A Political Ecology of Forest Exploitation in the Lower Peninsula of Michigan: 1800 – 1950

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Historical literature written about logging activity in Lower Michigan and the Great Lakes region between 1800-1950 is analyzed within two political ecology frameworks, Yapa's 'nexus of relations' and Blaikie's 'chain of explanation.' The dominant character of each of the factors composing the nexus of relations; social, cultural, economic, academic, ecological, technical, and political, during the period from 1800-1950, were identified and placed within the chains of explanation. Four distinct time periods were delineated based on the character of each of these factors encompassing settlement of the region; the establishment and beginning of the logging era; the intense exploitation of the forests; and the downfall of the logging industry. By interpreting the changes in each factor over time, linkages were drawn between the factors and landscape degradation that occurred as a result of logging activity. Through this research we found that intense modification of the Great Lakes forests from logging was caused by many interconnected factors that reflected not only economic situations during the different time periods, but also other dimensions such as human perceptions of the forests. All factors in the nexus played important roles in process of deforestation.

Keywords: logging history, historical political ecology, land degradation, Michigan

Introduction

The forests of Lower Michigan, as those of the Great Lakes Region in general including Michigan, Wisconsin, most of Minnesota, and Ontario, Canada, underwent intense change due to logging from the time the region was settled by Euro-Americans beginning in the mid 1700s until the mid 1900's. The landscape degradation which occurred as a result of logging activity is still evident today. Examining the causes and dynamics of these historical changes provides insight into the relationships people have with their landscapes and the natural resources there within. Landscape degradation as a result of logging was brought on by numerous factors, ranging from the social, to ecological and cultural, and the complex relations among these factors. For example, during the early 1800's society's utilitarian view of the forests contributed to the widespread logging without regulation or consideration of future repercussions. A better understanding of the process of landscape degradation, such as the degradation which occurred from logging in the Great Lakes region, and dynamics of the factors driving the process may provide insights into interactions between humans and their environment as well as help manage forests today and in the future.

Although the logging period in Lower Michigan has been studied by various researchers (Flader, 1983; Whitney, 1987) including the recent work presented in the book "The Forests of Michigan" by Dickmann and Leefers (2003), geographers have not studied the forests of the Great Lakes region as extensively as would be expected (Rohe, 1994). Here, we offer an analysis of historical logging in Michigan from both a historical regional geography approach as well as a political ecology perspective.

Political ecology provides a useful conceptual framework that serves as an optic through which to further understand and explore the history of logging in

Michigan including the nested hierarchy of factors contributing to the resulting extreme environmental transformation. Political ecology is an analytical approach to understanding nature-society relations and environmental change focusing on the political economic context in which changes were brought on the land (Blaikie and Brookfield, 1987; Zimmerer and Bassett, 2003b; Robins, 2004). The approach initially emerged out of studies analyzing land degradation and other environmental change in rural landscapes in developing countries. To date, this approach has had only limited application to understanding land use change in developed countries. However, recent shifts in research focus indicate a use of this perspective to understand environmental change in the developed world from a historical perspective (Zimmerer and Bassett, 2003a; Offen, Forthcoming). Karl Offen characterized historical political ecology as a

> field-informed interpretation of society-nature relations in the past (e.g. material, ideological, legal, spiritual), how and why those relationships have changed (or not changed) over time and space, and the significance of those interpretations for improving social justice and nature conservation today (Offen 2004: 21).

Although we do not meet his definition in full in this article, we have found the optic of political ecology a useful approach to shed new light on the landscape degradation resulting from widespread logging in the Great Lakes Region, specifically within Lower Michigan.

The purpose of this paper is to utilize political ecology to understand the interactions between the factors leading to the extensive logging of the forests and associated environmental destruction in the Great Lakes Region, with a particular focus on the Lower Peninsula of Michigan from 1800 to 1950. Intense landscape change, as brought about by the extraction of natural resources, for example through logging, is often the result of the interactions of many factors and circumstances. These factors include the social, cultural, economic, academic, ecological, technical, and political. Geographer Lakshman Yapa (1996), in his analysis of the production of agricultural seeds, theorized these factors as a 'nexus of relations' and offers it as a tool to explore the interactions, or 'web of relations,' between associated factors of a particular production system (Yapa, 1996). Here, we use this 'nexus of relations' as a basis to identify the interacting relations leading to the changes in the forests and landscapes of Lower Michigan (Figure 1). The factors identified in this approach are based on those outlined in Yapa (1996) with the addition of a physical (landscape) factor because of the importance of landscape characteristics in logging and associated environmental disturbance. The factors identified in this approach are

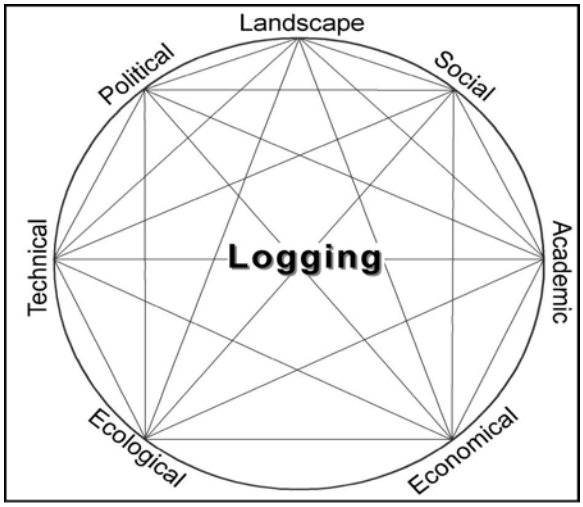

Figure 1 The factors comprising the Nexus of Relations for logging including: landscape, social, academic, economical, ecological, technical, and political. (Source: adapted from Yapa, 1996, p.72)

not discrete categories but are utilized to represent or model the dynamic processes occurring within relations.

This paper proceeds as follows. After a brief methodological note, we first describe the state of the forests in Michigan before Euro-American settlement and exploitation. We then present a regional historical geography utilizing the factors and their relationships from the 'nexus of relations' (Figure 1) as foci for each of four critical historical time periods: early exploration and settlement 1700 – 1800; intensive settlement and forest clearance 1800 – 1860; exploitation of the forests 1860 – 1920; and the downfall of logging 1920 – 1945. These time periods were identified using literature written about the region as well as by noting marked changes in character of each of the factors in the nexus of relations (Flader, 1983; Yapa, 1996). We then use Piers Blaikie's

'chain of explanation' (1998) another political ecologic explanatory device , to explore forest change (Figure 2). The use of the 'chain of explanation' permits the addition of a time factor to the nexus of relations.

The combination of these two frameworks is useful because it permits the elucidation of the impacts factors have on each other in one time period and the next. To our knowledge Yapa's 'nexus' and Blaikie's 'chain' have not been used together as an exploratory device. We feel that together they offer a broadly politicized context in which to view the history of logging in Lower Peninsula Michigan.

Methodological Note

In order to analyze the relationships between humans, their landscape, and logging using two political ecology frameworks the nexus of relations' and the 'chains of (Yapa, 1996; Blaikie, 1998), we examined literature from a variety of sources including historical literature written about exploration, settlement, and logging in the Great Lakes region during the period of 1700 to mid 1900's, as well as political ecology literature (Table 1).

First, we delineated four time periods based on the character of human-environment interaction over time. We designated the time periods based on coherent changes in more than one factor at a time. During each of the four time periods, the dominant character of each of the seven factors: ecological, political, technological, social, academic, geographical (landscape), and economic was identified from the historical literature which served as input for the 'chains of explanation' model (Figure 2).

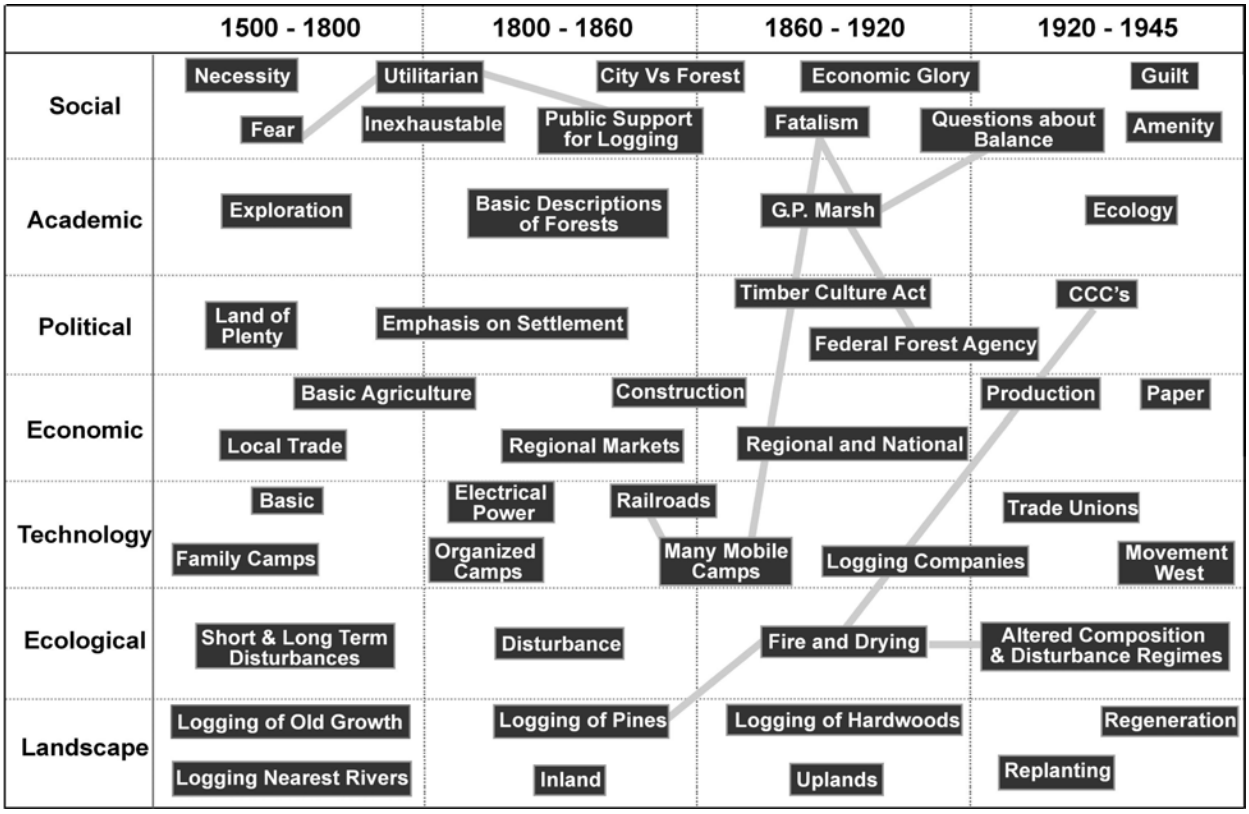

Figure 2. The Chains of Explanation: The factors from the Nexus of Relations are on the left side (y-axis) of the figure, time periods discussed in the text are listed across the top (x-axis). Each rectangle represents the dominant character of each factor for a particular era. Lines connect the most important relationships between factors. (Based on Blaikie 1998)

Example Historical Sources	Political Ecology Frameworks
Flader 1983 "Great Lakes forests: Environmental and social history"	Blaikie 1994 "Political ecology in the 1990's: An evolving view of nature and society"
Frelich 1995 "Old forest in the Lakes States today and before European Settlement"	Blaikie and Brookfield 1987 "Land degradation and society"
Whitney 1987 "A ecological history of the Great Lakes Forests of Michigan"	Yapa 1996 "Improved Seeds and Constructed Scarcity in Liberation Ecologies"
Williams 1989 "Americans and their forests"	Offen 2004 "Historical political ecology"

Table 1 Example data sources used in chain of explanation

We utilized historical accounts and historical literature from several authors to populate the model. Once the dominant character of each factor was established, we identified linkages between the different factors and their changes. The linkages were identified based on the insights from previous authors, political ecological studies in other regions, and our own interpretations.

Throughout the following sections, we focus specifically on the regional historical geography of Lower Peninsula Michigan. However, many of the sources we consulted were written about the entire Great Lakes Region, including Canada. Therefore, although we discuss the many factors and their interrelationships in the specific context of Lower Michigan, many of these apply generally to the entire Great Lakes Region. We also point out that logging in Lower Michigan took place in a particular era, but was part of a much larger transformation of the North American landscape. Extensive logging activity first began on the East Coast much earlier than in the Great Lakes Region, and moved westward through the Lakes States, then across the plains to the forests of the Rocky Mountains, and eventually culminating in the west coast mountain ranges. Therefore the changes in each of the factors we highlight below occurred in the context of the wave of logging activity throughout the continent (Lower, 1949; Williams, 1989).

The Forests of Lower Michigan before European Settlement

A variety of diverse and extensive forest communities covered the Lower Peninsula of Michigan during the early 19th century before extensive Euro-American arrival and subsequent disturbance. These forests can be categorized into three main types of communities; deciduous, coniferous, and mixed. The distribution and composition of forest communities in the Lower Peninsula were and continue to be strongly related to the physical characteristics of the landscape particularly, soils and

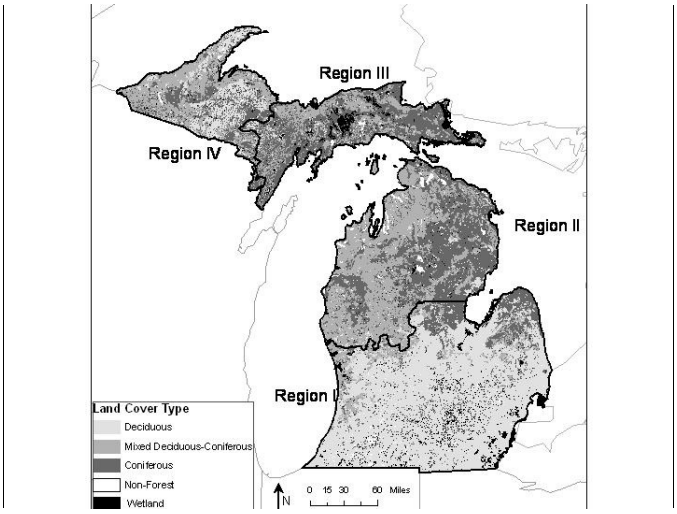

Figure 3 Map of generalized vegetation types in Michigan before Euro-American settlement and delineation of regions

climate. The Lower Peninsula of Michigan is typically divided into two physiographic regions (Albert et al., 1986) (Figure 3). The northern limit of Region I is roughly delimited by a line running from Saginaw Bay in the East horizontally across the state to Lake Michigan on the West (Figure 3). This line is approximately the 47 F isotherm of mean annual temperature. The southern Eastern Broadleaf Forests in Region I are dominated by Beech-Maple and Oak-Hickory communities. Region II, located north of Region I, encompasses the rest of the Lower Peninsula. In Region II, the northern Laurentian Mixed Forests are dominated by Hemlock-White Pine-Northern Hardwood communities (Barbour and Billings, 2000; Barnes and Wagner, 2004).

The southern physiographic Region I is characterized by a warmer climate than Region II. The forests prior to Euro-American settlement found in Region I were predominantly deciduous (Barnes and Wagner, 2004). Several types of communities were present including Oak-Hickory, Beech-Maple, Oak-Savannah, and deciduous swamps. The most common community, Oak-Hickory, was dominated by white oak *Quercus alba*, black oak *Quercus veluntina*, red oak *Quercus ruba*, pignut hickory *Carya glabra* and shagbark hickory *Carya ovata*. Second were the Beech-Sugar Maple communities dominated by American beech *Fagus grandifolia*, sugar maple *Acer Sacchrum* as well as some oaks including red oak, basswood *Tilia Americana,* and white ash *Fraxinus Americana*. Much less common were Oak-Savannas dominated by bur oak *Quercus macrocarpa*, black oak *Quercus velutina*, and northern pin oak, *Quercus ellipsoidalis* which grew out in the open as individuals or in groves often transitioning into prairie.

The forests communities in Region II, mainly coniferous and mixed forests, were quite different from those in the southern part of the state. Pine and Northern Hardwood communities dominated Region II. Pine communities dominated by white pine *Pinus strobus*, red pine *Pinus rubra,* and jack pine *Pinus banksiana*, preferred the sandy dry soils of outwash plains. Fire was an important component in theses forests, allowing the pines to out compete deciduous species, especially in the jack pine forests. The Pine communities were perhaps the most impressive forest on the landscape on the time of European arrival. White pine trees could reach heights of up to 120 feet and four feet in diameter at breast height (Dickmann and Leefers, 2003). The Northern Hardwoods community, dominated by sugar maple, American beech, yellow birch, eastern hemlock *Tsuga Canadensis*, red maple, basswood, balsam fir *Abies Balsamea,* and white pine, preferred more fertile and mesic soils of moraines.

Between the typical forests of Region I and II a transition or ecotone occurs between the southern deciduous and northern mixed-coniferous forests, often referred to as the tension zone (Potzger, 1948; Dickmann and Leefers, 2003). This ecotone is a gradual transition where north of the line species such as white pine and hemlock increase in dominance and south of the line oak species as well as sugar maple and American beech become more dominant. Climate is assumed to the be the broad scale influence of the transition zone while at finer scales, edaphic controls and disturbance are more important (Medley and Harman, 1987).

Several different disturbances and disturbance regimes were present and were important components of the Great Lakes forest systems before Euro-American settlement (Dickmann and Leefers, 2003). Fire was the most significant type of disturbance. It was an important component of both the oak forests in Region I and the pine and mixed pine forests in Region II. In the Oak-Hickory and Oak-Savanna communities low burning ground fires burned regularly ignited by lightning or by native people, maintaining an open canopy forest with grasses and forbs in the understory (Barnes and Wagner, 2004). Fires were also important in the Pine communities in Region II especially in the pine barren comprised mainly of jack pine and oaks where fires burned every thirty years or less (Dickmann and Leefers, 2003). Both small low intensity frequent fires and large scale stand-replacing fires, which occurred less often, burned in pine forests ignited by either anthropogenic sources (native activity) or lightning (Barnes and Wagner, 2004). Pines, which germinate well on ash covered soil, often regenerated after intense large scale stand-replacing fires. Low intensity fires also favored pine species because their thick bark protected them from fire while their deciduous competitors were cleared from the understory (Dickmann and Leefers, 2003). Other disturbances, such as windstorms, tornadoes, pests as well as disease, were present in all forest communities in the Lower Peninsula, although not as common as fire. In areas where a disturbance had occurred such as a from a small windstorm, pioneer species such as trembling aspen *Populus tremuloides*, bigtooth aspen *Populus grandientata*, and white birch *Betula Papyrifera*, would colonize open areas and establish until other species and eventually communities established (Dickmann and Leefers, 2003).

It is now well established that Native Americans had a significant impact on the overall environment in the Americas, including North America, before the arrival of Europeans (Vale, 2002). The intensity of that impact in Michigan, however, appears to have been relatively minor. The three nations that occupied Michigan, the Odawa (Ottawa), the Ojibwa (Chippewa), and the Bodewadmi (Potawatomi), formed an alliance known as the *Anishinabeg*, or the People of the Three Fires. They were semi-nomadic woodland peoples who cultivated small garden plots during the summer to supplements gathered and hunted resources (Dickmann and Leefers, 2003). Their greatest impact on the environment was through deliberate use of fire, particularly to manage soil fertility and to increase the abundance of desired fruit (especially blueberries) for gathering (Anderton, 1999; Lewis, 2002). The use of fire is highly characteristic of Native management of the physical environment in North America before Columbus (Fritzell, 1983). In Michigan, Native populations were relatively low, and the overall impact on the forests by Natives was minimal, and was more akin to an extension of natural impacts than to the drastic changes that would occur as a consequence of Euro-American occupation.

European Exploration and Settlement 1500 - 1800

French fur traders arrived in the locale of St. Ignace, Michigan in 1671. Several isolated French settlements were present in Michigan by the end of the 1600's and beginning of the 1700's. Michigan was attractive to the French settlers because of an abundance of resources, including game, fresh water, and immense forests. These settlers logged the forests mainly to clear land for agriculture but also to construct homes, forts, fur trading posts, and missions. The harvesting of timber by French settlers was mainly for subsistence (Barlowe, 1983; Lewis, 2002). The developing economy during these early times was based mainly on fur trading activities and regulation of these activities by government was virtually non-existent. The French viewed the forests as a necessity crucial to survival, establishment, and most importantly the fur trade (Lewis, 2002). The French settlements were surrounded by extensive thick forests and were thus isolated. Information about the wildness, abundance of resources, and isolation of settlements would eventually reach the East Coast and generated notions of Michigan as a wondrous western frontier. Detroit was settled in 1701. In 1796, fewer than 3,000 people lived in Michigan. Settlement in Michigan was somewhat slower than surrounding states in the Midwest and Great Plains because of a general lack of accessibility and knowledge about the internal geography of the state (Fritzell, 1983). As the settlement at Detroit grew, transportation became easier, and promises of a land of plenty as well as the benefits of land grants eventually drew settlers to Michigan from the East Coast as well as directly from Europe (Lewis, 2002).

Explorers during the 17th and 18th centuries wrote about Michigan as a place of fruitful and bountiful land where Americans could live out a simple, peaceful, and prosperous rural life. These romantic writings planted notions of grandeur in would be settlers minds and did not necessarily accurately portray the landscape itself or hardships settlers may encounter (Barlowe, 1983; Flader, 1983). As Fritzell states " Just so, one guesses, the intellectual or conceptual history of the Great Lakes forests begins in preconceptions held by explorers long before they set eyes on the forest itself" (1983, 275).

In the late 1600's and 1700's, the ideals and intellect of society were based mainly on God's divine creation of the Earth. Society, in general, believed the bountiful resources encountered on the North American landscape were placed there by God for people to use. In 1691, the naturalist John Ray was centuries ahead of his time when he romantically declared that God's gifts should be wisely used. Even academic descriptions of the forests in these early centuries consisted of verbose accounts of a fruitful and majestic wilderness well suited for agriculture.

Intensive Settlement and Establishment 1800 – 1860

The major thrust of Euro-American settlement of the Great Lakes region occurred between 1790 and 1860. The opening of the Erie Canal in 1825 was critical to settlement as it provided transportation for both settlers and goods. Most of the land not already allocated under the French and English land grants was included in the Northwest Territory (Barlowe, 1983; Lewis, 2002). People came mainly from the East Coast looking for new places to farm. Before 1818, most of the settlement in Michigan was limited to the Southeast corner near the hub of Detroit but soon after settlements began

expanding. By 1830, settlements had expanded across the majority of lands in the southern half of the Lower Peninsula (Region I). After 1835, settlement had expanded into Region II (Barlowe, 1983).

Forests were cut initially to provide material for homesteading and to clear land for agriculture. Thus, the first forests to be cut were those on rich uplands that would provide the best farmland, rather than the best timber. The average farmer only cleared approximately two acres of forested land per year. Because the forests provided resources needed for fuel and building but impeded the establishment of farms, early settlers perceived the forests with a "friend and foe" mentality (Williams, 1983). Settlers cleared land solely for subsistence needs. Because timber was widely available during the early development of agriculture, raw timber itself was not yet a mainstay in the local economy (Cronon, 1995).

As settlers began the arduous process of land clearance and agricultural development, they were quite overwhelmed and intimidated by the immense forests of Lower Michigan. Society's attitude and conceptions about their surroundings during these initial settlement activities include fear and reverence. Emerson and Thoreau both express a fear towards the immense forests and describe the forest and nature in general as a place of God. For Example, in 1836, Emerson wrote that the forest is a place where "all His excellence was shown to perfection" (Emerson, 1836; Williams, 1989). The idea of wilderness and the vast wilderness itself held not only pious connotations but also negative connotations including fear. Wilderness was a place that one only came to against one's will (Cronon, 1995). The forests of the Great Lakes region were so overwhelming to settlers that they conceived it as the "enemy" and a "hideous and desolate wilderness" (Barlowe, 1983; Twining, 1983). Thus the state of the societal factor, as relates to society's attitudes towards forests at this time can be characterized by necessity and fear (Figure 2).

The ecological and aesthetic values of forests had not yet entered the ideals of society, thus forests in themselves were not specifically valued (Cronon 1991). Most people held the utilitarian view that forests were only valuable for their products and were to obstacles concealing valuable farming land. Therefore logging activities were encouraged by society. Land clearance, agricultural establishment, and logging were fundamental activities for settlers arriving from the already highly modified landscapes of both Europe and the East Coast. In the Eastern United States, intense logging had been occurring for decades. Agriculture quickly filled in the landscape where heavy logging occurred (Williams, 1989). Yet, despite the immense efforts, agricultural activities in the Great Lakes region had mixed successes (Lewis, 2002).

As settlers from the East Coast started their lives and towns began to appear, organized logging was close behind. Logging started out as a one-man operation. Men would go into the forest to cut down and sell a single tree. As demand for wood increased, loggers became organized and cooperated both efforts and resources. At first, logging camps consisted of at the most 10 to 15 men. As new families arrived to the area, they would often purchase land near the small logging camps. These camps were basic consisting of a collection of log huts and bark shanties (Williams, 1989; Lewis, 2002). The camps were usually maintained by a family business owned by one man.

Population increased dramatically shortly after 1815 (Cronon, 1991). Settlers were having families and more people were migrating from the East Coast as well as directly from Europe. The population of Michigan in 1836 was 87,000; by 1850 the population was 400,000 (Lewis, 2002). Most of this activity occurred near Detroit and surrounding areas in Region I. Not only did all the settlers need wood for homes, fences, and barns in existing towns, more towns were appearing. On the East coast, especially in New York State, logging had already peaked. Loggers, their equipment, and families moved in a westward migration to the bountiful and romantic forests of the Great Lakes region. They left behind an insatiable demand for timber. Growing cities on the East Coast still required large amounts of timber.

As transportation networks became more advanced, the Lower Peninsula became more accessible and was thus viewed as an ideal place to settle because of easy access through water transport. Detroit, Milwaukee, and especially Chicago were experiencing considerable urban growth, and lumber demand was high (Cronon, 1991). Due to the growth of these cities as well as improvements in transportation, regional lumber markets developed. Chicago quickly developed as the region's and arguably the country's largest lumber market. Wood cut in northern Lower Michigan was able to reach Chicago cheaply and quickly through transport from inlands rivers and Lake Michigan. The development of Chicago as a regional lumber market hastened the shift from logging as

a necessity to logging as a capitalist venture. Just as Chicago was becoming a market hub where goods and lumber were traded and transported, settlement was increasing to the west in the plain states. As Cronon (1991) states, Chicago benefited from "the intersecting geographies of nature and capital". To the north and east of Chicago were the immense forests of the Great Lakes and to the west were the grasslands and the western frontier which was virtually completely dependent on Great Lakes lumber (Hays, 1983). Timber cut in the northern forests, not needed locally, was shipped to Chicago providing the lumber required for building on the prairies. At the same time, farming on the prairies was advancing and would provided goods needed in Lower Michigan towns and in lumber camps.

The towering white pines of Michigan were well suited for construction and prized in the economy of the Great Lakes and beyond. They were huge, easily worked and seemingly very abundant. White pine and red pine were preferred by loggers and cut first. These species also floated, a critical property, as most logs continued to be transported using rivers. Settlers, who cleared the land for agriculture, were more partial to hardwoods found in the Sugar-Maple-Beech communities, mainly because they grew on soil much more suitable to farming than the Pine communities. The value of several species in the Sugar-Maple Beech communities was not realized at first and species that were highly prized later such as cherry were cut and used for fence posts. The unselective manner in which lumber was acquired and utilized reinforces the settler's view of forests as an obstruction to agriculture. The use of highly valuable species in this manner also demonstrates society's naivety to the eventual scarceness of the forest resources (Cronon 1991).

As the cities continued to grow, more settlers entered the interior and towns began to form and grow farther away from the Detroit hub, the demand for timber rose and logging activity intensified to meet that demand. Logging camps that once consisted of 10 to 15 men in the early 1850s quickly grew in size and complexity. Ownership, at this time, was usually still by one man but many more single men were hired for various tasks. Instead of just shacks, several buildings were constructed. Often the logging camps had a building for cooking and eating, one for sleeping, or several depending on the number of men, a storehouse, and office. Advances in organization of labor, during this time period were crucial to increasing the amount of timber cut, processed, and delivered. Thus more timber was leaving the north-eastern shores of Lake Michigan for Chicago to meet the rising needs for lumber on the prairies.

Not only were there advances in the technology of labor organization at this time, during the period of 1800-1860, rapid advances in the technology of cutting, equipment, and transportation occurred. The basic human-powered saws used in the early 1800's were replaced by the 1830's with water-powered muley saw and gang saws. Even these new methods would soon be outdated as steam entered the logging camps. By 1854, 29% of Michigan's mills were steam powered while the others were water powered.

By 1859, technology had rapidly advanced and methods used during the first few decades were completely outdated. New technology, such as advanced saws, railroads, and steam allowed loggers to clear the landscape at a much faster pace than previously possible. Not only did logging camps now consist of more men, buildings, and equipment for cutting, the processing of lumber began to be conducted directly in the camps. Lumber would be processed in onsite mills, the center of portable camps, which would be moved to a new location once an area was cleared. This shift in the technology factor permitted mobility allowing more and faster exploitation of forests. Often the families of loggers or others interested in the economic activity moved with the towns. Men labored in the forests cutting and processing timber while the women maintained the home and often cooked for the men in the camps. With the advent of mills and better transportation, logging camps and their communities became mobile moving across the landscape in search of more towering forests.

While technology to obtain raw timber advanced rapidly, the technology to move the timber from the portable camps to markets was less efficient during the initial onset of rapid logging. Early methods of moving logs consisted of snaking logs by bullocks (linking and pulling), sleds drawn by horses or oxen, skidding logs on ice, or floating them down streams. Rivers quickly became overwhelmed with timber generated from many different logging companies. Thus experimentation in transportation began and eventually resulted in advancements in sledding and water transportation technology. Booms were developed to move logs more effectively by closing off sections of rivers. Rafts were used to transport logs down stream by boat. The railroad to Chicago was completed in 1852, allowing faster

transfer of timber (especially non-floating hardwoods) to meet the demands of the regional market. Eventually dams were constructed to permit the movement of large amounts of timber. Companies built dams and began to levy tolls from other companies for transfer of timber (Hurst, 1983; Williams, 1989).

Michigan became a state in 1848. The first real political action in response to logging activity occurred in 1851 when the Michigan legislature gave county supervisors the right to either grant or withhold permissions to construct dams and levy tolls. Increased traffic also sparked the practice of marking logs. In 1859, the government regulated marking logs on the Muskegon River (Fritzell, 1983). Political responses to logging activity at this time were solely to organize the logging effort in order to increase efficiency of transport to regional markets and enhance cooperation between logging companies.

Economic activity, political agendas, and the attitudes of settlers set the stage for the intensification of logging. Logging was not regulated nor was it a concern at this point in history. James Hurst discusses the role of society:

> Particularly important were certain attitudes broadly shared throughout the community. This consensus ran so deep that people accepted it as unquestionable common sense precluding examination, let alone controversy. In general, estimation of the forest was inexhaustible, its natural destiny was first to yield lumber and then to be cleared for producing cereal crops and everyone's well being would be promoted by the impatiently pressing pace of these developments and the greatest possible increase in production (Hurst, 1983, 137).

These conceptions limited any concern or regulation by the government. Knowledge of scientific processes, such those in ecology and soils were very basic at this time. Estimates of the amount of timber were not made until after 1860. Forestry as a science was in its infancy. There was confusion and uncertainty about how much timber was actually in the forests. Landscape exploitation and settlement were well underway before science was able to understand the effects. Science was so basic at this point in history that the expectations and actualities of science and society were the least divergent they have ever been in American History (Flader, 1983). Soon the academy would develop complex terminology to describe the forest but at this time such terminology was non-existent. The development of terminology and standards would have allowed for better communication between scientists, delineation of and comparison between different communities, as well as measurements of disturbance and regeneration. Eventually standards would be developed and the complexity of forest ecology and the terminology used to describe forests would create a communication barrier between the academy and the public (Williams, 1983). The General Land Office Survey, which began in Michigan around 1816 and completed in 1856, contains the best scientific record of the forests in Lower Michigan before the intensive logging which took place in the latter part of the settlement and establishment period (Barlowe, 1983; Comer et al., 1995).

The first glimmer of concern about forest destruction arose as organization and technology rapidly advanced during the middle of the 1800's. At the beginning of the settlement period, society perceived the forest as a wasteland whose only value lies in its conversion to agriculture. By the end of the 1850's, as cities emerged and became more prevalent on the landscape, the dominance of forests diminished. Problems such as crime and pollution, common in all cities, crept into the minds of society. Society's view of the city and the forest were changing places in the American intellect (Barlowe, 1983). The benefits of the forest, besides lumber and potential for agriculture, were beginning to be recognized.

In 1854, Lapham and other natural scientists in Wisconsin wrote warnings about the ruthless cutting in the hardwood forests and the possible future scarcity of wood (Hays, 1983). During the middle 1800's, a sense of fatalism began to arise in society's view of forests and natural landscapes. As lumber towns moved from one area of Lower Michigan to another, society began to realize the physical boundaries of their landscape and thus became concerned that virgin timber stands on which they so heavily rely may not always be just beyond the horizon. This marked the first realization that timber was not an inexhaustible resource. Questions about the long term feasibility of logging as the dominant economic activity were arising. Therefore advances in technology at the beginning of the settlement and establishment period lead directly to changes in the views of society by the end of the period. However, despite the glimmers of reality in the eyes of society, the search for economic

glory continued to overwhelmingly preoccupy the energy and views of society (Williams, 1989).

At the end of the 1850's, a separation between science and society begins to become more apparent. Scientific language was developing and became more difficult for society in general to understand and keep up with. Darwin wrote "*The Origin of Species*" in 1859 which broke down traditional thinking at the time (Darwin, 1859). Darwin wrote about the unity and harmony of nature and the web of life, ideas that had not entered the minds of society, especially those in the frontiers in the middle and western states.

Exploitation of Forests 1860 – 1920

After 1860, the scale and intensity of lumber harvesting changed dramatically. Logging was now concentrated and purposeful as large-scale systematic cutting replaced the cutting of single trees. Advances in technology led to industrial logging practices. This shift was spurred by several factors including: population and construction increases; demand for high quality lumber on the East Coast and Great Plains; movement of lumberman from the East Coast to the Great Lakes region; and lack of regulation in a highly competitive and newly developing logging economy.

Major technological changes occurred between 1869 and 1889. The transfer of product from the forest to the market became more efficient. Civil War (1861 – 1865) technology transferred westward quickly. Civil War veterans moved to the Great Lakes region bringing technology and skills learned in the East. Lumberman in the Great Lakes adopted the new technologies.

Steam was one such technology. By 1864, 49% of all saw mills in Michigan were steam powered, by 1874 72 %, and by 1909 90% (Williams, 1989). In 1876, two thirds of all saws were circular but by 1880 the more efficient band saw completely replaced the circular saw (Williams, 1989). Labor saving devices hastened the movement of logs from mill yards to the mill, into the saw and out to the loading area. Methods were also developed to move sawdust into the boiler quickly; increasing steam production. Steam efficiency increased three fold between 1870 and 1909. In 1870, steam provided 34 to 40 horsepower and in 1909 it provided 121 to 135. Production of timber in the Great Lakes region was three to four times the national average. In 1850, 3 billion board feet were produced in Michigan; in 1880 110 – 120 billion board feet were produced (Williams, 1989).

These technological advances occurred before advances in transportation. In the middle 1800's, the lumber along the best rivers and streams was already cut and loggers had to move to smaller streams, less efficient for navigation. In the 1860's the rivers were clogged with logs and logjams were common. Because efficiency in moving product to market was the most important factor in making a profit, major economic losses occurred due to the lag in transportation technology (Williams, 1989; Lewis, 2002).

Transportation technology quickly responded by the middle of the century. By 1870, every logging district had booms (physical structures) to help manage the movement of logs. Logging companies eventually combined their efforts and built immense temporary reservoirs to store logs until they could be moved down stream. In the earlier decades, most rafts just floated and only a few were pulled. By 1877, 95% of rafts were pulled or pushed by boats. The size of the boats and capacity to hold logs continued to increase (Williams, 1989) .

Before 1860's, transportation technology relied mainly on climate, since the majority of raw timber was moved in the winter when logs could be moved easily on snow or in the spring during when waters were high. These methods had a major disadvantage; they were completely reliant on climate. The delay created by an uncooperative climate immediately increased prices for lumber followed by a dramatic decrease when climate was satisfactory. In effort to diminish this reliance, loggers used snowplows to push snow from surrounding uplands to the trails below. Rut cutters were used to dig depressions that were filled with water and eventually froze forming ice roads. Basic railroad lines constructed in the 1840's quickly expanded in the following decades and filled in the need for transportation technology not reliant on climate. Mobile railroads also became important allowing short tracks to be put down and then transferred elsewhere as the logging camps moved rapidly across the landscape. The advent and implementation of the railroad in logging technology reduced the need for animal transportation and all the associated supplies. Networks of access roads were built leading to the main railways. Railroads and associated technology spread quickly and eventually became the main transportation method. In 1887, there were 127 railroads in Michigan, one of the quickest states to adopt the transportation

system. As a consequence of railroad construction, lumber mills relocated near railways.

The development of railroads sparked advances in the organization of logging companies. Large capitalized businesses were weeding out the small family logging companies mainly because businesses were able to keep up with technological changes and secure land holdings. Family business consolidated into larger companies. Advances in the acquisition, processing, and movement of timber occurred so rapidly that the capacities of even some large companies were often not sufficient to keep up the pace. Economic strength, communication, and resources were needed to keep up with the logging front as well as to secure future lands and product markets. In response, trade associations between logging companies formed. Collaboration between companies resulted in interlocking management teams consisting of several companies. The advances in organization and communication technology quickened the already rapid pace from towering forests to piles of lumber in Chicago to construction sites in cities from the Great Plains to the East Coast (Whitney, 1987; Williams, 1989).

Land ownership was the key to monopolizing the industry, especially because transportation was expensive and reduced profits despite the recent advances. Land was acquired through cash sales. Millions of acres of timbered lands were also distributed to the railroad companies and universities by the government land grants. More than half of those lands were transferred to the lumber companies. Lumber companies would solicit the lands by paying the owners of the land grant. The value of land during this time increased twenty to fifty fold in some areas. Trade associations and large companies would hire "timber cruisers" to find the most valuable timber (Sandberg, 1983).

By 1900, the great pine forests of Lower Michigan were gone and pine mills began to close. Lumber companies adapted and began to cut and market other species, especially those better suited for other markets such as furniture and organic chemicals. For example, tamarack was cut for use in piling, elm was used for containers to store food, basswood was used for furniture, and the bark of hemlock was used as a major source of tannin for the leather industry (Whitney, 1987). Northern hardwoods were used for charcoal in iron smelting furnaces. Maples, yellow birch, American beech, and oak were used for hardwood flooring. Soon after the hardwood market developed the paper industry flourished utilizing trees such as hemlock. By the end of this era the importance of timber as a source of pulpwood would begin to dramatically increase (Whitney, 1987). The complete loss of pine communities in the northern Lower Peninsula did not discourage the logging of other forest types such as the Northern Hardwoods and Sugar-Maple – Beech Communities; it only spurred adaptation and more complex markets. (Marsh, 1864; Williams, 1983).
As the devastation of the lumbering era became more visible to the public and the government, attitudes and policies began to change. When people realized the deterioration of the landscape around them, they looked toward the government for guidance and management. But the government found imposing restrictions on logging activity, which would call for radical policy changes, very difficult especially in a society where emphasis was on individual rights. Even if the state wanted the destruction to stop, too many factors were contributing to the process (population increase, development of cities, and transportation efficiency).

In 1864, George Perkins Marsh wrote his seminal book entitled *"Man and Nature"*(Marsh, 1864) . One third of this book was about the destructiveness of the clearing the forests in the Eastern half of the United States. This book inspired Franklin Hough, who addressed the American Association for the Advancement of Science, in 1873, on the protection of the American forests. His speech lead to a forest protection and management movement (Marsh, 1864; Williams, 1983). As Michael Williams states "the years between about 1850 and 1890 were pivotal in western scientific thought" (Williams, 1989). Concern began to arise among people as the forest disappeared and fires replaced them. Questions of balance between nature and morals were pondered. The utilitarian view was challenged by its own demise; the physical depletion of the fuel it required. Although Marsh died in 1882 during the peak of exploitation, he sparked an appreciation of forests in the general public but his warnings were not taken seriously until long after his time.

The devastation was occurring so rapidly that people were not concerned until it was too late. As society became aware of the devastation resulting from logging, the government increased intervention in land management. In 1873, the Homestead Act was altered to encourage tree planting. The Timber Culture Act, passed at the same time, was one of the first political responses in favor of reestablishment of forests, provided another

quarter section to any homesteader who would plant forty acres of trees and maintain them for ten years (Hays, 1983). In 1876, the first federal forest agency was formed. In the 1880's universities developed and included the management of forests as a subject of study. The academy moved beyond basic descriptions and began to study the ecology and management of ecosystems. Despite these changes, economic glory, personal rights, and extraction were common themes in society and government that led to only temporary management and not much in the way of policy (Williams, 1989).

In the early 1900's, major fires began to spread across the landscape that was once covered with towering forests. The slash left over from logging activity provided fuel for fires. Because the understory, including saplings, shrubs, herbs, mosses, and organic matter, was disturbed or completely removed during logging, the soils were dry, permitting fire to rage through the once healthy forests. These fires were so hot and intense that all organic matter left in the soil was burnt leaving the soil basically sterile. Exposed soil was eroded away during logging and well after. The changes in landscape began to affect the lives of people in living in Lower Peninsula as fire became a constant threat to farms, livestock, homes, and even cities. News of large fires, such as the Peshtigo fire in north-eastern Wisconsin, spread and instilled fear into society (Gess and Lutz, 2002). The public started demanding greater political involvement in the management of forests. Foresters at this time were seen as protectors from fire and restorers of landscapes. The Civilian Conservation Corps (CCC) organized fire crews, built access trails and roads and planted trees (Hays, 1983).

The Downfall of Logging: 1920 - 1940

By 1920, the lumbering industry had peaked and activity was in decline. Most of the pre-Euro-American forests were gone leaving little timber on the landscape. Big lumber companies such as Weyerhaeuser moved west to Washington State. The economic focus of Michigan and other states in the Great Lakes region shifted to industry and agriculture instead of logging. By the end of this period, the intense fires decreased and hardwood forests began to re-grow. In the next few decades, these young stands would assume new economic importance as they became the source for pulpwood used in the paper, fiberboard and waferboard industry (Whitney, 1987). With the advent of the automobile and development of Detroit as a hub for this industry and others, the main economic activity of Lower Michigan shifted from logging to industry. The automobile industry was filling the void in the economy generated by the downfall of logging. The automobile industry became the major employer instead of logging companies (Hays, 1983).

Communities in rural Michigan shifted to a focus on agriculture and small business instead of relying solely on logging as the main economic activity. However, many attempts at sustained agriculture failed. This failure often led to insecurities in rural Michigan (Whitney, 1987). Many families and farming businesses were not able to pay taxes and were forced to give up their land. When agriculture completely collapsed during the Great Depression, communities promoted the permanent state and federal ownership of tax reverted lands (Whitney, 1987). The political response to the agricultural failures was the New Deal which promoted many social and environmental programs some aimed at replanting the forests. The New Deal focused the activity of the Civilian Conservation Corps (CCC's) on replanting devastated pine forests mainly in Region II.

At the beginning of this period, society realized the scale of destruction which took place in the few previous decades. A sense of guilt arose among some of the educated factions of society. Society's view of nature was beginning to shift from a utilitarian view to one where forests held aesthetic value. As a result of industrialization, an urban middle class arose with relative wealth and with more leisure time than in the past. A wealthy upper class resulted from wealth gained during the logging era and continued to grow as industrialization took hold. As a result of increases in wealth and leisure time, wilderness became a place of leisure and recreation, as well as a way to connect with the frontiersman who settled the land. The forests as well as their products were no longer a necessity but were a convenient amenity after the 1920's.

A divergence between the expectations of foresters and the public as well as a clash of perceptions arose during this time. Foresters began to be concerned with the productivity of regenerating forests. Forests were viewed akin to a crop managed for maximum harvest, especially for the newly developing pulpwood industry. At the same time, society began to show interest in utilizing the forests for recreational purposes. Forests were again becoming an integral part of the community

but now for recreational needs. Forests also changed in the minds of scientists who now wanted to describe the forest and understand its ecology.

The Post-logging Forests

The impact of logging on the regeneration of the cut-over forests was severe. The forests that returned to the landscape were different in composition, size, structure, and basic ecology than those before:

> The transition from mixed pine type to aspen and oak types reflects the human imposition of a new disturbance regime to which many of the larger pines were not adapted; human exploitation also altered the configuration of the vegetation by creating a new even more disturbance-mediated type of plant community (Whitney, 1987: 681).

The immense pine forests found in Region II were affected directly by logging and indirectly through other disturbances such as fire. Although fire was an important component of these forests before European settlement, especially the pine dominated communities; the fires that occurred after logging were quite different and had a negative impact on regeneration. Large-scale fires successively swept through the Lower Peninsula as a result of slash build up from logging. These fires were much more intense, occurred more frequently, and over a larger area than before logging. As a result, many of the seedlings and seed trees were eliminated during these fires. Because the fires occurred frequently, any coniferous trees, which did regenerate after the initial fires, were not able to reach reproductive age and produce cones before they were destroyed in subsequent fires (Whitney, 1987). Soils dried out from exposure limiting the regeneration of moisture sensitive species such as hemlock. As a result, trees such as oaks and maples, which are able to regenerate by sprouting, were more successful after logging. Conditions resulting from the disturbances also favored aspen (*Populus tremuloides* and *Populus grandientata*), which are species capable of regeneration from sprouts and are able to successfully establish seedlings in post-fire mineral soils (Whitney, 1987).

The extensive and complete harvest of forests wiped out seed sources of many species especially white pine. Removal of the forest exposed and dried out soil which eliminated any seedlings or saplings (Whitney, 1987). Disease spread easily through many young trees. Forests of aspen, balsam fir, and spruce or sugar maple, and oak replaced much of the pine forests in Region II. Aspen quickly became dominant in many of the highly disturbed areas and dominated over half of some forests in less than 100 years. Logging -induced large-scale intense fires replaced the short-term, natural, low burning fire regimes. These fires destroyed seedlings. Fires created conditions favoring more aggressive sprouting species and wind dispersed sugar maple as opposed to animal dispersed American beech (Alhgren and Alhgren, 1983). Old growth forests of hemlock-beech and sugar maple in Region II were replaced by second growth forests dominated by sugar maple. Fires also supported the spread of fire tolerant species such as jack pine. Open forests of aspen, oak and red maple now stand where the once towering forests of red and white pine were (Dickmann and Leefers, 2003).

The hardwood forests in Region I were not as dramatically affected as the pine forests of Region II. Oak and sugar maple-beech forests were able to regenerate much more successfully than the pine forest in the North. Many of the hardwood forests were not completely logged, as was the case for the pine forests of Region II, but were selectively cut. Although cutting was still heavy in these forests, cut trees were gradually replaced by surrounding species (Frelich, 1995). The forests present in Region I today are generally similar to those before logging. Some differences are notable including the following: the size of the trees today are much smaller than those found pre-logging, the understory of the oak-savannas found near Native American settlements are much more closed today due to suppression of fire, and hickory, black cherry, and red maple, species less fire tolerant than oak, are more common today also as a result of fire suppression (Frelich, 1995).

The sheer acreage of forest has also changed. Several different types of forest have declined since settlement. The decline is greatest for old growth and old seral forests. The Great Lakes region currently has 19.8 million ha of forest compared with 32.7 in pre-settlement times (Whitney, 1987; Palik and Pregitzer, 1992; Frelich, 1995). Only a few stands of primary forests are left in the Great Lakes region, including the Boundary Waters Canoe Area of Minnesota, and the Porcupine Mountain Wilderness area in the Upper Peninsula of Michigan. Not only has the amount (acreage) of forests changed but the

character of the forests has also changed drastically (Dickmann and Leefers, 2003). The species composition of forests has changed as discussed above, but many new forests were (and continue to be) planted essentially as monocultures since the Civilian Conservation Corps replanted areas with one species, for example red pine.

The species composition, distribution, amount, disturbance regimes, and age structure were all effected. One hundred and ten years after the peak of the logging era the effect is still evident on the landscape. The landscape of Lower Michigan and most of the Great Lakes Region is vastly different than it was during the different eras discussed in this paper. Because the focus of this paper is on historical landscapes changes, we do not directly discuss the landscapes and forests present today. Several other studies document the changes between pre-settlement forests and today's forests (Whitney, 1987; Palik and Pregitzer, 1992; Frelich, 1995; Dickmann and Leefers, 2003).

Chains of Explanation

Each factor in the nexus of relations, social, political, ecological, economic, technical, landscape, and academic changed through the different periods of the above historical regional geography. The interactions of these factors led to changes in the forests of the Great Lakes region and specifically within Lower Michigan as described. Blaikie's chain of explanation, utilized as a political ecology framework, permits linkages to be made between these factors (Blaikie and Brookfield 1987; Blaikie 1998). As already introduced earlier in the paper, Figure 2 illustrates the chain of explanation (or perhaps better stated as chains of explanation) that demonstrates the complexity of relations and interactions between each of the factors, logging, and the resulting forest change.

The x-axis of the chain represents time, which is divided into the four eras. The y-axis of the chain represents each of the different factors in the nexus of relations. Thus the changes in each of the factors are displayed from left to right across the chain. Each box represents the dominant character of each factor during each era. Boxes often cross boundaries between eras indicating that the transition from one state to another within a factor was gradual. Population growth is an underlying assumption in the chain and is not directly represented. Lines drawn between boxes indicate linkages that were particularly evident as mentioned frequently or significantly in existing literature. All factors on the chain of explanation are linked in some manner and together have a combined effect all aspects of a resulting constituted landscape (Yapa, 1996). Within this complex web, we identified and interpreted several key linkages from the regional historical geography based on the insights from previous authors, political ecological studies in other regions, and our own interpretations which are illustrated in Figure 2 and outlined below:

- The portrayal of the Great Lakes region as a land of bounty by explorers predisposed soon to be settlers to thinking of forests as inexhaustible. The overwhelming character of the landscape and the popular literature led settlers to think of the forests as something to fear; yet they something they needed to survive. The necessity of forests brought about the utilitarian view that the only way a forest is good is if it is utilized. These social factors lead to public support for logging and was encouraged by government.

- The mobility of camps led directly to a sense of fatalism in society. As soon as camps began to move and cut an area over quickly, society began to realize that the camps could only move to so many places before all the trees are gone.

- In the next era, the work of George Perkins Marsh directly led to a major change in thinking among government and society. His work inspired Hough who started the first federal forest agency.

- Marsh's work also led people to think about the forest as something to appreciate. Appreciation of the forest led society to question the use of the forest and the balance between Man and nature.

- Technological advancements such as the development of the railroad allowed timber to be moved quickly to regional markets and hastened the pace of logging.

- As soon as the pines were gone, markets diversified and the focus quickly shifted to hardwood species for uses such as paper and food storage.

- Large scale re-planting efforts, such as those by the CCC's did not take place until after the pine forests were gone and devastating fires occurred.

Conclusions

The purpose of this paper was to present a new interpretation of historical forest change in Lower Michigan using regional historical geography and political ecologic frameworks. A 'nexus of relations' was used as a framework to identify the important factors contributing to the destruction of forests in this region and to illustrate their interrelations. We presented an historical narrative of four eras, highlighting the various factors and how they differed from era to era. These eras encompassed settlement of the region, the establishment and beginning of the logging era, the exploitation of the forest and the downfall of the logging industry. We then used the 'chain of explanation' to show how the nexus of relations changed over time.

This research demonstrates that the intense modification of Great Lakes forests from logging was caused by many interconnected factors that reflected not only economic situations during the different time periods, but also other dimension such as perceptions of the forest. All factors in the nexus played important roles in the process of deforestation. Often a change in one factor directly led to change in another. One important consideration we discovered through this process was the time lag between the change in the character of one factor and the response in another. For example, a sense of fatalism about the future of logging as an economic mainstay did not occur until several decades after the development of railroads and thus the mobility of logging camps. There were times that the technological changes associated with logging were occurring so fast that society and government were not able to keep up with it. Society in general began to respond only after the forests were gone. The speed at which people adapt or respond to economic change is a major factor in the modification of the Great Lakes forest. This lag between the adoption of society's ideals to technology contributed to land degradation in Lower Michigan. Thus, the speed of adaptation and the relationships between society, economy, politics, the landscape, technology, and academia all led to the deforestation of the Lower Michigan.

The past situation in Michigan is not altogether much different from deforestation in many parts of the world today (Hecht and Cockburn 1989; Williams 2002). Forests in places such as the Amazon Basin and Siberia are still thought of by many as endless resources. Technological change continues to affect the speed and type of species extracted, and changing economic situations continue to place great pressures on forests everywhere. Societal viewpoints are changing in many parts of the world, as they did in Michigan, from seeing forests as resources to forests as places for recreation and renewal. What differs from the past is the local forest resources are now also viewed as global resources, not just as local bounty. This adds layers of complexity to the political ecology of deforestation today. All these factors are occurring at the same time, and understanding past linkages may offer good insights for the future of forests everywhere.

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