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An investigation of the spatial, temporal, and organizational processes of the industrial frontier: A case study from the Upper Peninsula of Michigan. (Volumes I and II)

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AN INVESTIGATION OF THE SPATIAL, TEMPORAL, AND ORGANIZATIONAL PROCESSES OF THE INDUSTRIAL FRONTIER: A CASE STUDY FROM THE UPPER PENINSULA OF MICHIGAN

By

William Thomas Langhorne, Jr.

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ABSTRACT

AN INVESTIGATION OF THE SPATIAL TEMPORAL AND ORGANIZATIONAL PROCESSES OF THE INDUSTRIAL FRONTIER: A CASE STUDY FROM THE UPPER PENINSULA OF MICHIGAN

By

William Thomas Langhorne, Jr.

This study presents a comprehensive approach to the problem of understanding the industrial frontier by developing a model of the industrial frontier which is then applied in a case study. The model integrates the ideas of archaeologists, geographers, and sociologists; focusing on four major components (settlement system, change, organizational characteristics, transportation system) of the industrial frontier. These are treated so that both synchronic and diachronic aspects of the industrial frontier are revealed.

The study area for this research, the west unit of the Hiawatha National Forest, is explored using three types of data. First, archaeological data drawn from site files provides descriptive information about sites as well as about associated environmental features. Second, historical data provides information about various topics. Among these are local chronology and perspectives on everyday life. Finally, cartographic data provides information about the transportation system, intersite distances and relevant environmental features.

Both quantitative and qualitative analytical methods are used to evaluate these data. The former consist of descriptive and non-parametric

statistics, and interpretations of graphs. The latter methods are used when the data is in a non-quantifiable form.

The results of the study conformed to the model in most cases. The settlement system is organized in a hierarchial, dendritic fashion, with coastal entrepots, intermediate supply centers, and camps. The organizational characteristics emphasize uniformity of behavior and material culture in a variety or areas. Change, whether in behavior, material culture or transportation, occurs in a step like fashion, characteristic of almost immediate adoption of a new feature.

Equally important are those non-conforming results. The introduction of a new transport mode did not have the predicted disruptive effect on entrepots/hinterlands. Rather, it was conditioned by pre-existing settlement location. It did affect the definition of usable timber, resulting in significant changes in land ownership and related factors. Another finding, that the frontier was internally provisioned, was not predicted. This may be a unique result, attributable to local conditions, or it may characterize other industrial frontiers and require a re-evaluation of the model.

IN MEMORIUM

Frederick Pembroke Harriss, Jr.
(1900-1978)
Lydia Leonide Harriss Johnson
(1906-1979)
Mary Lou Langhorne
(1922-1985)

ACKNOWLEDGEMENTS

My career as a doctoral student has spanned eleven years from the time I first arrived at Michigan State until the time I submitted the final copy of this dissertation. I spent about half those years in residence and half in upstate New York where my spouse and later myself were employed. Throughout this rather lengthy period of time I have been influenced and assisted by a number of people, who each in their own way, made the journey more interesting.

First of all, there are the members of my doctoral committee who shepherded me through the program. Bill Lovis, my chair, possessed an infinite supply of patience throughout the entire process and was always willing to provide advice and helpful suggestions in response to my questions. His continued support, especially during my 1985 data collection trip when a sudden death in my family disrupted my plans, is remembered and appreciated. Larry Robbins' influence was felt in other ways. He provided my introduction to teaching anthropology, but more importantly, he enabled me to satisfy my curiosity about Africa which was kindled during adolescence when I first read early twentieth century accounts about the continent and its people. I will remember Chuck Cleland for a variety of things, most notably his readiness to challenge me on issues both in the classroom and in the dissertation. I will also remember the sign above his door, which reads, "Do something, lead, follow, or get the hell out of the way." There are times in my current

position when I wish more people were aware of this verse. Finally, there is Ken Lewis, who by virtue of our work in South Carolina, can claim to be both the oldest and newest member of my committee. I've learned a great deal from Ken over the years, both philosophically and pragmatically. He kindled my interest in frontiers and frontier processes and also began the process, later continued by Bill Lovis, of making me write better.

This dissertation could not have been written, however, without the data provided by the United States Forest Service. John Franzen, archaeologist for the Hiawatha National Forest, was instrumental in securing my access to this data and in providing a number of informative comments and suggestions during the earlier stages of the research and while I was visiting the Forest in 1985. His willingness to provide maps, photocopies, and other material and non-material assistance is greatly appreciated.

When I began my employment at SUNY-Binghamton, I found I had another supporter in my assistant dean, Don Blake. Throughout the entire dissertation process Don has allowed my free rein of the office word processing equipment, flexibility in taking time off to work on the dissertation and overall good natured support of my endeavors. He has also encouraged me to utilize my knowledge by allowing me release time to teach courses in the Anthropology Department. Thanks are also forthcoming to Marsha Peaslee, Linda Hills and Tonia Shadduck, who tolerated my rearranging their desks while using their word processors. Lastly, during the years 1985 to 1987 there were three outstanding students: Lisa Schwartz, Eileen Schwartz, and Denise Janus, who each in her own way made my advising job a lot easier.

There remains one final person who deserves the utmost in thanks and appreciation, not only for her tolerance, support and editorial advice, but also because she willingly gave these when she herself was under great pressure; my spouse of fifteen years Deborah Ann Croyle-Langhorne. Quite simply, I could not have finished the degree without her.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Research into North American frontiers has been carried out for almost a century. Beginning with the work of Turner (1893) scholars in North America, and later Europe, began to pose questions about the various socio-cultural phenomena that were unique to the frontier setting. Initially research was confined to historians of the American West, but growing awareness of the frontier as a spatio-temporal process led geographers, anthropologists and archaeologists to focus on that particular subject.

The research undertaken here will examine one particular type of frontier--the industrial frontier. The research will proceed through a case study of one example: the logging frontier of the Upper Peninsula of Michigan from 1870 to 1920. Beginning with the development of a model of the industrial frontier, this study will integrate ideas about the spatial, temporal, and organizational aspects of such frontiers into a coherent body of theory from which testable hypotheses can be formulated. These hypotheses will explore the relationship between site location and the environment, the spatial relationships among the sites themselves, and the nature of control on the industrial frontier. Analysis of these three areas will shed light on the relationship between the frontier, and the homeland, the organizational principles responsible for the expansion of this type of frontier and the relationships between extractive technology, the environment, and settlement. Moreover, available data indicates that there was a major change in exploitative technology midway through the study period. This shift should be manifested in the archaeological record as a changing locational pattern of sites with respect to environmental features and each other. Definition of such a shift in settlement pattern will allow statements to be made concerning change on industrial frontiers.

The development of frontier studies as a recognizable research area occurred nearly one hundred years ago with Frederick Jackson Turner's publication on the American Frontier (1893). Having as its central thesis the idea that the wide open spaces and unbounded lifestyle of the American west created a unique society found nowhere else, Turner's work became the researcher's focal point for a number of years. This situation led for a time to stagnation in the area of frontier studies as scholars became more involved in debating Turner's work than they were in developing new approaches. Thus, it was not until after the Second World War that new directions in frontier studies began to appear (Merk 1978, Steffen 1980, Turner 1893).

The 1960's saw a revitalization of interest in frontiers on the part of a variety of social scientists. Initially, this was applied research focusing on the problems of former colonies as they emerged as independent third world nations. As knowledge of the frontier setting and its processes came to light, the impact of applied studies performed by geographers and anthropologists was felt by historians and archeologists studying past frontiers (Casagrande, Thompson and Young 1964; Johnson 1970; Prescott 1965; Taafe, Morrill and Gould 1963).

During the past decade several important conceptual developments were made in the study of frontiers. Chief among these has been the work of Steffen (1980) which established two broad categories of frontiers: insular and cosmopolitan. Insular frontiers are those which are not closely bound to the homeland and which tend to become isolated from it through time. Cosmopolitan frontiers, in contrast, are always closely linked to the homeland. Steffen proposed that adaptation to the frontier condition could be studied by examining the inherent demands of the frontier environment and the behavorial characteristics of those immigrating to the frontier. This process of adaptation to frontier conditions produces results unique to each category of frontier. Insular frontiers, because of their isolation, would tend to be the scenes of fundamental changes, with not only behavior change to accomodate the frontier environment, but also change in the norms underlying the behavior. By contrast, cosmopolitan frontiers, because of their close linkages with the homeland, would be the scene of modal change, characterized by alteration of behavior to accomodate the frontier environment without the corresponding alteration in the basic behavioral principles people brought to the frontier (Steffen 1980).

Hardesty (1985), following Steffen's dichotomy, focused on cosmopolitan frontiers and has developed a model of change on industrial frontiers, a subtype of cosmopolitan frontiers, by borrowing principles from evolutionary biology. Hardesty proposed that the relative isolation of the insular frontier versus the cosmopolitan frontier made insular frontiers more likely to develop unique adaptations to local conditions. In contrast, industrial frontiers, a highly connected cosmopolitan frontier, were characterized by standardized behavioral responses to the frontier environment. In such a highly connected, standardized setting, systemic char produce a steplike or discontinuous pattern of change that occurs more or less simultaneously throughout the industrial frontier. The closest analog to this pattern is that of punctuated equilibria, found in evolutionary biology. However, Hardesty admits that other explanatory models, such as catastrophe theory, may also be valid in this case (Gould and Eldredge 1977, Hardesty 1985, Renfrew 1978).

In addition to dealing with frontier change at the macro level, Hardesty also explored ways of treating the spatial patterns of industrial frontiers as models of ecosystems. Using the Marginal Value Theorem, he has developed several propositions that can be tested archaeologically regarding this sort of behavior on industrial frontiers. According to the theorem, industrial colonists are expected to stay in a given patch until its net yield drops below that likely to be obtained from an average patch elsewhere in the frontier. The length of stay is thus dependent upon size of patch, variability of patch, rate of patch renewal, exploitative technology, transport costs and market price. If one of these considerations comes to dominate the others, it is then possible to predict the length of time a particular patch will be colonized. For example, if transport cost is to be minimized and other variables are to be maximized, then the duration of occupation will be long. Moreover, changes in these variables, with the exception of patch size and variability, are difficult to predict. However, given the highly linked nature of the industrial frontier, changes in technology and price, once they occur, are likely to be transmitted simultaneously throughout the frontier, so that differential patch advantages in terms of technology/price are not likely to develop. Furthermore, for patches with high renewal rates, regular re-colonization is expected to occur. Alternatively, if a patch is small and the resources easily obtainable, it is likely to be occupied once and then abandoned when its resources are exhausted. More complex patterns of abandonment and re-colonization are found in frontier patches with randomly available, non-renewable resources, large size, and/or resources not easily exploitable with available technology (Hardesty 1985).

Another archaeologist influenced by Steffen's frontier dichotomy is Lewis (1975, 1976, 1977a, 1977b, 1984). Although working primarily with insular frontiers, Lewis has linked the development of frontiers in general with the model of the evolution of the capitalist world system proposed by Wallerstein and his colleagues (Hopkins et.al.1982; Wallerstein 1976, 1979, 1980, 1983). In linking his frontier models with Wallerstein's world systems theory, Lewis has provided archaeologists with an overarching theoretical framework within which to test various propositions about frontiers.

Wallerstein's (1976, 1979, 1980, 1983) capitalist world system consists of an integrated network of regions which fall into one of three general categories: the core, the semiperiphery, and the periphery. Each of these categories exhibits certain characteristics and relates in certain ways to the others. These relationships are determined by a single, overarching division of labor. This division of labor, the capitalist system, is based on commodification and the capitalists' expropriation of surplus produced through the actions of purportedly free market forces. The expropriation of surplus creates a pathway or flow from labor to the capitalists which has a geographic as well as organizational component. Core states/regions are those toward which this expropriated surplus flows. They are generally characterized as high profit, high technology, high wage and are the loci of diversified production. They are also the seats of socio-economic-political power. Peripheral states/regions are characterized as low profit, low wage, low technology and are the loci of less diversified production, such as agriculture and the basic extractive industries. Capitalists expropriate surplus value from peripheral states/regions. While such states/regions may have their own political structures, these structures exercise effective power only in the immediate locale and have limited to no impact on the world system as a whole. Moreover, the driving forces of the capitalist system, commodification and expropriation, require a continual increase in both number and kind of goods and services to keep the system operational. It was this drive to find new commodities that led to the continual geographic expansion of the capitalist world system, which resulted in the colonization and peripheralization of the world. It is these colonies--frontiers-- that have bcome the focus of recent research (Hopkins et.al.1982; Wallerstein 1976, 1979, 1980, 1983).

In addition to the work mentioned above, Lewis (1984) is the source of preliminary discussions about the nature of cosmopolitan frontiers. According to Lewis (1984) cosmopolitan frontiers are typically short term, dedicated to the specialized production/acquisition of a single or limited number of goods/resources, and exhibit limited indigeneous development. They may be grouped into six subtypes: trading, ranching, exploitative plantation, industrial, military, and transportation. Industrial frontiers, as a subtype of cosmopolitan frontiers, exhibit the same characteristics that define cosmopolitan frontiers, plus some that are unique to the industrial setting. Generally, they are characterized by close linkages with the core state, short duration and are the scene of transient economic activity. Uniformity, in the broadest sense, characterizes behavior on industrial frontiers. Rather than occurring as an adjustment to a new cultural and natural environmnent, adaptation occurs almost exclusively along those parameters associated with production. That is, changes and/or innovations are linked almost solely to effecting greater rates of production and/or increases in product quality. Population generally fluctuates in size, composition and distribution throughout the duration of the industrial frontier. Furthermore, it varies considerably along the aforementioned parameters from what one would expect to find in the core state (Lewis 1984:263-292).

Although industrial frontiers include a number of technological activities which vary according to the nature of the resource and level of technological sophistication, there are three basic settlement types common to all regions. These are camps, where resource collection and processing occurs; entrepots, the collecting, processing, and re-distribution centers linking the frontier with the outside world; and intermediate supply centers. These latter are often closely associated with camps and may move with them. There is at least one entrepot associated with each frontier region, although there may be more depending on geography, the organization of the industry or other considerations. Since the primary activity associated with industrial frontiers is the extraction and removal of resources from the immediate area, transportation networks are closely linked to industrial frontiers. Just as industrial frontiers are transitory, the transportation networks associated with them tend also to be transitory and ephemeral.

Furthermore, industrial frontiers, because of their extractive nature, tend to be oriented toward the exploitation of specific loci rather that entire regions as is common among other types of cosmopolitan frontier. Consequently, one would expect to find the settlement pattern of an industrial frontier characterized by a set of linked points converging on the entrepot or entrepots and from there out of the region toward the core. Industrial frontiers vary in their duration depending on the ability of resources to be economically extracted under the prevailing technological system (Lewis 1984:284-286).

The work of Hardesty and Lewis, as well as that of geographers (Burghardt 1971, Taafe et. al. 1963) who deal with transport theory and developmental problems, will be drawn upon to develop a model of the industrial frontier. Lewis (1984) is the source of basic generalizations about the settlement patttern of industrial frontiers, while Hardesty (1985) provides similar generalizations about the nature of change on industrial frontiers. From the geographic literature (Burghardt 1971, Taafe et. al. 1963), ideas about the operation of frontier transport systems and the spatial component of change provide dynamic linking elements to the spatial generalizations of Lewis and provide a spatial component to Hardesty's ideas about industrial frontier change. Once the industrial frontier model is devised, a series of hypotheses will be generated and tested using data from the study area. These hypotheses will be focused on four general areas of importance to understanding industrial frontiers: the settlement system, change, organizational characteristics, and the transportation system. The results of these analyses will allow a more comprehensive understanding of the industrial frontier and its associated cultural processes.

The study area chosen for this research is the Upper Peninsula of Michigan between 1870 to 1920. These years correspond to the logging boom in the study area--an era of historical significance in the region. The logging frontier was chosen as an example of an industrial frontier because of its overall importance in the settlement of North America and because we currently lack knowledge of the characteristics and processes associated with this type of industrial frontier. Throughout the expanding settlement of North America during the nineteenth century, the logging frontier was one of considerable size, albeit shifting location, and played a significant role in both regional and national developments. This role was multifaceted and influenced various aspects of society, such as law, technology, labor organization, education, settlement, banking and others. During the nineteenth century and into the twentieth century, as the location of the logging frontier shifted, so did the parts of the socio-economic fabric where its influence was greatest felt. Nonetheless, it was one of the most influential socio-economic phenomena in the shaping of the North American continent as we know it today. It remains for researchers to investigate the specific nature of the logging frontier and the ramifications activities associated with it had for the development of North America.

The Upper Peninsula of Michigan was chosen as the study area because it is part of the Lakes States lumber region, the leading producer of pine and later hardwood during the late nineteenth and early twentieth centuries. Thus, in choosing it as a representative of a logging frontier, we have an area that was in the mainstream of this type of frontier development. Within the Upper Peninsula lies the West Unit of the Hiawatha National Forest which has been the subject of extensive archaeological and documentary research over the past ten years aimed at acquiring data related to the logging industry (Figure 1).

The archaeological data derived from this area will be used primarily to answer questions about the relationships between site location and the environment and intersite relationships. The data are based on the site file records present at the United States Forest Service Headquarters in Escanaba, which record pertinent information about archaeological sites located by field investigation, documentary/informant research and combinations of the two. Given the different sources upon which these site data are based, they will be divided into two subsets: those with detailed information (i.e. dates, ownership, etc.), usually common among sites for which field and documentary research has been carried out, and those with more limited information. There are 194 of the former and 250 of the latter, for a total of 444 sites that will be included in this analysis.

There are also several forms of documentary data available for this research, mainly local/regional histories, autobiographies/oral histories, and books about the conduct of the logging industry at various levels. The local/regional histories are used to establish an overall temporal framework within which developments can be viewed. The autobiographies/oral histories will be utilized to verify certain hypotheses made about the organization and operation of various facets of the logging industry. Finally, the sources dealing with the conduct of the logging industry serve two purposes. Some will be employed to establish bridging arguements to relate hypotheses about industrial frontiers to the actual situation in the study area. The remainder serve as data to provide answers or partial answers in conjunction with

FIGURE 1

MICHIGAN'S UPPER PENINSULA

A-West Unit, Hiawatha National Forest
(After Martin 1977)

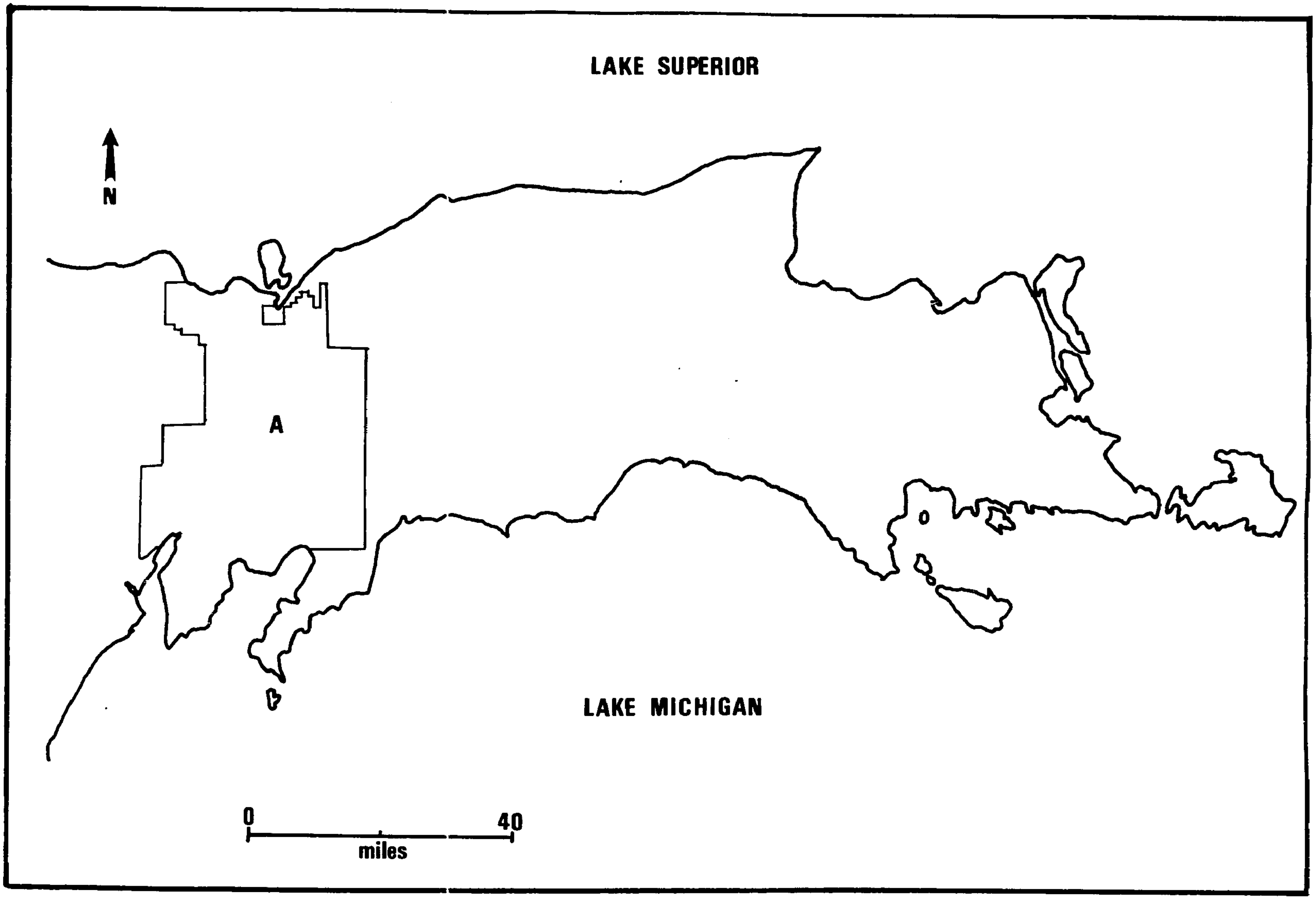

FIGURE 1

archaeological analysis to some of the hypotheses posed for this research. As is the case when dealing with any body of documentary data, care will be taken to ensure that the sources used to develop the hypotheses/ bridging arguements are not the same ones employed to supply answers to the questions posed in the hypotheses.

In summary, this research explores the industrial frontier through the examination of one example of such a frontier: the logging frontier of the Upper Peninsula of Michigan from 1870 to 1920. Because of the relative dearth of knowledge about such frontiers, attention will be broadly focused on the settlement system, change, organizational characteristics, and the transportation system. In addition to examining these topics within the study area, the implications the results of this analysis have for the larger scope of industrial frontiers will be discussed.

CHAPTER II

LOCAL HISTORY

Introduction

This chapter presents the socio-economic history of the study area for the period 1870 to 1920. While these issues will be addressed at the local level, it is important to understand some of the overlying processes which shaped the development of the study area. The most significant processes dealt with how land (hence timber) passed from the public sector into private ownership. Therefore, a discussion of the processes associated with land transfer in the nineteenth century will be presented prior to the description of the study area.

Land Transfer

Land was transferred from the public domain into private ownership in a variety of ways. These were governed primarily by a series of federal laws enacted between the late eighteenth and mid nineteenth centuries. These laws dealt with the transference of public land to both individuals and corporate bodies, with an underlying emphasis on encouraging settlement and development within a given territory. They also were supplemented or enhanced by state/territory regulations aimed at distribution state owned public land to private interests. In this latter case, however, the recipients of the land tended to be corporate entities rather than individual settlers/farmers.

The Land Ordinance of 1785 established the basis by which all states but the original thirteen colonies were surveyed and settled. It established the township and range grid system, which divided the territories into six mile square townships. Each township was futher divided into thirty-six one mile square sections. The Land Ordinance of 1785 also forbad settlement in an area until after it had been mapped, set the minimum purchase amount (640 acres), and set a minimum purchase price. Once an area was opened for public sale, land was purchased with either cash or a credit voucher. The usual purchasing procedure was to locate a suitable tract, establish its location within the township and range system, and file a claim at the nearest federal land office (Bailyn et.al. 1977, Degler et.al. 1979, Merk 1978).

Through its required mapping and procedures for public sale, the Land Ordinance of 1785 was the basis of future changes in land policy throughout the nineteenth century. In terms of its direct impact on the study areaa, it should be noted that the land survey was not completed until 1851 on the Upper Peninsula. Prior to that point legal sale of land occurred only in previously mapped areas (Bailyn et.al. 1977, Degler et.al. 1979, Dunbar 1970, Merk 1978).

This did not, however, limit settlement on the Upper Peninsula before 1851. Rather, pre-1851 settlers had to re-secure their right to own the land upon which they lived. Considerations such as this one led to the clarifiication of existing regulations by the Pre-Emption Act of 1841. This law guaranteed the right of prior occupants to purchase the land on which they lived at a sale in advance of the general public land sale for the area, with the provision that prior occupants could not purchase the land until it had been surveyed (Bailyn et.al. 1977, Degler et.al. 1979, Merk 1978).

In spite of a ready availability of land, only limited, primarily agricultural settlement of many new territories occurred before the Civil War. This phenomenon led to a short term surplus of land in some territories as settlers purchased the best farm land and left the rest. Because there were relatively few settlers, there could be varying amounts of relatively less productive or poor land left unsold in a given territory. The longer such land remained unsold, the greater burden it became to the federal government, since it neither provided income through its sale, nor was it taxable for future income. The Graduation Act (1854) was implemented to deal with this particular problem. It established a sliding scale of minimum purchase prices for unsold land, whereby the longer a particular tract of land remained unsold, the cheaper it got. Moreover, the minimum purchase amount for such land was reduced from 640 to 320 acres. Interestingly, a portion of the unsold land was considered "swamp land", which was not a particularly accurate description because much of this land, whether truly swampy or not, contained a variety of coniferous tree species prized by lumbermen, but which were relatively useless to farmers (Bailyn et.al. 1977, Degler et.al. 1979, Merk 1978).

In addition to these two laws, two Military Bounty Acts (1847, 1855) were designed to give veterans easier access to public land, in partial compensation for their military service. They did so by establishing special conditions relating to the sale of public land. Although the provisions of the 1847 Act were restricted to veterans of the Mexican War, those of the 1855 Act were open to anyone who had served in any capacity in the United States military since 1790 (Merk 1978).

The most significant piece of legislation dealing with individual acquisition of public land in the west, and one which affected the acquisition of lands in the Upper Peninsula was the Homestead Act (1862). This law quaranteed to every male over 21 years of age 160 acres of public land, provided he paid a modest initial fee and lived on/cultivated the land for five years, at which time full title would be surrendered to him. The Homestead Act replaced the Graduation Act and later, in 1891, the Pre-Emption Act was repealed and the Homestead Act altered so that a settler with a larger cash payment acquired title to the land after residing on it for fourteen months instead of five years (Bailyn et.al. 1977, Degler et.al. 1979, Merk 1978).

The passage and implementation of the Homestaead Act, coupled with the overall population increase between 1870 and 1900, led to the settlement of the trans-Mississippi United States. The population that settled these areas came from an increase in domestic fertility and immigration; initially from northern and western Europe and later from southern and eastern Europe. It was to these people, as individuals, that public land was passed under the provisions of the Homestead Act. Individuals, however, were not the only beneficiaries of a favorable publilc land policy. Throughout most of the nineteenth century corporations and other business interests were substantially assisted through government grants of public land (Bailyn et.al. 1977, Degler et.al. 1979, Merk 1978).

One of the national needs which became apparent by the mid-nineteenth century was the need for better transportation as the United States grew in size and complexity. To encourage the development of transportation, especially railways, the federal government instituted a railway grant system in 1856 which gave land to railways in return for laying track through an area. Although greatly abused, this granting system transferred a great deal of public land into private hands. It established a system whereby railway companies were given alternate sections of land extending from five to ten miles on either side of their tracks. The railroad had first choice of these sections, with the remainder sold in the usual manner. In additon to these federal grants, states sometimes awarded the railway companies additional public land from their own public land funds. Regardless of its source, once the railway companies received this land, they did with it as they pleased. Other transportation enterprises, such as roads and canals, were sometimes given similar grants, but these were nowhere as significant as those given to railroads (Bailyn et.al. 1977, Degler et.al. 1979, Merk 1978).

The various methods discussed above were the legal ways by which public land passed into private hands during much of the nineteenth centry. Although it was possible to sell timber rights to ones property, a practice followed by many homesteaders, much of the timber in the Great Lakes region passed into private hands under the provisions of one or more of these regulations. As such, they will be important in a later chapter when an analysis of landholding is undertaken. At this point, however, a discussion of the history of the study area during the period from 1870 to 1920 is appropriate.

The Study Area

The counties which comprise this study area (Alger, Delta, Schoolcraft) were originally part of Mackinac county, which was created in 1818 and encompassed the entire Upper Peninsula. Delta county was formed in 1843 by the subdivision of Mackinac and Chippewa counties. It was reduced twice, in 1861 and in 1885, as counties were formed further to the west. Schoolcraft county was also created in 1843 out of another subdivision of Mackinac and Chippewa counties. Alger county was created in 1885 by dividing Schoolcraft county (Jenks 1912)(Figures 2, 3).

Commercial logging on the Upper Peninsula dates from 1838 when a sawmill was built near the mouth of the Escanaba River. Over the next ten years a few other sawmills were built on the Sturgeon and Whitefish rivers, all of which were water powered. Logging was carried out mainly in the vicinity of the sawmills, with logs dragged to the mill by oxen or horses. The transport of timber was restricted to the winter months, and as a result the mills were in operation mainly from early spring through June. Exports from these early operations went to Sault Ste. Marie and after the Civil War to Chicago (Dunbar 1970, Karamanski 1984).

A major event in the region's history occurred in July 1848 when the land office at Sault Ste. Marie opened for sale all those lands in the counties comprising the West Unit of the Hiawatha National Forest. Prior to this point, major settlement and land transfers, especially in the interior, were blocked by the Land Ordinance of 1785 regulations. The logging industry began a slow steady growth during the 1850's, including the establishment of some steam sawmills along the south shore of the Upper Peninsula. However, it was not until after the Civil War and the

FIGURE 2

MICHIGAN

Counties
a-Delta
b-Alger
c-Schoolcraft

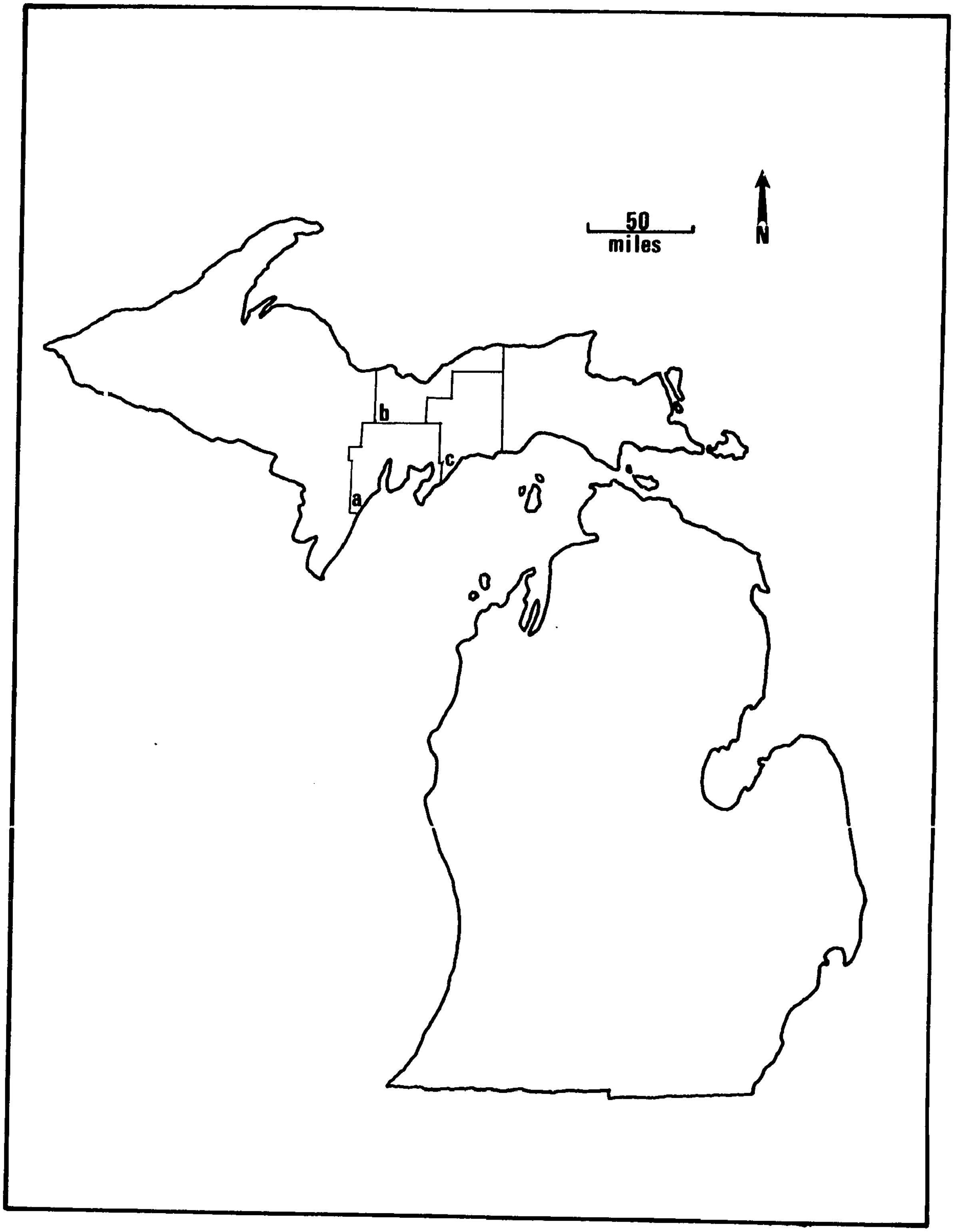

FIGURE 2

FIGURE 3

COUNTIES AND STUDY AREA

a-Delta
b-Alger
c-Schoolcraft

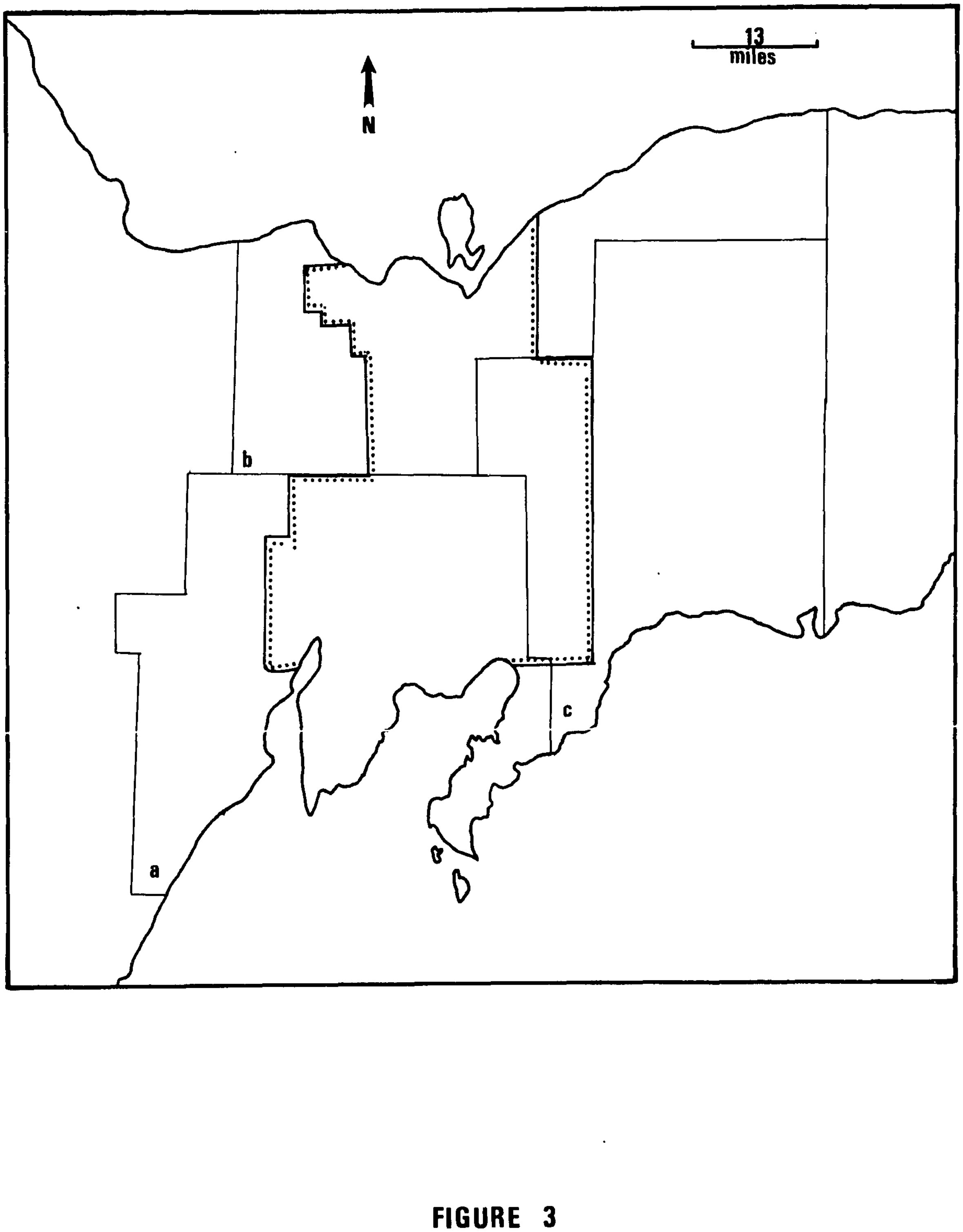

FIGURE 3

advent of the 1870's that logging began its monumental expansion on the Upper Peninsula (Dunbar 1970, Karamanski 1984).

By the 1870's the logging industry had become much like other industries during the nineteenth century--that is, composed almost entirely of corporations. This development was merely one facet of the overall increase in vertical and horizontal integration occurring at that time. Thus, from the beginning corporations were involved with the exploitation of Upper Peninsula timber. Decisions were made at the corporate level, which could produce a variety of ramifications down the line (Degler 1977, Dunbar 1970, Karamanski 1984, Reimann 1952, Todes 1931).

In spite of the fact that most of the forest in the eastern half of the Upper Peninsula was composed of mixed hardwoods and pine, the industry focused on the white and Norway pine during the period from 1870 to around 1900. There were two principle reasons for this, which relate to both building and logging technology. First, pine lumber from the Great Lakes region was a superior light-weight yet strong construction material. It continued to supercede brick and stone as the building material of choice throughout the study period. This was especially true in the plains states, where stone for building purposes was not common. Moreover, the transportation system, incorporating both water and rail, provided the plains states with easy access to the lakes states pineries (Davis 1964, Defebaugh 1906, Dunbar 1970, Karamanski 1984).

Secondly, pine and closely related species had a high degree of natural buoyancy which was essential to their transport to the sawmill with the prevailing water oriented technology. While other transport modalities existed, they were used in conjunction with water transport and hence buoyancy and related characteristics remained important (Dunbar 1970, Karamanski 1984).

Cedar and hemlock were two other buoyant coniferous species which began to be exploited between 1870 and 1900. During the late nineteenth century boom in railroad construction cedar was first choice wood for ties and as its properties became known, it was favored for posts, shingles and lath. Cedar blocks were also used to pave walkways and streets in some Upper Peninsula towns, including Escanaba (Karamanski 1984).

Hardwoods received scant attention until the 1890's. Those that were logged were usually used in the mining industry, either as supports in the shafts or as a source of charcoal for smelting. Such undertakings were usually restricted to the vicinity of the mine. Later operations of this sort became common in Alger county (Karamanski 1984).

The importance of water transport to the logging industry of the Upper Peninsula during the years from 1870 to 1900 cannot be underestimated, particularly for those counties comprising the West Unit of the Hiawatha National Forest. Especially important were those rivers in Delta county flowing into the Little and Big Bay de Noc. The Whitefish, Sturgeon, Rapid, Escanaba, Day, Ogontz, Fishdam, Manistique and others provided a means of transporting pine logs from the interior forests to the coastal towns for milling and/or shipping to market. The rapid growth of coastal towns, such as Escanaba, Nahma, Rapid River, Manistique and Gladstone during this period is directly attributable to their being situated near the points where one of the major rivers emptied into Lake Michigan or one of its bays (Dunbar 1970, Hudgins 1961, Karamanski 1984).

Associated with the expansion of commercial logging and the growth of towns in the Upper Peninsula was the influx of a multi-ethinic population, composed of the loggers themselves and the individuals associated with support services for the logging industry. A large number were French-Canadian or were from other areas of the United States where logging had previously been important. In addition, there were many Scandanavians and Irish. Since people from these two regions comprised the bulk of the immigrant population entering the United States during the mid-nineteenth century, it was not unexpected that people with these ethnic backgrounds should be found among the loggers during the later nineteenth century. A similar phenomenon occurred during the early twentieth century when many eastern Europeans turned up as loggers, reflecting once again the changing profile of the United States immigrant population (Abrams 1978, Degler 1977, Degler et.al. 1979, Draper 1930, Dunbar 1970, Dye 1975, Fitzmaurice 1889, Hulbert 1949, Karamanski 1984, Wells 1978).

By the 1890's a number of fundamental changes were underway in the Upper Peninsula logging industry. These changes were attributable to several factors, among them: the past conduct of logging in the Upper Peninsula, new technological developments, and changing markets for forest products. An understanding of these three factors is important to an overall understanding of the way the logging industry developed during the latter part of the study period.

The single most important technological advance of the 1890's was the penetration of common carrier railroads into the Upper Peninsula, followed by the development of logging railroads. Initial contact with the Upper Peninsula was made in 1872, when the Chicago and Northwestern Railway reached Escanaba. Over the next twenty years a number of other main line common carriers penetrated the Upper Peninsula. By the 1890's, through a combination of mergers and other maneuvers, four railroad corporations controlled all the common carrier lines in the Upper Peninsula. Most of this railroad building effort was fueled by the land grant system, which awarded railroad companies a certain amount of public land for each mile of track built (Calkins 1929, Dunbar 1970, Karamanski 1984, Mansfield 1899, Nute 1944).

The logging railroad, first pioneered in the Lower Peninsula in 1876, reached the Upper Peninsula by the mid 1880's. Favorably received, over the next decade it was adopted by most of the logging companies then involved in river driving. Companies adopting the logging railroad did so with several motives in mind. Most used them to tap previously inaccessible pine forests and then hardwoods, some moved simultaneously into both pine and hardwood production and others, who had exhausted the supplies of pine available to them, went exclusively into hardwood logging (Dunbar 1970, Karamanski 1984).

Throughout the 1890's, as the logging railroad became more common, river driving assumed a lesser role; by 1900 the logging railroad had effectively superceded the river drive in the Upper Peninsla logging industry. Logging railroads crisscrossed Alger, Delta and Schoolcraft counties, as well as other parts of the Upper Peninsusla. The logging railroads used in the Upper Peninsula differed from those in use elsewhere in that they were standard instead of narrow gauge. Standard gauge was more expensive, difficult to construct, had more demanding engineering specifications, and was less easy to remove and transport elsewhere. The investment required for standard gauge equipment necessitated a great deal of careful planning so that ultimately the venture would be profitable. Only large corporations had the necessary capital and power to construct such railroads and guarantee their profitability (Calkins 1929, Dunbar 1970, Karamanski 1984, Mansfield 1899, Nute 1944, Reimann 1952).

There were, however, advantages to using standard gauge track. In addition to interchangeability of equipment, the most obvious was the simple and more cost effective transition from the logging railroad to the common carrier line. Log cars, once loaded in the forest, moved along the logging railroad to its junction with the common carrier, where a switch was thrown to allow the log cars to be moved onto the common carrier line. There was no unloading and reloading to be done as when narrow gauge track was used, a principle which applied in reverse when transporting men and/or material into the forest. This cost effectiveness partially offset the additional cost of building at standard gauge. In addition to making previously inaccessible stands of/types of timber accessible, the logging railroad also caused some changes in forest operations; most notably, it made year round logging possible (Karamanski 1984).

As a result of the development of the logging railroad, Upper Peninsula loggers gained access to approximately 4.7 million acres of hardwoods. Since the Upper Peninsula forests contained more hardwood than pine, this type of wood became the principal product of Upper Peninsula forests after the turn of the century. Predominant species included yellow birch, sugar maple, hemlock, elm, basswood and beech. Clear cutting continued as the principal means of felling trees. In fact, it was more productive for hardwoods than for pine because odd lengths/sizes of hardwood were useful whereas pine was usually marketed as saw logs. The mining industry continued to be an important market for hardwoods, but a variety of others existed as well (Davis 1961, Defebaugh 1906, Dunbar 1970, Karamanski 1984, Longyear 1960).

Although the principal focus of logging had turned to hardwoods, coniferous species, such as cedar, spruce and tamarack, continued to be of interest because of their resistence to decay and their usefulness in odd lengths. The majority of these were cut for railroad ties, fence posts and telephone/telegraph poles. Spruce and tamarack were also marketed to the shipbuilding industry to provide ribs for wooden hulled vessels (Karamanski 1984).

The development of railroad logging also affected the location of milling facilities. This shift, however, lagged behind the development of the logging railroads and never resulted in the complete replacement of the old centers by the newer ones. The main milling centers of the pine era (i.e. Escanaba, Manistique, Nahma, etc.) were all located on a lakeshore near driveable rivers. They were thus the termini of river drives, where pine logs could be processed into lumber. Given their presence during the first part of the study period, they were the existing towns which were linked by common carrier railways when these first entered the Upper Peninsula. With the advent of the logging railroad, these pre-existing centers were the destinations for the timber transported by rail. Through time, smaller towns developed in the interior, though these tended to occur most frequently at the junctions of the logging railroads with common carrier lines. They initially appeared and functioned as transshipment points, supply depots and entertainment centers for men and material going into or out of the forest. Some of these interior towns, in fact, pre-date the arrival of logging railroads in the area. The location of many of these transitional centers can best be explained by their being supply centers rather than transshipment points. Furthermore, as logging railroads became established in the Upper Peninsula and for some time thereafter, composite operations developed. That is, some operations logged pine and shipped it by rail to the head of a driveable stream and then drove it in the spring. Occasionally, the reverse also happened. This particular practice influenced the location of interior towns (Bohn 1937, Dulnbar 1970, Karamanskil 1984).

Some of these interior towns eventually developed into milling centers. While this was not universally the case, it occurred frequently around the turn of the century and thereafter. Wetmore and Shingleton were two such interior towns in the West Unit of the Hiawatha National Forest which developed into milling centers. At such interior mill towns, the logs coming in on the logging railroad would be processed into a variety of products and then shipped to market on the common carrier line. Such towns tended to be larger and more diverse than the simple junction towns (Karamanski 1984).

Logging continued at a rapid pace during the last part of the study period, with clear cutting and railroad logging extracting a great amount of timber from the forest. Over time the amount of timber accessible to railroad logging declined as did the cost effectiveness of such logging operations. It became more common to decide not to log a given area because of these factors as the first quarter of the twentieth century wore on. Moreover, some astute observers realized what was occurring and estimated that the Upper Peninsula would decline much like the Lower Peninsula once the timber was gone. One author, writing at the turn of the century, estimated that in about ten years many Upper Peninsula towns would cease to be logging centers (Karamanski 1984, Mansfield 1899).

With the advent of World War I, prices rose in the lumber industry as they did in mining and agriculture. In spite of some labor troubles, logging continued at a fairly brisk rate and was a profitable venture. However, with the conclusion of the war, the logging industry felt the effects of the recession as much or more so than other Upper Peninsula industries. Furthermore, given the great dependence of agriculture and other support industries on logging, the ripple effect was quite profound. Although some logging continued during the 1920's, decreasing timber supplies and finally the Great Depression effectively ended the logging industry as it had been prior to 1920 (Dunbar 1970, Karamanski 1984).

Coincidental with the development of commercial logging in the Upper Penisnsla was the development of agriculture. In other parts of the United States, and indeed in the Lakes States, agricultural development was a primary motive for settlement. In the case of the Upper Peninsula, however, it was viewed as a vital support service for the logging and mining inustries. Prior to the Civil War, most farms on the Upper Peninsula were small and located near one of the established towns. After the Civil War (1870's) and the passage of the Homestead Act the number of farms grew and were more widely distributed over the landscape. This latter development was, however, one of direct association with the expansion of the logging industry. Throughout the remainder of the study period, the location and number of farms on the Upper Peninsula continued to be determined by the location and size of sawmill towns, ports, interior towns and other logging facilities (Chase 1936, Dunbar 1970, Karamanski 1984, Merk 1978, Watson 1923).

Farmers initially obtained land through public sale or by purchasing it from corporations who had recieved government land subsidies. They generally tried to pick land upon which hardwoods grew since this soil was more fertile than that which underlay pine. Early in the study period farmers were usually successful in finding virgin land. When they cleared the land they sold what timber they didn't use for their own purposes to lumber companies. Indeed, if they had originally puchased their land from a corporation, it was required that they turn over such excess timber to that corporation. By the 1890's it became more common that a farmer would begin farming through the purchase of cut over land from a lumber corporation rather than by obtaining virgin land (Chase 1936, Karamanski 1984, Watson 1923).

Two types of farmers came to the Upper Peninsula. First, there were those immigrants from other parts of the United States and Europe whose primary goal was to become farmers or continue farming as they had done in the past. The second group was those who came originally as loggers or miners or who were affiliated with one of these two extractive industries in some other capacity. Through savings, many of these individuals were able to acquire their own land and become full or part time farmers. In addition, ethnicity seemed to play some role in farming. Most farmers, whether they immigrated directly and began farming or worked in the logging industry before they began farming, tended to settle in areas where there were others of similar cultural background. This process was much the same as the rise of ethnic neighborhoods in urban areas and may be seen as a way by which people adapted to a new environment. It also fit in well with the organizational philosophy of the capitalist world system (Chase 1936; Karamanski 1984; Wallerstein 1980, 1983; Watson 1923).

The close relationship between logging and farming was manifested in other areas as well. During the first part (1870-1900) of the study period when pine was the principal timber cut, many farmers were also employed as loggers during the winter months. This phenomenon occurred because the busy period for winter logging coincided with a slack period for farming. Moreover, many farmers also leased their draft animals to logging operations in addition to/instead of working as loggers themselves. The extent to which this contributed to their income may be seen when it is realized that for many Upper Peninsula farmers farming itself was not their major source of income. With the advent of railroad logging in the 1890's, farmers still worked as loggers during the winter months, but they did not continue during the other periods of the year (Chase 1936, Draper 1930, Fitzmaurice 1889, Karamanski 1984, Watson 1923).

Farming was intimately tied to the logging industry in terms of its products, since most agricultural markets on the Upper Peninsula were local with export trade being limited or non-existant. The principal crops throughout the study period were hay and potatoes. Both of these crops are sturdy, cold resistant and grew well in sandy loam. Hay was put to a variety of uses. It was sold to logging companies as fodder for the draft animals in the camps. It could also be used by the farmer or sold to an dairy/stock farmer as cattle food. Products from livestock operations, such as cheese, milk and meat, were then sold to logging companies or to individuals living in one of the interior towns. Potatoes were sold to the loggers as food. After 1900, alfalfa, oats, rye, peas, sugar beets and seed corn were grown along with hay and potatoes. These crops, which had been tailored to grow in the Upper Peninsula's climate, were the result of early efforts at selective breeding conducted at

Michigan State University and elsewhere. They were utilized for both human and animal consumption (Dunbar 1970, Karamanski 1984, Kuhn 1955, Watson 1923).

Throughout the study period farming continued to grow along with the logging industry. During the pine era supplies were primarily hauled into the logging camps on wagons during the fall and on infrequent sled trips during the winter. The advent of railroad logging changed the marketing system dramatically. Fresh meat and produce were brought directly to the loggers in all but the most severe weather. Various accounts of logging camp life are especially clear about the kind and quality of food that was available and its importance to morale, etc. Furthermore, the appearance of interior towns and sawmilling centers at the railway junctions provided an additional market for agricultural products. Beyond these factors, the Upper Peninsula logging industry was still in a growth phase, which meant that the demand for agricultural products continually increased during the latter part of the study period. Needless to say, the number of farms continued to grow as well (Draper 1930, Dunbar 1970, Dye 1975, Fitzmaurice 1889, Karamanski 1984, Wells 1978).

During the last decade of the study period as the logging industry began to decline on the Upper Peninsula, farming did not follow as closely as one might have expected. This was attributable to World War I, which created a great demand for farm products. Some Upper Peninsula farmers, involved in mixed farming before the war, began to practice cattle or sheep ranching. The wartime demand for forest and mineral products also increased the demand for food for these workers. Thus logging, mining, and farming were granted a temporary respite from the decline into which they had been falling. With the conclusion of the war, things changed dramatically. There was an overall, national post war depression. The demand for forest and mineral products dropped below pre-war levels, to a point where they would have been had not the war created false demand. Futhermore, those external markets that had developed for Upper Peninsula agriculture disappeared. The internal market that had existed before World War I was dependent almost exclusively on the logging industry, which was also in decline. The result of these events was a dramatic decline in Upper Peninsula agriculture. The first to disappear were the ranches that had appeared during the war. However, the economic impact did not stop here as many of the smaller dairy and mixed farms also disappeared. This occurred because many farmers, spurred by the markets generated by the logging boom, had settled on marginal land. Consequently they were forced to abandon their farms because the soil was of such poor quality that it could not economically be farmed except under conditions of a guaranteed and stable/increasing demand, such as that formerly provided by the logging industry (Defebaugh 1906, Dunbar 1970, Hudgins 1961, Karamanski 1984, Watson 1923).

The iron industry, which had developed in the Upper Peninsula prior to the Civil War, continued throughout the last quarter of the nineteenth and into the early twentieth century. This industry dealt not with coke iron/steel, which had become the predominant type of iron manufactured in the rest of the country, but with charcoal iron. The reason for the continuation of this industry was that town blacksmiths and other small operations favored charcoal iron over coke iron/steel. The industry continued to operate on the Upper Peninsula because of the proximity of iron deposits and a source of hardwood for charcoal and framing timbers (Dunbar 1970, Karamanski 1984).

During the latter part of the study period the charcoal iron industry became one of the major users of the new hardwood supplies that became available with the advent of railroad logging. Some smelters were no longer located immediately adjacent to mines, but instead were located at intermediate points which shortened the relative distance between mines, fuel supply and shipping points. Gladstone was one such smelting center in the West Unit of the Hiawatha National Forest. The furnaces there required 1200 to 1600 acres of hardwoods per year to fuel them. Other smelters required similar volumes. Logging operations supplying smelters here and elsewhere were located throughout the study area (Dunbar 1970, Karamanski 1984).

During World War I, the associated labor shortage forced mining companies to adopt another strategy to fuel their furnaces. They hired immigrant "choppers" to scavenge an area for wood. These people often lived in abandoned dwellings and were usually paid by the amount of wood they cut. They enabled the mining industry to maintain a cheap supply of hardwood throughout the war years (Karamanski 1984).

With the end of the war, the mining industry on the Upper Peninsula suffered from the recession. Although charcoal iron production had increased annually until 1890, and remained high thereafter, it declined at this point. While it was not as severly effected as agriculture and logging, mining production levels during the 1920's fell to those of the pre-Civil War years (Dunbar 1970, Karamanski 1984).

Throughout the study period (1870-1920), the history of the eastern half of the Upper Peninsula can be seen as one increasingly oriented around the logging industry. Although mining may be considered as somewhat separate, it nonetheless was dependent on the logging industry for framing timbers and charcoal. Agriculture, however, was almost exclusively dependent on the logging industry. Although no longer the United States leader in timber production Michigan did produce significant amounts during the second decade of the twentieth century. However, it was no longer an industry on the rise and loggers began to leave the Upper Peninsula for the Northwest coast and the Inland Empire. World War I created a false demand for products of all three Upper Peninsula industries. At its conclusion and with the arrival of the recession in 1920, most logging and agricultural ventures came to a crashing halt. This marked the end of the Upper Peninsula logging industry as it had been known since 1870. Although logging continued during the 1920's and 1930's it was different from that of the boom years and was in transitioned to an era of managed forestry as is found today.

Summary

In reviewing the history of the eastern Upper Peninsula, it is apparent that the region was influenced markedly by the logging industry. Because of this, settlement was purposive, with occupancy of the region shifting in concert with changes in the extent and itensity of logging. Moreover, since logging was an extractive, export-oriented industry, it focused as much, if not more so, on processes external to the Upper Peninsula. These characteristics indicate that during the logging era the Upper Peninsula's features matched those of the industrial frontier model developed in Chapter IV.

Examination of the industrial frontier model draws upon historical data underlying the events described in this chapter as well as upon archaeological and environmental data, and focuses upon the spatial, temporal and organizational processes which characterize industrial frontiers. Should the model succeed in integrating these various data into a logical and systematic construct, which provides an understanding of the essence of industrial frontiers, it will also enhance the historical perspective of the events described in this chapter. First, however, it is necessary to discuss the natural context within which these events occurred.

CHAPTER III

THE NATURAL ENVIRONMENT

Introduction

This discussion of the natural environment of the study area illustrates the setting within which logging was conducted from 1870 to 1920. In addition to providing descriptive information about the natural setting of the study area, certain aspects of association among environmental features are discussed. In so doing, general rather than fine scale descriptions will be used. This approach is based on certain premises about the nature of the environment with respect to late nineteenth century historic occupation, the operation of the logging industry and the variables chosen for this research.

The late nineteenth century relationship between historic occupation and the environment differed from the relationships between earlier historic or prehistoric occupation and the environment. During earlier historic and prehistoric times, the survival of human populations depended directly on the availability of subsistence materials and the populations' ability to secure these for human use. By the late nineteenth century many Euro-American populations no longer directly procured subsistence items from the local environment. When subsistence materials were available locally, these were utilized. When not, the necessary items were shipped into the area. Hence, the technology of an industrialized state society made it possible to inhabit areas where the human population exceeded the carrying capacity of the local environment.

Within the capitalist world system the environment was something to be exploited for profit, rather than something from which one directly derived subsistence. Consequently, settlement in a given area tended to be purposive, aimed at the establishment of a market or the acquisition of a marketable commodity. Thus, the environmental parameters associated with historic settlement are likely to be found at a fairly general level and may not have the significance they do for earlier historic/pre-historic occupation. The logging industry, which operated on a cost minimization/profit maximization basis, is one example of such an occupation. Within this context, decisions to log an area were based on the presence of trees in sufficient quantity and accessibility to produce the greatest profit possible. Therefore, the presence of logging camps in an area was taken to be indicative of tree growth in sufficient quantity and accessibility to be profitable. This was the case regardless of the type of trees exploited and the local availability of subsistence goods.

Because of the considerations mentioned above, and in Chapter IV, the environmental variables used in this analysis did not include trees or potential food sources; detailed discussions of these have not been included. Rather, the aim of this chapter is to provide an understanding of the larger environmental setting within the study area and the associations which exist among certain features of this setting.

Discussion

While the eastern Upper Peninsula was covered by ice during all four of the major glacial episodes of the Pleistocene, the last major glacial period, the Wisconsinan, had the greatest effect on the modern land surface. It was during the Port Huron substage of this glaciation that most of the glacial features in the study area were formed. During the deglaciation a number of pro- and post-glacial lakes occupied the area within which the Great Lakes now reside. Fluctuations in the size and shape of these lakes, combined with changes in drainage pattern, effected many parts of the Upper Peninsula. Moreover, retreat of the glacial ice initiated the process of isostatic rebound. The ongoing nature of this process caused shifts in drainage and elevation for a considerable period after the final disappearance of glaciers from the region (Dorr and Eschman 1970, Goldman 1976).

The surface geology of the study area mirrors the effect of glaciation and the post-glacial Great Lakes. Much of the southern and eastern parts of the study area are composed of lake bed sands with isolated end moraines as well as ground moraines and outwash plains. The central portion of the study area is characterized by ground moraines and outwash plains, while the northern edge contains the Munising moraine and lake bed sediments. These glacial features affect the drainage, topography and other characteristics of the modern landscape (Dorr and Eschman 1970, Goldman 1976).

The results of glacial activity on current landform may be seen through an examination of each of the counties in the study area. Delta County is characterized by elevations between 580 and 1000 feet above sea level (asl). The northwestern parts of this county as well as the Garden Peninsula are composed of moraines and outwash features. The county as a whole is relatively poorly drained with a number of swamps and marshes. Alger County, with elevations between 600 to 1000 feet asl, is level to rolling and composed primarily of morainic highlands and lake bed sediments with swamps and marshes common in the level parts of the county. Schoolcraft County is a generally uniform sandy plain, with morainic highlands in the north. Elevations range between 580 and 1000 feet asl. The sandy lowlands are generally poorly drained and swamps and marshes are common (Martin 1977).

The climate of the study area is generally uniform, with any variation being directly attributable to the influence of the Great Lakes. Average annual snowfall varies from 130 inches on the northern coast to 100 inches inland and 55 inches near the Lake Michigan shore. Spring tends to be late and autumn early, although the latter can be delayed in areas adjacent to the warmer waters of Lake Michigan. Summertime temperatures rarely exceed 90 degrees Fahrenheit (F) while winters tend to be cold with approximately twenty days of below zero (F) temperatures. The growing season averages 120 days but varies between 80 days in the interior to 140 days near the lakes. The study area receives approximately 30 inches of rainfall each year, although numerous lakes and extensive wetlands cause much of this to be lost by evapotranspiration. However, this situation is ameliorated because winter snowfall and the subsequent spring thaw extensively recharges the aquifers which occur both in glacial drift and in the underlying bedrock. In addition to forming an aquifer, the glacial drift layer is also responsible for many surface water features. For example, the thinness of this deposit overlying impermeable bedrock often results in the occurrence of swamps and marshes (Berndt 1977, Goldman 1976).

The river systems of the study area are important to understanding the historic occupation for three reasons. First, they provided an easy route for the transportation of people and goods inland from the coast. Second, they were vital for the transportation of logs to the coast from the interior. Third, the nature of their drainages affected the location of settlement in that some areas were seasonally or perenially too wet for occupation.

A closer examination of these river systems, based upon the work of Berndt (1977), Goldman (1976) and Martin (1977), reveals that they have relatively small watersheds and lack the dendritic pattern typical of well developed drainage systems. Moreover, the drainage divide is closer to the Lake Superior shore than to the Lake Michigan shore, which results in the upper reaches of the Lake Michigan drainage being sluggish and difficult to trace (Figure 4).

Alger County straddles the drainage divide and its rivers and streams flow in both directions. Those flowing into Lake Superior are relatively short and flow fairly rapidly, while rivers and streams flowing into Lake Michigan are longer and flow more sluggishly . They frequently flow through the numerous swamps, marshes and lakes which characterize the southern parts of the county.

The Manistique River drainage is the principal river system in Schoolcraft County, also characterized by swamps, marshes and lakes. These features are particularly noticeable in the upper portions of the Manistique drainage where areas between streams can remain permanently covered by water, indicating the glacial drift's capacity to hold water as well as the inadequacy of the Manistique drainage.

Delta County contains a number of rivers and streams, most of which flow into the Bays de Noc of Lake Michigan, while others are components of drainages that flow into other counties. Many of these rivers occupy

FIGURE 4

MAJOR DRAINAGES IN THE STUDY AREA

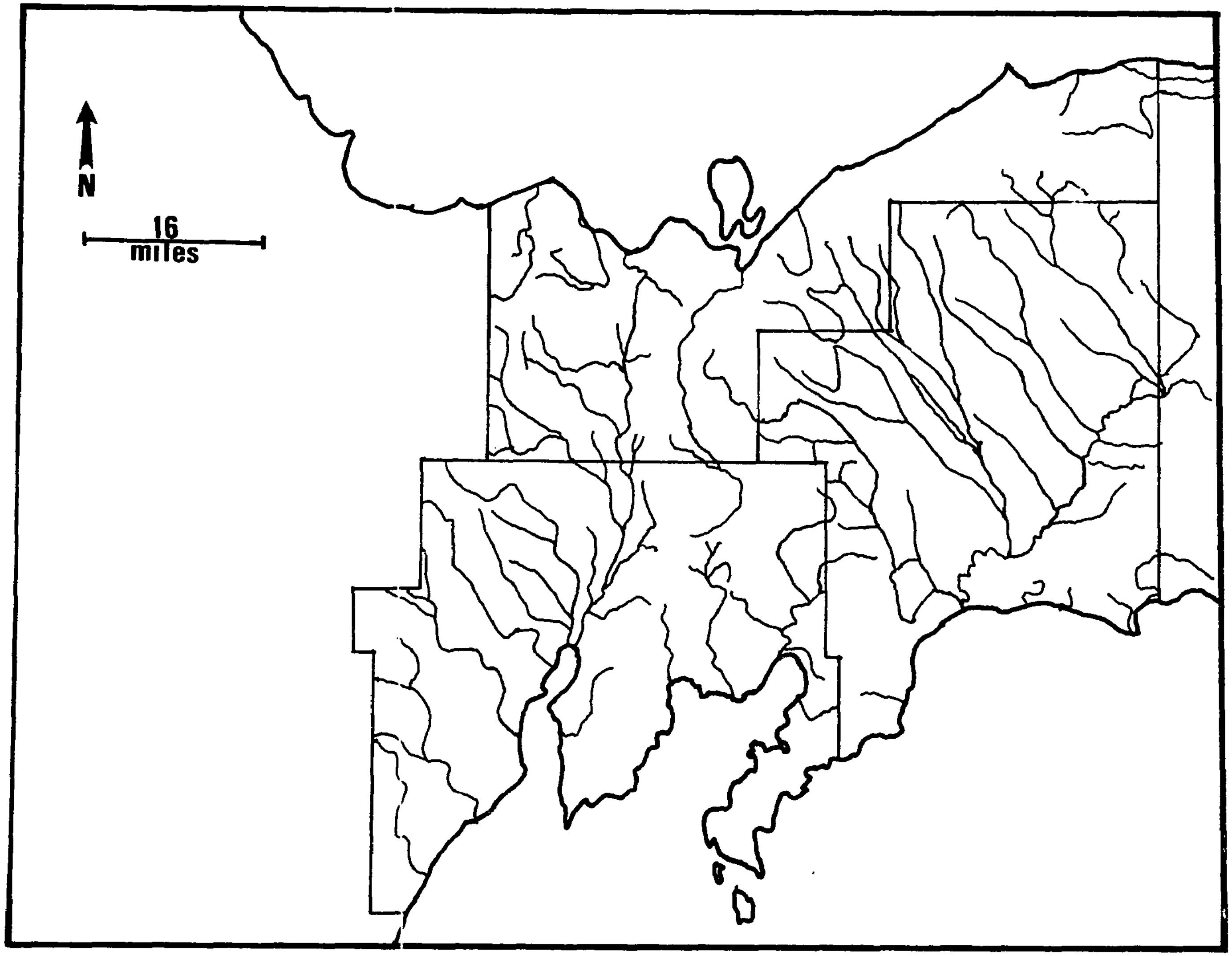

FIGURE 4

glacial drainage channels and, as elsewhere, these drainages are undeveloped with frequent lakes, swamps and marshes. Principal rivers of the county are the Whitefish, the Escanaba, the Rapid, and the Days.

The Upper Peninsula exists in a transitional zone in terms of the plant and animal communities there. To the north lies the Canadian Biotic Province, while to the south lies the Carolinian Biotic Province. Ecologists, such as Shelford (1974), whose work is the basis of the following discussion, have termed this particular transitional region the Lake Forest zone--characterized primarily by maple-beech-hemlock forest co-occurring with pine-hemlock forest.

Dominant species in the maple-beech-hemlock forest included sugar maple, yellow birch and beech. Minor species are represented by hemlock, white pine and spruce-balsam fir. Elm, basswood and ash occur when local conditions warrant. Lower stories in the forest contain a variety of shrubs and herbaceous species, including spicebush, chokeberry and jewelweed. The dominant tree species in the pine-hemlock forest include white pine, red pine, hemlock and jack pine. Lower stories in the forest are characterized by a variety of shrubs and herbaceous species, among them, Laborador tea, bunchberry, mountain ash, starflower, sarsaparilla, bilberry, honeysuckle, and lichen.

The Lake Forest zone is also characterized by a variety of water features including swamps, bogs, rivers/streams, inland lakes and Great Lakes. With the occasional exception of the Great Lakes shores, the biotic communities associated with these features duplicate those of the forest within which they occur. Timber species associated with these wetter areas include white cedar, black spruce, tamarack, aspen, birch and balsam fir. Lower story growth is also more aquatic in nature (e.g. water lilies, cattails, marsh grass, sphagnum moss) while still containing vegetation common to the major surrounding forest.

The association of the basic drainage patterns, surface geology and forest growth provide a more complete understanding of the study area. Although the forest is currently successionally modern growth (i.e. post logging era), it is assumed that it bears some resemblance to the pre-settlement growth (i.e. pre-logging/logging era). Moreover, because forest growth will not be used as a variable in this research, this approximation is acceptable for purposes of this study.

Discussion of environmental association is drawn from landform based environmental associations developed by the United States Forest Service (Burghardt and Wigger 1978) and from the work of Berndt (1977). Each association is reviewed on the basis of landform, soil characteristics, drainage and predominant forest type. By presenting these environmental characteristics in this way it is possible to identify the types of settings in which historic occupation, especially that associated with the logging frontier, would have occurred. Moreover, the relationships between landform and soil characteristics would impact directly upon the siting of logging camps and other settlements because these two environmental characteristics effect drainage, transportation, sanitation, building conditions and the overall habitability of the area.

The first association is that of moraines covered by glacial outwash which range from level to rolling to steep. Medium sands with pockets of gravel and organic soil are the primary soils associated with this landform. Although most of the soils have a well developed organic surface layer, natural fertility is low and the soil is subject to wind erosion. The uplands tend to be excessively to well drained contrasting with the poorly drained low lying areas. Northern hardwoods (maple-birch-beech) with red pine are the predominant tree type. Hemlock, spruce-fir and aspen occur as inclusions within the larger forest.

Glacial outwash sands are characterized by low, rolling hills and gradually sloping level plains. Soils are generally medium sand with gravel pockets. Areas near lake beds are lower, contain clay, stratified sands and silt, and are poorly drained. Other than these areas, the remainder tend to be excessively drained. The predominant timber type is jack pine mixed with red maple, white birch and aspen.

Various lacustrine deposits composed of silts and clays occassionally overlain by sand or loamy sand were derived from glacial lakes. The topography is generally flat to gently sloping and the drainage is somewhat poor to poor and ponded water is common. Timber species include aspen, balm of gilead, spruce-fir, red maple, white birch and tamarack. The wettest areas usually contain swamp conifers (cedar, black spruce, tamarack).

Both high and low relief settings characterize the moraines which cover limestone bedrock. In the former, the topography is gently rolling to steep in more heavily dissected areas. Boulders are scattered about the landscape. Soils are primarily loams and sandy loams, although some stratified sand and gravel outwash deposits occur, as do kames and eskers. The upland areas are well drained, while depressions are somewhat poorly to poorly drained. Northern hardwoods, spruce-fir, aspen, paper birch and inclusions of hemlock and yellow birch are the dominant timber species. In the case of the low relief setting, the topography is level and drainage ranges from somewhat poor to poor. As with the high relief setting, soils are primarily loams and sandy loams, although in this case they more frequently contain gravel and cobbles. Depressions often contain organic soil, silt, clay and sandy deposits; bedrock frequently occurs at the surface. In areas along the Great Lakes sand/gravel beach ridges are common, usually containing organic deposits between the ridges and generally better drained. Timber species include white cedar, balsam-fir, aspen, balm of gilead, white birch and spruce.

Moraines over sandstone bedrock share some features common with those over limestone. Topography tends to be varied, with fairly steep slopes and in some areas bedrock is present on the surface. Soils are primarily sandy loams with some sand and gravel deposits occurring in outwash areas. Organic soils occur in somewhat poorly to poorly drained depressions and other low lying areas. Upland areas are well drained. Timber species are northern hardwoods with inclusions of spruce-fir and hemlock.

The next association occurs primarily with glacial lake beds and drainage ways and consists of sandy ridges with intervening organic deposits which parallel waterways and the Great Lakes shorelines. The ridges are composed of sandy soils, while the interstitial areas contain a mixture of sandy and organic soils with occasional inclusions of silt and clay. The ridges are excessively to well drained while the lowlands are poorly to very poorly drained. Jack pine, white pine and balsam-fir are the dominant timber species on the ridges, with cedar, aspen, and black spruce occurring in the lowlands.

Sand dunes occur along the Great Lakes shorelines and in areas of glacial lake shores. They are characterized by excessively to well drained sandy soils, with poorly drained mineral and organic soils occurring between the dunes. Silt and clay are scattered throughout these lower areas. Major timber species on the dunes are northern hardwoods, aspen, paper birch and jack pine, with lowlands characterized by swamp conifers.

Throughout this discussion there has been frequent mention of organic deposits. These deposits occur primarily in low lying areas, such as glacial lake beds, kettle depressions, drainage channels and similar areas and vary in size and shape depending upon local conditions. Topography associated with organic deposits is level and the drainage is poor to very poor. Soils are of two general types: sphagnum peat and decomposed muck. The former tend to be very acid and occur most frequently in association with sandy outwashes and moraines, while the latter vary in acidity. Standing water is common in both types of soil throughout much of the year. The peat soils usually support black spruce and jack pine along with marsh plants while muck soils support swamp conifers with white cedar being most common.

In summmary, the Upper Peninsula was greatly affected by glacial and post glacial events which were responsible for most of the landforms, soils and drainage patterns in the study area. Landforms are variable, but soils are consistantly sand, sandy loam or loam. Organic soils occur at lower elevations and in the various depressions that exist across all landforms. The drainage associated with most of these is poor enough to result in ponded water throughout the year. Uplands are better drained and associated with northern hardwoods, spruce-fir, aspen, and pine. Lowlands usually contain swamp conifers, aspen and some pine.

Conclusions

The discussion of the natural environment in this chapter has illustrated several important characteristics of the study area. Although relatively uniform in climate, the study area is characterized by a variety of landforms and water related features. While some of these landforms and their associated soils and vegetation occur over broad expanses, within these expanses there can be considerable variation because of commonly occurring aquatic features. Not only do these features create local variation in vegetation, but their action through time also created local differences in elevation. Moreover, these environmental characteristics, particularly those associated with water, landform and soil type, could affect the nature of the historic occupation of the study area. It is from these that environmental variables will be developed for use in the analysis fo the Upper Peninsula logging frontier.

CHAPTER IV

MODEL AND HYPOTHESES

This chapter presents a model of the industrial frontier and a series of hypotheses drawn from this model. Also included is a review of previous research in the study area which serves as background for the development of the model.

Previous Research

Initial research into the settlement pattern of the Upper Penninsula logging industry was conducted by Martin (1977) who analyzed forty-five sites located in the East Unit of the Hiawatha National Forest. Beyond concluding that sawmills tended to be located close to water, Martin could not define any relationship between site location and environmental features. She did suggest, however, that future archaeological work in the Hiawatha National Forest should be based on Ecological Land Units (ELU's), the basic land use/planning units of the United States Forest Service. Martin also posed hypotheses regarding site location (prehistoric and historic) in the Hiawatha National Forest (Martin 1977).

In 1979 Lovis (1979) tested Martin's hypotheses. His archaeological sampling frame was based upon ELU's, as suggested by Martin. Although the sample size was quite small the identified archaeological sites represented both the East and West Units. In general, the author found a highly variable relationship between ELU's and site frequency, with the exception that ELU 4 contained the largest mean site density in both the East and West Units of the Hiawatha National Forest. Moreover, certain variables were not as sensitive to logging camp locations as when used for prehistoric sites (Lovis 1979).

Problems encountered in these earlier studies may be grouped into three categories: sample size, non-exclusivity of attributes and variable selection. Martin's sample of 45 was not only small but also was restricted to the East Unit. Lovis' sample of 32 was more evenly distributed but was still small. Dividing this into East and West Unit sub-samples, their size becomes even smaller. Because of small size, only a limited amount of statistical information can be obtained from these samples (Lovis 1979, Martin 1977).

Non-mutual exclusivity of the environmental attributes defining the ELU's is the second difficulty. This attribute similarity among ELU's ranges from mutual exclusivity (having 0 per cent common attributes) to being fairly similar (havng up to 75 per cent common attributes). A situation where distinctions between sampling units are blurred to varying degrees is not conducive to the production of precise analyses and/or clearly defined predictive criteria.

Finally, the variables used in these studies were derived from previous work in the locational analysis of prehistoric sites. It was assumed that variables important to prehistoric site location would also be important to historic site location. The inconclusive and/or equivocal results obtained from the analyses performed with small samples cast some doubt on this assumption (Lovis 1979, Martin 1977).

Karamanski (1984) and Weir and Rutter (1985) conducted two additional major research projects in which they had the advantage of a significantly larger data base than either Lovis or Martin. Their projects revealed that the West Unit of the Hiawatha National Forest contains a larger proportion of logging frontier sites that the East Unit, making it the more suitable area for research into this frontier.

Karamanski's (1984) research was primarily historical, designed to locate and analyze all available historical documentation on the logging frontier of Michigan's Upper Peninsula. The research provided a historical framework for the Upper Peninsula during the late nineteenth and early twentieth centuries and led to the discovery of a number of new sites. Karamanski also field tested a sample of sites located initially through documentary sources and performed a locational analysis of logging camps (Karamanski 1984).

The locational analysis had two overall goals: to determine if camp sites were randomly distributed over the landscape, and to determine if they fell into some pattern over time. Karamanski then proposed the investigation of two sets of variables he believed important to the explanation of patterning: distance to nearest navigable water source, and percentage of sites located in various environmental zones. This analysis was confined to the West Unit, with a total sample size of 195 logging camps divided among three temporal periods: White Pine 1838-1890 (31), Hardwood 1890-1937 (147) and Pulpwood 1938 to present (41).

Karamanski (1984) used the nearest neighbor statistic in his locational analysis. He first computed this measure for all logging camp sites in the sample and then for the camp sites within each of the three temporal periods. His results were statistically significant for each of the four categories. For the total sample (R=.78) a tendency toward randomness was suggested. For the subsamples, the R values tended to be intermediate between clustered and random (Pine .531, Hardwood .686, Pulpwood .621) (Karamanski 1984).

Karamanski offered two possible explanations for this pattern. The first maintained that pine timber may have been available only in very large, isolated stands. This would result in the establishment of a number of camps within a stand before its timber was exhausted, thereby creating a clustering effect. Since hardwood stands were more randomly distributed, hardwood era camps would also be randomly distributed. The second explanation focused on transportation: the pine era camps would cluster around navigable water sources, while the location of hardwood camps would be more random since they were not dependent upon water transport (Karamanski 1984).

Although Karamanski's initial explanation appeared plausible, further examination reveals some contradictions. Karamanski maintained that hardwood in the study area existed in small, randomly distributed patches, while the pine occurred in large, isolated stands, which accounted for the distribution of pine and hardwod camps. However, this particular conclusion only partially fit with the forest disribution in the study area. This conclusion was appropriate for pine, which existed in large stands. In terms of hardwood, however, there were differences between Karamanski's conclusions and the actual forest distribution. Karamanski maintained that hardwoods existed in small isolated stands, a proposition which did not fit the forest characteristics because there was a larger amount of hardwood forest than pine forest in the area. Karamanski's argument is rendered more implausible when the effect of water features is considered.

Karamanski posed an alternate explanation for this pattern. Pine camps were clustered because of their dependence on water for transport, while hardwood camps were more randomly distributed because they did not depend on water transportation. However, when he analyzed distance to nearest navigable water for both pine and hardwood era camps he found that hardwood camp sites were located more closely to navigable water than pine camp sites, refuting his own arguement (Karamanski 1984).

As explanation, Karamanski points out that the pine logging camps could be some distance away from navigable water, with the logs transported over ice roads to a staging area adjacent to the stream. While this argument is plausible, it has limitations. Furthermore, there are problems with Karamanski's interpretation of the mean distance to nearest navigable water measures presented in Table 7 (1984:148). In the case of pine camps, the standard deviation exceeds the mean, while for hardwood camp sites, the standard deviation (.42) effectively equals the mean (.44). These measures indicate that the set of distances used for the analysis do not conform to the normal distribution and therefore cannot be used as representative measures of either sample. Had Karamanski investigated this phenomenon further perhaps he could have been obtained some useful information (Alder and Roessler 1972, Bryant 1913, Karamanski 1984).

In his final analysis Karamanski analyzed the relationship between site location and land type. Using chi-square (A=0.05, df=18) he ascertained that 56.4 per cent of all lumber camp sites were located on moraines covered by glacial outwash. However, this analysis was performed only on the total sample so that there were no observations to report on the differential land type association between different technological/ temporal periods. An additional analysis which was not pursued, could have involved a proportional study of the land type associated with site location. Using a chi-square test, an observed distribution for a given number of cells could be compared with that expected to occur randomly. It would also have been useful to compare the distribution of site locations with the percentage distribution of land types in the study area. Karamanski informed us that the moraine with glacial outwash land type covered 35.8 per cent of the West Unit and contained 56.4 per cent of the logging camp sites. If, for example, this land type is the largest single land type in the West Unit one might expect that it would contain the greater percentage of logging sites, even if the actual percentages were not equal. Similar associations might be studied with other land types in the West Unit. This information was available at the time Karamanski's report was prepared, but apparently was not considered when the analysis was performed (Burghardt and Wigger 1978, Karamanski 1984).

The pooled sample used in Karamanski's environmental analysis, evoked another methodological/analytical comment. The modern forest growth associated with the moraine with glacial outwash land type, whereon 56.4 per cent of the pooled sample of sites occur, is northern hardwoods, red pine with inclusions of spruce-fir, hemlock and aspen. Even though the modern forest composition is not an exact duplicate of pre-settlement forest, this characteristic raises an interesting point. Given the overwhelming number of hardwood camp sites in the sample (67 per cent), it should be expected that the land type upon which most sites occur will contain northern hardwood forest mixed with pine. In other words, the results of the land type analysis could have been predicted through an examination of the sample composition. Hence, Karamanski's study of environmental association can best be considered an analysis of hardwood camps, with enough pine and pulpwood camps to prevent more than 56.4 per cent from being associated with this one land type (Karamanski 1984).

The remaining study of the logging frontier in the West Unit was performed by Weir and Rutter (1985). In was carefully thought out and points to some key areas that require further examination. The authors maintained that previous research analyzing the location of logging camps had perhaps focused too narrowly on transport considerations. They proposed the introduction of the concept of scale into such analyses to allow different sets of locational factors to be important at different levels of the spatial continuum. Three levels comprised their spatial scale: macro, meso and micro. The macro level, concerned with the overall location of the lumber industry at the continental level, is not relevant here. The meso level is concerned with the location of operations within regions and transport considerations are important at this level. Finally, the micro level is concerned with the actual siting of logging camps. The authors believe that locational factors at this level have more to do with the camp as a habitation area than as a resource extraction and transport setting (Weir and Rutter 1985).

Weir and Rutter began their analysis by noting that most of the sites in their sample were from the hardwood era and they operated with the assumption that their sample was non-representative. As with previous studies, they focused on problems associated with distance to water. The first of these maintained that earlier sites would be located closer to

Lake Michigan, a proposition that originated with Martin (1977), and which Weir and Rutter found to be the case. Next they tested site location with respect to distance to nearest navigable water. Their findings mirrored Karamanski's; hardwood camps were closer to navigable water than pine camps. Weir and Rutter attributed this to either small sample size or the possibility that this distance was not a variable relevant to the examination of of camp siting at the micro-level (Weir and Rutter 1985).

Weir and Rutter next turned their attention to drainage and slope, which they believed were important to micro scale considerations of camp location. The results of this analysis were highly significant, with over 80 per cent of the sites being located on excessive to well drained land. Furthermore, over 50 per cent of the sites were on level to gently rolling land. No well drained site was on flat ground (Weir and Rutter 1985).

The authors' final analysis was a modified catchment analysis of the logging camp sites with respect to forest type. This topic was pursued under the assumption that forests near the camps would conain the type of trees to be cut and camps could be distinguished by the predominant modern forest association. Using a two mile radius, they studied modern forest composition around the sites. They found that both pine and hardwood camp catchments contained both pine and hardwoods within a two mile radius. There was also considerable variation in the proportion of pines to hardwoods in both the pine camp catchments and the hardwood camp catchments. A chi-square test performed for these observations indicated that they had a high probability of occurring by chance (Weir and Rutter 1985).

All of the previous investigations into the Upper Peninsula logging frontier share common flaws. Most noticably they have focused almost exclusively on logging camps and have not viewed the frontier as a whole. While this characteristic is attributable to the contract format under which these investigations were performed, it has nonetheless produced a rather one-sided view of the study area.

Second, many of the assumptions and variables used in the analyses of camp location have been drawn directly from prehistoric archaeology. With the exception of Weir and Rutter (1985) there has been little or no attempt to evaluate these assumptions and variables in light of the available data about the practice of logging in the late nineteenth-early twentieth centuries. Hence, the lack of relevant results concerning camp location may be attributabed to inappropriately framed hypotheses and inappropriately chosen variables rather than to the actual situation in the study area.

The research undertaken here will remedy this situation through the development of a model of the industrial frontier and the evaluation this model with data from the Upper Peninsula logging frontier, thereby providing a systematic treatment of the region lacking in previous research. Moreover, the variables chosen for this analysis will be determined through the evaluation of contemporary logging textbooks, and thus will be relevant to the logging frontier.

A Model of the Industrial Frontier

In developing a model of the industrial frontier it is important to treat the spatial, temporal and organizational dimensions of human activity. This enables the researcher to obtain an understanding of the spatial structure and organizational processes of the industrial frontier within a given time frame as well as to evaluate how this structure and these processes evolve through time. Accordingly, the spatial dimension of the industrial frontier model will be discussed first, followed by a discussion of the organizational and temporal dimensions.

In modelling the spatial dimension of the industrial frontier, two bodies of theory will be drawn upon. The first is that of archaeological frontier theory (Lewis 1984), which presents a hypothetical settlement composition for the industrial frontier. The second is that body of geographic theory (Burghardt 1971, Taafe *et.al*. 1963) which deals with the penetration of an underdeveloped region by a more technologically advanced society. Taken together, these two bodies of theory will allow for the construction of a model of the industrial frontier which not only deals individually with the constituent sites, but also with the settlement pattern and settlement system.

Behavioral and organizational aspects of the industrial frontier will also be modelled. Behavior will be approached at the production level, while organization will be viewed as a pan-frontier phenomenon. The underlying premise for this approach will be drawn from Lewis (1984), Hardesty (1985) and a variety of historical sources (Abrams 1978; Degler 1977; Edwards *et*. *al*. 1972; Wallerstein 1980, 1983).

Change will be approached from three perspectives. The first will address the evolution of the settlement pattern. Suggestions as to how this occurs are drawn from geographic analysis of transport development in third world nations (Burghardt 1971, Taafe *et.al*. 1963).

Change in organizational/behavioral features will be addressed in terms of the hypothesized characteristics associated with these phenomena. One set of characteristics is drawn from Hardesty (1985) and deals primarily with behavior deemed common to the industrial frontier. The other set deals with larger scale organizational processes of the industrial frontier in light of the overall late nineteenth century-early twentieth century society in which they existed.

Finally, change will be addressed as a phenomenon in and of itself. Hardesty (1985), in addition to defining behavior and adaptation on the industrial frontier, proposed a pattern change should follow in this situation. He maintained that industrial frontier change will be steplike and discontinuous, analogous to the biological theory of punctuated equilibria.

Two overall features characterize the industrial frontier. First, industrial frontiers are oriented towards the exploitation/acquisition of a single resource. Second, industrial frontiers are of short duration. The relationship between these two premises is the obvious one: the industrial frontier will shift when the resources in a given area can no longer be profitably exploited. These two characteristics will be addressed in the hypotheses presented below (Hardesty 1985, Lewis 1984, Steffen 1980).

The development of the industrial frontier model appropriately begins with a disucussion of the settlement pattern associated with this type of frontier. The entrepot is the first of the three hierarchically arranged types of settlement on the industrial frontier. Entrepots are singular, or few in number, and contain all the higher order central place functions found on the industrial frontier. The entrepot is also the sole gateway between the frontier and the homeland. Raw or partially processed materials flow throught the entrepot to the homeland and, in return, manufactured goods and supplies flow through the entrepot to the hinterland. Given this consideration, the entrepot is both the port and the terminus of the frontier transportation system, whatever that system might be (Burghardt 1971, Lewis 1984, Taafe et.al. 1963).

Ordinarily only a single entrepot will exist on a frontier. However, it is possible to have more than one entrepot providing each has its own hinterland. Once established, entrepots remain in a fixed location for a longer duration than either intermediate supply centers or camps and have the potential to survive the demise of the industrial froniter. This survival potential exists because the size and diversity of entrepots could allow them to develop an internal economy of sufficient size to ensure their survival (Burghardt 1971, Lewis 1984, Taafe et.al. 1963).

The intermediate supply center is the next type of settlement common to the industrial frontier. These settlements occur more frequently than entrepots, but not as freqently as camps, and are located in the interior along transportation routes between the entrepot and the camps. They contain a limited number of central place functions, and serve primarily as supply bases for the camps and transshipment points for goods travelling between camps and the entrepot. These settlements are of short duration, lasting only as long as there are camps in the area to service (Burghardt 1971, Lewis 1984, Taafe et.al. 1963).

Camps are the most numerous type of settlement on the industrial frontier, focused exclusively on the production/acquisition of a single commodity. They may exhibit unique layouts, building designs, etc., as well as contain a unique material culture assemblage which relates to the camp's commodity and processing activities. Because of their extractive nature, these sites occur in close proximity to the resource. Moreover, camps are characterized by impermanence and frequent abandonment as the resource base shifts (Lewis 1984).

The three types of settlement on the industrial frontier are connected by a transportation system which might utililze a single mode of transport or several different sequential modes. Competing/simultaneous modes would be inefficient and are not likely to be found. Ultimately, all routes would converge on the entrepot regardless of the pattern in which they lay over the landscape. Because the camps' locations frequently changed, the transportation system was also subject to frequent changes. Therefore, the construction of transport routes and facilities was likely to be accomplished in the least costly fashion possible, unless other considerations prevailed (Burghardt 1971, Lewis 1984, Taafe et.al. 1963).

In strictly spatial terms, the industrial frontier may be conceived of as a series of coastal entrepots servicing a hinterland containing intermediate supply centers and camps. These interior settlements are connected to the entrepot by a transportation system. The boundary of the hinterland is loosely defined by the presence of settlements which are connected to a given entrepot.

Associated with this particular spatial pattern are certain behavioral and organizational patterns. The most significant of these is the production related behavior occurring in the camps. This behavior will be uniform across the entire frontier within any given time frame because camp behavior was selected for production efficiency. Thus, in order to reach and remain at peak production, all camps tended to practice the same behavioral repertoires. Furthermore, should a behavioral change occur, it would be rapidly adopted across the entire frontier, reflecting the universal quest for production efficiency and the large scale capitalist organizational characteristics of the industrial frontier (Hardesty 1985, Lewis 1984, Steffen 1980).

In addition to camp level behavioral patterns, larger scale organizational patterns associated with the industrial frontier relate to control over resources on this frontier. Given the umbilical relationship between the industral frontier and the homeland, this control over resources should mirror the situation in the homeland and reflect capitalist systemic processes in general. Because these are larger scale processes they will not be reflected in daily activities and therefore must be observed over longer periods of time (Hardesty 1985; Lewis 1984; Steffen 1980; Wallerstein 1980, 1983).

While patterns can be identified and studied, the industrial frontier was dynamic and it is appropriate to examine change as an industrial frontier phenomenon. The most common and expected change is the shift in camp location as the resources in a given area deplete. Since the industrial frontier is exclusively production oriented, changes in the locus of production and their rationale are important to understanding the operation of the entire frontier. This is especially true because such changes ultimately affect other components of the settlement pattern and other aspects of the industrial frontier (Hardesty 1985, Lewis 1984).

Other changes could occur in the settlement pattern as the result of the introduction of a new mode of transport. A shift in transport mode could effect the location of intermediate supply centers as well as their central place functions. More efficient use of the existing transport mode would not effect such a change because efficiency is manifested in scheduling and capacity, rather than in a major structural change (Burghardt 1971, Hardesty 1985, Taafe et.al. 1963).

Changes in transport mode may also affect the relationships of various entrepots/hinterlands on the industrial frontier. For example, if new transport modes are present in some, but not all hinterlands, then those without the new transport modes could be at a competitive disadvantage resulting in their decline as viable socio-economic systems. Also, an adjacent hinterland with a more well developed transportation system might "capture" part of a neighboring entrepot's hinterland by extending its transportation system to one of the neighbor's intermediate supply centers. In this case, the first hinterland could be so decimated that it could no longer function as a distinct socio-economic system. Its entrepot would decline or disappear and the intermediate supply centers and camps would be reoriented toward the neighboring entrepot (Burghardt 1971, Taafe et.al. 1963).

A third possible trajectory for industrial frontier settlement pattern change would be the evoluton of an intermediate supply center into an interior central place, containing all the central place functions of the entrepot with the exception of port facilities. The fact that the entrepot retained its port function would allow it to remain the dominant settlement, but the heirarchy would be less clearly defined. Moreover, the presence of an interior central place would cause an number of permutations in the transportation system and settlement pattern. This particular trajectory of change is viewed as least likely to occur on the industrial frontier because of this frontier's relatively short duration (Burghardt 1971, Taafe et.al. 1963).

Change in behavior and organizational patterns cannot be modelled to occur along a number of alternative trajectories. Rather, change in these areas must be viewed in terms of increases in productive efficiency (i.e.

profitability) and/or control over resources, regardless of what forms it takes. In the behavioral context, production activities will be uniform within camps and between contemporaneous camps on the industrial frontier. Change in these productive activities will occur only if the new behavior will impart a significantly increased productive potential to those adopting it (Hardesty 1985).

Change in the organizational patterns of the industrial frontier will occur only to increase the elites' control over available resources. This includes an increase in direct ownership of resources as well as the use of other organizational and entrepreneural activities to provide indirect control over resources. Moreover, resource control may also include control over labor, since labor is the means which converts the resources into a salable commodity. Hence, there is a relationship between this larger scale aspect of industrial frontier change and change in behavior occuring at the camp level (Abrams 1978; Degler 1977; Edwards et.al. 1972; Wallerstein 1980,1983).

Finally, the phenomena of change itself may be evaluated as a distinct process on the industrial frontier. In an examination of the southwestern mining frontier, Hardesty (1985) proposed that change on the industrial frontier should be steplike and discontinuous, analagous to the biological theory of punctuated equilibira (Gould and Eldredge 1977). Should Hardesty's conceptualization be a viable explanation of the process of industrial frontier change, it should be observable on all industrial frontiers. Therefore, the content of change in the study area, as well as the process by which change occurs will be evaluated.

In concluding this discussion of the industrial frontier model, three key points should be made. First, the industrial frontier is a unique type of frontier with its own settlement pattern and behavioral/ organizational features which are oriented toward the maintenance of the most efficient level of production possible. Second, because of this emphasis on production, uniformity rather than diversity is selected for on the industrial frontier, with change occurring only when it results in an increase in productivity. If an innovation meets this criterion, it will be rapidly adopted across the entire frontier. Thus, when viewed from a larger scale, the pattern of frontier change appears steplike and discontinuous.

Third, the relationships among the spatial and behavioral/ organizational features are complex and not as simple as they appear on the surface. These may be examined and defined further through the application of the model to case study of a specific industrial frontier.

Hypotheses

The discussion of the industrial frontier model revealed that there are several areas open for investigation. The most obvious is the identification of the settlement pattern based on known archaeological sites/settlements. From this, the activities associated with each settlement and the operation of the system as a whole can be inferred. In addition, the individual components of the settlement pattern can be examined to see what they reveal about the operation and production related concerns associated with the industrial frontier. Given the overriding emphasis on production on the industrial frontier, it is expected that this will be reflected in the settlement pattern as well as in other material and non-material culture on the frontier. Since camps are the one particular type of site devoted exclusively to production, they might be the most appropriate focus for this kind of analysis.

Change may also be examined in terms of settlement pattern and material and non-materal culture. Since camps are the loci of production and frequently change location, understanding how and why they relocate would be significant to understanding the productive processes of the industrial frontier. In the rare event a major change occurs, it should cause a significant increase in production. Moreover, the results of such changes should be easily visible in the archeological and historcal record. Preliminary research into the Upper Peninsula logging frontier indicates that such a major change occurred with the introduction of railway logging and this will be addressed in the hypotheses below.

Camps and camp activities play a major role on the industrial frontier. Hence, this examination of the Upper Peninsula logging frontier will focus on camps for a significant portion of the analysis. This research will differ from previous efforts in three ways. First, it will be assumed that because a site is a logging camp, it must be close to trees. Available historical data indicate that this was universally the case for sites during both the river drive and railway logging eras and stating or demonstrating that logging camps and trees co-occcur has little explanatory power in the attempt to analyze important industrial frontier processes. Therefore, forests will not be used as a variable or focus of study.

Second, following the suggestion of Weir and Rutter (1985), micro scale locational factors will be examined in the attempt to understand the locational criteria for logging camps. These authors maintain that actual camp siting will depend more on the habitability of a given area than on other criteria. This consideration is not inconsistent with the overall frontier emphasis on production, since a habitable camp site greatly reduces the danger of accident and disease while easing and effectuating daily work routines.

Third, previous attempts to treat logging camps as a group were limited to ascertaining their distributional characteristics by means of nearest neighbor analysis. A more fruitful approach in terms of industrial frontier processes is to deal with them in production related terms. Thus, through understanding what defined a camp's territory and how this related to camp movement, the spacing between camps and the organization of work within a camp, insight into the operational and spatial characteristics of this particular type of industrial frontier can be obtained.

In order to develop hypotheses about micro scale locational factors and inter-camp relationships it was necessary to learn the criteria governing the optimum location for a logging camp. Fortunately, sources for this information were readily available in the form of logging and forestry textbooks published shortly after the turn of the century.

During the latter part of the nineteenth century, with the growth of land grant colleges, there developed an emphasis on the practical skills (i.e. agriculture, engineering, etc.) necessary for an industrializing nation. A growth of knowledge and the appearance of experts in these areas led to their formalization and incorporation into the university curriculum. Forestry was one of these areas. With the formalization of the profession and the subject, textbooks which discussed the various ways to organize field operations, establish camps, build logging railroads, etc. began to appear shortly after the turn of the century. From these textbooks a set of considerations important in the location of logging camps can be drawn. While the textbooks represent the formal knowledge of the profession, which is always subject to modification by the folk wisdom of the logger in the forest, they are the only readily available source from which we can draw a related set of conditions considered important in camp location/operation. Moreover, these textbooks were written by individuals who were active in the lumber industry during the study period. Therefore, we might expect that they would be more accurate than descriptions prepared long after the fact (Brown 1923, 1934, 1936, 1947; Bryant 1913; Croyle-Langhorne 1982; Kuhn 1955).

Several observations can be made based on the examination of logging textbooks for micro scale locational parameters. First, loggers recognized that various settings were appropriate for the siting of logging camps. Secondly, these settings contained some characteristics that were common to river drive camps and railroad camps, as well as characteristics unique to each type of camp. Finally, some locational characteristics were considered more important than others (Brown 1923, 1934, 1936, 1947; Bryant 1913).

The first consideration dealt with the physical characteristics of the area in which the camp is to be built. For both river drive and railway camps this area should be level, well drained, and of an optimal size. Such characteristics simplified the construction of camp buildings and insured that surface water could quickly drain away, reducing the risk of malaria or other highly contagious diseases. The average size for river drive or railway camps should be between one and two acres to provide for the proper arrangement of camp buildings and associated work areas (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Based on the above discussion, the following propositions may be made.

<u>Hypothesis 1</u>: Logging camps, regardless of whether they are associated with river drive or railroad logging, should be located on fairly level, well drained land.

<u>Hypothesis 2</u>: Logging camps, regardless of whether they are associated with river drive or railroad logging, should range from approximately one to two acres in size.

The next consideration deals with water features. Previous analyses of this topic have produced unexpected and equivocal results when treated as the simple distance to nearest water. Examination of the logging textbooks reveals that this variable is, in fact, very complex and is linked to supply, sanitation and transportation considerations. An examination of the siting considerations for river drive camps illustrates the complexity of this variable.

First, camps should have a stream of pure running water nearby for drinking, cooking and washing purposes. This source need not be the stream one used for log driving, although it could be. In some instances, however, a well may have been driven or water hauled to camp from the driving stream (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Secondly, river drive camps should be located near a driveable stream or a lake with a driveable outlet. The driveable stream should be small with high banks, only slightly wider than than the longest log lengths cut, and be deep and clear of obstructions. Any obstructions should be removed or otherwise circumvented. The channel should be fairly straight and the watershed sufficient to provide five to six hours of driving time per day. Water used for driving could come from natural stream flow or from dams located along the driving stream. Larger streams and lakes were acceptable, but these frequently needed improvements (i.e. piers, booms, etc.) on a larger, more costly scale than the basic driving stream (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Thirdly, river drive logging camps were not to be located immediately adjacent to the driving stream. Rather, a landing or decking area would be adjacent to the driving stream with the camp located some distance uphill. Ideally, the main haul road from the cutting area to the landing should pass through the camp. Thus, the camp would be located at the same or a lower level than cutting operations, but some distance up slope from the landing area and driving stream. This arrangement was more efficient for the maintenance of draft animals, equipment and the transport of logs. The distance uphill from the driving stream could vary, but probably should fall between one half and one mile and rarely exceed one and a half miles. These distance figures relate to the effective work radius around a river drive camp for both humans and draft animals (Brown 1923, 1934, 1936, 1947; Bryant 1913).

These were the considerations made by loggers in locating river drive camps and the acknowledgement of these considerations throws a different light on the use of distance to water in studying camp location. While two of the points relate directly or indirectly to transport considerations, they do not follow the proxemic argument used in previous analyses. Rather, they rely more upon factors relating to the organization of work by camp members. Additional factors, such as the procurement of domestic water, could have been met by a variety of means which do not require immediate adjacency to a water source. Therefore, greater attention will be paid to considerations based on camp work organization than to simple distance to nearest water. From this perspective, additional hypotheses will be derived (Brown 1923, 1934, 1936, 1947; Bryant 1913; Karamanski 1984; Lovis 1979; Martin 1977; Weir and Rutter 1985).

Hypothesis 3: River drive era logging camps will be located near, but not immediately adjacent to driveable streams or lakes. They may be expected to occur between one half and one and a half miles from the driveable stream/lake and only occasionaly occur at distances greater than one and a half miles from the driveable stream/lake.

Hypothesis 4: River drive logging camps will be located at intermediate elevations within the surrounding area. They will be located above the level of the driveable stream/lake and equal to or lower than the elevations where active cutting will occur (i.e. lower than the highest elevation in the area).

Water related variables differ for railroad logging camps. First, proximity to a supply of pure drinking water is secondary to other considerations, since pure drinking water could be brought in by tank car. However, it was generally optimal to have some nearby source of water for engines, animals and washing (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Secondly, in rolling regions the main line of the logging railroad usually entered the region through and continued to follow a natural drainage since such a route provided the best grade over the shortest distance. Generally, builders of main lines tried to avoid grades over 3 per cent and curves greater than 12 degrees of arc. Spur lines should follow drainages or other natural grades away from the main line. They could tolerate somewhat steeper grades (less than 6 per cent when full, less than 10 per cent when empty) and curves up to 30 degrees. While main lines were expected to follow natural drainages, spur lines could sometimes deviate from these drainages/grades if the value/amount of timber in a particular area offset the increased cost of deviation (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Thirdly, railroad logging camps were expected to be located immediately adjacent to the rail line to facilitate the loading and unloading of supplies and labor and to serve as a decking area for the closer cutting operations. Since rail lines most likely followed a natural drainage, railroad logging camps would be located fairly close to a stream (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Finally, given the year-round potential of railroad logging, loggers generally tried to locate camps as far away from swamps as possible. This reduced the risk of malaria and other contagious diseases transmitted by insects or contaminated water supplies. Normally this problem would not exist in winter logging because swamps were frozen. However, since railroad logging has the potential for full year operations, this point must be taken into account (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Thus, while some emphasis is placed on water sources for drinking, washing and engines, the more important relationship is that between the logging camp and the rail line. As it so happens, the rail line also has a relationship to natural drainages, which perforce must then have a relationship to camp location. These propositions allow for the formulation of the following hypotheses.

<u>Hypothesis 5</u>: Railroad logging camps will generally be located fairly close to natural drainages/streams; probably no further than one mile away. Camps greater than one mile from a natural drainage/stream should be located on ground with approximately 6 per cent slope and in an area that, by inference, contained a heavy stand of timber.

<u>Hypothesis 6</u>: Railroad logging camps will be located as far as possible from swamps.

The logging textbooks provided valuable information about the intersite relationships between river drive logging camps. First, loggers recognized that there was a point where so much time was spent travelling to the cutting area from the camp that continued occupation of that particular camp was unfeasible. This travel time consideration was important because it limited the amount of time the loggers could work in the cutting area and affected the timing of other internal camp activities. The shorter hours of daylight during winter and adverse weather conditions were also taken into consideration. One and a half miles was the distance considered critical in this respect. Hence, when all appropriate timber had been cut within a one and a half mile radius of a river drive logging camp a move had to be seriously considered (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Related to this is the fact that horses and sleds were used to haul logs over ice roads from the cutting area to the landing. The horse team had certain limits in terms of the length of haul under given conditions. Factors such as size of load, slope, time of day (i.e. how long the team had been working), weather, etc., contributed to determining the distance a horse team could effectively haul. This distance ideally should be kept to the shortest possible, but under most conditions, especially with a good grade, a horse team could haul for approximately one to three miles without resting (Brown 1923, 1934, 1936, 1947; Bryant 1913).

It should be noted that forest composition had little effect on intersite spacing of river drive camps. Once it was established that a certain tract of land exceeded the threshhold of profitability for marketable timber, the considerations discussed above were the determinants of camp location both within the tract and with respect to each other. Forest composition affected the length of time it took to remove all the marketable timber from an area, but it didn't affect the location of camps once the threshhold was exceeded (Brown 1923, 1934, 1936, 1947; Bryant 1913; Hardesty 1985).

Based on the above discussions, an hypothesis about the spatial relationships among river drive logging camps can be put forth.

<u>Hypothesis 7</u>: The intersite spacing of river drive logging camps may be viewed as a function of the effective work zone around each camp. It is therefore hypothesized that river drive logging camps will generally be located between one and a half and three miles of each other.

Intersite relationships for railroad logging camps are a more complex issue, primarily because of the railroad. Generally, the main line of a logging railroad was constructed into an area with an eye towards many years of use. Spur lines were constructed off the main line to provide access to timber. Camps were then located along these railroad lines. As in river drive operations, horse power was used to haul logs from the cutting to the loading area with the average continuous horse haul ranging from one to three miles depending on the grade. Similarly, the maximum radius to which lumberjacks could be expected to walk to reach the cutting area was about one and a half miles (Brown 1923, 1934, 1936, 1947; Bryant 1913).

Sometimes, however, the railroad was used to transport workers and/or horses to some debarkation point along the line, whence they walked to the cutting area. This could increase the effective work zone around a camp as well as change its shape from an idealized circle to a more linear form. Moreover, one source recommends building spur lines one quarter to one half mile apart, with only occasional uses of intervals over one mile. Even without rail transport for horses and workers one camp could supply labor for a number of rail spurs so that not every rail spur would necessarily be associated with a camp. All of these considerations make it difficult to frame hypotheses about the intersite relationships between railroad logging camps (Brown 1923, 1934, 1936, 1947; Bryant 1913).

One relatively constant factor is that the use of the railroad to transport workers and/or horses from the camp to some intermediate point on the way to the cutting area can significantly enlarge and re-shape the work area around a railroad camp regardless of the interval between spur lines. This use of the railway need not have been a daily occurrence to have had an impact the situation.

Based on the above discussion, the following hypothesis may be stated.

Hypothesis 8: The intersite spacing of railroad logging camps is a function of the effective work zone around each camp. The work zone in this instance should have as its lower limit a radius of approximately one and a half to two miles. Its upper limit is not specifiable at this time.

The hypotheses presented above have been designed to allow an investigation of certain intersite relationships among both river drive logging camps and railroad logging camps. Although couched in terms of a simple linear distance measure between camps, these hypotheses will allow deeper inquiry into the relationship between sites because they focus on the human organization of space rather than on intersite relationships couched exclusively in terms of environmental factors or the departure from randomness. This focus on work zones will allow us to not only understand site distribution within the study area, but also to provide some insight into the organization of the logging industry.

Having addressed several hypotheses specific to camps it is now appropriate to move to a larger perspective and deal with the entire settlement pattern of the industrial frontier. The useful starting point will be the investigation of the general spatial parameters of the industrial frontier model.

Accordingly the following hypotheses may be proposed.

Hypothesis 9: The logging frontier, whether river drive or railroad, should contain three types of sites: camps, intermediate supply centers, and entrepots. These should exist in a hierarchial relationship to each other; with camps being the most numerous followed by intermediate supply centers and entrepots, either singular or very few in number.

Hypothesis 10: Intermediate supply centers will be camp oriented and function to supply the subsistence and technological needs of the logging camps as well as provide transportation/communication links with the entrepot and various personal goods/services for the workers. When camp locations move, intermediate supply centers will move or cease to exist.

Hypothesis 11: Entrepots will be singular or few in number, but larger and more diversified than other components of the industrial frontier settlement system. They will maintain direct and constant contact with the homeland and will be the termini of frontier transport/communications systems. They will be more permanent than other components of the frontier settlement system, often lasting beyond the demise of the logging frontier.

In addition to having three different types of sites, the industrial frontier was characterized by a multipurpose communication/transportation system which connected these sites. This system connected the frontier and the homeland allowing a two-way exchange of goods and information. It also provided the frontier with information about market conditions, supply sources and technological development. Finally, it provided a means of organization and control to those in the homeland in charge of various operations on the frontier. The communications/transportation system, regardless of its form, had the entrepot as its terminus and through the entrepot goods and information are exchanged with the homeland. Given these characteristics, the following hypothesis is proposed.

<u>Hypothesis 12</u>: On the industrial frontier, one may expect to find a communications/transportation sytem with its terminus at the entrepot and linking all the settlements on the frontier with the entrepot. It is the principal means by which goods and information are exchanged with the outside world.

Having addressed the settlement related aspects of the industrial frontier, it is necessary to focus attention on other characteristics. Among these are the issues of duration and cultural uniformity. The first might appear to be temporal in nature, however, in this case it also falls into the category of behavioral/organizational characteristics because of the way it relates to the issue of cultural uniformity and to the operating considerations of logging camps.

The Upper Peninsula logging frontier, like all industrial frontiers, should be of short duration. Several questions arise, however, regarding the way duration should be measured. For example, do we consider the duration in light of the human occupation of North America, the capitalist occupation of North America or the appearance of the United States as a nation? Rather than become involved in a long and ultimately unproductive discussion of scale, this question will be addressed by dealing with duration in terms of material culture. If a given settlement or system of settlements is expected to be of other than short duration, one would expect that building design and construction would reflect this fact. Conversely, if settlements were designed for short duration, one would expect that this would be apparent in their design and construction. Communications/transporation systems connecting these settlements would exhibit similar characteristics. These considerations may be restated as the following hypothesis.

<u>Hypothesis 13</u>: As an industrial frontier, the logging frontier should be of short duration. This characteristic should be reflected in the design and construction of the settlements on the logging frontier.

The next general characteristic maintains that the industrial frontier will be culturally uniform throughout its duration. This characteristic is based upon the social relations associated with the capitalist world system, within which the industrial frontier operates. Capitalism above all is a power relationship rather than a market system and is most manifest in those areas associated with production. Not only does this relationship occur on the industrial frontier, but given the purpose of the industrial frontier, it should be more visible there than in the homeland. This particular power relationship, coupled with the drive for efficiency, leads to uniformity in both behavior and material culture. Given these considerations, different levels of uniformity should be associated with each of the settlement components of the industrial frontier. While these components are not expected to be internally isomorphic, between component variation should be greater than within component variation (Bowles 1985, Edwards <u>et</u>.<u>al</u>. 1972, Evangelauf 1985, Lewis 1984).

The most structured behavior should be found in camps which are singularly established for the production of a commodity. Not only will work be carried out under a strict set of guidelines, focused on maximizing production, but also activities outside of work will be regulated. This pattern should hold true for both river drive camps and railroad camps. Behavior at intermediate supply centers and entrepots would be less structured because these settlements served other functions besides production (Bowles 1985, Edwards et.al. 1972, Hardesty 1985, Lewis 1984).

The material culture (primarily buildings in this case) associated with cultural uniformity is also expected to be oriented exclusively towards production and to be produced in fairly regular sizes and arrangements, while that associated with other types of sites is expected to be more diverse.

Thus, the following hypothesis may be stated.

Hypothesis 14: The logging frontier will be characterized by a high degree of uniformity, both in terms of behavior and material culture. It is expected that this uniformity will be most visible in areas directly relating to production and that it will vary among the three components of the industrial frontier settlement system.

The process of change on industrial frontiers has recently been examined by Hardesty (1985), in his study of the mining frontier of the United States' Southwest. Hardesty has developed several conceptual approaches to the phenomenon of change on the industrial frontier, one of which is the concept of standardization. From a more general perspective, standardized adaptive responses or cultural uniformity was addressed in Hypothesis 14. In this instance, however, interest is focused on how such a highly standardized system changes. Furthermore, the orientation of the industrial frontier dictates that change should be most visible and most significant in areas associated with production (Hardesty 1985).

To develop his model of change in standardized industrial frontier systems, Hardesty borrowed from the field of paleobiology, specifically the work of Gould and Eldredge (1977) concerning punctuated equilibria. Hardesty terms this pattern of change, when applied to cultural systems, as that of correlated episodes. Such a pattern of change is likely to be steplike and discontinuous, but more or less simultaneous over the entire industrial frontier. For example, a particular adaptation, usually a production technology, will be common across the entire industrial frontier and will remain in place until a significantly more efficient/ profitable technology appears. Once the new technology appears it will rapidly proliferate across the entire industrial frontier becoming the principal production technology. Such rapid proliferation is ensured by the communications/transportation system and the power relationships inherent in the capitalist system (Bowles 1985, Edwards *et.al*. 1972, Hardesty 1985).

The present research presents an opportunity to examine the process of change on the logging frontier. Historical reports indicate that logging began in the study area as river drive logging and later shifted to railroad logging. Such a shift in production, both in terms of resource and technology, should be significant. Therefore, it would be expected that such a change would conform to the principle of correlated episodes as developed by Hardesty. This expectation may be stated as the following hypothesis (Hardesty 1985, Karamanski 1984).

Hypothesis 15: The shift in production technology from river drive logging to railroad logging should be abrupt and occur within a short period of time. This shift should result in a movement from universal river drive logging to a situation of universal railroad logging.

In addition to his examination of industrial frontier change as correlated episodes, Hardesty (1985) proposed that industrial frontiers may be viewed as ecosystems. Specifically, Hardesty maintained that the Marginal Value Theorem may be used to model spatial patterns of industrial frontier ecosytems. This conceptualization allows researchers to examine problems of duration of occupation, re-occupation, abandonment, etc. as well as to consider such factors as resource renewability and technology.

The Marginal Value Theorem describes the industrial frontier as a web of patches which are the loci of resource availability. According to this theorem any patch will remain colonized until its rate of production drops to a level equal to the average rate of production for the frontier as a whole. The average includes allowances for the cost of moving to another patch and for the cost of production in another patch. The duration of occupation, therefore, depends upon the rate of patch renewal, variability of the patch, size of the patch, technological efficiency, transportation cost and market price. Hardesty maintains that all of these variables (with the exception of patch size and variability), are environmental and change stochastically, making the prediction of innovation and sudden change impossible (Hardesty 1985).

Hardesty (1985) used the Marginal Value Theorem to analyze the mining frontier and an associated logging frontier in the United States southwest. In both these cases he was dealing with a situation where complete abandonment and/or cessation of activity occurred. The episode of change under study here is one where a given technology is replaced by another without an intervening period of abandonment. As such, the marginal value approach may not be applicable to the present research. Therefore, some of the more important variables associated with the Marginal Value Theorem will be examined to ascertain if this approach is appropriate in this case. This examination may also point to other questions which might be asked should the Marginal Value Theorem prove inapplicable.

The most obvious area that the shift from river drive logging to railroad logging would effect is that of technological efficiency. The advent of the logging railroad theoretically made year around logging possible. Thus, supplying sawmills with logs and the actual harvesting of logs no longer had to be a seasonal occurrence. In addition, the logs suffered less damage in transport resulting in a greater amount of marketable product. Finally, and most importantly, the railroad opened the way for large scale, successful hardwood logging. Prior to the development of the logging railroad, large scale logging was restricted to pine because of its floatability. Now unlimited possibilities were available to loggers (Catton 1976, Dunbar 1970, Karamanski 1984).

This shift also complexly impacts upon transport cost. The logging railway advantages (rapid and continuous transport, the preservation of product quality), brought with them substantially increased costs when compared to river drive logging. Railway construction, while using natural grades whenever it could, still required a great deal of cutting and filling to stabilize track beds and lay track. Even though spur lines could be laid with less care and over more adverse terrain than main lines, this was still an expensive proposition. For example, the suggested right-of-way for main lines was 100 feet and any filled areas had to have approximately a fourteen foot width for track bed and drainage. In addition, most of the river improvements for river drive logging were made of local material. While this is true for some railway associated construction (e.g. fills, trestles, etc.), other materials (e.g. engines, rolling stock, rails, etc.) had to be imported from the homeland to the industrial frontier. Thus, in the short run railroad logging was an expensive undertaking, which could only become cost effective if used for a number of years to access large amounts of timber. When considering the construction of a logging railroad a logger had to insure that there was sufficient timber available to amortize the debt incurred by railway construction, logging operations, and to provide a large profit (Brown 1923, 1934, 1936, 1947; Bryant 1913; Karamanski 1984).

Patch size is difficult to accurately gauge on the logging frontier. During the river drive logging era, a patch consisted of only certain types and/or clusters of trees within any larger area. These were floatable pine related species. With the advent of railroad logging, all trees within any region are nominally usable. What then defines a patch? It can no longer be done by specifying a type of tree and effectively becomes all trees. This is further born out by the fact that the prevailing cutting technique during the railroad logging era was clear cutting. In terms of natural resources, then, the patch has become the entire frontier (Brown 1923, 1934, 1936, 1947; Bryant 1913; Hardesty 1985; Karamanski 1984).

Patch variability poses problems similar to those encountered with patch size. During the river drive era this concept may have had some relevance to the logging frontier, but with the advent of railroad logging and clear cutting this concept looses its utililty. Moreover, the study area's predominant forest type is hardwood, with most of the forest classified as mixed hardwood and pine. Given these factors, the advent of railroad logging, in addition to redefining patch size also reduced patch variability in terms of the natural resource being exploited (Hardesty 1985, Karamanski 1984, Weir and Rutter 1985).

Patch renewability is usually applicable to forests, which may regenerate in the long run, but it can be a complex characteristic to measure. First, there is the question of how this renewal is to be accomplished: by natural regeneration or by reforestation. Most of the forests in the United States, including those in the study area, have been renewed by the latter method. Second, will this be a long or short term prospect? Allowing that long and short are relative terms, I would argue that reforestation is a long term phenomenon vis a vis the industrial frontier. If one is examining succesive re-colonization over the long run, presuming re-forestation had occurred, then the archaeological record should appear as Hardesty (1985:217) describes it. However, the concept of renewability as the complete replacement of resources is not useful when observing an industrial frontier within the framework of its initial colonization. Furthermore, one must assume that the resource was perceived as either non-renewable or else was not thought of in terms of renewability, by industrial frontier colonists (Hardesty 1985, Karamanski 1984).

The re-colonization of an area after the introduction of a new technology, but prior to the complete removal of resources can also be considered as an issue of patch renewability. In this instance the introduction of a new, more cost effective technology makes it profitable to re-occupy an area to obtain resources unobtainable under the previously existing technology. In the case of the logging frontier, it could be expected that some of the early railway camps might be located near the sites of river drive camps to harvest hardwood timber untransportable in earlier times. This assumes that such timber was not used in camp or dam construction and was not used for fuel (Hardesty 1985).

The discussion above presented several difficulties with using Hardesty's Marginal Value Theorem approach in this research. Initially, it was suggested that this theorem was only applicable in areas where complete abandonment had occurred and this appears to be the case. Moreover, the unique characteristics of the study area and its forests support the conclusion that it would be inappropriate to use the Marginal Value Theorem in this case.

One aspect of renewability discussed above bears further examination because it assumes that resources were not depleted prior to the occurence of a major technological change. This change renders accessible a previously inaccessible resource prior to abandonment and therefore renews the resource in a relative sense. This allows the following proposition to be put forth.

Hypothesis 16: With the advent of railroad logging, some camps might be located near older river drive camps so as to obtain previously uncut hardwoods. This proposition assumes that such trees were not used for other than log production during the river drive era.

In discussing the Marginal Value Theorem, several characteristics of railroad loggging were brought to light. First, it allows for rapid transport of logs with limited product damage. Second, it was now possible to log hardwoods and to continue logging throughout the year. Since most of the timber in the study area is hardwood occurring as mixed hardwood/pine, the development of railway logging opened a great deal of territory to exploitation. Thus, commodity, transport efficiency, work patterns, resource base and marketability were all redefined and their capacities increased (Brown 1923, 1934, 1936, 1947; Bryant 1913; Catton 1976; Dunbar 1970; Karamanski 1984).

However, such developments were not without cost. Railways, both in terms of construction and maintenence, were significantly more expensive than the river improvements needed for river drive logging. In addition, the cost for equipment (i.e. rolling stock, engines, etc.) was great, because all of it had to be brought to the frontier from the homeland. This initial investment in technology and ongoing maintenence/labor costs had to be amortized through profits obtained from the sale of timber. Furthermore, these costs were so great that a number of years of profitable logging had to occur before the debt and operating costs were amortized and the entire operation showed a profit (Brown 1923, 1934, 1936, 1947; Bryant 1913; Catton 1976; Dunbar 1970; Karamanski 1984).

Thus, the situation that occurred with the advent of railroad logging was one in which the resource base expanded significantly as did the technology avaliable for exploitation. These developments, while producing an increase in volume and profits, were offset by greatly increased start up and operating costs. The critical factor determining the overall profitability of the operation was the abililty of the logging operators to continue in a given area for a number of years. Furthermore, while the timber resources may have at first appeared infinite to Upper Peninsula loggers, they were certainly aware that this was not the case. A prime and ready example of this was the decline of the Lower Peninsula pineries occurring at this time. Thus, the abililty to control access to timber resources became a key overarching organizational problem associated with the advent of railroad logging (Brown 1923, 1934, 1936, 1947; Bryant 1913; Catton 1976; Dunbar 1970; Edwards et.al. 1972; Karamanski 1984; Lovis et.al. 1978).

The considerations above lead to the followling hypothesis.

Hypothesis 17: With the advent of railroad logging and the inherent shift in technology/transport there was a shift in transport cost structure. The results of this in terms of the organization of the logging frontier should be seen in the increasing concentration of timberland ownership into the hands of fewer individuals/institiutions.

Summary

In this chapter a model of the industrial frontier was developed and series of hypotheses were derived from it to be tested in an analysis of the Upper Peninsula logging frontier. This was accomplished through a review and evaluation of recent work by archaeologists in the field of frontier studies, including some executed within the study area for this research. The characteristics of an industrial frontier were then discussed based on their contribution to the spatial, temporal or organizational dimensions of human activity. During the course of these discussions arguments were made as to how each characteristic might be identified and examined on the logging frontier. The results of these discussions were a series of hypotheses which will be tested using data from Michigan's Upper Peninsula. Because the industrial frontier was exclusively production oriented and existed within the capitalist system, these hypotheses focused mainly on production related factors. Moreover, a preliminary examination of available data revealed that it was most rich in areas related to production. Having established the scope of the analysis through the formulation of hypotheses, our attention will now focus on the analysis itself.

CHAPTER V

DATA SOURCES AND METHODOLOGY

This chapter presents the analytical methods used to evaluate the hypotheses posed in Chapter IV. Oriented toward the examination of the locational, temporal and organizational facets of the Upper Peninsula logging frontier, the hypotheses will be approached through a variety of methodologies that draw upon both archaeological and historical of data. The variables by which the data will be measured and the analytical methodologies are presented.

Data Sources

Archaeological Data

Archaeological data deals with the physical manifestations of human activity in the spatio-temporal continuum. Generally, this data focuses on the physical location of the site, the relationship among sites, the relationship between a given site and its natural setting, and the temporal framework within which these relationships occur. In this research, archaeological data is drawn from the United States Forest Service site files for the Hiawatha National Forest and from Ghost Towns of Michigan (Dodge 1973). These data sources may be used to address a number of the hypotheses posed in Chapter IV. Before this can occur, however, the data sources must be examined to determine if they possess any unique characteristics which would render them more or less suitable for the purpose at hand.

The first question that can be asked of the archaeological sources focuses on their ability to supply data about frontier settlements. Of the three types of settlement hypothesized to occur on industrial frontiers, camps can be identified most unambiguously from the available archaeological site file data. This data about logging camps is based on three sources: informants, field survey and site examination, and historical and arcaheological overviews.

Over the last decade, archaeologists have interviewed informants who were alive during or shortly after the years of the study period and have entered this informant into the U.S. Forest Service site files. This information has been of variable quality, depending on the accuracy of the informant's memory, the level of his/her involvement in the logging industry and related factors.

Field survey and site examination provide the second source of information. The Hiawatha National Forest has been one of the most extensively surveyed areas in Michigan and these investigations have produced a wealth of information about various kinds of archaeological sites. Many of these surveys were conducted prior to timber sales, acquisitions, or other forms of land exchange and in some instances, were performed to verify informant reports and/or local historical information.

A number of historical and archaeological overviews of the Hiawatha National Forest have been prepared over the past ten years (Karamanski 1984, Lovis 1979, Martin 1977). These have involved examinations of the archaeological sites and history of the Hiawatha National Forest to place these into a broader spatio-temporal perspective. The most recent of these studies (Karamanski 1984) was devoted entirely to the historic period. The author consulted a number of primary documents including timber cruise reports and company records, county and state archival materials, and a number of other privately held sources. This study provided information about new sites and supplemented information about logging camps already on file. Moreover, in recent years the Hiawatha National Forest archaeologist has been conducting title searches, which have produced a wealth of temporal information about some of these sites.

Several assumptions were made about the quality of this data on logging camp location. First, it was assumed that locational information and associated environmental information was correct, especially if the locational information came from more than one source. It was also recognized that in some instances locational information might be incorrect or conflicting. In the case of former, the lack of alternative methods of verification dictated the acceptance of the locational specifications. While incorrect locations could produce abberations during the analysis, these can be filtered out with the available analytical procedures.

In the most common type of information conflict the site's township and range designation did not match the written directions to the site and/or the written description of the site's setting. This mismatch was usually the result of human error that occurred when the sites were plotted onto U.S. Forest Service maps and close inspection of the site form often revealed the cause of the conflict. Typographical errors, for instance, could cause the discrepancies. Common typographical errors included digit reversal (i.e. section 21 versus section 12; FR 2317 versus FR 2371; etc.), the incorrect translation of abbreviations from field notes (i.e. m for miles instead of meters), and a switch of letters in sub-section designations (i.e. SW versus SE). The latter might also have been a field recording error. That is, operating near a subsection boundary, the survey crew could have mistakenly assigned the site to an adjacent unit. Alternatively, the site might have crossed the sub-section boundary and a field judgment was made to assign it to one or another units, while written description indicated that it overlapped the boundary. These discrepancies were resolved through a re-examination of the site form and the amended locational information was entered into the analysis.

The validity of the cultural/historical information presented on the site forms was weighted according to the the source(s) of that information. When information was verified by all of the sources discussed above, it was assumed to be correct and accepted at face value. In cases where the cultural/historical information on the site was derived from a single source that was a primary document (i.e. timber cruise reports, logging company records, title searches, etc.) it was also accepted at face value.

A more conservative approach was taken when the single source was either an informant report or field survey. In the case of the former, any associated cultural/historical information supplied by the informant was not included so as to avoid the possibility of informant bias or misinterpretation. This resulted in the site appearing in the analysis as a logging camp of unknown temporal and technological affiliation. In cases where the site was reported as a result of field survey, cultural/historical information was utilized only if the artifactual collection was deemed to be sufficiently large and diagnostic.

Site file records can also provide information on intermediate supply centers. However, the term intermediate supply center is an artificial definition imposed for analytical purposes. That definition is based upon a certain number and range of activities which should occur in all intermediate supply centers. To avoid the premature imposition of an artificial definition onto the data, all of the site file listings for settlements were categorized as potential intermediate supply centers. Later in the analysis the exact nature of these settlements was defined with a set of explicit criteria.

The other main source of information on intermediate supply supply centers was Ghost Towns of Michigan (Dodge 1973). Organized on a county by county basis, this reference provided the general location of settlements with respect to their distance along rail lines from major termini. It also provided a summary of the settlement composition in terms of the major economic activities and, for many of these settlements, occupation dates and duration of occupation. All the settlements listed as occurring during the study period were considered as potential intermediate supply centers. As with the information derived from the site files, the exact characteristics of these sites were defined elsewhere in the analyis.

Ghost Towns of Michigan (Dodge 1973) also provided information on entrepots. Again, to avoid the premature imposition of an artificial definition, all settlements were treated as potential entrepots. Later, settlements were sorted into their appropriate categories (entrepots, intermediate supply centers) before they were analyzed.

Maps were an additional, valuable data source. They were drawn from two sources: the 1975 U.S. Forest Service Class A Maps (1:31680) and the soil survey of the Hiawatha National Forest (Berndt 1977). These provided direct information on site identification since many of the settlements listed in Ghost Towns of Michigan (Dodge 1973) are also noted on the U.S. Forest Service maps. Moreover, they provided all of the information about spatial and environmental relationships among sites and between sites. Thus, they were a key data source serving as the vehicle through which simple site location was converted into meaningful archaeological data.

Historical Data

Historical data is that available in written form, which provides us with information about the characteristics of a given subject as understood by the author within his/her particular frame of reference. In this study, historical data were drawn from four sources: local/regional histories, autobiographies/biographies/reminiscences, topical studies, and the U.S. Census. The historical data obtained from these sources enabled the hypotheses relating to organizational, procedural, and temporal questions to be addressed. Moreover, the U.S. Census data supplemented the other quantitative information available about entrepots and intermediate supply centers.

Local/regional histories were used to deal with questions concerning the temporal framework within which the Upper Peninsula logging frontier developed and to address questions about the organizational and procedural components of the logging industry. Depending on when they were written, local/regional histories may contain overt or covert bias in their presentation of information. Examples of this would include those written to induce settlement or "development" of the region or those written to substantiate one of the many mythologies that had grown about the region.

Autobiographies, biographies or reminiscences compose the second source of historical data. These documents have various uses depending on the author and his/her particular frame of reference. Some, written by persons who actually worked in the lumber camps, provide information about daily life, work organization, etc. Others written by individuals who lived in the Upper Peninsula during the study period, but who had only indirect contact with the lumber industry provide only indirect evidence about logging camps. However, they do provide valuable information about other components of the logging frontier settlement system.

The third source of historical data were topical studies which examine a subject across space and time. These retain some of the advantages of focused information (i.e. autobiographies) while at the same time have the advantages of a broader perspective usually found at the regional level. These sources were useful in the study of certain procedures and organizational processes on the Upper Peninsula logging frontier as well as how these various procedures/processes changed through time.

The final source of historical data was the U.S. Census. This provided information about entrepots and intermediate supply centers which have survived to the present day, and which were not included in Ghost Towns of Michigan (Dodge 1973).

Variables

This section deals exclusively with the archaeological data used in this research. It describes how the variables used in this study were defined and recorded in preparation for quantitative analysis, beginning with some general observations common to all the variables.

One of the important aspects of this analysis was the role played by the U.S. Forest Service Class A Maps and the soil survey in the derivation of variables. Initially, using site file information, all sites were plotted on the appropriate Class A map. Every attempt was made to avoid the introduction of error when measuring distances. When a distance had to be measured, this was done by measuring from the center of the character representing the site to the destination. When some information about the soil association, general environmental features, etc. was required, the appropriate map from the soil survey was consulted. As with the Class A maps, sites were located on the soil survey as accurately as possible. Fortunately, this type of information had already been recorded on the site form for a number of sites. Such information was spot checked, especially if there were locational discrepancies, but was generally assumed to be correct.

The variables used in this research fall into two groups: nominal and continuous. These divisions occur with the three types of sites under consideration. Each variable, regardless of its type, is discussed below as to the way it was recorded, the way it was measured, and its contribution to the analysis. The discussion begins with those variables associated with camps and is followed by discussions of the variables associated with intermediate suppply centers and entrepots.

Camps

In addition to analytical variables, there were a number of entries which were used for identification purposes. A listing of variables, their column widths, acronyms and the various states for nominal variables can be found in Appendix A.

Site type

This entry distinguished among river drive, railway or unknown sites. The site type designation (SITTYP) is a single digit entry which classifies the site. This classification was based on information from the U.S. Forest Service site forms. A distinction between river drive and railway camps was made only when written documentation was present on the site form in addition to/instead of field examination information. This documentation occurred in several forms. The first of these was documentation (e.g. timber cruise reports, company records, etc.) associating the site with a particular lumber company and/or with a particular time span. This was possible because certain lumber companies operated exclusively river drive operations, while others were exclusively railway operations.

Sites which had limited documentation but which were located on rail lines as described by field survey, were classifed as railway sites. This classfication made the assumption that the site was built after the railway grade was built, rather than the railway grade being built through a pre-existing or abandoned site. Given the operating considerations of the logging industry and the lack of information to the contrary, such an assumption was warranted. However, to guard against too liberal an interpretation of such evidence, these sites were coded differently from those for which extensive written documentation was available, although they were used as a single group for analytical purposes.

Finally, sites for which there was no specific documentation or field survey information were classified as unknown. This classification meant there was evidence the site was a logging camp, but there was no evidence as to what type of camp it actually was.

Site size

The next variable was site size (SITSIZ). This was measured in acres and recorded to two decimal places, making the entire entry three digits in size. Information about site size was not uniformly available for the sites in the sample, but when it was available it came from two sources: field survey and timber cruise reports. Regardless of the measures used to report site size, these were all converted to acres for purposes of this analysis. In cases where site size was unknown, zero entries were used.

Soil phase

This variable was a nominal scale one representing the smallest soil grouping (SOLPHAS) into which the soil around the site could be classified. It was recorded in a three digit format. Many of the site forms already had this information entered on them. This information allowed hypotheses concerning drainage and site location to be addressed.

Soil series

This variable represented soil series (SOLSER) which was the next higher order soil grouping to which the soil in the preceding variable belonged. This was a nominal scale variable and was recorded in a two digit format. The values were obtained from the site form and the soil survey (Berndt 1977). This variable was used because the use of soil phase might introduce unwarranted complexity into the analysis. This variable dealt with the same hypotheses as soil phase, but at a more general level.

Slope

This was a nominal scale variable (SLOPE) entered in a single digit format. The orginal measurements were obtained from the site forms and/or the soil survey, which recorded the slope in terms of percentage intervals. Each of these intervals was assigned a nominal scale code. This variable enabled hypotheses dealing with slope, elevation, etc. to be addressed.

Distance to nearest water

This variable (DINEWAT) was continuous and measured in miles. It was recorded to two decimal places, with the total entry being three digits in length. It was measured by taking the distance from a logging camp to the nearest water source as represented on the U.S. Forest Service Class A Maps. It allowed hypotheses dealing with distance to nearest water to be addressed.

Distance to nearest driveable water

This variable (DIDRWAT) was continuous and measured in miles. It was recorded to two decimal places, with the total entry being three digits in length. It was measured by taking the distance from a given logging camp to the nearest driveable water, which was defined so as to include a major river, which flow into a major river, lakes linked by streams to a major river, etc. In essence, the variable sought to measure the distance between the camp and the nearest point where it connects to a dendritic river system which ultimately led to either the Lake Michigan or Lake Superior coast. The presence of dams on some of the streams and rivers served as corroborative evidence as to what was driveable water. The information provided by this variable enabled hypotheses relating to transportation and communication to be addressed. Also, it allowed distinctions between river drive and railway camps to be made.

Orientation of nearest driveable water

This variable (ORDRWAT) was measured on the nominal scale and was recorded as a single entry reflecting the orientation of the nearest driveable water with respect to camp location. Specifically, it measured whether the nearest driveable water was downslope from the camp, upslope from the camp or at approximately the same elevation of the camp. This variable served to characterize railway and river drive camps.

Type of nearest water

This variable (TYPPNWAT) was nominal scale and was recorded as a single digit entry representing the type of water nearest the camp. It contributed to the general understanding of camp siting factors.

Distance to the nearest camp of the same type

This variable (DNSAMCAM) was continuous and was measured in miles. It was recorded to two decimal places, with the total entry being three digits in length. It was measured by taking the straight line distance between a given logging camp and the next nearest camp of the same type as plotted on the U.S. Forest Service Class A maps. This variable enabled camp location to be more clearly defined with respect to cultural as well as natural criteria.

Distance to the nearest camp of a different type

This variable (DNDIFCAM) was continuous and was measured in miles. It was recorded to two decimal places with the total entry being three digits in length. This variable was measured by taking the straight line distance between a given camp and the nearest camp of a different type, including those camps of unknown type. As with the preceding variable, this variable allowed inferences to be made about the cultural criteria of camp location.

Type of the nearest site of a different type

This variable (TYPNDIC) was nominal and was recorded by a single place entry. It was designed to record the site type from which the preceding variable was derived. In this way, a distinction could be made as to whether the nearest site of a different type was unknown or was from a known different historical/technological era. This allowed the information obtained from the previous variable to be used with greater precision.

Distance to the nearest swamp

Measurements for the distance to the nearest swamp (DNSWAM) were made in miles and recorded to two decimal places. The entire entry was three digits in length. This measurement was made by taking the straight line distance from a given logging camp to the nearest edge of a swamp. This variable allowed distinctions between river drive and railway camps to be made as well as provided evidence of seasonality.

Elevation

Elevation (ELEV) was measured in feet and was recorded as a four digit entry. It was measured using the topographic contours on the U.S Forest Service Class A Maps. This variable, as with the three related ones that follow, was aimed at providing further information about the natural and cultural criteria of site location. Also, it was useful in distinguishing betweeen river drive and railway camps.

Highest elevation within one and a half miles

The highest elevation within one and a half miles (HIEL) was a continuous variable measured in feet. It was recorded as a four digit entry. It was measured using the elevation contours on the U.S. Forest Service Class A Maps within a one and a half mile radius of each camp.

Lowest elevation within one and a half miles

The lowest elevation within one and a half miles (LOEL) was a continuous variable measured in feet. It was recorded as a four digit entry. It was measured using the elevation contours on the U.S. Forest Sevice Class A Maps within a one and a half mile radius of each camp.

Relative elevation of the site within a one and a half mile radius

This variable (RELEL) was a nominal scale, entered as a single digit. It was a measure of the site elevation with respect to the other elevations within a one and a half mile radius around the camp. It was coded for highest, lowest or intermediate elevation, and used to address hypotheses about the camp's setting.

Distance to the nearest U.S. Forest Service or county road/trail

The distance to the nearest U.S. Forest Service or county road/trail (DINRD) was a continuous variable measured in miles. It was recorded to two decimal places, with the entire entry being three digits long. This was measured by taking the shortest straight line distance from each camp to the nearest U.S Forest Service or county road/trail. In cases where the camp was located on a road/trail, the distance was entered as 0.01. This was done to indicate that the site was located on a road/trail. An entry of 0.00 was reserved for those sites over 9.99 miles from a road/trail. Using 0.01 introduced some bias into the measurement, however, this only amounted to 52.8 feet and was insignificant. This variable was chosen because many of the roads/trails are built over or adjacent to the grades of former logging railroads. It should be noted that when the road/trail was definitely identifiable as an old railroad grade, this distance measure was entered under the next variable as well as this variable. This measure was used to distinguish between railway and river drive camps.

Distance to nearest known railway

The distance to the nearest known railway (DINRWAY) was a continuous variable measured in miles. It was recorded to two decimal places, with the total entry being three digits long. It was measured by taking the straight line distance from each camp to the nearest known railway. In instances where the camp was located on a rail line, this distance was entered as 0.01 miles. Although this entry was not exact and introduced an error factor (52.8 feet) into the analysis, this was not significant. This variable aided in distinguishing river drive from railway camps and was useful in examining certain locational characteristics of railway camps.

Occupation date

Occupation date (OCCUP) was a nominal scale varible recorded as a six digit entry. This was recorded for those sites where there was docummentary information about a single occupation date or a duration of occupation. It was recorded using the last three digits of the occupation date or dates (e.g. for 1895-1910, 895910; for 1905, 905905). Sites for which there were no specific dates availabvle were coded as 333333. This variable was used to establish a temporal framework for the analysis, which was then used to address a number of individual hypotheses.

Relative occupation

Relative occupation (RELOC) was a nominal scale variable recorded in a single digit format. This was measured as late nineteenth century, late nineteenth century/early twentieth century, and early twentieth century.

It was recorded for all sites where there were definite occupation dates that could be entered under the preceding variable. This variable, used by itself and in conjunction with the preceding one, aided in the establishment of a temporal framework for the analysis, which was then used to address a number of hypotheses presented earlier.

Intermediate Supply Centers and Entrepots

Intermediate supply centers and entrepots were the other two types of sites present on an industrial frontier. These sites were settlements of a larger scale with more diversified activities than the camps, which presented some problems since they must be distinguished from one another prior to the analysis. In general, entrepots were expected to be more diverse, larger and of longer duration than intermediate supply centers. Moreover, there were some characteristics unique to each which proved useful in making final distinctions between the two. The discussion which follows addresses variables that were pertinent to both types of sites, as derived from Lewis (1984)(Appendix B).

A priori site type

This variable (APRIOR) was a nominal scale entry one digit long. It represented an intuitive, a priori assessment on the part of the analyist as to whether the settlement was an intermediate supply center or an entrepot. As such, it was not utilized in the main part of the analysis, but was used to organize and characterize individual settlements in the analysis.

Distance to the nearest settlement

This variable (DNST) was continuous and was measured in miles. It was recorded to two decimal places, with the entire entry being four places in length. It was a straight line measure of the distance from one settlement to the next nearest settlement in the sample. It provided information about the spacing of settlements on the logging frontier.

<u>A priori definition of the nearest settlement</u>

A priori definition of the nearest settlement (APPRNSET) was a nominal variable one place long and was the intuitive assessmennt of settlement type of the nearest settlement. It was used only for comparative purposes.

<u>Distance to nearest water</u>

Distance to the nearest water (DINEWAT) was a continuous variable measured in miles. It was recorded to two decimal places, with the entire entry being three places long. It was a straight line measure of the distance from the settlement to the nearest water. It was used in determining the general setting around the settlement and its potential association with transportation/communication networks.

<u>Type of nearest water</u>

The types of nearest water (TYPNWAT) was a nominal scale variable recorded to one place. It recorded the type of water most closely associated with each settlement. It aided in the understanding of the settlement's location, its place within a transportation/communication system, and was useful in distinguishing intermediate supply centers from entrepots.

<u>Distance to nearest railway</u>

This variable (DINRWY) was continuous and measured in miles. It was recorded to two decimal places, with the entire entry being three digits long. It is a straight line measurement of the distance from the settlement to the nearest railway. In the event the settlement was located on a rail line, this variable was entered as 0.01, as was done with logging camps. This variable aided in the understanding of a given settlement's participation in a transportation/communication network.

Type of nearest railway

The type of nearest railway (TYPNRW) was a nominal scale variable recorded in one digit. This variable defined the type of rail line to which the measurement in the preceding variable was taken. Choices included logging railway, main line railway or both (i.e. a junction). This variable allowed for the refinement of our understanding of the way each settlement participated in the transportation/communication network.

Number of rail lines within two miles

This variable (NORWYL) was continuous and recorded to two places. It measured the number of rail lines within a two mile radius of each settlement. Individual branches were counted as individual rail lines even though they eventually fed into fewer, higher volume lines. This variable provided further information about transportation as well as enabling intermediate supply centers to be distinguished from entrepots.

Terminus of a logging railway

This variable (TRLGRWY) was nominal scale and indicated whether or not the settlement was at the terminus of a logging railway. It provided information about the froniter transportation system.

Terminus of a main line railway

As with the preceding variable, this variable (TRMNRWY) was nominal scale and indicated whether or not the settlement was the terminus of a mail line railway.

Port facilities

Port facilities (PORT) was a nominal scale variable and was designed to indicate whether or not the settlement contained port faciilities. This variable distinguished between intermediate supply centers and entrepots.

Direct link to homeland

This variable (DIRLKHM) was nominal scale and was designed to measure whether or not the settlement was in direct contact with the homeland. Direct contact meant that shipments/messages from the settlement did not pass through any other settlement, whether smaller or larger, prior to being received by a center in the homeland. This variable aided in distinguishing between intermediate supply centers and entrepots.

Distance to nearest verifiable logging camp

This variable (DINLCMP) was continuous and recorded to two decimal places. The entire entry was four places long. It measured the straight line distance from the settlement to the nearest verifiable logging camp.

Type of nearest verifiable logging camp

This was a nominal scale variable (TYPNLCMP) and was measured whether or not the nearest logging camp was a river drive, railway, or unknown camp.

Distance to nearest U.S. Forest Service road or county road

The distance to the nearest U.S. Forest Service/county road (DINRD) was continuous and measured in miles. It was recorded to two decimal places and the entire entry was three places long. It was a straight line measure of the distance from the settlement to the nearest U.S. Forest Service/county road. Given that these roads frequently paralleled or were built on top of former track beds, this variable provided additional information about railways associated with the settlement.

Occupation date

Occupation date (OCCUP) was a nominal scale variable recorded to six places. It was used when a definite occupation date or dates could be assigned to a given settlement. The first three digits represented the earliest known occupation date and the last three the latest. In cases where only one date was available, it was repeated (i.e. 1895-1910, 895910; 1910, 910910). For settlements where there were no specific dates available, this variable was entered as 333333.

Relative occupation

Relative occupation (RELOC) was a nominal scale measure recorded as a one digit entry. It assigned a general occupation (late nineteenth, early twentieth, late nineteenth/early twentieth century) date to the settlement. In cases where definite dates were available both the occupation date variable and this variable were utilized. In instances where only a relative date was available, the occupation date variable was entered as 333333 and this variable was used to provide information on the temporal framework of the settlement, providing such information could be inferred from available data.

The remaining variables dealt with the types of activities and population associated with intermediate suppply centers and entrepots. They were used primarily to distinguish between the two hypothesized types of settlement and then to define the activity set associated with each. They are discussed below in the same fashion as those above. However, their purpose for this research has been presented in this paragraph and will not be repeated for each variable. Unless otherwise noted, all of these variables were single place entries and were continuous.

Railway station

This variable (RWYSTA) measured the number of railway stations present in the settlement.

Other railway facilities

This variable (ORWYFAC) measured the number of railway facilities, other than stations, present in a settlement. These might include roundhouses, repair shops, etc. This variable was recorded to two places.

Lumber mills

The lumber mills variable (LUMMLS) measured the number of lumber mills present in the settlement. These mills were not limited to sawmills, but could also include shingle mills, stave mills, etc.

Warehouses

The warehouse variable (WARHS) measured the number of warehouses present in the settlement.

Logging equipment

This variable (LGEQP) measured the number of establishments selling logging equipment in the settlement.

General store

The general store variable (GNLSTO) measured the number of general stores operating in the settlement.

Post office

This variable (PO) recorded the number of post offices present in the settlement.

Saloon/hotel/brothel

The saloon/hotel/brothel variable (SHOWHOR) measured the number of these establishments in the settlement. In frontier settings these establishments were often one and the same, whether officially listed as such or not. Therefore, in measuring them for this analysis it was decided to lump them into one variable. This variable was recorded to two places (Murphy 1983).

Specialty retail

This variable (SPCRET) measured the number of retail establishments, other than general stores, present in the settlement.

Real estate brokers

The real estate broker variable (RELEST) measured the number of real estate brokers/establishments operating in the settlement.

Retail/wholesale timber sales

This variable (REWHTIM) measured the number of timber brokers operating witin the settlement.

Telephone

The telephone variable (TELPH) was nominal and indicated whether or not the settlement was on a telephone service.

Telegraph

The telegraph variable (TLGRH) was nominal and indicated whether or not the settlement had telegraph service.

Banks

The bank variable (BANK) measured the number of banks in the settlement.

Schoo1

This variable (SCHOOL) measured the number of schools and/or teachers in the settlement.

Religious

This variable (RLFAN) measured the number of religious facilities in the settlement.

Finished wood manufacturers

This variable (FINWDMN) measured the number of finished wood manufacturers in the settlement. These establishments were involved in the manufacture of hardwood products that were usable without further processing. As such, they were examples of the limited manufacturing that could occur on the industrial frontier. Examples of these products included furniture, bowls, tableware, etc.

Physician/dentist/pharmacy

This variable (MEDIC) measured the number of these health care providers in the settlement. In frontier settings these roles often overlapped, as with the saloon/hotel/brothel variable, and for this reason they have been lumped together for this analysis.

Lawyers

The lawyer variable (LWYR) measured the number of lawyers in the settlement.

Hospital

This variable (HOSP) measured the number of hospitals present in the settlement. This variable was measured separately from that of physicians/dentists/pharmacists since a hospital represents a significant community investment in a physical plant and operating procedures. Such a communilty investment was qualitatively and quantitatively different from a physician/dentist in private practice. Thus, the presence of a hospital would be a significant discriminator between intermediate supply centers and entrepots.

Local/state/federal government

This variable (LSFGOVT) measured the number of governmental functions performed by the settlement. It should be noted that the federal government component of this variable did not include post offices, which were measured by a separate variable.

Heavy industry

The heavy industry (HIND) variable recorded the number of heavy industries operating in the settlement. Excluded from this variable were those heavy industries associated with the logging industry, which were measured elsewhere. Examples of industries which were included in this variable were iron foundries, shipbuilding, charcoal kilns, etc.

Light industry/service

The light industry/service (LIND) variable was designed to measure the number of light and service industries in the settlement. It was recorded as a two place entry. Examples of activities included in this variable were blacksmith shops, coopering, barbershops, tailors, etc.

Fishing related

The fishing related variable (FISH) measured the activities associated with commercial fishing in the settlement. In addition to fishermen, this variable also measured retail and wholesale fish brokers, processing activities, etc.

Total manufacturing

This variable (TOTMNF) was the sum of all manufacturing activities occurring in the settlement. This included lumber mills, heavy industry, light industry and fishing. This variable was used because for some settlements only a measure of total manufacturing establishments was available. Therefore, for the remainder of the settlements it was necessary to collect manufacturing establishments into one variable so that a greater number of settlements could be compared. This variable was recorded to two places. Given that entrepots were expected to have a larger total manufacturing component than intermediate supply centers, this variable was important in distinguishing between the two types of settlements.

Population 1900

This variable (POP00) was the population for the given settlement taken from the 1900 census. In instances where the population was recorded only to township level, this was used as the best approximation. If more than one settlement existed in a township, and township data was all that was available, the population was divided equally among the settlements. This variable was recorded to four places.

Population 1910

Population 1910 (POP10) was the population for the given settlement taken from the 1910 census. The same considerations apply in this case as for the preceding census data.

Population 1920

Population 1920 (POP20) was the population for the given settlement taken from the 1920 census. The considerations discussed above also apply in this case.

Methodology

The discussion of variables in the previous section established the dimensions along which the archeological data research were analyzed. This section introduces some of the methodologies which were used to evaluate this data, discusses sampling considerations, and describes the facility and software employed in the analysis. In some instances specific hypotheses were evaluated with methodologies that were uniquely suited to the questions posed by the hypothesis. In these cases a discussion of the methodology was presented with the evaluation of the hypothesis (Chapter VI).

Sampling Considerations

It was obvious from the outset of this research that sampling would be one of the thornier issues to be addressed prior to beginning the analysis. The nature of the site file data precluded it from being considered a probability based sample, since most of the archaeological work in the area resulted from contract projects. Data derived from overview projects might be considered to be based on a 100% sampling fraction. However, since each additional overview has turned up more sites, there was reason to believe that the archaeological record was not yet fully represented in the United States Forest Service site files (Alder and Roessler 1972; Downie and Heath 1974; Haggett, Frey and Cliff 1977; Hammond and McCullagh 1974; Karamanski 1984; Lovis 1979; Mueller 1975).

In the case of field investigations, the project areas were defined on the basis of management considerations and not to ensure representative coverage of the West Unit of the Hiawatha National Forest. Although within these project areas probability based sampling might have been conducted, taken together these studies cannot be said to constitute a probability based sample of the study area (Alder and Roessler 1972; Downie and Heath 1974; Haggett, Frey and Cliff 1977; Hammond and McCullagh 1974; Lovis 1979; Martin 1977; Mueller 1975).

Nonetheless, there were a large quantity of logging camp sites in the West Unit of the Hiawatha National Forest. The entire sample for this research consisted of 444 logging camp sites, broken down as follows: river drive sites (45), railway sites (149), and unknown sites (250). Statistically speaking, each of these sub samples was large enough for processing with large sample techniques, even though the sample itself was judgment rather than probability based. Moreover, since the variables chosen for this research were both nonimal and continuous, non-parametric statistics will be employed frequently, thereby lessening the effect of a non-probability based sample. Parametric statistics were also used, since they supplied interesting and necessary ways of examining the data. However, in using these, interpretations were made with caution since they ultimately were predicated upon data being collected in a probability based fashion (Alder and Roessler 1972, Downie and Heath 1974).

Facility, Hardware and Software

This analysis was conducted through the University Computer Center of the State University of New York at Binghamton. It was preformed on an IBM 4381 system operating under VM with CMS for interactive use. Access was obtained via Digital Equipment's DECMate II network, which was established on campus for communication and routine word processing activities. Programs used to analyze the data were drawn exclusively from those available in the SAS package. These included not only those general procedures discussed below, but also those which were used only once or twice within the context of a specific hypothsis. Procedures were run completely on an interactive basis, with data being stored on a disk within the main computer facility. Printed output was obtained using the work station printer attached to the DECMate II terminal (SAS Institute 1983, 1985a, 1985b).

Analytical Procedures

After proof reading the data that had been entered into permanent storage to ensure its coding, formatting, etc. were correct, a number of procedures were executed to determine the basic structure and characteristics of the data. The first of these was to obtain simple frequency information for each of the variables. This information was used to look for patterns in the raw data that might be used directly with one of the hypotheses, to suggest ways in which the results could be re-organized in a more meaningful fashion or to suggest different and/or more sophisticated procedures that might be performed on the data.

In addition to examining the tables generated by the program above, procedures were executed to produce two types of graphic information: histograms (CHART) and cross-plots (PLOT). The CHART procedure was executed to produce histograms for all variables, while the plot procedure was used only for those pairs of variables where there was valid reason to believe that some relationship existed. The results of these procedures were utilized directly to deal with some of the hypotheses. They were also examined to ascertain if other and/or more sophisticated procedures might be performed to generate additional knowledge about the data.

Throughout the research, simpler descriptive statistics were employed most frequently to address the hypotheses, usually in the form of simple frequency tables and their associated histograms. Cross tabulations were also employed in this fashion, for both nominal and continuous data. The reason for focusing on these simpler measures was because the sample of sites used in this research, while large, was derived non-probabilistically (Alder and Roessler 1972, Downie and Heath 1974).

Parametric statistics were used, in spite of having a non-probability based sample, because of the information they provided about the continuous variables used in the study. In these instances, attention was paid to the normality of distribution for the particular variable under analysis, since parametric stastics also operate under the assumption of normal distribution. In cases where the observations for the particular variable deviated only slightly from normality, the results of the parametric statistics were utilized directly. In cases where the deviation from normality was large, attempts were made to transform the variables to another scale of measure to attain normal or near normal distribution prior to further analysis (Alder and Roessler 1972, Downie and Heath 1974).

Summary

The data from this research were drawn from both archaeological and historical sources. The historical data were used to evaluate hypotheses in a subjective fashion, while the archaeological data were analyzed quantitatively. In the case of the archaeological data, two sets of variables were formulated to deal with questions posed about the two overall groupings of sites (logging camps, intermediate supply centers/entrepots) found on the logging frontier. These variables were both nominal scale and continuous scale. Statistical manipulations of these variables were kept relatively simple, because the data for this research were not obtained probablistically. All statistical operations, data storage, etc., were conducted at the Computer Center of the State University of New York at Binghamton.

AN INVESTIGATION OF THE SPATIAL, TEMPORAL, AND ORGANIZATIONAL PROCESSES OF THE INDUSTRIAL FRONTIER: A CASE STUDY FROM THE UPPER PENINSULA OF MICHIGAN

By

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CHAPTER VI

RESULTS

The analysis results are discussed on a hypothesis by hypothesis basis in the order of their introduction in Chapter V. Quantitative analyses addressed many of the hypotheses while others were analyzed in a qualitative/subjective fashion. For analytical purposes, the camp sample was divided into three subgroups based on site type: unknown sites (250), river drive sites (45), and railway sites (149).

Hypothesis 1

All camps, regardless whether they are associated with river drive or railway logging, should be located on fairly level, well drained land.

Hypothesis 1 was evaluated through reference to the three variables dealing with soils and slope: soil phase (SOLPHAS), soil series (SOLSER), and slope (SLOPE).

The initial run of the FREQUENCIES program produced tables for each of the 193 soil phases, 75 soil series and 9 slope categories. Since these large tables obscured the data, the entries were condensed into smaller groups. Moreover, since soil phase and soil series duplicated information, only the soil series was used to address this hypothesis.

The soil series variables were placed into two groups: well drained soils and poorly drained soils, based on information obtained from the soil survey (Berndt 1977). In the well drained group, soils were characterized as well to moderately well drained, level to steeply sloping, composed of sandy material with rapid to moderate permeability. This group's soil series included: Blue Lake, Bohemian, Croswell, Duel, East Lake, Kalkaska, Karlin, Keweenaw, Kiva, Limestone Bedrock, Longrie, Onota, Rousseau, Rubicon, Steuben, Summerville, and Wallace. The soils of the poorly drained group were somewhat poorly to very poorly drained, level to depressed in slope, contained loamy or organic soils either on the surface or immediately beneath a surface layer of sand, and were variably to slowly permeable depending on the existence of a surficial layer of sand over the loamy/organic soil. The soils in this group were: Alluvial, Au Gres, Burt, Carbondale/Lupton, Cathro/Tacoosh, Charlevoix, Chippeny, Dawson/Greenwood, Ensley, Iosco, Kawbagwam, Kinross, Munising, Nahma, Roscommon, Saugatuck, Skanee, Tawas, and Trenary.

The original nine categories for the slope (SLOPE) variable were collapsed into three: 1-6 per cent, lower; 7-18 per cent, middle; and over 18 per cent, upper. Although this reduced some of the variability in the sample, it eliminated overlapping categories and reduced confusion.

Drainage and Soil Type-River Drive Sites

As in Table 1 illustrates, the river drive sites generally corresponded to the Hypothesis 1 predictions regarding soil drainage with 66.4 per cent (30) of the river drive sites located on well drained soil and 28.9 per cent (13) located on poorly drained soil. Of all the groups, the river drive group had the lowest percentage of sites corresponding to what was predicted by Hypothesis 1. Since river drive camps were designed and sited only for winter use, when the ground was frozen, poor soil drainage was less significant. By the time the spring thaw brought drainage problems the camps would be abandoned as the river drive began. Sites with poorly drained soil also provided uncomfortable, unsanitary conditions during the fall movement of supplies and loggers into the areas. Why these conditions were acceptable for some sites is probably related to the perception that they were temporary, and hence tolerable for the short term in light of the site's potential.

TABLE 1

SOIL CHARACTERISTICS BY SITE TYPE

Site Type	Soil Group	Number	Percentage
River Drive Camps	Well drained	30	66.4
	Poorly drained	13	28.9
	Unknown	2	4.5
Railway	Well drained	128	87.0
	Poorly drained	18	12.2
	Unknown	1	0.8
Unknown	Well drained	196	78.4
	Poorly drained	49	19.6
	Unknown	5	2.0

Drainage and Soil Type-Railway Sites

Among railway sites, 87 per cent satisfied the conditions put forth in Hypothesis 1, while only 12.2 per cent failed to do so. This was generally expected given the potential for their year round use and the constraints of railway construction. Flat, well drained soil ensured that they were built and used under optimal cost considerations since poorly drained areas required costly filling and stabilization. Thus, it was more cost effective to lay more track over optimal terrain than less track over terrain which required extensive modification for construction. The 12.2 per cent of the sites which failed to satisfy Hypothesis 1 probably reflected the variation expected in any sample. They could represent sites which were in a unique setting or which were designed for winter use only.

Drainage and Soil Type-Unknown Sites

The unknown group also satisfied the conditions put forth in Hypothesis 1 with 78.4 per cent of the sites located in well drained settings and 19.6 per cent in poorly drained settings. This group was not expected to satisfy the conditions of Hypothesis 1 to the same extent as the other groups because the group was, by definition, unknown and as such represented an amalgm of river drive and railway sites. Furthermore, although the sites in the unknown group were supposed to be logging camps, it was possible that non-logging camp sites were included because of an overall sparseness of data for this group. This would result in greater than expected variation in the group. Whether or not this group contains non-logging camp sites cannot be determined at this point.

Slope

In addition to proposing that the area around logging camps should be well drained, Hypothesis 1 also maintained that the area should be fairly level. To investigate this, the three slope variable categories were examined (0-6 per cent, lowest; 7-18 per cent, middle; over 18 per cent, upper).

Slope-River Drive Sites

River drive camps conformed to the prediction in Hypothesis 1 regarding slope. The largest number of sites (35/78 per cent) occurred in the 0-6 per cent slope range indicating that these sites were constructed in level or only very slightly elevated places. The remainder (10/22 per cent) occurred in the 7-18 per cent range. While the upper end of this range is fairly steep, the lower end is at a level close to that of the lowest range. Since there were no sites in the lowest part of the middle range, the river drive camp sample fell into two, fairly distinct slope intervals. The first contained the greatest number of sites, was level, and conformed to the propositions put forth in Hypothesis 1. The second interval (containing fewer sites) was steeper and might not correspond to the conditions set forth in Hypothsis 1. However, since the majority of sites (78 per cent) satisfied the propositions put forth in Hypothesis 1, the river drive sample may be said to do so as a whole.

TABLE 2

SLOPE BY SITE TYPE

Site Type	Slope Interval	Number	Percent
River Drive	Lower (0-6%)	35	78
	Middle (7-18%)	10	22
	Upper (over 18%)	0	0
Railway	Lower (0-6%)	108	72.4
	Middle (7-18%)	35	23.4
	Upper (over 18%)	4	2.6
	Unknown	2	1.3
Unknown	Lower (0-6%)	168	67.2
	Middle (7-18%)	68	27.2
	Upper (over 18%)	9	3.6
	Unknown	5	2.0

Slope-Railway Sites

The railway camp sample also satisfied the slope prediction of Hypothesis 1 with 72.4 per cent of the sites occurring in the 0-6 per cent slope interval. Thirty-five (23.4 per cent) of the sites were in the 7-18 per cent slope interval. Yet, while the railway camp sample satisfied the slope conditions of Hypothesis 1, it did so to a lesser degree than expected. Hypothesis 5, which addresses the relationship of location and site considerations will further examine this phenomenon.

Slope-Unknown Sites

The unknown sample conformed to Hypothesis 1's conditions, although to a leser degree than the other samples (67.2 per cent of the sites were in the 0-6 per cent slope interval). Sixty-eight (27.2 per cent) of the sites fell into the 7-18 per cent slope interval. The fact that this sample probably contained river drive and railway camps as well as sites that were not logging camps explains the lower (in comparison to the other two samples) conformity.

Slope, Drainage and Soil Type

The final analysis of Hypothesis 1 examined soil and slope interaction within each of the samples. A cross tabulation of the data for each of the samples showed how each sample was simultaneously distributed across soil groups and slope intervals (Table 3).

TABLE 3
CROSSTABULATION OF SOIL GROUP WITH SLOPE INTERVAL

RIVER DRIVE

		Slope Interval			
		Lower	Middle	Upper	
Soil Group	Well Drained	21(46.36%)	10(22.2%)	0	
	Poorly Drained	14(31.1%)	0	0	14
		35	10	0	45

X^2 = 5.77 (2X2 table)
df = 1
X^2(.05) = 3.84

RAILWAY

		Slope Interval			
		Lower	Middle	Upper	
Soil Group	Well Drained	91(61.9%)	34(23.1%)	4(2.7%)	129
	Poorly Drained	17(11.5%)	1(0.6%)	0	18
		108	35	4	147

X^2 = 4.04 (2X2 table)
df = 1
X^2(.05) = 3.84

UNKNOWN

		Slope Interval			
		Lower	Middle	Upper	
Soil Group	Well Drained	122(49.8%)	65(26.5%)	9(3.7%)	196
	Poorly Drained	46(18.8%)	3(1.2%)	0	49
		168	68	9	245

X^2 = 15.1 (2X2 table)
df = 1
X^2(.001) = 10.83

River Drive-Slope, Drainage and Soil Type

The largest group (46.36 per cent) of river drive sites were located in areas that were well drained and in the lower slope interval. The next largest group (31.1 per cent) of sites had poor drainage and were located within the lower slope interval. The remaining sites (22.2 per cent) occurred in settings that were well drained but in the middle slope interval. These results supported those obtained earlier in that the largest percentage of sites occurred in well drained, level settings. Although such sites were not in the majority for the river drive sample, they were the largest group produced from the cross tabulated sample.

The relationship between slope and soil was investigated to ascertain if it was significantly different from what would result from random processes. In this case, an appropriate statistic was chi square (X^2) which was used to test the hypothesis (H_0) that the pattern observed in the table occurred by chance (Alder and Roessler 1972, Reynolds 1984).

As can be seen from Table 3, a chi square test performed on the river drive table for soil and slope rejected the null hypothesis at the 0.05 level, indicating that the distribution of sites in the table could be attributed to non-random factors (Alder and Roessler 1972, Reynolds 1984). This further supported the Hypothesis 1 conclusions that the locations for river drive sites favored those areas that were well drained and level.

Railway Sites-Slope, Drainage and Soil Type

Most of the railway sites (61.9 per cent) occurred in well drained, level settings. The second largest percentage of sites (23.1 per cent) occurred in well drained settings, with slopes from the middle interval. The next largest percentage of sites (11.5 per cent) occurred in poorly drained, level settings. The remainder of the sites occurred at insignificant levels, restricting the chi square analysis to a 2X2 table that used the three cells with the largest entries (Alder and Roessler 1972, Reynolds 1984). The resulting chi square test was significant at the 0.05 level, indicating that the pattern for railway camps did not occur by chance.

Unknown Sites-Slope, Drainage and Soil Type

The largest percentage of unknown sites (49.8 per cent) occured in well drained, level areas, with 26.5 per cent in well drained areas with slopes in the middle range and 18.8 per cent being poorly drained and level. The remainder of the cell entries were insignificant. A chi square with a 2X2 table was performed to test the hypothesis that this pattern was random (Alder and Roessler 1972, Reynolds 1984). The results of the chi square test were significant at the 0.05 level, indicating that the observed pattern had very little probability of chance occurrence. This was in keeping with the results obtained for the other samples and with the conditions set forth in Hypothesis 1.

Summary-Hypothesis 1

Hypothesis 1 was addressed by individual examinations of soil characteristics and slope. The results supported, albeit at different levels, the argument that logging camps, regardless of type, occured in well drained, level settings. Hypothesis 1 also addressed the relationship between slope and soil characteristics within each subsample and the results supported the hypothesis. In conclusion, Hypothesis 1 was upheld by the data.

<u>Hypothesis 2</u>

All logging camps, regardless of whether they are associated with river drive or railway logging, should range from approximately one to two acres in size.

This hypothesis was examined in several ways, using a combination of metrical and graphic techniques. Since sites with no size data were eliminated from the analysis, each sample had a smaller number of sites available for analysis than in other hypotheses. It was also assumed that there was some underrepresentation of site size for logging camps, which was directly attributable to visibility problems encountered under field conditions (Table 4).

TABLE 4

DESCRIPTIVE STATISTICS FOR SITE SIZE

<u>River Drive Sites</u>

N = 9	Range = 0.12 - 3.03
Mean = 1.39	Median = 1.34
Standard deviation = 1.09	
Skewness = 0.40	
Kurtosis = -1.20	

<u>Railway Sites</u>

N = 54	Range = .06 - 8.73
Mean = 1.82	Median = 0.94
Standard Deviation = 2.03	
Skewness = 1.73	
Kurtosis = 3.05	

<u>Unknown Sites</u>

N = 24	Range = 0.11 - 3.27
Mean = 0.93	Median = 0.83
Standard Deviation = 0.79	
Skewness = 1.53	
Kurtosis = 2.39	

River Drive

The river drive site sample contained nine site size observations usable for this analysis. Although this sample size is quite small for ordinary statistical analysis, the analysis proceeded with this factor in mind. These observations generated a mean site size of 1.39 acres which fell within the range predicted by Hypothesis 2. The standard deviation about the mean was 1.09 placing values for two or more standard deviations below the mean outside of the sample range and into the range of negative numbers. This indicated that the sample was not normally distributed. A skewness value of .40 and Kurtosis of -1.20 supported this interpretation indicating a slight positive skew to the data.

A histogram produced for river drive camps revealed that the data was not distributed in a normal curve, but rather in a flat curve. The histogram was composed of single observations for each value, precluding further interpretation beyond the notation that six (66 per cent) of the observations occured above the one acre site size minimum. Furthermore, two (22 per cent) of the sites occured above the two acre suggested maximum. Given the limited sample, this could indicate that one acre was acceptable for a minimum site size, but two acres was too small for a maximum site size, allowing the conclusion that the river drive sites conformed to the propositions put forth in Hypothesis 2 (Figure 5).

Railway

The railway camp subsample contained 54 useable site size observations. These generated mean site size of 1.82 acres with a standard deviation of 2.03. While these results initially supported Hypothesis 2, the size of the standard deviation indicated that the data were not normally distributed. This observation was further supported by the skewness (1.73) and kurtosis (3.05) statistics which indicated that the distribution of values above the mean was heavier than those that below. Moreover, the median of this distribution was 0.94, or about half the value of the mean. As the median is the midpoint of any given distribution, it is generally expected that it should be fairly close to the mean, when the distribution is normal. This distribution, then, was characterized by large values in the positive tail of the curve, which were sufficiently numerous to skew the mean higher than warranted. A Kolmogorov-Smirnov D statistic was generated to test the null hypothesis that the distribution was normal. The null hypothesis was rejected at the 0.1 level (0.223) by a D value of 0.225 (Alder and Roessler 1972, Beyer 1971, Blalock 1972, Downie and Heath 1974, SAS Institute 1985).

A visual inspection of a frequency histogram revealed that the distribution of the SITSIZ variable for railway camps was mostly single observations per given site size. While there were several modes in the sample, none were composed of more than two observations. These occured at 0.06, 0.13, 0.46, 0.97, 1.75, 3.64 and 4.12. With the exception of the first two, there seemed to be little logic in merging any of these into modal categories (Figure 6).

This examination of railway camps produced mixed results. Although the mean fell within the range predicted for site size by Hypotheses 2, there was reason to believe that this measure was not an accurate descriptor of the sample. The median (0.94) was a better descriptor of the sample. Thus, although it came quite close, it cannot be said that the railway camp sample met the conditions put forth in Hypothesis 2.

FIGURE 5

SITE SIZE OF RIVER DRIVE SITES

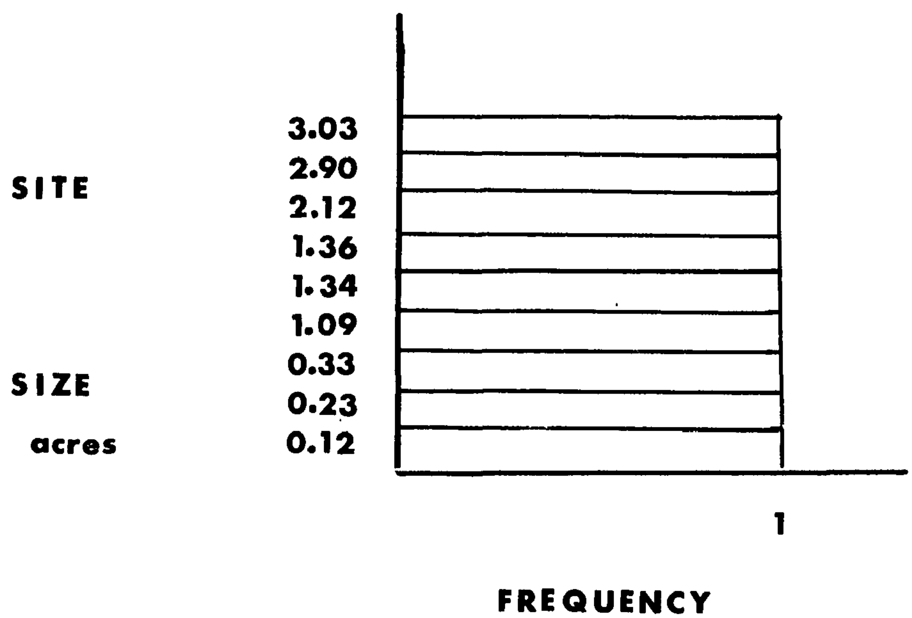

SITE
SIZE
acres
3.03
2.90
2.12
1.36
1.34
1.09
0.33
0.23
0.12
1
FREQUENCY

FIGURE 5

FIGURE 6

SITE SIZE OF RAILWAY CAMPS

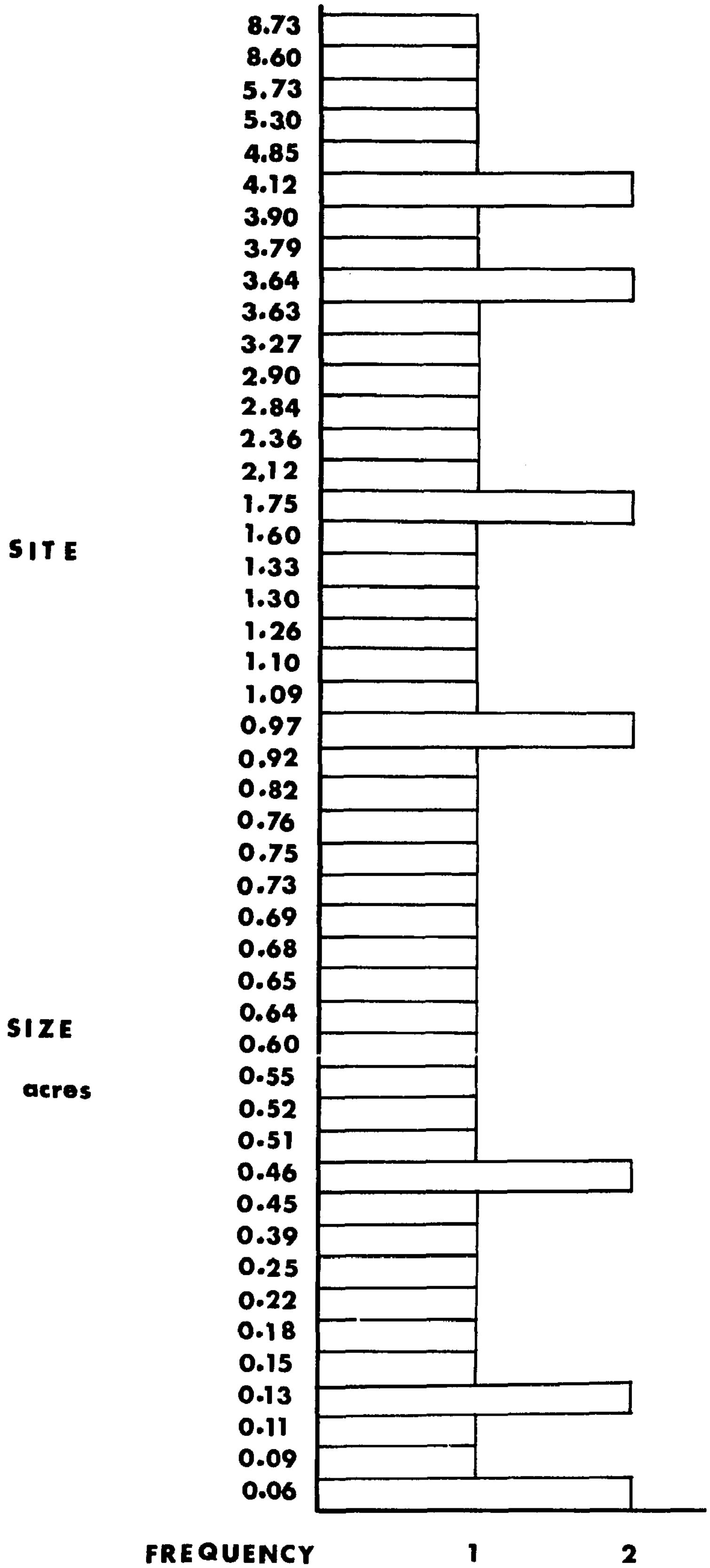

8.73
8.60
5.73
5.30
4.85
4.12
3.90
3.79
3.64
3.63
3.27
2.90
2.84
2.36
2,12
1.75
1.60
1.33
1.30
1.26
1.10
1.09
0.97
0.92
0.82
0.76
0.75
0.73
0.69
0.68
0.65
0.64
0.60
0.55
0.52
0.51
0.46
0.45
0.39
0.25
0.22
0.18
0.15
0.13
0.11
0.09
0.06
SITE
SIZE
acres
FREQUENCY
1
2

FIGURE 6

Unknown

The unknown site subsample contained 24 observations usable in this analysis. The mean was 0.93 and the standard deviation was 0.79. Initially, these statistics did not support the propositions put forth in Hypothesis 2. Moreover, the data were not normally distributed, given the relationship of the standard deviation to the mean. The skewness (1.53) and kurtosis (2.39) statistics both indicated a heavier positive tail of the distribution. As with the railway camp sample, this was caused by some large outlying variables on the positive side of the mean. The median (0.83) was smaller than the mean and probably better describes this sample because of the problem of high positive outliers. However it also was below the expected values for Hypothesis 2 (Alder and Roessler 1972, Downie and Heath 1974, SAS Institute 1985a).

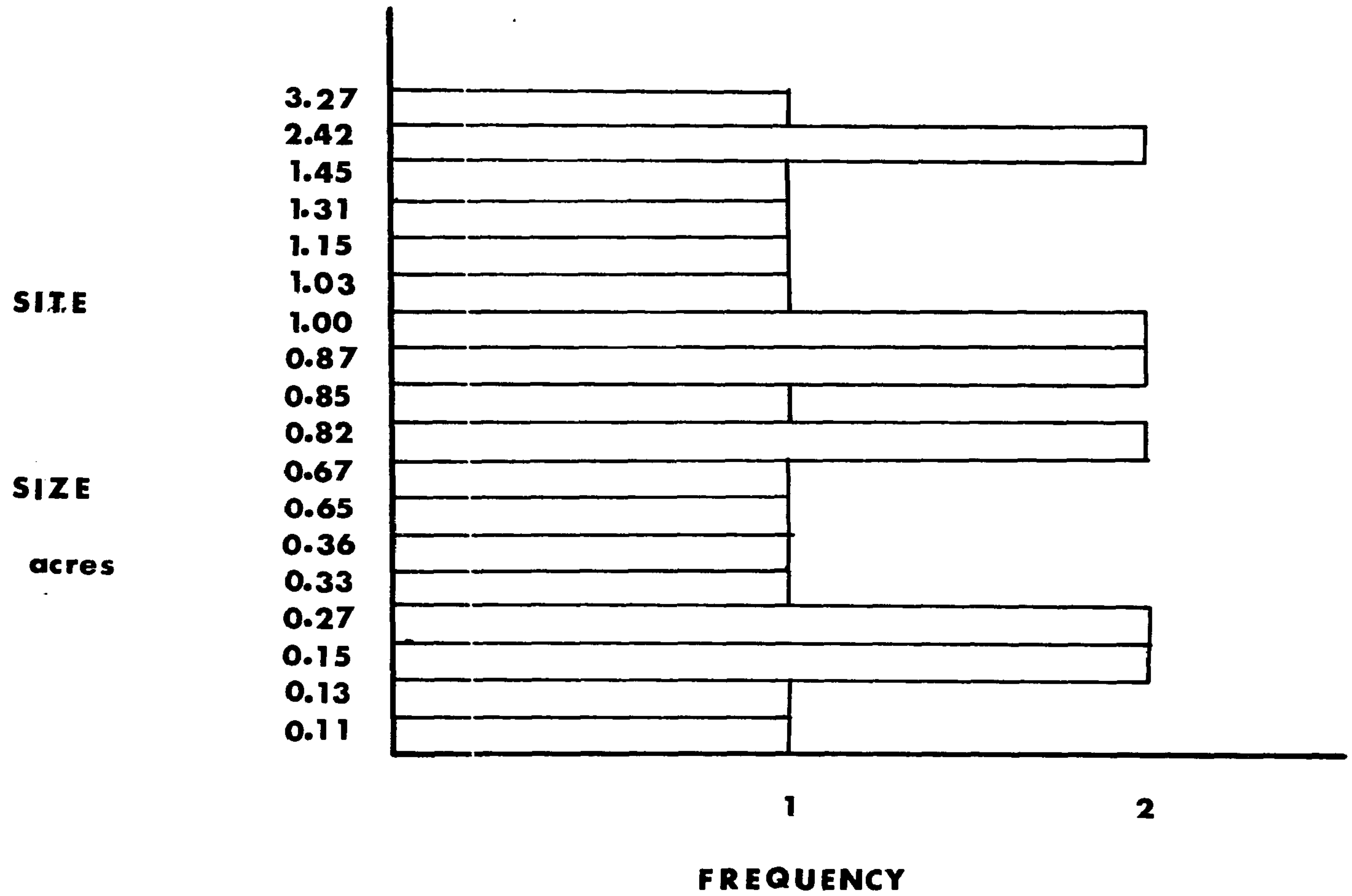
The frequency histogram for the unknown sites revealed that most of the values were represented by single observations. There were several modes, each containing two observations. These were merged into the following modal categories: 0.15-0.27 (4/16.6 per cent), 0.82-1.0 (6/25 per cent), 2.42 (2/8 per cent). The largest modal category occured just outside the parameters established by Hypothesis 2. However, given the median (0.82) the bulk of the distribution occured far enough below the lower parameter to result in the rejection of Hypothesis 2 for the unknown site sample (Figure 7).

Summary

Hypothesis 2 was accepted for the river drive camp subsample but rejected for both the railway camp and unknown samples. The median was a better indicator of the central tendency of the three bsamples than the

FIGURE 7

SITE SIZE OF UNKNOWN SITES



SITE
SIZE
acres
3.27
2.42
1.45
1.31
1.15
1.03
1.00
0.87
0.85
0.82
0.67
0.65
0.36
0.33
0.27
0.15
0.13
0.11
1
2
FREQUENCY

FIGURE 7

mean. In the railway camp sample, the median (0.94) was close enough to the hypothesized range of site size that provisional acceptance could be given to Hypothesis 2 in light of the cautionary mention of field visibility. The unknown site sample deviated sufficiently from the hypothesized values for site size that it must remain rejected. Thus, the evaluation of Hypothesis 2 produced mixed results, which must be used with circumspection during the later phases of the analysis.

Hypothesis 3

River drive logging camps will be located near, but not immediately adjacent to driveable streams or lakes. They may be expected to occur between one half and one and a half miles from the driveable stream/lake and only rarely occur at distances greater than one and one half miles from a driveable stream/lake.

This hypothesis was examined using metrical data concerning the distance to the nearest water and the distance to the nearest driveable water. The data was analyzed by both statistical techniques and visual inspection of graphs.

TABLE 5

RIVER DRIVE CAMPS

Distance to Nearest Water

N = 45	Median = 0.13
Mean = 0.24	Range = 0 - 1.5
Standard Deviation = 0.33	Mode = 0.03
Skewness = 2.09	
Kurtosis = 4.36	

Distance to Nearest Driveable Water

N = 45	Median = 0.25
Mean = 0.45	Range = 0.03 - 3.13
Standard Deviation = 0.56	Mode = 0.03
Skewness = 2.65	
Kurtosis = 10.34	

Distance to Nearest Water

Although Hypothesis 3 did not distinguish distance to nearest water from distance to nearest driveable water, some clarification was necessary. Most any unpolluted water source could be used for domestic purposes, but only specific types of water could be used for log driving. It was important, then, to distinguish distance to nearest water from distance to nearest driveable water.

The mean distance to nearest water (DINEWAT) for the river drive subsample (n = 45) was 0.24 and the standard deviation was 0.33, which initially satisfied the condition that nearest water, if used for domestic purposes, would be closer than the one half mile interval posed in Hypothesis 3. However, the standard deviation was larger than the mean indicating that the distribution of the variables for this subsample was not normal. Both skewness and kurtosis indicated that the positive tail of the distribution was heavier than the negative tail, a point in keeping with a standard deviation larger than the mean. Moreover, the median was 0.13, close to only half the size of the mean, while the mode (0.03) was even lower. All of these factors indicated that a few large variables in the positive tail of the distribution probably high skewed the mean. Therefore, it was not the best estimate of the central tendency for the distance to nearest water (Table 5)(Alder and Roessler 1972, Downie and Heath 1974, SAS Institute 1985a).

The frequency histogram data verified that the mean was skewed high and that the distribution was not normal. With the exception of several observations at 0.75, the distribution trailed off to a string of single observations at 0.31, which extended to 1.50 and accounted for the high skew of the mean. In this distribution, the mode and the median were better measures of central tendency than the mean (Figure 8)(Alder and Roessler 1972).

This corollary to Hypotheses 3 was satisfied, although not without some difficulties. Given the characteristics of the distribution, the median or the mode were more appropriate measures of central tendency than the mean. Thus, nearest water, particularly if used for domestic purposes, may occur closer to camp than the hypothesized distance to nearest driveable water.

Distance to Nearest Driveable Water

The results of the analysis of this variable revealed that the mean distance to nearest driveable water (DNDRWAT) was 0.45 miles with a

FIGURE 8

DISTANCE TO NEAREST WATER FOR RIVER DRIVE SITES

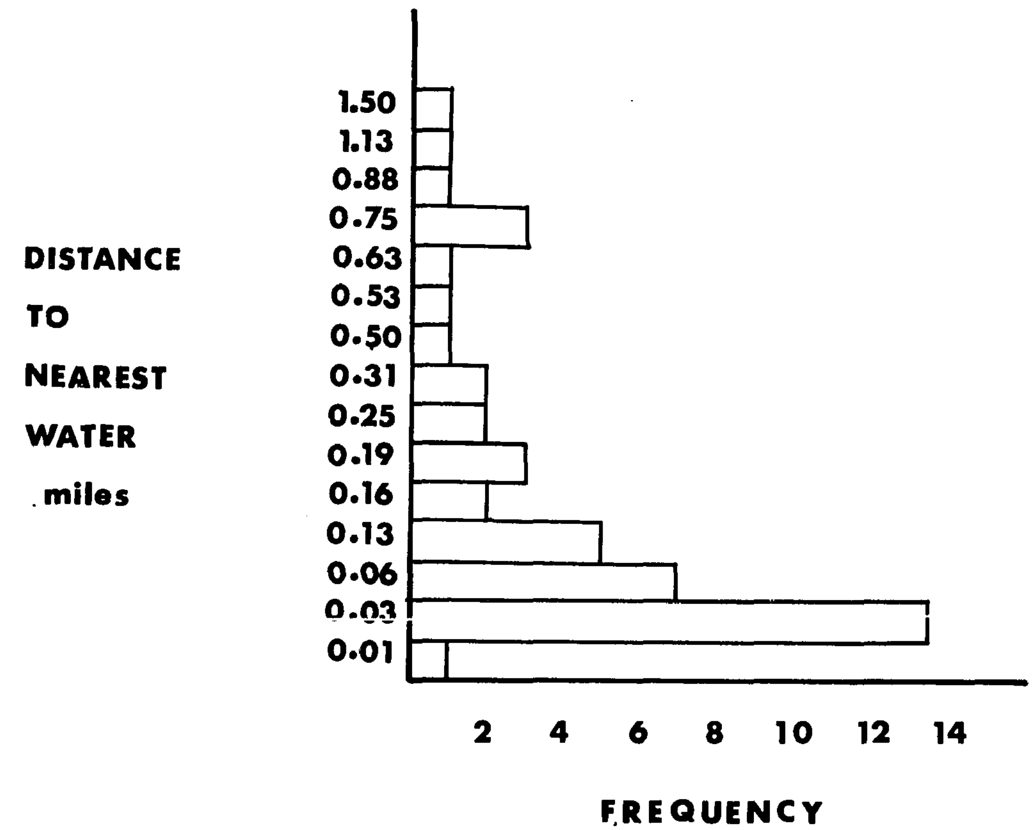

DISTANCE
TO
NEAREST
WATER
miles
1.50
1.13
0.88
0.75
0.63
0.53
0.50
0.31
0.25
0.19
0.16
0.13
0.06
0.03
0.01
2
4
6
8
10
12
14
FREQUENCY

FIGURE 8

standard deviation of 0.56, indicating that the data involved in these computations were not normally distributed. The skewness (2.65) and kurtosis (10.34) statistics indicated that the positive tail was significantly heavier than the negative tail providing further support for this inference. Moreover, the median (0.25) was only slightly larger than half the size of the mean, further supporting the proposition that the mean was skewed high since most of the observations under study were less than or equal to 0.25 (Alder and Roessler 1972, Downie and Heath 1974, SAS Institute 1985a).

A frequency histogram for the DNDRWAT distribution reflected the points drawn from the descriptive statistics in that most of the variates were clustered at the low end of the distribution (mode = 0.03, median = 0.25). Although the mode occured at 0.03, there were two other smaller modal categories located at 0.31 (0.25-0.44) and at 0.69 (0.69-1.13) which contributed to the high skew of the mean. Thus, the mode, which contributes 20 per cent to the total distribution, and the median are better measures of central tendency than the mean (Figure 9).

Hypothesis 3 was only partially upheld in terms of distance to nearest driveable water. Since only one (2.2 per cent) of the observations occurred outside of the maximum of 1.5 miles stated in the hypothesis, Hypothesis 3 was satisfied in terms of the upper limit. More important was the fact that the majority of the observations did not occur within the stated range. The mode and median, the more reliable measures of this particular distribution, showed that most (53 per cent) of the observations occurred between 0.03 to 0.25 miles from the camps. Though not immediately adjacent to driveable water, the camps were not one half to one and one half miles away from the nearest driveable water either.

FIGURE 9

DISTANCE TO NEAREST DRIVEABLE WATER
FOR RIVER DRIVE SITES

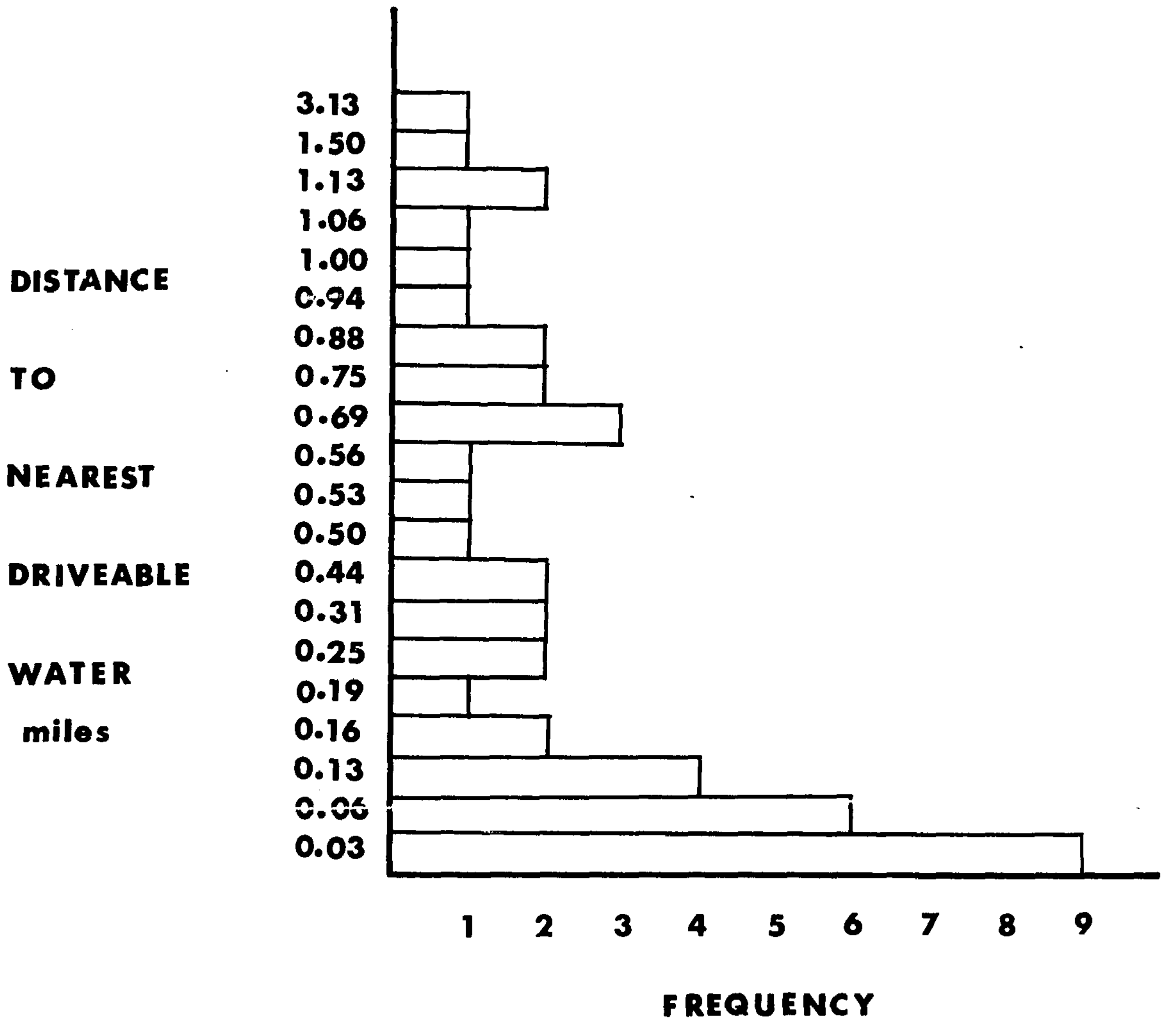

DISTANCE
TO
NEAREST
DRIVEABLE
WATER
miles
3.13
1.50
1.13
1.06
1.00
0.94
0.88
0.75
0.69
0.56
0.53
0.50
0.44
0.31
0.25
0.19
0.16
0.13
0.06
0.03
1
2
3
4
5
6
7
8
9
FREQUENCY

FIGURE 9

Perhaps the original hypothesis was couched with a too robust lower limit. To provide a better perspective, the distances in miles (0.03 - 0.25) were converted to feet (158-1320). This conversion provided a better picture of the distance than tenths and hundredths of a mile measurements. Again, no site was on the banks of a stream, lake etc., but none were between one half and one and one half miles away. Interestingly, the 0.03 (158 ft.) mile mode was also the lower limit of the range for this variable, so that no site was nearer to driveable water than 158 feet. Thus, while the results of the analysis of distance to nearest driveable water did not conform to the stated range for these values in Hypothesis 3, they did conform to the intention of the hypothesis.

Relationship between Distance to Water Variables

The relationship between the two variables was next examined by their cross tabulation and through a cross plot of one against the other. The data from these variables were grouped into larger intervals than the recording intervals to eliminate the large number of zero value cells in the cross tabulation. The intervals were: 0-0.25, 0.26-0.50, 0.51-0.75, 0.76-1.0, 1.01-1.25, 1.25-1.50 (Table 6).

TABLE 6

CROSSTABULATION OF DISTANCE TO NEAREST WATER AND

DISTANCE TO NEAREST DRIVEABLE WATER

		Distance to Nearest Driveable Water					
		0.25	0.50	0.75	1.0	1.25	1.50
Distance	0.25	24	2	4	2	2	0
to	0.50		3	0	0	0	0
Nearest	0.75			3	2	0	1
Water	1.0				0	0	0
	1.25					0	0
	1.50						0

Identical Crosstabulations in Raw Data

Values	Number
0.03/0.03	9
0.06/0.06	6
0.13/0.13	4
0.16/0.16	2
0.19/0.19	1
0.25/0.25	2
0.31/0.31	2
0.5/0.5	1
0.53/0.53	1
0.75/0.75	2
0.88/0.88	1
1.13/1.13	1
	32

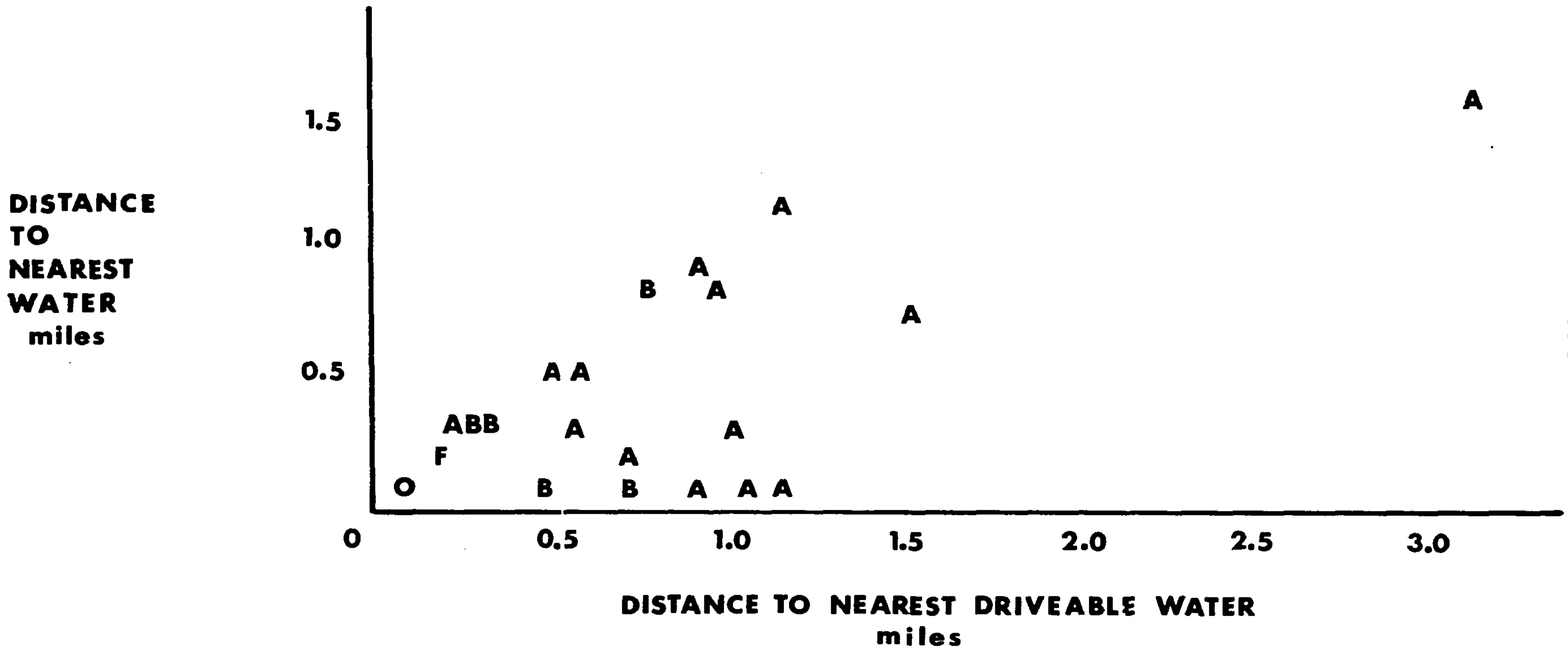
As can be seen from Table 6, most of the values for the crosstabulation of the distance to water variables occured in the 0.01-0.25 cell (24/53 per cent) which was six times larger than the next largest cell frequency. Thus, the majority of sites were located within 0.25 miles of both nearest water and nearest driveable water. These results are graphically presented in Figure 10, which shows the heavy concentration of variables near the vertex and within an area bounded by 0.25 on both axes. Moreover, it appeared that for a large number of observations (32/71 per cent) distance to nearest water and distance to nearest driveable water were the same indicating the nearest water source was also the nearest driveable water source.

Table 7 illustrates the type of water associated with river drive camps when the nearest driveable water was also the nearest source of water in general. Streams (53 per cent) were the most common type of water associated with river drive camps and major rivers (31 per cent) the next. Taken together, these two accounted for over 80 per cent of the water type/river drive camp associations when the nearest driveable water was the nearest water. Other types of water (Great Lakes, lakes, springs and lake/river or stream) occurred significantly less frequently under these conditions.

FIGURE 10

CROSS PLOT OF DISTANCE TO NEAREST WATER BY
DISTANCE TO NEAREST DRIVEABLE WATER
FOR RIVER DRIVE SITES

(A=one site, B=two sites, etc.)



DISTANCE TO NEAREST WATER miles
1.5
1.0
0.5
0
0.5
1.0
1.5
2.0
2.5
3.0
A
ABB
F
O
B
B
A
A
A
A
A
A
A
A
A
B
A
A
A
A
DISTANCE TO NEAREST DRIVEABLE WATER miles

FIGURE 10

TABLE 7

TYPE OF NEAREST WATER

WHEN NEAREST WATER AND NEAREST DRIVEABLE WATER ARE THE SAME

Type of Water	Number of Sites	Percentage
Streams	17	53
Major Rivers	10	31
Lakes	1	3
Lake/stream or Lake/river	3	9
Spring	1	3

Summary

Hypothesis 3's propositions, maintaining that the distance between river drive camps and the nearest driveable water should be between one half and one and a half miles, were only partially confirmed. Although the upper boundary of one and one half miles was only exceeded by one observation, the lower limit of one half mile did not encompass the majority of variables. The median and the mode, more appropriate measures for this sample, were significantly lower than the lower boundary of the hypothesized range. While no camp was located on a river or stream bank most (53.3 per cent) were between 0.03 and 0.25 miles away, thereby negating part of Hypothesis 3. This percentage is not overwhelming, but it does lend credence to the idea that there is some bounded zone wherein which the majority of camps are likely to occur. Another interesting point to come out of this particular examination was that for 71 per cent of the observations the nearest driveable water was also the nearest water. Behaviorally this might indicate that loggers did not discriminate in their sources of water for domestic or transportation purposes. More importantly, it indicated the priority transportation and access thereto held over camp locations. Further information about these considerations was obtained when an examination of the type of nearest water was conducted. Streams, as nearest water/driveable water, accounted for over half the observations. If major rivers are added to streams, then over 80 per cent of the observations were included in these two types of water. Thus, a general set of characteristics for river drive camps has emerged from the study of Hypothesis 3. River drive camps will most likely be located between 0.03 and 0.25 miles from driveable water. This driveable water is most likely to be the nearest source of water to the camp. Moreover, the nearest water/driveable water is most likely to be a stream, or secondarily a major river.

Hypothesis 4

River drive logging camps will be located at intermediate elevations within the surrounding area. They will be above the level of the driveable stream/lake and equal to or lower than elevations where active cutting will occur (i.e. lower than the highest elevation in the area).

This hypothesis was explored through the analysis of several variables. The variable measuring orientation of the nearest driveable water provided information on whether the nearest driveable water was above, below or at the same elevation as a given river drive camp. In addition, the relative elevation of the camp was examined for a one and a half mile radius with three options for type of elevation: lowest, highest, or intermediate. Finally, the actual elevation of the river drive camps was examined to ascertain if there was any uniform pattern to the selection of elevations at which to locate camps.

Orientation of Nearest Driveable Water

This variable was designed to measure if the river drive site was above, below, or at the same elevation as the source of nearest driveable water. As shown in Table 8, most (39/86.7 per cent) of the river drive camps were located above the level of the nearest driveable water. The remainder of the sites (6/13.3 per cent) were at the same level as the nearest driveable water. This data suppported Hypothesis 4 in that the majority of river drive camp sites were located above the level of the nearest driveable water (Table 8).

TABLE 8

ORIENTATION OF NEAREST DRIVEABLE WATER

RIVER DRIVE SITES

	Number	Percentage
Above Camp	0	0
Same Elevation	6	13.3
Below Camp	39	86.7
	40	100

Relative Elevation

An analysis of relative elevation evaluated the proposition that river drive sites would be located at intermediate elevations within the surrounding area. This variable measured the elevation of river drive sites with respect to the highest and lowest elevations within a one and one half mile radius of the camp. The one and one half mile radius was chosen because it was the same distance used in other hypotheses to establish territory around a site. Most of the sites (42/93.3 per cent) were located at intermediate elevations with respect to the surrounding territory (Table 9). One (2.2 per cent) site was located at the highest elevation, while two (4.4 per cent) were located at the lowest elevation. These results conformed to what was expected for Hypothesis 4 (Table 9).

TABLE 9

RELATIVE ELEVATION

RIVER DRIVE SITES

	Number	Percentage
Highest	1	2.2
Intermediate	42	93.3
Lowest	2	4.4
	45	100

Relative Elevation and Driveable Water Orientation

Because Hypothesis 4 was upheld in terms of both relative elevation and orientation toward driveable water the relationship between these two variables was examined. The most common characteristic (82.2 per cent) for river drive sites was their location at intermediate elevations within the surrounding area and above the elevation of nearest driveable water (Table 10). The next most common characteristic (11.1 per cent) was the sites' locations at intermediate elevations with respect to the surrounding area and at the same level as the nearest driveable water.

Together, these two sets of characteristics describe over 90 per cent of the river drive sites in the sample.

TABLE 10

RELATIVE ELEVATION AND DRIVEABLE WATER ORIENTATION

RIVER DRIVE CAMPS

		Relative Elevation		
		Highest	Intermediate	Lowest
Orientation of Nearest Driveable Water	Above Camp	0	0	0
	Same Elevation	0	5 (11.1%)	1 (2.2%)
	Below Camp	1 (2.2%)	37 (82.2%)	1 (2.2%)

Further examination of these two variables revealed an interesting pattern (Table 11). Those sites located on the same level as the nearest driveable water were constrained within a 0.75 mile distance from the nearest driveable water, which appeared to relate to the floodplain width of driveable streams.

TABLE 11

RELATIONSHIP BETWEEN DISTANCE TO NEAREST DRIVEABLE WATER

AND ORIENTATION OF NEAREST DRIVEABLE WATER

RIVER DRIVE SITES

		Driveable Water Orientation	
		Same Elevation	Below Camp
	0-0.25	3 (6.6%)	21 (46.6%)
Distance to	0.26-0.50	2 (4.4%)	3 (6.6%)
Nearest	0.51-0.75	1 (2.2%)	6 (13.3%)
Driveable	0.76-1.00	0	4 (8.8%)
Water(miles)	1.01-1.25	0	3 (6.6%)
	1.26-1.50	0	1 (2.2%)
		6 (13.2%)	38 (84.1%)

Table 11 also illustrates a rather marked pattern for those sites which were located above the level of nearest driveable water. In this case, the largest single concentration (46.6 per cent) of sites was those located within 0.25 miles from driveable water. The next largest concentration (13.3 per cent) was located between 0.51 and 0.75 miles from nearest driveable water, followed by those (8.8 per cent) between 0.76 and 1.00 miles from nearest driveable water. If the latter two categories (0.51-0.75, 0.76-1.00) are combined, the 0.51-1.00 interval contains 22.1 per cent of the sites. Thus, there exists a pattern of heaviest site concentration between 0-0.25 miles from nearest driveable water, followed by a smaller, but still sizeable (22.1 per cent) concentration between 0.51-1.00 miles from nearest driveable water. The two are separated by a 0.25 mile zone of relatively low site presence. The latter pattern, however, was spread over twice the area as the former one, which resulted in a significantly decreased density of sites. This pattern may reflect differential access to transportation and/or a relationship to work zones. Specifically, distribution may represent the interplay of work zone size with the distance to nearest driveable water. The lower density of sites in the outer zone was in part a product of distance increasing transport difficulties. It is also attributable to the fact that these sites were located on the fringes of the effective cutting radius of camps in the inner zone. This explanation remains only a possibility, albeit a plausible one. Further study, using a number of complete samples from single drainages rather than the pooled sample used here, would be necessary to verify this proposition.

Elevation

Having established that most (93.3 per cent) river drive sites occurred at intermediate elevations with respect to a one and one half mile radius of the camp, it was useful to investigate whether this relative elevation could be translated into specific elevations or ranges of elevation. This was accomplished through a cross tabulation of relative elevation values with elevation and by the production of a frequency histogram of elevation for sites located at intermediate elevations within a one and one half mile radius of river drive camps.

As can be seen from Table 12, there were definite modes in this data, most noticeably at the 726-750 foot interval (9) and the 776-800 foot interval (9). Smaller peaks occurred at the 676-700 foot interval (5), the 601-625 interval (5) and the 576-600 foot interval (4). A further condensation of the data resulted in two major modes: one from 576-625 feet (9) and the second from 726-800 feet (20). These groupings contain a significant percentage (9/64 per cent, 20/44.4 per cent) of the sites in the sample.

TABLE 12

CROSSTABULATION

RELATIVE ELEVATION BY ELEVATION

RIVER DRIVE SITES

		Relative Elevation		
		Lowest	Intermediate	Highest
	575-600	1	4	1
	601-625		5	
Elevation	626-650		2	
(feet asl)	651-675		3	
	676-700		5	
	701-725		2	
	726-750		9	
	751-775		2	
	776-800	1	9	
	800-825		1	

One interpretation of this pattern is that it reflects chronology. Elsewhere it has been noted that the earlier (i.e. river drive) sites tended to be located nearest the Lake Michigan coast, while more recent sites were located inland (Karamanski 1984, Martin 1977). The pattern described above could represent an increase in number of river drive camps through time as the logging industry grew and an increase in elevation as loggers moved further inland.

The results of a crosstabulation of elevation and relative occupation for river drive sites located at intermediate elevations within the study area supported the proposition that earlier sites would be located at lower elevations (Table 13). Below 750 feet asl, all (29/69 per cent) but one (1/2 per cent) of the sites dated to the late nineteenth century. Above 751 feet asl, with exception of four sites (4/9.5 per cent), between 776 and 800 feet asl, all (8/19 per cent) sites were transitional between the late nineteenth and early twentieth centuries. Table 14 presents a breakdown of Table 13 in ten year increments, beginning with 1871, illustrating more sharply the relationship between elevation and occupation date. Moreover, it also illustrates that the "heyday" of river drive logging in the study area was between 1881 and 1890. This supports (by inference) earlier suggestions (Karamanski 1984, Martin 1977) that early river drive sites would be located near the coast.

TABLE 13

CROSSTABULATION

ELEVATION BY RELATIVE OCCUPATION

RIVER DRIVE SITES-INTERMEDIATE ELEVATIONS

		Relative Occupation	
		Late 19th	Late 19th/Early 20th
	575-600	4	0
	601-625	5	0
Elevation	626-650	2	0
(feet asl)	651-675	3	0
	676-700	5	0
	701-725	1	1
	726-750	9	0
	751-775	0	2
	776-800	4	5
	801-825	0	1

TABLE 14

CROSSTABULATION

ELEVATION BY OCCUPATION

RIVER DRIVE SITES-INTERMEDIATE ELEVATION

		Initial Occupation Date			
		1871-1880	1881-1890	1891-1900	¨1900
	575-600		3		
	601-625		4		
Elevation	626-650	1	1		
(feet asl)	651-675		2	1	
	676-700	1	3		
	701-725	1	1		
	726-750	3	5	1	
	751-775		1		1
	776-800	1	5	1	3
	801-825				1

Summary

Hypothesis 4 maintained that river drive logging camps will be located at intermediate elevations within a one and a mile radius around each camp. Furthermore, river drive logging camps will be above the level of driveable streams but below the highest elevation within the surrounding area (i.e. one and a half mile radius). The analysis has supported Hypothesis 4 in that most of the river drive camps occurred above the level of the nearest driveable water and also were located at intermediate elevations within the surrounding area. In addition to separately satisfying both of these aspects of Hypothesis 4, the analysis revealed that the river drive camps also simultaneously satisfied them, since a cross tabulation revealed that most river drive camps were located both above the level of the nearest driveable water and at intermediate elevations within the surrounding area.

Further analysis provided insights into the locational characteristics of river drive camps. In addition to supporting earlier statements about the relationship between chronology and distance inland the analysis revealed that camps located at the same level as the nearest driveable water occurred within 0.75 miles of the nearest driveable water. This characteristic led to the inference that these sites were floodplain camp sites, and that the 0.75 mile distance represented floodplain width.

Camps located above the level of nearest driveable water occurred in two modal categories with respect to distance to nearest driveable water: those less than 0.25 miles away and those between 0.5 and 1.0 miles away. The closer group was the larger and more dense of the two which was inferred to reflect the difficulty of transporting logs over a greater distance to driveable water. It also could be interpreted to reflect the effect of a cutting zone around logging camps, which would establish a minimum distance between camps for the effective use of space, a point which will be addressed in a later hypothesis. However, since the river drive sample was a pooled sample from the entire study area and not from a single drainage, inferences of this nature must remain speculative at this point.

Hypothesis 5

Railway logging camps will generally be located fairly closely to natural drainage/streams, probably no further than one mile away. Camps greater than one mile from a natural drainage system should be located on ground with approximately 6 per cent slope in an area that, by inference, contained a heavy stand of timber.

Sites Less Than One Mile from Water (Drainage)

This hypothesis was approached initially through the examination of the distance to nearest water variable for railway logging camps. As shown in Table 15, the mean was 0.43 miles with a standard deviation of 0.37, indicating that these observations were not normally distributed. The skewness (1.33) and kurtosis (1.92) statistics confirmed this interpretation and indicated that the positive tail of the distribution was the heaviest. One potential cause was a number of high positive outliers.

TABLE 15

DISTANCE TO NEAREST WATER

Railway Camps

N = 149	Median = 0.38
Mean = 0.43	Mode = 0.50
Standard Deviation = 0.37	Range = 0.01-1.94
Skewness = 1.33	
Kurtosis = 1.92	

Additional support for these propositions was found in the median (0.38) and the mode (0.50). Over half the observations occurred at or below the 0.38 median, while the mode indicated that the value with the largest number of observations was 0.50. The range (0.01-1.94) also indicated that the distribution continued some distance to the positive side of the mean. The frequency histogram also supported this interpretation. Furthermore, although the histogram appeared to be multi-modal, there were a cluster of observations which accounted for a large percentage of the total observations on this variable. Those observations ranged between 0.06 and 0.56 on the histogram and comprised 69 per cent (103) of the total number of observations on this variable. Moreover, Hypothesis 5 specified a distance less than or equal to one mile away from water. The distribution revealed that 92.6 per cent of the observations occurred at or below 1.0 miles (Figure 11).

The examination of the type of water associated with sites less than or equal to one mile from the nearest water was undertaken because Hypothesis 5 maintained that this one mile distance was applicable to the natural drainages associated with a stream or river. That is, drainages which were essentially dendritic and which ultimately flowed into Lake Michigan or Lake Superior. Lakes, with their internal drainage, would not necessarily ensure that there was a dendritic pattern along which a railway grade could have been established.

The data presented in Table 16 shows that the majority of the sites (86 per cent) located less than or equal to one mile from water were most closely associated with some sort of flowing, dendritic drainage system such as a stream or river. This confirmed one of the propositions put forth in Hypothesis 5.

FIGURE 11

DISTANCE TO NEAREST WATER FOR RAILWAY SITES

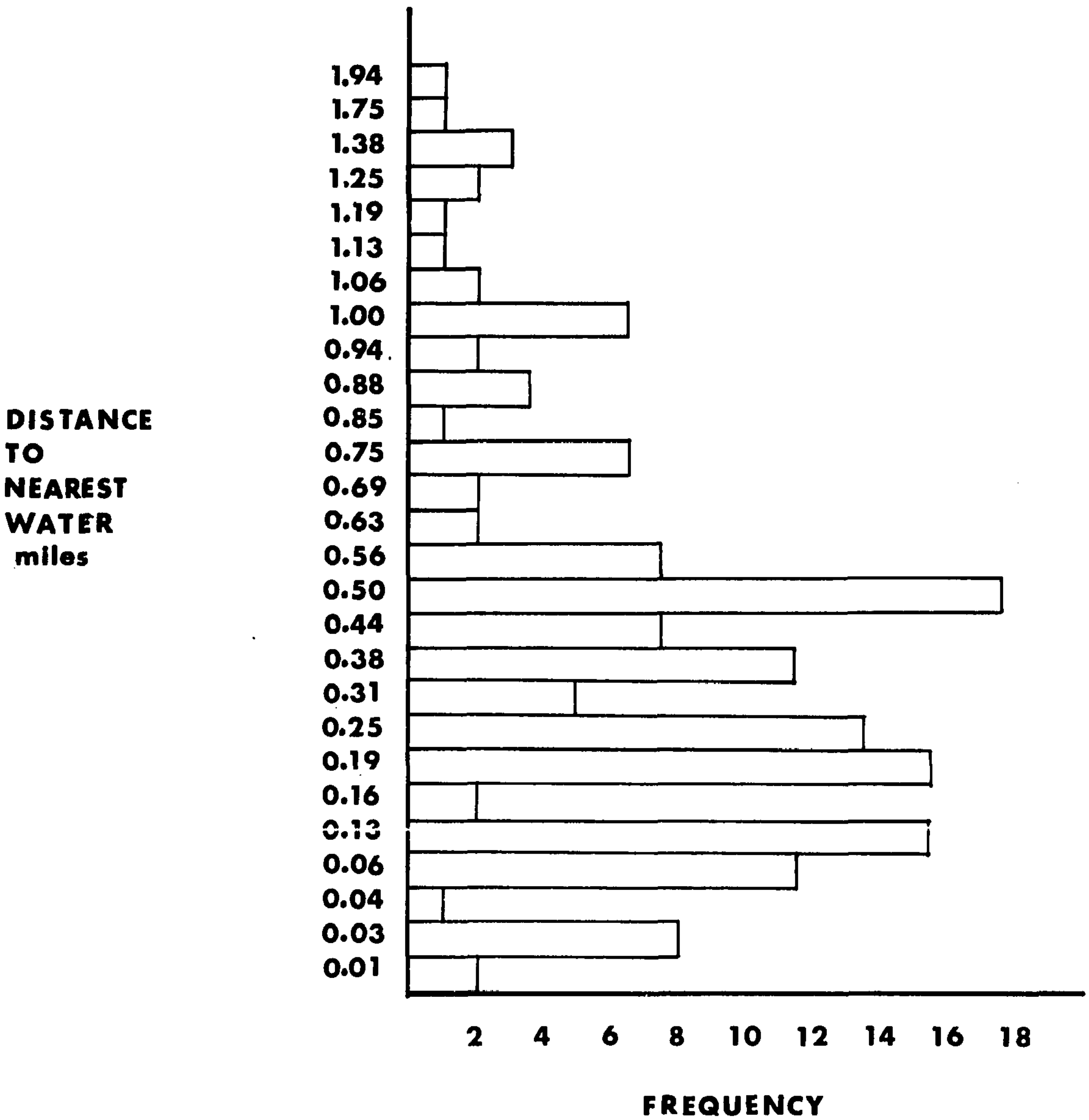

DISTANCE
TO
NEAREST
WATER
miles
1.94
1.75
1.38
1.25
1.19
1.13
1.06
1.00
0.94
0.88
0.85
0.75
0.69
0.63
0.56
0.50
0.44
0.38
0.31
0.25
0.19
0.16
0.13
0.06
0.04
0.03
0.01
2
4
6
8
10
12
14
16
18
FREQUENCY

FIGURE 11

TABLE 16

TYPE OF NEAREST WATER

RAILWAY CAMPS WITHIN ONE MILE OF WATER/NATURAL DRAINAGE

Type	Number	Percent
Flowing/Dendritic	114	86
Lakes (internal drainage)	18	14

Sites Over One Mile from Water (Drainage)

Hypothesis 5 also maintained that railway camps located more than one mile away from a natural drainage system would be located on ground that had approximately 6 per cent slope. The information presented in Table 17 partially confirms this proposition. Most of the observations (82 per cent) occurred in the lower (0-6 per cent) slope interval, and the remainder (18 per cent) were in the middle (7-18 per cent) slope interval. Hence it can be said that the data generally supported the proposition, but the exact extent cannot be determined.

TABLE 17

SLOPE

RAILWAY CAMPS OVER ONE MILE FROM A NATURAL DRAINAGE

Slope	Number	Percent
Lower (0-6%)	14	82
Middle (7-18%)	3	18
Upper (over 18%)	0	0

The Converse

Another approach to these two components of Hypothesis 5 was an examination of the relationlship of slope of sites located less than or equal to one mile from water and the type of water associated with sites more than one mile away from nearest water. Table 18 presents data on the slope of railway sites less than one mile from water. When compared to the information in Table 17, some similarities and differences emerged. First, the largest single slope group from either table was the lower (0-6 per cent) slopes. Second, the middle and upper slope groups were larger for the sites less than one mile from water than for sites over one mile from water.

TABLE 18

SLOPE

RAILWAY CAMPS LESS THAN ONE MILE FROM WATER

Slope	Number	Percent
Lower (0-6%)	94	72.4
Middle (7-18%)	32	24.6
Upper (over 18%)	4	3.0

A chi square test for the independence of classificatory criteria explored the relationship between the slope of railway sites less than one mile from water and those greater than one mile from water. Table 19 reveals that the null hypothesis cannot be rejected, therefore the observations occurring less than one mile from water and those occurring greater than one mile from water behaved as independent populations in terms of slope. This lent further, albeit indirect, support to the proposition that railway camps greater than one mile from water/drainages would occur in areas of approximately 6 per cent slope. Thus it is possible to state that railway sites greater than one mile from water occurred at slopes of aproximately 6 per cent, with deviations occurring in the 0-6 per cent range rather than into the next highest range. Moreover, this behavior was different than that of sites located less than one mile from water.

TABLE 19

CHI-SQUARE: SLOPE FOR RAILWAY SITES GREATER AND LESS THAN ONE MILE FROM WATER

Slope	Distance to Nearest Water		
	Less than One Mile	Greater than One Mile	Total
Lower (0-6%)	94	14	108
Middle (6-18%)	32	3	35
	126	17	143

$X^2 = 0.45$ df = 1 $X^2(0.05) = 3.84$

To carry this investigation further, types of water associated with sites less than one mile from water and with those greater than one mile from water were examined. When the data in Table 20 was compared to that of Table 16, the flowing dendritic type of water was dominant. However this dominance was not as marked as for camps located more than one mile from water as it was for those located less than one mile from water.

TABLE 20

TYPE OF NEAREST WATER

RAILWAY CAMPS GREATER THAN ONE MILE FROM WATER/NATURAL DRAINAGE

Type	Number	Percent
Flowing/dendritic	10	58.8
Lakes (internal drainage)	7	41.2

This relationship was explored further through the use of a chi-square test which evaluated the null hypothesis that there was no relationship between type of nearest water associated with camps greater than one mile from water and that associated with those camps less than one mile from water. The results of the chi-square test called for the rejection of the null hypothesis since railway sites located more than one mile from water were not independent in terms of the type of water with which they were associated. Although these results deviated from what was expected, they do not refute the conclusions reached earlier in this section regarding the type of water with which railway sites less than one mile from water would most likely be associated (Table 21).

TABLE 21

CHI-SQARE TEST: TYPE OF WATER ASSOCIATED WITH RAILWAY CAMPS

GREATER THAN ONE MILE FROM WATER AND LESS THAN ONE MILE FROM WATER

Type	Distance to Water		
	Less than One Mile	Greater than One Mile	Total
Flowing/ Dendritic	114	10	124
Lakes (internal drainage)	18	7	25
	132	17	149

$X^2 = 8.39$

df = 1

X^2 (0.05) = 3.84

Maps

A subjective examination of the United States Forest Service Class A Maps provided a rough count of known logging railways that allowed further examination of this hypothesis. Also counted were rail lines which roughly paralleled a current stream/river or took advantage of a drainage which could have been occupied by a stream or other notable topographic features. This was not intended to be an exhaustive examination but rather an indication of whether logging railways actually followed the lay of the land whenever possible. The results revealed that there were 166 known mapped logging railways/spurs in the study area. Of these 108 (65 per cent) followed (in some fashion) the topography of the area to minimize the adverse effects of steepness in railway construction, indicating that most of the logging railways met the general expectatons put forth implicitly under Hypothesis 5. Although it might have been anticipated that a greater percentage would have adhered to the predicted pattern, several points should be remembered. First, the sample included the well known logging railways/spurs in the study area rather than all logging railways/spurs in the study area. Thus the sample was probably not representative of the universe. Second, the examination was carefully done but general and subjective, introducing the probability that more of the railways may have followed the topography than those counted. Third, there could be more drainage areas which still had favorable slopes ($\le$ 6 per cent) and thus would have been acceptable for logging railway construction.

Summary

Hypothesis 5 maintained that railway logging camps will generally be located fairly closely to a natural drainage system; probably no further than one mile away. Camps located more than one mile from a natural drainage system should be located on ground with approximately 6 per cent slope. Initial examination of the entire logging camp subsample revealed that the observations for distance to nearest water variable were not normally distributed. All measures of central tendency were well below the hypothesized one mile limit. Most of the observations clustered between 0.06 and 0.56 miles and 92 per cent of all observations were less than or equal to one mile from the camp. The examination of those sites that occurred less than or equal to one mile from water revealed that most were closest to some form of dendritic drainage (i.e. rivers, streams, etc.) while only 14 per cent were closest to lakes. This confirmed the first part of Hypothesis 5.

For sites over one mile from water, 82 per cent fell within the 0-6 per cent slope range, with 18 per cent in the 7-18 per cent range. This provided a general confirmation of the second part of Hypothesis 5. An examination of the converse cases revealed that the slope for sites greater than or equal to one mile from water was significantly different than that for sites less than or equal to one mile from water, while the nearest water associations for both groups were fairly similar. A brief examination of maps of known logging railways confirmed that many of these were located in topographic settings that would have been advantageous as defined by Hypothesis 5. Overall, then, the propositions set forth by Hypothesis 5 have been confirmed.

Hypothesis 6

Railway logging camps will be located as far as possible from swamps.

This hypothesis related to the potential for railway camps to operate year round and thus be occupied during warmer months when swamps thawed and created a number of problems, including insect born disease, potential contamination of water supplies, and difficulty in transporting logs and loggers. Therefore it was hypothesized that camp location would generally avoid swampy areas. Unfortunately, no specific parameters can be established to determine the optimal distance from swamps. The analysis presented below addresses this hypothesis by drawing primarily upon distance measures, as well as informant and historical data.

As shown in Table 22, the mean distance from nearest swamp was 0.28 miles with a standard deviation of 0.32, indicating that the distribution was not normal since there were no values less than zero in the data. The skewness (2.15) and kurtosis (5.41) statistics further supported this conclusion and indicated that the distribution was skewed to the positive side of the mean. A comparison of the mean to the median (0.19) and mode (0.06) provided further evidence that high positive outliers were responsible for the skewed distribution. Thus, the mean was not the most accurate measure of central tendency for this distribution. In this case the median (0.19) was the better choice as a measure of central tendency, indicating that the median distance between camp and swamp was approximately 0.19 miles.

TABLE 22

DISTANCE TO NEAREST SWAMP

RAILWAY CAMPS

N = 129	Median = 0.19
Mean = 0.28	Mode = 0.06
Standard Deviation = 0.32	Range = 0.01-1.75
Skewness = 2.15	
Kurtosis = 5.41	

A frequency histogram revealed that the distances clustered around two modal categories: 0.01 - 0.06 (50/33 per cent), and 0.19 - 0.38 (48/32 per cent). Taken together, these two modal categories accounted for 65 per cent of the observations in this distribution. They also contained the median (0.19) and the mode (0.06) for the entire distribution. Thus, most railway logging camps were located between 0.01 and 0.06 miles from swamps or between 0.19 and 0.38 miles from swamps and each of these intervals contained similar numbers of observations, indicating balance between the two modal categories (Figure 12).

In terms of satisfying the expectations of the hypothesis, these results were equivocal. Certainly the second modal category (0.19-0.38) was sufficiently distant to have satisfied the hypothesis outright. The other modal category (0.01-0.06), or at least its lower boundary, was relatively close to swamps even though most of the observations in it occurred in the upper part of the category. Nevertheless, the camps in this category were located fairly closely to swamps in general and with respect to the other modal category.

A further exploration of Hypothesis 6 involved the examination of the distance to nearest swamp for river drive sites. Those siting river drive camps, which operated exclusively in winter, did not have to worry about proximity to swamps. This comparison provided further insight into the location of railway camps and aided in the resolution of the issues raised above.

As revealed in Table 23, the descriptive statistics indicated that river drive sites were generally located closer to swamps than railway sites. In spite of a non-normal, high skew to the distribution (standard deviation = 0.28, skewness = 2.20, kurtosis = 5.16), the mean (.20), median (0.13) and mode (0.01) were all indicative of locations closer to swamps than for railway camps. The range was almost 0.50 smaller for river drive sites than for railway sites. The frequency histogram for river drive sites also exhibited modality. The first modal category (0.01-0.03) contained 44.4 per cent of the observations in the sample, indicative of locations closer to swamps than with those of the first modal category associated with railway camps (0.01-0.06). Furthermore, it contained a larger percentage of the observations for the river drive sample than the comparable modal category did for the railway sample (44.4

FIGURE 12

DISTANCE TO NEAREST SWAMP FOR RAILWAY SITES

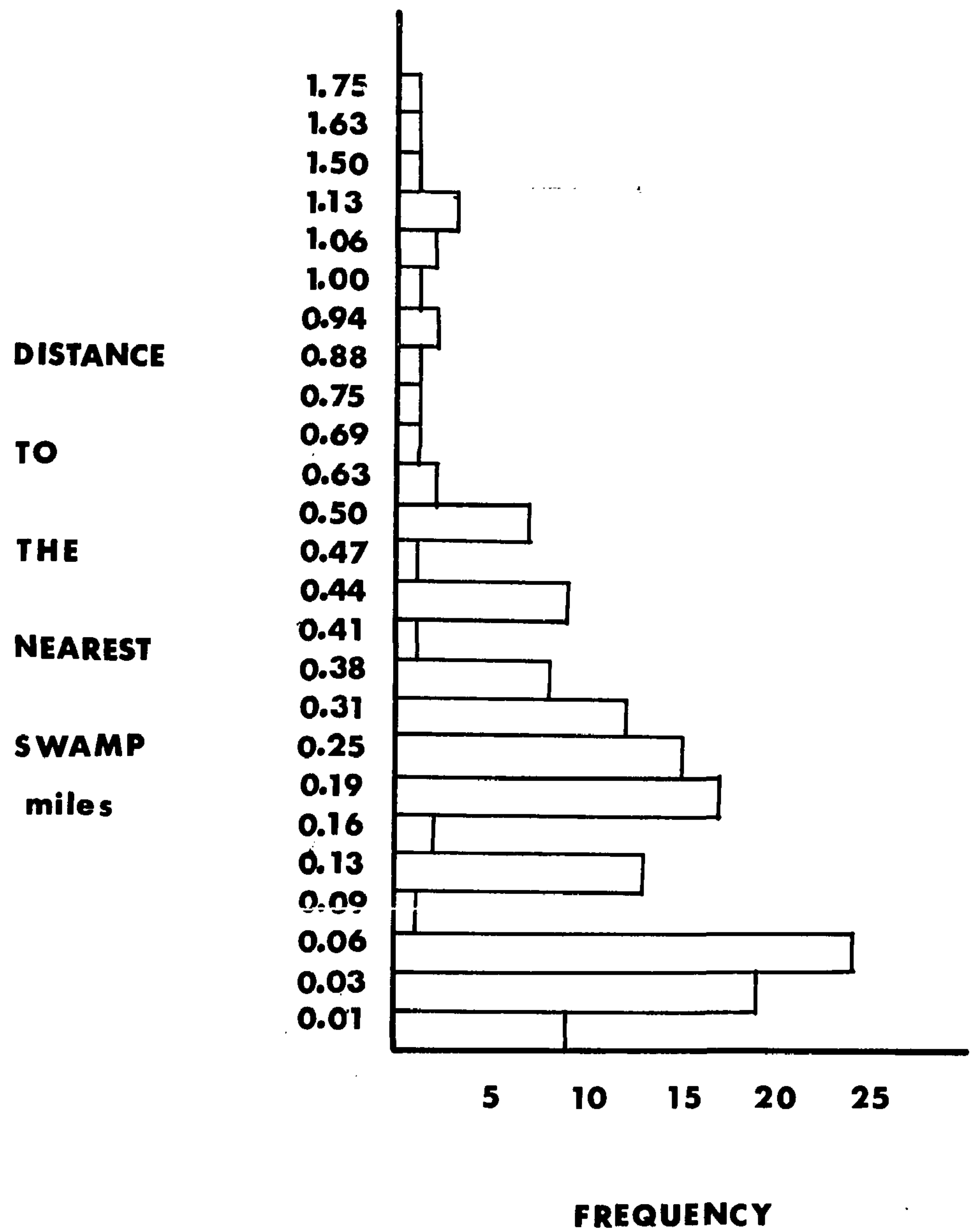

DISTANCE
TO
THE
NEAREST
SWAMP
miles
1.75
1.63
1.50
1.13
1.06
1.00
0.94
0.88
0.75
0.69
0.63
0.50
0.47
0.44
0.41
0.38
0.31
0.25
0.19
0.16
0.13
0.09
0.06
0.03
0.01
5
10
15
20
25
FREQUENCY

FIGURE 12

per cent vs. 33 per cent). The second modal category (0.13-0.25) was also indicative of locations closer to swamps than with the comparable modal category for railway camps (0.19-0.38). It also contained a smaller percentage (28.9 per cent) of the observations for the river drive sample than its counterpart did for the railway sample (32 per cent) (Figure 13).

TABLE 23

DISTANCE TO NEAREST SWAMP

RIVER DRIVE CAMPS

N = 45	Median = 0.13
Mean = 0.20	Mode = 0.01
Standard Deviation = 0.28	Range = 0.01-1.31
Skewness = 2.20	
Kurtosis = 5.16	

From the results of the examination of river drive camps, it was concluded that although railway camps seemed to be located fairly closely

FIGURE 13

DISTANCE TO NEAREST SWAMP FOR RIVER DRIVE SITES

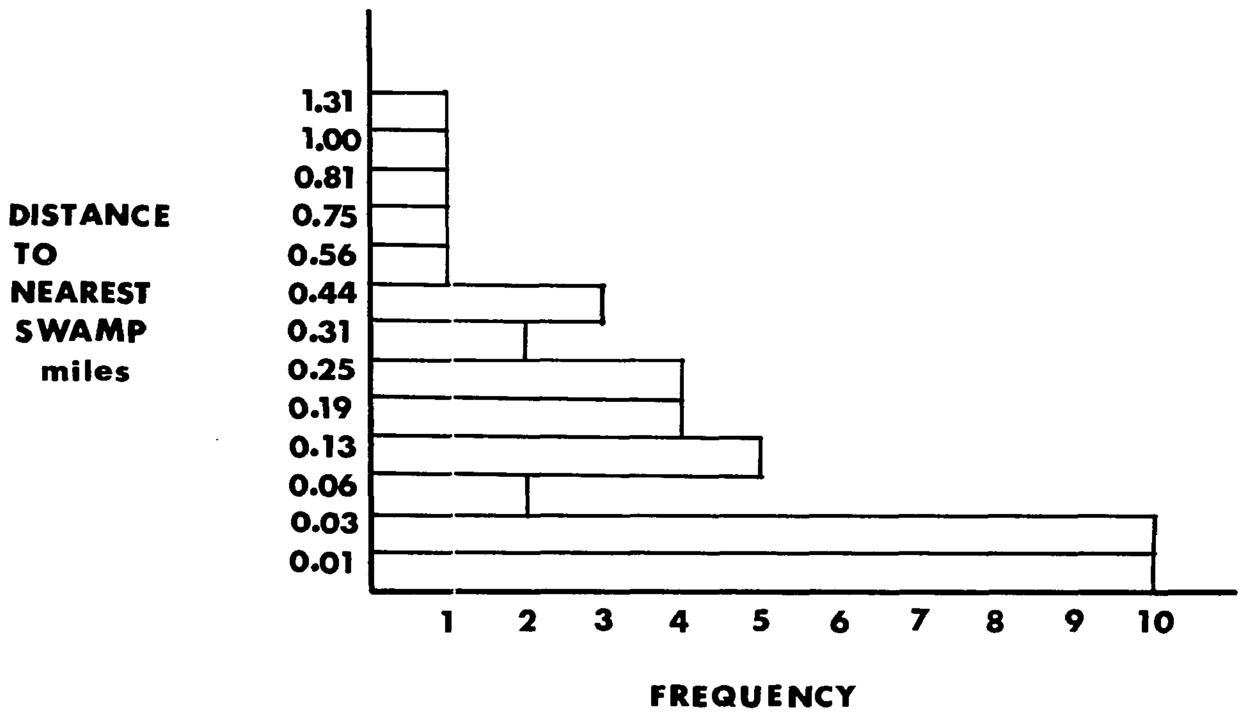

DISTANCE
TO
NEAREST
SWAMP
miles
1.31
1.00
0.81
0.75
0.56
0.44
0.31
0.25
0.19
0.13
0.06
0.03
0.01
1
2
3
4
5
6
7
8
9
10
FREQUENCY

FIGURE 13

to swamps (especially those in the lower modal range category) they were still not as close to swamps as river drive camps. Since river drive logging was restricted to winter when the swamps were frozen, their measures may be taken as a scale against which railway camps can be compared. Since railway camps were generally located further from swamps than river drive camps, this may be interpreted as a response to the conditions of potential for year round logging.

Historical and informant data also shed light on this hypothesis, especially with respect to the apparently small distance from swamps that defines the lower modal category for the railway camp sample. Numerous histories of the logging industry, both in the Great Lakes region and elsewhere, maintained that one of the greatest boons associated with the development of the logging railway was the ability to conduct logging year round. However, the ability to log year round and doing so may not be one and the same. Karamanski (1984:68) noted that with the introduction of the logging railroad, summer logging became an ". . .established practice. . ." He did not, however, indicate how prevalent this practice was. There is reason to believe that summer logging was not predominant in the study area and winter logging dominated the scene until the end of the study period (Franzen 1985).

These historical data have implications for the pattern observed for the distribution of observations of distance to nearest swamp. Specifically, the lower modal category (0.01-0.06) could be representative of those railway camps still devoted exclusively to winter logging when swamps were frozen because their location with respect to swamps closely paralleled that of river drive camps. Railway camps in the second modal category and those further away could be the ones where year round logging was practiced as well as some which were still devoted exclusively to winter logging

Historical data drawn from the 1900 Census of Manufactures, which included a report on the lumber industry, also supported the dominance of winter railway logging. This data was a study of monthly employment in logging camps and sawmills for the entire state. The use of this larger scale data was appropriate because most of the logging activity in Michigan had shifted to the Upper Penninsula by 1900. Although not without its shortcomings (such as incomplete or inconsistent collection) this report revealed an interesting pattern in the employment profile and hence the seasonal patterns of the Michigan logging industry (United States Census Office 1902).

Specifically, logging camp employment was at its highest level during the winter months (December through March) and then declined during the spring and summer, bottoming out in July. Overall, the logging camp workforce decreased by 68 per cent between January and July, while in contrast sawmill employment increased by 50 per cent between December and May. Sawmill employment peaked in May, remained high from June through August and began to decline in September, while throughout the fall logging camp employment increased. Although at no time was there an actual cessation of either logging camp or sawmill operations, the fact that logging employment peaked in winter supports the contention that winter logging continued to dominate the study area. Hence, in spite of the potential for summer logging the railway provided, relatively little was actually practiced (Table 24).

TABLE 24

AVERAGE MONTHLY EMPLOYMENT

MICHIGAN

1900

Month	Logging Camps	Sawmills
January	21,382	17,747
February	21,043	18,896
March	18,930	22,013
April	11,777	26,239
May	9,329	30,637
June	8,052	28,791
July	6,931	26,234
August	7,301	25,598
September	8,508	24,461
October	10,908	22,975
November	15,114	20,894
December	18,005	15,465

Summary

Hypothesis 6 maintained that railway camps would be located as far as possible from swamps to allow for health and sanitary considerations which arose during year round logging. While no specific distance was proposed, the railway camps were compared to the river drive camps, which were exclusively involved in winter logging, to address this problem in a relative fashion. Most observations for river drive logging and railway logging camps could be grouped into two modal categories for each type of camp. Those for river drive camps were closer to swamps than were either of the two categories for railway logging. It was suggested that the railway camp pattern could be explained by the fact that some, but not a dominant amount, of year round logging was practiced. This inference was further supported by the 1900 employment profile for the Michigan lumber industry. In conclusion, Hypothesis 6 has been upheld by the data.

Hypothesis 7

The intersite spacing of river drive camps may be viewed as a function of the effective work zone around each camp. It is therefore expected that river drive camps will generally be located between one and a half and three miles of each other.

Descriptive statistics for the observations on the DNSAMCAM variable (Table 25) revealed that the mean was 1.96 miles for the distance between river drive camps, but with a standard deviation of 1.40, this distribution was not normally distributed. This inference was born out by the skewness (1.19) and kurtosis (1.85) statistics which indicated that the tail to the positive side of the mean was heavier, resulting in a slight high skew to the mean. A better measure of the central tendency for this distribution was either the median (1.81) or the mode (1.81) which happened to be the same for DNSAMCAM. Thus, based on an examination of the descriptive statistics for DNSAMCAM, it can be said that Hypothesis 7 has been accepted since both the mean (1.96) and the median/mode (1.81) lie between 1 1/2 and 3 miles.

TABLE 25

DISTANCE TO NEAREST CAMP OF THE SAME TYPE

RIVER DRIVE CAMPS-MILES

N = 45	Median = 1.81
Mean = 1.96	Mode = 1.81
Standard Deviation = 1.40	Range = 0.09-6.38
Skewness = 1.19	
Kurtosis = 1.85	

The frequency histogram revealed that a bi-modal distribution characterized the DNSAMCAM variable. The first modal category was between 1.81 and 2.13 and contained 9 (20 per cent) of the observations while the second modal category was between 2.75 and 3.00 and contained 6 (13 per cent) of the observations on DNSAMCAM. The remaining variates were evenly distributed across the range. While these modal clusters represented patterns in the data, even when taken together they did not comprise the majority of observations on DNSAMCAM. This argued for a fairly even distribution across the range of values for this variable. Furthermore, only 17 (37 per cent) of the observations occurred below the one and one half mile minimum and only 5 (11 per cent) occurred above the 3.0 mile maximum stated in the hypothesis. Thus, the majority (52 per cent) of the sites fell within the predicted range (Figure 14).

Summary

Hypothesis 7 has been accepted based on the examination of the DNSAMCAM variable for river drive sites. The majority of the sites fell between the one and one half to three mile interval stated in the

FIGURE 14

DISTANCE TO NEAREST CAMP OF THE SAME TYPE
FOR RIVER DRIVE SITES

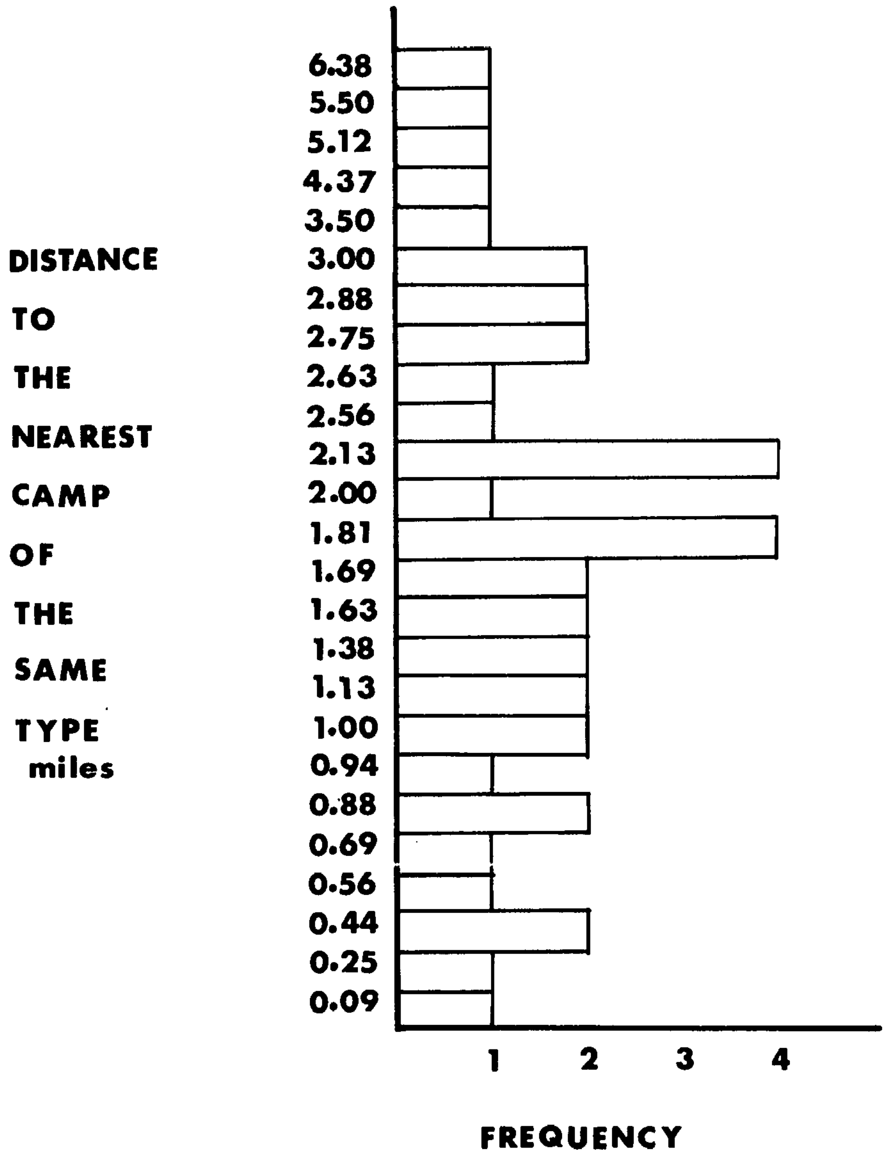

DISTANCE
TO
THE
NEAREST
CAMP
OF
THE
SAME
TYPE
miles
6.38
5.50
5.12
4.37
3.50
3.00
2.88
2.75
2.63
2.56
2.13
2.00
1.81
1.69
1.63
1.38
1.13
1.00
0.94
0.88
0.69
0.56
0.44
0.25
0.09
1
2
3
4
FREQUENCY

FIGURE 14

hypothesis. Moreover, the median/mode, the appropriate measure of central tendency for this distribution, also fell within the stated range.

Hypothesis 8

Intersite spacing of railway logging camps will be a function of the effective work zone around each camp. The work zone in this instance should have as its lower limit a radius of approximately 1 1/2 to 2 miles. It's upper limit is not specifiable at this time.

As illustrated in Table 26, the mean for DNSAMCAM was 1.11 miles. The standard deviation of 0.84 revealed that the observations on this variable were not normally distributed, a proposition born out by the skewness (1.82) and kurtosis (4.65) statistics. All of these measures indicated that the mean was skewed high, most likely attributable to high value marginal outliers to the positive side of the mean. A more appropriate measure of central tendency in this case was the median (0.94).

TABLE 26

DISTANCE TO NEAREST CAMP OF THE SAME TYPE

RAILWAY CAMPS

N = 149	Median = 0.94
Mean = 1.11	Mode = 0.75
Standard Deviation = 0.84	Range = 0.19-5.25
Skewness = 1.82	
Kurtosis = 4.65	

The frequency histogram for DNSAMCAM revealed it to be multi-modal: 0.25-0.50 (38/25.5 per cent), 0.75-1.0 (39/26 per cent), 1.19-1.50 (29/19.4 per cent). Combined, these categories contained 70.9% of the observatons for DNSAMCAM. Around these modal categories, other observations were usually singular and widely dispersed (Figure 15).

Initial interpretation ruled that this data did not conform to what was expected under Hypothesis 8. However, when the hypothesis was being framed, it was mentioned that the work zones around camps might differ from the idealized circle used for river drive sites because the railroad could be used to transport lumberjacks as well as lumber. Moreover, it should be noted that some authorities recommended the construction of railroad spurs at 0.25 to 0.50 mile intervals with these lines intended for a number of years use to amortize the cost of their construction. Taking these consideratons as a corollary to Hypothesis 8, a re-examination of the data distribution produced some interesting patterns. First, the three modal categories (i.e. 0.25-0.50, 0.75-1.0, 1.19-1.50) were almost harmonic repetitions of the 0.25-0.50 mile distance. Specifically, each of the modal categories was approximately 0.25 in size and was separated from the other categories by a gap of approximately 0.25. Although contradictory to the original Hypothesis 8 this evidence fits in well with the corollary. These modal categories clustered around the intervals expected if loggers used multiples of 0.25-0.50 miles to construct logging railways. As would be expected, most of the sites fell within the lower two modal categories.

The cartographic evidence presented in Figures 16 and 17 provided further support. The source for Figure 16 was a map prepared in 1932 when the Hiawatha National Forest was created which shows recently abandoned

FIGURE 15

DISTANCE TO NEAREST CAMP OF THE SAME TYPE
FOR RAILWAY SITES

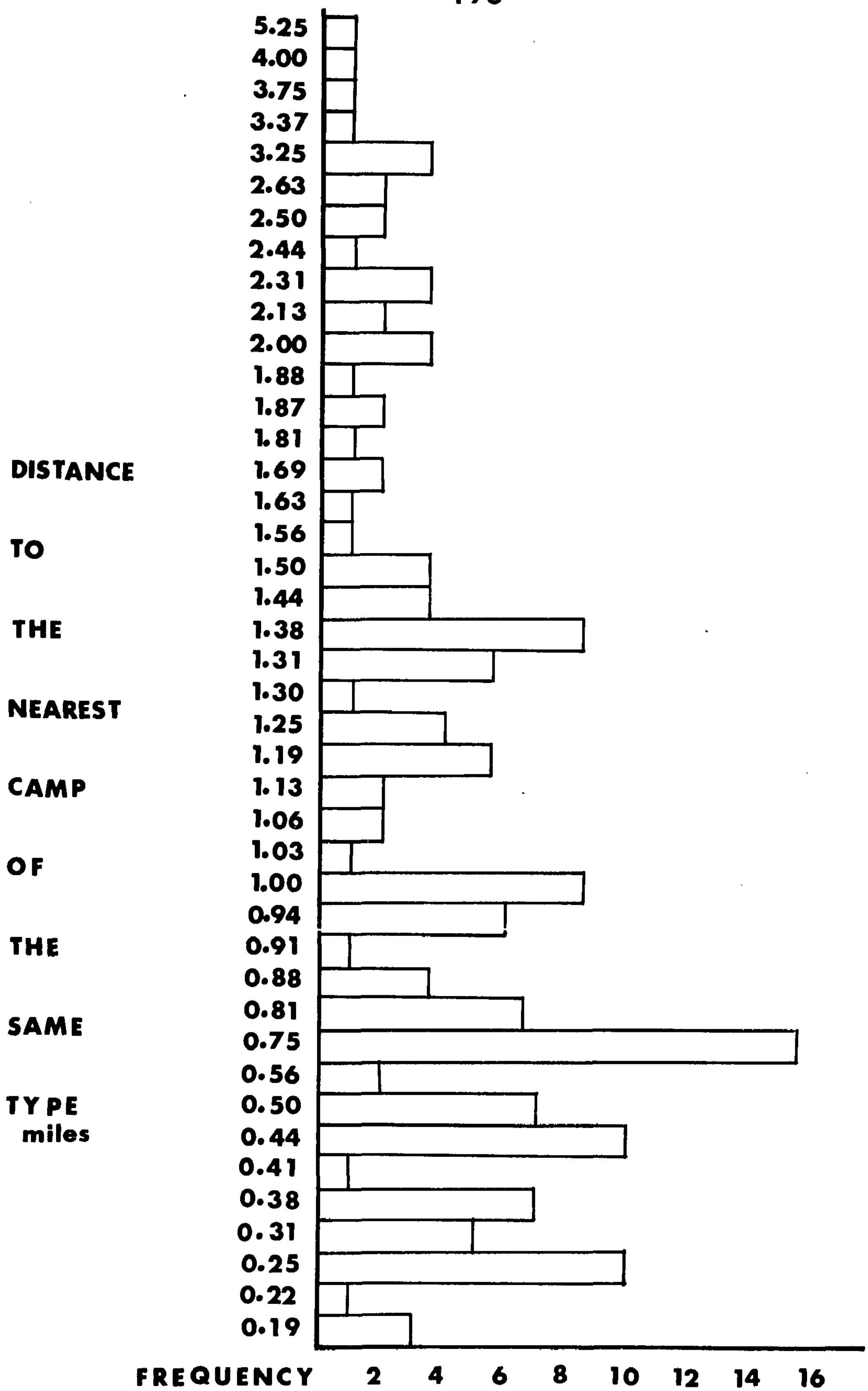

5.25
4.00
3.75
3.37
3.25
2.63
2.50
2.44
2.31
2.13
2.00
1.88
1.87
1.81
1.69
1.63
1.56
1.50
1.44
1.38
1.31
1.30
1.25
1.19
1.13
1.06
1.03
1.00
0.94
0.91
0.88
0.81
0.75
0.56
0.50
0.44
0.41
0.38
0.31
0.25
0.22
0.19
DISTANCE TO THE NEAREST CAMP OF THE SAME TYPE miles
FREQUENCY
2
4
6
8
10
12
14
16

FIGURE 15

FIGURE 16

T44N R19W LOGGING RAILWAYS

(After Hiawatha Nationa Forest Map 1932)

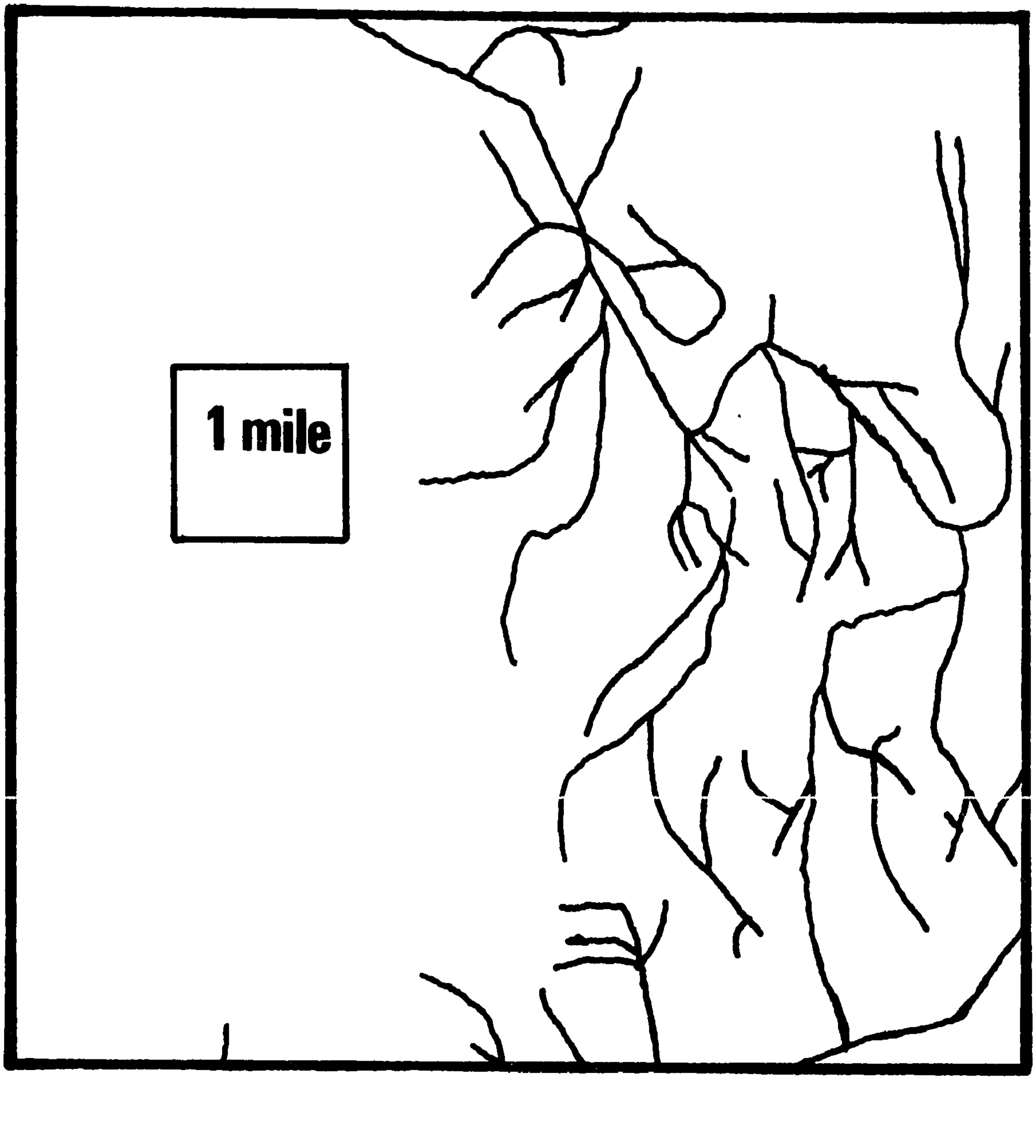


FIGURE 16

FIGURE 17

T46NR20W LOGGING AND MAIN LINE RAILWAYS

(After Hiawatha National Forest Site File)

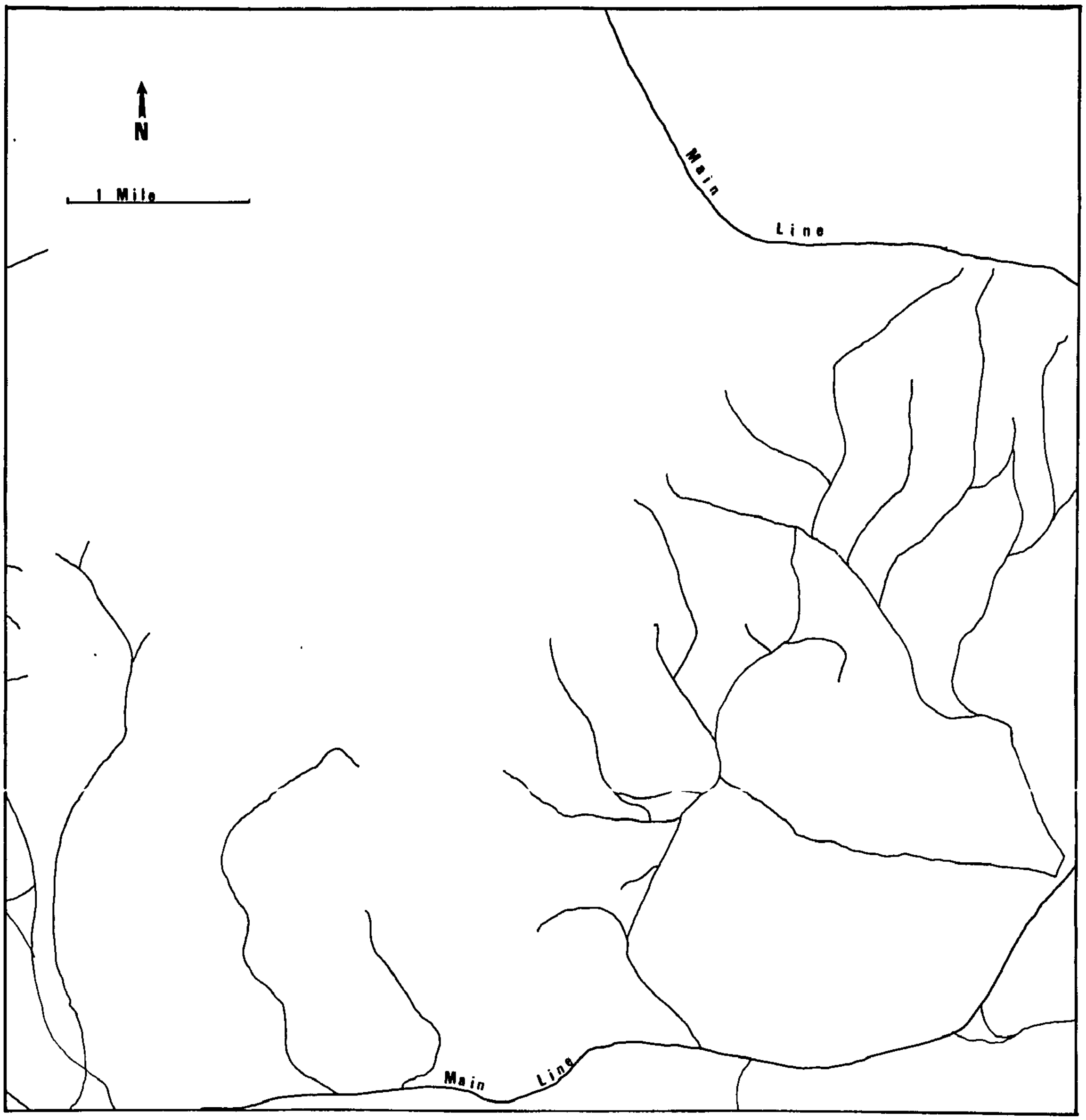


FIGURE 17

logging railways in the interior of the Upper Penninsula. The locational patterns showed that logging railways were built according to preconceived intervals. Figure 17 shows an area that has been fairly well researched and the railways on this map also indicated a construction pattern similar to that described above. Thus, there was evidence supporting the proposition that such a construction pattern was typical of the study area.

While researching his historical overview of the Hiawatha National Forest and the logging frontier, Karamanski (1984) interviewed a number of informants and examined a number of primary documents. Significant among the informant commentary was the fact that the camps were located to maximize utilization potential. "You want five winters from a camp because it costs you too much to build all them camps and to build your ice road, all that..." (Karamanski 1894:78). Moreover, company records revealed that a great deal of long range planning went into the selection of sites and the construction of logging railroads. For example, the Cleveland Cliffs Corporation did its planning on a ten year basis (Karamanski 1984).

Summary

Although the observations on the DNSAMCAM variable did not allow for the acceptance of Hypothesis 8 as originally stated, interesting results were obtained. Logging railroads, and by inference camps, were constructed in harmonic intervals. This proposition, based on the modal categories of observations on DNSAMCAM, is supported by cartographic evidence as well as by informant data and allows the inference that railway logging camps had an effective work zone which differed in size and shape than that around river drive camps. Camps were located at multiples of 0.25 to 0.50 miles from each other to correspond to recommended intervals for railway construction. Given the rate of cutting that occurred in the study area, it would not have been possible for camps to last for more than one season if cutting was restricted to the 0.25-0.50 interval between camps. Therefore, it was inferred that the work zone around the camps was most likely a generally ellipsoidal or triangular shape. Some variation was to be expected in the shapes of the work zones since perimeter railway camps may have different work zone criteria and local topographic conditions might cause the recommended methods of railway construction to be altered.

Hypothesis 9

The logging frontier, whether river drive or railroad, should contain three types of sites: camps, intermediate supply centers, and entrepots. These should exist in a hierarchical relationship to each other with camps being the most numerous followed by intermediate supply centers and entrepots, either singular or few in number.

Preliminary Considerations

Hypothesis 9 is the first hypothesis in which the distinction between intermediate supply centers and entrepots had to be made. This process involved several steps beginning with a simple frequency and descriptive statistic tabulation of the variables recorded for these settlements, as described in Chapter 5. An examination of the results of this tabulation revealed several things. First, for a number of continuous variables there were only zero (0) entries or only one or two observations with entries of one (1), representing a lack of available data rather than absence of the characteristic. Since such variables are of limited or no use, the following variables were deleted: logging equipment dealers, real estate brokers, banks, lawyers, warehouses, hospitals, and distance to nearest road. This last variable was deleted because all settlements were located on roads.

Secondly, two variables were originally recorded as continuous variables but they had only two alternative values, zero and one. In this case the zero value meant that none were present and was not representative of an unknown situation. Therefore, these two variables (post office, railway stations) were converted to nominal scale variables.

Finally, an examination of the descriptive statistics for the continuous variables in this sample showed that some were approximately normally distributed while others were not. Since normality of distribution is a presupposition for most of the more sophisticated statistical methods as well as the mechanism by which simple descriptive statistics such as the mean, standard deviation, etc. are given meaning, only those variables with approximately normal distribution were included in the more sophisticated analysis. These variables were number of rail lines within two miles; distance to the nearest logging camp; local, state or federal government facilities; heavy industry; population 1900; population 1910; and population 1920.

Three Types of Sites

The first part of Hypothesis 9 maintained that there should be three types of sites on the logging frontier: camps, intermediate supply centers, and entrepots. The simplist of these distinctions (that between camps and the other two types of sites) was considered an a priori given at the beginning of this research. Therefore, they were acknowledged as one component of the frontier settlement system and attention was focused on the problem of distinguishing between intermediate supply centers and entrepots.

As discussed in Chapter 5, an a priori classification of the settlements grouped them as either entrepots or intermediate supply centers. With this distinction established, it could be tested by examining the two groups to determine if they were significantly different. If they differed, it could be inferred that there were entrepots and intermediate supply centers on the logging frontier.

The nominal scale variables were investigated by an examination of their frequencies, histograms, and a cross tabulation and/or a chi square of site type by variable. The nominal scale variables included were port, relative occupation, type of nearest water, direct link to homeland, post office, type of nearest railway, type of nearest logging camp, terminus of a logging railorad, and terminus of a main line railroad.

The port variable displayed a clear distinction between those settlements tentatively classified as intermediate supply centers and entrepots. As shown in Table 27, all of the proposed entrepots were ports, while only 4 (14.8 per cent) of the proposed intermediate supply centers were ports, establishing that there was a significant difference between the entrepot and intermediate supply centers on the basis of possessing port facilities.

TABLE 27

CROSSTABULATION

SETTLEMENTS BY PORT VARIABLE

Settlement Type	Port: Absent	Present	Total
Intermediate Supply Center	23 (85.1%)	4 (14.8%)	27 (100%)
Entrepot	0	6 (100%)	6 (100%)
			33

Continuity Adjusted $X^2 = 13.0$

df = 1

X^2 (0.05) = 3.84

Fisher's Exact Test P = 0.0002

This data was further explored through the use of several non-parametric statistics, however, because the overall sample size was small and because more than one cell had values less than or equal to 5, the chi square test was not used. The continuity adjusted chi square, a chi square computed to allow for the conditions described above, was used to test the null hypothesis that there was no relationship between the two variables comprising the table. The Fisher's exact test measured the probability that the data table was created by random process (Blalock 1972, Downie and Heath 1974, Reynolds 1984, SAS Institute 1985b).

When the measures were examined for Table 27, the adjusted chi square rejected the hypothesis of independence of association at the 0.05 level. Furthermore, Fisher's exact test indicated that there was only a 0.0002 probability that the distribution in the table ocurred as the result of random processes. The a priori distinctions between entrepots and supply centers were substantiated based on these measures and the frequency distribution presented in Table 27.

The relative occupation variable data revealed that settlements classified as entrepots were less clearly distinguished from those classified as intermediate supply centers. All of the entrepots existed during the late nineteenth century through the early twentieth century, while only 51 per cent of the intermediate supply centers existed throughout this same period. Some were earlier (3.7 per cent), while others (44.2 per cent) were restricted to the early twentieth century. Hence, there was some similarity between intermediate supply centers and entrepots (Table 28).

TABLE 28

CROSSTABLULATION

SETTLEMENTS BY RELATIVE OCCUPATION

Settlement Type	Relative Occupation: late 19th	late 19th/early 20th	Early 20th	Total
Intermediate Supply Center	1 (3.7%)	14 (51.8%)	12 (44.4%)	27 (100%)
Entrepots	0	6 (100%)	0	6 (100%)

Contingency Coefficient = 0.35

Contingency Coefficient (max) = 0.70

Cramer's V = 0.38

The data in Table 28 were also examined with the contingency coefficient and Cramer's V (Downie and Heath 1974, Reynolds 1984, SAS Institute 1985b). These are chi square based measures of association designed to be used with assymetric tables. They range from 0 to 1, with 0 equalling complete independence and 1 equalling complete dependence. Furthermore, the maximum value of the contingency coefficient may be adjusted to account for the level of assymetry in the table. This examination revealed that, in terms of the contingency coefficient, the values in the table were midway between completely independent and completely associative. Cramer's V also revealed that the data in the table were between independence and association. In this latter case, the measure indicated that the data were closer to independence than to association. Thus, occupation did not clearly distinguish between entrepots and intermediate supply centers.

Next the relationship between the two hypothesized types of settlements and the type of nearest water was examined. As Table 29 illustrates, this variable introduced a noticeable distinction between the two types of settlement. For the intermediate supply centers, three roughly equal categories (streams, rivers, Great Lakes) contained a larger number of settlements than the other two categories. Most of the entrepots (83.3 per cent) were associated with Great Lakes. The remaining entrepot (which constituted 16.7 per cent of the sample) was probably associated with a Great Lake and a river mouth or an interdunal lake. Type of nearest water, then, upheld the distinction between entrepots and intermediate supply centers.

TABLE 29

CROSSTABULATION

SETTLEMENTS BY TYPE OF NEAREST WATER

Settlement Type	Streams	River	Lake	Great Lake	2 or more	Total
	Type of Nearest Water					
Intermediate Supply Centers	8 (29.6%)	9 (33.3%)	2 (7.4%)	6 (22.2%)	2 (7.4%)	27 (100%)
Entrepots	0	0	0	5 (83.3%)	1 (16.7%)	6 (100%)

Contingency Coefficient = 0.49

Contingency Coefficient (max) = 0.70

Cramer's V = 0.56

The contingency coefficient and Cramer's V indicated that there was some association between settlement type and type of nearest water, since both were over the midpoints of their ranges for this particular table. Thus both indicated association between settlement type and type of nearest water, revealing discernable differences between entrepots and intermediate supply centers.

The next variable concerned direct linkage to the homeland. Since this variable was merely a reflection of the port variable, a table identical to Table 27 was produced. Furthermore, the conclusions reached from the examination of this variable were the same as those reached in the examination of the port variable. Therefore, it is safe to say that entrepots were more directly linked to the homeland than were intermediate supply centers.

The post office variable was examined next. As can be seen in Table 30, a majority of the intermediate supply centers (62.9 per cent) did not have post offices. In contrast, 100 per cent of the entrepots had post offices. On the basis of frequency alone there was a significant difference between entrepots and intermediate supply centers, which was further substantiated by the continuity adjusted chi square and Fisher's exact test. The chi square was significant at the 0.05 level, indicating that the data distribution of observations in the table were not independent. The Fisher's exact test indicated that the distribution observed in Table 30 had only a 0.007 probability of random occurrence. Therefore, in terms of the post office variable, intermediate supply centers and entrepots differed significantly.

TABLE 30

CROSSTABULATION

SETTLEMENTS BY POST OFFICES

	Post Office		
Settlement Type	Absent	Present	Total
Intermediate Supply Center	17 (62.9%)	10 (37.1%)	27 (100%)
Entrepots	0	6 (100%)	6 (100%)

Continuity Adjusted $X^2 = 5.47$

df = 1

X^2 (0.05) = 3.84

Fisher's Exact Test P = 0.007

The type of nearest railway associated with each settlement type revealed some differences between the two. As shown in Table 31, main line railways were most frequently (74 per cent) associated with intermediate supply centers, followed by logging railroads (18.5 per cent), and junctions (7.4 per cent). Entrepots were most frequently associated with junctions (66 per cent) and mainline railroads (33.3 per cent). This frequency data revealed that there were some noticeable differences between the type of railways associated with entrepots versus those associated with intermediate supply centers. This was further born out by the contingency coefficient and Cramer's V. The contingency coefficient was well over half way to its maximum value, indicating that the data tended toward complete association. Cramer's V also indicated that the data tended toward association, abeit not as strongly as the contingency coefficient. Therefore, on the basis of the nearest railway variable, entrepots and intermediate supply centers were determined to be separate.

TABLE 31

CROSSTABULATION

SETTLEMENTS BY TYPE OF NEAREST RAILWAY

	Nearest Railway			
	Logging	Mainline	Junction	Total
Settlement Type				
Intermediate Supply	5	20	2	27
Centers	(18.5%)	(74.0%)	(7.4%)	(100%)
Entrepots	0	2	4	6
		(33.3%)	(66.6%)	(100%)

Contingency Coefficient = 0.51

Contingency Coefficient (max) = 0.70

Cramer's V = 0.60

The type of logging camp nearest each of the settlements did not reveal as many differences between the two types of settlements as did some of the other variables. In general, both entrepots and intermediate supply centers were most closely located near unknown camps, followed by railway camps and river drive camps (Table 32). The contingency coefficient was less than halfway between 0 and 0.70 (max) indicating a tendency towards independence rather than association between the two variables. Cramer's V supported the contingency coefficient, providing further evidence that the two types of settlements could not be differentiated through reference to type of nearest logging camp.

TABLE 32

CROSSTABULATION

SETTLEMENTS BY NEAREST LOGGING CAMP

	Nearest Logging Camp			
	Unknown	River Drive	Railway	Total
Settlement Type				
Intermediate Supply	17	1	9	27
Centers	(62.9%)	(3.7%)	(38.3%)	(100%)
Entrepots	3	1	2	6
	(50%)	(16.7%)	(33.3%)	(100%)

Contingency Coefficient = 0.21

Contingency Coefficient (max) = 0.70

Cramer's V = 0.21

The settlements were also evaluated as to whether or not they were the terminus of a logging railway. As Table 33 illustrates, little difference was discernable between entrepots and intermediate supply centers. None (100 per cent) of the entrepots were the terminus of a known logging railroad, nor were most (88.9 per cent) of the intermediate supply centers. This was supported by the continuity adjusted chi square, which was not significant at the 0.05 level, and by Fisher's exact test, which indicated that this distribution was attributable to random processes.

TABLE 33

CROSSTABULATION

SETTLEMENTS BY TERMINUS OF LOGGING RAILWAY

	Terminus of Logging Railway		
	Absent	Present	Total
Settlement Type			
Intermediate Supply	24	3	27
Centers	(88.9%)	(11.1%)	(100%)
Entrepots	6	0	6
	(100%)		(100%)

Continuity Adjusted $X^2 = .0005$

df = 1

X^2 (0.05) = 3.84

Fisher's Exact Test P = 1.00

The final nominal scale variable was whether or not these settlements were the terminus of a main line railway. Analysis revealed some differences between the two types of settlements in that none (100 per cent) of the intermediate supply centers were located at the terminus of a main line railway while half (50 per cent) of the entrepots were (Table 34). This interpretation of frequency distribution was further supported by a continuity adjusted chi square which was significant at the 0.05 level. Moreover, Fisher's exact test revealed that the distribution observed in Table 34 had only a 0.003 probability of random occurrence. Therefore, the analyses of this variable substantiated the premise that entrepots and intermediate supply centers were separate and distinct phenomena.

TABLE 34

CROSSTABULATION

SETTLEMENTS BY TERMINUS OF MAIN LINE RAILWAY

	Terminus of Main Line Railway		
	Absent	Present	Total
Settlement Type			
Intermediate Supply	27	0	27
Centers	(100%)		(100%)
Entrepots	3	3	6
	(50%)	(50%)	(100%)

Continuity Adjusted $X^2 = 9.41$

df = 1

X^2 (0.05) = 3.84

Fisher's Exact Test P= 0.003

The nominal scale variables supported the proposition that there were differences among the settlements which allow their classification as either intermediate supply centers or entrepots, with six out of eight nominal variables fully supporting the proposition.

Continuous Variables

Continuous variables were used in this analysis only if they were approximately normally distributed. The number of rail lines within two miles; distance to the nearest logging camp; local, state, and federal government functions; heavy industry; population 1900; population 1910; and population 1920 were the variables satisfying this stipulation. As with the nominal scale variables, the methodology in this section focused on distinguishing between probable entrepots and probable intermediate supply centers.

Discriminant analysis examined the continuous variables of the two groups allowing both groups to be examined simultaneously with respect to several variables. One of the more important aspects of this methodology was that it not only analyzed the two groups with respect to their cohesiveness as groups but also indicated those members of each group which might be more appropriately classified into the other group. This afforded a more comprehensive check on the whole classification scheme than did the methods used earlier with the nominal scale variables (Klecka 1980, SAS Institute 1985b).

The discriminant analysis results generally confirmed the a priori classification of the settlements. All of the settlements (100 per cent) classified as intermediate supply centers remained classified as such. Likewise most (66.6 per cent) of the settlements previously classified as enterpots remained so classified. Two of the entrepots were reclassified as intermediate supply centers: Nahma and Rapid River (Table 35).

TABLE 35

DISCRIMINANT ANALYSIS RESULTS

RECLASSIFICATION

From	To	
	Intermediate Supply Center	Entrepot
Intermediate Supply Center	27 (100%)	0
Entrepot	2 (33.3%)	4 (66.6%)

Settlements reclassified as Intermediate Supply Centers: Nahma
Rapid River

Since Nahma and Rapid River were reclassified, they were examined more closely to ascertain if there were any readily apparent reasons why this occurred. Of the two, Rapid River had the higher posterior probability of belonging to the intermediate supply center group. A close examination of the variables revealed that Rapid River had lower population counts (population 1900, 1910, 1920) than did the other entrepots, with the exception of Nahma. In the absence of direct census data for Rapid River an averaged township population figure was used. Thus, the population data for Rapid River was probably not representative of true size. Moreover, Rapid River was also one of the least well documented entrepots with respect to the other variables. No data were available for heavy industry and local, state, federal government facilities, resulting in zero entries. Hence, Rapid River's incorrect reclassification occurred because of missing or underrepresented data.

Nahma's reclassification reflected some of the same reasons as Rapid River's, although its posterior probability (0.74) of belonging to the intermediate supply center group was not nearly as strong as Rapid River's. As with Rapid River, Nahma's population was recorded using the township averaging method, which resulted in an underrepresentation of its population. Although Nahma was well represented on a number of variables, many of these were not used in the analysis because they were not approximately normally distributed for the sample as a whole. Hence, while the data was present for Nahma, the behavior of certain variables within the sample as a whole precluded its inclusion in the final analysis. Therefore, missclassification was attributable to underrepresentation on the population variables and because variables on which Nahma was well represented did not meet the criterion of approximately normal distribution for the sample as a whole. In terms of settlement composition, the logging frontier was characterized as predicted in Hypothesis 9.

A Hierarchy of Settlements

The second part of Hypothesis 9 maintained that the logging frontier was characterized by a hierarchy of settlements, with camps being the most numerous followed by intermediate supply centers and entrepots. This proposition was initially addressed using the pooled sample of sites from the study area, which resulted in a count of 6 entrepots, 27 intermediate supply centers and 194 logging camps. If all potential camps had been included rather than only those of known temporal/technological affiliation, the number of logging camps would have been 444. Based on this initial data, the second part of Hypothesis 9 was upheld. Further examination of this question was pursued by grouping the camps, entrepots and intermediate supply centers according to temporal/technological associations.

River Drive Era

There were 45 verifiable river drive camps in the study area. Their modal decade was between 1881 and 1890, with most (40) of the sample occurring between 1871 and 1900 (see Hypothesis 4). All of the entrepots under consideration were either in existance before this period or established during it. Twelve of the intermediate supply centers existed before the period (3) or came into existance during it (9). Thus, the hierarchy proposed for the logging frontier was upheld with respect to the river drive era.

Railway Era

A similar analysis studied the railway temporal/technological association. In this case the temporal control on the logging camp sample was less complete than that of the river drive camps since about 63 per cent (94) of the railway camps could not be specifically dated. Therefore the analysis was restricted to that segment of the sample where there was temporal control. Of this group 14 (25 per cent) dated before 1900, overlapping with part of the river drive sample. The remainder of the sample (41/75 per cent) occurred after 1900. All six of the entrepots existed throughout this period. Fifteen (15) intermediate supply centers developed raising the total of intermediate supply centers to 25.

These results supported Hypothesis 9. The intermediate supply center frequency initially appeared to be large for the number of camps in the study area. If the pre-1900 railway camps were included, the number of camps increased to 55. While this still seemed a bit small for the number of intermediate supply centers, it should be remembered that most (63 per cent) of the known railway camps were not included in this analysis because there was no specific temporal information available. It was also noted that there was a large group (250) of unknown camps. Presumably a number of these were railway camps (and river drive) which, had temporal information been available, would have raised the total number of camps present in both samples. Moreover, since entrepots and intermediate supply centers were more visible in the data, their numbers probably were more accurately represented than those of the camps. All things considered, Hypothesis 9 was supported by this analysis.

Hypothesis 9, therefore, has been satisfied both in terms of settlement composition and in terms of settlement heirarchy. Not only were three types of sites demonstratead to exist on the logging frontier, but also their arrangement corresponded to the predicted heirarchy. It is now appropriate to consider additional hypotheses which address the individual types of settlements found on the logging frontier.

Hypothesis 10

Intermediate supply centers will be camp oriented and function to supply the subsistence and technological needs of the logging camp as well as provide transportation/communication links with the entrepot and various personal goods/services for the workers. When camp locations move intermediate supply centers will move or cease to exist.

Missing or idiosyncratic data posed special problems in dealing with this hypothesis. In some cases, adjustments were made to the quantitative data or to the type of questions the quantitative data were used to address. In other cases subjective data had to be substituted for or used in conjuction with quantitative data in order to adequately address a topic.

Camp Orientation, Goods and Services

Hypothesis 10 maintained that intermediate supply centers would be camp oriented to function almost exclusively to provision logging camps and provide transportation/communication links with the outside world. This proposition was generally supported by the results of the analysis (Table 36). In terms of transportation, most (23/85 per cent) of the intermediate supply centers were located on a rail line. Four (15 per cent) were not located on rail lines and ranged between 0.88 to 4.5 miles from the nearest rail line. Furthermore, the three most distant of these had no railway station, which precluded the possibility that they could have been connected to the main line by a spur. The available data indicated that one of these settlements was most likely associated with the earlier river drive era and was abandoned before the rise of the railway logging era. While the other two settlements dated to the railway era there was no data to indicate that they were any closer to rail lines. Perhaps the line or spur on which they were located was torn up before it was recorded on any generally available map or other written sources. In spite of these four anomalous cases, Hypothesis 10 was supported.

TABLE 36
INTERMEDIATE SUPPLY CENTERS
ASSOCIATED ACTIVITIES

Activity/Characteristic	Value	Number	Percent
Distance to Nearest Railway	Located on	23	8.5
	0.88 mi.	1	3.7
	2.50 mi.	1	3.7
	4.00 mi.	1	3.7
	4.50 mi.	1	3.7
Type of Nearest Railway	Mainline	20	74.0
	Logging	5	18.5
	Junction	2	7.4
Railway Station	Present	24	88.9
	Absent	3	11.1
Other Railway Facilities	Present	4	14.8
	Absent	23	85.2
General Store	None	19	70.0
	1	4	14.8
	2	3	11.1
	4	1	3.7
Post Office	Present	10	37.1
	Absent	17	62.9
Saloon/Hotel/Whorehouse	None	22	81.4
	1	3	11.1
	3	1	3.7
	4	1	3.7
Specialized Retail	None	23	85.0
	1	2	7.4
	2	1	3.7
	3	1	3.7
Local/State/Federal Govt.	None	21	77.8
	1	3	11.1
	2	1	3.7
	4	2	7.4
Heavy Industry	None	23	85.0
	1	3	11.1
	2	1	3.7
Light Industry/Service	None	20	74.0
	1	1	3.7
	2	2	7.4
	3	1	3.7
	5	2	7.4
	10	1	3.7

TABLE 36 (cont'd.)

Activity/Characteristic	Value	Number	Percent
Lumber Mills	None	18	66.6
	1	4	14.8
	2	2	7.4
	3	2	7.4
	4	1	3.7
Retail/Wholesale Timber Agents	None	21	77.8
	1	4	14.8
	2	1	3.7
	5	1	3.7
Type of Nearest Water	Streams	8	29.6
	Major River	9	33.3
	Lake	2	7.4
	Great Lake	6	22.2
	Two of the Above	2	7.4

The fact that most of the intermediate supply centers were located on rail lines and had railway stations indicated, inferentially, that they were also communicationally well connected. It was assumed that the post office variable would more strongly support the hypothesis of connectivity, yet only 37.1 per cent of the intermediate supply centers had post offices, a finding which seemed somewhat contradictory. However, an examination of relevant historical and demographic data cleared the contradictions. First, settlements without post offices were smaller and contained fewer other activities than those with post offices. Therefore, the presence of a post office related to the number of other activities present in the settlement rather than to its location on a rail line.

Secondly, historical evidence revealed that some intermediate supply centers received their mail from an adjacent intermediate supply center which had a post office. Therefore, having fewer post offices than settlements was the norm and did not indicate missing data (Reimann 1982).

Finally, the demographics of the loggers influenced the role of post offices. The lumberjack population was typically described as a polyglot, multi-ethnic group with little formal education. Given this description, it may be inferred that even though they were the largest population on the frontier, they had little use for postal service. Communication between the company and the camp superintendent could be transmitted along the rail lines to any intermediate supply centers with a railway station since the railway companies and logging companies were usually one and the same. From there messages would be carried to the camps. Hence, only settlements with activities other than service as a railhead for logging companies were candidates for direct postal service (Bohn 1937, Draper 1930, Dye 1975, Hulbert 1960, Reimann 1982, Wells 1978).

Another role of the intermediate supply center was providing for the subsistence and technological needs of the logging camps and providing personal goods/services for the loggers. The data revealed that 30 per cent of the intermediate supply centers contained one or more general stores and 15 per cent of the intermediate supply centers contained specialized retail activities. General stores provided a variety of goods and services not only to the loggers but also to local inhabitants and not only sold a variety of products, but also served as post offices, banks, and occasionally railway stations. Specialized retail activities (e.g. shops specializing in a limited range of products) by definition were focused on the unique needs of their markets. It was surprising, in general, that specialized retail activities occurred even infrequently in intermediate supply centers. Moreover, given the multiple roles played by the general store, it might be expected that they would be more prevalent than the data indicated. There were several reasons why this was not the case.

First, all intermediate supply centers were not equal. Some contained a variety of activities while others apparently served only as railheads for nearby logging operations. Although there was no direct evidence as to how this pattern developed, historical data allowed some speculation. One explanation relates to the presence of farming in the study area. Shortly after the logging boom began farmers moved in and began farming the cut over lands. The timber companies encouraged such activity since it gave them a nearby source of fresh food for the camps. The farmers also benefited from this symbiotic relationship because they were able to profitably farm marginal land, knowing that they would get their asking prices from the logging companies. It was surmised that those intermediate supply centers which contained a great number of activities were also the centers of farming in the area. Hence, they had a steady year-round population which formed a market base to support a number of economic activities (Karamanski 1984).

Secondly, some intermediate supply centers were located nearer to areas of higher density logging than others. When the total logging activity around a given intermediate supply center was greater than that around another, it contained a greater number of activities. Also, the logging activity around a given intermediate supply center might be closer to the settlement than was the case of other intermediate supply centers. In this case, the intermediate supply center would contain a greater number of activities to serve a more accessible market, regardless of the total amount of logging activity in the area. Furthermore, as logging activity moved away from settlements, they experienced decline, since it was increasingly difficult for their clientele to reach them. There is evidence that this latter process occurred in the study area (Dodge 1973, Karamanski 1984, Reimann 1982).

Finally, camp stores played a role in limiting the loggers patronage of establishments in the intermediate supply centers. Each camp had a camp store which stocked a variety of personal items (with the exception of liquor) needed by the loggers. Camp stores were run on a credit basis and located in the camp; so the logger didn't need ready cash or have to travel any distance to make a purchase. While the presence of camp stores probably did not inhibit the growth of an intermediate supply center where there was another population to serve, they could have held growth in check because the loggers were only seasonally available as customers. Moreover, it was unlikely that an intermediate supply center would grow beyond a railhead so long as it relied solely on the loggers as a source of commerce (Bohn 1937, Draper 1930, Dye 1975, Hulbert 1960, Reimann 1982, Wells 1978).

Two logging related activities occurred in some of the intermediate supply centers: lumber mills (33.4 per cent) and retail/wholesale timber agents (22.2 per cent). The presence of lumber mills was unexpected since it was anticipated that they would occur only at entrepots. However, following the argument presented above, it was most likely that these lumber mills served the local population, as small facilities that catered to local demand. The presence of timber agents is less problematical. They most likely sold lumber to local concerns or arranged for the purchase of the odd stand of timber not already under the control of one of the area's dominant companies.

Light/service industries were present in 26 per cent of the intermediate supply centers and heavy industry was present in 15 per cent of the intermediate supply centers. The presence of the former was expected given the pattern of well developed and underdeveloped intermediate supply centers that emerged from this research. Light/service industries included such activities as black smithing, barber shops, wagon repair, etc. These activities were expected in small towns that serviced local farming and/or small scale maufacturing communities. They were also activities that serviced the needs of a seasonal influx of loggers or a request for a specialized repair/job from a logging camp supervisor. The presence of heavy industry was more problematical since these activities were generally expected to be associated only with entrepots. Perhaps an intermediate supply center provided advantageous location for such an activity. In any event, this activity occurred in a minority of the intermediate supply centers and therefore provided no grounds for the rejection of Hypothesis 10.

Local, state, or federal government functions occurred in only 22.2 per cent of the intermediate supply centers, and in all cases were restricted to law enforcement. These officials were there to maintain law and order, if possible, when lumberjacks visited the settlement (Dodge 1973, Reimann 1982, Wells 1978).

A final activity, saloon/hotel/brothel, occurred in 18.6 per cent of the intermediate supply centers. This figure was somewhat lower than expected given the historical documentation and the fact that there were more intermediate supply centers capable of supporting such activities than the 18.6 per cent in which they occurred. A re-examination of Dodge (1973), the source of settlement data, revealed that he inconsistently recorded data about these establishments, even when other sources indicated their existance. For this reason, 18.6 per cent was accepted as the minimum figure for such activities among the intermediate supply center sample. Given the periodic nature of the lumberjack influx these establishments needed to be located in a larger intermediate supply center which had a local population to service and which might also be a more likely stopover for travellers. For example, Seney, perhaps the largest of all intermediate supply centers in the Upper Penninsula given its unique location, had 21 saloons, 5 brothels and a permanent population/community. While other intermediate supply centers were never this large, they probably contained these activities in proportion to their size. Following this arguement, the maximum figure for settlements containing this activity can be estimated at 25 per cent (Dodge 1973, Reimann 1982, Wells 1978).

Mobility and Duration

The second part of Hypothesis 10 maintained that when camp locations shifted, intermediate supply centers would either move or cease to exist. Carrying this argument further, it was anticipated that intermediate supply centers would be of relatively short duration. Specifically, when large scale logging declined or ceased in the area, they would either be abandoned or else continue with a greatly reduced set of activities.

The results of the analysis supported this part of Hypothesis 10. As Table 37 illustrates, most (59.3 per cent) of the intermediate supply centers disappeared with the demise of logging in the study area. A number of others (18.5 per cent) survived the logging decline but with a greatly reduced range of activities. Only a small number (18.2 per cent) survived the logging decline at a level remotely similar to that of the logging boom. Hence, when logging declined in the study area both the logging camps and the intermediate supply centers which serviced them disappeared.

TABLE 37

INTERMEDIATE SUPPLY CENTERS

DURATION

Status	Number	Percent
Still Exist	5	18.5
Disappeared with Logging Decline	16	59.3
Still Exist/Greatly Reduced	5	18.5
Unknown	1	3.7

During the examination of the raw data for this segment of the analysis, an interesting pattern emerged. Most of the intermediate supply centers (21/77.8 per cent) dated to the later years of the study period (after 1890). These were the years generally ascribed to the railway logging era or regarded as transitional between river drive and railway logging on the Upper Penninsula logging frontier. Therefore, it is probable that the hierarchical settlement pattern normally associated with an industrial frontier did not fully emerge on the Upper Penninsula logging frontier until the advent of railway logging. In the discussion above it was noted that three intermediate supply centers were not located on a rail line and therefore were probably associated with river drive logging. This information, coupled with chronological information, led to the inference that during the river drive era of the logging frontier the hypothesized frontier settlement hierarchy was not as complex as that of the later railway era.

Summary

The results of this analysis supported Hypothesis 10. Intermediate supply centers were part of a transportation/communication system (railway) and contained many activities oriented toward servicing the needs of lumber camps. When logging declined, intermediate supply centers disappeared or continued with a greatly reduced range of activities. Information presented about railway association and chronology, coupled with the discussion presented in Hypothesis 9, led to the inference that the hierarchical settlement pattern associated with industrial frontiers was less complex during the earlier, river drive technological/chronological era on the Upper Penninsula logging frontier than it was during the railway technological/chronological era.

Hypothesis 11

Entrepots will be singular or few in number, but larger and more diversified than other components of the frontier settlement system. They will maintain direct and constant contact with the homeland and will be the termini of frontier transportation/communications systems. They will be more permanent than other components of the frontier settlement system, often lasting beyond the demise of the logging frontier.

Number, Size, and Diversity

The first part of Hypothesis 11 maintained that entrepots would be few in number but larger and more diversified than other components of the logging frontier. This part of Hypothesis 11 was addressed through the comparison of entrepots to the other components of the logging frontier.

The study area contained 6 entrepots, 27 intermediate supply centers and 444 logging camps. These numbers supported Hypothesis 11's contention that entrepots would be few in number. The initial comparison of these settlements and related arguments were presented in Hypothesis 9, so no further discussion will be presented here and the reader is referred to Hypothesis 9.

Size

The size of logging camps was difficult to measure since population data was not available for logging camps. Although logging camps typically contained 50 to 200 people and there were a number of such camps in existence during the census years covered by this research, it was not the practice of census enumerators to collect data on the inhabitants of logging camps. Loggers were considered transients and the census takers did not relish difficult (uncomfortable) trips to the interior camps so they restricted their work to the supposedly permanent, more accessible settlements of the study area. For some logging camps, site size acreage data was available, however comparable information was not available for the entrepots and intermediate supply centers. Therefore, it was decided to restrict the discussion of size to a comparison of populations of the entrepots and intermediate supply centers (Bohn 1937; Karamanski 1984; Reimann 1952, 1982; Wells 1978).

As Table 38 illustrates, the population of the three census years was considerably larger for the entrepots than for the intermediate supply centers and the mean entrepot population was approximately 17 times the mean intermediate supply center population. This confirmed the proposition that entrepots would be larger than other settlements on the logging frontier.

TABLE 38

POPULATION - DESCRIPTIVE STATISTICS

ENTREPOTS AND INTERMEDIATE SUPPLY CENTERS

1900

Entrepots

Mean = 3291
Median = 2697
Mode = 241
Range = 241 - 9308

Intermediate Supply Centers

Mean = 179.6
Median = 121
Mode = 66
Range = 0 - 469

1910

Entrepots

Mean = 3769
Median = 3581
Mode = 314
Range = 314 - 9999

Intermediate Supply Centers

Mean = 212.6
Median = 148
Mode = 102
Range = 0 - 550

1920

Entrepots

Mean = 4497
Median = 4995
Mode = 279
Range = 279 - 999

Intermediate Supply Centers

Mean = 254.5
Median = 252
Mode = 94
Range = 0 - 572

The characteristics of the data associated with entrepots and intermediate supply centers precluded a conventional approach to the study of diversity in which a comparison of the differential presence and frequency of attributes would be made. In this case missing data and the fact that some of the variables which should have been continuous variables had to be considered binary because only presence or absence information was available rendered such approaches meaningless. Instead, alternative approaches were utilized.

One strategy was to group related variables together to form three composite variables: total manufacturing, social services, and commercial activities. Total manufacturing was a summation of all known manufacturing in the settlement (lumber mills, finished wood manufacturers, heavy industry, and light industry). The commercial variable was the summation of values entered on the general store, specialized retail, warehouse, and fishing variables. Social sevices consisted of a summation of the post office, saloon/hotel/brothel, school, religious facilities, medicine, lawyers, hospital and local, state, federal government variables. While this approach masked some of the samples' variability, it allowed the analysis to continue and even made available a new source of data. This approach was based on the supposition that size and diversity were positively related.

The results of this analysis (Table 39) revealed that entrepots had larger and inferentially more diverse entries for each of the three composite variables than did intermediate supply centers. Bearing in mind the assumptions under which this particular analysis was conducted, it can be said that Hypothesis 11 was supported because the results reveal that entrepots were more diverse than intermediate supply centers.

TABLE 39

DIVERSITY

ENTREPOTS AND INTERMEDIATE SUPPLY CENTERS

Entrepots		Intermediate Supply Centers
Total Manufacturing		
13	Mean	2
9.5	Median	0
2	Mode	0
2 - 39	Range	0 - 15
Commercial		
1.33	Mean	0.89
0	Median	0
0	Mode	0
0 - 6	Range	0 - 7
Social Service		
21	Mean	1.52
4	Median	0
1	Mode	0
1 - 105	Range	0 - 11

Transportation and Communication

The second part of Hypothesis 11 maintained that entrepots would be in direct contact with the homeland and would be the termini of frontier transportation/communication systems. This was addressed through the examination and measurement of the relevant nominal scale transportation/

communication variables. A direct link to the homeland was defined as the ability to leave the settlement and travel directly to the homeland without passing through another settlement. Consequently any settlement with port facilities possessed a direct link to the homeland, since one could leave the Upper Penninsula and travel via water directly to the homeland without passing through another settlement. Since all the entrepots in the study area were ports, they were all considered to have direct links to the homeland.

Prior to the introduction of the railway system, transportation/communication consisted of moving people and goods overland under their own power or through the use of draft animals. Water transport was the principal means by which timber was transported from the camp to the entrepot. Furthermore, while there was little movement via water in the opposite direction, the drainages of the rivers and streams formed a natural roadway from the coast to the hinterland. Therefore it was expected that entrepots would be at or near the mouths of large rivers emptying into either Lake Michigan or Lake Superior.

An examination of the appropriate cartographic data revealed that this corollary to Hypothesis 11 was supported for the study area. All (100 per cent) of the entrepots were located at or near the mouth of a major river which emptied into either Lake Michigan or Lake Superior. In fact, two entrepots, Escanaba and Gladstone, were located at intermediate distances between the mouths of three rivers (Ford, Escanaba, Days). Another (Rapid River), was located at the mouths of three rivers (Tacoosh, Rapid, Whitefish) which emptied into Little Bay de Noc.

It can be argued that the introduction of the railroad system would change the definition of the entrepot. With this in mind, it was decided that the most appropriate settlement characteristics would be it's location on a main line railway with features such as junctions, a high diversity of rail lines and it's service as the terminus of a main line. Main line railway location was defined as a situation where a large volume of traffic passed through the settlement. This traffic volume would be greater than that on any one of its feeders. Moreover, the traffic on the main line was greater than the sum of the traffic on the feeders, because some main line traffic traversed the region to reach a destination in another region. A high density of rail lines within the node or a given distance from the node was indicative not only of the relative size of the node, but also of its importance as a transshipment point. Furthermore, the importance of a node increased if it served as a transshipment point between two different modes of transport, such as between rail and water (Burghardt 1971; Haggett et.al. 1977; Morrill 1974; Hudson 1969; Johnson 1970; Taafe, Morrill and Gould 1963; Lindberg 1968).

All of the entrepots in the sample were located on main line railroads. Furthermore, 66.7 per cent were located at junctions of main line railroads. The mean number of rail lines within a two mile radius from the entrepot was 2.7 (compared to 1.9 for intermediate supply centers). Moreover, half of the entrepots were in locations considered to be the terminus of a main line railroad, which occurred when a main line railroad joined another in the entrepot. Although this might more properly be considered a junction, since continued travel by rail was possible, it differed from a situation where two main line railroads simply crossed and continued in their original direction because in all cases port facilities were involved. Such situations were considered termini, especially since the entrepots were transhipment points between two modes of transport (rail/water).

The initial consideration of transportation/communication links assumed that the two processes were one in the same. That is, communication involved the physical movement of something (i.e. a messenger, a letter, etc.) from sender to receiver. Hence, in order for communication to occur, a transportation network (river, road or railway) had to be in place. During the late nineteenth century a number of communications breakthroughs occurred, including the development of the telephone. It thus became possible to communicate with the homeland without a physical object moving from the frontier to the homeland. Bearing this in mind, it was anticipated that entrepots would be connected to a telephone system. It was also possible, but not verifiable, that the entrepots were part of a telegraph system because that technology had been available since mid century and because it was common practice to run telegraph and later telephone lines along main railways.

The data for entrepots revealed that most (4/67 per cent) were equipped with telephone service. Most likely the other two (33 per cent) entrepots had telephone service but data was not available to verify this. In comparison only 3 (11 per cent) of the intermediate supply centers were known to be equipped with telephone service.

Permanency

The final part of Hypothesis 11 maintained that entrepots were more permanent than other components of the frontier settlement system, often lasting beyond the demise of the logging frontier.

An examination of the entrepots' occupation dates revealed that all still existed in 1986. However, one (Nahma) was significantly reduced in size and diversity so that it no longer functioned as an entrepot. Its current size and functions were most like those expected in intermediate supply centers. Nevertheless, 5/83 per cent of the entrepots were in existence and functioning as entrepots in 1986. This contrasted with the intermediate supply center data which revealed that only 18.5 per cent of these settlements still existed with approximately the same features as during the study period. A further 18.5 per cent of the intermediate supply centers still exist, but at a greatly reduced level. Therefore, while 100 per cent of the entrepots survived to the present, at most only 37 per cent of the intermediate supply camps managed to survive the demise of the logging industry. Furthermore, none of the study's logging camps existed in 1986. One of the phenomenon reflected by this differential survival rate was the ability of the diverse economies of the entrepots to adapt to change more readily than other settlements. In addition to serving timber interests, many of the entrepots were also involved in mining, shipping, fishing, and servicing the growing agricultural community. In contrast camps and most intermediate supply centers were severely restricted in scope. Thus, Hypothesis 11 was supported because entrepots were the most permanent type of settlement in the logging frontier (Hulse 1981, Karamanski 1984).

Summary

In spite of idiosyncratic data, the propositions put forth in Hypothesis 11 were upheld. Entrepots were fewer in number and larger in size than the other types of settlements on the logging frontier.

Moreover, entrepots were more diverse than other types of settlements on the logging frontier. Entrepots were also located to serve as significant nodes in the frontier transportation/communciation network. Even with changes in the transportation/communication technology, they maintained their position relative to other settlements on the logging frontier. Entrepots were also longer lived than other types of settlements on the logging frontier, a characteristic reflective of their more diverse economic base.

Hypothesis 12

On the logging frontier one may expect to find a communication/transportation system with its terminus at the entrepot and linking all the settlements on the frontier with the entrepot. It is the principal means by which goods and information were exchanged with the outside world.

An elaboration of the model presented in Chapter IV was needed to evaluate this hypothesis. This involved an examination of the ways in which transportation/communication systems evolved in conjunction with gateway settlements. According to the industrial frontier model, gateway settlements (i.e. entrepots) developed in areas that were vital to transportation and separated two regions with significantly different types and intensities of production. They functioned as entryways into an extended hinterland and were the termini of an elongated transportation system stretching into the interior. Most typically such gateway settlements were located on the coast. The area encompassed by this transportation system was known as the tributary area of each gateway settlement (Burghardt 1971, Hirth 1978, Taafe et.al. 1963).

As frontier settlement advanced into the interior, a gateway settlement developed along two possible trajectories. When the tributary area was small, no other major settlements developed within its boundaries leaving the gateway as the locus of all higher order central place functions. When the tributary area was large and highly productive, the gateway lost some of its central place functions as interior central places developed. In spite of the development of interior central places, the gateway settlement usually remained dominant because of its transportation and closely related central place functions (Burghardt 1971, Hirth 1978, Taafe et.al. 1963).

Two other factors influenced the development of the gateway system: productivity and duration. If the tributary area was one of low productivity, regardless of size, the gateway community remained dominant for all central place functions. There was limited development of interior settlements in the tributary area. If productivity declined and the tributary area contracted, the position of the gateway relative to the interior settlements strengthened. The gateway settlement also remained dominant if the tributary area was one of high productivity but relatively short duration. In this situation the gateway settlement usually grew rapidly and attained a high order status because of the volume and type of products passing through it. However resource depletion dictated that this high level of productivity would be short lived thereby limiting opportunity for higher order central places to develop in the tributary area and compete with the gateway. Lower order central places developed, but because of the relationship between duration and high level production, there was a decline in productivity and subsequent contraction of the tributary area before these settlements attained higher order status (Burghardt 1971, Hirth 1978, Taafe et.al. 1963).

The transportation systems which developed in association with gateway settlements were essentially dendritic, fanning out into the hinterland of the gateway. These transportation systems defined the tributary area for the gateway settlement because it was through the transportation system that goods and services flowed to and from the gateway and thence to the homeland. Where a number of gateways occurred, their transportation systems often developed in parallel fashions as greater penetration into the hinterland was attained. When lower order central places developed along parallel transportation networks, horizontal ties sometimes occurred. That is, lower order central places in two tributary areas would become linked without connecting through the gateways. These links were insignificant as long as the respective gateways dominated their tributary areas. However, should a gateway decline or its tributary area contract, some of these lower order central places could become part of an adjacent tributary area. Furthermore, if too many horizontal links developed between adjacent tributary areas, one gateway/tributary area could expand and encompass settlements formerly belonging to another (Burghardt 1971; Hirth 1978; Taafe et.al. 1963).

The above considerations held as long as a single mode of transportation was common to all gateways and tributary areas. Changes in this mode, such as speedier transport, had little effect on the form and function of the transportation system as a whole. However, the introduction of an entirely new mode of transportation caused distortion in existing transportation systems, which in many cases caused the decline of some gateway communities and their tributary areas (Burghardt 1971, Hirth 1978, Taafe et.al. 1963).

Analysis

In examining the study area in light of the model presented above, two preliminary distinctions were made. First, to control for chronology, the focus was on the two chronological/technological associations which characterized the study area: the river drive logging era and the railway logging era. Secondly, the data used to examine Hypothesis 12 were exclusively historical, being either local/regional histories or autobiographies/reminiscences.

The settlement/transportation system for the river drive logging era conformed to what was expected under the industrial frontier model. Initially settlement was restricted to coastal areas, with economic activity restricted to resources on or near the coast. Beginning in the 1870's and by the 1880's, large scale commercial river drive logging was established in the area. Simultaneously the size of the gateways increased as lumber mills, transportation facilities and related service industries were developed to support the growing logging industry. Gateways were located near river mouths and transportation routes followed the river drainages. The transportation systems were unique in several ways. First, there was an element of directionality involved in their use. Travel upland, while possible on water, was most common overland, including the movement of loggers and supplies to the logging camps. The second phase of the transportation system dealt with the transportation back to the gateway, which for all timber and some loggers was accomplished by water. Thirdly, the transportation system was seasonal.

Overland travel effectively ceased when the camps became snow-bound (usually late December) and did not resume until spring (March). Even with river improvements, river driving was restricted to the late spring and early summer months (April-July) (Chase 1936, Defebaugh 1906, Dunbar 1970, Hudgins 1961, Karamanski 1984, Longyear 1960, Mansfield 1899, Maybee 1976, Reimann 1952).

As predicted, the transportation system defined the tributary area associated with each gateway because of the relationship between product and transportation capacity. Only pine and similar timber were buoyant enough to be transported to the gateway via river drive, limiting timber production to those species. Furthermore, cutting operations had to occur within a certain distance of driveable water so that logs could be efficiently transported to the decking area. Thus, the transportation systems not only specified the type of product but also defined the tributary area in which it could be efficiently cut. Moreover, because of the restricted nature of the tributary area and the peculiarities of the transportation system few internal settlements were established (Chase 1936, Defebaugh 1906, Dunbar 1970, Hudgins 1961, Karamanski 1984, Longyear 1960, Mansfield 1899, Maybee 1976, Reimann 1952).

The settlement/transportation system for the railway logging era generally conformed to what was predicted by the industrial frontier model with some exceptions. While these did not contradict the overall support of the gateway model and Hypotheses 12, they provided an interesting illustration of the multiple influences which shape any given transportation/settlement system.

When main line railways were first established in the Upper Penninsula, the transportation system and settlements associated with the earlier river drive logging era already existed. These older systems continued to function as the railway system was formed. Although the study area was initially linked to the outside world by a main line railway in 1872, it was not until the late 1880's that main line railways were well established in the Upper Penninsula. By this time main lines ran along both the northern and southern coasts, connecting the costal settlements with Sault Ste Marie, Canada, and the Lower Penninsula to the east and Duluth and Menominee to the west. Railway development peaked and mainline routes stabilized in the 1890's and the appearance of logging railways coincided with the stabilization of main line routes. Originally developed on the Lower Peninsula as narrow gauge lines, these were used on the Upper Penninsula as standard gauge lines which ran in two general configurations. One was a single dendritic pattern beginning in the gateway and extending into the interior. The other occurred as a branch of the main line track moving into the interior (Calkins 1929, Chase 1936, Defebaugh 1906, Dunbar 1970, Hudgins 1961, Karamanski 1984, Longyear 1960, Maybee 1976, Nute 1944, Reimann 1952).

From the description above it can be seen that events in the study area deviated from the expected trajectory in terms of the introduction of a new mode of transportation and the resulting shift in settlement pattern. First, rather than occurring in single tributary areas associated with single gateways, the main line railways connected all the gateways. The mainline railway was so constructed because at the time only the gateway settlements had populations sufficient to serve as a market for the goods and services provided by the railway. As a result, a situation of differential access to main line transportation did not arise and the gateways and their tributary areas remained intact.

Secondly, the introduction of logging railways enlarged and redefined the tributary areas. The use of the logging railroad released logging operations from seasonal constraints and, more importantly, enlarged the scope of potential products to include all timber, thereby making the entire study area a potential tributary area. Some of these lines led directly from the gateways into the hinterland, branching in a dendritic fashion as they extended further inland. Others simply branched off a main line and headed into the interior, branching in the same fashion as the first group. This latter type of logging railroad, while defining a tributary area, was difficult to associate with a given gateway since it terminated on the main line rather than in a settlement. Therefore it distorted the expected pattern because it potentially was associated with any of the gateways along the main line. Nevertheless, the rapid extension of the logging railways into the interior increased the tributary area for the coastal gateways to the point where it included the entire study area. With the increased output from the expanded tributary areas, gateway communities grew in size and number of central place activities, thereby supporting the industrial frontier model.

Once logging railways were established and the intensity of logging increased, two types of interior settlements began to appear along the rail lines. The smaller ones usually contained only a railway station, while the larger ones were more diversified and could contain general stores, post offices, light/service industries, saloon/hotel/brothels, and occasional lumber mills or heavy industry. Even though this second group was larger and more complex than the first, none of these settlements possessed a sufficient number of higher order central place functions to displace the gateways as the primary settlements on the frontier. The eventual depletion of timber meant that continued expansion and intensified productivity, which would have allowed settlements to reach higher levels with in a central place hierarchy, was not possible.

Summary

Hypothesis 12 was supported by the data. For each of the two occupation eras of the logging frontier there was a distinctive transportation system and overall settlement pattern. In the case of the river drive era, the transportation system and settlement pattern corresponded to the industrial frontier model's predictions for a relatively small, low production situation. The railway era changed the transportation system and settlement patterns, but not in exactly the same way as the industrial frontier model predicted. Rather than competing gateways/tributary areas developing because of differential access to the new mode of transport, the gateways maintained the same relative relationship to each other because all were involved in the new transportation system. The redefinition of tributary area and development of interior settlements predicted by the gateway model occurred during the logging era. Taking all the results into account, the propositions of the gateway model were upheld by the analysis, supporting Hyothesis 12.

Hypothesis 13

As an industrial frontier, the logging frontier should be of short duration. This characteristic should be reflected in the design and construction of the settlements on the logging frontier.

In investigating chronology or duration of occupation, one of the key issues that had to be addressed was scale of measurement. Generally speaking, there were two scales of measurement by which this hypothesis could be addressed: absolute and relative. Absolute chronology defined the duration in terms of years of duration. Such an approach provided temporal parameters within which a phenomenon occurred but did not provide an indication of whether this could be considered a short or long term occupation.

In contrast, the measure of relative chronology allowed the duration of occupation to be evaluated with respect to a measure other than absolute years. The approach used here was based on a subjective evaluation of some of the material culture and operating procedures associated with the logging frontier. Such an approach was relevant to the situation in the study area because it allowed for the evaluation of short versus long term investments in material culture and of the way the material culture was used on the logging frontier.

The approach used in this analysis maintained that large scale material culture (e.g. camps, rail lines) could be evaluated with respect to its potential for permanence or their potential for short versus long term use. It was expected that short term use would be reflected by materials which had a relatively short life span in the capacity in which they were used. Short term use was also indicated by makeshift construction techniques. Furthermore, the relationship between these two was not necessarily a direct one. That is, short term materials could be used with short term construction techniques, long term materials could be used with short term techniques, or some other combination of the two could be used, all of which would be taken as evidence of short occupation duration. All of these propositions were evaluated using historical data.

Analysis

Logging camp construction varied throughout the study period. The earliest techniques involved cutting a trail into the forest during the late summer and fall. The camp was then constructed in log cabin fashion, with mud chinking between the logs and pine bough roofs. Most of the external construction materials were garnered from the site. The inside floor was dirt, two to three tiers of bunks were arranged around the perimeter of the cabin and there was a fire pit or simple stove in the center with a smoke hole in the roof. Logs in the round was the predominant construction material. Windows were rare. These buildings might also be semi-subterranean if dugout construction was used or if earth was piled against the outside walls. Other buildings in the camp were similarly constructed with the internal arrangements differing according to building function (Draper 1930, Dye 1975, Fitzmaurice 1889, Franzen 1984, Hulbert 1949, Maybee 1976, Nute 1944, Reimann 1952, Rohe 1986, Wells 1978).

This particular method of construction and the resulting material culture qualified as short term for several reasons. First, a roof constructed of pine boughs was waterproof only so long as the needles remained fresh. Once they began to age they would fall off, decreasing the waterproof qualities of these buildings and increasing their combustability, especially if a fire pit rather than a stove with a stovepipe was used for heat. Secondly, the mud chinking between the logs eventually dried, became detached and fell out. This was caused by the natural desication of the clay as well as by shifts in the framework of the building induced by freezing/thawing. Thirdly, a combination of the first two problems, plus excessive amounts of moisture rendered the interior of such buildings uninhabitable after a certain amount of time. The dirt floors became muddy, and the shifting in the structure because of freezing/thawing rendered the entire structure unstable. Finally, this particular type of camp construction was characteristic of the early years of river drive logging on the Upper Penninsula. Given the nature of the product, and related factors, it was rare that such camps were occupied for more than two seasons (Draper 1930, Dye 1975, Franzen 1984, Hulbert 1949, Maybee 1976, Nute 1944, Reimann 1952, Rohe 1986, Wells 1978).

The next general change in camp construction occurred during the transition to railway logging. The basic foundation and framing methods remained the same, as did the log construction. Differences occurred in flooring, roofing, ventilation and heating as well as in source of construction materials. The floors were now made of split logs so that a dry, flat, relatively even surface existed in all the camp buildings. Roofing, both framing and sheathing, was of sawn lumber and planks which were brought in overland or via rail. The roof and gable were usually covered with tarpaper held in place with battens. Pre-hung windows in the bunkhouses and other buildings provided light and ventilation. Heat was provided by metal stoves with stovepipes that insured adequate ventilation and reduced the danger of fire. The internal arrangement of the various camp buildings remained essentially the same (Draper 1930, Dye 1975, Franzen 1984, Hulbert 1949, Maybee 1976, Nute 1944, Reimann 1952, Rohe 1986, Wells 1978).

Such changes in construction seemed initially to imply greater permanence. Roof construction was better and more waterproof. Wooden rather than dirt floors and improvements in ventilation and heating all bespoke longer term occupancy as did the increased reliance on manufactured components. Furthermore, historical data indicated that with the arrival of railway logging, camps were built to last a number of years. This longer lived camp construction and occupancy reflected the shift in product from pine to any wood that could be exploited, thereby requiring longer to deplete any given area. Also, the new railway technology only effected transportation of construction materials to the camps and the transportation of the timber from the forest to the saw mills. Woods operations remained substantially the same, so that changes in this area were usually limited to increased camps and crews (Draper 1930, Dye 1975, Franzen 1984, Hulbert 1949, Maybee 1976, Nute 1944, Reimann 1952, Rohe 1986, Wells 1978).

This appearance of permanence in camp construction was deceptive because many of these characteristics were designed to facilitate the rapid relocation of the camps. Gables and roofs constructed of sawn lumber were dismantled, loaded on railway cars and moved to new locations for reassembly. With the exception of new tarpaper, the roof was effectively recycled a number of times before the lumber had to be discarded. Similarly, pre-hung windows were removed from the log cabin matrix and shipped to a new camp. Barring breakage, windows were used in a number of different camps. Likewise, metal stoves were also dismantled and transported to the new camps. Thus, features which appeared to be indicative of permanence were in fact designed to increase the portability and recyclability of construction materials. In the long run, this lessened the cost of camp construction. Therefore, although occupied for a longer duration, camps were made more portable rather than permanent

(Draper 1930, Dye 1975, Franzen 1985, Hulbert 1949, Maybee 1976, Nute 1944, Reimann 1952, Rohe 1986, Wells 1978).

The final change in camp construction occurred during the railway logging era, and was the shift from partial log construction to complete sawn lumber construction. Once constructed, camp buildings were covered with tarpaper held down with battens. The other features of the buildings replicated those described immediately above. This initial investment in a more expensive, more permanent type of construction appeared to be indicative of longer term occupation. In much the same fashion as described for the roof, entire buildings were dismantled, moved to another camp location and re-assembled with the addition of new tarpaper and sometimes floors. Windows, stoves and doors were also recycled. Therefore camp construction again reflected the short duration of logging frontier occupancy (Draper 1930, Dye 1975, Franzen 1984, Hulbert 1949, Maybee 1976, Nute 1944, Reimann 1952, Rohe 1986, Wells 1978).

The epitome of this trend of increasing the initial cost of camp construction while increasing its recyclabiltiy did not occur in the Upper Penninsula until after the end of the study period. It is mentioned in this analysis because it provided further support for the proposition that settlements on the logging frontier were designed to be of short duration. This development was that of railway car camps. These were camp buildings (i.e. bunkhouses, camp offices, camp stores, cookhouses, etc.) constructed on railway cars. When a camp was to be established, the appropriate number and variety of these cars were hitched to an engine and hauled to the camp site, which in this case was a siding off the railroad. Only the barn, blacksmith shop, root cellar and latrine could not be constructed in this fashion. These buildings were built on the ground and were of sawn lumber construction so they could be dismantled and reconstructed when the train camp moved on. While this method required a higher initial capital outlay, it greatly increased the recyclability of the buildings so that construction costs were amortized over a number of camp locations and over a number of years (Karamanski 1984).

Intermediate supply centers were also studied in light of permanency. Earlier it was established that there were two types of intermediate supply centers, one more elaborate and one more simple. Because the more simple of these settlements usually consisted of little more than a railway station and functioned exclusively as an unloading/loading terminal, it was accepted without further elaboration that such settlements were of short duration and limited function. The larger intermediate supply centers contained a number of services beyond a railway station. These settlements were constructed of sawn lumber which was usually unfinished or covered with tarpaper and battens and which was hauled to the location by rail except in those settlements with a sawmill. Buildings were often multi story and quite sizeable by contemporary standards. Nevertheless, these settlements were still focused on a short term occupation. This position was formulated and maintained because of the lack of certain features, principally the lack of any local government functions except law enforcement. Although it was not anticipated that the intermediate supply centers would become high order central places, it was expected that there might be other civic functions indicative of a permanent community. Such services as organized fire protection, schools, and later presence of a telephone service were considered indicative of permanency. All of these services were lacking or else present in very few of the intermediate supply centers. Since investment in these services was not made in the majority of cases, the mode and organization of such settlements was focused on short rather than long term occupation (Bohn 1937; Draper 1930; Dye 1975; Hulbert 1949; Karamanski 1984; Maybee 1976; Nute 1944; Reimann 1952, 1982; Wells 1978).

Summary

The testing of Hypothesis 13 was based on an evaluation of relative rather than absolute chronology. The analysis focusing primarily on logging camps, the most numerous type of settlement on the logging frontier, and examined construciton methods and materials in light of their implications for short or long term occupation. Construction techniques and materials were indicative of short term occupation for both the river drive and railway logging eras. In the case of the latter, the initial examination revealed what appeared to be contradictory data. That is, construction techniques/materials were more expensive and more durable, indicating longer term occupation. However, two characteristics of the new construction techniques/materials, portability and recyclability, revealed that the permanency was not to be assumed. Rather these techniques/materials made it possible to transport the camps to new locations and rebuild them, recycling most of the materials, resulting in a cheaper cost in the long run, and indicating that they were intended for short durations of occupation. Likewise an examination of the construction techniques and types of services provided by the intermediate supply centers revealed that these settlements were built for short rather than long term duration. Therefore, Hypothesis 13 was supported.

Hypothesis 14

The logging frontier will be characterized by a high degree of uniformity, both in terms of behavior and material culture. It is expected that this uniformity will be most visible in areas directly relating to production and that it will vary among the three components of the industrial frontier settlement system.

The evaluation of Hypothesis 14 focused primarily upon the behavior and material culture which characterized the logging camps as areas of primary production. Furthermore, there was a sufficient historial data base in the form of reminiscences and local/regional histories to enable logging camps to be evaluated for uniformity. Material culture consisted of the built environment (architecture) and the artifactual assemblage commonly associated with logging. Behavior was categorized as to whether or not it was related directly to production.

It was also necessary to establish a working definition of uniformity to evaluate material culture and behavior. This definition was not intended to be a rigid yardstick by which uniformity would be evaluated but rather a broad set of guidelines to allow for local and temporal variation around a common theme. In terms of material culture, uniformity was defined with respect to two subsets of data. The architecture of the logging camps was evaluated by the design of individual buildings and their layout within the camp. To be considered uniform, building design had to be broadly similar across the dimensions of space and time. It was not expected that building design would be identical, but that the constellation of features which defined each type of building would be similar in the majority of the same type of buildings. Furthermore, it was expected that the type of buildings which ocurred in a logging camp and their layout within camps would be similar across the dimensions of time and space. In terms of the production artifact assemblage, a general similarity in its composition was expected across time and space. As with architecture, there was room for variation in the assemblage, but the majority of elements in the assemblage were expected to be the same (Ferguson 1977).

Different issues were addressed when defining uniformity in terms of production and non-production related behavior . One consideration was that behavior occurred in the camps and therefore within an environment that was structured by building design and layout. Such behavior also involved the use of the production artifact assemblage, illustrating another tie between material culture and behavorial repertoire on the logging frontier. Recognition of the existance of these relationships led to certain expectations about behavioral uniformity. First, uniformity in production behavior was the performance of the same tasks in similar ways across the dimensions of time and space. This uniformity was maintained by both folk wisdom passed among the loggers and by instructions from supervisors, and was reinforced through the use of the same tool assemblage. Changes in available technology might or might not lead to behavioral changes. For example, if a change led to the production of a more efficient model of a traditional tool, speed of production might be increased but not the manner in which the tool was used. If a new tool was introduced, then behavior would change because nothing in the pre-existing behavioral tradition provided instructions as to how to use the tool. It was also possible, but not likely, that changes in behavior would cause changes in the tool assemblage.

Secondly, on the logging frontier work place and residence were one and the same, easing the maintainence of uniformity in non-productive as well as in productive behavior. In this instance, non-productive behavior was defined as behavior which did not directly relate to the cutting, transporting, and processing of timber. It was expected that such behavior would relate more closely to architecture and layout than to the tool assemblage. Bearing these points in mind, it was expected that non-productive behavior would be regulated by a series of proscriptions. These were expected to be fairly wide-ranging since they regulated all non-productive behavior. While some might have been passed among the loggers as folk wisdom, most were established and enforced by the camp superintendent and his minions. In addition to proscriptions, regulation was also expected to specify participation in certain activities as well as the duration of participation. Furthermore, enforcement of such regulations was expected to occur through both overt and covert means.

Finally, it was expected that change would occur in some of the material culture and behavior discussed above. This phenomenon was in keeping with the definition of uniformity as broad similarities or as a constellation of shared attributes rather than as isomorphism. These changes were not expected to disrupt the pre-existing patterns of behavior and material culture in the study area. Rather they were expected to be changes in the productive arena which significantly increased productivity. As such, they were expected to be readily and rapidly adopted across the logging frontier with little resistance on the part of the loggers (Hardesty 1985).

Analysis

The analysis of architecture supported Hypothesis 14. There was a general similarity in construction and layout of logging camps across the logging frontier and through time from the river drive era into the railway logging era. From the discussion of the construction techniques for camps presented in the discussion of Hypothesis 13 it was learned that construction and design remained similar throughout the study period with changes, when they occurred, directed towards increased portability and recyclability of camp buildings. Furthermore, these changes were focused primarily on the external covering of the buildings. The internal arrangements of the buildings remained the same. Specifically, bunks were fixed in position around the walls of the building with a stove located in the open space in the center. There might also be miscellaneous chairs or benches in the open space. (Draper 1930, Dye 1975, Franzen 1985, Fitzmaurice 1889, Hulbert 1949, Maybee 1976, Reimann 1952, Rohe 1986, Wells 1978).

Other buildings, most noticeably the cookhouse, retained the same internal structure through time in spite of changes in external covering. The kitchen occupied one end of the building and was separated from the dining room by a wall which housed a large opening for food service. The larger dining room was furnished with long row tables nailed to the floor, and benches. There was also an area where the cook and/or his assistants could sleep to guard the kitchen at night. The stable and blacksmith shop were also similar in construction throughout the study period. The stable consisted of rows of stalls for the horses and the blacksmith shop contained a forge, workbenches and a work area. A storeroom was usually adjacent to the barn. The camp office and store were generally rectilinear buildings whose only noticiable internal divisions were sleeping areas for the camp supervisor and camp clerk (Draper 1930, Dye 1975, Fitzmaurice 1889, Franzen 1985, Hulbert 1949, Maybee 1976, Reimann 1952, Rohe 1986, Wells 1978).

Although the internal design of camp buildings remained the same, camp layout changed at two points during the study period. The first was with the surge in logging that occurred shortly after the beginning of the study period. Initially, camps had been small and each building was multi-functional. Commonly the cookhouse served as camp office and storeroom with the barn serving as blacksmith shop and storeroom. The bunkhouse was the only unifunctional building. As logging increased, building use became more specialized and they fulfilled the roles described above. Root cellars provided additional food storage areas. If more than one bunkhouse was needed exact dupicates were constructed. Also, if the camp was large enough, separate cabins were built for the filer and scaler. All camp buildings were grouped in a loose circle, a design probably reached through a series of permutations, but which predominated after the influx of loggers and the increase in logging operations (Draper 1930, Dye 1975, Fitzmaurice 1889, Franzen 1985, Hulbert 1949, Maybee 1976, Reimann 1952, Rohe 1986, Wells 1978).

The second change in camp layout occurred with the introduction of the logging railroad. This change affected the layout rather than the numbers or types of buildings in the camp. In contrast to the loose cluster of buildings which characterized the river drive era, railway logging era camps were laid out linearly, parallel to the railroad tracks which provided easier access to the main transportation route (Draper

1930, Dye 1975, Fitzmaurice 1889, Franzen 1985, Hulbert 1949, Reimann 1952, Rohe 1986, Wells 1978).

An examination of the tool assemblage associated with logging activities also provided support for Hypothesis 14. With only a few changes, the production tool asssemblage remained remarkably similar throughout the study period. Initially this assemblage consisted of various axes, wedges, ground tackle, peavies, cant hooks, and chains. Also included were two vehicles: a sled and a sprinkler. The axes and wedges were used to fell and trim the trees. The remainder of the tools were used to maneuver the logs onto the sled and later to unload them into/onto the next link in the transportation system. The sprinkler iced the roadways so that the sleds moved easily. Two changes occurred in this tool assemblage during the study period. The two-man crosscut saw was introduced for felling purposes. This shift did not displace axes from the assemblage, since they were still used to establish the direction of fall, trim felled trees and clear brush, but the saw made the actual felling of trees quicker and neater. The addition of the crosscut saw necessitated the addition of a can or jar of kerosene to clean sap from the saw blade to ensure continuous rapid cutting. The second change was the substitution of draft horses for oxen to pull the sleds and sprinklers. Although oxen were cheaper to feed and had greater individual pulling capacity, horses were more maneuverable and had greater endurance for woods work. Moreover, well maintained ice roads reduced the differential pulling power between horses and oxen. Once initiated, these two changes were readily adopted across the study area (Draper 1930, Dye 1975, Fitzmaurice 1889, Hulbert 1949, Maybee 1976, Reimann 1952, Wells 1978).

Production related behavior on the logging frontier also supported Hypothesis 14. Techniques of woods work, which included cutting trees and transporting them to a frozen river or railway line, remained the same throughout the study period. Although there were two changes in the tool assemblage, the manner in which woods work was done created a pre-adaptive situation, so that these changes were readily and easily accepted into the production behavioral repertoire. Beginning in the early autumn, a roadway was cut into the forest from the nearest accessible point connecting the forest with the outside. The new road extended past the point where the camp was to be built into the forest where cutting was to occur. A camp was constructed with some of the trees felled in road construction and supplies and equipment brought in from the outside. With the arrival of colder weather the road into the forest was iced. This road was resurfaced daily by the sprinkler, which not only applied a fresh coat of water but also cut grooves into the ice for the sled runners. Actual felling was done by men working in pairs. Initially using axes and wedges, and later crosscut saws, axes, and wedges, these teams felled and trimmed the trees. Once the trees were felled and trimmed, the teamsters loaded them onto a sled and hauled them to a siding or decking area. Peavies, cant hooks, chains and dogs, and ground tackle were used for this task. The shift to crosscut saws and horses made little difference in the way pairs of fellers and the teamsters worked. Thus, while change occurred in the tool assemblage, there was no corresponding change in the production related behavior associated with the tool assemblage (Draper 1930, Dyer 1975, Fitzmaurice 1889, Hulbert 1949, Maybee 1976, Nute 1944, Reimann 1952, Wells 1978).

The behavior associated with production activities was established and reinforced through two different mechanisms. First, the actual procedures followed in woods work were passed along from more experienced loggers to the novices. An apprenctice system of sorts existed for all activities on the logging frontier, from cook to teamster. Inexperienced workers learned by doing and were promoted through the ranks until they reached senior positions in their specialities. Often workers switched from one speciality to another because of higher pay, better working conditions, orders from the camp supervisor, etc. Nevertheless, job training through the semi-formal appprentice system maintained uniformity throughout the logging frontier (Draper 1930, Dye 1975, Fitzmaurice 1889, Hulbert 1949, Maybee 1976, Nute 1944, Reimann 1952, Wells 1978).

Secondly, supervisory personnel exercised control over production behavior. In most cases this was on the larger scale, such as planning where to cut on a particular day, which had little direct effect on production behavior. However, such individuals directly impacted production behavior through the establishment of quotas, reinforced with rewards or fines. They exercised control over work assignments and could punish or reward workers by assigning them to unpleasant or easy tasks. They also had the power to hire and fire workers at will. Uniformity was also enforced through manipulating accounts at the camp store (Draper 1930, Dye 1975, Fitzmaurice 1889, Hulbert 1949, Maybee 1976, Reimann 1952, Todes 1931, Wells 1978).

Uniformity found in non-production behavior also provided further support for Hypothesis 14. This uniformity was enforced by camp supervisors through a variety of overt and covert means. Overt means took the form of a variety of proscribed activities. The list of such activities was fairly lengthy and was common across the logging frontier, including: no talking at meals, no liquor in camp, curfews and enforced lights-out, no women in camp, no eating between meals (this was enforced to varying degrees), and no fighting. Some camps also had regulations prohibiting card playing and gambling. The regulations were enforced in a variety of ways, such as locking the cookhouse to prevent between meal eating. In later years, when some camps had electric power, a master switch extinguished the lights. Visual inspection by the camp supervisors was also a method of enforcement (Draper 1930, Dye 1975, Fitzmaurice 1889, Hulbert 1949, Maybee 1976, Reimann 1952, Todes 1931, Wells 1978).

There was also a smaller list of prescribed activities, including: specified intervals for clothes washing, specified intervals for bathing, specified intervals for fumigating bunkhouses, and specified times for letter writing. These regulations were enforced by the camp supervisor and his minions (Draper 1930, Dye 1975, Fitzmaurice 1889, Hulbert 1949, Maybee 1976, Reimann 1952, Todes 1931, Wells 1978).

From the above discussion it was apparent that uniformity was the rule in both production related and non-production related activities on the logging frontier. Maintenence and enforcement of uniformity was essential to production efficiency and to the capitalist control over the work force and the logging frontier in general. The examples presented gave some idea of the variety of activities which were regulated and the general ways in which some of them were enforced. A closer examination of the issue of enforcement and control illustrated its pervasiveness on the logging frontier.

There were a variety of methods available to enforce the regulations governing production and non-production related behaviors. For example, workers were usually hired by seasonal contracts which generally ran from September to June. These contracts gave unlimited freedom to the camp supervisor to organize the work force since termination was the obvious punishment for infractions. This was an extreme measure, a last resort, because employed too frequently it decimated the workforce. Other punishments did not deplete the work force and often they were not revealed to the worker until the end of the contract when wages were paid. One method imposed fines which were deducted from wages at the end of the year. These might be assessed to replace some article broken in a brawl, or as simply punitive damages. The camp store was another monetary control. This institution played a key role in camp life, even during the railway logging years, because the workers were usually confined to camp most of the time. Camp stores normally offered a variety of goods such as clothing, tobacco, toiletries, writing paper, pencils, candy, patent medicine, shoes/boots, sewing supplies and other miscellaneous items. The storekeeper also delivered mail to the nearest post office when going out for supplies. The fee for delivery varied, but in one instance was mentioned to be ten cents. Items in the camp store were not priced. A seasonal record of each workers purchases was kept. At the end of the season the cost of the items purchased was deducted from the worker's wages before he was paid. This cost was manipulated to adjust for the amount of wages the capitalists actually wished to pay. Moreover, this amount varied from season to season and could vary among workers during the same season (Draper 1930, Dye 1975, Fitzmaurice 1889, Hulbert 1949, Maybee 1976, Reimann 1952, Todes 1931, Wells 1978).

Another way to enforce regualtions was to manipulate subtle clauses in the contract. Generally, workers were not paid for missed days of work. Workers might miss days for a number of reasons, including sickness, or job related injuries as well as self-induced conditions, such as hangovers. Furthermore, if these days were numerous, provisions of the contract were called into play which resulted in further loss of pay for the worker. An extreme, but not rare example of this was the case of a worker who was killed on the job. When his widow went to collect the wages owed to her deceased husband, she found that the company had deducted 20 per cent because her husband had broken his contract by getting himself killed before June (Reimann 1952, Todes 1931, Wells 1978).

In light of such activities it was surprising that workers in the logging industry were not caught up in the drive towards unionization which characterized the late nineteenth and early twentieth centuries. There were several reasons for this. First, even during the railway logging era camps were isolated most of the year. This stymied the organizing efforts of unions. Moreover, visitors bent on establishing unions were not welcome (Karamanski 1984, Todes 1931, Wells 1978).

Secondly, capitalist elites followed the same practice of institutionalized racism/ethnocentrism in logging as they did in other realms of the economy. In many cases camps were set up and populated by workers from the same ethnic group. The overlapping ties of common language, culture and religion usually created a strong bond and camp identity among these workers. These bonds were fostered since they prevented the occurrence of inter-camp unity. Extra work, supply shortages, etc. were blamed on nearby camps or camps further down the rail line. The camps chosen as scapegoats were always those containing a different ethnic group. This created and fostered feelings of bitterness between camps thereby preventing the development of any effective inter-camp solidarity. If camps were too large or if there were not enough workers from a single ethnic group to fill a camp, alternative strategies included hiring individuals from similar geographic origins or with some other common trait (e.g. language, religion). This situation did not provide as complete control as that with only a single ethnic group, but it insured better control than a heterogeneous camp (Abrams 1978; Degler 1977; Hopkins et.al. 1982; Karamanski 1984; Reimann 1952; Todes 1931; Wallerstein 1980, 1983; Wells 1978).

At the very end of the study period the red scare provided another regulatory method that was common in other logging regions. Socialist and communist organizations, common throughout Europe and occasionally North America since the late nineteenth century, attained notoriety because of a series of violent uprisings in Russia culminating with the Revolution of 1917. Capitalist elites generated a great deal of fallacious propoganda about socialists and communists. Since many of the aims of union organizers were similar to those espoused by socialists, unions were exposed to a great deal of red baiting and outright violence. Such organizations were widely decried as un-American providing capitalists with the scourge of patriotism to control workers and undermine union activity. This worked especially well with recent immigrants trying to become American. By associating socialism, unions and un-Americanism with ethinic background, capitalists forced workers into further compliance. (Abrams 1978; Degler 1977; Hopkins et.al. 1982; Karamanski 1984; Reimann 1952; Todes 1931; Wallerstein 1980, 1983; Wells 1978).

Summary

Hypothesis 14 was upheld by this analysis. Uniformity in both material culture and behavior characterized all facets of life on the logging frontier. Material culture, both architecture and the production tool assemblage, was standard throughout the study period. Architectural changes occurred mainly in the layout of camps with the advent of railway logging and in the exterior covering of camp buildings. The same internal arrangement was maintained. The production tool assemblage underwent two changes, which increased the efficiency of woods work, but which did not displace other items in the assemblage. As hypothesized by Hardesty (1985), both of these changes were adopted rapidly across the frontier.

Behavior was similarly uniform across the logging frontier, whether it was production or non-production related. In the case of production related behavior, uniformity was maintained to increase output. Uniformity in non-production behavior was part of a pervasive effort to ensure a docile and malleable work force. The isolated conditions of the logging camps and the capitalists use of ethnocentrism made it easy for the controls exercised over both types of behavior to continue unchallenged.

Hypothesis 15

The shift in production technology from river drive to railroad logging should be abrupt and occur within a short period of time. This shift should result in a movement from universal river drive logging to a situation of universal railroad logging.

Hypothesis 15 was derived from Hardesty's (1985) discussion of change on the industrial frontier in which he maintained that when change occurred in areas related to production it would rapidly spread across the frontier. Aspects of change related to the production tool assemblage were discussed in Hypothesis 14, where it was demonstrated that such rapid change did occur. In this case, a much larger phenomenon was examined: the shift from river drive to railway logging.

Data used in the examination of this hypothesis came from two sources. The first was the occupation data available for most of the samples of river drive and railway logging camps used in this analysis. The second was historical data which dealt with the transition from river drive to railway logging. This was most commonly found in local/regional histories and in reminiscences of the logging era.

Analysis

An examination of the occupation dates for river drive and railway logging camps supported Hypothesis 15. The initial occupation dates for most of the river drive sites occurred between 1881-1890; a smaller number were occupied between 1891-1900, after which there were effectively no more river drive sites built in the study area. Railway sites first appeared in numbers between 1881-1900. Their greatest surge in numbers occurred between 1901-1910. This particular pattern indicated that there was an abrupt cessation in the use of river drive camps by 1900, while at the same time there was a surge in the use of railway camps. The decade from 1891 to 1900 was apparently a transition period between the extensive use of river drive camps and the extensive use of railway camps (Table 40).

TABLE 40

INITIAL OCCUPATION DATES

RIVER DRIVE CAMPS

AND

RAILWAY CAMPS

Initial Occupation Date	River Drive	Railway
1871-1880	7	2
1881-1890	26	8
1891-1900	8	4
1901-1910	0	13
1911-1920	1	7

Further examination of Hypothesis 15 was undertaken through the use of time lines. Figure 18 illustrates the known occupation spans for river drive sites, most of which occurred before 1890. Other river drive sites lasted for a number of years, but all were established at or before 1900. Several sites had fairly long occupation spans, which was somewhat unexpected. Some of these probably began their occupation as river drive sites and were later converted to railway sites, thereby guaranteeing their continued occupation. Given the selective cutting involved in river drive logging, it was plausible that such river drive sites, if appropriately located, could be converted to railway camps.

FIGURE 18

TIME LINE: INITIAL OCCUPATION TO ABANDONMENT
FOR RIVER DRIVE SITES

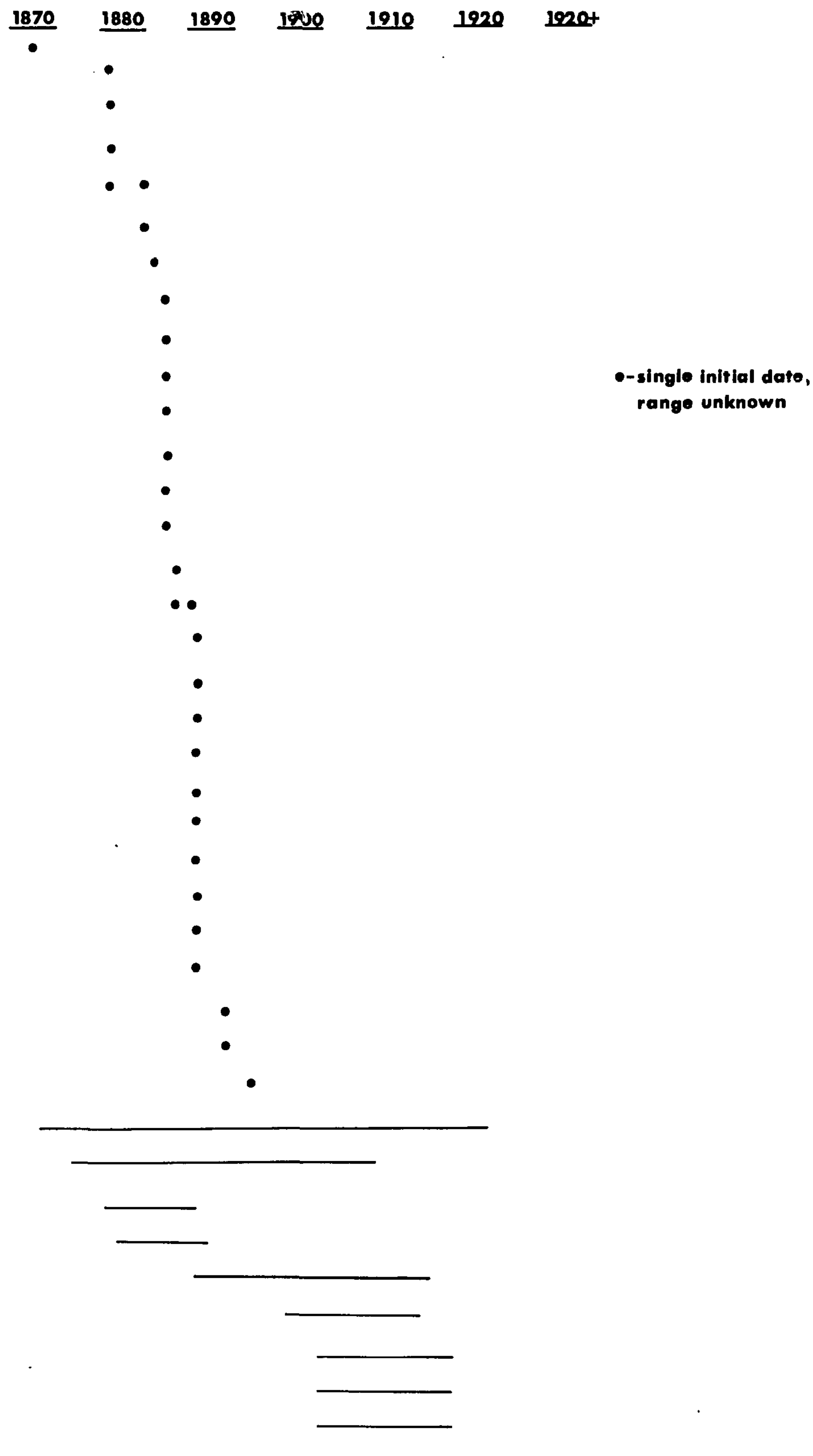

1870
1880
1890
1900
1910
1920
1920+
●-single initial date,
range unknown

FIGURE 18

Railway sites had more time line data available than river drive sites and thereby provided some additional information about change and occupation. While some railway sites began in the 1870's, most were initially occupied after 1900. Given the temporal parameters associated with the initial development of the logging railroad, those camps begun in the 1870's and early 1880's were most likely river drive camps which were subsequently converted to railway camps. The railway camp time line was stepped, which illustrated the continued abandonment and establishment of logging camps through time as the logging frontier expanded across the study area (Figure 19).

FIGURE 19

TIME LINE: INITIAL OCCUPATION TO ABANDONMENT FOR RAILWAY SITES

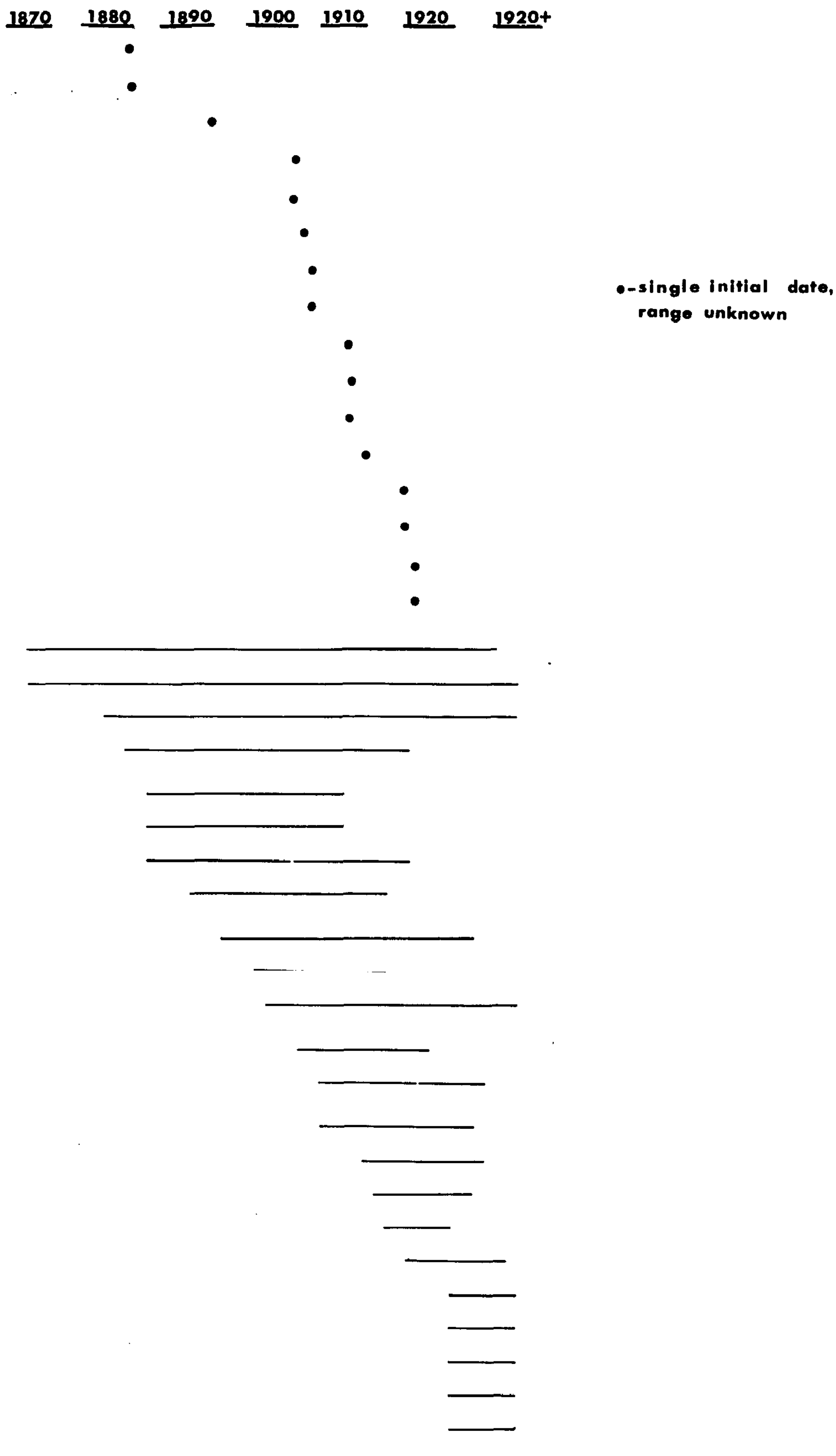

1870
1880
1890
1900
1910
1920
1920+
•-single initial date, range unknown

FIGURE 19

Historical data also supported Hypothesis 15. Nute (1944) in discussing logging on the Upper Penninsula, stated that by 1900 railway logging had almost completely replaced river drive logging. Although not directly stated, it was implied that this change had swept the Upper Penninsula. Karamanski (1984) also maintained that the adoption of railroad logging by Upper Penninsula loggers was very rapid. Furthermore, he maintained and justifiably so, that the advent of railway logging was the single most important event in Upper Penninsula logging during the first quarter of the twentieth century. Other researchers have also maintained that the 1890's was the period in which railway logging grew extensively as the river drive system declined (Franzen 1985).

Hypothesis 16

With the advent of railway logging, early camps might be located near older river drive era camps so as to obtain hardwoods previously uncut. This proposition assumes that such trees were not utilized in some fashion during the river drive era.

Hypothesis 16 was based on Hardesty's (1985) concept of patch reoccupation which stated that a previously occupied and abandoned area could be reoccupied if the introduction of a new production technology rendered reoccupation and exploitation profitable. In this case the new production technology was the logging railway.

During the river drive era only floatable timber was harvested. Given the forest composition of the study area, this selective cutting could have left nonfloatable timber in the vicinity of river drive sites, assuming that such timber was not used in construction or related activities. Data for this analysis were drawn from measures of the distance to nearest camp of a different type and the type of nearest camp.

Analysis

Hypothesis 16 was not substantiated because of small sample size and contradictory distance measures. An examination of the type of camp most closely associated with river drive camps revealed that these were unknown camps followed by railway camps (Table 41). These unknown camps might have been river drive, railway or non-logging sites and were excluded from the analysis which focused on the railway camps.

TABLE 41

TYPE OF NEAREST CAMP

RIVER DRIVE SITES

Camp Type	Number	Percent
Railway	13	29
Unknown	32	71

The distance between river drive camps and the nearest railway camp ranged between 0.69 to 6.50 miles with a median distance of 1.75 miles. Since the distribution represented by these measures was composed of a series of observations and was too small for large sample techniques, no further descriptive statistics were computed. Within the limits of the available data the results were, at best, equivocal. The median distance in this case (1.75 miles) was almost the same as that between river drive camps (1.81 miles) as was the range. This indicated that rather than being located close to river drive camps to harvest previously uncut non-floatable timber, the railway camps were located at the same distance from river drive camps as river drive camps were from each other. From this it was inferred that the non-floatable timber had been partially or fully cut, thereby rendering reoccupation of the area unprofitable (Table 42).

TABLE 42

DISTANCE BETWEEN RIVER DRIVE CAMPS AND NEAREST OTHER CAMP, WHEN THE LATTER WAS A RAILWAY CAMP

Median = 1.75 miles

Range = 0.69 - 6.50 miles

These results were cautiously extrapolated further. When Hypothesis 16 was framed, implicit to its formulation was the assumption that river drive and railway logging settlement patterns might overlap because of reoccupation to harvest the remaining non-floatable timber in the vicinity of river drive camps. Because Hypothesis 16 was not supported (allowing for small sample size) it was inferred that the river drive settlement pattern and the railway logging settlement pattern were separate phenomena as far as camps were concerned. The analysis did, however, produce two characteristics for river drive camps and the timber around them. First, if there was unfloatable timber within the work zone around river drive camps, it may have been used in camp construction and maintenance or in the subsequent construction of rail lines. Any remaining timber was insufficient to support reoccupation. Second, river drive camps may have been sited in or adjacent to continuous stands of floatable timber, a contention made by Weir and Rutter (1985). When all floatable timber was harvested, the area was logged out, precluding future logging. Whatever the explanation, Hypothesis 16 was not supported by the analysis.

Hypothesis 17

The change in logging industry cost structure brought about by the introduction of the logging railway should result in the increasing concentration of timberland ownership in the hands of fewer individuals/institutions.

This hypothesis was designed to examine one facet of the logging industry as a component of the capitalist world system. With the higher initial costs of railway logging, it was anticipated that capitalist elites would seek to guarantee their profit through a further extension of their control over the means of production. Since the logging railway was already under their control, extensions of control might be expected in the areas relating to labor and raw materials. Control over labor was discussed in Hypothesis 15, so this analysis will focus on control over raw materials. Because the raw material in question, timber, was closely associated with land, the analysis focused on the process of land acquisition and the consolidation of acquisition to measure control over the means of production. Data for this analysis were drawn from historical sources including autobiographies/reminiscences, local/regional histories and topical studies, one of which was a special report on the lumber industry prepared by the U.S. Bureau of Corporations (1914).

Analysis

The analysis upheld Hypothesis 17 because with the establishment of the logging railway, timberland ownership was consolidated in the hands of a few individuals/institutions. Initially timberlands passed from government to private ownership in what appeared to be an egalitarian and dispersed fashion. Under the Homestead Act, for example, individuals could obtain up to 160 acres provided they lived on the land for five years and made some improvements. Land was also sold at state or federal public auctions. To encourage railway and canal construction in the Upper Penninsula the federal government granted land to companies who built or promised to build railways and canals. Canal companies received blocks of land, while railways were granted alternating sections, following the pattern used in the rest of the country. Land was also dispersed through state swampland grants. The federal government granted these lands to the state on the condition that the land be drained to make it suitable for agriculture. The state could either drain the land or sell it with a requirement of sale that the buyer drain the land. Michigan chose the latter option and the money from the land sales was put into a trust for public education (Catton 1976, Chase 1936, Degler et. al. 1979, Dunbar 1970, Maybee 1976, Merk 1978, Shands and Healy 1977, Steen 1976, Todes 1931, U.S. Bureau of Corporations 1914, Watson 1923, Wells 1978).

Taken at face value, these methods of land distribution did not seem conducive to the concentration of ownership. They were, however, extremely susceptable to manipulation and outright fraud; some occurred during the river drive era, but the fraud reached its peak during railway logging. Here is how it worked.

Manipulation of the provisions of the Homestead Act focused on corporations or land grabbers who arranged for an individual to stake a claim for the 160 acres and then paid that individual to relinquish the land. The land was logged over and abandoned, ultimately to revert to the state or federal government for non-payment of taxes. In later years, land offices made a feeble attempt to verify that the conditions of the grant had been met (a cabin of the required size, with glazed windows constructed on the property). The claimant was asked to appear at the land office and verify that he had met the conditions; however these "verifications" were never checked by site visits. Had the land office actually visited some of these claims it would have found that the "cabin" was the appropriate size, provided one measured in inches instead of feet and that "glazed windows" meant drilling a hole in the wall and plugging it with a liquor bottle (Dunbar 1970, Hudgins 1961, Todes 1931, Watson 1923, Wells 1978).

Another ploy was to file claims under the names of juveniles or the deceased. "Representatives" could file the claims by maintaining that they were acting on behalf of the claimant who was unable to attend because of pressing business in a nursery or graveyard. Land office personel even participated in some of the strategies. A favorite tactic was to collect a number of adolescent males, pay them, and have them file claims. When they arrived at the land office they stood on a large "21" that had been written on the floor. This way the children could claim they were males, over twenty-one, wishing to file a claim for Homestead Act lands (Dunbar 1970, Hudgins 1961, Todes 1931, Watson 1923, Wells 1978).

Public land sales were also open to manipulation. A coterie interested in the available parcels would meet before the sale and divy up the parcels. When the actual sale took place, only the person who had been previously alotted a parcel bid. As single bidder he could make the bid low, sometimes even below the federally established minimum, and still be guaranteed purchase at his price (Hudgins 1961, Wells 1978, Reimann 1952, Todes 1931).

Sometimes, however, such plotting was not possible. In this case a buyer or his agent would submit an exhorbitant bid for a parcel of land, guaranteeing that the highest bid. After the sale was closed, the bidder withdrew the bid, leaving the parcel unsold and unclaimed. The land office then had to dispose of the land on an individual basis for the best price. Usually within a week of his withdrawal the agent would offer a low price to the land office and purchase the parcel at his price, often below the established minimum (Reimann 1952, Todes 1931, Wells 1978).

While both the federal railway and the canal grants provided another opportunity for land grabbing, this was more common with the railway grants. Railways would apply for land grants and then never build the railroad. Alternately they would submit survey maps as if they were maps of the completed rail line and collect the land grant. Often these survey maps were prepared without the benefit of a survey: they were simple and deliberate forgeries. Once the railways owned the land they utilized it as they saw fit. This included logging, but sometimes the land was sold to other companies (Hudgins 1961, Reimann 1952, Todes 1931, Wells 1978).

Most of the state swampland was dispersed through public sale and manipulations of the sale of swamp lands were identical to those used to manipulate other public land sales. Most of these lands were sold for less than the minimum set price. Some of the state swamp lands were used as state grants to support railroad or road construction. These were manipulated in the fashion described above for federal railway grants (Hudgins 1961, Reimann 1952, Todes 1931, Wells 1978).

In summary, although there were a number of ways to transfer frontier lands from government to private control, each was subject to a variety of manipulations which assured the capitalists that they would get the amounts of land at the price they wanted. These land acquisitions focused exclusively on the maintenance of control over production through the acquisition of land and hence the available timber supply.

In addition to direct ownership, which was sometimes costly, there were other ways to gain control over timber. Companies were merged so that the controlling company could take over the smaller company's timber. The "mergee" was usually kept operationally separate so that its timber could be cut and it could lapse into bankruptcy without harming the controlling company. Controlling companies also established subsidiary companies with interlocking directorates. The subsidiary companies would cut the timber, transfer the profits to the primary company and then go out of existance if necessary (Reimann 1952, Todes 1931, U.S. Bureau of Corporations 1914, Wells 1978).

These two methods of concentrating land ownership (direct and indirect acquisition) were common in the Upper Peninsula and successful. As Table 43 illustrates, about half of the Upper Peninsula land was held by thirty-two owners. Moreover, the Cleveland Cliffs Iron Company held 14.2 per cent of the land, a fact that was skillfully camoflaged by the distribution of the land among thirteen companies that were wholely owned subsidiaries of Cleveland Cliffs.

TABLE 43

LAND OWNERSHIP IN THE UPPER PENINSULA

1910

Holders	Acreage	Percent	Cumulative Percent
Cleveland Cliffs	1,515,392	14.2	14.2
First Group (12 holders of over 100,000 acres each)	2,413,794	22.6	36.8
Second Group (19 holders, 40,000-100,000 acres each)	1,095,497	10.3	47.4
Third Group (58 holders 15,000-40,000 acrea each)	974,343	9.1	56.2

Cleveland Cliffs is a prime example of how interlocking directorates (and other measures) facilitated the consolidation of land ownership. As illustrated in Table 44, four clusters of corporations controlled a minimum of 13 per cent of the land in the Upper Peninsula. Furthermore, these four clusters originally appeared as twelve of the thirty-one major individual land holding companies on the Upper Peninsula. Rather than assume that these clusters were all that were present among the thirty-one nominally separate companies, it was perhaps more valid to assume that these four were the less well camoflaged of the group. The remaining nineteen individual companies were also probably connected in some fashion so as to reduce the total number of entities controlling the land. If

Cleveland Cliffs' holdings are added to these four, then five companies held 27.2 per cent of the land on the Upper Peninsula (U.S. Bureau of Corporations 1914).

TABLE 44

CONNECTIVITY AMONG MAJOR UPPER PENINSULA LANDHOLDERS

1910

Interlocking Directorate	Acreage	Percent
One		
Keweenaw Land Association	965,000	9.0
Michigan Iron and Land Company		
J.M. Longyear		
J.C. Ayer's Estate		
Albany Pool		
Two		
Calumet and Hecta Mining	100,000+	1.0
Tamarack Mining Company	(minimum)	
Three		
Wisconsin Land and Lumber	100,000+	1.0
Northwestern Cooperage and Lumber	(minimum)	
United Logging Company		
Four		
Detroit, Mackinac and Marquette Railway	176,681+	2.0
South Shore Land Co.		

An examination of the amount of timber in the landholdings was undertaken. In this case, however, only general level information was available. It was not possible to isolate the timber resources associated with individual corporations, except for those of Cleveland Cliffs. As revealed in Table 45, the holdings of timber reserves are even more suggestive of a highly controlled situation. While thirty-two nominally individual corporations held 47.1 per cent of the land on the Upper Peninsula, this land contained 67.7 per cent of the available timber. More importantly, these figures represented the available timber for land owned in 1910. They did not include timber which had already been cut for lands which were then abandoned (U.S. Bureau of Corporations 1914).

TABLE 45

TIMBER RESERVES OF UPPER PENINSULA LANDHOLDERS

1910

Landholder	Board Feet ($\times 10^7$)	Percentage of Total Owned Land
Cleveland Cliffs Iron Company	4.2	17.6
First Group (12)	7.2	29.7
Second Group (19)	4.9	20.3
	16.3	67.6

In addition to direct ownership, other methods of indirect control were used in the study area and were usually directed against smaller holders who neighbored next to the vast blocks of land held by corporations. If the small landowner was not involved in logging, his/her land was indiscriminately logged over by the corporation. If the individual attempted small scale logging, he was denied access to the logging railway or other resources necessary to the removal and processing of his timber. Ultimately this forced the small land owners to sell or otherwise transfer their holdings to the corporations on the corporations' terms(U.S. Bureau of Corporations 1914).

Hypothesis 17 was supported by the data from the study area. With the advent of railway logging control over resources became concentrated in the hands of relatively few individuals/institutions, both in terms of land ownership and in terms of the amount of timber present on this land. This control was achieved through a variety of means, most of which were nominally illegal, and resulted in the dominance of corporate logging during the last part of the study period.

SUMMARY

This chapter presented the results of the analysis of the hypotheses posed earlier. The evaluation of these hypotheses produced a variety of results, all of which added to the understanding of the logging frontier. A number of hypotheses (1,2,4,5,6,7,9,10,11,12,13,14,15,17) were accepted outright. Others (3, 8, 16) appeared to be only partially acceptable or rejectable. Upon closer examination, these hypotheses were found to have been partially acceptable because assumptions used in their formulation were not appropriate to the study area. Nonetheless, through this closer inspection further insights were obtained about the nature of the logging frontier. The results presented in this chapter will be discussed in the concluding chapter in light of their contribution to our understanding of the Upper Peninsula logging frontier and logging frontiers in general.

CHAPTER VII

CONCLUSIONS

This research has examined the logging frontier of Michigan's Upper Peninsula as a case study of the industrial frontier, with the goal of understanding the adaptive strategies associated with frontier settlement. Industrial frontiers were vital to the overall settlement of many parts of North America and, on a smaller scale, were often the only significant historical occupation of various locales. Examination of the patterns and processes associated with these frontiers provided, not only information about the specific Upper Michigan case under examination, but also information about the ongoing adaptation and settlement of industrial frontiers. The results of this particular research allowed for the examination of four such patterns and processes: the settlement system; technological/behavioral change; organizational characteristics; and the transportation system.

Settlement System

Lewis' description of industrial frontier settlement composition served to focus the investigation of the settlement system of Michigan's Upper Peninsula. Industrial frontier settlement was characterized by three major features. First, industrial frontiers contained three types of settlements: entrepots, intermediate supply centers, and camps. Entrepots served as gateways which connected the frontier with the homeland and were the largest and most diverse settlements on the industrial frontier. Intermediate supply centers, which were not mandatory for industrial frontiers, contained a more limited range of activities and focused mainly on servicing the camps. Camps focused exclusively on production. Secondly, both a numerical and organizational hierarchy existed among these three types of settlements, and corresponded to what would be expected in a gateway situation. Camps were the most numerous and most organizationally simple, followed in order of decreasing number and increasing organizational complexity by intermediate supply centers and then entrepots. Finally, these settlements were connected by a transportation system. Although Lewis did not specify the type of transportation system, the general principles and related factors for such systems were derived from Burghardt (1971) and Taafe et.al. (1963).

Results of the analysis revealed that Lewis' characterization of industrial frontiers was supported by the logging frontier situation in that the three types of settlement existed in the appropriate hierarchical arrangement. More importantly, this relationship remained relatively stable through time in spite of a change in the transportation system, which was one of the key factors that could affect change in the frontier settlement system (Burghardt 1971, Taafe et.al. 1963). Moreover, while changes in the mode of transport should have altered frontier settlement, such alteration was not as profound as expected. In spite of the introduction of a new transportation technology, the settlement composition of the logging frontier (as opposed to numbers and pattern) remained the same. This finding is important not only because it contradicts previous ways in which changes in transport mode were viewed, but also because it illustrates the role of the pre-existing settlement pattern and various historical events in shaping the new transportation system. Previous models of transport systems (Burghardt 1971, Taafe _et.al_. 1963) have generally assumed that the introduction of a new and competing transport technology would disrupt pre-existing settlement pattern/composition because the new transport technology would allow certain entrepots and their hinterlands to more effectively exploit and then transport commodities to the homeland. This assumption was based on the premise that new transportation technologies would be oriented on an entrepot to hinterland axis. However, that premise did not hold in this case. Historically, a number of entrepots and hinterlands existed prior to the appearance of the railroad. From the available information, it was apparent that the desire to traverse the Upper Peninsula and link the entrepots was the initial impetus behind railway construction. Thus, main line railroads initially were oriented perpendicularly to the pre-existing entrepot/hinterland axes. Therefore, no entrepot/hinterland declined because of the transport advantage of a neighbor. Logging railroads appeared subsequent to the main line and linked the main line with the hinterland. So, not only did the settlement composition remain the same, but all of the entrepots and most of the intermediate supply centers also continued to exist after the development of the new transportation technology.

Furthermore, introduction of the new transportation technology did not simply replace the pre-existing dendritic entrepot/hinterland pattern with a similar one using the new technology, but rather introduced a more complex pattern. This pattern involved a linear base line from which the expected dendritic routes penetrated into the hinterland. Moreover, this transport pattern affected the settlement pattern but not the settlement composition of the industrial frontier. Specifically, intermediate supply centers were located linearly along the main line railway rather than on the dendritic entrepot/hinterland axis of the pre-railway era. In spite of these changes, the overall relationships between entrepots, intermediate supply centers, and camps remained unchanged after the emergence of the new transport technology.

The results of this research also provided insights into the characteristics of entrepots, which were accurately described by Lewis (1984) and Burghardt (1971). On the logging frontier these settlements were the principal settlements and, as such, were larger, more diverse and fewer in number than any other type of settlement. Most continued to exist after the demise of the frontier because they developed internal economies not directly dependent on the exploitation of the dominant commodity. Nahma (the entrepot which declined with the demise of the logging frontier) illustrated a phenomenon discussed by Burghardt (1971) and Taafe *et.al*. (1963) where a gateway declines because the cessation of productivity in its hinterland is coupled with the acquisition of the remaining hinterland production by adjacent, competing entrepots. Thus, the behavior of entrepots on the industrial frontier can be understood through reference to the Burghardt (1971) model of gateway communities.

The concept of intermediate supply centers and their place in the industrial frontier settlement system was more complex than originally thought. Lewis' (1984) maintained that these settlements were not required on industrial frontiers and therefore might not always be present. Furthermore, they were thought to be primarily camp oriented, offering a limited range of goods and services. While initially this conception was appropriate, the appearance of railway logging not only increased the number of intermediate supply centers (acceptable under

Lewis' description) but also differentiated them into two types of settlements: a smaller, limited function settlement and a larger more diverse one. The appearance of farming communities, which developed to serve the needs of the camps and which were associated with some of the intermediate supply centers, explained such diversification. This observation is important because industrial frontiers were ordinarily provisioned by sources external to the frontier. In this instance, however, sources on the frontier itself supplied provisions. This contradiction between the predicted method of provisioning and that observed in this case may be explained by several characteristics of the study area. First, it was more efficient to provision camps from frontier sources, a strategy which compensated for the seasonal limitations on transportation from the homeland to the frontier. A second part of the explanation of the phenomenon, which goes beyond the preliminary questions of effort, accessibility, and efficiency, provides a clue as to why this phenomenon developed so differently than expected. This issue involved the nature of investment and risk. As with any venture, farming involved some risk, especially if the farmed area was subject to the adverse climatic conditions found in the study area. Who assumed this risk and how this influenced settlement was important to understanding why farming, and the associated intermediate supply centers, developed. Rather than establish company farms, analogous to camp stores, capitalist elites encouraged independent farmers to farm so the individual farmer assumed the risk of operation. Because of the guaranteed market, both sides initially prospered. However, with the demise of the logging frontier in the study area, capitalist investors simply switched the theater of their operations, while farmers faced bankruptcy.

This particular phenomenon provided an important corollary to the industrial frontier model, both in terms of settlement and overall organization. Under ordinary circumstances, industrial frontiers were provisioned from sources external to the frontier. However, in certain situations where provisioning was impeded (i.e. seasonal constraints on frontier/homeland transport), farming may develop on the industrial frontier provided parties other than the capitalist elites assume the risks of such ventures. As this study shows, the occurrence of such situations led to the elaboration of some intermediate supply centers to serve the needs of farming communities. If no one was willing to undertake the risk of such farming ventures, then provisioning would have been provided by sources external to the frontier.

Summary

The industrial frontier settlement system cannot be understood through a single model or set of conditions. Lewis' (1984) description was useful when dealing with the overall settlement composition. The way such settlements were connected and the ways in which they were likely to behave as a system was modelled by Burghardt (1971) and Taafe _et_._al_. (1963), who deal with gateway systems and the evolution of transport systems respectively. The settlement composition of the industrial frontier showed itself to be stable in spite of the introduction of new transport technology. Furthermore, the impact of a new transport technology was influenced heavily by historical factors and therefore did not have as drastic an effect on settlement as Burghardt suggests. Generally, while such changes in transport technology alter the settlement pattern, they do not alter the industrial frontier settlement composition.

The roles of entrepots and intermediate supply centers were adequately explained through reference to the three models mentioned above. Differentiation among intermediate supply centers may reflect activities unique to the regional setting within which the industrial frontier is located. In the case examined for this research, such differentiation arose out of an attempt to internally provision the industrial frontier. Other types of industrial frontier may exhibit similar characteristics, providing the parameters of risk and return are controllable by investors.

Technological/Behavioral Change

Change on the industrial frontier was investigated through the use of Hardesty's model (1985) of frontier change. This model had three salient points. First, uniformity of adaptation was the rule across the industrial frontier. This uniformity was expected to be most visible in areas related to production. Secondly, change, when it occurred, was rapidly adopted across the industrial frontier, thereby returning the situation to one of uniformity. Thus, the pattern of industrial frontier change envisioned by Hardesty was rapid and steplike, sharing common elements with the biological theory of punctuated equilibrium. Finally, the occupation and re-occupation of various parts of the frontier, characterized as resource patches, was believed to be based on the productive potential of the patches. Productive potential could be altered, most usually by a change in technology, thereby increasing or decreasing the possiblilty that a given patch would be occupied or abandoned.

The results of this analysis supported Hardesty's model of industrial frontier change in terms of uniformity and rate of change. Adaptation in the productive sphere was uniform across the entire frontier both in terms of material culture and behavior. When it ocurred, change was related exclusively to production and usually affected the material culture, which then brought about changes in behavior, if such were warranted. Uniformity was maintained through a variety of methods, with the ultimate purpose being the insurance of efficient production methods and the provision of control over the work force. In this respect, uniformity of adaptation mirrored the homeland's industrial organization, illustrating another characteristic of the industrial frontier; that of being in close contact with and sharing common institutions with the homeland. Uniformity further served to illustrate the limited scope of the industrial frontier. That is, the exploitation of a single resource was the exclusive focus of the industrial frontier, with all non-productive activities subordinated to this singular goal.

When used to examine occupation, the patch model of productive potential appeared to have limited explanatory power in the case under study. During the initial river drive occupation, with its particular environmental parameters, the patch concept proved useful in providing a key to understanding the location of logging camps, since the techno-environmental parameters of the patch model were relevant to conditions on the frontier. With the advent of railway logging, locational parameters changed, thereby rendering it difficult to adequately define a patch. It was argued that this particular aspect of Hardesty's model would be more useful on those industrial frontiers (such as the mining frontier), where access to resources was point oriented. In the case of the logging frontier, not only did the resource occur in a zonal fashion, but with a shift in technology it became accessible throughout most of that zone. This rendered analysis of the occupation and/or productive potential for specific patches irrelevant, thereby defeating the purpose of the model.

Summary

Change and adaptation on the industrial frontier were amenable to explanation through some of the parts of Hardesty's model. These dealt with uniformity of adaptation and the rapid, steplike fashion which characterized change on the industrial frontier. The use of the patch approach, while amenable to some industrial frontiers, was not applicable in this case because of the nature of the resource and technological developments which occurred during the course of the study period.

Organization

The larger scale organizational features of the industrial frontier were examined in light of the characteristics of the capitalist world system within which the frontier occurred (Wallerstein 1980, 1983). These characteristics included control of resources and control of labor/technology, both of which were expected to be concentrated in the hands of relatively few individuals/entities. Moreover, these factors related to the characteristic uniformity associated with industrial frontiers.

The results of this research supported the expectations drawn from Wallerstein's (1980, 1983) conceptualization of the capitalist world system. Control over resources was concentrated in the hands of a few individuals/entities. In this particular case, this control took the form of outright ownership of the resource, though there were a variety of other indirect ways to control resources such as control of access to supplies, transportation and labor. In this instance, however, these alternative methods were utilized only to a limited extent or not at all.

Control over labor also occurred and that control extended from production related to non-production related behavior. Such control was designed to ensure that production occurred as efficiently as possible, thereby mirroring labor conditions in the homeland. Moreover, it was the source of the uniformity of adaptations which characterized the industrial frontier. Differences in this control would create different levels of productivity, some more profitable that others, and the elites chose profitability which in the end translated into uniformity. This conscious selection for the most productive type of behavior (i.e. most profitable) and control over it, produced a state of uniformity across the entire industrial frontier. Changes, whether in labor and/or technology, were rapidly adopted so that individual operations would not operate at less profitable levels than others. This conscious selection for uniformity, and the way changes were incorporated into this frontier system, fits into the step-like pattern used by Hardesty to model change on the industrial frontier. Although this pattern is similar to that of punctuated equilibrium, there was an important difference. The industrial frontier's uniformity and the pattern of change were under the conscious control of elites, rather than resulting from non-conscious processes analogous to those of biological evolution. Once an innovation occurred, regardless of its source, its potential for adoption depended on whether or not it increased production efficiency. If it did, the mechanism of adoption will be a conscious, uniform, rapid spread of the innovation across the entire frontier. It is the element of consciousness which distinguishes this process from the biological analogues and from other probabalistic approaches to culture change.

Summary

The overall organizational structure of the industrial frontier, then, was oriented toward the control of both resources and labor/technology. This occurred to maintain maximum, guaranteed productivity on the industrial frontier. Since these processes were responsible for the uniformity of adaptation which characterized the industrial frontier, they also played a role in change on the industrial frontier. In the preceding section, uniformity of adaptation and a step like pattern of change were found to characterize the industrial frontier. Although this pattern resembled the pattern of punctuated equilibrium, the causal processes associated with it were quite different. Rather than change and adaptation occurring through the interaction of populations and environment on the industrial frontier, it was administered by sources external to the frontier, with the key determining factor being the increase in productivity brought about through the adoption of a given innovation.

Transportation

Transportation was not analyzed as a separate topic, except to illustrate that a transportation system existed on the industrial frontier and to provide a description of it. However, as earlier discussion has shown, transportation considerations on the industrial frontier were complex and pervasive and underlay many of the issues analyzed in this research. The more important aspects of transportation, with respect to industrial location, have been known for a number of years (Daggett 1968, Hamilton 1967, Hartshorne 1968, Lloyd and Dicken 1977, Miller 1970). However, for purposes of this research, the relevant aspects of transportation may be placed into two groups which can be termed the functional mode and the definitional mode. The functional mode (not important to this discussion) consists of transportation considerations, such as scheduling, fees, etc., which deal with the actual operation of a transportation system.

The definitional mode, however, is the key to understanding the effect of transportation on this particular industrial frontier. Considerations which comprise the definitional mode include the technical construction considerations of a given type of transport, the type of goods the system is capable of handling, the operational complexity of the system, construction cost, etc. The characteristics associated with a given transportation system effectively defined the type of industrial activity occur within that system. This consideration was separate from, but of equal or greater importance than, the actual factors related to the production of any commodity. For example, if the production technology and source for a given commodity are known, it must also be possible for a transportation system to link the source area with the market before production can be undertaken. In order for this to occur, the foregoing considerations for transport must be satisfied within acceptable parameters. Thus, the characteristics of a transportation system play a key role in determining the location and commodity being produced.

The logging frontier is a prime, though perhaps unique, example of this premise. Prior to the advent of railway logging, loggers were aware that the majority of the trees in the study area were hardwoods, hence the source of timber was readily known. Also, the production technology (i.e. felling procedures) was known. However, the only transportation system was the river drive, which could only accomodate floatable timber. With the advent of railway logging, all timber became transportable. Thus, a previously known source and previously known production technology could be joined so production could occur. Hence, the productive potential of the entire frontier as well as its settlement pattern was altered, in effect redefining this particular industrial frontier. Therefore, the characteristics of the industrial frontier transport system were significant not only to the movement of goods, but also in the definition of those products and the nature of production on the frontier.

While such transportation considerations are undoubtedly important for all industrial frontiers, the case analyzed here may represent an anomaly. Therefore, at this point it would not be appropriate to base future analyses of industrial frontiers exclusively on their transportation systems. The reasons for this may be offered as a corollary to the proposition that the transportation systems on the industrial frontier served to define the frontier as well as move goods. Specifically, the production technology must be capable of significant increase if the full effect of a new transportation mode is to be felt. That is, production must increase to the point where the new transportation system is running at or near full capacity for the full impact of the new system to be felt. This can only occur if production methods meet certain criteria. Generally, they must be technologically simple, easy to perform, and capable of significant increases in production through the application of increased labor.

Bearing this in mind, it can easily be seen that other types of industrial frontier, such as the mining frontier described by Hardesty (1985), may not be as greatly influenced by a transportation shift as was the logging frontier. In Hardesty's example, the production process was technologically complex (i.e. on site smelting), not easy to perform, and could not be increased through the direct application of labor, since the capacity of the smelter as well as the number of workers determined the rate of production. In this situation, investment in an expensive, larger capacity transportation system, if unaccompanied by the introduction of a new, more efficient mode of smelting, would have called for an increase in the capacity of the smelter. Otherwise, the new transportation system would not be cost effective since it would be underutilized. Moreover, given the point oriented source of ore, as opposed to the zonal pattern of timber which characterized this research, it is doubtful if the application of a new mode of transport to the situation described by Hardesty would have re-defined and enlarged the industrial frontier.

Summary

The significance of transportation to the industrial frontier underlay many of the findings about the industrial frontier produced by this research. The introduction of a new transportation system produced a new settlement pattern. More importantly, the introduction of a new transportation system on this frontier redefined the frontier itself and significantly increased the productive output. While it is tempting to focus exclusively on transportation systems when dealing with other industrial frontiers, several cautionary points must be made. Specifically, the Upper Peninsula logging frontier examined in this research was characterized by the zonal availability of resources and a simple and easily operated production technology, in which increased labor input resulted directly in increased production. On other types of industrial frontiers, such as the southwest mining frontier, transportation is undoubtedly important. However, its level of importance may not be quite the same as in the case examined here.

Conclusions

This research has examined the industrial frontier to elucidate the salient patterns and processes associated with this particular type of occupation. In doing so, topics of settlement system, change, overall organization and transportation were investigated. The conclusions drawn from the examination of these topics led to certain statements about the industrial frontier writ large and about the particular industrial frontier used as a case study. In the conduction of this analysis and the drawing of these conclusions, several broader issues were brought to mind. These fell into two groups: current approaches to industrial frontiers and suggestions for future research.

Current approaches to the study of industrial frontiers and cosmopolitan frontiers in general are only beginning to develop a body of theory which will allow industrial frontiers to be investigated as totalities. In the case of industrial frontiers, there was a body of geographic theory as well as some anthropological theory upon which to draw. The former focused mainly on transportation and settlement systems, both as individual components on the frontier and as related phenomena, each capable of responding to changes in the other. Much of the anthropological theory was based on the geographic theory. The remainder dealt with the processes of change on the industrial frontier and the characteristics of adaptive strategies believed to operate there.

Only recently have archaeologists become interested in industrial frontiers as manifestations of capitalist state societies (Hardesty 1985). Therefore, there have been limited opportunities for ideas about the latter to affect research on the former. However, the characteristics of the industrial frontier, particularly its short duration, make it amenable to such research. As demonstrated in this research, use of some general concepts proposed by Wallerstein (1980, 1983), led to the development of propositions about the nature of change and adaptation on the industrial frontier, as well as to an understanding of its organization of production. Although some of these propositions were deterministic in nature, the context of the industrial frontier rather than the society as a whole allowed such statements to be made. Since frontiers, by definition, only partially represent the range of societal variability present in the homeland, their analysis provides us not only with an understanding of the nature of the particular frontier, but also with a glimpse at characteristics of society in the homeland.

Given the relative recency of interest in the archaeology of industrial frontiers, the potential for future research is wide ranging. Based on the findings of this research, several topics suggest themselves. First, the role of transportation is crucial in understanding a number of characteristics of industrial frontiers. Our understanding of this phenomenon needs to be refined further by studying it on other types of industrial frontiers. This should include other logging frontiers, since such research would determine whether or not the role of transportation in this study area was typical of all logging frontiers or unique.

Secondly, further refinement of models of industrial frontier change is needed. Evidence suggests that the characteristics of the resource may affect the applicability of different models, or of different components within one overall model. These questions need to be resolved before a systematic understanding of industrial frontier change can be obtained.

Thirdly, the overall organizational features of other industrial frontiers should be examined. This obviously concerns the control of resources and labor, but may also include other factors, such as the way a particular industrial frontier is provisioned. Other industrial frontiers (i.e. other industries and logging frontiers elsewhere) may vary from the situation observed in the study area. Further refinement of our knowledge of these overall organizational features will allow greater understanding of industrial frontiers and may be important when dealing with other types of cosmopolitan frontier.

Finally, the settlement system and spatial components of industrial frontiers seem to be fairly well understood, in that they are explainable with currently available theoretical models. However, more of a direct linkage needs to be made between Lewis' description of settlement composition and geographic models dealing with settlement pattern and transportation. This would provide a more unified approach to dealing with the spatial characteristics of industrial frontiers.

In summary, the archaeological investigation of industrial frontiers is a fertile area open to research along a variety of dimensions. Given the relative recency of many of these frontiers, a greater range of data is available on them than on some other topics. They present archaeologists with a unique opportunity to study phenomena of significance not only on a local level, but also at a larger level; that of understanding the expansion and settlement of a considerable portion of North America.

APPENDICES

APPENDIX A

LOGGING CAMP VARIABLES

Acronym	Format	Description
SITYP	1.0	Type of logging camp 0 - unknown 1 - River drive 2 - Railway 3 - Railway (with extensive documentation)
SITSIZ	3.2	Size of site in acres (0-unknown)
SOLPHAS	3.0	Soil Phase: 001 Alluvial 002 Alpena gravelly sandy loam 003 Au Gres sand 004 Au Gres loamy sand 005 Blue Lake sand (0-6% slope) 006 Blue Lake sand (7-18% slope) 007 Blue Lake sand (19-40% slope) 008 Bohemian fine sandy loam (0-6% slope) 009 Bohemian fine sandy loam (7-18% slope) 010 Bowers silt loam 011 Brevort mucky loamy sand 012 Brimley fine sandy loam 013 Bruce mucky fine sandy loam 014 Burt mucky sandy loam 015 Carbondale/Lupton/Rifle 016 Cathro muck 017 Cathro/Tacoosh muck 018 Charlevoix sandy loam 019 Chatham fine sandy loam (0-2% slope) 020 Chatham fine sandy loam (3-6% slope) 020 Chatham fine sandy loam (7-18% slope) 022 Chippeny muck 023 Croswell sand 024 Dawson peat 025 Dawson/Greenwood peat 026 Deerton sand (0-6% slope) 027 Deerton sand (7-18% slope) 028 Deerton/Burt 029 Deford loamy fine sand 030 Duel loamy sand 031 East Lake sand 032 East Lake acid loamy sand (0-6% slope)

033 East Lake acid loamy sand (7-18% slope)
034 Eastport sand
035 Eastport/Roscommon sand
036 Emmet sandy loam (0-2% slope)
037 Emmet sandy loam (3-6% slope)
038 Emmet sandy loam (7-12% slope)
039 Ensign fine sandy loam
040 Ensley/Angelica
041 Fairport silt loam (0-2% slope)
042 Fairport silt loam (3-6% slope)
043 Gilchrist sand
044 Grayling sand (0-6% slope)
045 Grayling sand (7-18% slope)
046 Greenwood peat
047 Iosco sand
048 Kalkaska sand (0-6% slope)
049 Kalkaska sand (7-18% slope)
050 Kalkaska sand (19-40% slope)
051 Karlin sandy loam (0-6% slope)
052 Karlin sandy loam (7-18% slope)
053 Kawbawgan sandy loam
054 Kawkawlin silt loam
055 Keweenaw loamy sand (0-6% slope)
056 Keweenaw loamy sand (7-18% slope)
057 Kinross muck sand
058 Kiva sandy loam (0-6% slope)
059 Kiva sandy loam (7-20% slope)
060 Lake beach
061 Limestone rockland
062 Longrie sandy loam (0-2% range)
063 Longrie sandy loam (3-6%)
064 Longrie/Summerville sandy loam
065 Mancelona loamy sand (0-6% slope)
066 Mancelona loamy sand (7-18% slope)
067 Melita sand
068 Menominee loamy sand (0-6% slope)
069 Menominee loamy sand (7-18% slope)
070 Munising sandy loam (0-6% slope)
071 Munising sandy loam (7-18% slope)
072 Munising sandy loam (19-40% slope)
073 Nahma loam
074 Nester silt loam (0-2% slope)
075 Nester silt loam (3-6% slope)
076 Onaway fine sandy loam (0-2% slope)
077 Onaway fine sandy loam (3-6% slope)
078 Onaway fine sandy loam (7-12% slope)
079 Onaway fine sandy loam (13-18% slope)
080 Onota/Chippeny
081 Onota/Deerton (0-6% slope)
082 Onota/Deerton (7-18% slope)
083 Otisco loamy sand
084 Pickford silt loam
085 Pickford moderately wet silt loam
086 Pickford moderately wet complex

087 Roscommon muck sand
088 Roscommon/Kalkaska sand
089 Rousseau fine sand (0-6% slope)
090 Rousseau fine sand (7-18% slope)
091 Rousseau fine sand (19-40% slope)
092 Rubicon sand (0-6% slope)
092 Rubicon sand (7-18% slope)
093 Rubicon sand (19-40% slope)
094 Ruse silt loam
095 Saugatuck sand
096 Shelldrake sand
097 Skanee sandy loam
098 Steuben fine sandy loam (0-6% slope)
099 Steuben fine sandy loam (7-18% slope)
100 Summerville fine sandy loam
101 Sundell fine sandy loam
102 Sundell sandy variant loamy fine sand
103 Tawas muck
104 Trenary fine sandy loam (0-2% slope)
105 Trenary fine sandy loam (3-6% slope)
106 Trenary fine sandy loam (7-12% slope)
107 Trenary fine sandy loam (13-18% slope)
108 Wainola fine sand
109 Wallace sand (0-6% slope)
110 Wallace sand (7-18% slope)
112 Yalmer sand (0-6% slope)
113 Yalmer sand (7-18% slope)

SOLSER 2.0 Soil Series
01 Alluvial
02 Alpena
03 Angelica
04 Au Gres
05 Au Gres gravelly subsoil variant
06 Blue Lake
07 Bohemian
08 Bowers
09 Brevort
10 Brimley
11 Bruce
12 Burt
13 Carbondale
14 Cathro
15 Charlevoix
16 Chatham
17 Chippeny
18 Croswell
19 Dawson
20 Deerton
21 Deford
22 Duel
23 East Lake
24 East Lake acid variant
25 Eastport

26 Emmet
27 Ensign
28 Ensley
29 Fairport
30 Gilchrist
31 Grayling
32 Greenwood
33 Iosco
34 Kalkaska
35 Karlin
36 Kawbawgam
37 Kawkawlin
38 Keweenaw
39 Kinross
40 Kiva
41 Lake beaches
42 Limestone rockland
43 Longrie
44 Lupton
45 Mancelona
46 Marsh
47 Melita
48 Menominee
49 Munising
50 Nahma
51 Nester
52 Onaway
53 Onota
54 Otisco
55 Pickford
56 Pickford moderately wet
57 Rifle
58 Roscommon
59 Rousseau
60 Rubicon
61 Ruse
62 Saugatuck
63 Shelldrake
64 Skanee
65 Steuben
66 Summerville
67 Sundell
68 Sundell sandy variant
69 Tacoosh
70 Tawas
71 Trenary
72 Wainola
73 Wallace
74 Wheatley
75 Yalmer

SLOPE 1.0 Slope of the camp's setting
0 - unknown
1 - 0-2%

		2 - 0-6% 3 - 7-12% 4 - 13-18% 5 - Over 20% 6 - 7-18% 7 - 0-4% 8 - 2-40% 9 - 19-40%
DINEWAT	3.2	Distance to nearest water (miles)
DIDRWAT	3.2	Distance to nearest driveable water (miles)
ORDRWAT	1.0	Orientation of nearest driveable water 0 - same elevation 1 - lower elevation 2 - higher elevation
TYPNWAT	1.0	Type of nearest water 0 - stream 1 - major river 2 - lake 3 - Great Lake 4 - lake/stream or lake/river combination 5 - spring
DNSAMCAM	3.2	Distance to nearest camp of the same type (miles)
DNDIFCAM	3.2	Distance to nearest camp of a different type (miles)
TYPNDIC	1.0	Type of nearest camp of a different type 0 - unknown 1 - River drive 2 - Railway 3 - Railway (with extensive documentation)
DNSWAM	3.2	Distance to the nearest swamp (miles)
ELEV	4.0	Elevation of site (feet asl)
HIEL	4.0	Highest elevation within 1 1/2 mile radius of camp (feet asl)
LOEL	4.0	Lowest elevation within 1 1/2 mile radius of camp (feet asl)
RELEL	1.0	Relative elevation of camp with respect to other elevations within 1 1/2 mile radius of camp. 0 - lowest 1 - intermediate 2 - highest
DINRD	3.2	Distance to nearest U.S. Forest Service/county road/trail (miles)

DINRWY	3.2	Distance to nearest known railway (miles)
OCCUP	6.0	Occupation dates (i.e. 1895-910, 895910; 1910, 910910).
RELOC	1.0	Relative occupation 0 - unknown 1 - late 19th century 2 - late 19th century/early 20th century 3 - early 20th century

APPENDIX B

ENTREPOT/INTERMEDIATE SUPPLY CENTER VARIABLES

Acronym	Format	Description
APRIOR	1.0	A priori assessment of settlement type 0 - Intermediate supply center 1 - Entrepot 2 - Possibly subsequent to study period
DNSET	4.2	Distance to nearest settlement (miles)
APRNSET	1.0	A priori definition of nearest settlement 0 - Intermediate supply center 1 - Entrepot 2 - Possibly subsequent to study period
DINEWAT	1.0	Distance to nearest water (miles)
TYPNWAT	1.0	Type of nearest water 0 - stream 1 - major river 2 - lake 3 - Great Lake 4 - stream/lake or river/lake combination 5 - spring 6 - two or more of the above
DINRWY	3.2	Distance to nearest railway (miles)
TYPNRWY	1.0	Type of nearest railway 0 - logging railway 1 - mainline railway 2 - junction of two or more railways
NORWYL	2.0	Number of rail lines within a 2 mile radius of the settlement
TRLGRWY	1.0	Terminus of a logging railway 0 - no 1 - yes (includes junction of logging railway into mainline)

TRMNRWY	1.0	Terminus of a mainline railway 0 - no 1 - yes (includes junction of two main lines)
PORT	1.0	Port facilities in the settlement 0 - no 1 - yes
DIRKLHM	1.0	Direct link to homeland 0 - no 1 - yes
TYPNLCMP	1.0	Type of nearest verifiable logging camp 0 - unknown 1 - River drive 2 - Railway 3 - Railway (with extensive documentation)
DINRD	3.2	Distance to nearest U.S. Forest Service/county road/trail (miles)
OCCUP	6.0	Occupation date(s) (i.e. 1895-1910, 895910; 1915, 915915)
RELOC	1.0	Relative occupation 0 - unknown 1 - late 19th century 2 - late 19th/early 20th century 3 - early 20th century
RWYSTA	1.0	Number of railway stations in the settlement
ORWYFAC	2.0	Other railway facilities in the settlement
LUMMLS	1.0	Number of lumber mills in the settlement
WARHS	1.0	Number of warehouses in the settlement
LGEQP	1.0	Number of establishments selling logging equipment
GNLSTO	1.0	Number of general stores in the settlement
PO	1.0	Number of post offices in the settlement
SHOWHOR	2.0	Number of saloons/hotels/brothels in the settlement
SPCRET	1.0	Number of specialized retail establishments in the settlement
RELEST	1.0	Number of real estate brokers in the settlement
RTWHTIM	1.0	Number of retail/wholesale timber agents in the settlement

TELEPH	1.0	Telephones present in the settlement 0 - no 1 - yes
TLGRH	1.0	Telegraph present in the settlement 0 - no 1 - yes
BANK	1.0	Number of banks in the settlement
SCHOOL	1.0	Number of schools in the settlement
RLFAN	1.0	Number of religious facilities in the settlement
FINWDMN	1.0	Number of finished wood manufacturers in the settlement
MEDIC	1.0	Number of physicians/dentists/pharmacists in the settlement
LWYR	1.0	Number of lawyers in the settlement
HOSP	1.0	Number of hospitals in the settlement
LSFGOVT	1.0	Number of local, state and federal government functions/facilities in the settlement
HIND	1.0	Number of heavy industries in the settlement
LIND	1.0	Number of light and service industries in the settlement
FISH	1.0	Number of fishing related activities/facilities in the settlement
TOTMNF	2.0	Total number of manufacturing/industrial functions/facilities in the settlement
POP00	4.0	Population of the settlement - 1900
POP10	4.0	Population of the settlement - 1910
POP20	4.0	Population of the settlement - 1920

APPENDIX C

LOGGING CAMP SITES

River Drive Sites

Township Number	Section Number	Site Number (USFS)
T38N R21W	05	01-119
T39N R21W	34	01-186
T40N R19W	09	01-202
	10	01-198
T40N R20W	16	01-203
T41N R17W	13	02-277
	27	02-280
T41N R18W	09	02-019
	20	02-261
	21	02-260
T41N R19W	03	01-241
	09	01-243
	21	01-141
	26	02-287
T41N R21W	02	01-183
T42N R17W	03	02-092
	04	02-235
T42N R18W	01	02-050
T42N R20W	19	01-184
	20	01-191
T43N R17W	05	02-275
	26	02-293
	31	02-292
T43N R18W	10	02-276
	24	02-080
	27	02-018
	34	02-017

T43N R19W	05	01-201
T43N R20W	03	01-189
	14	01-256
	17	01-030
	18	01-255
	36	01-188
T44N R17W	10	02-156
		02-289
		02-297
	21	02-225
	22	02-223
	33	02-257
T44N R18W	12	02-243
		03-243
	21	03-246
	25	03-429
	32	02-271
T45N R17W	09	03-374
T47N R21W	22	03-051

Railway Sites

T39N R21W	04	01-154
	27	01-158
T40N R21W	25	01-111
T41N R18W	13	02-350
	14	02-075
	22	02-170
T41N R19W	05	01-024
		02-124
	06	01-034
	20	01-051
	22	02-094
		02-095
		02-09
	33	02-234
		02-326
T42N R17W	05	02-176
		02-355
	07	02-356
	18	02-300
	20	02-304
	21	02-290
	24	02-181

T42N R18W	07	02-009
	12	02-357
	17	02-013
	19	02-203
	21	02-014
	30	02-385
	31	02-047
T42N R19W	03	01-064
	11	02-200
		02-368
		02-369
	12	02-008
	14	02-167
	17	01-026
	20	01-021
	29	01-020
	30	01-134
T43N R17W	17	02-114
	21	02-204
T43N R18W	01	02-053
	18	02-029
	30	02-168
	32	02-012
T43N R19W	01	01-110
	02	01-019
		01-058
	03	01-043
	09	01-057
	11	01-018
	15	01-044
		01-054
	16	01-045
	26	01-120
	27	01-055
	33	01-031
	34	01-048
T43N R20W	05	01-022
	27	01-015
T43N R21W	03	01-166
	08	01-167
	11	01-103
T44N R17W	08	02-175
	29	02-358
T44N R18W	03	03-239
	04	03-240

	06	03-241
	10	03-414
	24	03-247
	26	02-269
T44N R19W	01	03-032
	03	03-218
		03-466
	10	03-220
	13	03-410
	14	03-368
		03-370
	15	03-226
		03-298
	16	03-476
	19	03-038
	21	03-477
	23	03-232
	25	03-234
		03-367
	26	03-235
	27	03-236
		03-361
	32	03-040
T44N R20W	20	03-206
	31	03-257
	33	03-216
T45N R17W	07	03-183
	18	03-187
		03-188
	20	03-189
	30	03-307
	32	03-272
T45N R18W	08	03-432
	09	03-036
	12	03-164
	20	03-012
	22	03-172
	27	03-253
	33	03-177
T45N R19W	01	03-141
	05	03-144
		03-149
	08	03-493
	13	03-652
	30	03-395
T45N R20W	02	03-093
	03	03-552

	29	03-136
		03-137
		03-138
	30	03-139
		03-140
	31	03-273
T46N R18W	02	03-437
	10	03-106
	11	03-027
	16	03-045
	21	03-655
	22	03-443
T46N R19W	18	03-017
	19	03-363
	20	03-636
	27	03-099
T46N R20W	07	03-402
	13	03-573
	23	03-081
	24	03-082
	27	03-083
	29	03-578
	32	03-089
T46N R21W	10	03-062
	13	03-066
		03-067
	14	03-302
	15	03-380
	16	03-597
		03-598
	22	03-379
	24	03-073
	26	03-362
T46N R23W	21	03-329
T47N R20W	34	03-586

<u>Unknown</u>

T39N R21W	15	01-156
T40N R21W	11	01-236
T41N R18W	02	02-174
	15	02-103
	17	02-087
	35	02-055

T41N R19W	05	01-273
	06	01-277
	08	01-283
	13	02-078
	17	01-242
	21	02-097
	26	02-288
	31	01-276
T41N R20W	13	01-087
		01-286
	17	01-053
	20	01-052
	24	01-287
	25	01-274
T41N R21W	12	01-098
	25	01-093
		01-257
T42N R17W	02	02-091
	04	02-099
	08	02-175
	10	02-165
	17	02-301
		02-329
T42N R18W	06	02-071
		02-231
		02-262
	13	02-088
	24	02-093
	33	02-171
T42N R19W	02	02-338
		02-367
	06	01-131
	09	01-023
	22	02-159
	24	02-236
	33	01-137
T42N R20W	01	01-271
	08	01-090
	11	01-116
	21	01-139
	36	01-187
T42N R21W	15	01-054
	24	01-107
	36	01-101
T43N R17W	07	02-023
	19	02-245

	22	02-179
	29	02-177
T43N R18W	03	02-199
	07	02-031
	11	02-110
T43N R19W	03	01-042
		01-119
	18	01-046
T43N R20W	12	01-152
	17	01-259
	34	01-153
T43N R21W	24	01-115
T44N R17W	08	02-058
		02-178
	09	02-213
	15	02-188
	19	02-
	32	02-067
T44N R18W	11	03-612
	17	03-245
	22	02-153
	23	02-154
		02-195
	25	02-046
	29	02-005
	30	03-251
	32	02-074
		02-155
	34	02-164
	35	02-172
	36	02-328
T44N R19W	02	03-217
	04	03-467
	05	03-468
	06	03-469
	09	03-471
	13	03-223
	21	03-228
	22	03-230
		03-303
	28	03-237
	31	03-238
	32	03-482
	36	03-486
T44N R20W	01	03-196
	02	03-541

	04	03-197
	06	03-198
		03-199
	09	03-200
		03-201
	13	03-202
		03-546
	16	03-203
	18	03-204
	19	03-205
	20	03-207
		03-260
	24	03-210
	32	03-214
		03-261
		03-550
T45N R17W	04	03-371
	07	03-182
		03-419
		03-420
	08	03-421
	10	03-360
	11	03-418
	21	03-190
	26	03-373
	28	03-192
	30	03-193
	31	03-375
	32	03-195
	33	03-425
		03-640
	35	03-611
T45N R18W	01	03-158
	02	03-159
	03	03-430
	06	03-116
	08	03-162
		03-399
	14	03-165
		03-166
	20	03-167
	24	03-169
		03-170
		03-171
	29	03-173
	30	03-175
	31	03-176
		03-436
	33	03-431
	35	03-179

T45N R19W	03	03-143
		03-489
	07	03-491
	10	03-146
		03-147
		03-494
	12	03-148
	17	03-150
		03-151
	19	03-497
	25	03-152
	27	03-153
	29	03-281
	34	03-156
		03-157
T45N R20W	04	03-121
	05	03-122
	08	03-385
	11	03-125
	12	03-126
	13	03-558
		03-559
	14	03-127
	15	03-129
	18	03-132
		03-565
	20	03-274
	23	03-135
	32	03-256
		03-383
T46N R18W	02	03-103
	08	03-519
	10	03-026
		03-105
	11	03-401
	14	03-613
	16	03-094
	20	03-095
	21	03-097
	22	03-109
		03-110
	26	03-111
		03-112
	27	03-311
	28	03-113
	30	03-114
		03-115
	31	03-116
	33	03-102
		03-117
	34	03-118

T46N R20W	03	03-406
	04	03-074
		03-396
	06	03-075
	09	03-076
	10	03-407
	11	03-572
	16	03-077
	17	03-042
	20	03-080
	28	03-084
	30	03-087
	34	03-090
		03-306
	35	03-093
T46N R21W	01	03-060
	08	03-592
	10	03-063
	11	03-065
	17	03-070
	18	03-071
T46N R23W	02	03-332
	14	03-340
	22	03-331
	25	03-355
	26	03-341
T47N R18W	01	03-030
	12	03-059
		03-452
	14	03-454
		03-455
	28	03-462
T47N R19W	18	03-527
	19	03-529
	30	03-535
T47N R20W	13	03-582
		03-583
	14	03-313
	28	03-584
T47N R21W	21	03-049
		03-050
	22	03-053
	30	03-604
	34	03-606

APPENDIX D

ENTREPOTS AND INTERMEDIATE SUPPLY CENTERS

Intermediate Supply Centers

Name	Township/Range	Section Number
Onota	47N 19W	29
Rock River	47N 21W	15
Selma	46N 23W	22
New Dalton	46N 23W	17/16
Yalmer	46N 23W	6/7
Dukes	46N 23W	27/26/34/35
Au Train	47N 20W	32
Dixon	46N 20W	31
Stillman	46N 20W	36
Ridge	46N 20W	12
Hanley	46N 19W	36
Juniper	46N 18W	30
Doty	46N 18W	22
Evelyn	46N 18W	22
Steuben	44N 17W	20
Brampton	41N 22W	21
Winde	41N 22W	7/8/6/5
Garth	41N 21W	33
Gena(Masonville)		
Ensign	41N 20W	31

Cooks	41N 17W	30
Maywood	40N 22W	26
Chaison	40N 22W	07
Nahma Junction	40N 20W	01
Isabella	40N 19W	02
Stonington	38N 22W	1/2
St. Jacques	40N 20W	02
Eben Junction	46N 21W	29
Chatham	46N 21W	34
Slapneck	46N 21W	36
Wetmore	46N 19W	13
Perkins	41N 22W	04
Maplewood	41N 21W	
Elkhorn	41N 17W	11/10/15/14
Springer	41N 17W	26
Kipling	40N 22W	10
West Gladstone	40N 22W	19
Alton	40N 21W	3/10
Ogontz	40N 20W	8/9/17/16

<u>Entrepots</u>

Nahma

Gladstone

Escanaba

Rapid River

Manistique

Munising

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