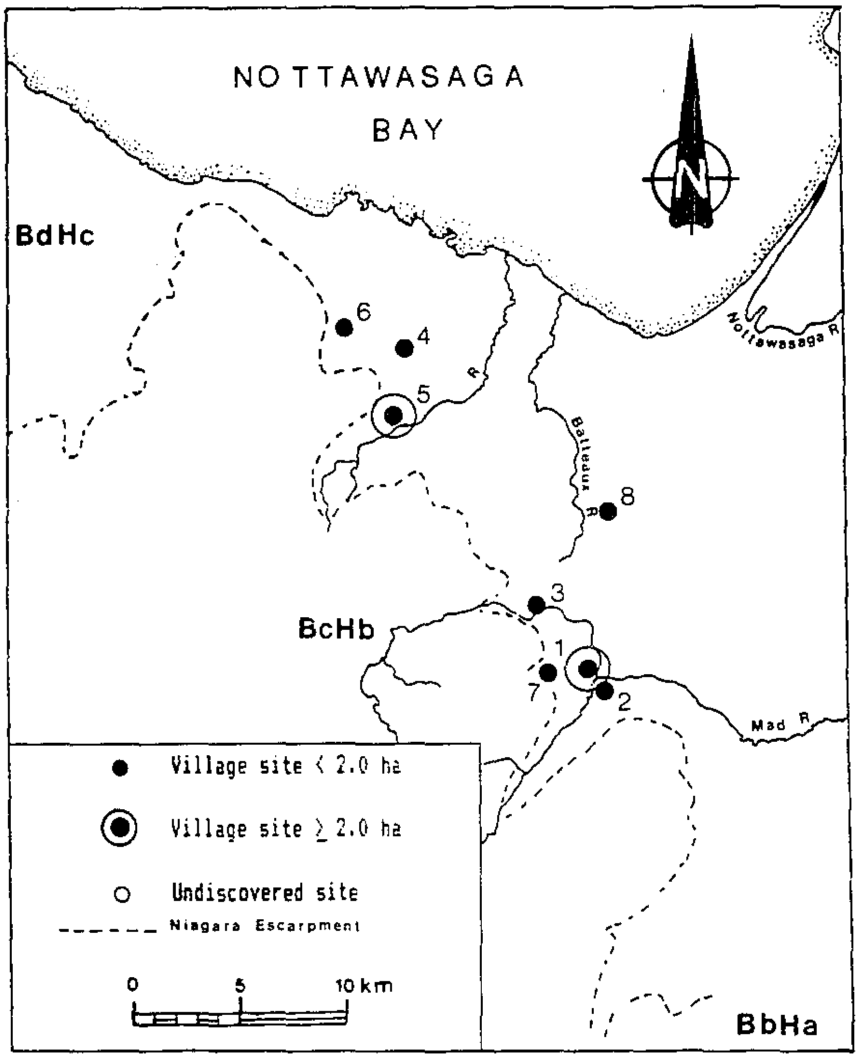

Figure 72. Petun villages ca. A.D. 1623

Key:

1) Unnamed - [BbHa-10 - 4.8 ha]
2) " - [BbHa-15 - 0.8 ha]
3) " - [BcHb-3 - 1.0 ha]
4) " - [BcHb-20 - 0.8 ha]
5) " - [BcHb-22 - 4.8 ha]
6) " - [BcHb-25 - 1.0 ha]
7) " - [BbHb-1 - 0.8 ha]
8) " - [BcHa-13 - 0.8 ha]

These were Algonkians whose four or five tribal groups occupied Manitoulin Island and the lower Bruce Peninsula, just west of the Petun country (Waisberg 1977). In A.D. 1615, the Ottawa population was approximately 1,200-1,600 persons (Feest and Feest 1978:774; Waisberg 1977:26,166) of which at least one tribe of 350-400 habitually spent the winters in or on the outskirts of Petun villages (Trigger 1976:319).

Other Algonkian groups also regularly wintered among the Huron, thus contributing slightly to Huron population totals. The Ononchatoronon (Iroquets) wintered among the Arendarhonon on the outskirts of Cahiague between A.D. 1608 and 1616 (Trigger 1976:247-248,262). They were a group of Algonkians and possibly descendants of St. Lawrence Iroquoians (i.e. Hochelagans) whose homeland was in eastern Ontario in the South Nation River drainage. Considering that they inhabited 15 cabins in A.D. 1640-1641 (Thwaites 1896-1901, 21:247) **after a series of devastating epidemics of European disease** and presumably occupied the south half of Cahiague in A.D. 1615, they may have originally numbered over 1,000 people. Similarly, the Nipissing (Nipisirini) wintered every year among the Attignawantan in the lower Wye River valley (Trigger 1976). They occupied a separate village and numbered 700-800 ca. A.D. 1615-1616 (Biggar 1922-1936, 3:40). Thus, the total number of Algonkians wintering in or adjacent to Huron and Petun villages prior to 1630 was potentially 2,000.

Epidemics and abandonment (A.D. 1634-1650)

Prior to the summer of A.D. 1634, the French Jesuits who had lived among the Huron estimated their population at 30,000 persons and the number of their villages at 20 (Thwaites 1896-1901, 6:59; 7:225, 8:115, 10:313). There are no recorded estimates of Petun population for the early 1630s, but in A.D. 1639 they are said to have occupied nine villages (Thwaites 1896-1901, 19:127). Archaeological and inferred (i.e. "missing sites") site totals for the late 1620s and 1630s indicate that in A.D. 1633 there were approximately 21,200 Huron (living in 25 villages) and 8,200 Petun (inhabiting 10 villages), providing a grand total of 29,400 Huron and Petun ca. A.D. 1633 (Table 47 and Figures 73 and 74).

Without warning in the late summer of 1634, an epidemic of measles (Dobyns 1983:17,322; Johnston 1987; Heidenreich 1987; Trigger 1976:500-501,1981) spread throughout the Attignawantan villages and lasted over the winter (Thwaites 1896-1901, 7:221). This epidemic appears to have been confined mostly to the Attignawantan and, at least in one village, Ihonatiria, mortality rates were approximately 20% (Trigger 1976:851). If the 1634 epidemic was in fact measles, mortality rates in a non-immune population are characteristically 10-20% (Johnston 1987; Ramenofsky 1987a:148). Assuming that only the Attignawantan were infected and that they constituted approximately half of the entire Huron population (Thwaites 1896-1901, 10:77), the Huron (and Petun because of the close ties between the Attignawantan and Petun (Trigger 1976)) may have suffered a 10% depopulation - a loss of about 2,500 people.

An epidemic of influenza hit the Huron in early September of 1636 and persisted until the spring of 1637 (Heidenreich 1987; Johnston 1987; Trigger 1976:526-527,1981b). Mortality in affected villages and regions would have averaged 5-10% (Benenson 1975; Johnston 1987), reducing Huron-Petun population by another 1300-2500 people. The Nipissing who wintered in the Huron country lost 70 persons during this epidemic, approximately 10% of their population (Thwaites 1896-1901, 14:37).

Another epidemic of an unidentified childhood disease struck the Huron in the summer of 1637 and lasted until the autumn of the same year (Heidenreich 1987; Johnston 1987; Trigger 1976:528, 1981b). If the illness was scarlet fever, as suggested by Dobyns (1983:322), mortality in a virgin soil population like the Huron and Petun would have been about 10% (Benenson 1975). Thus, between 1634 and 1637, the Huron and Petun populations experienced a 20% depopulation, leaving only 23,000 Huron-Petun by the winter of 1637.

Survivors of this series of epidemics were left in a weakened condition and prone to secondary infections, primarily of the respiratory tract (Ramenofsky 1987a:148,152). In fact, these and other epidemics had deleteriously affected most of the native groups of the Northeast causing social upheaval and forced relocations. In the summer of 1638, a group of 600-700 Wenroronon refugees migrated from their homeland east of the Niagara River in New York State and joined the Attignawantan (Trigger 1976:562-563). Archaeological evidence for the Wenro immigration is the presence of Genoa Frilled pottery on certain sites such as Ossossane II [BeGx-25], where it

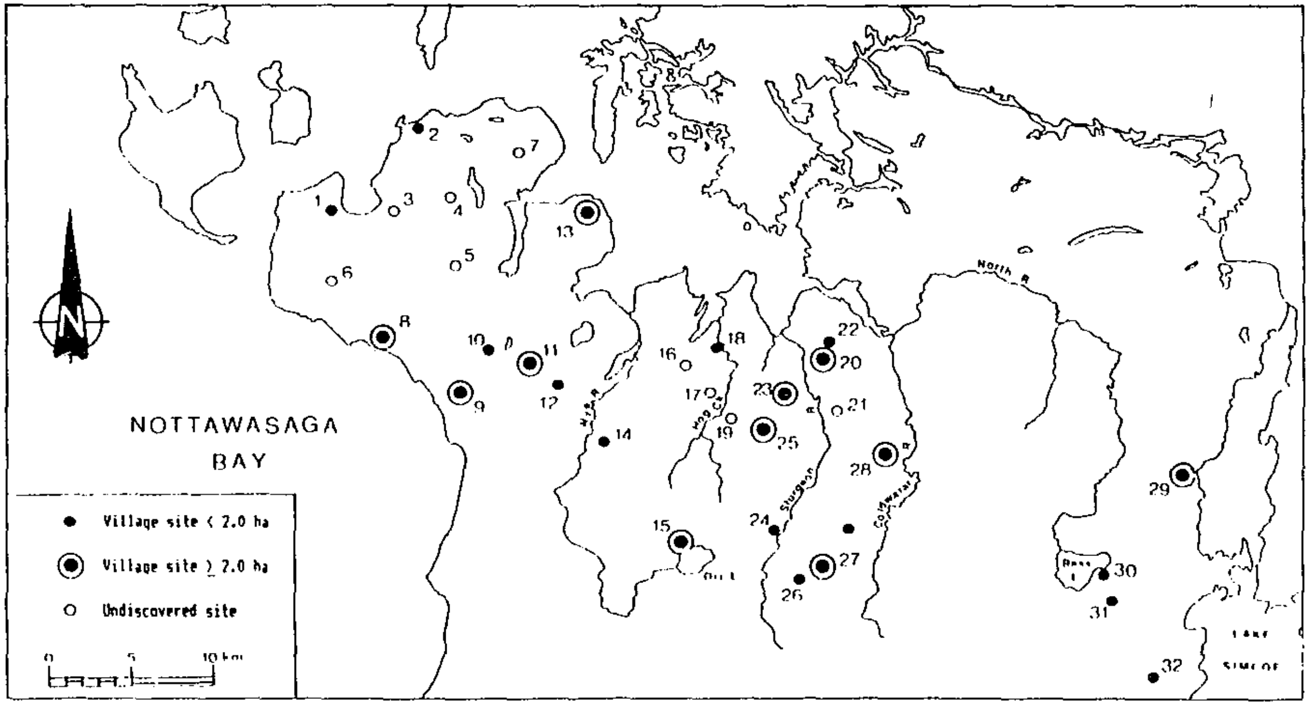

Figure 73. Huron villages ca. A.D. 1634-1639.
(see following page for key to site numbers)

Key to Figure 73:

1) Tondakea - [BeHa-3 - 0.9 ha]
2) Ihonatiria - [BfHa-1 - 0.8 ha]
3) Oenrio - ? [Small - 0.6 ha]
4) Anonatea - ? [Small - 0.8 ha]
5) Onentisati - ? [Small - 0.8 ha]
6) Arontaen (Taruentutunum) - ? [Small - 0.8 ha]
7) Arendaonatia - ? [Small - 0.8 ha]
8) Arente - [BeHa-13 - 3.2 ha]
9) Ossossane I (La Conception) - [BeGx-24 - 2.4 ha]
10) Angoutenc I - [BeGx-15 - 1.6 ha]
11) Angoutenc II - [BeGx-10 - 2.0 ha] - **after 1636**
12) Iahenhouton - [BeGx-36 - 0.8 ha]
13) Quieunonascaran - [BeGx-9 - 3.2 ha]
14) Andiatae - [BeGx-22 - 0.6 ha]
15) Scanonaenrat - [BdGw-L - Large - 2.2 ha]
16) Unnamed village - ? [Small - 0.8 ha] - **after 1638**
17) Kaontia - ? [Small - 0.8 ha] - **after 1638**
18) St. Louis - [BeGw-D - 1.8 ha] - **after 1638**
19) St. Denis - ? [Small - 0.8 ha] - **after 1638**
20) St. Joachim I - [BeGw-i - 2.0 ha]
21) St. Joachim II - ? [Small - 0.8 ha] - **after 1638**
22) Unnamed village - [BeGw-L - Small - 0.8 ha]
23) Ataratiri (St. Jean I) - [BeGw-5 - 2.0 ha]
24) Ekhiondatsaan (La Chaudiere) - [BdGw-B - 1.7 ha]
25) Unnamed village - [BeGw-3 - 3.7 ha]
26) Unnamed village - [BdGw-14 - 0.6 ha]
27) Teanaustaye (St. Joseph II) - [BdGw-26 - 4.0 ha]
28) Taenhatentaron and Arethsi - [BeGv-3 - 4.0 ha]
29) Contarea - [BdGu-L - 3.0 ha]
30) Unnamed village - [BdGu-J - Small - 0.8 ha]
31) Unnamed village - [BdGu-5 - 0.8 ha] - **after 1635**
32) Unnamed village - [BdGu-D - Small - 0.8 ha]

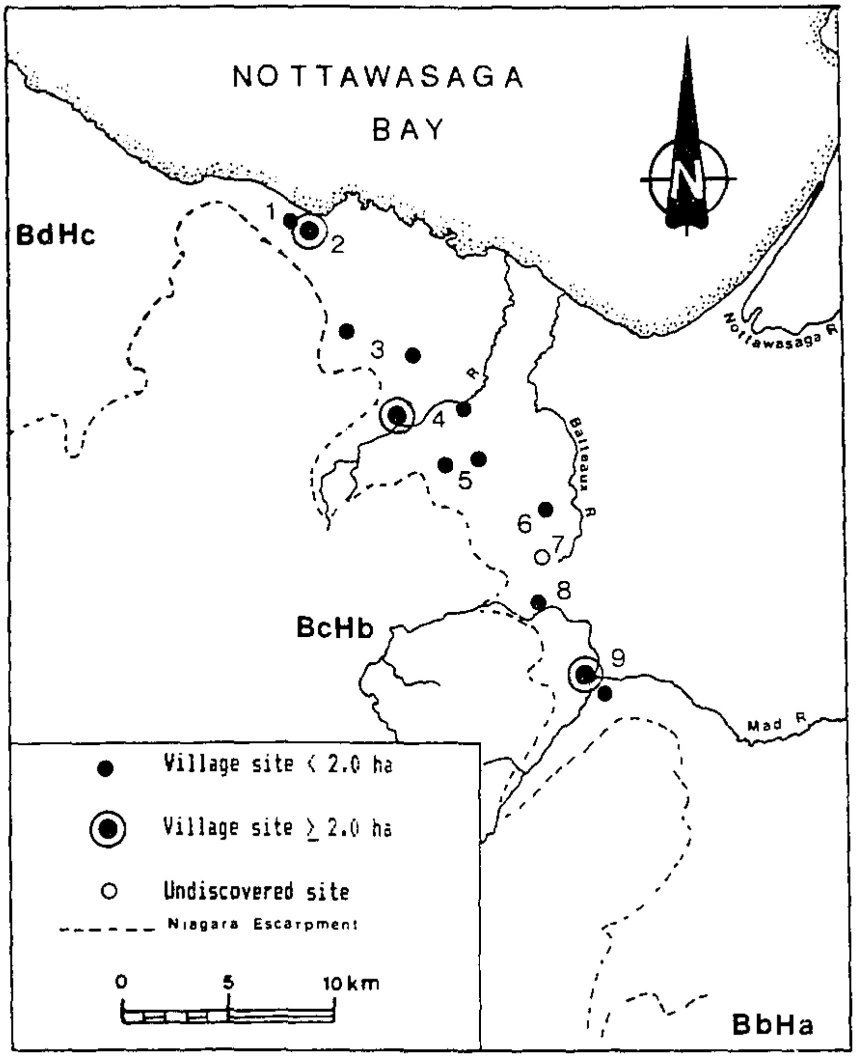

Figure 74. Petun villages ca. A.D. 1634-1639.

Key:

1) St. Simon/St. Jude (Ekarenniondi) - [BdHb-2 - 1.2 ha]
2) St. Mathew - [BdHb-1 - 2.4 ha] - **after 1638**
3) St. Bartholomew - [BcHb-25 - 1.0 ha]
   [BcHb-20 - 0.8 ha]
4) St. James/St. Philip - [BcHb-22 - 4.8 ha]
   [BcHb-16 - 0.7 ha]
5) St. Jean (Etharita) - [BcHb-10 - 4.8 ha **(1.0 ha until 1640)**]
   [BcHb-17 - 1.2 ha]
6) St. Thomas - [BcHb-1 - 0.9 ha]
7) St. James - ? [Small - 0.8 ha]
8) St. Andrew - [BcHb-3 - 1.0 ha]
9) St. Peter and St. Paul (Ehwae) - [BbHa-10 - 4.8 ha]
   [BbHa-15 - 0.9 ha]

constitutes 20% of the pot rims, and Edwards [BeGx-27], where it comprises 91% of all pots recovered (Ridley 1973b).

Smallpox ravaged the already decimated Huron and Petun from the early fall of 1639 until the spring of 1640 (Dobyns 1983:322; Heidenreich 1987; Trigger 1976:588-589,1981b). Mortality would have been very high in a virgin-soil population, on the order of 40-60% (Heidenreich 1971:97-98; Johnston 1987; Ramenofsky 1987a:146-149, 1987b). Thus, on the basis of depopulation ratios, the Huron-Petun population would have been somewhere in the vicinity of 10,000-12,000 people, precisely the number documented by Jerome Lalemant in the 1639-1640 census (Thwaites 1896-1901, 17:223, 19:127). The Jesuits could not possibly have picked a worse time to conduct a census and village survey for cartography purposes of the Huron-Petun than the winter of 1639-1640. Many villages were abandoned after 1639 because they were no longer demographically or politically viable communities:

> The remnants of the Huron found themselves living in villages that were too large for them. Many longhouses were empty or almost empty, since up to half of their inhabitants were dead. In the summer of 1640 this resulted in a decision to relocate the town of Ossossane, although the existing settlement was only five years old (21:159). The extra labour involved in founding a new, albeit smaller, town so soon after the last move must have been a very heavy burden to the people of Ossossane. It may be assumed that similar, premature moves were made in other parts of the Huron country. (Trigger 1976:602)

Likewise, in the Petun country, two of the largest villages, Ehwae and Pretty River were no longer deemed defencible strongholds. Ehwae was attacked and partly burned in 1640 by an unknown enemy force. Both communities shifted farther north and joined other smaller villages to become Etharita and Ekarrenniondi respectively (Garrad 1980,1981).

Calculating post-epidemic Huron-Petun population from archaeological settlement data is particularly difficult because of the high frequency of village abandonments, relocations, and amalgamations of village remnants that took place in the late 1630s and in 1640. Nevertheless, using the 1639-1640 Jesuit lists of village names and number for each Huron tribe and for the Petun, matching archaeological sites to villages on the **Corographie du Pays des Hurons** (see Figures 75 and 76), and multiplying hearth counts by six people per hearth yields a ca. A.D. 1647 Huron population of 8,600 persons (residing in 19 villages) and a Petun population of only 2,900 people, for a combined Huron-Petun total of 11,500. Increased raiding and destruction of Huron villages by the Five Nations Iroquois between A.D. 1647 and the late spring of 1649 reduced the number of Huron villages to 15 and the left only two remaining Petun villages at the time of dispersal in 1649-1650.

The demographic impact of European epidemics on the Huron and Petun, causing close to 60% depopulation, is congruent with other "virgin-soil epidemics" (Crosby 1976). European transoceanic voyages from the late fifteenth to the late nineteenth centuries acted as vectors for the spread of infectious diseases to non-Western and non-immune populations of the world, often with calamitous consequences (McNeill 1976:176-207). Aboriginal groups along the Northeast coast of North America were absolutely decimated in the early 1600s by European diseases (Cook 1973; Snow 1980:32-35; Snow and Lanphear 1988). Depopulation rates for New England native groups of the early seventeenth century range from 67-95% (Snow and Lanphear 1988:24)!

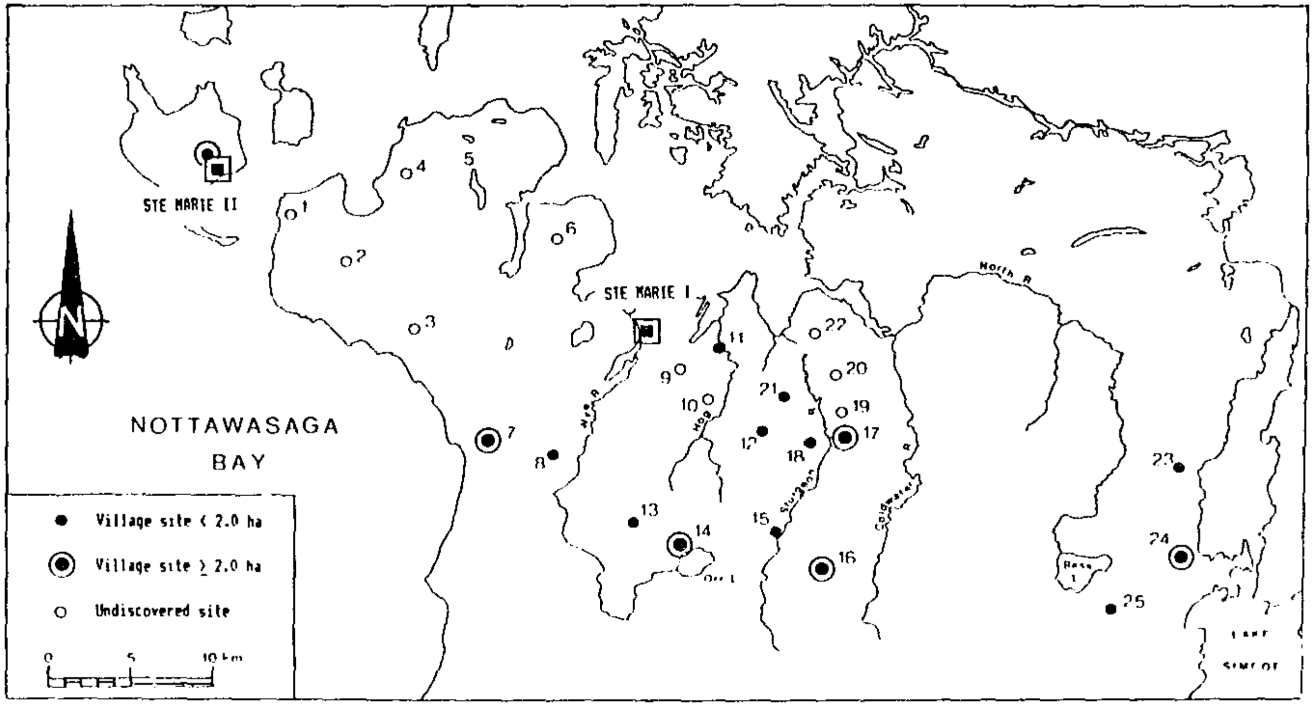

Figure 75. Huron villages ca. A.D. 1640-1650.
(see following page for key to site numbers)

Key to Figure 75:

1) Tondakea - ? [Small - 0.8 ha]
2) Ste. Cecile (Arontaen) - ? [Small - 0.8 ha]
3) Ste. Magdelaine (Arente) - ? [Small - 0.8 ha]
4) Oenrio - ? [Small - 0.8 ha]
5) Karenhasa - ? [Small - 0.8 ha]
6) St. Charles - ? [Small - 0.8 ha]
7) Ossossane II - [BeGx-25 - 4.0 ha]
8) Ste. Francis Xavier (Wenro village) - [BeGx-27 - 0.8 ha]
9) Ste. Anne - ? [Small] - 0.8 ha]
10) Kaontia - ? [Small - 0.8 ha]
11) St. Louis - [BeGw-? - 1.8 ha] - **destroyed 1649**
12) St. Denis - [BdGw-4 - 0.9 ha]
13) Unnamed village - [BdGx-8 - 0.8 ha] - **overlooked in 1639-1640 census**
14) St. Michel - [BdGw-L - Large - 2.2 ha]
15) La Chaudiere - [BdGw-E - 1.7 ha] - **destroyed 1648**
16) St. Joseph II - [BdGw-2A - 4.0 ha] - **destroyed 1648**
17) St. Ignace I - [BeGw-9 - 2.1 ha] - **abandoned 1648**
18) St. Ignace II - [BeGw-11 - 1.6 ha] - **destroyed 1649**
19) Arethsi - ? [Small - 0.8 ha]
20) St. Joachim - ? [Small - 0.8 ha] - **destroyed 1649**
21) St. Jean I - [BeGw-5 - 2.0 ha] - **abandoned 1642**
22) St. Jean II - ? [Small - 0.8 ha] - **destroyed 1649**
23) Ste. Elisabeth - [BdGu-R - Small - 0.8 ha] - **ALGONKIAN VILLAGE - abandoned 1647**
24) Ste. Jean Baptiste - [BdGu-D - Large - 2.2 ha] - **abandoned 1647**
25) Unnamed village - [BdGu-5 - 0.8 ha] - **attacked 1642? - overlooked in 1639-1640 census**

1640s - 1647 = 19 villages

fall 1648 = 17 villages

spring 1649 = 15 villages

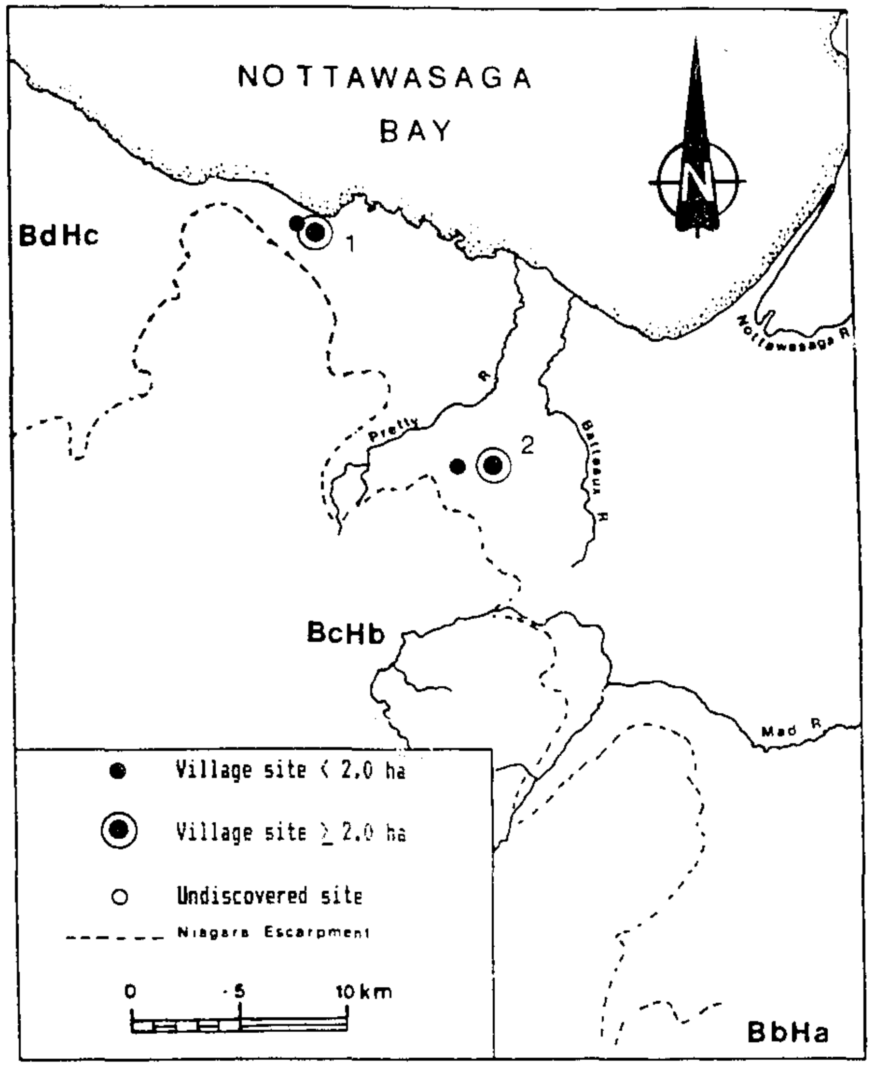

Figure 76. Petun villages ca. A.D. 1640-1650.

Key:

1) St. Mathew (Ekarenniondi) - [BdHb-2 - 1.2 ha]
[BdHb-1 - 2.4 ha]
2) St. Jean (Etharita) - [BcHb-10 - 4.8 ha]
[BcHb-17 - 1.2 ha]

Smallpox was the most virulent, with 50-90% mortality rates being recorded for virgin-soil epidemics of this disease (Johnston 1987:20).

In prehistoric times, the Huron-Petun had never experienced an acute crowd infection, except for tuberculosis (Buikstra 1981; Hartney 1981; Pfeiffer 1984,1986). Most acute crowd infections are believed to have developed in the Old World during the Neolithic (ca. 9000 B.C.) (Black 1975; MacNeill 1976). By this time, Beringia had sunk, essentially isolating the native populations of the Americas from the Old World. It was not until the early seventeenth century that native groups living in the interior of the Northeast came into contact with live infections of European disease. Prior to A.D. 1600, visiting Europeans were primarily adult males who took about six weeks to cross the Atlantic Ocean, preventing most live infections from being transmitted. The trans-Atlantic sea voyage presumably acted like a quarantine period for the European sailors (Snow 1980). Those diseases that were introduced failed to spread far because of the relatively low population densities in the Northeast (Ramenofsky 1987b). In the early 1600s, however, shiploads of European colonists began arriving on Northeast shores. Infected children of these first colonies are believed to have been responsible for initiating a continuing series of disease epidemics among interior Northeastern aboriginal groups (Snow and Lanphear 1988).

Acute crowd infections among non-immune populations, such as the early seventeenth-century Huron-Petun, have high mortality rates because everyone is susceptible and gets sick at once (preventing nursing, water fetching, tending fires), no quarantine is normally practiced (high residential density of Iroquoian houses and villages would have hastened the spread of disease), secondary infections (e.g. pneumonia) erupt because of depressed immune systems, diseases follow each other in rapid succession, and food-getting activities (e.g. corn harvest) are curtailed (Black et al. 1977; Burnet and White 1972:16-17; Crosby 1976:293-297; Hurlich 1983; Neel 1977). Infants (0-2 years) and the old (>40 years) are selectively killed by acute crowd infections, although adolescents and young adults (15-30 years) can experience high mortality rates from smallpox, measles, mumps, and chickenpox because of over-reactive immune responses (Burnet and White 1972:97-99). Ontario Iroquoian skeletal populations that were buried during the 1630s epidemics, at Ossossane and Grimsby, reveal extremely high juvenile mortality rates (Jackes 1986).

Following the destruction of the villages of St. Louis and St. Ignace II in mid-March of 1649, the Huron decided to abandon and burn their remaining 13 villages. Many of the Huron, particularly the Christian converts, fled to Christian Island (Gahoendoe) with the French, where they established a temporary village composed of over 100 longhouses holding several thousand people (Trigger 1976:772-775). Famine , disease, and starvation killed hundreds of Huron over the winter of 1649-50. Similarly, after the destruction of Etharita in December of 1649, the surviving Petun and Ossossane Huron refugees, numbering about 500 (Trigger 1976:789), abandoned the Petun country in the spring of 1650. Half of the 600 Huron remaining on Gahoendoe in the same spring left the island and journeyed to Quebec with the Jesuits. The last 300 Huron abandoned Gahoendoe in the spring of 1651 and joined the others at Quebec (Trigger 1976:786-789). Thus ended the Huron-Petun occupation of Ontario.

CHAPTER 8

CONCLUSIONS

It was the intent of this study to reconstruct and explain trends in the population size of the Huron-Petun of south-central Ontario, Canada from A.D. 900-1650.

Archaeological settlement remains provided the basis for reconstructing Huron-Petun population. Employing a direct historic analogy, hearth counts were generated for each major temporal phase of Huron-Petun development. According to seventeenth century accounts, Huron longhouses contained a row of central hearths, each hearth shared by two nuclear families. Palaeodemographic life tables provided rough approximations of the size of prehistoric and protohistoric nuclear families. Ethnohistory provided family size estimates for the historic period. It was found that the number of persons per hearth was between 10 and 11. Using hearth density constants, calculated for each time period from excavated village plans, a Huron-Petun population curve was constructed.

This curve makes four significant contributions to Ontario prehistory:

(1) The adoption of corn agriculture in Ontario does not appear to have occurred because of population pressure. Middle Woodland hunter-gatherers had relatively high death rates because of crisis mortality during severe winters. The introduction of corn removed the need for the annual splintering of Middle Woodland summer aggregation camps and removed much of the winter famine mortality as well. Population began to grow about A.D. 900 as a consequence of reduced crisis mortality.

(2) During the fourteenth century, a population explosion occurred in south-central Ontario. Between A.D. 1300 and A.D. 1430 population almost quadrupled (from 8,000 to 30,000 people) as a result of intrinsic growth. Rapid population growth was fueled by relatively low juvenile mortality and moderate fertility and by the colonization of Simcoe County by daughter villages from the Toronto region. Annual growth rates reached 1.2% - an extremely high rate for pre-industrial times. By A.D. 1450, however, population growth had ceased because of lower fertility resulting from increased morbidity from tuberculosis and other density-dependent diseases, inter-tribal warfare, local extirpation of deer and heavier reliance on corn. Trade with northern Algonkians increased substantially over the course of the fifteenth century in order to supply the burgeoning Huron-Petun population with essential resources such as deer hides, meat, and dried fish.

(3) No drastic reduction in Huron-Petun population during the late sixteenth or early seventeenth century seems to have taken place. Population hovered between 30,000 and 28,000 for the whole of the sixteenth century and on into the seventeenth century. Epidemics of Old World disease did not sweep through the Huron-Petun country until the 1630s. Between A.D. 1634 and 1640, the Huron-Petun experienced catastrophic depopulation; almost two thirds of the population perished.

(4) Early seventeenth-century estimates of 30-32,000 Huron are too large if they referred only to the Huron. Archaeological estimates of 28-30,000 for a combined Huron-Petun population suggest that early seventeenth-century writers probably lumped the Petun with the Huron

when it came to population counts. Archaeological village counts concur with seventeenth-century counts; 18-25 Huron villages at any one time and 7-9 Petun villages. The congruence between the historical and archaeological data is quite remarkable.

In light of demographic theory, the timing of Huron-Petun population growth and its cessation conforms most closely to a Malthusian situation, assuming that the introduction of corn agriculture to Southern Ontario ca. A.D. 700 was not a subsistence strategy employed by Middle Woodland groups to relieve population pressure. Available archaeological data suggest the possibility for slow but steady population growth throughout the Middle Woodland period. However, neither palaeodemographic data nor best estimates of Middle Woodland population support a population pressure or Boserupian situation immediately prior to the adoption of corn agriculture in Southern Ontario. It is true that Middle Woodland people incorporated wild rice and other starchy foods in their diet on a scale unprecedented in Archaic times. Increased reliance on storable starchy foods, however, was likely not in response to growing population but to growing sedentism and the sustenance of large seasonal communities. Consequently, when corn entered Southern Ontario ca. A.D. 700, it was embraced by late Middle Woodland peoples who were preadapted to harvesting, storing, and consuming starchy plant foods.

The superior reliability and productivity of corn over its wild counterparts (e.g. wild rice) reduced the frequency and intensity of late winter famines and permitted the earlier weaning of infants. Rapid population growth, which began in the Early Iroquoian period and continued throughout the thirteenth and fourteenth centuries, was the natural result of lower mortality and increased fertility rates. By A.D. 1450, however, Huron-Petun population growth had stopped, again in conformity with Malthusian theory. In the late fourteenth century, overcrowded villages and a decline in animal protein per capita resulted in the establishment of a synergy between tuberculosis and chronic malnourishment, lowering fertility. This acted as a positive check on further population growth. In addition, the demand for deer hide clothing by a population of 30,000 Huron-Petun would have resulted in the extermination of local deer herds. In order to minimize deer herd loss, it is possible that the Huron-Petun saw the need to control their numbers and began to practice lengthy periods of postpartum abstinence as a preventative check on population growth. From A.D. 1450 to A.D. 1615, both preventative and positive checks maintained a constant Huron-Petun population level at 30,000 persons.

In summary, Huron-Petun population history best fits a Malthusian model, although a Boserupian model is not ruled out. If late Middle Woodland population was in fact pressing against local, seasonal resources in particular regions and if corn was available, it is possible that local population pressure may have partially promoted the adoption of corn agriculture in Southern Ontario ca. A.D. 700. It is suspected that when sufficient archaeological data become available, neither Malthusian nor Boserupian demographic models will be adequate to deal with the historical complexities of population change in prehistoric Ontario.

This study has revealed some crucial gaps in our understanding of Iroquoian demography. First, except for the obvious cases of the St. Lawrence Iroquoian and Wenro migrations into south-central Ontario, it is not known at present whether or not the Neutral contributed to Huron-Petun population increase from the fourteenth to sixteenth centuries. Further, the timing of population growth has yet to be empirically demonstrated for neighbouring Northern Iroquoians, such as the Five Nations, the St. Lawrence Iroquoians, and the Neutral confederacy. Protohistoric depopulation, particularly for the St. Lawrence Iroquoians, should not be ruled out at present.

Information on prehistoric Huron-Petun diets is woefully inadequate for explaining certain phases of population change. Palaeodemography and isotope analyses of human bone have provided better data on Huron-Petun subsistence than zooarchaeology. The record of Northeast climatic change also deserves closer scrutiny for trends that may have contributed to population movements. In general, we still have a poor grasp of the environmental conditions surrounding the emergence and development of corn agriculture in Southern Ontario.

The Huron-Petun abandoned south-central Ontario in A.D. 1650, leaving behind their burned settlements and garbage. Seven centuries of occupation are documented in approximately 750 settlement sites. We have probably already lost about 100 of these to urbanization, transportation corridors, and extraction industries. If the rate of site destruction increases, it will become increasingly difficult to further this research. This study ends on a plea of urgency for more archaeological attention to be paid to regional site survey in order to facilitate the study of population trends. We cannot afford to wait until every site is dug and every potsherd analyzed before writing population histories of prehistoric peoples. In many parts of Ontario the data are fast disappearing and, if archaeologists do not act soon, historians will be the only ones writing about population pressure and Malthusian crashes.

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APPENDIX 1 SITE DATA

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
AkGt-2	Elliot	1960	p	Mid. Iroq.	Uren	67		1.6	Donaldson 1965 Kapches 1981
AkGt-6	Macklin	1896	p			0		0.8	Konrad 1973
AkGt-14	Brookes	1896	p			0		3.2	Konrad 1973
AkGt-17	Archie Little II	1973	p	Mid. Iroq.	Middleport	2		0.4	Konrad and Ross 1974 MPP 1988
AkGt-18	Little's Road	1973	p			0		0.0	Konrad and Ross 1974
AkGt-21	Hood	1973	p			0		1.8	Konrad 1973 MPP 1986a
AkGt-29	Thomson	1956	p	Mid. Iroq.	Uren	70		0.0	Emerson 1956 Kapches 1981a
AkGt-41	Milne	1987	p	Mid. Iroq.	L. Middleport	4		1.0	MPP 1988
AkGu-3	Jackes	1887	p	L. Prehist.	L. Late Prehistoric	74		3.0	Boyle 1887 Noble 1974
AkGu-9	Doncaster I	1971	p	L. Prehist.		0		1.8	Konrad 1973
AkGu-10	Riseborough	1971	p	L. Prehist.	L. Late Prehistoric	91		1.2	Konrad 1973 Ramsden 1977a:74,263
AkGu-11	DeGreer	1972	p			0		0.8	Konrad 1973
AkGu-13	Downsview	1948	p	L. Prehist.	L. Late Prehistoric	416		2.0	Emerson 1954 Wright 1966:69 Ramsden 1977a:69,263
AkGu-14	Thornhill	1925	p	Mid. Iroq.		0		1.8	Konrad 1973 MPP 1986b:125,1988 pc
AkGu-15	Baker	1972	p	Mid. Iroq.	Middleport	0		1.0	Konrad 1973 MPP 1986b:118,1987 pc
AkGu-16	Reaman	1924	p	Mid. Iroq.	L. Middleport	40		2.4	Konrad 1973 MPP 1986b:118,1988 pc

Key to abbreviations:
BORDEN NO. = Borden number for registered sites/ letter for unregistered sites **DISC DATE** = Year of site discovery **AGE:** p = prehistoric/ c = contact (site with European item(s)) **PERIOD:** E. Iroq. = Early Iroquoian Mid. Iroq. = Middle Iroquoian L. Prehist. = Late Prehistoric Contact = Contact (protohistoric and historic) **PHASE:** E. = Early/ M. = Middle/ L. = Late **RIM NO.** = Number of analyzable rim sherds for site **REL SIZE** = Relative size of site (S = small/ L = large) **Size(ha)** = Size of site in ha (0.0 ha = precise size not known)

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
AkGu-17	Doncaster (II)	1928	p	L. Prehist.	E. Late Prehistoric	314	S	2.4	Konrad 1973 Wright 1966 MPP 1986a:101-103 Lennox et al.1986
AkGu-19	East Don	1925	p	L. Prehist.		0		1.8	Konrad 1973 MPP 1986a
AkGv-A	Avery	1969	p	L. Prehist.		0		2.4	MPP 1986b:142
AkGv-1	Seed	1925	c	Contact	E. Protohistoric	106		2.0	Wright 1966 B. Snow 1978 Burgar 1984,1988 Crawford 1985
AkGv-2	McKenzie-Woodbridge	1947	c	Contact	E. Protohistoric	310		3.6	Emerson 1954 Ramsden 1977a:220 Johnson 1980 Kapches 1982a
AkGv-3	Boyd	1950	p	L. Prehist.	L. Late Prehistoric	36		2.0	Donaldson 1962b Kapches 1982a Ramsden 1977a MPP 1986b:28
AkGv-5		1972	p			0		1.8	Konrad 1973
AkGv-8	Parsons	1949	p	L. Prehist.	L. Late Prehistoric	681		2.8	Emerson 1956 Kapches 1982b Ramsden 1977a
AkGv-9	Supertest	1955	p			0		1.8	Konrad 1973
AkGv-10	Groundskeeper	1972	p			0		1.8	Konrad 1973
AkGv-11	Black Creek	1949	p	L. Prehist.	M. Late Prehistoric	376		2.0	Emerson 1954 Wright 1966:101 Ramsden 1977a:69,263

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
AkGv-12	Emery	1955	p	L. Prehist.		0		1.8	Konrad 1973
AkGv-14	Keffer	1925	p	L. Prehist.	L. Late Prehistoric	3200		2.0	Finlayson et al. 1987
AkGv-16	McNeil	1911	p	L. Prehist.		0		1.8	Orr 1911
									Konrad 1973
									MPP 1986b:118,1988 pc
AlGh-2	Payne	1966	p	L. Prehist.	M. Late Prehistoric	204		1.0	Emerson 1966
									Pendergast 1963
									Sweetman 1972
									Ramsden 1977a
AlGh-9	Huff	1976	p	Mid. Iroq.	Middleport	0		1.6	Swayze 1973
AlGi-4	Taylor I	1972	p	E. Iroq.	E. Early Iroquoian	0		0.4	Sweetman 1972
AlGi-5	Hillier (Taylor 2)	1972	p	L. Prehist.	E. Late Prehistoric	97		2.2	Sweetman 1972
									Ramsden 1977a:263
AlGm-2	Cobourg	1974	p	L. Prehist.	M. Late Prehistoric	0		1.7	Roberts 1978
									Ramsden 1978b:103
AlGn-7		1978	p			0		0.0	Roberts 1978
AlGo-2	Zion School	1968	p	E. Iroq.		0		1.2	Roberts 1978
AlGo-15	Roby	1978	p			0	L	0.0	Roberts 1978
AlGo-16	Boyko	1978	p	E. Iroq.		0	S	0.0	Roberts 1978
AlGo-17	Young	1978	p	E. Iroq.		0	S	0.0	Roberts 1978
AlGo-21	Canton I	1978	p	L. Prehist.	L. Late Prehistoric	0		0.0	Roberts 1978
AlGo-23	Irwin	1978	p			0		0.0	Roberts 1978
AlGo-29	Auda	1978	p	E. Iroq.	E. Early Iroquoian	30		0.2	Kapches 1981b
AlGo-41	Eldorado	1980	p	E. Iroq.	M. Early Iroquoian	22		0.2	Kapches 1983a,1988
AlGp-7	Orono North	1978	p	Mid. Iroq.	Uren	8		2.0	Roberts 1978
AlGr-9	Hogarth	1978	p			0		0.0	Roberts 1978
AlGr-10	Harvey Pascoe	1978	p	Mid. Iroq.	L. Middleport	3		0.0	Roberts 1978

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
AlGr-41	McLeod	1965	p	L. Prehist.	M. Late Prehistoric	52		1.6	Dodd 1984:336
									Ramsden 1977a:263
AlGs-1	Miller	1959	p	E. Iroq.	M. Early Iroquoian	7490		0.4	W. Kenyon 1968
AlGs-2	F. Beare	1950	p	L. Prehist.		0		0.8	Konrad 1973
									MPP 1988b
AlGs-4	Reesor	1973	p	Mid. Iroq.	Middleport	0		1.2	Konrad 1973
AlGs-9	Waltham	1960	p	Mid. Iroq.		0		1.2	Konrad 1973
AlGs-10	Boys	1954	p	E. Iroq.	L. Early Iroquoian	257		0.4	Ridley 1958
									Konrad 1973
									Reid 1975
AlGs-11	Carleton	1954	p	E. Iroq.	L. Early Iroquoian	0		1.2	Konrad 1973
AlGs-14	Decker's Hill	1973	p	E. Iroq.		0		0.4	Konrad and Ross 1974
AlGs-23	Golf Course	1973	p			0		1.6	Konrad and Ross 1974
AlGs-29	Pearse	1973	p	Mid. Iroq.	E. Middleport	3		2.0	Konrad and Ross 1974
									Poulton 1979
AlGs-71	Hoar	1977	p	Mid. Iroq.	L. Middleport	9		3.0	Poulton 1979
AlGs-73	Webb II	1977	p	Mid. Iroq.	E. Middleport	3		1.2	Poulton 1979
AlGs-79	Webb I	1977	p	Mid. Iroq.	Uren	3		0.4	Poulton 1979
AlGs-101	Delancey	1978	p	Mid. Iroq.	Uren	27		0.2	Spittal 1978
									Ambrose 1981
AlGs-102	Bolitho	1978	p	E. Iroq.	M. Early Iroquoian	126		0.6	Spittal 1978
									Ambrose 1981
AlGs-103	Winnifred	1978	p	E. Iroq.	L. Early Iroquoian	31		0.4	Spittal 1978
									Ambrose 1981
AlGs-104	Ginger	1978	p	E. Iroq.	M. Early Iroquoian	43		0.4	Spittal 1978
AlGt-1	Milroy	1954	p	Mid. Iroq.	L. Middleport	106		0.8	Donaldson 1962a
									Kapches 1981a:71
									Ramsden 1977a:263

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
AlGt-2	Draper	1953	p	L. Prehist.	M. Late Prehistoric	881		4.2	Wright 1966 Hayden 1979 Finlayson 1985
AlGt-4	Robb	1954	p	Mid. Iroq.	E. Middleport	184		1.2	Donaldson 1962a Kapches 1981a MPP 1986a
AlGt-6	Peter Reesor	1935	p			0		1.8	Konrad 1973
AlGt-7	Reesor	1972	p			0		1.8	Konrad 1973
AlGt-8	Woodland Park	1965	p	Mid. Iroq.	E. Middleport	50		0.5	Konrad 1973 Konrad and Ross 1974 MPP 1988
AlGt-9	Sewell	1955	p	Mid. Iroq.	E. Middleport	0		2.4	Konrad 1973 Kapches 1981a:179
AlGt-12	Russell Reesor	1955	p	L. Prehist.	E. Late Prehistoric	0		0.8	Konrad 1973 Konrad and Ross 1974 MPP 1986a:113
AlGt-14	Ken Reesor II	1962	p	L. Prehist.	E. Late Prehistoric	70		1.6	Donaldson 1962a Konrad 1973 Ramsden 1977a:263
AlGt-18	Faraday	1972	p	Mid. Iroq.	E. Middleport	7		1.6	Konrad 1973 Kapches 1981a:178
AlGt-19	Burkholder I	1955	p			0		1.2	Konrad 1973 MPP 1986a:120
AlGt-22		1955	p			0		1.8	Konrad 1973 MPP 1986a:122
AlGt-32	White	1972	p	L. Prehist.	M. Late Prehistoric	0		0.6	Konrad 1973 Hayden 1979 Finlayson 1985:481-487

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
AlGt-35	Burkholder II	1973	p	L. Prehist.	E. Late Prehistoric	0		1.8	Konrad and Ross 1974 Kapches 1981a MPP 1986a:1128
AlGt-36	New	1973	p	Mid. Iroq.	L. Middleport	54		1.0	Konrad and Ross 1974 Kapches 1981a:71 Pearce 1986
AlGt-60	Hamlin	1972	p	Mid. Iroq.	L. Middleport	211		2.4	MPP 1988b
AlGt-65	Gostick	1976	p	L. Prehist.	E. Late Prehistoric	11		1.2	Poulton 1979 Finlayson 1985
AlGt-66	Spang	1976	p	L. Prehist.	L. Late Prehistoric	47		3.4	Poulton 1979 Finlayson 1985:434
AlGt-67	Best	1976	p	L. Prehist.	M. Late Prehistoric	71		1.8	Poulton 1979
AlGt-68	Dent Brown	1976	p	L. Prehist.	E. Late Prehistoric	28		1.8	Poulton 1979
AlGt-87	Pugh	1977	p	L. Prehist.	M. Late Prehistoric	0		2.8	Poulton 1979 Timmins 1981 Finlayson 1985
AlGt-96	Robin Hood	1972	p	L. Prehist.	M. Late Prehistoric	18		0.6	Konrad 1973 Poulton 1979 Williamson 1983
AlGt-97	Carruthers	1977	p	L. Prehist.	M. Late Prehistoric	4		0.6	Poulton 1979
AlGt-157	Radcliffe	1979	c	Contact	L. Protohistoric	12		2.8	Dibb 1979
AlGt-162	Russell	1987	p	Mid. Iroq.	L. Middleport	8		0.4	MPP 1988b
AlGu-A	Mill Road	1931	p			0		0.6	MPP 1986b:90
AlGu-1	Boyle-Atkinson	1899	p	L. Prehist.	M. Late Prehistoric	0		1.0	Konrad 1973 MPP 1987a
AlGu-3	Murphy-Goulding	1930	p	L. Prehist.		0		1.8	Konrad 1973
AlGu-5	Watford	1965	p	L. Prehist.		0		1.8	Konrad 1973

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
AlGu-7	Walkington	1928	p			0		0.0	Konrad 1973 MPP 1986b:118
AlGu-8	McNair-Stevenson	1928	p	L. Prehist.	E. Late Prehistoric	0		1.8	Konrad 1973 MPP 1988 pc
AlGu-12	Bruce Creek	1955	p	L. Prehist.	M. Late Prehistoric	0		4.3	Konrad 1973 Dibb 1979 MPP 1987b
AlGu-13	Van Nostrand-Wright	1979	c	Contact	E. Protohistoric	0		4.3	Dibb 1979
AlGu-15	Hoshel-Huntley	1955	p	L. Prehist.	L. Late Prehistoric	0	L	0.0	Dibb 1979
AlGu-17	Wilcox Lake	1983	p	Mid. Iroq.	Uren	0		0.8	Dibb 1983 (Borden form) Ron Williamson pc 1988
AlGu-23	Sherwood Side Road	1911	p			0		0.0	Konrad 1973 MPP 1986b:118
AlGv-A	Shurgain	1987	p	L. Prehist.	L. Late Prehistoric	30		2.6	MPP 1987 pc
AlGv-2	Teston	1925	c	Contact	E. Protohistoric	50		2.4	MPP 1987 pc
AlGv-11	Mulloy-Blake	1911	p	L. Prehist.		0		3.2	Konrad 1973 MPP 1986b:118
AlGv-12	Humber River	1911	p	Mid. Iroq.		0		1.8	Konrad 1973
AlGv-18	Jarrett-Lahmer	1911	p	L. Prehist.	L. Late Prehistoric	0		2.0	Konrad 1973 MPP 1986b:118,1987 pc
BaGg-1	Waupoos	1957	p	L. Prehist.	M. Late Prehistoric	81		0.8	Pendergast 1964 Ramsden 1977a:255
BaGh-2	Barber II	1972	p	Mid. Iroq.	L. Middleport	0	S	0.0	Sweetman 1972
BaGh-4	Miller	1972	p	L. Prehist.	E. Late Prehistoric	20		2.4	Sweetman 1972
BaGh-16	Barber 3	1972	p			0		1.0	Sweetman 1972 Kapches 1984
BaGi-1	Allisonville	1957	p	L. Prehist.		0		1.0	Swayze 1973

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BaGi-4	Wallbridge	1972	p	Mid. Iroq.	L. Middleport	0		1.5	Sweetman 1972
BaGi-6	Redner I	1972	p	E. Iroq.		1	S	0.0	Sweetman 1972
BaGi-7		1974	p	Mid. Iroq.	Middleport	0	L	1.0	Swayze 1973
BaGi-8	Squire	1952	p	Mid. Iroq.	L. Middleport	40		1.0	Squires 1958 Swayze 1973
BaGi-9	Root	1950	p			0	M	0.0	Swayze 1973
BaGk-2	Breeze	1968	p	Mid. Iroq.	Uren	68	S	0.8	Pearce 1977,1978
BaGo-1	Larmer	1967	p	Mid. Iroq.	Middleport	0	S	0.0	Ellis and Foster 1986
BaGo-4		1978	p	E. Iroq.		0		0.8	Roberts 1978
BaGo-18	Brown	1978	p	L. Prehist.	L. Late Prehistoric	3		1.0	Roberts 1978
BaGo-27	Austin IV	1978	p	Mid. Iroq.	Uren	0		0.0	Roberts 1978
BaGo-28	Beach Hill	1978	p			0		0.8	Roberts 1978
BaGo-29	Gibbs	1978	p	Mid. Iroq.	E. Middleport	0		1.2	Roberts 1978 McKillop and Jackson 1985
BaGo-30	Elizabethville	1977	p	L. Prehist.	E. Late Prehistoric	0		1.2	Roberts 1978
BaGp-1	Strong	1967	p	L. Prehist.	M. Late Prehistoric	0		1.0	Roberts 1978
BaGp-11	Kirby	1976	p	L. Prehist.	E. Late Prehistoric	9		2.4	O'Brien 1976b Roberts 1978
BaGp-14	Sawyer	1976	p			0		2.0	O'Brien 1976b Roberts 1978
BaGp-19	Morgan	1976	p	Mid. Iroq.	L. Middleport	2		1.0	O'Brien 1976b Roberts 1978
BaGp-31	Ned Foster	1978	p	L. Prehist.	M. Late Prehistoric	0		0.4	Roberts 1978
BaGp-36	Fleetwood Creek 2	1987	p	L. Prehist.	M. Late Prehistoric	4		1.2	Pihl 1988
BaGq-2	Venasse	1978	p			0		0.6	Roberts 1978
BaGq-9		1978	p			0	S	0.0	Roberts 1978
BaGr-1	Pascoe	1974	p	Mid. Iroq.	E. Middleport	5		1.0	Roberts 1978

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BaGs-1	Appleby	1972	p			0		1.8	Konrad 1973
BaGu-2	Aurora	1918	c	Contact	E. Protohistoric	284		3.4	Emerson 1954 Ramsden 1977a Dibb 1979
BaGv-1	Bosomworth	1958	p	L. Prehist.	L. Late Prehistoric	428		1.2	Emerson 1959 Wright 1966:150 Ramsden 1977a:255,263
BaGw-1	Beeton	1966	c	Contact	E. Protohistoric	210		1.4	Latta 1980 Ramsden 1977a:263
BaGw-2	Dermott	1974	c	Contact	L. Protohistoric	10		1.2	Storck 1979
BbGi-1	Lite	1951	p	L. Prehist.	M. Late Prehistoric	419		1.0	Pendergast 1972 Ramsden 1977a:263
BbGk-7	Ames	1963	p	L. Prehist.	L. Late Prehistoric	117		1.6	Ridley 1974 Jeff Bursey pc 1987
BbGl-4	Richardson	1968	p	E. Iroq.	L. Early Iroquoian	347		0.4	Pearce 1977,1978
BbGp-12	Bark	1983	p	L. Prehist.	M. Late Prehistoric	57		1.2	Kapches 1984 Saunders 1985 Rick Sutton pc 1988
BbGp-13	Wilson	1962	p	L. Prehist.	E. Late Prehistoric	0		3.0	Kapches 1984 Rick Sutton pc 1988
BbGr-2	Thomas	1955	p	L. Prehist.	L. Late Prehistoric	234		0.7	Donaldson 1962
BbGr-3	Ward (Layton)	1974	c	Contact	E. Protohistoric	35		0.8	Ramsden 1981
BbGs-1	Baird (Baird-Short)	1962	p	L. Prehist.	L. Late Prehistoric	0		0.0	Donaldson 1962c
BbGs-10	Balthazar (Harshaw)	1973	p	L. Prehist.	M. Late Prehistoric	15		3.1	R. O'Brien 1978 (Borden form)
BbGs-11	Markson	1978	p	L. Prehist.	E. Late Prehistoric	0		0.8	R. O'Brien 1978 (site form)
BbGt-2	McKnight	1978	p	L. Prehist.	L. Late Prehistoric	0	L	0.0	R. O'Brien 1978 (site form)
BbGv-A	Hunter Innisfil n.d. #9	1887	p	L. Prehist.	L. Late Prehistoric	0		0.0	Hunter n.d. #9 Emerson and Popham 1952

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BbGv-E	Hunter Innisfil n.d. #548	1904	p			0		0.0	Hunter n.d.
BbGv-B	Hunter Innisfil n.d. #186	1889	c	Contact	L. Protohistoric	0		0.0	Hunter n.d.
BbGv-12	Goodeve	1904	p	L. Prehist.	M. Late Prehistoric	70		1.6	Hunter n.d. #506 R. O'Brien 1988 pc
BbGv-19	Brassington	1888	p	L. Prehist.	M. Late Prehistoric	27		3.1	Hunter n.d.(#84) Warrick 1988a
BbGv-20	Cooper	1889	c	Contact	L. Protohistoric	60		2.2	Hunter n.d.(#108) Warrick 1988a
BbGv-22	Lucas	1888	c	L. Prehist.	L. Late Prehistoric	37		1.2	Hunter n.d.(#63) Warrick 1988a
BbGv-30	Blu Meanie	1986	p	L. Prehist.	L. Late Prehistoric	10		0.8	Warrick 1988a
BbGw-A	Hunter Innisfil n.d. #187	1889	p			0	S	0.0	Hunter n.d.
BbGw-2	Graham-Rogers	1889	c	Contact	E. Historic	63		1.6	Hunter n.d.(#97) Emerson 1961 Ridley 1966 Ramsden 1977a
BbGw-5	Dykstra	1985	p	Mid. Iroq.	E. Middleport	20		0.3	Warrick and Molnar 1986 Warrick 1988a
BbGw-9	Hubbert	1889	p	L. Prehist.	E. Late Prehistoric	2		2.0	Hunter n.d.(#105) Hunter 1976 Warrick and Molnar 1986
BbGw-10	Cleary	1963	p	L. Prehist.	E. Late Prehistoric	38		4.6	Warrick and Molnar 1986 Warrick 1988a
BbGw-11	Roof	1888	p	L. Prehist.	M. Late Prehistoric	25		1.0	Hunter n.d.(#96) Warrick 1988a
BbGw-13	Lougheed	1897	p	Mid. Iroq.	L. Middleport	29		0.6	Hunter n.d.(#243) Christie and Warrick 1986 Warrick 1988a

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BbGw-14	Paisley	1986	p	L. Prehist.	M. Late Prehistoric	22		1.0	Warrick 1988a
BbHa-3	Howie	1966	c	Contact	E. Historic	0		0.8	Garrad 1976
BbHa-6	Sidey-Mackay	1904	c	Contact	L. Protohistoric	420		1.4	Garrad 1975,1978,1980,1981 Ramsden 1977a:220-228,263
BbHa-7	Melville	1889	c	Contact	E. Historic	750		2.0	Garrad 1975,1980
BbHa-8	Day	1966	c	Contact	E. Historic	9		0.8	Garrad 1975
BbHa-10	Hamilton-Lougheed	1888	c	Contact	M. Historic	202		4.8	Garrad 1975,1980,1981
BbHa-15	Mingay	1909	c	Contact	M. Historic	0		0.8	Garrad 1975
BbHb-1	Best	1926	c	Contact	E. Historic	4	L	0.8	Garrad 1975
BcGp-A	Laidlaw #44	1917	p			0	S	0.0	Laidlaw 1917(#44)
BcGq-A	Laidlaw #42	1917	p	L. Prehist.		0		0.0	Laidlaw 1917 (#42)
BcGq-B	Laidlaw #58	1917	p	L. Prehist.	L. Late Prehistoric	0	S	0.0	Laidlaw 1917 (#58)
BcGq-2	Lean	1917	p	L. Prehist.	L. Late Prehistoric	7		1.6	Laidlaw 1917 (#51) Ramsden 1977c
BcGr-A	Laidlaw #46	1917	p			0	S	0.0	Laidlaw 1917 (#46)
BcGr-4	Kirche	1900	c	Contact	E. Protohistoric	1115		1.4	Laidlaw 1900(#24) Nasmith 1981
BcGr-1	Jamieson	1899	p	L. Prehist.	M. Late Prehistoric	44		1.6	Laidlaw 1900 (#26) Ramsden 1981
BcGr-2	Thornbury	1967	p	L. Prehist.	L. Late Prehistoric	0		1.0	Hakas 1967 (Borden form)
BcGr-5	Trent (Foster)	1899	c	Contact	L. Protohistoric	64		3.2	Laidlaw 1900 (#23) Burger and Pratt 1973:14 Ramsden 1981
BcGv-A	Hunter Oro #18	1903	p	L. Prehist.		0		0.4	Hunter 1903
BcGv-B	Hunter Oro #20	1903	p			0		0.0	Hunter 1903
BcGv-C	Hunter Oro #64	1903	p			0		0.0	Hunter 1903
BcGv-D	Hunter Vespra #25	1907	p			0		0.0	Hunter 1907

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BcGv-E	Hunter Innisfil #8	1887	c	Contact	L. Protohistoric	0		1.4	Hunter n.d.(#8)
									Hugh Jackson 1986 pc
BcGv-F	Hunter Innisfil #115	1887	c	Contact	L. Protohistoric	0	S	0.0	Hunter n.d. (#115)
									Hugh Jackson pc 1986
BcGv-G	Hunter Innisfil #87	1888	p			0		0.0	Hunter n.d.(#87)
BcGv-H	Hunter Innisfil #183	1889	p			0	M	0.0	Hunter n.d.(#183)
BcGv-I	Hunter Innisfil #323	1901	c	Contact	E. Protohistoric	0		0.0	Hunter n.d. (#323)
BcGv-J	Hunter Innisfil #324	1902	p			0		0.0	Hunter n.d. (#324)
BcGv-K	Hunter Innisfil #325	1903	p			0		0.0	Hunter n.d.(#325)
BcGv-M	Hunter Innisfil #503	1904	p			0		0.0	Hunter n.d. (#503)
BcGv-1	Rix	1907	c	Contact	E. Protohistoric	37		1.6	Hunter 1907(#24)
									Ridley 1966
									Hunter 1978
BcGv-2	Hunter Oro #17	1903	p	L. Prehist.	L. Late Prehistoric	165		2.6	Hunter 1903
									Ridley 1966
BcGv-6	MNR Innisfil (Fennell)	1888	p	L. Prehist.		0		1.8	Hunter n.d.(#106)
									Hunter 1978
BcGv-8	Webb	1889	p	L. Prehist.	M. Late Prehistoric	0		4.0	Hunter n.d.(#107)
									Emerson and Popham 1952
									Hunter 1978
BcGv-11	McDonald	1887	p	L. Prehist.	E. Late Prehistoric	137		3.4	Hunter n.d.(#90)
									Warnica 1963
									Hunter 1978
									Warrick 1988a
BcGv-13	Painswick	1889	p			0		1.4	Hunter n.d.(#173)
									Hunter 1978
BcGw-A	Hunter Vespra #6	1907	p			0		0.0	Hunter 1907

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BcGw-B	Hunter Vespra #7	1907	p			0		0.0	Hunter 1907
BcGw-C	Hunter Vespra #8	1907	p			0		0.0	Hunter 1907
BcGw-D	Hunter Vespra #13	1907	p	L. Prehist.	M. Late Prehistoric	0		0.0	Hunter 1907
BcGw-E	Hunter Vespra #14	1907	p			0	M	0.0	Hunter 1907
BcGw-F	Hunter Vespra #15	1907	p			0		0.0	Hunter 1907
BcGw-G	Hunter Vespra #16	1907	p	L. Prehist.		0		0.0	Hunter 1907
BcGw-H	Hunter Vespra #18	1907	p			0	S	0.0	Hunter 1907
BcGw-I	Coutts	1907	p	L. Prehist.	L. Late Prehistoric	13		1.4	Hunter 1907(#19) Ridley 1974
BcGw-J	Hunter Vespra #20	1907	p			0	S	0.0	Hunter 1907
BcGw-K	Hunter Vespra #21	1907	p			0	S	0.0	Hunter 1907
BcGw-L	Hunter Vespra #22	1907	p			0		0.0	Hunter 1907
BcGw-M	Hunter Vespra #26	1907	p			0	M	0.0	Hunter 1907
BcGw-N	Hunter Vespra #27	1907	p	Mid. Iroq.		0	S	0.0	Hunter 1907
BcGw-O	Hunter Vespra #31	1907	p	Mid. Iroq.		0	S	0.0	Hunter 1907
BcGw-P	Hunter Vespra #32	1907	p	Mid. Iroq.		0		0.4	Hunter 1907
BcGw-Q	Hunter Vespra #38	1907	p	Mid. Iroq.		0	S	0.0	Hunter 1907
BcGw-R	Hunter Vespra #39	1907	p	Mid. Iroq.		0		0.4	Hunter 1907
BcGw-S	Hunter Vespra #42	1907	p	Mid. Iroq.		0		0.6	Hunter 1907
BcGw-T	Hunter Vespra #44	1907	p	Mid. Iroq.		0	S	0.0	Hunter 1907
BcGw-U	Hunter Vespra #45	1907	p	L. Prehist.		0		1.4	Hunter 1907
BcGw-W	Diaboles	1889	p			0		0.0	Hunter n.d.(#184) Hugh Jackson pc 1985
BcGw-V	Hunter Vespra #48	1907	p	L. Prehist.		0	S	0.0	Hunter 1907
BcGw-X	Hunter Innisfil #247	1897	p			0	S	0.0	Hunter n.d. #247
BcGw-1	Beswetherick	1907	p	Mid. Iroq.	E. Middleport	125		2.8	Hunter 1907(#40) Ridley 1973 Hunter 1976,1978 Ramsden 1977a

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BcGw-2	Bell	1907	p	L. Prehist.	M. Late Prehistoric	50		0.8	Hunter 1907(#49) Ridley 1966 Hunter 1978
BcGw-5	Gervais	1907	p	Mid. Iroq.	L. Middleport	43		1.8	Hunter 1907(#43) Ridley 1966 Hunter 1976
BcGw-6	Miller	1907	p	L. Prehist.	M. Late Prehistoric	8		1.6	Hunter 1907(#42) Ridley 1968 Hunter 1978
BcGw-7	Irene-Davis	1973	p	L. Prehist.	M. Late Prehistoric	62		1.6	Hunter 1907(#5) Ridley 1973 Hunter 1976
BcGw-8	Sparrow Farm	1907	p	Mid. Iroq.	E. Middleport	15		0.5	Hunter 1907(#37) Ridley 1968 Hunter 1976
BcGw-9	Carson	1907	p	L. Prehist.	E. Late Prehistoric	6		2.2	Hunter 1907(#46) Ridley 1966 Hunter 1976,1978
BcGw-10	Dunsmore	1907	p	Mid. Iroq.	L. Middleport	10		0.8	Hunter 1907(#47) Ridley 1968 Hunter 1978
BcGw-11	Cundles-Brown	1907	p	Mid. Iroq.	E. Middleport	10		0.8	Hunter 1907(#54) Ridley 1970 Hunter 1976,1978
BcGw-12	Partridge	1907	p	Mid. Iroq.	E. Middleport	9	M	0.8	Hunter 1907(#23) Ridley 1966 Hunter 1978

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BcGw-13	Cowan	1973	p	Mid. Iroq.	E. Middleport	20		0.4	Ridley 1973 Hunter 1978
BcGw-14	Cooper	1907	p	L. Prehist.	M. Late Prehistoric	18		1.6	Hunter 1907(#11) Hunter 1976
BcGw-15	Little	1889	p	Mid. Iroq.	L. Middleport	27		1.5	Hunter n.d.(#103) Hunter 1976,1978 Lennox 1984 Warrick 1988a
BcGw-18	Barrie	1907	p	Mid. Iroq.	Uren	69		1.0	Hunter 1907(#41) Ridley 1958 Hunter 1978 Wright 1966
BcGw-26	Wiacek	1889	p	Mid. Iroq.	L. Middleport	119		0.7	Hunter n.d. #104 Lennox et al. 1986
BcGw-27	Molson	1889	c	Contact	L. Protohistoric	57		1.8	Hunter n.d. (#131) Lennox 1984 Molnar 1986 Warrick 1988a
BcGw-28	Little II	1888	p	Mid. Iroq.	E. Middleport	28		0.5	Hunter n.d.(#102) Lennox 1984 Warrick and Molnar 1986
BcGx-A	Hunter Flos #18	1907	p			0		0.0	Hunter 1907(#18)
BcGx-15	Kenny	1968	p	Mid. Iroq.	L. Middleport	28		1.0	Ridley 1968
BcHa-1	White	1926	p	L. Prehist.	L. Late Prehistoric	292		1.2	Garrad 1975,1980,1981
BcHa-2	White-Coyle	1889	c	Contact	L. Protohistoric	39		0.8	Garrad 1975,1980 Molnar 1987
BcHa-3	Paddison	1966	p	L. Prehist.	L. Late Prehistoric	25		0.8	Garrad 1975

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BcHa-4	Duff-Perry	1966	p	L. Prehist.	L. Late Prehistoric	0		0.6	Garrad 1975
BcHa-5	Peacock	1966	c	Contact	E. Historic	31		0.9	Garrad 1975
BcHa-13	Currie-Brack	1966	c	Contact	E. Historic	9		0.8	Garrad 1975,1984
BcHa-15	Carmichael	1966	p	L. Prehist.	L. Late Prehistoric	13		0.8	Garrad 1975
BeHa-16	Macey Lake	1976	p	L. Prehist.	L. Late Prehistoric	0	S	1.2	O'Brien 1976 (Borden form)
BcHa-43	Edmunds	1966	c	Contact	L. Protohistoric	4		0.7	Garrad 1975
BcHb-1	Glebe	1908	c	Contact	M. Historic	549		0.9	Garrad 1975,1980
BcHb-3	Connor-Rolling	1889	c	Contact	M. Historic	286		1.0	Garrad 1975,1980,1984
BcHb-7	Graham-Ferguson	1889	c	Contact	E. Historic	208		0.8	Garrad 1975,1980,1984
BcHb-10	Kelly-Campbell	1908	c	Contact	L. Historic	486		4.8	Garrad 1975,1980,1981,1984
BcHb-16	McDermid	1904	c	Contact	M. Historic	0		0.7	Garrad 1975
BcHb-17	McEwen	1966	c	Contact	L. Historic	25		1.2	Garrad 1975
BcHb-18	Currie	1918	c	Contact	E. Historic	15		0.8	Garrad 1975
BcHb-11	Bell	1966	c	Contact		0		0.7	Garrad 1975
BcHb-19	Young-McQueen	1923	c	Contact	L. Protohistoric	252		1.2	Garrad 1975,1980,1981
BcHb-20	Rock Bottom	1909	c	Contact	M. Historic	140		0.8	Garrad 1975,1980,1984
BcHb-22	Pretty River	1904	c	Contact	M. Historic	31		4.8	Garrad 1975,1980,1981,1987
BcHb-25	McAllister	1971	c	Contact	M. Historic	272		1.0	Garrad 1975,1980
BcHb-26	MacMurchy	1909	c	Contact	E. Historic	1668		2.8	Garrad 1975,1978,1980,1981
BcHb-27	Haney-Cook	1908	c	Contact	E. Historic	359		1.6	Garrad 1975,1980,1985
BcHb-31	McQueen-McConnell	1923	c	Contact	E. Historic	183		0.8	Garrad 1975,1980
BdGm-1	Quackenbush	1955	p	L. Prehist.	M. Late Prehistoric	37		3.6	LeBlanc and Tomenchuk 1974 MPP 1986c Carruthers 1987 pc
BdGm-5	Drain	1973	p	L. Prehist.	M. Late Prehistoric	0		0.8	MPP 1986c
BdGm-7	McCauley-Wilson	1973	p	L. Prehist.	M. Late Prehistoric	0		1.8	LeBlanc and Tomenchuk 1974
BdGp-A	Laidlaw #52	1912	p			0		0.0	Laidlaw 1912 (#52)

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BdGq-A	Laidlaw #6	1898	p	L. Prehist.		0		1.5	Laidlaw 1898 (#6)
BdGq-1	Dawn	1977	p	L. Prehist.	L. Late Prehistoric	37		3.0	Ramsden 1981
BdGr-A	Laidlaw #40	1912	p			0	S	0.0	Laidlaw 1912 (#40)
									Ramsden 1988 pc
BdGr-B	Laidlaw #38	1903	p			0		0.0	Laidlaw 1904 (#38)
BdGr-C	Laidlaw #21	1898	c	Contact	E. Protohistoric	0		0.0	Laidlaw 1898 (#21)
BdGr-D	Laidlaw #36	1903	p			0		0.0	Laidlaw 1904 (#36)
BdGr-1	Benson	1898	c	Contact	E. Protohistoric	645		1.8	Laidlaw 1917(#7)
									Ramsden 1977b,1978b,1988
BdGr-2	Hardrock	1901	p	L. Prehist.	M. Late Prehistoric	97		0.6	Laidlaw 1902 (#32)
									Emerson 1954
									Ramsden 1977a, 1977c
BdGr-4	Summer's	1898	p	L. Prehist.	L. Late Prehistoric	0		2.0	Laidlaw 1898 (#10)
									Ellis and Foster 1984(Borden)
BdGr-6	Coulter	1912	c	Contact	E. Protohistoric	1422		3.3	Laidlaw 1912 (#1)
									Damkjar 1982
BdGs-A	Laidlaw #53	1912	p			0		0.0	Laidlaw 1912 (#53)
BdGs-1	Logan Hill	1890	p	L. Prehist.		0		1.7	Laidlaw 1898 (#2)
									Ramsden 1978a
BdGu-A	Hunter Oro #56	1903	p			0		0.0	Hunter 1903
BdGu-B	Anderson	1903	p	L. Prehist.	M. Late Prehistoric	0		1.6	Hunter 1903(#57)
									Ridley 1974
BdGu-C	Hunter Oro #60	1903	p			0		0.0	Hunter 1903
BdGu-D	Hunter Oro #61	1903	c	Contact	M. Historic	0		0.0	Hunter 1903
BdGu-E	Hunter Oro #68	1903	p			0		0.0	Hunter 1903
BdGu-F	Hunter S.Orillia #1	1904	p			0		0.0	Hunter 1904
BdGu-G	Hunter S. Orillia #2	1904	p	L. Prehist.	L. Late Prehistoric	0	S	0.0	Hunter 1904

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BdGu-H	Hunter S. Orillia #3	1904	p	L. Prehist.	L. Late Prehistoric	0		2.2	Hunter 1904
BdGu-I	Hunter S. Orillia #4	1904	p			0		0.0	Hunter 1904
BdGu-J	Hunter S. Orillia #5	1904	c	Contact	M. Historic	0	L	0.0	Hunter 1904
BdGu-K	Hunter S. Orillia #7	1904	c	Contact	E. Historic	0	L	0.0	Hunter 1904
BdGu-L	Hunter S. Orillia #8	1904	c	Contact	E. Historic	0		3.0	Hunter 1904 Hammond 1905
BdGu-M	Hunter S. Orillia #14	1904	c	Contact	E. Historic	0		1.0	Hunter 1904
BdGu-N	Mt. Slaven	1904	c	Contact		0		0.0	Hunter 1904(#15)
BdGu-R	Hammond #25	1905	p	L. Prehist.		0	L	0.0	Hammond 1905
BdGu-O	Hammond #28	1905	c	Contact	M. Historic	0		0.0	Hammond 1905
BdGu-P	Hunter N.Orillia #8	1904	p	L. Prehist.	L. Late Prehistoric	0	S	0.0	Hunter 1904
BdGu-Q	Hunter N. Orillia #9	1904	c	Contact	L. Protohistoric	0		0.5	Hunter 1904 Hammond 1905 Ridley 1974
BdGu-R	Hunter N.Orillia #11	1904	c	Contact	M. Historic	0		0.0	Hunter 1904 Hammond 1905
BdGu-S	Hammond #15/16	1905	p	L. Prehist.		0		0.8	Hammond 1905
BdGu-T	Hammond #19	1905	p			0	L	0.0	Hammond 1905
BdGu-1	Sopher	1948	c	Contact	E. Protohistoric	259		1.5	Hammond 1905(#25) Noble 1968,1969 Ramsden 1977a
BdGu-3	Martin	1904	p	L. Prehist.	M. Late Prehistoric	14		0.6	Hunter 1904(#11) Hammond 1905 Ridley 1973
BdGu-4	Johnstone	1904	p	L. Prehist.	M. Late Prehistoric	10		1.8	Hunter 1904(#13) Hammond 1905 Ridley 1973

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BdGu-5	Hunter Oro #41	1903	c	Contact	M. Historic	17		0.8	Hunter 1903
									Ridley 1966
BdGu-7	Horne	1968	p	L. Prehist.	L. Late Prehistoric	0		3.4	Richardson 1973 (Borden form)
BdGv-A	Hunter Medonte #45	1902	c	Contact		0	S	0.0	Hunter 1902
BdGv-B	Hunter Medonte #52	1902	p			0		0.0	Hunter 1902
BdGv-C	Hunter Medonte #54	1902	p			0	S	0.0	Hunter 1902
BdGv-D	Hunter Medonte #55	1902	c	Contact	L. Protohistoric	0	S	0.0	Hunter 1902
BdGv-F	Hunter Medonte #62	1902	c	Contact	M. Historic	0		0.0	Hunter 1902
BdGv-G	Hunter Medonte #65	1902	p			0		0.0	Hunter 1902
BdGv-H	Hunter Medonte #66	1902	c	Contact	L. Protohistoric	0	S	0.0	Hunter 1902
BdGv-I	Hunter Medonte #67	1902	p			0		0.0	Hunter 1902
BdGv-J	Hunter Medonte #69	1902	c	Contact	M. Historic	0		0.0	Hunter 1902
BdGv-K	Hunter Medonte #72	1902	c	Contact	L. Protohistoric	0		0.0	Hunter 1902
BdGv-L	Hunter Oro #11	1903	p			0	S	0.0	Hunter 1903
BdGv-M	Hunter Oro #25	1903	p			0	L	0.0	Hunter 1903
BdGv-N	Hunter Oro #31	1903	p			0		0.0	Hunter 1903
BdGv-O	Hunter Oro #32	1903	c	Contact	E. Historic	0		1.8	Hunter 1903
BdGv-P	Hunter Oro #34	1903	p			0	M	0.8	Hunter 1903
BdGv-Q	Hunter Oro #35	1903	c	Contact	L. Protohistoric	0		0.0	Hunter 1903
BdGv-R	Hunter Oro #36	1903	p			0		0.0	Hunter 1903
BdGv-S	Hunter Oro #37	1903	p			0	S	0.0	Hunter 1903
BdGv-T	Hunter Oro #43	1903	p			0		0.4	Hunter 1903
BdGv-U	Hunter Oro #47	1903	p	L. Prehist.	E/M Late Prehistoric	0	L	0.0	Hunter 1903
BdGv-V	Hunter Oro #52	1903	p			0		0.0	Hunter 1903
BdGv-W	Hunter Oro #53	1903	p			0		0.8	Hunter 1903
BdGv-X	Hunter Oro #55	1903	p			0		0.0	Hunter 1903
BdGv-Y	Hunter N.Orillia #3	1904	p			0	M	0.0	Hunter 1904

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BdGv-E	Hunter Medonte #57	1902	p			0		0.0	Hunter 1902
BdGv-1A	Warminster (N Village)	1946	c	Contact	E. Historic	854		3.4	McIlwraith 1947 Emerson 1962 Trigger 1976:304 Sykes 1983
BdGv-1B	Warminster (S Village)	1946	c	Contact	E. Historic	0		2.6	McIlwraith 1946,1947 Sykes 1983
BdGv-3	Ball	1975	c	Contact	L. Protohistoric	2728		3.5	Knight 1978 Knight and Cameron 1983 Knight 1987
BdGv-4	McCarthy	1903	p	L. Prehist.	M. Late Prehistoric	29		2.2	Hunter 1903(#24) Ridley 1972
BdGv-5	McNiven	1903	c	Contact	E. Protohistoric	22		3.4	Hunter 1903(#26) Ridley 1973
BdGv-8	Broadfoot	1903	p	L. Prehist.	E. Late Prehistoric	19		1.2	Hunter 1903(#38) Ridley 1973
BdGv-9	Starr	1903	p	L. Prehist.	L. Late Prehistoric	32		1.4	Hunter 1903(#45) Ridley 1973
BdGv-10	Bev Cooke	1902	p	L. Prehist.	M. Late Prehistoric	9	S	0.4	Hunter 1902(#53) Ridley 1972
BdGv-12	Schandlen	1902	p	L. Prehist.	L. Late Prehistoric	0	L	3.1	Hunter 1902(#61) Ridley 1973
BdGv-14	Baumann	1766	p	L. Prehist.	M. Late Prehistoric	368		2.8	Ridley 1968 Stopp 1985
BdGw-A	Hunter Medonte #8	1902	c	Contact	E. Historic	0	S	0.8	Hunter 1902
BdGw-B	E.D. Tinney	1902	c	Contact	L. Historic	7		1.8	Hunter 1902(#13) Ridley 1971

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BdGw-C	G. McFadden	1972	p	L. Prehist.	M. Late Prehistoric	11		1.8	Ridley 1972
BdGw-D	Hunter Medonte #14	1902	c	Contact	M. Historic	0		0.0	Hunter 1902
BdGw-E	Hunter Medonte #15	1902	c	Contact		0		0.0	Hunter 1902
BdGw-F	Hunter Medonte #24	1902	c	Contact	M. Historic	0		0.0	Hunter 1902
BdGw-I	Hunter Medonte #30	1902	p			0	S	0.0	Hunter 1902
BdGw-G	Hunter Medonte #34	1902	c	Contact	L. Historic	0		0.0	Hunter 1902
BdGw-H	Hunter Medonte #43	1902	c	Contact	M. Historic	0	L	0.0	Hunter 1902
BdGw-I	Hunter Medonte #51	1902	c	Contact	E. Historic	0	L	1.8	Hunter 1902
BdGw-J	Copeland	1903	p	L. Prehist.	M. Late Prehistoric	2645		1.4	Hunter 1903 (#2) Channen and Clark 1965 Jeff Bursey 1990 pc
BdGw-K	Hunter Oro #6	1903	p			0		0.0	Hunter 1903
BdGw-Q	Orr Lake	1898	c	Contact	L. Historic	346	L	0.0	Hunter 1899(#48),1907(#26) Kidd 1950
BdGw-M	Hunter Flos #27	1907	c	Contact	E. Historic	0		0.0	Hunter 1907
BdGw-N	Hunter Flos #28	1907	p			0		0.0	Hunter 1907
BdGw-O	Hunter Flos #29	1907	p			0		0.0	Hunter 1907
BdGw-P	Hunter Flos #31	1907	p			0		0.0	Hunter 1907
BdGw-Q	Hunter Flos #33	1907	c	Contact	E. Historic	0		0.0	Hunter 1907
BdGw-R	Hunter Flos #34	1907	c	Contact	L. Protohistoric	0		0.8	Hunter 1907
BdGw-S	Hunter Flos #41	1907	p			0	S	0.6	Hunter 1907
BdGw-T	Hunter Flos #43	1907	p			0		0.0	Hunter 1907
BdGw-U	Hunter Vespra #12	1907	p			0		0.0	Hunter 1907
BdGw-1	Ellesmere-Morrison	1902	p	L. Prehist.	M. Late Prehistoric	102		3.0	Hunter 1902(#45) Ridley 1966 Hunter 1976 Ramsden 1977a:263

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BdGw-2A	Fitzgerald-Train	1902	c	Contact	L. Historic	0		3.0	Hunter 1902(#26) Jury 1949 Ridley 1971 Latta 1985b:167
BdGw-2B	Fitzgerald-Train	1971	p	L. Prehist.	M. Late Prehistoric	0		1.9	Ridley 1971
BdGw-3	Auger-Yates	1902	c	Contact	M. Historic	0		2.8	Hunter 1902(#33) Ridley 1972 Hunter 1976 Latta 1985a,1985b
BdGw-4	Prentice	1902	c	Contact	L. Historic	0	L	0.8	Hunter 1902(#17) Ridley 1970
BdGw-5	Thompson	1902	p	L. Prehist.	L. Late Prehist [illegible]	16		1.5	Hunter 1902(#22) Ridley 1972
BdGw-6	Angus-Rawn	1970	p	L. Prehist.	E. Late Prehistoric	32		0.8	Ridley 1970
BdGw-7	W. Miller	1902	c	Contact	E. Protohistoric	0		0.9	Hunter 1902(#29) Ridley 1970
BdGw-8	S. Clark	1902	p	L. Prehist.	E. Late Prehistoric	0		1.1	Hunter 1902(#31) Ridley 1970
BdGw-9	Cranston	1902	p	L. Prehist.	E. Late Prehistoric	10		2.2	Hunter 1902(#31A) Ridley 1971
BdGw-10	Hunter Medonte #11	1902	p	L. Prehist.	E. Late Prehistoric	0		0.8	Hunter 1902 Ridley 1971
BdGw-11	John Thompson	1902	p	Mid. Iroq.	L. Middleport	24		2.2	Hunter 1902(#5) Ridley 1972
BdGw-12	R. Devit	1971	p	L. Prehist.	E. Late Prehistoric	16		1.0	Ridley 1971
BdGw-13	Hervieux	1902	c	Contact	M. Historic	0		2.4	Hunter 1902(#3/4) Ridley 1972 Hunter 1976

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BdGw-14	W.J. Hay	1902	c	Contact	M. Historic	4		0.6	Hunter 1902(#25) Ridley 1970
BdGw-15	J. Barr	1902	p	L. Prehist.	M. Late Prehistoric	19		0.8	Hunter 1902(#32) Ridley 1972 Hunter 1976
BdGw-17	Drury	1902	c	Contact	M. Historic	0		1.5	Hunter 1902(#35) Ridley 1969 Latta 1985b
BdGw-18	R. Luaree	1902	c	Contact	E. Protohistoric	10	L	0.5	Hunter 1902(#36) Ridley 1972
BdGw-19	Percy Nixon	1902	p	L. Prehist.	M. Late Prehistoric	11		2.5	Hunter 1902(#37) Ridley 1971
BdGw-20	Martin	1907	p	L. Prehist.	E. Late Prehistoric	13		0.6	Hunter 1907(#36) Ridley 1967
BdGw-21	McGuire	1907	p	L. Prehist.	M. Late Prehistoric	38	L	4.2	Hunter 1907(#35) Ridley 1966 Hunter 1976
BdGw-22	Dunn #1	1903	p	L. Prehist.	L. Late Prehistoric	10	S	0.8	Hunter 1903(#1B) Ridley 1972
BdGw-23	Dunn #2	1903	c	Contact	E. Protohistoric	7		1.5	Hunter 1903(#1A) Ridley 1973
BdGw-24	W.A. Tinney	1902	p	Mid. Iroq.	L. Middleport	28	L	2.0	Hunter 1902(#19) Ridley 1969
BdGw-25A	Hunter Tay #18	1900	c	Contact	L. Protohistoric	0	L	1.8	Hunter 1900(#18/19) Ridley 1966
BdGw-25B	Hunter Tay #18	1900	p	L. Prehist.	M. Late Prehistoric	32		1.5	Hunter 1900(#18/19) Ridley 1966

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BdGw-26	Boyd	1976	p	L. Prehist.	E. Late Prehistoric	4		1.2	Hunter 1976
BdGw-27	Flanagan	1902	p	L. Prehist.	M. Late Prehistoric	0		1.0	Hunter 1902(#23) Jury 1948 Ridley 1974 Hunter 1976
BdGx-7	Hunter Flos #9	1907	p	Mid. Iroq.	L. Middleport	14	S	0.5	Hunter 1907 Ridley 1966
BdGx-A	Hunter Flos #8	1907	p			0		0.0	Hunter 1907
BdGx-B	Hunter Flos #12	1907	p			0		0.8	Hunter 1907
BdGx-C	Hunter Flos #19	1907	p			0		0.0	Hunter 1907
BdGx-D	Hunter Flos #21	1907	c	Contact		0		0.0	Hunter 1907
BdGx-E	Hunter Flos #25	1907	c	Contact	L. Protohistoric	0		0.0	Hunter 1907
BdGx-F	Hunter Tiny #46	1899	c	Contact	E. Historic	0		0.8	Hunter 1899
BdGx-8	Ellery	1907	c	Contact	L. Historic	0	L	0.8	Hunter 1907(#22/23) Ridley 1972
BdGx-10	Forest (Forbes)	1971	p	L. Prehist.	E. Late Prehistoric	0		2.4	Ridley 1971
BdGx-12	McRae	1899	p	Mid. Iroq.	L. Middleport	22		1.6	Hunter 1899(#36) Ridley 1969
BdGx-13	Webb	1945	p	Mid. Iroq.	L. Middleport	56		1.9	Ridley 1952,1973
BdHb-1	Plater-Martin	1909	c	Contact	L. Historic	200		2.4	Garrad 1975,1980,1984,1988
BdHb-2	Plater-Fleming	1962	c	Contact	L. Historic	122		1.2	Garrad 1975,1980,1981,1984,1988
BeGr-A	Laidlaw #31	1899	p	L. Prehist.	M. Late Prehistoric	0		1.0	Laidlaw 1900 (#31)
BeGr-B	Laidlaw #30	1899	p	L. Prehist.	M. Late Prehistoric	0	S	0.0	Laidlaw 1900 (#30)
BeGr-C	Laidlaw #19	1898	p			0		0.0	Laidlaw 1898 (#19)
BeGr-D	Laidlaw #61	1917	p			0	M	0.0	Laidlaw 1917 (#61)
BeGr-E	Laidlaw #18	1898	p			0		0.0	Laidlaw 1898 (#18)

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BeGr-1	Wet Back	1977	c	Contact	E. Protohistoric	0		1.0	Ramsden 1977c,1978a,1981
BeGs-A	Laidlaw #13	1898	p	L. Prehist.	L. Late Prehistoric	0		0.4	Laidlaw 1898 (#13)
BeGu-A	Laidlaw N.Orillia #1	1904	p			0		1.0	Laidlaw 1904
BeGu-B	Laidlaw N.Orillia #3	1904	p			0	L	0.0	Laidlaw 1904
BeGv-3	Thompson-Walker	1902	c	Contact	M. Historic	0	L	4.4	Hunter 1902(#45)
									Ridley 1969
									Hunter 1976
									Latta 1985b
BeGv-4	Bidmead	1855	c	Contact	E. Historic	200		2.1	Hunter 1902(#48)
									Ridley 1969
									Hunter 1976
									O'Brien 1986 pc
BeGw-A	Hunter Medonte #40	1902	c	Contact	L. Historic	0		0.0	Hunter 1902
BeGw-B	Hunter Medonte #44	1902	p			0		0.0	Hunter 1902
BeGw-C	Hunter Tay #6	1900	c	Contact	L. Historic	0		0.0	Hunter 1900
BeGw-D	Newton (ST. LOUIS)	1900	c	Contact	L. Historic	0		2.0	Hunter 1900(#8)
									Jury and Jury 1955
									Heidenreich 1971:43
BeGw-E	Hutchinson's	1900	c	Contact	E. Protohistoric	0		1.6	Hunter 1900(#9)
									Ridley 1974
BeGw-F	Nichols	1900	p	L. Prehist.	L. Late Prehistoric	0		2.0	Hunter 1900(#12)
									Ridley 1968
BeGw-G	Hunter Tay #20	1900	c	Contact		0	L	0.0	Hunter 1900
BeGw-H	Hunter Tay #21	1900	c	Contact	M. Historic	0	L	0.0	Hunter 1900
BeGw-I	Hunter Tay #22	1900	c	Contact		0	S	0.0	Hunter 1900
BeGw-J	Hunter Tay #23	1900	c	Contact	E. Historic	0	S	0.0	Hunter 1900
BeGw-K	Hunter Tay #32	1900	c	Contact	E. Historic	0		0.0	Hunter 1900

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BeGw-L	Hunter Tay #38	1900	c	Contact	M. Historic	0	S	0.0	Hunter 1900
BeGw-M	Hunter Tay #39	1900	c	Contact	E. Historic	0	M	0.0	Hunter 1900
BeGw-N	Hunter Tay #41	1900	c	Contact		0	S	0.0	Hunter 1900
BeGw-O	Hunter Tay #42	1900	c	Contact		0	S	0.0	Hunter 1900
BeGw-P	Dutton	1900	c	Contact	M. Historic	0	L	1.6	Hunter 1900(#4) Ridley 1974
BeGw-Q	Hunter Tay #5	1900	p			0	S	0.0	Hunter 1900(#5)
BeGw-R	St. Ignace	1932	c	Contact	L. Protohistoric	0		1.2	Jury and Fox 1947 Jury 1976 Heidenreich 1971:44-48
BeGw-1	Hamilton-Peden	1900	c	Contact	M. Historic	0		3.2	Hunter 1900(#40) Ridley 1970 Hunter 1976,1986 pc
BeGw-3	Robinson	1900	c	Contact	L. Historic	0	L	3.8	Hunter 1900(#31) Ridley 1969 Heidenreich 1971:44
BeGw-4	Sallows	1900	p	L. Prehist.	L.Late Prehistoric	4		1.8	Hunter 1900(#30) Ridley 1969
BeGw-5	Holms	1900	c	Contact	M. Historic	0		2.0	Hunter 1900(#25) Ridley 1969 Latta 1985b:168
BeGw-6	Gratrix	1900	p	Mid. Iroq.	L. Middleport	4	S	0.6	Hunter 1900(#40) Ridley 1971
BeGw-7	Hunter Tay #33	1900	p	L. Prehist.	M. Late Prehistoric	12	S	0.4	Hunter 1900 Ridley 1970
BeGw-8	Laura Potter	1969	p	Mid. Iroq.	L. Middleport	20		1.2	Ridley 1969
BeGw-9	Dunlop	1902	c	Contact	L. Historic	0		2.1	Hunter 1902(#41) Ridley 1968 Latta 1985b:167

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BeGw-11	Shiels	1902	c	Contact	L. Historic	0		1.4	Hunter 1902(#20)
									Ridley 1970
									Latta 1985b:167
BeGw-12	Waubashene Beach	1976	c	Contact	E. Historic	0		1.0	Hunter 1976
BeGw-15	Alonzo	1976	c	Contact	E. Historic	0		0.8	O'Brien 1986 pc
BeGw-18	Jacklin	1975	c	Contact	E. Historic	0		1.0	Hunter 1986 pc
									Latta 1985b
BeGx-B	Hunter Tay #1	1900	p			0		2.2	Hunter 1900
BeGx-C	Hunter Tiny #14	1899	c	Contact		0		0.0	Hunter 1899
BeGx-D	Mailloux #1	1971	p	L. Prehist.	L. Late Prehistoric	4	S	0.4	Ridley 1971
BeGx-E	Mailloux #2	1971	p	L. Prehist.	L. Late Prehistoric	50		0.8	Ridley 1971
BeGx-F	Hunter Tiny #22	1899	p			0	M	0.0	Hunter 1899
BeGx-G	Hunter Tiny #23	1899	c	Contact		0		0.0	Hunter 1899
BeGx-H	Hunter Tiny #26	1899	c	Contact	E. Historic	0	S	0.0	Hunter 1899
BeGx-I	Hunter Tiny #27	1899	p			0	L	0.0	Hunter 1899
BeGx-J	Hunter Tiny #28	1899	p			0		1.0	Hunter 1899
BeGx-K	Hunter Tiny #35	1899	c	Contact	L. Historic	0		0.0	Hunter 1899
BeGx-L	Hunter Tiny #38	1899	p			0	L	0.0	Hunter 1899
BeGx-M	Hunter Tiny #41	1899	c	Contact	E. Historic	0		0.0	Hunter 1899
BeGx-A	Herman-Wrights	1899	p	L. Prehist.	M. Late Prehistoric	10		1.4	Hunter 1899(#40)
									Ridley 1971
BeGx-2	Fournier	1900	p	L. Prehist.	M. Late Prehistoric	0		1.6	Hunter 1900(#3)
									Russell 1967
BeGx-3	Copeland Creek	1899	p	L. Prehist.		0		1.6	Hunter 1899(#15)
									Hunter 1988 pc
BeGx-4	Deshambault	1956	p	L. Prehist.	M. Late Prehistoric	90		2.0	Tyyska 1969
									Latta 1973

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BeGx-5	Farlain Lake	1969	p	L. Prehist.	M. Late Prehistoric	130		3.8	Ridley 1969
									Tyyska 1969
									Latta 1973
BeGx-6	Mailloux	1967	c	Contact	E. Historic	0		2.4	Hunter 1971 (Borden form)
BeGx-7	Brasseur	1969	p	L. Prehist.	M. Late Prehistoric	0		2.0	Hunter 1971(Borden form)
BeGx-8	Jones	1968	c	Contact	L. Protohistoric	0		2.0	Hunter 1971(Borden form)
BeGx-9	Chew	1971	c	Contact	M. Historic	0		3.2	Hunter 1976(Borden form)
BeGx-10	Crawford	1899	c	Contact	L. Historic	0		2.0	Hunter 1899(#37)
									Ridley 1966
BeGx-11	Farlain Lake II	1976	p	L. Prehist.	M. Late Prehistoric	44		1.2	O'Brien 1976b
BeGx-12	Pinery	1976	p	L. Prehist.	L. Late Prehistoric	28		1.2	O'Brien 1976b
BeGx-15	Le Caron	1899	c	Contact	M. Historic	0		1.6	Hunter 1899(#30)
									Ridley 1967
									Johnston and Jackson 1980
BeGx-17	Quesnel	1949	p	L. Prehist.	E. Late Prehistoric	0		1.2	Ridley 1969
BeGx-18	Joseph Grozelles	1899	p	L. Prehist.	M. Late Prehistoric	20		2.0	Hunter 1899(#16)
									Ridley 1970
BeGx-19	Lalonde	1899	p	L. Prehist.	E. Late Prehistoric	126	L	5.4	Hunter 1899(#33)
									Ridley 1971
									J. Bursey 1988 pc
BeGx-20	Hertz	1900	c	Contact	L. Protohistoric	0		3.0	Hunter 1900(#15)
									Ridley 1968
									Trent Univ 1973(Borden form)
BeGx-21	Forget	1900	p	L. Prehist.	L. Late Prehistoric	74		1.5	Hunter 1900(#13)
									Ridley 1973
BeGx-22	John Leonard's	1899	c	Contact	M. Historic	0		0.8	Hunter 1899(#45)
									Ridley 1970

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BeGx-23	Francis Bernaults	1899	c	Contact	L. Protohistoric	0		1.4	Hunter 1899(#24/25) Ridley 1967
BeGx-24	Angoutenc	1968	c	Contact	M. Historic	715		2.4	Ridley 1968
BeGx-25	Ossossane	1899	c	Contact	L.Historic	0		4.0	Hunter 1899(#34) Ridley 1966 Kenyon and Kenyon 1983
BeGx-26	Curry	1900	c	Contact	E. Historic	0	L	2.5	Hunter 1900(#16) Ridley 1969
BeGx-27	Edwards	1898	c	Contact	L. Historic	60		0.4	Hunter 1899(#44) Ridley 1967,1973
BeGx-28	Penetang Lake	1977	p	L. Prehist.	L. Late Prehistoric	0		2.0	O'Brien 1977 (Borden form)
BeGx-36	H.Wright/G.Edwards	1899	c	Contact	M. Historic	0		0.8	Hunter 1899(#39) Hunter 1986(Borden form)
BeHa-A	Hunter Tiny #5	1899	p			0		0.0	Hunter 1899
BeHa-B	Hunter Tiny #8	1899	p			0		0.0	Hunter 1899
BeHa-C		1974	p	L. Prehist.	L. Late Prehistoric	5		0.4	Ridley 1974
BeHa-2	Maurice	1899	c	Contact	E. Protohistoric	289		0.6	Hunter 1899(#4) Tyyska 1969
BeHa-3	Robitaille	1967	c	Contact	M. Historic	111		1.0	Ridley 1967 Tyyska 1969 Fox 1979
BeHa-5	Charlebois	1969	c	Contact	E. Protohistoric	156		1.1	Tyyska 1969 Latta 1973
BeHa-6	Cedar Point	1899	c	Contact	L. Protohistoric	119		1.5	Hunter 1899(#3) Ridley 1966 Tyyska 1969 Latta 1973

BORDEN NO.	SITE NAME	DISC DATE	AGE	PERIOD	PHASE	RIM NO.	REL SIZE	SIZE (ha)	REFERENCES
BeHa-7	Desroches	1969	p	L. Prehist.	L. Late Prehistoric	0		0.8	Fox 1977(Borden form)
BeHa-8	Peacock	1969	p	L. Prehist.	M. Late Prehistoric	0		1.5	Fox 1971(Borden form) J. Hunter 1987 pc
BeHa-9	Thunder Bay #3	1967	c	Contact	L. Protohistoric	0		0.8	Ridley 1967
BeHa-10	Dorion	1967	p	L. Prehist.	M. Late Prehistoric	0		3.8	Ridley 1967 Fox 1971(Borden form)
BeHa-11	Davey	1970	p	Mid. Iroq.	L. Middleport	0		2.8	J. Hunter 1971(Borden form)
BeHa-12	Vints	1899	c	Contact	E. Historic	0		2.0	Hunter 1899(#17) Ridley 1967 Kenyon and Kenyon 1983
BeHa-13	Arente	1970	c	Contact	M. Historic	0		3.2	Hunter 1971(Borden form)
BeHa-14	Beauchamp	1971	p	L. Prehist.	L. Late Prehistoric	0		2.0	J. Hunter 1978(Borden form)
BeHa-15	Thunder Bay #2	1967	p	L. Prehist.	M. Late Prehistoric	21		0.6	Ridley 1967
BfGx-1A	Second Lake	1970	p	L. Prehist.	L. Late Prehistoric	37		1.0	Kenyon 1970 Gwynne 1970 O'Brien 1976b
BfGx-1B	Second Lake	1970	p	L. Prehist.	E. Late Prehistoric	0		0.6	Gwynne 1970
BfGx-2	Gignac Lake	1976	c	Contact	M. Historic	65		1.2	O'Brien 1976b
BfGx-3	Second Lake II	1976	p	L. Prehist.	M. Late Prehistoric	39		1.2	O'Brien 1976b
BfGx-9	Sawlog Bay I	1974	c	Contact	E. Protohistoric	0		0.5	O'Brien 1974(Borden form)
BfGx-10	Sawlog Bay II	1974	c	Contact	E. Protohistoric	0		3.0	R. O'Brien 1974(Borden form)
BfHa-1A	Gwynne	1966	c	Contact	M. Historic	0		0.6	Ridley 1966 Kenyon 1970 O'Brien 1976b
BfHa-1B	Gwynne	1966	p	L. Prehist.	E. Late Prehistoric	0		0.6	Ridley 1966 Gwynne 1971 O'Brien 1976b

APPENDIX 2 LATE NINETEENTH AND EARLY TWENTIETH CENTURY SITE SURVEY DATA

TINY TOWNSHIP, SIMCOE COUNTY (Hunter 1899)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
1	p	+++	L	Ste. Marie II	Ste. Marie II and village
2	p	-	S	Not a village	Camp site
3	p	+++	2.0	BeHa-6	
4	p	-	n/a	Ossuary	
5	p	-	n/a	BeHa-A	
6	i	++	n/a	Ossuary	
7	i	+++	n/a	Ossuary	
8	p	-	n/a	BeHa-B	
9	p	-	n/a	Ossuary	
10	i	-	n/a	Not found	Ridley 1974
11	i	+	n/a	Not a village	18th century burial
12	i	+	n/a	Not a village	18th century burial
13	i	-	n/a	Ossuary	
14	i	-	n/a	BeGx-4	
15	i	-	n/a	BeGx-3	
16	p	-	n/a	BeGx-18	
17	p	-	n/a	BeHa-12	
18	i	-	n/a	Ossuary	
19	i	-	n/a	Ossuary	
20	i	-	n/a	Burials	Archaic (Old Copper) burials
21	p	-	n/a	Not a village	Fishing camp site (on lakeshore)
22	p	-	n/a	Not a village	Ridley 1974 -No site reported by landowner
23	p	+++	n/a	BeGx-6	
24	i	++	n/a	Ossuary	
25	p	+	n/a	BeGx-23	
26	p	+++	S	BeGx-H	
27	p	-	L	BeGx-I	
28	p	-	S	BeGx-J	
29	p	-	S	BeGx-M	
30	p	++	n/a	BeGx-15	
31	i	-	n/a	Ossuary	
32	i	-	n/a	Ossuary	
33	i	-	L	BeGx-19	
34	p	+	L	BeGx-25	
35	p	+++	n/a	BeGx-K	
36	p	-	2.0	BdGx-12	
37	p	+++	2.0	BeGx-10	
38	p	-	L	BeGx-L	
39	p	+++	0.8	BeGx-36	

TINY TOWNSHIP, SIMCOE COUNTY (Hunter 1899)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
40	i	++	n/a	BeGx-A	
41	p	+	n/a	BeGx-M	
42	p	+	S	Not a village	Cabin/Hamlet
43	i	-	S	Not found	Ridley 1974
44	p	-	n/a	BeGx-27	
45	p	+	n/a	BeGx-22	
46	p	++	0.8	BdGx-F	Same as Hunter Flos #20
47	i	-	n/a	Ossuary	Same as Hunter Flos #24
48	i	+++	n/a	Ossuary	Same as Hunter Flos #22
49	p	+++	L	BdGw-L	Same as Hunter Flos #26

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* Mode of Discovery p = A.F. Hunter personal observation i = Informant

** Quantity of Fe Axes - = Absent (i.e. no finds reported)
+ = Few ++ = Several or simply "iron <u>axes</u>"
+++ = Numerous, abundant, large quantity

*** Size Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter)
S = Small (no acreage given) L = Large (no acreage given)

TAY TOWNSHIP, SIMCOE COUNTY (Hunter 1900)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
1	p	-	n/a	BeGx-B	
2	p	+++	n/a	BeGx-1	Ste. Marie I
3	p	-	S	BeGx-2	
4	p	++	L	BeGw-A	
5	p	-	n/a	BeGw-B	
6	i	+++	S	BeGw-C	
7	p	-	S	Not a village	Fishing camp site (multi-component)
8	p	+++	1.8	BeGw-D	St. Louis
9	p	++	4.8	BeGw-E	
10	p	++	n/a	Ossuary	
11	p	++	L	Not found	Ridley 1968
12	p	-	L	BeGw-F	
13	p	+	n/a	BeGx-21	
14	p	++	1.2	Not a village	Ridley 1968 - Cabin/camp site
15	p	+	n/a	BeGx-20	
16	p	++	L	BeGx-26	
17	p	+	S	Not found	Ridley 1974
18	p	++	L	BdGw-25	
19	p	+	S	BdGw-25	
20	p	+	L	BeGw-G	
21	p	++	L	BeGw-H	
22	i	+	n/a	BeGw-I	
23	p	+	n/a	BeGw-J	
24	p	-	S	Not a village	Pre-Late Woodland camp site
25	p	++	6.0	BeGw-5	
26	p	+++	n/a	Not found	Ridley 1969
27	i	+	n/a	Not found	Ridley 1969
28	p	+	S	Not found	Ridley 1969
29	i	++	n/a	Not found	Ridley 1970
30	p	-	n/a	BeGw-4	
31	p	+++	L	BeGw-3	
32	i	+	n/a	BeGw-K	
33	p	+	S	BeGw-7	
34	i	++	n/a	Not a village	18th-19th century Algonkian site
35	i	++	n/a	Not a village	18th-19th century Algonkian site
36	i	+	n/a	Not a village	Not sufficient data
37	p	+	S	Not a village	Hunting camp site
38	p	++	S	BeGw-L	
39	p	++	S	BeGw-M	

TAY TOWNSHIP, SIMCOE COUNTY (Hunter 1900)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
40	p	++	S	BeGw-6	
41	p	++	S	BeGw-N	
42	p	++	S	BeGw-O	
43	p	-	n/a	Not a village	Fishing camp site

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* Mode of Discovery — p = A.F. Hunter personal observation; i = Informant

** Quantity of Fe Axes — - = Absent (i.e. no finds reported); + = Few; ++ = Several or simply "iron axes"; +++ = Numerous, abundant, large quantity

*** Size — Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter); S = Small (no acreage given); L = Large (no acreage given)

MEDONTE TOWNSHIP, SIMCOE COUNTY (Hunter 1902)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes	Size***	Status	Comments/Reference
1	p	+	n/a	Not found	Ridley 1969
2	p	++	0.8	Not found	Ridley 1969
3	p	++	n/a	BdGw-13	
4	p	+++	n/a	BdGw-13	
5	p	+	n/a	BdGw-11	
6	p	+	n/a	Not found	Ridley 1971
7	p	+++	n/a	Not found	Ridley 1971
8	p	++	S	BdGw-A	
9	i	++	n/a	Not a village	Ridley 1971 - No site reported by landowner
10	p	++	n/a	Not found	Ridley 1969
11	p	++	n/a	BdGw-10	
12	p	++	n/a	Not a village	Ridley 1971 - No site reported by landowner
13	p	++	n/a	BdGw-B	
14	p	++	n/a	BdGw-D	
15	p	++	n/a	BdGw-E	
16	i	+++	L	Not found	Ridley 1971
17	p	+++	L	BdGw-4	
18	p	-	n/a	Ossuary	
19	p	++	L	BdGw-24	
20	i	++	n/a	BdGw-11	
21	i	++	n/a	Ossuary	
22	p	+	3.0	BdGw-5	
23	i	++	0.8	BdGw-27	
24	i	+++	n/a	BdGw-F	
25	p	+	n/a	BdGw-14	
26	p	+++	6.0	BdGw-2	
27	p	+++	n/a	Ossuary	
28	i	++	n/a	Not found	Ridley 1971
29	p	+	0.8	BdGw-7	
30	p	-	S	BdGw-8	
31	i	+++	0.8	BdGw-8	
	i	+++	0.8	BdGw-9	
32	i	++	S	BdGw-15	
33	p	++	n/a	BdGw-3	
34	p	+++	n/a	BdGw-6	
35	p	+++	2.0	BdGw-17	
36	i	+	L	BdGw-18	
37	p	++	n/a	BdGw-19	
38	i	-	n/a	Not a village	Ridley 1969 - No site reported by landowner
39	i	-	L	Not found	Ridley 1969
40	p	+++	n/a	BeGw-A	

MEDONTE TOWNSHIP, SIMCOE COUNTY (Hunter 1902)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
41	i	++	n/a	BeGw-9	
42	p	++	L	Not found	Ridley 1969
43	p	+++	L	BdGw-H	
44	i	-	n/a	BeGw-B	
45	i	++	S	BdGv-A	
46	p	+	L	BeGv-3	
47	i	+	n/a	Not a village	
48	p	+++	n/a	BeGv-4	
49	p	+	2.8	BdGw-1	
50	i	-	n/a	BdGw-29	Archaic site
51	p	+	L	BdGw-I	
52	i	-	n/a	BdGv-B	
53	p	-	S	BdGv-10	
54	p	-	n/a	BdGv-C	
55	p	+	S	BdGv-D	
56	p	-	S	Not a village	Cabin site (<0.1ha)
57	p	-	n/a	BdGv-E	
58	p	-	S	Not a village	Cabin site (one midden,low artifact density)
59	p	-	L	Not found	Ridley 1968
60	p	-	S	Not found	Ridley 1968
61	p	-	L	BdGv-12	
62	i	++	n/a	BdGv-F	
63	i	++	S	Not a village	Cabin site to BdGv-F (too close to to BdGv-F to be coeval village)
64	p	+++	n/a	Ossuary	of BdGv-F
65	i	-	n/a	BdGv-G	
66	p	+	S	BdGv-H	
67	p	-	n/a	BdGv-I	
68	i	+	n/a	BdGv-3	
69	p	+++	n/a	BdGv-J	
70	p	-	S	Not found	Ridley 1973
71	i	+	n/a	Not found	Ridley 1973
72	p	+	n/a	BdGv-K	
73	i	+++	n/a	Not found	Ridley 1974
74	i	++	n/a	Not found	Ridley 1974

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* Mode of Discovery — p = A.F. Hunter personal observation   i = Informant

** Quantity of Fe Axes — - = Absent (i.e. no finds reported)
+ = Few   ++ = Several or simply "iron <u>axes</u>"
+++ = Numerous, abundant, large quantity

*** Size — Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter)
S = Small (no acreage given)   L = Large (no acreage given)

NORTH ORILLIA TOWNSHIP, SIMCOE COUNTY (Hunter 1904; Hammond 1905)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
1	i	+	n/a	Burial	
2	i	++	n/a	Not a village	Not sufficient data
3	p	-	n/a	BdGv-Y	
4	i	-	n/a	Not a village	Camp site (low artifact density)
5	p	+++	n/a	Not a village	Camp site (low artifact density)
6	i	++	n/a	Ossuary	
7	i	-	n/a	Ossuary	
8	p	-	n/a	BdGu-P	
9	p	++	n/a	BdGu-Q	
10	p	-	n/a	Burials	
11	p	+++	L	BdGu-R	
12	p	++	n/a	Not a village	Camp site (18th-19th century Algonkian and pre-Woodland)
				(Boyle 1904)	
B1	p	-	1.0	BeGu-A	
B2	i	-	n/a	Not a village	Not sufficient data
B3	p	-	L	BeGu-B	
				(Hammond 1905)	
15	p	-	S	BdGu-S	
16	p	-	L	BdGu-S	
17	p	-	n/a	Burials	
18	p	-	n/a	Burials	
19	p	-	L	BdGu-T	

* Mode of Discovery p = A.F. Hunter personal observation i = Informant

** Quantity of Fe Axes - = Absent (i.e. no finds reported)
+ = Few ++ = Several or simply "iron axes"
+++ = Numerous, abundant, large quantity

*** Size Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter)
S = Small (no acreage given) L = Large (no acreage given)

SOUTH ORILLIA TOWNSHIP, SIMCOE COUNTY (Hunter 1904; Hammond 1905)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
1	p	-	n/a	BdGu-F	
2	p	-	n/a	BdGu-G	
3	p	-	2.2	BdGu-H	
4	p	-	n/a	BdGu-I	
5	p	+++	L	BdGu-J	
6	i	-	S	Not a village	Cabin site (low artifact density)
7	p	++	L	BdGu-K	
8	p	+	3.0	BdGu-L	
9	p	++	n/a	Not a village	Lakeshore location
10	p	++	n/a	Burials	18th-19th century Algonkian
11	p	++	1.4	BdGu-3	
12	p	+	n/a	Not found	Ridley 1974
13	p	-	n/a	BdGu-4	
14	p	-	1.0	BdGu-M	
15	p	++	L	BdGu-N	
16	i	+	n/a	Not a village	Isolated finds
17	i	+	n/a	Not a village	Not sufficient data
18	i	+	n/a	Not a village	Portage camp site (lakeshore site)
19	i	-	n/a	Not a village	No water source
20	i	++	n/a	Not a village	Camp site (multi-component)
21	i	-	S	Not a village	Camp site (low artifact density)
22	p	-	n/a	Not a village	Fish weir site
				(Hammond 1905)	
23	p	-	n/a	Ossuaries	
24	p	-	n/a	Burials	
25	p	-	L	BdGu-1	
26	p	-	n/a	Burials	
27	p	-	n/a	Not a village	Camp site (< 0.05 ha)
28	p	+++	n/a	BdGu-O	
29	p	-	n/a	Not a village	Camp site (one midden only)

* Mode of Discovery p = A.F. Hunter personal observation i = Informant

** Quantity of Fe Axes - = Absent (i.e. no finds reported)
+ = Few ++ = Several or simply "iron axes"
+++ = Numerous, abundant, large quantity

*** Size Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter)
S = Small (no acreage given) L = Large (no acreage given)

FLOS TOWNSHIP, SIMCOE COUNTY (Hunter 1907)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
1	i	-	S	Not a village	Camp site (Archaic?)
2	i	+	S	Not a village	Fishing camp site
3	p	-	n/a	BcGx-6	Multi-component Woodland camp site
4	i	-	n/a	Not a village	Camp site (Archaic?)
5	i	-	S	Not a village	Cabin site (one midden)
6	i	-	S	Not a village	No water source
7	i	-	n/a	Not a village	Camp site (Archaic?)
8	p	-	n/a	BdGx-A	
9	p	-	S	BdGx-7	
10	p	-	n/a	Not a village	Multi-component camp site
11	i	-	n/a	Not a village	Multi-component camp site
12	p	-	1.0	Not a village	Site plan too linear to be village
13	p	-	n/a	BcGx-12	Archaic site
14	p	-	n/a	Not a village	Camp site(Archaic/Woodland)
15	p	-	n/a	Not a village	Camp site(Archaic/Woodland)
16	p	-	n/a	Not found	Ridley 1973
17	p	-	n/a	Not found	Ridley 1973
18	p	-	n/a	BcGx-A	
19	p	-	n/a	BdGx-C	
20	p	++	L	BdGx-F	Same as Hunter Tiny #46
21	p	++	n/a	BdGx-D	
22	i	+++	n/a	Ossuary	Same as Hunter Tiny #48
23	p	++	L	BdGx-8	
24	i	-	n/a	Ossuary	Same as Hunter Tiny #47
25	p	+	n/a	BdGx-E	
26	p	+++	n/a	BdGw-L	Same as Hunter Tiny #49
27	p	+	n/a	BdGw-M	
28	i	-	n/a	BdGw-N	
29	p	-	n/a	BdGw-O	
30	p	-	n/a	Not a village	No water source
31	p	-	n/a	BdGw-P	
32	i	-	n/a	Not a village	Not sufficient data
33	i	+	n/a	BdGw-Q	
34	p	+	0.8	BdGw-R	
35	i	-	L	BdGw-21	
36	i	+	n/a	BdGw-20	

FLOS TOWNSHIP, SIMCOE COUNTY (Hunter 1907)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
37	i	-	n/a	Not a village	Not sufficient data
38	i	-	n/a	Not a village	Camp/cabin site (low artifact density)
39	p	-	0.2	BdGw-28	Camp/cabin site
40	i	+	n/a	Not a village	No water source
41	p	-	S	BdGw-S	
42	p	-	n/a	BcGw-6	
43	p	-	n/a	BdGw-T	

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* Mode of Discovery p = A.F. Hunter personal observation i = Informant

** Quantity of Fe Axes - = Absent (i.e. no finds reported)
+ = Few ++ = Several or simply "iron axes"
+++ = Numerous, abundant, large quantity

*** Size Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter)
S = Small (no acreage given) L = Large (no acreage given)

VESPRA TOWNSHIP, SIMCOE COUNTY (Hunter 1907)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
1	i	+++	n/a	Not a village	19th century Algonkian site
2	i	-	S	Not a village	Pre-Huron camp site
3	i	-	n/a	Not a village	Camp site (Archaic?)
4	i	-	n/a	Not a village	Camp site (Archaic?)
5	p	-	1.6	BcGw-7	
6	i	-	n/a	BcGw-A	
7	i	-	n/a	BcGw-B	
8	i	-	n/a	BcGw-C	
9	p	+	n/a	Not a village	18th century Algonkian camp site
10	i	-	n/a	Not a village	No water source
11	p	-	n/a	BcGw-14	
12	p	-	n/a	BdGw-U	
13	p	-	n/a	BcGw-D	
14	p	-	L	BcGw-E	
15	p	-	n/a	BcGw-F	
16	p	-	n/a	BcGw-G	
17	p	-	S	Not a village	Small camp site(< 0.05 ha)
18	p	-	S	BcGw-H	
19	p	-	2.0	BcGw-I	
20	i	-	S	BcGw-J	
21	p	-	S	BcGw-K	
22	p	-	S	BcGw-L	
23	p	-	L	BcGw-12	
24	p	-	n/a	BcGv-1	
25	p	-	n/a	BcGv-D	
26	p	-	L	BcGw-M	
27	p	-	S	BcGw-N	
28	p	-	S	Not a village	Camp site (low artifact density)
29	p	-	0.1	Not a village	Ridley 1975 - Camp site (Archaic?)
30	p	-	S	Not a village	Ridley 1975 - Camp site
31	p	-	S	BcGw-O	
32	p	-	0.4	BcGw-P	
33	p	-	S	Not a village	Cabin site(low artifact density)
34	i	+	n/a	Burials	18th-19th century Algonkian site
35	p	-	S	Not a village	Camp site (low artifact density)
36	p	+	S	Not a village	Ridley 1975 - Cabin site
37	p	-	S	BcGw-8	
38	p	-	S	BcGw-Q	
39	p	-	0.4	BcGw-R	

VESPRA TOWNSHIP, SIMCOE COUNTY (Hunter 1907)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
40	p	-	0.8	BcGw-1	
41	p	-	0.4	BcGw-18	
42	p	-	0.4	BcGw-S	
43	p	-	L	BcGw-5	
44	p	-	S	BcGw-T	
45	p	-	1.4	BcGw-U	
46	p	-	2.0	BcGw-9	
47	p	-	n/a	BcGw-10	
48	p	-	S	BcGw-V	
49	p	-	0.8	BcGw-2	
50	i	-	n/a	Not a village	Not sufficient data
51	p	-	n/a	Not a village	Multi-component camp site
52	i	+	n/a	Ossuary	
53	i	-	n/a	Ossuary	
54	p	-	n/a	BcGw-11	

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* Mode of Discovery p = A.F. Hunter personal observation i = Informant

** Quantity of Fe Axes - = Absent (i.e. no finds reported)
+ = Few ++ = Several or simply "iron <u>axes</u>"
+++ = Numerous, abundant, large quantity

*** Size Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter)
S = Small (no acreage given) L = Large (no acreage given)

ORO TOWNSHIP, SIMCOE COUNTY (Hunter 1903)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
1A	p	+	2.0	BdGw-23	
1B	p	-	n/a	BdGw-22	
2	p	-	1.4	BdGw-J	
3	i	+	n/a	Burial	18th century Algonkian burial?
4	p	-	S	Not found	Ridley 1973
5	p	-	S	Not found	Ridley 1973
6	p	-	n/a	BdGw-K	
7	i	-	n/a	Burials	
8	p	-	S	Not a village	No water source
9	i	-	n/a	Not a village	Not sufficient data
10	i	-	S	Not a village	No water source
11	i	-	S	BdGv-L	
12	i	-	n/a	Not a village	Not sufficient data
13	p	-	n/a	Not a village	No water source
14	p	-	S	Not a village	Cabin site (< 0.05 ha)
15	i	-	n/a	Not a village	No water source
16	i	-	n/a	Ossuary	
17	p	-	3.8	BcGv-2	
18	i	-	0.4	BcGv-A	
19	i	-	n/a	Not a village	Camp site (no middens)
20	i	-	n/a	BcGv-B	
21	i	-	S	Not a village	Camp site (low artifact density)
22	p	+	n/a	Not a village	18th or 19th century Algonkian site
23	p	+	n/a	Not a village	18th or 19th century Algonkian site
24	i	-	n/a	BdGv-4	
25	i	-	L	BdGv-M	
26	p	-	1.2	BdGv-5	
27	i	-	n/a	Not a village	No water source
28	p	+	2.4	Not found	Ridley 1973
29	i	+	n/a	Ossuary	
30	p	+	n/a	Not a village	Camp site - Ridley 1973
31	i	-	n/a	BdGv-N	
32	p	++	1.8	BdGv-O	
33	p	-	n/a	Not a village	Camp site (Archaic)
34	p	-	n/a	BdGv-P	
35	p	+	n/a	BdGv-Q	
36	i	-	L	BdGv-R	
37	i	-	L	BdGv-S	
38	p	+	L	BdGv-8	
39	i	-	S	BdGv-8	
40	p	-	n/a	Not found	Ridley 1974

ORO TOWNSHIP, SIMCOE COUNTY (Hunter 1903)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
41	i	-	n/a	BdGu-5	
42	p	-	n/a	Not a village	No water source, no middens
43	p	-	0.4	BdGv-T	
44	p	-	n/a	Not found	Ridley 1974
45	i	-	n/a	BdGv-9	
46	p	-	n/a	Not a village	Camp site (low artifact density)
47	p	-	n/a	BdGv-U	
48	i	-	n/a	Not a village	Camp site (low artifact density)
49	i	-	n/a	Not a village	No water source
50	p	-	S	Not a village	No water source
51	i	-	n/a	Not found	Ridley 1974
52	i	-	n/a	BdGv-V	
53	i	-	0.8	BdGv-W	
54A/B	i	+	S	Not villages	No water source
55	i	-	n/a	BdGv-X	
56	i	-	n/a	BdGu-A	
57	p	+	1.6	BdGu-B	
58	p	-	S	Not a village	Camp site (no middens,low artifact density)
59	p	-	S	Not a village	Camp site (low artifact density)
60	p	-	n/a	BdGu-C	
61	p	++	L	BdGu-D	
62	i	-	0.1	Not a village	Camp site (< 0.1 ha)
63	i	+	n/a	Not a village	Camp site
64	i	-	n/a	BcGv-C	
65	i	-	n/a	Not a village	Ridley 1975 - No site reported by landowner
66	i	+	S	Not a village	Fishing camp (on lakeshore)
67	i	+	n/a	Not a village	18th century Algonkian camp site
68	p	-	n/a	BdGu-E	
69	i	+	n/a	Not a village	Camp site (multi-component)

* Mode of Discovery — p = A.F. Hunter personal observation — i = Informant

** Quantity of Fe Axes — - = Absent (i.e. no finds reported)
+ = Few — ++ = Several or simply "iron <u>axes</u>"
+++ = Numerous, abundant, large quantity

*** Size — Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter)
S = Small (no acreage given) — L = Large (no acreage given)

INNISFIL TOWNSHIP, SIMCOE COUNTY (Hunter n.d.; Hugh Jackson pc 1985)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
8	p	++	1.4	BcGv-E	Destroyed
9	p	-	n/a	BbGv-A	19th century Algonkian component too
61	p	-	4.0	BbGw-10	
62	p	-	n/a	Not found	Warrick 1988
63	p	+	2.4	BbGv-22	
84	p	-	2.2	BbGv-19	
85	p	+	n/a	Not a village	19th century Algonkian camp/burials
87	i	-	n/a	BcGv-6	
90	p	-	n/a	BcGv-11	
96	p	-	n/a	BbGw-11	
97	p	++	0.8	BbGw-2	
102	p	-	0.8	BcGw-28	
103	p	-	L	BcGw-15	
104	p	-	S	BcGw-26	
105	p	-	2.4	BbGw-9	
106	p	-	0.2	BcGv-6	
107	p	-	n/a	BcGv-8	
108	p	-	n/a	BbGv-20	
115	p	+	n/a	BcGv-F	Destroyed (village + ossuary)
119	i	-	n/a	Not found	Warrick 1988
131	i	-	n/a	BcGw-27	
172	p	-	0.03	Not a village	Camp/cabin site (< 0.05 ha)
173	i	-	n/a	BcGv-13	Destroyed (village)
183	p	-	n/a	BcGv-H	
184	i	-	n/a	BcGw-W	Destroyed (village)
185	p	-	n/a	BcGw-32	Camp site (Warrick 1988)
186	p	+	n/a	BbGv-B	
187	p	-	n/a	BbGw-A	
188	p	-	1.0	Not found	Warrick 1988
196	p	+	n/a	Burials	19th century Algonkian camp/burials
232	p	-	n/a	BcGv-8	
233	p	-	n/a	BcGv-8	
234	i	-	n/a	Not a village	Camp site (multi-component)
236	i	-	n/a	Not a village	Camp site (lakeshore site,low artifact density)
243	p	-	0.4	BbGw-13	
247	p	-	n/a	BcGw-X	
323	p	+	n/a	Destroyed	
324	i	-	n/a	BcGv-J	
325	i	-	n/a	BcGv-K	

* Mode of Discovery — p = A.F. Hunter personal observation — i = Informant

** Quantity of Fe Axes — - = Absent (i.e. no finds reported); + = Few; ++ = Several or simply "iron <u>axes</u>"; +++ = Numerous, abundant, large quantity

*** Size — Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter); S = Small (no acreage given); L = Large (no acreage given)

INNISFIL TOWNSHIP, SIMCOE COUNTY (Hunter n.d.; Hugh Jackson pc 1985)

Hunter Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
326	i	-	n/a	Not a village	Camp site (pre-Iroquoian)
327	i	-	n/a	Not found	Warrick 1988
328	i	-	n/a	Not a village	Not sufficient data
346	i	-	n/a	Not a village	Not sufficient data
377	p	-	n/a	Not found	Warrick 1988
435	p	-	n/a	Not found	Warrick 1988
436	i	-	n/a	Not a village	Not sufficient data
443	i	-	n/a	Destroyed	
500	i	-	n/a	Not a village	Not sufficient data
501	i	-	n/a	Not a village	Not sufficient data
502	i	-	n/a	Not a village	Not sufficient data
503	**p**	-	**n/a**	**BcGv-M**	
504	i	-	n/a	Not a village	Not sufficient data
505	i	-	n/a	Destroyed	
506	**p**	-	**n/a**	**BbGv-12**	
548	**p**	-	**n/a**	**BbGv-E**	

* Mode of Discovery: p = A.F. Hunter personal observation; i = Informant

** Quantity of Fe Axes: - = Absent (i.e. no finds reported); + = Few; ++ = Several or simply "iron axes"; +++ = Numerous, abundant, large quantity

*** Size: Site size recorded by A.F. Hunter: 0.8 = hectares (as reported by Hunter); S = Small (no acreage given); L = Large (no acreage given)

VICTORIA COUNTY (Laidlaw 1898; 1900; 1912; 1917)

Laidlaw Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
1	p	-	n/a	BdGr-6	
2	p	-	1.7	BdGs-1	
3	p	-	2.2	BdGr-8	Hamlet site (one midden) Ramsden 1977c
4	p	-	n/a	Not a village	Camp site (lakeshore site)
5	p	-	2.5	Not a village	Hamlet site (low artifact density) Ramsden 1977c
6	p	-	L	BdGq-A	
7	p	-	L	BdGr-1	
8	p	-	S	Not a village	Camp/hamlet site (lakeshore site) Ramsden 1988
9	p	-	L	Not found	Ramsden 1977c
10	p	-	4.5	BdGr-4	
11	p	-	L	Not found	Ramsden 1977c
12	p	-	n/a	Not a village	Camp site (lakeshore site)
13	p	-	0.4	BeGs-A	
14	p	-	S	Not a village	Camp/hamlet site (one midden)
15	i	-	n/a	BeGq-1	Hamlet site (lakeshore site) Ramsden 1988
16	p	-	L	Not found	Ramsden 1981
17	p	+	n/a	Not a village	18th century Algonkian camp site
18	p	-	n/a	BeGr-E	
19	p	-	n/a	BeGr-C	
20	p	-	n/a	Not a village	Not sufficient data
21	p	+	n/a	BdGr-C	
22	p	-	n/a	Not a village	Not sufficient data
23	p	-	4.1	BcGr-5	
24	p	-	L	BcGr-4	
25	i	-	n/a	Not a village	Low artifact density
26	p	-	n/a	BcGr-1	
27	p	-	n/a	Not a village	Camp site (lakeshore site)
28	p	-	n/a	Not a village	Camp site (Archaic, 18th century Algonkian)
29	p		S	Not a village	Hamlet site - Ramsden 1988
30	p	-	n/a	BeGr-B	
31	p	-	1.0	BeGr-A	
32	p	-	L	BdGr-2	
33	p	-	S	Not a village	Camp site (lakeshore site)
34	i	-	n/a	Not a village	Not sufficient data
35	i	-	n/a	Not a village	Camp site (lakeshore site)
36	p	-	n/a	BdGr-D	
37	p	-	n/a	Not a village	Pre-Huron site
38	p	-	n/a	BdGr-B	
39	p	-	n/a	Not a village	Not sufficient data
40	p	-	S	BdGr-A	

VICTORIA COUNTY (Laidlaw 1898; 1900; 1912; 1917)

Laidlaw Site No.	Mode of Discovery*	Quantity of Fe axes**	Size***	Status	Comments/Reference
41	p	-	n/a	Not a village	Camp site (lakeshore site)
42	p	-	n/a	BcGq-A	
43	p	-	n/a	Not a village	Camp site (lakeshore site)
44	p	-	S	BcGp-A	
45	p	-	n/a	Not a village	Not sufficient data
46	p	-	S	BcGr-A	
47	p	-	n/a	Not a village	Camp site
48			n/a		
49			n/a		
50	p	-	S	Not found	Ramsden 1977c
51	p	-	L	BcGq-2	
52	p	-	n/a	BdGp-A	
53	p	-	n/a	BdGs-A	
54	p	-	n/a	Not a village	Camp site
55	p	-	n/a	Not a village	Camp site
56	p	-	n/a	Not a village	Camp site
57	p	-	n/a	Not a village	Not sufficient data
58	p	-	S	BcGq-B	
59	p	-	n/a	Not a village	Not sufficient data
60	p	-	n/a	Not a village	Not sufficient data
61	p	-	n/a	BeGr-D	

* Mode of Discovery p = G.E. Laidlaw personal observation i = Informant
** Quantity of Fe Axes - = Absent (i.e. no finds reported)
+ = Few ++ = Several or simply "iron <u>axes</u>"
+++ = Numerous, abundant, large quantity
*** Size Site size recorded by G.E. Laidlaw: 0.8 = hectares (as reported by Laidlaw)
S = Small (no acreage given) L = Large (no acreage given)