ONEOTA SETTLEMENT PATTERNS AROUND LAKE KOSHKONONG IN SOUTHEAST WISCONSIN: AN ENVIRONMENTAL CATCHMENT ANALYSIS USING GIS MODELING

By

Richard Wynn Edwards IV

A Thesis Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Master of Science
in Anthropology

at
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ABSTRACT
An environmental catchment analysis was conducted to determine the nature of Oneota settlement patterns on the western shore of Lake Koshkonong in Jefferson County, Wisconsin. Previous studies have used coarse-grained analyses which have led to an overgeneralization of Oneota settlement patterns. This research uses a fine-grained analysis to elucidate the variation of Oneota village placement within the study area. Prehistoric vegetation patterns were recreated using the General Land Office Survey notes and soil data. Two kilometer catchments were drawn around four sites; Crescent Bay Hunt Club (47JE904), Schmeling (47JE833), Twin Knolls (47JE379), and the Carcajou Point (47JE002). Analysis of these catchments clarified the nature of environmental variation in Oneota settlement patterns, increasing our understanding of their overall lifeways.
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CHAPTER ONE
INTRODUCTION

Research Problem

Past research of Wisconsin prehistory has focused on a variety of aspects of Oneota culture including its origins, subsistence practices, and settlement patterns (e.g., Gibbon 1972; Hall 1962, 1986; Overstreet 1976, 1978, 1981, 1997; Rodell 1983). Of particular interest has been the variation in environmental and geographic locations of Oneota (and related) sites (e.g., Berres 2001, Jeske 1989, Richards and Jeske 2001, Sasso 1989). The focus of this thesis is the settlement strategy used by people who lived in the Lake Koshkonong region of Jefferson County, Wisconsin during the late prehistoric period (circa AD 1100-1400). Like past research on the topic, this thesis examines the environmental contexts around known habitation sites. However, unlike past work on this topic, this research utilizes catchment analyses which allows for the researcher to quantify environmental variables; this particular study employs finer grained data than what has typically been used (i.e., Jeske 1990b; Langford tradition in Illinios; Overstreet 1976, 1978; Rodell 1983; Oneota eastern Wisconsin; Sasso 1989; Oneota in western Wisconsin).

The four sites used in this study are the Crescent Bay Hunt Club (47JE904), the Schmeling (47JE833), the Twin Knolls (47JE379), and the Carcajou Point sites (47JE002). It was possible to create a model of Oneota settlement within the study region by examining several variables, such as the composition of environmental zones around each site, nature of the ecotones near the habitations, the agricultural potential of each village, and various other environmental contexts such as elevation and distance to water. When compared to other models of Oneota and related Upper Mississippian settlement patterns, the model generated by this study is more capable of explicitly
describing the variation present in the study region. Specifically the model will be used to answer five main research questions: 1) what was the environmental context of each site; 2) was each of the study sites placed in the same environmental context; 3) were the sites placed to optimize agricultural production; 4) what is the nature of settlement pattern of Oneota village sites near Lake Koshkonong; 5) How does the results of this thesis compare to the results of the previous studies of Upper Mississippian settlement patterns.

The Sites

The Crescent Bay Hunt Club site is an Oneota village site located on the shores of Lake Koshkonong. The site was initially reported by Stout and Skavlem (1908) and was first excavated in 1968 by David Baerreis of the University of Wisconsin-Madison. In 1998, the University of Wisconsin-Milwaukee (UWM) began a long-term excavation at the site. AMS dates taken from food residue inside of ceramic vessels, as well as diagnostic ceramic artifacts have securely dated the site to circa A.D. 1200-1400 (Jeske, Foley Winkler et al. 2003).

The Schmeling site is just to the north of the Crescent Bay Hunt Club. Both habitation sites are separated by a natural draw. The UWM field school began work at the site in 2006 and returned in 2008 under the direct supervision of Kate Foley-Winkler with Robert J. Jeske as principle investigator. The bulk of the material recovered dated to the Developmental Oneota Horizon and is supported by a calibrated radiocarbon date of A.D. 1220-1270 (Foley Winkler 2008).
Initially reported as an archaeological site in 1890 by Stephen D. Peet, the Carcajou Point village site is located primarily on the shore of Lake Koshkonong, about five kilometers east of Crescent Bay and Schmeling. The site of White Crow’s Village, a Winnebago (Ho Chunk) settlement, the site is best known for the Oneota occupation excavations published by Robert Hall in 1962. The site also contains intact late Paleoindian, Archaic, Woodland and Historic components (Hall 1962; Jeske, Hunter et al. 2003; Ricahrds et al. 1998; Stout and Skavlem 1908).

Located approximately two and a half kilometers north of the Schmeling Site, the Twin Knolls site is located along Koshkonong Creek. The site was first reported by Stout and Skavlem in 1908 as the Koshkonong Creek Village Site (95-96). The site was later relocated by Jennifer Musil as part of a UWM survey of the region. Musil confirmed the Oneota association of the site based on the high proportion of shell tempered ceramics (Musil 1987:144-146). In 2008, the site was resurveyed as part of the UWM field school. Based on artifacts recovered from the site has tentatively been dated to A.D. 1200-1400 (Cowell et al. 2008). Unlike the other sites in this study, Twin Knolls is not directly associated with Lake Koshkonong, but with Koshkonong Creek. In fact, the north edge of the site is less than 40 meters from the creek, but nearly 5 km (7 km by creek) from the Lakeshore.

The following chapters will provide additional information on the sites including background on their cultural contexts in order to address the objectives above. The remainder of this chapter will provide background information including an in-depth discussion of Oneota archaeology and material culture, such as Oneota subsistence patterns, agricultural practices, and previous settlement models. Chapter Two is a
discussion of the methods and methodology used for this study. Chapter Three supplies an in-depth discussion of each of the study sites and provides the results of the analysis, and Chapter Four is a discussion and interpretation of the results, the implications of the study and Chapter Five discusses possible avenues for future research.

This rest of this chapter is intended to contextualize the research presented in this thesis, both culturally and archaeologically. It describes the current state of research on Oneota culture and defines the term Oneota (e.g., theories of their origins, how they are identified archaeologically, and their subsistence patterns). This chapter also summarizes the four settlement patterns, to which the results of this thesis will later be compared.

**History of Oneota Research**

Oneota is a well known cultural phenomenon found throughout much of central North America, as far west as Nebraska, to the north as far as Ontario, Canada, and as far east as Michigan (Hall 1962; Overstreet 1997:11; Rodell 1983; Staeck 1995). Oneota is classified as an Upper Mississippian culture, a term that originally only referred to groups that made a ceramic ware found in and near the upper Mississippi River Valley which includes ceramic wares found in various areas of Wisconsin (McKern 1931:3-6). Upper Mississippian was later expanded to include not only the Oneota culture but the Fort Ancient and Fischer cultures as well (Hall 1962:5-6). The term Upper Mississippian allows for the simultaneous contrasting of these typically northern groups from the clearly distinct Middle Mississippian groups, such as the one found at Cahokia, while still highlighting the similarities between the two cultures which implies that the two were not entirely independent and interacted in a currently unknown manner (Hall 1986:365).
A major concern is the conflation of Oneota as an archaeological culture with the dynamic human cultures that produced it. It is important to remember that Oneota, as used in this thesis, refers to a constellation of material culture traits, not to a single ethnic or culturally identifiable group. Brown describes Oneota as the “dominant stylistic complex in the Prairie Peninsula at this period” (Brown 1965:122). The culture was named by Keyes (1929, 1934), referring to archaeological sites probably associated with a group known historically in Iowa. He differentiated the Oneota from other groups in the region based upon their use of shell-tempered ceramics and triangular hafted bifaces. Keyes also notes that Oneota sites were located in a restricted geographic range compared to previous groups; Oneota village sites were found almost exclusively on high ground overlooking rivers. In fact, the name Oneota comes from the original name for the Upper Iowa River, which is near most of the known Oneota sites at the time Keys was describing them.

Despite the Iowa origin of the term Oneota, some of the best evidence of early Oneota comes from eastern Wisconsin, which spans roughly eight hundred years, though this timeline is currently debated (Overstreet 1995; Theler and Boszhardt 2006). It is currently unclear if Oneota developed in eastern Wisconsin or somewhere to the south or potentially in multiple areas. The origins of Oneota are still debated but most arguments fall into one of two groups, in situ development and migration (Gibbon 1982). One theory is that during a warm phase in the region’s climate, prior to A.D. 1200, people from the Middle Mississippian site of Cahokia spread outward and settled at sites such as Aztalan in central Wisconsin (J. B. Griffin 1960). After A.D. 1200, the climate began to cool and it made exclusively agricultural subsistence unsustainable, which in turn led to groups
such as the occupants at Aztalan to abandon their settlements to diversify their
subsistence practices and include a variety of wild plants. This mixed economy, which
developed over several generations, resulted in what we see archaeologically as Oneota
(J.B. Griffin 1960:26-27). McKern (1942) argued for a theory similar to Griffin’s;
namely that the Oneota developed to the southeast of Wisconsin and subsequently
invaded the region displacing the Woodland population (Gibbon 1969, 1982).

After the use of radiocarbon dating at Oneota and Middle Mississippian sites
became widespread, numerous authors argued against Griffin’s Cahokian devolution. It
was argued that the early Oneota sites predated the Mississippian occupation at Aztalan.
Gibbon argued that argued that the Oneota developed from the Late Woodland Effigy
Mound builders, over a period of several hundred years. He argued that a desire for a
more stable food base and an external exchange of ideas (i.e., maize horticulture) not
only made the transition possible, but was the driving force. While the changing climate
Griffin cites as the impetus for Mississippian expansion may have hastened the transition,
Gibbon argues that it was not necessary for the development of Oneota lifeways (Gibbon
1972, 1982).

Others argued that the transition from Woodland to Oneota occurred later in time,
as population density increased and deer populations decreased after the advent of the
bow and arrow (Theler and Boszhardt 2000, 2006). The increased population density led
to increased sedentism. During this time, these increasingly sedentary populations began
to interact with Middle Mississippians and were heavily influenced by their southern
neighbors. Largely independent of migration or military action, over time the local
Woodland population developed into the Oneota. Opponents of the in situ theories, e.g.,
Overstreet (1995), argue that the speed at which the Oneota replaced the Woodland population seems too fast for an in situ development and further argue that if such a transition took place, there should be increased evidence of interaction between Woodland and Oneota populations. Given the lack of interaction and the speed with which the residents of Oneota sites occupied southern Wisconsin, Overstreet argues that an invasion and migration from the south are more likely. Currently the data are insufficient to settle the dispute and determine where and how the Oneota originated, though Overstreet (1997) suggests that perhaps the truth lies in some amalgam of the current theories.

**Identifying Oneota Archaeologically**

Oneota culture is identified in archaeological contexts primarily by their unique ceramic style; that is, shell tempered vessels that tend to be globular in form with decorations on the shoulders. These decorations are trailed or punctate designs which are usually curvilinear or geometric. Oneota vessels tend to have constricted necks whose rims flare outward. The use of shell tempering agents and trailed designs began to appear roughly A.D. 1100 and quickly became the dominant style. Ceramic style types are used to differentiate Oneota sites from other contemporaneous sites in the midcontinent, but are also to define horizons, or temporally-related associations of Oneota material (Benn 1995:113-114; Staeck 1995:3; Stevenson 1985:6-7).

Typical lithics associated with Oneota sites include simple triangular hafted bifaces, similar to those found in the preceding Late Woodland period, as well as thumbnail scrapers, and grooved abraders. Polished, grooveless celts are typically found
in major habitation areas. It is difficult to use lithics to associate sites with the Oneota because the majority of Oneota chipped stone repertoire is not unique to any cultural group (Gibbon 1986:327-328; Stevenson 1985:8).

In addition to its use as a tempering agent, shell was also used to make pendants, and tools that have been interpreted as fishing lures, hoes, spoons, and scrapers. The scapulas of bison and elk were used as hoes for use in agricultural fields. Oneota copper artifacts are found to a limited extent; however many of the copper artifacts found have been non-utilitarian items such as pendants (Gibbon 1986:329-330; Overstreet 1997:251).

**Wisconsin Oneota**

A discussion of the entirety of Oneota in all of its geographical contexts is well beyond the scope of this research. Therefore, the following sections will be limited to a discussion to Wisconsin Oneota. Included in the subsequent paragraphs is a discussion of the distribution and chronology of Oneota within the state. Before such topics can be discussed, it is necessary to define several terms used in Oneota taxonomy.

The following terms will only be briefly defined, for a more complete discussion see Henning (1998a, 1998b). Localities are geographic areas that are no larger than an area inhabited by a single community. This area should also be culturally homogeneous across space, though not necessarily across time. A region is a larger geographic area; this term has several rules for its use. However, the one of the most importance for the purpose of this thesis is that it is large enough for two or more phases to exist simultaneously. A horizon refers to a specific time period across a superregional area (e.g., Wisconsin) for an entire group (e.g., Oneota). A horizon is typically bounded by
the length of popularity of a particular type of artifact such as ceramic styles. A phase is a discrete spatiotemporal cultural unit; a term that defines a single cultural group at a specific place in time.

_Wisconsin Oneota Localities/Regions_ Overstreet recognizes eight clusters of Oneota habitation sites within the State of Wisconsin (1997). In the west, within the Mississippi River Valley are the Lake Pepin Locality and the La Crosse Region. Lake Pepin is located in southern Pierce, southwestern Pepin, and northwestern Buffalo Counties. The majority of the La Crosse Region is found within La Crosse County; however, it extends into extreme southern Trempealeau County and northern Vernon County. In the east, there is the Door Peninsula Region, the Green Bay Locality, the Middle Fox River Passageway, the Grand River Locality, and the Lake Koshkonong Locality. The Middle Fox River Passageway includes the shores of Lake Winnebago as well as the middle Fox River Valley and the Wolf River Valley. Sites in this locality are found primarily in Winnebago, Calumet, and Fond du Lac Counties. The Door Peninsula and Green Bay Localities are, as their name suggests in the Door Peninsula and near the city of Green Bay (Door and Brown Counties respectively). The Grand River Locality extends from central Marquette County to central Green Lake County. The Lake Koshkonong Locality is primarily in southwest Jefferson County, along the shores of Lake Koshkonong and the Rock River (Overstreet 1997:253 Figure 10.1).

_Wisconsin Oneota Chronology_ Each of the Oneota localities has its own unique cultural history (typically broken down into phases); however, in ideal contexts within Wisconsin each Oneota component at a site can generally be placed into one of four horizons. Hall (1962:106-109) developed the first three (Emergent Oneota,
Developmental Oneota, and Classic Oneota). The Historic Horizon was added by Overstreet (1976, 1978). The use of the horizons allows for an easy understanding of the various phases throughout the state independent of the geographic region in which the site is found. Current research suggests that divisions between these horizons may have little analytical utility (Jeske 2008; Moss 2010). It is interesting and potentially useful to note that these categories have not been used extensively outside of Wisconsin (Benchley et al. 1997:145).

The Emergent Oneota Horizon dates, as described by Overstreet (1997), from A.D. 950-1150. Many have questioned the validity of the early results from radiocarbon dating (e.g., Benchley et al. 1997; Boszhardt 1998; Theler and Boszhardt 2000, 2006; Tiffany 1998). Jeske (2008) notes that, when calibrated, all but one reported Oneota date in Wisconsin is at least as late as A.D. 1150 at one sigma. However Henning (1995:69), referring to Iowa, Wisconsin, and Minnesota, notes that “[e]arly Oneota dates from all three states are sufficiently numerous that they should not be ignored, averaged, or written off.” The Emergent Horizon is represented in the Door Peninsula Region by the early Mero Complex, in the Middle Fox River Passageway by the McKern Phase, in Lake Koshkonong by the Early Koshkonong Phase, and in Lake Pepin by the Silvernale Phase. Ceramics from this horizon are almost always undecorated (though this does not appear to be the case in Pepin Locality), and handles are rare. Compared to later Oneota horizons, the Emergent has very few end scrapers (Hall 1962:55-56; Overstreet 1997:255-266). Hall notes that during this time period, several ceramic styles were present at the Carcajou Point, including Grand River Trailed, Grand River Plain, early forms of Carcajou Curvilinear, and Diamond Bluff Trailed (Hall 1962:109).
Overstreet notes that there are at least two Emergent Horizon sites with house structures and a total of three different house types are represented. House types include; wigwam, rectangular, and pit houses (Overstreet 1997:260). Oneota subsistence at this time includes a variety of flora (wetland resources as well as cultigens such as maize) and fauna (which includes a variety of upland game such as deer and elk as well as fish and other aquatic animals) although there is virtually no published flotation recovered data. Overall, the Emergent Oneota diet can be classified as diverse (Benchley et al. 1997:160; Hunter 2002:22; Overstreet 1995:36-39)

The Developmental Oneota Horizon ranged from A.D. 1150-1350 and is exemplified in the Door Peninsula Region by the Late Mero Complex, and the Green Bay Phase. In the Middle Fox Passageway, the Developmental Horizon is expressed as the Grand River Phase while in the Lake Pepin Locality it is represented by the Adams Phase. In La Crosse, the Early Brice Prairie Phase is classified as Developmental Horizon. In the Koshkonong region there is no spatiotemporal phase name for the Developmental Horizon, but all four sites in this thesis fall into that time frame (Cowell et al. 2008; Foley Winkler 2008; Hall 1962:107; Jeske 2001:4; Overstreet 1978:39; 1997:256).

Hall (1962:107) notes that there are few handles exhibited on Oneota ceramics from this time period. Overstreet adds that the designs used on the ceramics are still largely the same, though more sloppy. Despite this, decorated ceramics, while still uncommon are more likely to be found in Developmental than Emergent contexts. It appears that, that during this time period, subsistence practices did not change significantly from earlier times. Village sites in the Developmental Horizon, on average,
are larger and occupied longer than their predecessors of the Emergent Horizon and a number of these settlements are enclosed by palisades. Until recently it was thought that Developmental Horizon house structures were thought to have been represented primarily by mat-covered wigwams (Overstreet 1978:39-41; 1995:44,50). Recent work at the Crescent Bay Hunt Club uncovered what initially appeared to be a palisade wall, but after additional excavation and GIS analysis it is now interpreted as a longhouse structure (Moss 2008, 2010).

The Classic Horizon dates from roughly A.D. 1350-1650 and is exemplified by six distinct phases, three of which are in La Crosse region; the Late Brice Prairie Phase, the Pammel Creek Phase, and the Valley View Phase. In the east, the late Lake Winnebago Phase existed in the Middle Fox River Passageway and expanded into the Door Peninsula where the Green Bay Phase is also represented. The Late Lake Koshkonong Phase could be found along the shores of the Rock River and Lake Koshkong. Scholars disagree as to whether there was a change in subsistence patterns during this time period. Overstreet argues that there was little change, other than a probable intensification of corn horticulture (Overstreet 1997:256, 274-287). According to Gibbon (1986:333), at some point during the transition from the Developmental Horizon to the Classic Horizon, there appears to have been a shift in subsistence practices with an increase in bison hunting.

The Classic Horizon sees the appearance of several new ceramic types including, Koshkonong Bold and Perrot Punctate. Perhaps the biggest change in ceramics is the proportion of decorated vessels, which nears 90 percent. Settlement patterns seem to change somewhat during this time as populations increase and become more concentrated
in even larger village sites. It also appears that there is a change in the lithic assemblage as well, most significant of which is the change in proportion of end scrapers to triangular hafted bifaces, with end scrapers being relatively more numerous in Classic horizon sites (Overstreet 1995:50-53).

The extent of the Historic Oneota Horizon is a debated issue. According to Benchley (1997), only material from the Orr phase, which originates in the west, can be reliably dated to the historic period. There is a gap chronologically between the latest dates for the Lake Winnebago Phase and historic sites belonging to the Winnebago (the assumed descendents of the Oneota) (P. Richards 1993). Additionally there appears to be stylistic gaps between these sites, as well, making it impossible at this date to empirically link the Oneota with any historically known groups. Richards further elaborates that the incomplete early historic record (which begins in 1634 with the arrival of Jean Nicolet) has no firsthand accounts and very little information about the Winnebago. It also contains a thirty-year gap (1634-1665) during the Iroquois Wars which prevented direct French presence in the region. For a more complete discussion, detailing the difficulties linking historically known groups to prehistoric ones, also see Brown and Sasso (2001:212-213).

It has been argued that, with the exception of the Orr Phase ceramics, there does not appear to be any clear continuity between any prehistoric Oneota ceramic styles and those used by historically known groups that some traumatic event occurred between the 16th and 17th centuries. Green (1993) has argued that European disease arrived prior to direct contact and caused a massive depopulation of the region. Oneota groups, who lived
in dense villages along major water/trade ways, were likely to have been greatly affected (Benchley et al. 1997:161; Green 1993:303; Richards 1993:276-278).

In eastern Wisconsin, only five Oneota sites have yielded European trade goods, although the association of artifacts is debated at each site. The Astor site in Green Bay is the best candidate in eastern Wisconsin for an historic Oneota site with ties to earlier eastern Wisconsin Oneota phases (i.e., Lake Winnebago Phase). In western Wisconsin, there are several sites that date to the 17\textsuperscript{th} century, however many of them appear to have been abandoned prior to European presence in the region since there are no Oneota sites with European trade goods. With so few sites dating to the historic period, little is known about this horizon and most of the current interpretations of the limited data heavily debated (Benchley et al. 1997:161-164, 166; Overstreet 1997:287, 290; P. Richards 1993:279-281, 286).

**Oneota Agriculture:**

Though researchers have not been able to agree how much the Oneota relied on cultivation, most if not all Oneota researchers in Wisconsin will agree that the cultivation was an important aspect of the Oneota economy (e.g., Arzigian 1989; Arzigian 2000; Gibbon 1972; Overstreet 1976, 1997; Sasso 2003). Without an understanding of Oneota agriculture, it is unlikely that an accurate model of settlement patterns can be created. Therefore, this section is dedicated to describing the nature of Wisconsin Oneota cultivation.

*Domesticates of the Eastern Woodlands* Today eastern North America is recognized as “an independent center of cultivation and domestication of indigenous seed
Among the first plants to be domesticated in eastern North America were originally wild floodplain weeds, including *Curcurbita pepo*, i.e., squash, *Iva annua*, also known as Marsh Elder, or Sumpweed, and *Chenopodium berlandieri* or Goosefoot (Asch and Asch 1985:153, 159, 171).

The domestication and use of such plants in the Eastern Woodlands is commonly referred to as the Eastern Agricultural (or horticultural, depending on the intensity) Complex. As wild plants, these wetland weeds were already adapted to grow in disturbed areas, such as those affected by floods. According to the floodplain weed theory of domestication, the Eastern Agricultural Complex began as these weeds colonized not only naturally disturbed river valleys, but areas modified by humans (e.g., long-term base camps). It is likely that these plants were initially of minor importance to the humans cohabitating with the weeds. Over time, humans not only increased their exploitation of these plants, but also began to take an active role in insuring that these plants would continue to grow. Humans also insured that the plants would grow in increasing efficiency and numbers by preparing the soil and actively planting seeds. Over several generations, these plants began to change morphologically, typically in ways that, in the wild, would be detrimental for the survival of the plant or its ability to successfully reproduce. It is at this point of morphological change that plants are considered to be domesticated, though in reality domestication is a long and gradual process, therefore plants exist on a continuum of domestication. Some common morphological changes include increased seed size, and thinner seed coats. These changes can be seen, in the eastern woodlands of North America, archaeologically prior to 4,000 BP (Olsen 2003; Rindos and Johannessen 2000; Smith 1995). It is also possible to compare a plant’s
natural geographic distribution to the archaeological contexts in which it is found. If they are found archaeologically outside of their natural habitat, it can be used as an additional line of evidence signifying domestication of plants, with the assumption that human activity was the cause of its unnatural placement (Asch and Asch 1985:150).

Floral Utilization by the Oneota Brown argues that the Oneota likely exploited a wide variety of resources that include large game hunting, wetland exploitation, and maize agriculture (Brown 1982:111). Oneota may have practiced this diversified subsistence strategy to minimize risk (Brown 1982; Clelland 1966; Hart 1990; Olsen 2003:120). In western Wisconsin, using the Pammel Creek (47LC61) site as an example, Arzigian argues that maize, beans, squash, wild rice, little barley, and various nuts are the floral resources often recovered in Oneota contexts. With the exception of corn, little barley and wild rice appear to be among the plants most commonly utilized by the western Wisconsin Oneota (Arzigian 1989, 2000). Floral studies at other sites in western Wisconsin (e.g., the Sand Lake Site, 47LC44) have yielded similar results and also include grassfoot, purslane, and carpetweed (Sasso et al. 1985:147-158). In eastern Wisconsin, the Crescent Bay Hunt Club site has yielded maize, wild rice, little barley, several species of chenopods (both wild and domesticated), amaranth, purslane and bottle gourd (Olsen 2003:2, 135-134; Overstreet 1981:474-475; Yarnell 1966:199). Oneota groups were clearly using plants of the Eastern Agricultural complex (Yarnell 1966).

Maize Agriculture There is an abundance of evidence for Oneota use of maize (e.g., Arzigian 1989; Arzigian 2000; Hall 1962; Overstreet 1981; Yarnell 1966); however, its level of significance as part of the Oneota diet is currently unclear. Based upon the recovery of maize, beans, and squash, and the construction of ridged fields, it is
clear that a significant amount of energy was expended on agriculture but there is currently no way to know how prominent a role agricultural foods played in the Oneota diet (Hart 1990:570-571; Sasso et al. 1985:169-170). Overstreet (1997:283) indicates a small sample of individuals associated with Lake Winnebago Trailed vessels yielded carbon isotope data consistent with heavy consumption of maize, although he provides no source nor names the site from where the data come.

In the state of Wisconsin, there are at least 459 known agricultural sites. Of those 459, there are 203 sites known to possess a feature commonly known as garden beds (or functionally related features e.g., as corn hills, cornrows, ridged fields, etc.). Since the mid-seventeenth century, garden beds have been reported regionally in Wisconsin and Michigan. They have also been reported in many other parts of the country, though not with the same frequency. Garden beds are found in a variety of settings, including both eastern and western Wisconsin as well as uplands and lowlands (Gallagher et al. 1987; Sasso 2003; Sasso and Brown 1987).

The physical traits of ridged fields and related agricultural features are variable. Peske describes the garden beds of Lasley’s Point as, “linear, convoluted features” (1966:190). Sasso and Brown (1987) describe garden beds as rows of earthen mounds where crops could be planted. The height of these ridges seems to vary considerably; the tallest of those excavated by Peske was three and a half inches (8.9 cm) higher than the furrows between the ridges. However, Fowler (1969:374) describes some garden beds as being two feet (0.6 m) higher than the furrows. Not all forms of cultivation mounds are long ridges; smaller circular cultivation mounds are often called corn hills (Sasso and Brown 1987:3). Fowler (1969) points out that some series of garden beds are extensive,
and cover an area up to 100 acres (40.5 hectares). Sasso (2003:262) notes that, near Lasley’s Point, garden beds cover nearly 600 hectares of land. If they are all contemporaneous, such a large area implies a significant investment into crop production.

The classification of these features as actual agricultural features is supported by the excavation of refuse heaps near the Lasley’s Point fields. Bison scapula hoes, corn cobs, corn kernels, and corn pollen were recovered from the refuse contexts in close association with the garden beds (Peske 1966:190,192). Additionally, Riley and Freimuth argue that with the number, size, and distribution of the ridges, agriculture is the most likely use of the features (Riley and Freimuth 1979:271).

What purpose did these ridged fields serve, and why did the cultivators at Oneota sites determine it necessary to build such features? Yarnell (1964:129-130) argues that prehistorically, the risk of maize cultivation is too great in regions that average fewer than 120 frost free days. While the growing season of maize is roughly 70 days, there is still a high risk of a late killing frost in the spring or an early killing frost in the fall. Within the state of Wisconsin, the majority of known prehistoric agricultural villages have less than 160 average frost-free days. While greater than the 120 day minimum, there is still a significant risk of frost damage (Yarnell 1964:134-135, 138-139).

Working with the hypothesis that the garden beds allowed for better drainage of water off the top of the ridge and into the furrows, thereby reducing the risk of frost damage, Riley and Freimuth created experimental garden beds near the University of Illinois Urbana-Champaign campus. After taking careful weather and temperature measurements, they concluded garden beds would reduce the chance of frost damage. While this does not prove that ridged fields were used as protection against frost damage,
it verified the validity of the hypothesis’ underlying assumption (Riley and Freimuth 1979). Currently most scholars agree that frost prevention is the functional purpose of ridged fields (e.g., Brown 1982; Sasso and Brown 1987). It has also been suggested that their ability to drain water could also have been useful during the warmer periods (i.e., when frost is not a concern) in lowland locations that are more prone to flooding or heavy rains. Additionally, ridged fields would also have been useful as a means of weed control, and modifying the soil so that it is better suited for cultivation, i.e., aerating the soil, loosening the soil to allow for denser plantings, enriching the soil, killing soil dwelling insects, and erosion control (Gallagher et al. 1985, 1987; Gallagher and Sasso 1987:147-148).

While it has been widely accepted that these are agricultural features, little else is known about them. There is little data pertaining to the cultural context or the date of origin of the garden beds, however, many garden bed sites are linked historically to Winnebago (Ho Chunk) villages. There is also evidence of garden beds extending into prehistory, though few can be tied directly to Oneota contexts. One set of garden beds near the Eulrich Site has been linked to the Lake Winnebago Phase, and the garden beds at Lasley’s Point have been associated with an unidentified Oneota phase based on recovered ceramics. Excavations at the Sand Lake site in the La Crosse region has also yielded buried garden beds, where ceramics associated with Pammel Creek have associated them with western Wisconsin Oneota contexts. While most garden bed sites have no cultural association, it is commonly assumed that many are of Oneota origin, though some have been associated with the Late Woodland and Historic time periods.
Soil is a vital aspect to consider while investigating the agricultural practices of any group. Vita-Finzi (1978:71) takes it one step further and claims that “the student of sites cannot evade thinking about soil.” Understanding soil is important for two reasons. First, it allows for a better understanding of the reasons behind site placement, and second, it helps aid our understanding of the role of agriculture in prehistoric societies.

During investigations of garden bed sites in the La Crosse Locality, Sasso et al. (1985:171) found that Oneota agricultural sites seem to be placed in locations that take advantage of soils with optimal characteristics for maize growth. Overstreet (1976:241) suggests that by understanding soils around village sites it may be possible to better understand the importance of agriculture/horticulture to the prehistoric inhabitants. He argues that there is a relationship between site location and soils conditions, thereby allowing him to infer that site location is carefully chosen based upon the soils present. Largely due to tilling technology, the residents of Oneota sites selected soils that were warm and light or fine textured, with well established drainage but moisture retentive (Overstreet 1976:246). Sasso and Brown (1987) also analyzed the soils chosen to place Oneota agricultural sites. They also concluded that the soils must be tillable with the available technology (e.g., scapula or shell hoes). Jeske (1989) argues that Fisher and Huber Oneota sites in northern Illinois are surrounded by relatively wet soils compared to contemporaneous in Langford site occupants. Jeske also argues that Oneota site occupants used scapula hoes to till the wetter soils while Langford site occupants who used digging sticks and antlers to till drier soils in upland settings. The other two key soil
factors essential to maize agriculture are the fertility and productivity of the soil, and its ability to provide moisture during critical growth periods of the plants.

**Langford:**

Oneota site occupants were not isolated from other Upper Mississippian groups and interacted with their Langford neighbors in Northern Illinois (Jeske 1990b). The first site excavated with a Langford tradition component was the Fisher Site in Will County, Illinois. The site was excavated by George Langford (see Langford 1927) and contained material that was clearly Upper Mississippian, but did not fit into Oneota or Fort Ancient traditions (Hunter 2002). Langford sites in the Rock, Fox, and DesPlaines Rivers of Illinois are among the closest contemporaneous neighbors (geographically) to the Koshkonong Oneota complex. Like Oneota, Langford is an Upper Mississippian tradition, however it can be differentiated by the absence of shell tempered ceramics, differences in subsistence and settlement practices (Jeske 2003). Langford wares, with few exceptions, are found exclusively in northern Illinois (Jeske 1990b:223). In comparison to shell-tempered Fisher wares, John W. Griffin describes Langford wares as having similar but less complicated designs. The vessels may be corded or smooth, and decorations are typically some form of punctate or trailing. Griffin concluded that Langford ceramics at the Fisher site are decorated less often than their Fisher counterparts (Griffin 1946:17-18), and this dichotomy holds true at the Lawrence site in the Rock River valley (Berres 2001; Jeske 2003). The Langford Tradition is roughly contemporaneous with the Developmental Phase Oneota to the north in Wisconsin; it dates from just prior to A.D. 1100 to A.D. 1450. Like Oneota, Langford sites yield data
that indicate a generalized economy focused largely on wetland resources and maize agriculture (Jeske 1990b:223,225).

**Settlement Patterns of Upper Mississippians:**

The following is a summary of the three different models of Oneota settlement patterns and one description of Langford settlement patterns. Two of the studies encompass southeastern Wisconsin, one covers western Wisconsin, and the final study is situated in northern Illinois. Each of these studies look at many of the same factors (e.g., soil types and vegetation zones) however they do not necessarily look at these factors the same way. While not the only difference among these studies, the most notable discrepancy is the scale of analysis. Overstreet and Rodell both use large scales of analysis while Jeske and Sasso use a much finer scale of analysis; these distinctions greatly affect the results of the studies.

**Homogeneity Model** Overstreet outlined his generalized Oneota settlement pattern in his 1976 dissertation and further elaborated it in a chapter of the 1978 *Mississippian Settlement Patterns* edited by Bruce D. Smith. In both the dissertation and book chapter, Overstreet looks at a wide temporal range that includes all four Oneota Horizons. However, in his conclusions, he summarizes his findings, including settlement patterns for each horizon separately.

Overstreet (1976, 1978) employed a regional approach to model Oneota settlement patterns. Due to regional differences, he did not consider the Orr Phase in western Wisconsin, and in the east, he discounted the Green Bay Phase since he felt, at that time, the Green Bay Phase was not adequately understood (Overstreet 1976:4). He determined the settlement patterns primarily by looking at four main factors. Those
factors included the Oneota economy, the location of the site in relation to major biotic provinces and physiographic zones, the proximity of sites to major aquatic environmental zones, and the distribution of soils near the sites.

Overstreet posits that Oneota sites in eastern Wisconsin were situated within diverse environments with access to several different environmental zones. However, when comparing the overall environmental characteristics each site is described as situated in a relatively similar setting. Rather than providing an explicit discussion of the environment around any site, Overstreet infers the general nature of the environment from two sources. In order to determine the general topography and extent of prairies, Overstreet looks to the nature of the Eastern Ridges and Lowlands, which is the physiographic zone that encompasses the majority of eastern Wisconsin. Within this region, Overstreet notes that almost all Oneota sites are situated within the sub region known as the Green Bay-Lake Winnebago-Rock River lowlands. This sub region is divided into three sections; the northern section is inundated by water beneath Green Bay. The central plains region is characterized by very little relief. Overall, the vegetation is forested and it has few, typically small, patches of prairie. This region contained all of Overstreet’s study area with the exception of the Koshkonong sites, which were located in the third region. To the south is a region with considerably more relief, and like the plains region it comprises a mix of forest and prairie (Overstreet 1976:43-45).

The types of plants available were determined by the location of the sites in reference to the tension zone between two or three major biotic provinces. The first is the Canadian Biotic Province which extends into central Wisconsin and is characterized by coniferous hardwood forests. The next is the Illinoisan to the south, which is composed
of a mixture of oak forests, savanna and prairie. The Carolinian Biotic Province, which may extend into southern Wisconsin, is primarily composed of deciduous forests. The interaction of the two or three biotic provinces in Overstreet’s study area creates a tension zone, or a large ecotone, where a variety of plants from each biotic province is present. Overstreet argues that based on the position of the sites within the physiographic region and tension zone, that all of the eastern Oneota phases are within a mixed forest prairie environment. Based upon the proximity of most Oneota sites to lakes and rivers, Overstreet (1976:46-50, 55) indicates that, in addition to the forest/prairie mixture, there is a variety of wetlands present at each site, and because each of these sites are situated similarly within these macro physiographic/biotic settings they must have had similar local environmental contexts.

In addition to the environmental features, Overstreet argues that Oneota settlements were placed with specific reference to soil types, which is linked to the importance of horticulture in Oneota economy. Overstreet (1976:241-247) found that Oneota sites tend to be found on fine sandy loams and other soils that would be good for agricultural potential. By placing villages on soils with high agricultural potential, it is possible to grow maize and other cultigens nearby, thus minimizing travel time to garden plots.

Overstreet’s pioneering model of Oneota settlement patterns is limited by three main factors. The first limiting factor is the scale of his environmental analysis. Because of the scale, he is unable to evaluate the variation within each region, thereby hampering his ability to interpret accurately the nature of the human interaction with the environment around each site. The second limiting factor is directly related to the first;
an inability to quantify the environmental zones within the study area. The lack of quantification limits his ability to compare the distribution of sites in relation to environmental zones accurately and may obscure regional variation in settlement patterns. The third limiting factor pertains to the sites Overstreet used in his study. Overstreet concentrated on village sites and did not account for the role of interaction with smaller sites, with the exception of garden bed or other agricultural sites. This concentration is in part due to the nature of the archaeological research at the time, which concentrated on the excavation of large sites at the expense of a smaller sites and regional surveys.

*Diversity Model* In his 1983 master’s thesis, Rodell started where Overstreet left off and took a “step toward understanding Oneota settlement and subsistence,” (Rodell 1983:1). Like Overstreet, Rodell takes a regional approach to determine the vegetation patterns around southeastern Wisconsin Oneota sites; he uses biotic provinces and physiographic regions to determine the environmental characteristics (Rodell 1983:5). However, Rodell did not come to the same conclusions as Overstreet. Rodell argues that the Oneota sites were not in a single ecozone, but a diverse one, which limited the extent of Oneota adaptations. The variation in environment could be as seen two continuums of change; from north to south, and from east to west (Rodell 1983:4-5, 83). Rodell then went beyond the macro level environmental zones that Overstreet used and examined what vegetation zone each site was within, based upon Finley’s (1976) 1:500,000 scale map of the vegetation patterns produced from the General Land Office survey notes (Rodell 1983:99). This map has since been digitized (Figure 1) and is currently available
Rodell had more data to work with than Overstreet. Three systematic surveys were conducted in Rodell’s study area. These surveys included the areas surrounding the Rock/Crawfish River, conducted by the University of Wisconsin-Milwaukee; the southern Fox River, conducted by the Great Lakes Archaeological Research Center (GLARC); and the western shore of Lake Winnebago also conducted by GLARC (1983:90-92). In total, Rodell examined 62 sites and the environment surrounding them for his preliminary settlement model. Rodell notes that there is little information about many of the sites since they were either identified by survey and were not excavated, or they were small sites previously reported but never fully investigated (1983:95). After plotting the study sites on soils maps, Rodell determined that Oneota sites were placed on five different soil types. The first included well to poorly drained soils over lacusterine and glacial materials. The second type was well-drained, highly permeable sands, while the third soil type was characterized as somewhat poorly drained to well-drained loams over sand and gravel. Oneota sites were also found on moderately well drained to well-drained soils over loam subsoils and bedrock as well as organic soils.
Figure 1. Portion of “Original Vegetation Cover”.
that were classified as poorly drained (1983:96). It is important to note that while these results do not correspond with Overstreet (1976), Rodell’s sites include a variety of site types as well as sites without a known function. Overstreet’s data were restricted to known Oneota villages. Village sites are locations in which agriculture was believed to play a significant role which could have limited the potential soil types of the sites.

Rodell concludes that Oneota sites, as Gibbon (1969, 1972) argued, are found in an environmentally diverse region. However, Oneota site occupants only exploited a portion of the available habitats. He characterized the exploited environmental zones as “wetland-eutrophic lake settings occurring along portions of the Fox-Wolf and Rock Rivers” where agriculturally viable soils and oak forest/savannas were present (1983:107).

Rodell’s research was, like Overstreet’s, restricted by the scale of his analysis. While Rodell’s use of the Finley (1976) map did allow him to quantify the environment in a limited way, the fact that it was at a 1:500,000 scale limits its usefulness. Rodell did attempt to account for all Oneota site types by incorporating recent data from regional surveys that were not available to Overstreet. However, he did not account for differing site types when comparing site location to the environment. Because of the nature of the surveys, Rodell notes that much of that information had not been determined. The inability to differentiate site types makes it difficult to make meaningful comparisons between a site and its environmental context.

Function and Settlement Model for Western Wisconsin  Sasso (1989) presented a model of Oneota settlement patterns for western Wisconsin, based on a systematic survey
of the Coon Creek drainage near La Crosse. One of the most significant aspects of Sasso’s research is that he makes an active attempt to recognize and take into account a variety of site types. He differentiates among seven distinct Oneota site types in the Western Wisconsin region (Table 1). This type of analysis allows for the consideration of activities that took place outside of the villages, thereby illuminating various aspects of the Oneota economy and the nature of relationships among different site types. The first is major habitation sites which includes villages of various sizes. The next category is defined as minor habitation sites and it includes small hamlets as well as minor remote habitations. Hamlets are typically near known village sites and may represent farmsteads. The remote minor habitations were most likely used as seasonal open air base camps. They were situated significant distances away from any known villages. Rockshelters are the third site type and are interpreted as being functionally similar to the remote minor habitations. The next site type, ephemeral/extractive sites, likely represented a multitude of subtypes, each with a different functional purpose. As the name implies they were likely used on a very short basis. Defensive sites are defined as habitation sites that include palisades or defensive features; several such sites have been identified in the La Crosse Locality. Oneota mortuary sites are often placed on high ground and usually take the form of a cemetery or a mound. The final site type consists of garden beds and other agricultural sites (1989:242-250).
Table 1. Oneota Site Types (Sasso 1989:242-250).

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Site Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Habitation Sites (Village)</td>
<td>Large scale, warm weather base camp that housed the majority of the region’s population. Probably occupied from spring into fall.</td>
</tr>
<tr>
<td>Minor Habitation Sites (Hamlet)</td>
<td>Small, single family base camp/farmstead. Near major habitation sites. Probably occupied from spring into fall.</td>
</tr>
<tr>
<td>Minor Habitation Sites (Remote)</td>
<td>Small, remote open air base camps.</td>
</tr>
<tr>
<td>Rock Shelter Sites</td>
<td>Similar to remote base camps, but offered some level of shelter from the elements.</td>
</tr>
<tr>
<td>Ephemeral/Extractive</td>
<td>Short term sites, utilized for a single purpose (e.g., kill site or butchering site)</td>
</tr>
<tr>
<td>Defensive Sites</td>
<td>Specialized version of the Village and Hamlet sites where evidence of defensive structures is evident (e.g., palisades).</td>
</tr>
<tr>
<td>Mortuary Sites</td>
<td>Typically take the form of a cemetery or mound, placed on high ground</td>
</tr>
<tr>
<td>Agricultural Sites</td>
<td>Sites where there is evidence of Oneota cultivation, typically found archaeologically as garden beds or corn hills</td>
</tr>
</tbody>
</table>

To reconstruct the vegetation patterns in the Coon Creek region, Sasso referred to the General Land Office. The surveyors recorded the general vegetation patterns along the section lines; their notes and plat maps can be extremely useful for determining prehistoric vegetation patterns (which will be discussed in greater detail next chapter). It is important to note that use of the GLO notes rather than Finley’s map allows analysis on a much finer scale. The region investigated by Sasso was a mixture of wetlands, forests, savanna, and prairie. The wetlands and forests tended to cluster in and near the flood plains. The uplands were a mixture of forests, savanna and prairie; however, the proportion of prairie increased with distance from the floodplains (Sasso 1989:121, 126). Sasso (1989:120-121) also accounts for the distribution of soils. The soils within the study area are variable but related to their physiographic setting. Wet lowlands are the most common soil type, and contain silts, silt loams, and mucks. Terraces are dominated by sandy loams and the uplands contain mostly silt loams.
Sasso (1989:254-255) argues that understanding subsistence strategies is the most important factor in understanding Oneota settlement patterns. Like the previously discussed studies, Sasso describes the Oneota subsistence as diverse; however, he argues that within the La Crosse region there is a dichotomy of Oneota subsistence practices. The residents of Oneota sites exploited both aggregated and dispersed resources depending on seasonality. During the warm months, crops would be planted and the aggregated resources available in the nearby wetlands were utilized. After harvest, the sites’ occupants would concentrate on less concentrated resources such as upland game.

After accounting for soils, vegetation, site type, and seasonality, Sasso argues that large Oneota villages were occupied in the summer and the residents dispersed into smaller settlements after harvest. The villages themselves are placed on terraces near streams and rivers, where flooding is not a threat and the inhabitants still have access to the nearby wetland resources as well as productive soils for agriculture. In situations where defenses are evident, the sites still tend to conform to this pattern; however, their placement is often more restricted to locations that also offer natural defensive benefits. Hamlet sites tend to be situated in locations similar to the villages (Sasso 1989:250-251). Remote habitation sites are rarely found in upland settings, but rather are typically found near the mouths of small valleys where they are optimally located to allow access to a variety of habitats. These settlements likely represent winter habitations after the aggregated resources no longer tied the residents to concentrate near the floodplains and agricultural areas (1989:251, 253). Ephemeral sites are found near large habitation sites as well as on the periphery of the Oneota territory. Sasso (1989:252) interprets these as “special purpose excursions from major village settlements (i.e., during the summer) or
from remote seasonal base camps,” and “conceivably could have taken place during any season of the year.” One limitation of this analysis is that it did not quantify the environmental context of the sites, which eliminates the possibility of an inter-site analysis that could explicitly measure environmental variation around sites with presumed different functions

**Function and Settlement Model for Northern Illinois** Jeske’s settlement model of the Langford tradition is based primarily on excavations at the Washington Irving (11K52), Robinson Reserve (11CK2), Zimmerman (11LS13), and LaSalle County Home (11LS14) sites. It is supplemented by survey and excavation data from other Langford and Oneota (both Fisher and Huber) sites in northern Illinois (Jeske 1990b). Jeske (1989) has argued that Langford settlement differs from contemporary and adjacent Oneota sites (also c.f. Berres 2001; Jeske 2003b), noting that Fisher and Huber sites are restricted to the Upper Illinois River Valley, the Middle Rock River Valley and the Calumet Lake Plain and Dunes regions around the southern edge Lake Michigan. Unlike Langford sites, there are no known Oneota sites in the smaller river valleys such as the DesPlaines, Fox, Kishwaukee and DuPage, nor in the uplands among those valleys. Recent comparisons of Langford to Oneota show that Langford groups relied less on wetland resources than Oneota groups and instead exploits upland game more heavily (Hunter 2002). Despite this difference, Jeske (1990b, 2000b) points out that wetland resources were still an important aspect of the Langford diet, so one could understandably expect that Langford settlement patterns would reflect both the importance of upland and wetland resources. The differences between Langford and Oneota settlement patterns could then be expected to reflect the differential emphasis on upland resources.
Jeske’s settlement pattern provides a small-scale analysis and an account for seasonality, unlike Overstreet’s or Rodell’s. Like Sasso, Jeske reconstructed the original vegetation based on the notes from the GLO survey. After comparing environmental, subsistence, and settlement data, Jeske’s conclusions were generally similar to Sasso’s. Jeske argues that the Langford occupied large villages from spring through fall. These habitations were situated along rivers where they could exploit good farmland and wetland resources. During winter, the Langford would disperse into several small groups which are exemplified by small ephemeral sites away from the villages in forest environments (Jeske 1989:232-234). Like Sasso, Jeske does not quantify the environmental contexts of the sites and therefore suffers from the same inability to compare individual sites. However, Jeske (1989) does account for soils. After examining Langford and Oneota sites in northern Illinois, Jeske concludes that there are significant differences in the types of soils that each site type is found on. Langford sites tend to be found on drier soils than Oneota sites. He argues that the difference in preference may be due to differences in agricultural technology, where the Langford residents were using digging sticks in flat agricultural fields and the Oneota were likely using hoe technology with garden beds. Scapula and shell hoes are nonexistent at Langford sites, but are common at Oneota sites (Jeske 1989).

The settlement analysis conducted for this thesis was designed to incorporate the strengths of each of its above-mentioned predecessors. In order to ensure a fine-grained analysis, this thesis incorporates GLO notes, maps, and soil data to construct a model of the prehistoric environment within two kilometers of each of the four study sites. A fine-grained data set is important because, as Tiffany (1982:4) argues, “if Oneota site
placement is to be understood, the more detailed the resource maps the better.” Soil data are also used to model the agricultural potential of the land within the study area.

Catchment analysis and a geographic information systems (GIS) program will be used to quantify a series of environmental variables such as proportion of environmental zones, total area of ecotones, distance to water, and proportion of arable land. By measuring each of these variables, this research can account for various economic aspects of site placement including the importance of access to natural resources (e.g., water, wild rice, deer, arable land). Finally, the system will be used to explore the placement of other sites in the region. While there are not enough data to create a true settlement system model, it will explore potential relationships among the sites of the region. The results of the analysis will answer the following questions: 1) what was the environmental context of each site; 2) was each of the study sites placed in the same environmental context; 3) were the sites placed to optimize agricultural production; 4) what is the nature of the Oneota settlement patterns in the Koshkonong Region.
CHAPTER TWO

METHODOLOGY AND METHODS

In order to determine the settlement patterns seen for Oneota sites in this region, several different lines of evidence determined from several different methods were utilized, including optimal foraging theory and catchment theory. This chapter describes the various methods used, including the methodologies for each method, and how each method applies to the current research.

It is assumed that settlements are not placed randomly across the landscape but will be located in areas that are logically placed according to physical constraints and culturally defined rules (c.f. Goldstein 1982; Hart and Jeske 1987; Roper 1979). Nutritional requirements are one physical constraint; sites must be located in areas that are capable of providing enough food, water, and other vital resources necessary for human survival. Energy efficiency is another physical consideration that is linked directly to nutritional requirements. The concept of energy efficiency states that humans will attempt to expend the least amount of energy possible while maximizing energy intake. Both of these factors are mitigated by culturally defined rules and preferences which may limit or emphasize certain resources or locations over others. This concept is integrally related to optimal foraging theory discussed in more depth below. It is also necessary to assume that artifacts recovered from sites represent prehistoric activities and behaviors that occurred at the site or related sites (c.f. Hart and Jeske 1987; Jeske 1990a:150; Roper 1979).
Optimal Foraging Theory:

Optimal foraging theory has its base in biological, economic, and ecological theories, though they have been adapted for use in anthropological research. Optimal foraging in anthropology developed as a means for cultural ecologists to empirically measure variables such as energy costs (e.g., Lee 1969) and better understand how environmental conditions can affect human behavior (Jochim 1983; Smith and Winterhalder 1981). Optimal foraging theories rely on the parallels between animal and human foraging strategies and biological needs. It requires that research questions (e.g., those pertaining to settlement patterns, resource exploitation, etc) are framed in a way that they can be examined by a cost-benefit analysis where costs typically refer to time or energy expenditures and benefits are calories or other chemicals (e.g., calcium) needed for survival. A typical optimal foraging study will analyze all the potential food resources available to a given group and will rank them in order of efficiency. The most efficient resources are those that offer the highest reward relative to the cost of exploiting that resource (Keene 1983; Winterhalder 1981b; Yesner 1981).

All optimal foraging models require a means to measure energy expended while obtaining resources. The unit of cost is often time, which is affected by several factors. Total time is composed of three components; time spent searching for the resource, pursuit time (i.e., time from when the resource is spotted until it is killed and/or collected), and consumption time, which is also includes the time necessary to make the food edible (e.g., cooking meat). The mobility, population density, and level of aggregation can affect the total time. Typically, resources that are highly mobile are
harder to find, therefore search time is often longer for animals than plants. Resources with lower population density are also harder to find, thus increasing search time. Due to their clustered nature, aggregated resources have shorter pursuit times (Keene 1981).

Traditional optimal foraging models require several key pieces of information in order to function. First, it is necessary to know what resources were exploited by a group. For archaeological research, this information can be collected by examining the environment or by looking at faunal data from archaeological contexts. The former requires the assumption that the inhabitants would have chosen to exploit all potential resources; the latter is plagued by issues of preservation and data recovery techniques (Yesner 1981).

In an oversimplified sense, most optimal foraging theories are based on one of two assumptions about the environment. The resources are either uniformly distributed in a homogeneous environment (fine-grained environment), or the resources are differentially clustered into patches (coarse-grained environment), these patches represent aggregated resources. It is also possible for a region to have fine-grained sections and coarse-grained sections, or in some cases, an area may exhibit both but during different seasons. Course-grained environments require the researcher to account for patch selection, or how the forager(s) select which patch to exploit. Typically, each patch is examined separately to determine its resource potential, and the costs of exploiting its resources. The patch with the lowest cost will then be exploited first, and will be exploited until its cost/benefit ratio drops from resource depletion below the level of another patch. This second patch will then be exploited (O'Connell and Hawkes 1981:107-108; Winterhalder 1981a:68-69).
Optimal foraging theories applied to settlement patterns assume that there is a relationship between natural resource distribution/availability and the location and size of a group. For example, if resources are randomly and evenly dispersed throughout an area (as in fine-grained environments), a central location for all individuals in the region is inefficient in terms of distance traveled. Instead, several small settlements spread throughout the region would maximize the chance of an encounter and minimize travel to resources. However if resources are aggregated and their locations are predictable (as in coarse-grained environments), a centralized settlement allows for more efficient exploitation of the resources (Heffley 1981; Moore 1981; O’Connell and Hawkes 1981).

Additionally, the mobility of resources can also play a role in determining the location of settlements. Sedentary resources are more likely to strongly affect settlement placement, while highly mobile resources will have less effect. If a settlement is placed near an immobile resource, the residents will consistently be near that resource. Since the highly mobile resource will not be found in the same location for any significant length of time, the time spent exploiting the resource will not be greatly affected by maintaining a base camp or village near the sedentary resource (Jochim 1976:54-55).

Heffley (1981:140-142) discusses the settlement patterns of the Upper Tanna in Alaska. Throughout much of the year, caribou are the most efficient food resources to exploit, though early July marks the spawning runs of white fish, a seasonally important resource. During the caribou migrations and the spawning runs, these animals are an aggregated resource that can be exploited in predictable locations each year. While these resources are clustered, the several families of Tanna would gather to exploit the resources together. As the spawning runs and caribou migrations end, there is no access
to predictable or aggregated food resources. Once this occurs the large groups of Tanna break apart into one and two family groups and disperse throughout the region to increase their hunting efficiency.

After gathering as much data on the various costs, values, and availability of each of resources, many optimal foraging theorists create what is called a linear programming model. Keene (1981:14) defines a linear program as a “plan or schedule of activities” that assumes variables are proportionally related to one another. The plan is designed to optimizing the intake of key nutrients while minimizing effort and energy. A successful program should be able to predict what time of year and to what extent the various resources will be (or were in archaeological contexts) utilized. Some examples of linear programming models include Keene (1981, 1983b) and Reidhead (1981).

While the present analysis will not incorporate a linear programming model to explicate the Oneota settlement patterns, several of the basic assumptions about human behavior used here are shared with Optimal Foraging Theory. Specifically economy and efficiency (i.e., minimizing effort while maximizing productivity) are considered two of the prime factors of settlement location. For the purposes of this thesis, it will be assumed that Oneota diet was both economically feasible and relatively efficient within cultural and local ecological constraints (c.f. Jochim 1976:6-7).

Based on Rodell’s (1983) research, the environment is interpreted as patchy, though this will be discussed in greater detail below. The Lake Koshkonong environment may be characterized as a series of patches ripening in both the wetlands and oak savannas throughout various times of the year. Winterhalder (1981a:90-91) notes that while deer are often present as a dispersed resource, in fact, they are often relatively
clustered--females maintain relatively small territories, while males move from territory to territory. Deer often move along well-defined paths along lake and river shorelines, forest edges, and the edge of agricultural fields. Hunters increase their chance of locating deer using *a priori* knowledge of the animal’s behavior and tracking skills that would allow the hunter to pursue the animal before seeing it. In fact, it is relatively easy to kill deer by sitting still near areas where they are known to congregate, or to drive them towards a central spot where hunters wait. In areas similar to the study area, it is possible to sustainably kill 16 deer per square mile per year (Keene 1983:101-104). Both wild rice and planted cultigens are interpreted as aggregated resources. Depending on the season and the technology employed, fish can be either aggregated or dispersed resources.

Within an optimal foraging context and given the nature of the resources available, the Oneota settlements would need to be placed in locations that allowed them to exploit the local resources in an efficient manner. That is, the settlements should be placed where they can effectively exploit aggregated resources (i.e., near wetlands and land with high agricultural potential) while still optimizing the chance of locally finding dispersed prey (e.g., near forest edges).

While food resources are important, they are not the only part of the equation. When using optimal foraging theory to analyze subsistence patterns, it is also necessary to consider resources other than physical nourishment. Food resources, while important, may not have been the only factor in deciding settlement locations. Other important resources include water, fuel, and other raw materials (Jochim 1976).
Ecotones

Another important environmental aspect to consider is the distribution of ecotones, “a transition between two or more diverse communities … a junction zone or tension belt which may have considerable linear extent but is narrower than the adjoining community areas” (Odum 1959:278). These areas are important because they typically have characteristics of both zones, which may attract a wider variety of flora and fauna. The interaction of two ecozones can also create a unique niche that supports species diversity as well as species that exist only in border areas (Odum 1959:278-280). The archaeological implications are clear from an optimal foraging perspective. Areas like the forest edge or lakeshores will attract a wider variety of species, both flora and fauna, than the center of a forest or the middle of a lake (Keene 1983; Winterhalder 1981a). In these complicated environments (i.e., two or more environmental zones overlapping), it is possible to exploit a wider variety of resources within a smaller area, minimizing effort and maximizing productivity.

The archaeological importance of ecotones has been demonstrated. For example, Jeske (1990a) showed that Langford site occupants on the current site of the Fermi National Accelerator Laboratory between the DuPage and Fox River chose locations that were within 500 meters of the forest/prairie boundary as depicted on GLO survey maps. Hart and Jeske (1987) used a logit regression model to analyze the location of sites within the Illinois-Michigan Canal and concluded that ecotones were of great importance to late prehistoric groups when choosing site locations. Both studies showed a closer association with ecotones for late prehistoric sites than for Archaic sites, which concurs with OFT expectations for settling near areas of aggregated resources.
Catchment Analysis:

Catchment analysis was initially developed by Vita-Finzi and Higgs (1970) as a means of relating the environment surrounding a site to the economic activities conducted by the site’s inhabitants. As described by Tiffany (1982), site catchment analyses require the researcher to define an arbitrary border around the site in which economic activities would have taken place. By examining the distribution of natural resources within the arbitrary border, it is possible to infer site function and subsistence practices. Catchment analyses draw upon several different theories, primarily ecological, geographical, and anthropological (2). It also allows for a better understanding of how a site’s inhabitants interacted with the local environment by examining the evidence of the inhabitants’ activities and a detailed analysis of the local environment from which the majority of resources would be gathered (Stevenson 1979:3).

The real value of catchment analyses is that they offer a consistent framework when studying economic aspects of multiple sites that for comparisons to be made. Though the connection is not always made explicit, catchment analyses are linked with optimal foraging theories in that they both assume people will behave economically and efficiently. For example, it is usually assumed that village and base camp sites are placed in locations that will allow the easiest (lowest energy cost) exploitation of the most resources (Gallagher and Stevenson 1982:20). Such an assessment fits well with Roper’s (1979:131) findings of Woodland sites in Illinois. She concluded that base camps were placed in locations that allowed easy access to the most important resources, while still providing access to secondary resources and shelter from the environment. Michalik (1982:40) also hypothesizes that by comparing sites within this consistent framework, it
is possible to determine seasonal variation in settlement patterns since each habitation site should be placed nearest the resources that are available while the habitation site is occupied. For example, a marsh may be extremely productive in the summer so a summer habitation may be placed to efficiently exploit it. As the productivity of the marsh declines due to seasonal nature of its resources, efficiency is no longer increased by maintaining a nearby habitation so it may be temporarily abandoned in favor of a location with readily available resources.

Because of the economic nature of catchment studies, it is assumed that the area closest to the site is the most heavily utilized, and as distance from the site increases exploitation decreases. The actual boundary of a catchment would be the point at which food resources are not regularly gathered. Determining where such a boundary should be drawn can be difficult. Vita-Finzi and Higgs’ catchment based studies have relied on ethnographic data e.g., Lee (1969) !Kung study focusing on walking time (Gallagher and Stevenson 1982; Roper 1979; Tiffany 1982). Vita-Finzi and Higgs (1970) created a series of concentric rings around their study site. At each ring, the proportion of resources utilized was reduced, so within the first catchment ring, resources were 100% utilized and 50% in the second. The largest ring had a radius of five kilometers and represented a one-hour walk from the site. Therefore, the inner catchment ring was one kilometer (within which resources are hypothetically fully utilized) and the radius of each subsequent catchment was increased by one.

Oneota studies have utilized a variety of catchment sizes Michalik (1982) utilized a one mile catchment for the Huber Phase Hoxie Farm site in Illinois. Hunter (2002) also utilized a one mile catchment radius for the Crescent Bay Hunt Club and Washington
Irving sites. Tiffany (1982) utilized a two kilometer catchment for Iowa Oneota sites, while Gallagher and Stevenson (1982) employed a series of five concentric catchment rings ranging from two to ten kilometers around eight sites in the La Crosse Locality. Interestingly enough, Gallagher and Stevenson did not utilize circular catchments; instead, they used a method that accounted for the effects of terrain and non-walking modes of transportation (e.g., canoe). By taking into account these additional factors, the catchments more closely resemble the terrain in the region.

Several issues have been raised with catchment analyses, though most are concerned with misuse of catchments rather than the underlying theory. For example, Roper (1979:127) cautions that it is necessary to differentiate between a site’s territory and its catchment. A catchment is the area that is habitually exploited, while the territory should include all areas that may be exploited. Michalik (1982:40) notes, “the circular catchment is basically an analytical device: it does not represent the actual catchment of a site.” Therefore, it should not be taken as a literal representation of all economic activities that took place at the site. Though not the first to raise some of these issues, Brooks (1986) identifies several limitations of past catchments analyses, several of which are applicable to research of the nature presented here. These include: a reliance on modern data to reconstruct the prehistoric environment; natural resources are described in generalities; failure to account for seasonality of a study site; permanence of a site; failure to empirically validate the perceived substance patterns.

The analysis presented here takes into account these concerns, for example, several lines of data are used to reconstruct the prehistoric vegetation, including textual data and soils data that are supported by palynological data. To avoid generalities, the
GIS provides specific measurements of the distribution of vegetation zones. Data pertaining to the seasonality, village permanence, and exploitation of natural resources are examined on a site-by-site basis. While not eliminating all problems associated with catchment analysis, by attempting to take into account as many known problems as possible, it is hoped that the model developed serves as a reasonable approximation for the past environment.

For this analysis, a double catchment of one and two kilometers will be utilized in order to provide a finer resolution and to still maintain a reasonable catchment size. Roper (1979:81) notes “that even though this seems to incorporate a high degree of redundancy … it permitted a more accurate assessment of immediately available resources, as well as those that were somewhat farther away. Based on Vita-Finzi and Higgs’ estimations, this double catchment should allow a reasonable approximation of the areas that were most likely exploited by the prehistoric occupants of the sites.

Additionally, two kilometers seems to coincide with relevant archaeological (e.g., Brown and Sasso 2001; Sasso 2003) and ethnohistoric (e.g., Denevan 1992; Jackson 1964; Kinietz 1965; Quimby 1960) research in this region. Tiffany (1982:2) argues that based on ethnographic descriptions of agricultural settlements, a minimum of a one mile catchment radius is necessary to adequately support a sedentary populace. Descriptions of agricultural fields in the Great Lakes region were recorded as being “near” the associated village. For example, referring to the Sauk, Fox and Miami, Quimby (1960:133) argued, “subsistence was based upon a combination of farming and hunting. In cleared fields near the villages the women planted and cultivated corn, beans, and squash.” By examining the distribution of garden bed and Oneota habitation sites, Sasso
(2003:262-263) was able to provide some quantifiable distances. His analysis showed that within Winnebago County, known garden bed sites were never more than 2.32 kilometers from a known Oneota village site. Many garden bed sites were well within this range; the closest garden bed site to a known Oneota village was less than 0.1 kilometers, and on average garden beds were only 0.78 kilometers from villages. He does caution that most of these garden beds have not been securely associated with Oneota artifacts much less any particular Oneota habitation site but appear to fit known patterns from northern Illinois. While the Oneota association of the agricultural sites may be tentative, the results compare well with Vita-Finzi and Higgs’ estimations and should provide an adequate proxy for estimating agricultural distance.

Even though non-circular catchments may provide a more realistic approximation of the natural barriers, a circular catchment was chosen for this thesis. As Michalik noted, a catchment is an analytical tool; it cannot do more than approximate the economic area of importance to a site’s inhabitants. While a topographic based catchment may provide a more accurate approximation, the additional information gained is not significant to justify the additional calculations necessary to create the more complex catchments or compensating for the variable area among site catchments. A circular catchment, while not as sophisticated, will facilitate comparisons among sites and in determining the vegetation distribution (c.f. Hunter 2002:60).

**Reconstructing the Prehistoric Vegetation:**

There are currently two available accepted methods that can be used to assess the prehistoric vegetation patterns of Wisconsin. The first requires an examination of the
surveyors’ notes from the General Land Office Survey. The second requires an examination of the soil distribution and determining the original vegetation based upon the soil types (e.g. Jeske 1990a; Moran 1978, 1980; Sasso 1989; Staff n.d.).

The General Land Office (GLO) Survey was commissioned to be the first survey of the Northwest Territory of the United States, which included land that is currently the state of Wisconsin. Within the state, the survey was conducted between 1832 and 1866. The purpose of the survey was to establish the Public Land Survey System’s (PLSS) township and range grid across the state in order to sell the land to Euro-American settlers. The surveyors were tasked with first plotting, marking, and then recording the exterior boundary of each township. Once this was completed, the surveyors were required to do the same thing for the interior section lines (Land 2005).

In addition to setting up the town/range grid, the surveyors were also required to record the general vegetation patterns that were encountered. Since the surveyors did not deviate from the section lines, there are no notes for the interior of the sections and many small vegetation features were likely missed. Additionally, the surveyors were concerned with recording economically important resources and long-lived trees. Potentially profitable resources (e.g., hardwoods trees) are overrepresented and other species, especially those within prairies and lightly wooded savannas are underrepresented. Readers of the GLO field notes need to be aware that there was likely much more diversity than the notes indicate (Moran 1978, 1980).

The study area near Lake Koshkonong was surveyed in 1833 and 1835 (Brink 1835; Miller 1833). Despite the roughly 600 year gap between the Oneota occupation of the study sites and GLO survey, the field notes may still be used to accurately model the
prehistoric vegetation potentially as many as 5000-6000 year BP, when the oak savannas first dominated the peopled Wisconsin landscape (Griffin 1994). According to King (1981), the Volo Bog in Lake County, Illinois, which is approximately 90 kilometers to the southeast of the study area provides vegetation history for greater than 10,000 years. After the end of the last glaciation (roughly 9,000 BP) a cold weather forest developed. During the Hypsithermal (8,000-5,000 BP) the prairie expanded but quickly retreated after precipitation levels rose. Oak dominated forests in northern Illinois developed during the dry period but remained after 5,000 BP. According to King, the increase in moisture levels may have changed the boundaries of the vegetation zones within the preexisting mixed prairie/oak forest landscape; however, it did not significantly affect the overall vegetation patterns of the region.

Starting about 900 BP, the Neoglacial period marked a drop in temperatures and an increase in cold weather trees (e.g. pine and birch); this colder climate lasted into the early 19th century. The Oneota occupied the region at the beginning of the Neoglacial, and the GLO survey of the region took place at the end. Based on these factors, the GLO should prove to be an accurate estimate of the vegetation around the Oneota sites at the time they occupied them (King 1981). Despite the 90 kilometers between Volo Bog and Lake Koshkonong, the interpretations of the pollen deposits should still be valid for reconstructing of the Jefferson County vegetation. Jeske (1999:21) argued that his survey area, 100 kilometers north of Volo Bog “should reflect major patterns encompassing the area.” Supporting data for this assumption comes from a wide range of locations. Duane Griffin (1994) examined the palynological data from Wisconsin, Illinois, and Indiana. Using data from Lake Mendota and Devils Lake, Griffin concludes that in Wisconsin, the
savanna-dominated environment developed approximately 5,500 BP, as expected from the Volo Bog data.

Robert Finley (1976) produced a map based off of the GLO survey notes at a 1:500,000 scale for the entire state of Wisconsin. Although used by a number of researchers for environmental reconstruction, (e.g., Rodell 1983), Finley’s map is not suited to the task at hand as it is overly generalized and skips over important environmental features. A comparison of the Finley map and the GLO plat map produced by Brink (1835) shows that, while generally correct, the Finley map is missing several important environmental features. Finley misses Koshkonong Creek in addition to several wetland features (Figure 2) that can be found on the Brink map. Finley’s map also indicates that a much larger portion of the region is forested than Brink indicated in his notes or map.

In addition to the surveyor’s notes, soil series are important variable in reconstructing past vegetation. Soil types are strongly related to the vegetational community that exists at the time the soil is forming (c.f. Michalik 1982). The Official Soil Series Descriptions by the USDA (Staff n.d.), coupled with a soil map (e.g., Glocker 1979), can be used to model the original vegetation of an area. The vegetation map produced from the soils includes Koshkonong Creek and far more detail than either Finley’s map or the GLO plat map (Figure 3). With Finley’s map, the differences can be explained by the difference in resolution; however, it is not as easy to explain the differences between the soil and GLO maps. Part of it may be due to the nature of the GLO survey, and its lack of data in the interior of the sections. For more information on the statistical correlation of GLO vegetation types and soils see Hart and Jeske (1987).
Figure 2: Comparison of GLO and Finley vegetation maps (adapted from Brink 1835; Wisconsin-Madison 1990)
There are also accuracy issues with some of the soil data. Figure 3 depicts the border (the vertical line that separates sections 12 and 13 from sections 7 and 18) of Jefferson and Dane Counties. These two areas were surveyed at separate times by separate crews. As a result, the interpretations do not always correspond very well, as can be seen in by the abrupt end of the prairie in section 13.

In addition to the surveyor’s notes, soil series are important variable in reconstructing past vegetation. Soil types are strongly related to the vegetation since the soil and GLO sources each provide different data for modeling the prehistoric vegetation, both sources were used to supplement and complement the other. The GLO notes were the primary reference when constructing the general vegetation patterns. The GLO plat map and the soil data were both used to determine more accurately the extent and boundaries of some vegetation zones. Since Koshkonong Creek does not neatly follow the section lines, the surveyors would not have adequately mapped the contours of the creek to accurately represent its winding nature. Therefore, when possible the creek was mapped relying on the soil data rather than the GLO. The combination of these data results in a more detailed representation of the environment than can be had from using only one or the other of the data (Figure 4).
Figure 3. Comparison of GLO and Soil Based Vegetation Map.
Figure 4. Vegetation Model of Study Area.
Vegetation Zones:

The general definitions of vegetation patterns used here are the same as used by Jeske (c.f. 1999:31-34) and by ARG (1985). For this research, vegetation zones will be broken into six separate vegetation categories. The first is forest, an area that has greater than 50 percent tree coverage. GLO notes indicate that various types of oaks dominated much of southeast Wisconsin; however, birch and maple, among others were present to a lesser degree (c.f. Curtis 1959). Within the study area, it does not appear there were any forested areas of significant size. Rather the area is dominated by savanna, primarily oak savanna. Many scholars have speculated about the role of fire, both natural and cultural in origin, in maintaining the prairie. It is possible that the lack of thickly wooded areas near Lake Koshkonong is a product of natural fires in conjunction with periodic fires started by the local human inhabitants (e.g., Goldstein and Kind 1995; Schorger 1937:117-118; Theler and Boszhardt 2006:442; Will-Wolf and Monague 1994).

In general terms, a savanna, also known as an oak opening or a barren, is a mixture of forest and prairie with large amounts of both trees and grasses (White 1994). More precisely, a savanna is an area with more than one tree per acre, but has less than 50 percent canopy coverage. A prairie is grassland with less than one tree per acre. The category wetlands includes several distinct types of vegetation zones (e.g., marshes, wet prairie, swamps). Jeske (1999:33) notes that it is usually not possible to determine what wetland type was present based on GLO notes since all types are often referred to as swamps or marshes. In the case of Brink (1835), wetlands are referred to as “wild meadows,” with no further information concerning the type of wetland. The final two categories are open water (i.e., lakes) and rivers. This diverges from Jeske’s system; he
includes lakes and rivers with wetlands arguing that the two are indistinguishable in the GLO. However, the size of Koshkonong Lake and Creek are substantial enough that they are easily differentiated in both the GLO notes and plat map, and therefore could be differentiated in this analysis. Since lakes, rivers, and wetlands (e.g., marshes) all have distinguishable characteristics, it is likely that the humans interacted with each differently. For example, various fish can be found in Lake Koshkonong that are not found in the wetlands, which do not have the same transportation potential (i.e., canoe travel) as rivers or the lake.

**Vegetation Zones as Discrete Resource Zones:**

Each vegetation zone has a specific suite of plants that grows within its borders. The suite of flora present in a vegetation zone affects the type, quantity, and density of fauna that will regularly occupy that zone. Based on these two factors, it is possible to predict the resource potential for the various vegetation zones (c.f. Goldstein and Kind 1995; Jeske 1988, 1999).

Forests provide a wide variety of resources from early spring through the beginning of fall. In addition to firewood and raw materials, trees often provide nuts (e.g., walnuts) and fruits (e.g., cherries). The underbrush often contains a variety of food resources (e.g., blackberries, blueberries, and goosefoot). The forest is the habitat of a variety of animals including deer, raccoon, fox, wolf, bear, and squirrel. On a scale ranging from low, to good, to high, Goldstein and Kind rate the forest high on its food potential (Goldstein and Kind 1995:19,27; Jeske 1999:35-36,38).
According to Goldstein and Kind (1995:19,29,34), the prairie provided few useful resources to humans. In reference to flora, “the prairies offer nothing that cannot be obtained with less effort elsewhere in Southeastern Wisconsin” (Goldstein and Kind 1995:29). They argue that the prairie fauna was similarly limited; that the only valuable animal primarily restricted to the prairie was the bison. They rate the prairie as having low food potential and argue that it is best to exploit the prairie in the winter. Jeske also argues that the prairie has limited economic value, though it does provide a variety of seeds and tubers (e.g., amaranth, chenopodium, and duck potato). In addition to bison, the prairie could also provide elk, coyote, and rabbit (Jeske 1999:37-38).

Since savanna is essentially a combination of prairie and forest it offers a wide range of exploitable flora and fauna from both environmental zones. Goldstein and Kind (1995:26,28,34) rate the barrens as good sources of food and argue that they are best exploited during the winter and used for agriculture in the summer. Since the barren is the primary environmental zone within the study area, and its floral resources would be available from late spring into fall, Oneota site occupants may have exploited the barrens’ resources throughout the year.

Wetland resources are extremely diverse. Fauna found within the wetlands include animals associated with upland habitats (e.g., deer), but also include aquatic and semi-aquatic animals (e.g., turtles). Additionally wetlands often attract waterfowl such as ducks and geese. Maygrass, sumpweed, strawberries, and wild rice are just a few of the plants available from wetland environments (Jeske 1999:33,37).

Like wetlands, rivers and lakes provide access to a wide variety of plants and animals. The water attracts upland animals, while providing shelter for aquatic mammals
(e.g., beaver and muskrat), waterfowl, and aquatic reptiles. The water is also home to a variety of fish such as bass and pike. These environmental zones would have been capable of providing a considerable amount of food (Jeske 1999:33). Wild rice was likely an important resource; it was certainly one of many abundant resources. Lapham notes in 1850 that the lake was a plentiful supply of food resources:

At the time of our visit (July, 1850), wild rice was growing abundantly over almost the whole surface, giving it the appearance of a meadow than a lake. Fish and mollusks also abound in its waters, finding plenty of food in the warm mud beneath, and among the roots and stems of the grass and rushes [Lapham 1850:35].

Five of the six resource zones can be found within the study area. Clearly, there was a wide diversity of resources available to inhabitants of the four study sites. The questions that must then be asked; 1) what was the actual environmental composition of within the study area; 2) how were the sites placed in relation to these environmental zones; 3) what evidence do we have for Oneota utilization of resources from these zones.

**Geographic Information Science/Systems:**

GIS typically refers a computer program that combines database storage and management with mapping capabilities. It allows for the spatial representation and analysis of data. The value in the ability to calculate spatial analyses, explore data, or create maps easily should be apparent to all archaeologists. Dillemuth (1999:96)
accurately claims that, “the results show that the use of GIS is a powerful and efficient way to investigate a prehistoric landscape.” In the past, GIS has been used for settlement analyses, Brandt et al. (1992) created a multi-layer map that rated the land surrounding their sites based on several factors (e.g., distance to water and soil texture). They used each of the variables to determine the quality or favorability of an area for archaeological populations. In total, more than 75 sites from five different time periods in the Netherlands were tested. They used the results of their catchment analysis to determine the common traits found at various sites and compared the results to non-surveyed areas to determine the potential of finding archaeological sites.

Hunt (1992) analyzed Late Woodland sites in New York state, suggesting that the primary benefit of GIS is its capability to give the researcher, “the ability to overlay multiple thematic coverages, generate new coverages as the result of mathematical computation between two or more coverages, manage large multivariate data structures, compute basic statistics, and satisfy cartographic standards” (Hunt 1992:285). Hunt continues that a GIS allows for more complexity than many past catchment analyses allowing for analyses that are more meaningful. Additionally its ability to convert coordinate systems and vary scales allows it to incorporate a variety of sources that otherwise would be extremely difficult and tedious if not impossible.

For the research presented here, Environmental Systems Resources Institute’s (ESRI) ArcGIS 9.3 and 9.3.1 software suites were utilized. ArcGIS is an extremely versatile program which is capable of reading raster (data are cell based e.g., JPEG files) and vector files (spatial information is stored as equations and linked to a separate file containing the attribute data). It allows the user to manipulate either, or convert from one to the other. It also offers a wide range of tools useful for exploring, summarizing, and conducting spatial analyses on the data. For the research presented here, a vector dataset will be used. Raster datasets were considered, but due to time constraints were not used in the present analysis.

Careful planning is always the first step in creating a GIS. A Universal Transverse Mercator (UTM) projected coordinate system was chosen for the project, so
the data would be displayed with reference to a universal datum rather than arbitrary site data. All of the sites may then be displayed with reference to one another and to other mapped objects from the real world or mapping phenomena (e.g., soil types or PLSS townships or sections). Additionally, use of UTM coordinates uses the familiar and easily interpreted meters as the base map units compared to other systems that use latitude and longitude or the imperial measurement system. Geodatabases were created so that relevant information (e.g., site name, site number, etc) would also be recorded and stored in a systematic way with the proper spatial files.

The first items that needed to be mapped were the sites’ boundaries so that the extent of the study area could be determined. While it was already determined that the study area would contain the land within two kilometers from each of the sites, the computer needs to be told exactly where the sites are so that it can create the study area. The Schmeling site was digitized from a preexisting non-GIS site map (c.f. Foley Winkler 2008) by georeferencing (modifying the file so that it has the appropriate UTM coordinates and is properly scaled) the site map and then using ArcGIS to digitize the map as vector files. The site boundaries were determined by the extent of the positive shovel probes and the artifact scatter from the pedestrian survey. The boundaries were then digitized as a polygon feature. Similar processes were conducted by James Moss, Shannon Cowell, and Seth Schneider of the University of Wisconsin-Milwaukee for the Crescent Bay Hunt Club and Twin Knolls sites (Cowell et al. 2008; Moss 2008) and adopted for this project. Original site maps were not available for the Carcajou Point site so a digital image was downloaded from the ASI files (Division of Historic Preservation 2003). The image was georeferenced and the outer boundaries of the four sites that make
up the Carcajou Point complex (47JE002, 47JE812, 47JE813, and 47JE814) were
digitized.

The next step was to turn the sites’ boundaries into points. It was decided that
using the center point of each site would be the optimal choice since it would allow for
the construction of circular catchments and provide a single point for measurements.
Such measurements would provide the mean value for each site. ArcGIS offers a tool
that can turn polygons into a point at its center. Using the buffer tool, a one and two
kilometer circular polygon (i.e., the catchment) was created around each of the sites. The
union tool was then used to create a separate polygon feature that shared the non-
overlapping boundaries of each of the two-kilometer catchments. This new polygon
represents the entire study area.

The GLO sketch maps for Town 5 north, Ranges 12 and 13 east were
georeferenced, and soil data were downloaded from the USDA (Staff n.d.). After the soil
data were symbolized to represent the vegetation, these two sources were used in
conjunction with the GLO survey notes to produce the model of prehistoric vegetation.

The clip tool was used to insure that no two environmental zones were
overlapping. The proportion of each ecozone within each catchment was calculated in
several steps. The vegetation model layer was copied into eight different files. The next
step involved selecting the associated catchment feature and using the clipping tool to
erase all areas of the vegetation model that were not within the catchment. This was done
twice for each site so that each site had two associated files, a two-kilometer catchment
and a one-kilometer catchment. Within the attribute table for each of these files is the
total area, in square meters, occupied by each ecozone.
To model the ecotones, the ecozone features were converted from polygons to lines and then 250-meter polygon buffers were generated. This process had to be conducted separately for each of the eight catchment files. Each overlapping polygon was clipped so that no two ecotone features overlapped or extended beyond the catchment. The attributes tables were updated so that each environmental zone that was part of the ecotone (i.e., is within 250 meters of ecotone) was stored as part of the file. Each combination of ecozones was stored as separate entries so it is possible to determine how many square meters are classified as, for example, a wetland/prairie ecotone and how many square meters are classified as wetland/prairie/savanna ecotone.

Distance to water was calculated by using the “Near” tool, which is designed to find the shortest distance between the two specified points or features. The tool was used three times total, first to determine the distance from each site point to open water (e.g., Lake Koshkonong), then to the nearest creek/river (e.g., Koshkonong Creek), and finally to the nearest wetland. These distances, in meters, were stored within the attribute table of the site-points file.

Based on previous work with Oneota agriculture (e.g., Overstreet 1976; Sasso and Brown 1987) a series of soil characteristics were chosen (e.g., ability to be tilled by prehistoric technology, water available at the roots, and drainage) were chosen to rate the soil’s maize production potential as poor, fair, or good (Sasso, personal communication). Soil qualities were determined from the soil survey books of Jefferson and Dane Counties (Glocker 1979; Glocker and Patzer 1978). The first criterion examined was the soil’s capacity to be tilled by Oneota technology (e.g., scapula or shell hoes). Because of the extensive root systems of prairie soils, they were immediately discounted, as were all
soils that were primarily clay. Loams and silts were considered to be the best soil types for tilling with Oneota technology. Loamy sands, silt loams, sandy loams, and silty sands were also considered to be acceptable soils for Oneota agriculture. Silty clay loams were considered to be marginal as they would have been more difficult to till.

The next criterion was drainage capability of the soils. Only soils classified as well drained or moderately well drained were classified as good soils. Those that were classified as somewhat poorly drained were considered fair. If the soils drain too quickly, the plants are not likely to get enough water, and if it drains too slowly, they are likely to be overly inundated. Either case will at the least stunt the growth/productivity of the plants or kill them. For this reason, areas under standing water and mucks were discounted. Related in some respects to the previous criterion, the availability of water at the roots was the next criterion examined. Soils that had high to moderate water levels at the roots were accepted as potential soils for Oneota agriculture. Like those with proper drainage qualities, soils that provided moderate or high water levels would have given the crops enough water without drowning them.

The final aspect examined was slope. Slope is important due to drainage and erosion issues, as well as the practicality of tilling and harvesting (Sasso, personal communication). In the study area, slope of soils is typically classified as zero to six percent slope, six to twelve percent slope, and greater than twelve percent slope (Glocker 1979). Soils with less than a six percent slope were rated good. Soils of six to twelve percent slope were considered fair. Soils with greater than a twelve percent slope were considered to be too steep. The final list of soils within the study area that would have been productive for Oneota technology is listed in the appendix.
ArcGIS allows a user to make complex selections. Soils with the proper attributes were selected and exported as a separate file. The new files were copied then clipped eight times so that each site had its own agricultural model at both catchment distances. The total area classified as good and fair were recorded separately within the attribute tables.

**Resource Pull Analysis**

Jochim (1976) advocated the idea that the more attractive resources (i.e., those that can be exploited most economically) exhibit a pull on human populations. These resources attract the inhabitants of the region to set up settlements close to them. If there are multiple strong pulls in a region, the settlements will be placed to best exploit the widest variety of high pull resources without sacrificing efficiency. If this is applied to catchment analysis, then the smaller catchments would be expected to have a disproportionate amount of the high pull resources. To apply such a test to the current research, the entire study area was rated based on the economic potential of the resource zone, the agricultural productivity, and the number of ecotones present. Wetlands and savannas were rated as a four, lakes and creeks were rated two, and prairie was rated one. Land with poor agricultural potential was rated zero, fair agricultural land was rated two, and good agricultural land was rated four. Finally, the number of environments in an ecotone determined the score of the ecotones. The most possible in this study was four, and the least was zero. Each of the variable layers for each of the catchments was subjected to the union overlay tool in the ArcToolbox. The result of using this tool was a new shapefile that divided the map into homogenous zones (i.e., those that all shared the
same variable values), to which four new attribute fields (one for each of the variables and one for the total value) were added. The field calculator was then used to determine the total value. For this study area, the minimum score was one and a maximum score was twelve. While this score is at best a crude measure of resource pull, it acts as a heuristic device to elucidate patterns that may not otherwise be visible.

An **alysis**

Once the total area of each ecozone, ecotone, and arable land are calculated for each catchment, they, along with the faunal assemblages and distance to water types from each site will be compared. To analyze the first research question, what was the environmental context of each site; each of the above-mentioned variables will be summarized and placed into an optimal foraging context with specific reference to known Oneota subsistence patterns.

The second question, was each study site placed in the same environmental context, will be answered by comparing the sites’ environmental contexts. The analysis would not have been possible without the extensive assistance of Dr. J. Patrick Gray, and was accomplished with the use of weighted log ratio analysis (wLRA). WLRA is a form of composition analysis that is necessary due to the nature of the data. Composition analysis is necessary when the variables (e.g., environmental zones or ecotones) are considered relative or closed data; that is, the values are not fully independent. Therefore, when the values of a variable for a particular catchment (e.g. environment), are added together their total is equal to 100 percent of that catchment. In such cases, if the values of one environment type changes, one or more of the other environment types
must change correspondingly (for a detailed explanation see Pawlowsky-Glahn and Egozcue 2006).

The wLRA is related to correspondence analysis (CA) in that it is used to analyze two-way tables, so long as the values of the tables are positive. Like CA, wLRA allows the relationship between column and row values to be expressed with two factors or dimensions. The advantage of the wLRA is that it is capable of taking into account the relative proportions of values. Its main limitation is its inability to calculate zero values (Greenacre and Lewi 2009). Since the data values for this thesis include zero, especially the ecotone data, wLRA would not normally be appropriate. However, due to the large population of the catchments (i.e., thousands of square meters) adding one to the zero values will allow for wLRA but will not significantly skew the results (Gray, personal communication).

The results of a wLRA are expressed in a biplot, which “is a graphical display of the rows and columns of a rectangular n x p data matrix X, where the rows are often individuals or other sample units and the columns are variables” (Aitchison and Greenacre 2002:377). While there are several types of biplots, in general the biplot displays variables (e.g., environment zone) as rays, and sample units (e.g., sites) as points. The standard deviation of the variables can be calculated by measuring the length of the ray, and by measuring the cosine of the angle of the ray, it is possible to determine the intervariable correlations (Aitchison and Greenacre 2002). By using the wLRA and its generated biplots, it is possible to determine if the sites were situated in similar environments and, if not, how they were different.
The third question, were the sites placed to optimize agricultural production, will be answered by analyzing the distribution of the arable soils and their distance to the Oneota sites. The fourth question is: what is the nature of Oneota settlement pattern near Lake Koshkonong? To answer this question, the variation is locations, especially in reference to environmental zones and bodies of water will be determined. From this, the overall pattern will be inferred and described in detail.
CHAPTER THREE

THE STUDY SITES

All four of the study sites are located in Town 5 north, Range 13 east in Jefferson County, Wisconsin. These are not the only Oneota sites within the region; however, each of the sites has been extensively surveyed, and three of the sites have subjected to excavation. After assessing the Archaeological Site Inventory, it was determined that these four sites were the only ones in the region that 1) had enough data collected to allow for comparisons, and 2) were substantial enough to be considered village sites and included in the survey. Crab Apple Point is the only other possibility; however, little is known of the Oneota occupation, and not enough is known about the site to differentiate its multiple components as would be necessary before including in the study (Division of Historic Preservation 2003; Richards and Jeske 2002:43). The following is a brief summary of the sites, their locations (Figure 5), histories, and interpretations.

The Crescent Bay Hunt Club Site (47JE904):

The Crescent Bay Hunt Club site is located in the southwest quarter of the northeast quarter of Section 19, Town 5 north, Range 13 east (Figure 6). It is situated atop a ridge that rises eight meters above wetlands located east of the site, and is roughly 180 meters west of the current shoreline of Lake Koshkonong. It is situated atop a ridge that rises eight meters above wetlands located east of the site, and is roughly 180 meters west of the current shoreline of Lake Koshkonong (Hanson 1996; Jeske, Hunter et al. 2003). It is possible that the site was first reported by Stout and Skavlem (1908), though it is not clear if they are referring to the Crescent Bay site, Schmeling to the north, or
Figure 5. Map of Case Sites within Study Area.
Figure 6. Location of the Crescent Bay Hunt Club site (47JE904).
material immediately south of site’s location (Jeske 2000a). The site was first excavated in 1968 by the University of Wisconsin-Madison under the direction of David Baerris (Gibbon n.d.). No additional work was done at the site for nearly thirty years, until 1995 when the Southeast Wisconsin Archaeological Project at the University of Wisconsin-Milwaukee conducted a survey of the property (Hanson 1996). In 1998, UW-Milwaukee returned to work at the site as the focus of its bi-annual field school under the direction of Robert J. Jeske. The UW-Milwaukee field school has returned to the site every other year since 1998 for a total of six field seasons to date (Hanson 1996; Jeske, Hunter et al. 2003).

The 1968 excavations uncovered ceramic sherds, including vessels that can be described as Carcajou Curvilinear, Carcajou Plain, Grand River Trailed, or Grand River plain. A variety of lithics including scrapers, ground stone tools, and triangular points were recovered as well. In addition to the artifacts, many Oneota features were uncovered including over 180 postholes of a wigwam style house (Gibbon n.d.). Since 1998, the University of Wisconsin has conducted an extensive subsurface investigation of the site including numerous shovel probes and test pits. As a result, the students uncovered dozens of features including an additional wigwam style house as well as what is currently being interpreted as an Oneota longhouse (Hunter et al. 2003; Mollet and Jeske 2001; Moss 2008, 2010). Ceramics recovered during the UW-Milwaukee excavations are from the Emergent, Developmental, and Classic Horizons and also include Fisher wares from Illinois which may suggest a southern connection (Jeske 2001, 2003a, n.d.). Human remains were recovered at Crescent Bay in a variety of contexts including refuse pits. There does not appear to be a separate or formal cemetery at the
site. All burials found at Crescent Bay have been found within the habitation area (Foley Winkler and Jeske 2003). Recent spatial analyses place several burials within the boundaries of the longhouses and Moss (2010) argues that at least two burials were placed under the floor of the structure.

Based on the recent excavations (Figure 7), the Crescent Bay Hunt Club site is interpreted as an Oneota village site that dates primarily between A.D. 1200-1400 (Jeske 2008). It is clear that several of the houses were rebuilt at least once; evidenced by the number of postholes around the wigwams and the overlapping wall trenches in the longhouse. While it is not clear how long the site was occupied, given the number of structures rebuilt it is likely that the site was occupied for several years, abandoned for some time and then reoccupied. This pattern would likely have been occurred multiple times during the site occupation (Moss 2010).

Although only a limited number of features have been examined for floral or faunal analyses at this time, it appears that the subsistence pattern used at the Crescent Bay Hunt Club is very similar to the general Oneota subsistence pattern discussed above. After examining the floral remains, Olsen (2003:164) determined that the residents of the site were exploiting more than 35 taxa of plants which included both “indigenous seeds and exotic cultivars [Zea mays, Chenopodium].” According to Hunter (2002:84), over half of the faunal remains recovered from Crescent Bay were fish (Table 2). Mammals were the next most common remains, followed by bird, and then reptile. Both faunal and floral data indicate a heavy emphasis on wetland resources, along with upland game (elk, bison) and corn. The site was optimally placed to exploit the variety of resources surrounding the site (Jeske, Foley Winkler et al. 2003).
Figure 7. Locations of Positive Shovel Probes and Excavation Units (adapted from Moss 2008).
## Table 2. (adapted from Hunter 2002:84).

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>1101</td>
<td>56</td>
</tr>
<tr>
<td>Mammals</td>
<td>355</td>
<td>18</td>
</tr>
<tr>
<td>Bird</td>
<td>274</td>
<td>14</td>
</tr>
<tr>
<td>Reptile</td>
<td>232</td>
<td>12</td>
</tr>
<tr>
<td>Mussel</td>
<td>17</td>
<td>0.01</td>
</tr>
<tr>
<td>Total</td>
<td>1979</td>
<td>100</td>
</tr>
</tbody>
</table>

The data indicate occupation of Crescent Bay Hunt Club from at least spring through fall and the possibility a winter occupation is not unreasonable. However, it is notoriously difficult to establish a winter occupation based on subsistence data alone so a winter occupation is currently a tentative interpretation (c.f. Hunter 2002; Jeske n.d.; Jeske, Foley Winkler et al. 2003; Olsen 2003). The presence of a longhouse in conjunction with wigwam styles houses does lend credence to the argument of a winter occupation. It is possible that each house type represents a different season of occupation, though currently the radiocarbon data are not refined enough to establish conclusively if both house types were utilized concurrently or sequentially (Moss 2010).

### Environmental Zones

Based on the vegetation model developed for this thesis, the Crescent Bay Hunt Club was situated within an oak savanna, but overlooks a large wetland to the east that separates the site from the shore of Lake Koshkonong. The lakeshore was located east of the site and extended to the south and southwest. The oak savanna expands to the west, north and south of the site, with prairie emerging approximately one kilometer to the west. Small patches of prairie are also scattered throughout the site’s catchment.

Within one kilometer of the site, oak savannas are clearly the most prominent environmental zone near the site, accounting for roughly 60 percent of the catchment. Wetland and prairie are the two next most numerous environmental zones, accounting for
19 and 15 percent respectively. Lake Koshkonong accounts for less than 10 percent of the total one-kilometer catchment for the Crescent Bay Hunt Club. Within two kilometers, oak savanna and prairie maintain relatively similar proportions; however, wetlands become less prominent, only five percent, and the lake occupies nearly a quarter of the larger catchment. Koshkonong creek is also present in the two-kilometer catchment though it only accounts for roughly one percent of the area (Table 3 and Figure 8).

<table>
<thead>
<tr>
<th>Table 3. Environmental Zones within Crescent Bay Hunt Club Catchments.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crescent Bay Hunt Club</td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>1 km - Total Area (m²)</td>
</tr>
<tr>
<td>1 km - Proportion</td>
</tr>
<tr>
<td>2 km - Total Area (m²)</td>
</tr>
<tr>
<td>2 km - Proportion</td>
</tr>
</tbody>
</table>

*Ecotones*  The Crescent Bay Hunt Club was situated in a complicated environment near multiple ecotones (Figure 9). To the west of the site, the primary ecotone was defined by the boundary between the prairie and savannas. To the south and east, a series of complex environmental boundaries formed a series of ecotones composed of prairie, wetland, savanna, and lake environments. As noted above, the western prairie/savanna ecotone was likely relatively limited productivity during the warm months compared to this southern and eastern ecotonal region. The interaction of savanna, prairie, and wet habitats would have attracted a variety of plants and animals, and is centered over the large wetland to the east of the site which is highly productive in its own right.

Overall, the ecotonal composition was relatively similar at the one and two kilometer levels (Table 4). Within one kilometer, ecotones account for 72 percent of the total catchment area and 61 percent of the two-kilometer. The majority of the difference
Figure 8. Map of Environmental Zones around Crescent Bay Hunt Club.
Figure 9. Map of Ecotones near Crescent Bay Hunt Club.
can be accounted for by the large homogeneous savannas to the north and northwest of the site within the two-kilometer catchment. The two ecotones that exhibited the largest change were the water/savanna and wetland/prairie/savanna ecotones. The water/savanna ecotone accounts for less than one percent of the one-kilometer catchment; however, the extended shoreline within the two-kilometer catchment increases the ecotone to 14 percent of the two-kilometer catchment. The wetland/prairie/savanna ecotone (i.e., an

<table>
<thead>
<tr>
<th>Crescent Bay Hunt Club</th>
<th>Water/Wetland</th>
<th>Water/Prairie</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>163,642</td>
<td>0</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>243,942</td>
<td>201</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.02</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water/Savanna</th>
<th>Wetland/Prairie</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>699</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>1,734,027</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wetland/Savanna</th>
<th>Prairie/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>90742</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.03</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>685847</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water/Wetland/Prairie</th>
<th>Water/Wetland/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>30,618</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.01</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>39,648</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water/Prairie/Savanna</th>
<th>Wetland/Prairie/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>56,222</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.02</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>307,669</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.02</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water/Wetland/Prairie/Savanna</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>259,749</td>
</tr>
<tr>
<td>1 km - Prop of total Catchment</td>
<td>0.08</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>275,855</td>
</tr>
<tr>
<td>2 km - Prop of Catchment</td>
<td>0.02</td>
</tr>
</tbody>
</table>
area that is near the boundary of each of the three environmental zones) composes more than 20 percent of the one-kilometer catchment. Due to the localized nature of the wetland, there is little increase in the total area occupied by this ecotone within the two-kilometer catchment and therefore only accounts for six percent of the larger catchment.

*Agricultural Potential* The Crescent Bay Hunt Club site was situated near a significant amount of arable land. Based on the environmental and soil data, the site was situated on nearly 150 hectares of arable land, which accounts for almost half of the one-kilometer catchment (Table 5 and Figure 10). Within two kilometers, that amount nearly triples to more than 425 hectares and accounts for 34 percent of the catchment.

<table>
<thead>
<tr>
<th>Table 5. Arable Land within the Crescent Bay Hunt Club Catchments.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crescent Bay Hunt</td>
</tr>
<tr>
<td>1 km - Total Area (m²)</td>
</tr>
<tr>
<td>1 km - Proportion</td>
</tr>
<tr>
<td>2 km - Total Area (m²)</td>
</tr>
<tr>
<td>2 km - Proportion</td>
</tr>
</tbody>
</table>
Figure 10. Map of Agricultural potential near Crescent Bay Hunt Club.
The Schmeling Site (47JE833):

The Schmeling site currently overlooks Lake Koshkonong and is located in the southwest quarter of the northeast quarter of Section 19 Town 5 north Range 13 east (Figure 11). Initially recorded by the University of Wisconsin-Milwaukee as part of a regional survey in 1987, the Schmeling site is located north of the Crescent Bay Hunt Club site on the same ridge. A draw, which runs from the northwest to the southeast, separates the two sites. The original description of the site listed it as having a Late Woodland and an Oneota occupation. In the summer of 2006 the UW Milwaukee field school conducted an intensive pedestrian survey of the farm fields just west of the ridge. The field school also conducted a shovel probe survey, at 10-meter intervals, of the woods to the north, east, and south of the farm field. The pedestrian survey defined two major scatter areas and two artifact concentrations (Figure 12). Over thirty of the shovel probes yielded artifacts. Four two meter by two meter excavation units were placed near the densest concentration of positive shovel probes. Four additional excavation units and surface collection were conducted during the next field school in 2008 (Foley Winkler 2008).

Based on the artifacts collected, it is clear that Schmeling is a multi-component site. The earliest occupants appear to be members of the Paleo-Indian tradition; while the latest occupants were from the historic period. The Paleo-Indian occupation appears to be concentrated in the southwest portion of the site, while the historic occupation was located in the northeast (Foley Winkler 2008; Jeske and Winkler 2008). The majority of artifacts however indicate that the most substantial component of the site is an Oneota occupation. The conclusion is supported by the abundance of Grand River and Carcajou
Figure 11. Map of the Schmeling Site’s Location.
Figure 12. Map of Archaeological Investigations at Schmeling (adapted from Edwards IV 2008).
ceramic wares found at the site. Additionally a single calibrated radiocarbon date of A.D. 1220-1270 (two-sigma) indicates a contemporaneous occupation with Crescent Bay (Foley Winkler 2008).

The degree to which the Schmeling and Crescent Bay sites are associated is currently unknown. A preliminary examination of the faunal remains recovered from the site indicates that, like Crescent Bay, the Oneota occupants were exploiting a variety of resources with an emphasis on wetland fauna; Table 6 contains the counts from the preliminary analysis (McCarthy and Matenaer n.d.). To date no floral analysis has been conducted. Refuse pits at both sites exhibit similar deposition patterns. From on the current level of excavation it appears that Schmeling may have a separate cemetery in contrast to Crescent Bay (Foley Winkler 2008). Based on the current data, it is unclear if Crescent Bay and Schmeling were occupied sequentially or contemporaneously. Regardless of its association, based on the artifact density, Schmeling is clearly a substantial habitation site. There are no data to suggest that the seasonality or length of occupation differs significantly from the Crescent Bay Hunt Club (c.f. Foley Winkler 2008).

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>199</td>
<td>35</td>
</tr>
<tr>
<td>Mammal</td>
<td>162</td>
<td>29</td>
</tr>
<tr>
<td>Bird</td>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>Mollusk</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Reptile</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>UNID</td>
<td>171</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>569</td>
<td>100</td>
</tr>
</tbody>
</table>

*Environmental Zones* Based on the vegetation model, Crescent Bay and Schmeling were located in superficially similar environmental settings. To the west of
the site was prairie, and to the south and east was wetland and lake. Oak savannas accounted for over 60 percent of both Schmeling’s catchments (Figure 13). Like Crescent Bay, wetland accounted for a much larger proportion of the one-kilometer catchment (nearly one-fifth), than the two-kilometer (one twentieth). Interestingly, despite the fact that the two sites are adjacent to each other, their relationship to Lake Koshkonong is different. Schmeling’s spatial relationship to the lake was the inverse of Crescent Bay’s; it accounted for nearly one-fifth of the two-kilometer catchment, but less than one percent of the smaller analysis unit. Prairies accounted for a substantial portion of both catchments, and Koshkonong Creek, a minor portion of the two-kilometer catchment, was not present within one kilometer (Table 7).

Table 7. Environmental Zones within Schmeling Catchments.

<table>
<thead>
<tr>
<th>Schmeling</th>
<th>Savanna</th>
<th>Prairie</th>
<th>Wetland</th>
<th>Lake</th>
<th>Creek</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Total Area</td>
<td>2,099,086</td>
<td>480,868</td>
<td>547,605</td>
<td>12,561</td>
<td>0</td>
<td>3,140,119</td>
</tr>
<tr>
<td>1 km - Proportion</td>
<td>0.67</td>
<td>0.15</td>
<td>0.17</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2 km - Total Area</td>
<td>8,168,570</td>
<td>1,426,957</td>
<td>666,248</td>
<td>2,192,631</td>
<td>105,982</td>
<td>12,560,389</td>
</tr>
<tr>
<td>2 km - Proportion</td>
<td>0.65</td>
<td>0.11</td>
<td>0.05</td>
<td>0.17</td>
<td>0.01</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Ecotones** Like Crescent Bay, ecotones accounted for a significant portion of both Schmeling’s catchments. Within one kilometer, 68 percent of the area was occupied by an ecotone of some type; within two kilometers, it dropped to 63 percent (Table 8). The most substantial ecotone at either one or two kilometers was the prairie savanna that is primarily to the west of the site, but is also present in lesser amounts to the east and south. The wetland/prairie/savanna ecotone was common within one kilometer. Within two kilometers, the water/savanna ecotone accounted for 13 percent of the total area. The remainder of the ecotones accounted for small portions of the total catchments. The majority of the ecotones are to the east and south of the site near the lakeshore. To the
Figure 13. Map of Environmental Zones around Schmeling.
north of the site, the majority of the land is occupied by savanna and therefore few
ecotones. The prairie and savanna boundary create the only ecotone to the west of the
site. Overall, the ecotonal geographic composition of the catchments is very similar to
those found at the Crescent Bay Hunt Club (Figure 14).

Table 8. Ecotones within the Schmeling Catchments.

<table>
<thead>
<tr>
<th>Schmeling</th>
<th>Water/Wetland</th>
<th>Water/Prairie</th>
<th>Water/Savanna</th>
<th>Wetland/Prairie</th>
<th>Wetland/Savanna</th>
<th>Prairie/Savanna</th>
<th>Water/Wetland/Prairie</th>
<th>Water/Wetland/Savanna</th>
<th>Water/Prairie/Savanna</th>
<th>Wetland/Prairie/Savanna</th>
<th>Water/Wetland/Prairie/Savanna</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>71,209</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8,513</td>
<td>20,782</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>0.04</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>226,587</td>
<td>199</td>
<td>1,630,632</td>
<td>10,403</td>
<td>735,751</td>
<td>3,244,837</td>
<td>394,592</td>
<td>701,796</td>
<td>0.13</td>
<td>0.21</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>133,364</td>
<td>1,060,983</td>
<td>10,403</td>
<td>0.04</td>
<td>0.34</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>735,751</td>
<td>3,244,837</td>
<td>10,403</td>
<td>0.05</td>
<td>0.26</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.13</td>
<td>0.21</td>
<td>0.00</td>
<td>0.04</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>161,081</td>
<td>2,142,014</td>
<td>161,081</td>
<td>2,142,014</td>
<td>161,081</td>
<td>2,142,014</td>
<td>161,081</td>
<td>2,142,014</td>
<td>161,081</td>
<td>2,142,014</td>
<td>161,081</td>
<td>2,142,014</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.05</td>
<td>0.68</td>
<td>0.05</td>
<td>0.68</td>
<td>0.05</td>
<td>0.68</td>
<td>0.05</td>
<td>0.68</td>
<td>0.05</td>
<td>0.68</td>
<td>0.05</td>
<td>0.68</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>339,816</td>
<td>7,878,954</td>
<td>339,816</td>
<td>7,878,954</td>
<td>339,816</td>
<td>7,878,954</td>
<td>339,816</td>
<td>7,878,954</td>
<td>339,816</td>
<td>7,878,954</td>
<td>339,816</td>
<td>7,878,954</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.03</td>
<td>0.63</td>
<td>0.03</td>
<td>0.63</td>
<td>0.03</td>
<td>0.63</td>
<td>0.03</td>
<td>0.63</td>
<td>0.03</td>
<td>0.63</td>
<td>0.03</td>
<td>0.63</td>
</tr>
</tbody>
</table>
Figure 14. Map of Ecotones near Schmeling.
Agricultural Potential  Arable land accounted for nearly half of the land within one kilometer of the Schmeling site. Within two kilometers, the arable lands dropped to roughly one-third of the catchment. In total, there was over 141 hectares of arable land within one kilometer of the site and greater than 460 hectares within two kilometers (Table 9). The majority of the arable land within one kilometer of the site was directly west and southwest; however, within two kilometers it could be found to the north as well (Figure 15).

Table 9. Arable Land within the Schmeling Catchments.

<table>
<thead>
<tr>
<th>Schmeling</th>
<th>Good</th>
<th>Fair</th>
<th>Total Arable</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Total Area (m²)</td>
<td>658,731</td>
<td>752,764</td>
<td>1,411,495</td>
<td>1,728,626</td>
</tr>
<tr>
<td>1 km - Proportion</td>
<td>0.21</td>
<td>0.24</td>
<td>0.45</td>
<td>0.55</td>
</tr>
<tr>
<td>2 km - Total Area (m²)</td>
<td>2,118,656</td>
<td>2,552,143</td>
<td>4,670,798</td>
<td>7,889,683</td>
</tr>
<tr>
<td>2 km - Proportion</td>
<td>0.17</td>
<td>0.20</td>
<td>0.37</td>
<td>0.63</td>
</tr>
</tbody>
</table>
Figure 15. Map of Agricultural potential near Schmeling.
The Twin Knolls Site (47JE379)

The Twin Knolls site is located in the southeast quarter of Section 7 of Town 5 north, Range 13 east and is situated just south of (less than 40 meters) an oxbow in Koshkonong Creek. The site is currently situated within a modern farm field on a knoll that rises approximately 30 meters above the creek (Figure 16).

Twin Knolls was first recorded by Stout and Skavlem (1908:95-96) during their survey of the Lake Koshkonong region. In the 1908 issue of the *Wisconsin Archeologist*, the site was listed as the Koshkonong Creek Village Site. They encountered several dense artifact scatters that they inferred were the remnants of refuse pits. Additionally they encountered points, axes, and celts, in addition to the skeletal remains of two individuals that had been brought to the surface by the plow.

The site was again surveyed as part of the Lake Koshkonong Survey which was conducted by the University of Wisconsin-Milwaukee from 1983 until 1986 (Musil 1987:123). Based on the ratio of grit tempered to shell tempered ceramics, Musil determined that the site was primarily of Oneota origin. A total of three artifact concentrations were encountered. The first was located in the center of the site and contained over 1,400 sherds of ceramics (nearly 70% of those recovered), as well as a copper awl and greater than 70 percent of formal lithic tools. Concentration two is located at the southern edge of the site; it was mainly composed of faunal remains within a dense greasy black soil. Musil posited that this concentration could be evidence of a house or a midden feature. The third concentration was located in the northeastern
Figure 16. Map of the Twin Knolls Site’s Location.
portion of the site. Like concentration one, there was a large number of ceramic and lithic artifacts recovered, including nearly 20% of the triangular points recovered from the site. Musil does not explicitly hypothesize about function of the site, but given the size of the site, the density of the artifacts, and her hypothesis that concentration two is possible evidence of a house, one can infer that she interpreted Twin Knolls as a village site (Musil 1987:144).

Musil (1987:144-145) also identifies two other sites that are extremely close to the Twin Knolls site. The sites are BU-59 and BU-63 (field numbers), to the northwest and north east of Twin Knolls respectively. Musil suspects that future fieldwork may show that all three sites are actually separate parts of a single site. Each site has since been given a formal site number. Site BU-59, the Marsden North site is 47JE854; BU-63, the Weisensell Site is 47JE855 (Division of Historic Preservation 2003).

The University of Wisconsin-Milwaukee returned to the site in 2008 (Cowell et al. 2008). A pedestrian survey was conducted at the site and additional ceramics, lithics, and faunal remains were recovered. Based on artifact scatters, the site boundaries were expanded in all directions. The majority of artifacts recovered were ceramics, 95 percent of which was shell tempered. Madison wares, Grand River Trailed, Carcajou Plain, Carcajou Curvilinear, Carcajou, Busseyville, and Allamakee Trailed vessels were all found at the site. The site also yielded a variety of formal lithic tool types anddebitage. The majority of hafted-bifaces at the site were simple triangular, though a small number of corner notched points, and the base of a Paleo-Indian point were also recovered. Faunal remains were also collected but have not been analyzed. Since no shovel probes or excavations have been conducted at the site, no features have been found (Cowell et al.
2008). Despite this, the size and density of the artifact scatter are strong indicators that this site was once a sizable habitation site, quite possibly a village (Figure 17).

Given the significant presence of Oneota artifacts, one might expect that the inhabitants practiced similar subsistence patterns seen at nearby Oneota sites. However, since Twin Knolls is located away from the lake and it is not clear exactly how its location would have affected the subsistence patterns of the site’s inhabitants. There are currently not enough data to determine the seasonality or length of occupation of the site. Further work, most notably excavations, faunal, and floral analyses are necessary in order to determine the actual nature of the site.

*Environmental Zones* Unlike the other sites, Twin Knolls was situated away from the lake, near Koshkonong Creek. Lake Koshkonong does not appear in either the one or two kilometer catchment boundaries. The site was most closely affiliated with savannas, which composed the entirety of the site’s boundaries and accounted for greater than 80 percent of either catchment. The creek itself accounted for two percent of the catchments while prairie and wetland account for the remainder. Sporadic wetlands could be found within one kilometer of the site to the east and northwest. Likewise, patches of prairie could be found dispersed throughout the one-kilometer catchment of the site. Within one kilometer, neither prairie nor wetlands encompassed a significant portion of land; however, within two kilometers, the wetlands accounted for over 12 percent of the catchment. They were located along the creek shore as well as to the north and northeast of the site (Figure 18 and Table 10).
Figure 17. Map of Archaeological Investigations at Twin Knolls (adapted from Cowell et al. 2008).
Figure 18. Map of Environmental Zones around Twin Knolls.
Table 10. Environmental Zones within Twin Knolls Catchments.

<table>
<thead>
<tr>
<th>Twin Knolls</th>
<th>Savanna</th>
<th>Prairie</th>
<th>Wetland</th>
<th>Lake</th>
<th>Creek</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Total Area</td>
<td>2,747,716</td>
<td>199,414</td>
<td>118,405</td>
<td>0</td>
<td>74,598</td>
<td>3,140,132</td>
</tr>
<tr>
<td>1 km - Proportion</td>
<td>0.88</td>
<td>0.06</td>
<td>0.04</td>
<td>0.00</td>
<td>0.02</td>
<td>1.00</td>
</tr>
<tr>
<td>2 km - Total Area</td>
<td>10,488,508</td>
<td>310,649</td>
<td>1,469,804</td>
<td>0</td>
<td>290,070</td>
<td>12,559,033</td>
</tr>
<tr>
<td>2 km - Proportion</td>
<td>0.84</td>
<td>0.02</td>
<td>0.12</td>
<td>0.00</td>
<td>0.02</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Ecotones  Twin Knolls was situated within an extremely diverse environment. While savanna may have been nearly ubiquitous around the site, the creek and small patches of wetland and prairie create an extremely complicated environment. The winding nature of Koshkonong Creek (Figure 19) elongated the transitional boundaries between environmental zones. The site itself was placed directly within four different ecozones, and is surrounded on three sides by a variety of ecotones. Ecotones occupy 74 percent of the one-kilometer catchment, and 71 percent of the two-kilometer catchment.

The water/wetland/prairie/savanna, water/wetland/savanna, and wetland/savanna ecotones are the largest within one kilometer of the site. However, within two kilometers, the wetland/savanna and water/wetland/savanna ecotones become the largest, accounting for 40 percent of the total catchment (Table 11).

Agricultural Potential  The Twin Knolls site was placed near a large amount of arable land. In the one-kilometer catchment, the majority extended to the south and west of the site. Within two kilometers, it continued to the south and west, but was also present in large quantities to the north, across Koshkonong Creek (Figure 20). Approximately 213 hectares (circa 70%) of the land within one kilometer of the Twin Knolls site was arable. Expanding the model to two kilometers more than doubles the arable land, totaling over 733 hectares (60%) of the larger catchment (Table 12).
Figure 19. Map of Ecotones near Twin Knolls.
Table 11. Ecotones within the Twin Knolls Catchments.

<table>
<thead>
<tr>
<th></th>
<th>Water/Wetland</th>
<th>Water/Prairie</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water/Savanna</th>
<th>Wetland/Prairie</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>313,785</td>
<td>0</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.10</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>814,405</td>
<td>0</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.06</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Wetland/Savanna</th>
<th>Prairie/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>218,730</td>
<td>479,604</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.07</td>
<td>0.15</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>3,119,603</td>
<td>911,210</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.25</td>
<td>0.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water/Wetland/Prairie</th>
<th>Water/Wetland/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>0</td>
<td>248,729</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.00</td>
<td>0.08</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>0</td>
<td>1,844,493</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.00</td>
<td>0.15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water/Prairie/Savanna</th>
<th>Wetland/Prairie/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>292,450</td>
<td>334,703</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.09</td>
<td>0.11</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>497,942</td>
<td>657,542</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.04</td>
<td>0.05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water/Wetland/Prairie/Savanna</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>451,359</td>
<td>2,339,360</td>
</tr>
<tr>
<td>1 km - Prop of total Catchment</td>
<td>0.14</td>
<td>0.74</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>1,029,228</td>
<td>8,874,423</td>
</tr>
<tr>
<td>2 km - Prop of Catchment</td>
<td>0.08</td>
<td>0.71</td>
</tr>
</tbody>
</table>
Figure 20. Map of Agricultural potential near Twin Knolls.

Table 12. Arable Land within the Twin Knolls Catchments.

<table>
<thead>
<tr>
<th>Twin Knolls</th>
<th>Good</th>
<th>Fair</th>
<th>Total Arable</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Total Area (m²)</td>
<td>1,169,905</td>
<td>963,659</td>
<td>2,133,564</td>
<td>1,006,569</td>
</tr>
<tr>
<td>1 km - Proportion</td>
<td>0.37</td>
<td>0.31</td>
<td>0.68</td>
<td>0.32</td>
</tr>
<tr>
<td>2 km - Total Area (m²)</td>
<td>3,406,921</td>
<td>3,926,079</td>
<td>7,333,000</td>
<td>5,227,530</td>
</tr>
<tr>
<td>2 km - Proportion</td>
<td>0.27</td>
<td>0.31</td>
<td>0.58</td>
<td>0.42</td>
</tr>
</tbody>
</table>
The Carcajou Point Site (47JE002)

The Carcajou Point site has a long history of archaeological investigations; only a summary of some of the major or important investigations are presented here. The first mention of the site appears in the General Land Office Survey notes. It is listed as the site of a historic Indian village between Sections 16 and 21 (Brink 1835). The historic component of the village is known as White Crow’s Village. Stout and Skavlem (1908) describe it as “one of the largest village sites of which we have present knowledge of in southern Wisconsin.” They report that the site was situated on high, level ground and extended a half mile west of the shore and was nearly a mile long, north to south. Stout and Skavlem found a large number of historic trade goods in addition to several small mounds. After speaking to the people that had grown up on and farmed the property, they found that the area had a large number of burials and was probably the site of a cemetery. They also found several refuse pits which they excavated. The pits contained a variety of faunal remains including deer, bird, fish, mussel, and turtle (Stout and Skavlem 1908:89-93).

The Carcajou Point site is actually made up of four separate sites (Division of Historic Preservation 2003). The original, 47JE002, was originally excavated by Robert Hall from 1957-1959. During his first field-season, Hall was able to definitively determine that the site had both historic and prehistoric components. Hall ceased referring to the site as White Crow’s Village to reflect the prehistoric nature of the site, and not just its Winnebago (now Ho Chunk) heritage (Hall 1962:7-11).

While excavating the site, Hall uncovered multiple burials, ceramic potsherds, faunal remains, mussel shell, stone tools, chertdebitage, and charcoal. Features
uncovered include wall trenches, what Hall describes as beaker and basin-shaped pits, and postholes. Excavations uncovered evidence two to three types of house structures including wigwams, semi-subterranean houses, and a rectangular house (Hall 1962).

Starting in 1983, the University of Wisconsin-Milwaukee expanded its survey of the Crawfish and Rock River valleys to include a survey of the Carcajou Point site and the surrounding region. In addition to the area excavated by Hall, the survey identified three other areas that were later given the designation 47JE812, 47JE813, and 47JE814. In total, the survey collected nearly 100 stone tools, greater than 1,000 pieces of debitage, and more than 300 ceramic sherds. All four areas of the Carcajou Point site were classified as Oneota based on an analysis of the artifacts recovered; however, there was also evidence of a Woodland occupation. Based on artifact densities and distributions, it appears that the bulk of the Oneota occupation occurred in the southern portion of the site (c.f. Je2 and Bu6 in Figure 18, Rodell 1984:145) Figure 21 shows the boundaries of the four Carcajou Point sites. While there were gaps between the sites in the survey, Rodell argues that it is most likely due to disturbance, past collectors, and survey conditions. Two other Oneota sites in Section 17, Town 5 north, Range 15 east were surveyed. The sites were the Hearthstone (47JE089) and Purnell (47JE815) sites, of which little is known (Musil 1987; Rodell 1984).
Figure 21. Map of the Carcajou Point Site’s Location.
In 1989 and 1990 UWM conducted archaeological investigations at the eastern and extreme western edge of the site. In total 23 features were uncovered, many of which contained shell-tempered ceramics. Far more shell-tempered ceramics were recovered from the Figliuzzi property in the west, and the northern portion of the Kelly property in east half of the site. While both study areas were multi-component, each had a significant Oneota component, most likely part of a substantial habitation site (Brubaker and Goldstein 1991).

In 1997, the State Historical Society of Wisconsin determined that Wisconsin Electric and Power Company could place a natural gas pipeline and approximately 80 2x2 meter bell-holes across the site with no adverse affect. As Region 9 archaeologist for the now-defunct Wisconsin State Regional Archaeology Program, Robert Jeske monitored the placement of the pipeline and called a halt to excavation activities immediately after human remains, lithics, ceramics, and other cultural materials were pulled up by the pipeline excavations (Gaff 1998).

A cultural resource management firm, Historic Resource Management Services (HRMS) returned to Carcajou Point as part of a contract with Wisconsin Energies to monitor and mitigate adverse affects by the of bell holes, backhoe trenches, and slit trenches necessary for the installation of new gas mains. Archaeological investigations were limited to the southern portion of the site, similar to the area that Hall worked in roughly 40 years prior (Richards et al. 1998). Over eighteen features were uncovered in addition to thousands of artifacts. Nearly 2,000 formal stone tools, more than 3,000 ceramic sherds, and more than 1,100 fragments of faunal remains. Radiocarbon dates place the site between A.D. 1015 and 1300. Ceramic and feature analyses identified the
Oneota artifacts indicating the Oneota site occupants were the primary inhabitants of Carcajou Point though there was also evidence of a small Woodland population. Lithic analysis also indicated late prehistoric occupations; the presence of lanceolate and side notched points indicates there were earlier components as well. Oneota subsistence data can be inferred from two pits securely dated to the Oneota time period (Table 13). Overall, the features exemplify a substance pattern that indicates the typical Oneota mixed economy with an emphasis on fish and mammals, primarily deer (Richards et al. 1998).

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Feature 8</th>
<th>Feature 9</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>97</td>
<td>159</td>
<td>256</td>
</tr>
<tr>
<td>Mammal</td>
<td>43</td>
<td>17</td>
<td>60</td>
</tr>
<tr>
<td>Bird</td>
<td>3</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td>Reptile</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>UNID</td>
<td>255</td>
<td>43</td>
<td>298</td>
</tr>
<tr>
<td>Total</td>
<td>387</td>
<td>235</td>
<td>633</td>
</tr>
</tbody>
</table>

In 2002, UW-Milwaukee placed exploratory shovel probes, a one-meter by two-meter test unit, a one-meter-by-one-meter test unit, and two block excavations located in the northeast corner of the site, just to the east of the 1983 survey tract in an area, referred to as the Kelly North Tract (Jeske, Hunter et al. 2003). Based on radiocarbon dates and artifact analysis, the main occupation of the Kelly North Tract was not Oneota but Woodland and Archaic. Combining this information with Rodell’s, it appears that the majority of the Oneota occupation was in the southern portion of the site.

Overall, the site has been interpreted as a large multi-component site that includes significant Paleoindian, Archaic, and Late Woodland occupations, a very large Oneota village, and an historic Ho Chunk village. Several archaeologists have postulated the
nature of the Oneota component of the site (e.g., Hall 1962; Overstreet 1976: etc.).

Overstreet (1976, 1978) argued that the site was likely occupied year around, exploited the typical Oneota set of resources, including wetland, upland game, and corn. Based on the small amount of faunal data (c.f. Overstreet 1976; Richards et al. 1998), there is no reason to discount this argument. Like Crescent Bay, and for similar reasons, the evidence for a winter occupation is weak. However, similarly to the longhouse at Crescent Bay, the semi-subterranean pit houses and the rectangular house (c.f. Hall 1962) was probably more substantial structures than the wigwams. It is possible that they may indicate a winter occupation of the site.

*Environmental Zones* The Carcajou Point site was located within an oak savanna along the shore of Lake Koshkonong. The site was also situated between two wetlands, one to the northeast, and one to the southwest (Figure 22). Near the northwest edge of the two-kilometer catchment was the edge of another wetland that extended further west, beyond the catchment border. Koshkonong Creek flowed into the lake west of the site.

Unlike the other sites in this study, only minimal amounts of prairie grew within both catchments. Savanna and lake environmental zones were the most abundant near the site. Together they composed over 90% of the one and two-kilometer catchments. The remainder of the catchments was mainly composed of wetlands (Table 14).

<table>
<thead>
<tr>
<th>Carcajou Point</th>
<th>Savanna</th>
<th>Prairie</th>
<th>Wetland</th>
<th>Lake</th>
<th>Creek</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Total Area (m²)</td>
<td>1,653,512</td>
<td>5,241</td>
<td>215,475</td>
<td>1,266,007</td>
<td>0</td>
<td>3,140,235</td>
</tr>
<tr>
<td>1 km - Proportion</td>
<td>0.53</td>
<td>0.00</td>
<td>0.07</td>
<td>0.40</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2 km - Total Area (m²)</td>
<td>5,224,370</td>
<td>48,940</td>
<td>1,071,648</td>
<td>6,111,744</td>
<td>103,868</td>
<td>12,560,570</td>
</tr>
<tr>
<td>2 km - Proportion</td>
<td>0.42</td>
<td>0.00</td>
<td>0.09</td>
<td>0.49</td>
<td>0.01</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Figure 22. Map of Environmental Zones around Carcajou Point.
**Ecotones**  Relative to the other sites, Carcajou Point was placed in a simple environment with a small amount of ecotones. Within one kilometer of the site, ecotones barely occupy 50 percent of the land. Within two kilometers, ecotones only account for 44 percent of the land. The three largest ecotone types were closely related, water/savanna, wetland/savanna, and water/wetland/savanna (Table 15 and Figure 23).

Within one kilometer of the site, the majority of the ecotones are east and southwest of

<table>
<thead>
<tr>
<th>Carcajou Point</th>
<th>Water/Wetland</th>
<th>Water/Prairie</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>125,304</td>
<td>0</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.04</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>330,120</td>
<td>0</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.03</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water/Savanna</th>
<th>Wetland/Prairie</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>591,378</td>
<td>0</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.19</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>1,524,852</td>
<td>0</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.12</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Wetland/Savanna</th>
<th>Prairie/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>242,513</td>
<td>120,630</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.08</td>
<td>0.04</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>1,464,792</td>
<td>297,931</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.12</td>
<td>0.02</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water/Wetland/Prairie</th>
<th>Water/Wetland/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>0</td>
<td>474,450</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.00</td>
<td>0.15</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>0</td>
<td>1,598,421</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.00</td>
<td>0.13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water/Prairie/Savanna</th>
<th>Wetland/Prairie/Savanna</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>50,736</td>
<td>0</td>
</tr>
<tr>
<td>1 km - Proportion of Catchment</td>
<td>0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>254,176</td>
<td>86,286</td>
</tr>
<tr>
<td>2 km - Proportion of Catchment</td>
<td>0.02</td>
<td>0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Water/Wetland/Prairie/Savanna</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Area of Ecotones (m²)</td>
<td>0</td>
<td>1,605,010</td>
</tr>
<tr>
<td>1 km - Prop of total Catchment</td>
<td>0.00</td>
<td>0.51</td>
</tr>
<tr>
<td>2 km - Area of Ecotones (m²)</td>
<td>1,034</td>
<td>5,557,612</td>
</tr>
<tr>
<td>2 km - Prop of Catchment</td>
<td>0.00</td>
<td>0.44</td>
</tr>
</tbody>
</table>
Figure 23. Map of Ecotones near Carcajou Point.
the site, along the lakeshore and the bordering wetlands. At the two-kilometer level, this pattern holds true, with the addition of a large ecotone around Koshkonong Creek.

*Agricultural Potential* Carcajou Point was also not situated close to a similarly large amount of agriculturally viable land. Over 60% of the Carcajou Point catchments would not have been farmable by the inhabitants of Oneota sites, which is due, in large part to the large proportion of lake within the catchments (Table 16). While relatively less than the other sites, there was still over 100 hectares of arable land within one kilometer of the site and over 300 hectares within two kilometers. The majority of the arable land within the catchments was located north and northwest of the sites in the surrounding oak savannas (Figure 24).

<table>
<thead>
<tr>
<th>Carcajou Point</th>
<th>Good (m²)</th>
<th>Fair (m²)</th>
<th>Total Arable (m²)</th>
<th>Poor (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 km - Total Area</td>
<td>797,794</td>
<td>357,685</td>
<td>1,155,479</td>
<td>1,984,756</td>
</tr>
<tr>
<td>1 km - Proportion</td>
<td>0.25</td>
<td>0.11</td>
<td>0.37</td>
<td>0.63</td>
</tr>
<tr>
<td>2 km - Total Area</td>
<td>1,627,666</td>
<td>1,601,126</td>
<td>3,228,792</td>
<td>9,332,148</td>
</tr>
<tr>
<td>2 km - Proportion</td>
<td>0.13</td>
<td>0.13</td>
<td>0.26</td>
<td>0.74</td>
</tr>
</tbody>
</table>
Figure 24. Map of Agricultural potential near Carcajou Point.
CHAPTER FOUR

DISCUSSION

When combined with the preexisting data for Oneota settlement patterns and subsistence, the environmental data collected for this thesis pertaining to the known Oneota village settlements in the Lake Koshkonong Locality allows for a more in-depth examination and explanation of Oneota settlement patterns. This thesis was designed to answer five main research questions about the Oneota occupation within the region. The first question, what was the environmental setting of each known Oneota village, was discussed in the previous chapter in detail. This chapter will examine the data to answer the remaining research questions.

Question # 2: Were each of the sites situated in a similar environment?

To answer this question effectively, there are two aspects of the environment that must be looked at. First, it is necessary to examine the similarity of the environments by comparing the proportions of environmental zones within each of the sites’ catchments. Second, to better understand the nature of the environment and its economic potential, an examination of the ecotones within the study area needs to be conducted.

Environmental Zones  From a cursory examination of the relative proportions of the environmental zones at each of the four sites, it appears that there is a significant degree of variation among them (Figures 25 and 26). Twin Knolls had far more savanna than the other sites, and the lack of lake within both the one and two-kilometer catchments further separate the site from the others. Carcajou Point stands out for the dichotomous distribution of lake and savanna environments.
In order to determine if these differences are statistically significant a wLRA was conducted. According to the high Chi Square values of the wLRA are highly effective at
interpreting the varying proportions of environmental zones among the sites. At the one-kilometer level, the first dimension from the wLRA explains roughly 93 percent of the variation, and the second dimension explains nearly 7 percent. At the two-kilometer level, the first dimension explains over 98 percent of the variation and the second dimension explains over 2 percent. Figure 27 is a biplot of the catchments, a graphical representation of the results of the wLRA. The results of the biplot support the non-statistical conclusions drawn from Figures 25 and 26. Within the one-kilometer catchment of Crescent Bay Hunt Club, Schmeling, and Carcajou Point were situated in relatively similar environmental settings. However, Twin Knolls was located in a statistically different location than the other sites at both the one and two-kilometer catchment level. Unlike the other sites, Twin Knolls is not associated with Lake Koshkong and was the only site clearly associated with Koshkonong Creek. Within the two-kilometer catchment, Carcajou Point significantly differs from Crescent Bay and Schmeling (as well as Twin Knolls) due to its low proportion of prairie.

Figure 27. Biplot Results of wLRA for Environmental Zones.
Based on the distribution of sites among various environmental zones, proportions of various ecotones, and distances to important resources, it is clear that the sites were not placed in the same environments. Due to their close proximity, Crescent Bay and Schmeling were located in environments that were relatively similar to one another. Despite its relative proximity (approximately three kilometers), it does not appear that Twin Knolls was actually associated with Lake Koshkonong. Instead, the site was located along the creek edge, where its residents could exploit a wide diversity of resources that would be present due to the variety and amount of ecotones present near the site. Conversely, Carcajou Point was located right on the shore of Lake Koshkonong where its residents could exploit the rich resource base that the large body of water could provide. Given the environmental differences, it is likely that a detailed faunal and floral analysis of the sites would indicate subtle differences in the resources being exploited. For example, Twin Knolls’ residents may have exploited a higher degree of upland and riverine resources than the others, and Crescent Bay may have exploited a higher degree of lacusterine resources.

**Ecotones**  Based on the raw numbers, the sites appear to be placed in different locations in reference to ecotones (Figures 28 and 29). Compared to the other sites, ecotones within the Carcajou Point catchments accounted for the lowest proportion of total area. The ecotones that were present were primarily water/savanna and water/wetland/savanna. On the opposite end, Twin Knolls had the most total area covered by ecotones. The site also appears to have had the most heterogeneity of ecotones near the site. Schmeling and Crescent Bay appear to have a similar composition of ecotones, which were primarily wetland/prairie and prairie/savanna ecotones.
Figure 28: Ecotone proportions of 1 km Catchment.

Figure 29: Ecotone proportions of 2 km Catchment.
However, with eleven different ecotones, it is difficult to assess the similarity of the ecotonal composition of the sites. At present, there is no way to determine if one ecotone is more economically important than others.

At the two-kilometer level, the relative proportions appear to exhibit a similar situation. Carcajou Point had the least amount of ecotones, evenly split between three different ecotone types. Twin Knolls had the greatest amount, though the wetland/savanna ecotone appears to have been one of the largest within the catchment. These raw numbers also indicate that Schmeling and Crescent Bay had relatively similar amounts of the same ecotones.

The results of the wLRA clarified the ecotonal relationships among the sites and illuminated patterns that were otherwise not visible (Figures 30 and 31). At the one-kilometer level, the first dimension of the wLRA explained 49.84 percent of the variation, and the second explains 39.69 percent of the variation, totaling 89.53 percent of the variation. For the two-kilometer catchment, the first dimension explains 57.71 percent, and the second explains 31.37 percent, totaling 89.18 percent of the variation. The statistical comparisons indicate that there is more site variability than was indicated by the proportions or raw numbers. For example, despite the difference in raw counts, Twin Knolls and Carcajou Point have relatively similar ecotonal compositions. However, there are statistically significant differences among the sites; at one kilometer, Crescent Bay is statistically different from the other sites and at two kilometers, Schmeling is different.
Figure 30. Biplot of Ecotonal Data (1 kilometer).

Figure 31. Biplot of Ecotonal Data (2 kilometer).
Summary of Environmental Variability After accounting for the varying composition of the ecotones and environmental zones within the catchments, it is clear that the sites were not placed within the same environmental settings. This argument is supported by the results of the weighted Log Ratio Analyses which indicate significant differences among the sites at both catchment levels for ecotones and environmental zones.

Question # 3: Were the Oneota sites situated to maximize agricultural potential?

A test of proportions shows that at both the 1km and 2 km catchment level Twin Knolls has significantly more good arable land (in hectares) than the three other sites at the 95% confidence interval. Crescent Bay, Carcajou Point and Schmeling are all similar at 1km. At the 2km level, Schmeling has significantly more arable land than Crescent Bay and Carcajou Point, although statistically less arable land than Twin Knolls.

Equally interesting is the difference in good arable land between 1km and 2km catchments at each site. If one compares proportions of arable land by hectare, Crescent Bay and Carcajou have significantly less arable land at the 95% confidence interval, while the Twin Knolls 2km has significantly less at 90%. Schmeling retains the same proportion below 80% confidence. If one uses acres, Crescent Bay, Carcajou Point and Twin Knolls have significantly less arable land at the 99% confidence interval, while Schmeling has the same proportions.

Looking at the entire spectrum of good, fair and poor arable soils gives a different picture. Despite the large absolute differences of total arable land within the catchments, the wLRA indicates that none of the sites differ significantly from the mean (Figure 32).
It appears that despite the variation in good soils, each site was placed within a similar agricultural setting. Nonetheless, even the wLRA shows that Twin Knolls does have significantly more arable land in both catchments than Carcajou Point. While typically less than half of the catchment, each of the sites was placed near hundreds of hectares of arable land (Figures, 33 and 34).

The much higher proportion of good quality soils in the 1km catchments indicates that Oneota sites are specifically located near high quality arable soils. Despite the fact that medium and poor quality soils result in a relatively homogeneous farm-friendly environment, islands of high quality soils were actively sought out and settlements established to take advantage of those patches.

The question then becomes, was this sufficient land to feed the Oneota populations? Flannery (2009:92-93) examined the productivity of modern corn and argued that a Mesoamerican village of 350 people could have been fed on a diet primarily of corn with fewer than 80 hectares of arable land. While the corn grown by the Oneota might not have been as productive as the modern maize used in Mexico, given the diversity of the Oneota diet, the hundred plus hectares within one kilometer alone would likely have proven more than enough land to grow the desired amount of maize. It is likely that the sites were placed, in part, to allow the site’s inhabitants to effectively grow maize, as well as take advantage of wild resources.
Figure 32. Biplot of Agricultural Data.

Figure 33. Agricultural Potential within 1 km of each site.
Figure 34. Agricultural Potential within 2 km of each site.

**Question 4: What was the nature of the Oneota settlement pattern in the Lake Koshkong Locality?**

Settlements must be placed in areas that satisfy the physical needs of the residents while also conforming to non-economic needs of the culture. It is outside the scope of this project to examine most non-economic factors of settlement placement, however, it is important to consider the elevation of a site and the nature of the soils around it. While not necessarily economic in nature, these factors deal directly with the habitability of an area and cannot be ignored when considering factors that determine settlement placement. It is also necessary to examine the distances from sites to economically important environmental features, the region’s economic pull (c.f. Jochim 1976), and the relationship between the Oneota villages and other site types in the region.
**Elevation** Using the USGS Busseyville Quadrangle map, the elevations of each of the sites were determined (Table 17). The first five columns of values in the table refer to the elevation of the site as a polygon (i.e., the two-dimensional boundaries of the site). The average columns do not indicate spatial weighted averages but the mean of the highest and lowest elevations. Using the polygon to determine the elevation of the sites is useful in describing the variation within the sites; however, perhaps a better measure of site elevation comes from the centroids of the sites. By measuring the elevation from the center, modern erosion at the sites’ edges should have less effect on the readings, and might better represent the elevation of the more heavily occupied and utilized portions of the sites. Using this, Crescent Bay is the highest site at 253 meters above sea level, while Twin Knolls and Carcajou Point are the lowest at 247 meters. Since the most heavy concentration of Oneota artifacts at Carcajou Point came from the southern portion of the site, the centroid may not be the most accurate measure of elevation. The height of the southern portion of the site is approximately 790 to 800 feet (241 to 244 meters) above sea level. While the absolute elevations may vary from site to site, they were placed in similar settings in relation to the surrounding topography (Figure 35).

All the sites were placed on high ground overlooking an aquatic environment, on or near the edge of a hill or ridge which leads to the water below, affording the residents of the sites some level of protection from flooding. For example, the northwest corner of the wetlands east of Crescent Bay and Schmeling are at an elevation roughly of 237 meters (780 feet) above sea level, 13 meters below Schmeling and 16 below Crescent Bay. Koshkonong Creek is roughly 10 meters below the centroid of Twin Knolls, and the lake was approximately 10 to 15 meters below Carcajou Point. Elevation in relation
to the nearby water is not the only important factor to consider. To the west of Twin Knolls, Schmeling, and Crescent Bay, there are hills that peak at over 260 meters above sea level, which could have provided some measure of protection from strong winds from the west.

Table 17. Elevation of sites.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Crescent Bay</td>
<td>820</td>
<td>840</td>
<td>830</td>
<td>250</td>
<td>253</td>
<td>830</td>
<td>253</td>
</tr>
<tr>
<td>Schmeling</td>
<td>800</td>
<td>830</td>
<td>815</td>
<td>244</td>
<td>248</td>
<td>820</td>
<td>250</td>
</tr>
<tr>
<td>Twin Knolls</td>
<td>800</td>
<td>820</td>
<td>810</td>
<td>244</td>
<td>247</td>
<td>810</td>
<td>247</td>
</tr>
<tr>
<td>Carcajou Point</td>
<td>770</td>
<td>820</td>
<td>795</td>
<td>234</td>
<td>242</td>
<td>810</td>
<td>247</td>
</tr>
</tbody>
</table>

Distance to Well-Drained Soils  Soil drainage is an important criterion for determining the habitability of land. For many of the same reasons, water drainage is also important for the comfort and health of the humans living and sleeping on or near the soils (Jochim 1976). Therefore, soil drainage present at a site is important for both economic and other practical reasons as well. All four sites were similarly placed in reference to well-drained soils (Table 18). Each site is located on soils that are either well drained or moderately well drained. In conjunction with their relatively high elevations, it is not likely that the sites would have remained wet for very long, even after heavy rains since the soils well drained soils would topography of the land would pull the water down hill and the nature of the soils would expedite that process.

Table 18. Distance of Sites to Important Resources.

<table>
<thead>
<tr>
<th>Resource</th>
<th>CBHC</th>
<th>Schmeling</th>
<th>Twin Knolls</th>
<th>Carcajou Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake</td>
<td>787</td>
<td>967</td>
<td>3044</td>
<td>344</td>
</tr>
<tr>
<td>Creek</td>
<td>1387</td>
<td>1262</td>
<td>134</td>
<td>1394</td>
</tr>
<tr>
<td>Wetland</td>
<td>238</td>
<td>313</td>
<td>135</td>
<td>434</td>
</tr>
<tr>
<td>Ecotone</td>
<td>0</td>
<td>50</td>
<td>0</td>
<td>94</td>
</tr>
<tr>
<td>Well Drained Soil</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Figure 35. Topography of land near the Study Sites.
**Distance to Water Sources** There are three primary sources of water within the study area; Lake Koshkonong, Koshkonong Creek, and the various wetlands. Since water was not only an essential resource in and of itself, but vital for many other activities (e.g., transportation), site distance to water is an important aspect to consider (Table 18). Twin Knolls is more than three linear kilometers from Lake Koshkonong, nearly 10 times farther than is Carcajou Point. However, Twin Knolls was the closest to both creek and wetland sources of water. Carcajou Point was the furthest from these other resources, though Crescent Bay and Schmeling were located more similarly to Carcajou Point than Twin Knolls. In sum, there was considerable variation in settlement locations with reference to distance from specific water types, though each site appears to be placed near a specific wetland habitat. It appears that Carcajou Point was placed to most effectively interface directly with the lake and its resources. Twin Knolls was situated where its residents could best exploit the creek and nearby wetlands. Crescent Bay and Schmeling were effectively placed with access to a variety of aquatic environments, primarily a large wetland to the east of the sites. However, Crescent Bay and Schmeling are significantly more distant from navigable, open water than either Carcajou Point or Twin Knolls.

**Distance to Ecotone** Each of the sites was placed near multiple ecotones. The centroid of Crescent Bay and Twin Knolls were actually within the boundary of ecotones. The centroid of both Schmeling and Carcajou Point were less than 100 meters from the edge of an ecotone. Residents of the sites were clearly well placed to effectively exploit the additional benefits of these more diverse environments. The ecotones actually extended into the boundary of the sites. Therefore, if the site boundaries, instead of
centroids, were used for this analysis then the minimum distance to ecotone would have been zero for all of the sites. Ignoring the variation in ecotone types, the sites were similarly placed near ecotones.

**Resource Pull Analysis** The resource pull analysis was designed to determine which areas within the study area had the strongest economic pull. Scores were based on the quality of the arable land, number of environmental zones within each ecotone, and the productivity of the environmental zones present at any given location (Table 19, Figure 36). Based on an economic approach one would expect that the high resource zones i.e., those with the highest scores, would cluster within the one-kilometer catchment, since this would indicate that the sites were placed near the most dense cluster or clusters of valuable resource zones. An initial comparison of the proportions of high value zones indicates that within one kilometer the proportions are relatively similar to the proportions within the two-kilometer catchment (Figures 37, 38 and Tables 20, 21). Therefore, the distribution of the high value resource zones does not initially appear to cluster within the one-kilometer catchment zones. Due to the small amount of high value resource zones in either catchment, however a different approach can elucidate some interesting patterns otherwise not visible.

<table>
<thead>
<tr>
<th>Variables</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>n/a</td>
<td>Prairie</td>
<td>Lake/Creek</td>
<td>n/a</td>
<td>Savanna/Wetland</td>
</tr>
<tr>
<td>Ecotones</td>
<td>0 Ecozones</td>
<td>1 Ecozone</td>
<td>2 Ecozones</td>
<td>3 Ecozones</td>
<td>4 Ecozones</td>
</tr>
<tr>
<td>Arable Land</td>
<td>Non-Arable</td>
<td>n/a</td>
<td>Fair Potential</td>
<td>n/a</td>
<td>Good Potential</td>
</tr>
</tbody>
</table>
Figure 36. Resource Pull Analysis: Geographic Distribution of Scores.
Figure 37. Distribution of Resource Pull Scores (1 km Catchment).

Table 20. Resource Pull Analysis Score Distribution (Proportion of 1 km Catchment).

<table>
<thead>
<tr>
<th>Study Sites</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crescent Bay Hunt Club</td>
<td>0.00</td>
<td>0.00</td>
<td>0.10</td>
<td>0.13</td>
<td>0.03</td>
<td>0.21</td>
<td>0.14</td>
<td>0.23</td>
<td>0.05</td>
<td>0.10</td>
<td>0.02</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Schmeling</td>
<td>0.00</td>
<td>0.00</td>
<td>0.10</td>
<td>0.14</td>
<td>0.01</td>
<td>0.24</td>
<td>0.13</td>
<td>0.22</td>
<td>0.04</td>
<td>0.09</td>
<td>0.02</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Twin Knolls</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.06</td>
<td>0.03</td>
<td>0.22</td>
<td>0.07</td>
<td>0.33</td>
<td>0.05</td>
<td>0.16</td>
<td>0.05</td>
<td>0.02</td>
<td>1.00</td>
</tr>
<tr>
<td>Carcajou Point</td>
<td>0.00</td>
<td>0.21</td>
<td>0.00</td>
<td>0.16</td>
<td>0.06</td>
<td>0.20</td>
<td>0.06</td>
<td>0.22</td>
<td>0.01</td>
<td>0.04</td>
<td>0.03</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
An examination of the total area ranked as each score as a proportion of the total area within two kilometers with the same score indicates there actually was a clustering of high value resource zones near the sites. This was obscured in the initial examination of the data by the relatively small amount of high value land in comparison to the total area of the catchment size. Though they were a small proportion of both catchments, the majority of the area ranked with scores of 11 or 12 was within one kilometer of each of
the sites (Table 22). While not quite as clear of a pattern as expected, it does support the theory that sites were placed near high value resource zones. It is possible that the arbitrary nature scale used, the relatively small amount of high value land, or the heterogeneity of the environments is responsible for the obscured patterns.

Table 22. Resource Pull Analysis – Distribution of Resources, 1km values as proportion of 2km.

<table>
<thead>
<tr>
<th>Site</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crescent Bay</td>
<td>n/a</td>
<td>0.00</td>
<td>0.25</td>
<td>0.23</td>
<td>0.34</td>
<td>0.20</td>
<td>0.50</td>
<td>0.34</td>
<td>0.68</td>
<td>0.36</td>
<td>0.97</td>
<td>1.00</td>
</tr>
<tr>
<td>Schmeling</td>
<td>n/a</td>
<td>0.00</td>
<td>0.24</td>
<td>0.30</td>
<td>0.09</td>
<td>0.22</td>
<td>0.41</td>
<td>0.29</td>
<td>0.89</td>
<td>0.33</td>
<td>0.81</td>
<td>0.35</td>
</tr>
<tr>
<td>Twin Knolls</td>
<td>0.00</td>
<td>n/a</td>
<td>0.80</td>
<td>0.17</td>
<td>0.29</td>
<td>0.23</td>
<td>0.16</td>
<td>0.29</td>
<td>0.16</td>
<td>0.30</td>
<td>0.33</td>
<td>0.87</td>
</tr>
<tr>
<td>Carcajou Point</td>
<td>n/a</td>
<td>0.13</td>
<td>0.11</td>
<td>0.55</td>
<td>0.36</td>
<td>0.24</td>
<td>0.19</td>
<td>0.43</td>
<td>0.19</td>
<td>0.25</td>
<td>0.80</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Relationships to Other Oneota Sites The current data indicate that Crescent Bay, Carcajou Point, and Schmeling were all practicing a subsistence pattern that generally corresponds to the aquatic plant/animal, maize, and deer diet that is evident at Oneota sites throughout the state. Returning to Sasso’s (2003:262) discussion of mean distance from Oneota village sites to garden bed sites, if a similar pattern is assumed to have existed in the Koshkonong Locality, there was clearly a substantial amount of arable land throughout the entire range (0 to 2.32 km) Sasso reported for Winnebago County. There are currently three known non-culturally affiliated garden bed sites within the study area. The Loge Bay site, first reported by Stout and Skavlem (1908:94), is recorded in the ASI files as both 47JE087 and 47JE089. The site is located in northwest quarter of the northeast quarter of Section 16, Town 5 North, Range 13 East, and was described by Stout and Skavlem as a series of garden beds and a small cornfield north of Carcajou Place (roughly near the Carcajou Point site). The Messember Garden Beds were first identified by Stout and Skavlem, but were formally reported by Charles Brown (1909:127) as garden beds that formerly existed in the southeast quarter of the southeast
quarter of Section 18, Town 5 North, Range 13 East. Stout and Skavlem (1908:79-80) also identified corn hills on the east edge of the Crab Apple Point site.

Each of the garden bed sites are at least partially within the one-kilometer catchment of one or more of the study sites and wholly within two kilometer catchments (Figure 39). While these sites have no known cultural affiliation, given their close proximity to the Oneota villages, it is not unreasonable to postulate that they may have been Oneota garden beds. If these sites were of Oneota origin, they would clearly fit with the postulated patterns elsewhere in the state (average minimum distance of the garden bed site to study site is approximately 0.7 km), and would indicate that Oneota villages and garden plots were placed in locations that did not require extensive travel.

While the garden beds may not be securely associated with Oneota material culture, there are several other sites in the region that are. Most of the sites were located and recorded during the 1980’s by the UWM and or Stout and Skavlem in 1908. Due to the limited nature of the archaeological investigations, little is known about the size and function of the sites. The majority of the sites were classified as campsite/villages in the state’s codification files, two were listed as unknown, one was listed as a burial, and several were listed as campsite/village and burial. Do to the paucity of data concerning these sites, there is little one can do other than speculate as to their relationships with the study sites, though additional work at these sites could provide a great deal of information regarding the ways in which the occupants of the region utilized the landscape (Figure 40). Based on the spatial locations of the sites, some were placed in a similar fashion as the Oneota study sites, while others were placed in different
Figure 39. Physical relationships among the Study Sites and Garden Beds.
Figure 40. Oneota Sites in Study Area.
environmental/economic contexts. Future work may indicate that the regions inhabitants utilized the landscape in a similar fashion as the Oneota site occupants in western Wisconsin, as presented in Sasso (1989). Some of the other Oneota sites within the study area may represent hamlets or extractive camps. With more data from these sites, it may be possible to develop a settlement model rather than simply the settlement pattern description presented here, thus allowing for a deeper understanding of culture and lifeways practiced by the residents of Oneota sites. A list of the sites can be found in Table 22.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Site Number</th>
<th>Site Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldthrope Burials</td>
<td>47JE094</td>
<td>Burial</td>
</tr>
<tr>
<td>Purnell</td>
<td>47JE815</td>
<td>Campsite/Village</td>
</tr>
<tr>
<td>Carlson</td>
<td>47JE826</td>
<td>Campsite/Village</td>
</tr>
<tr>
<td>Marsden</td>
<td>47JE832</td>
<td>Campsite/Village</td>
</tr>
<tr>
<td>McKelvy Knoll</td>
<td>47JE849</td>
<td>Campsite/Village</td>
</tr>
<tr>
<td>Hearthstone</td>
<td>47JE089</td>
<td>Campsite/Village</td>
</tr>
<tr>
<td>Loge Bay</td>
<td>47JE087</td>
<td>Garden Beds</td>
</tr>
<tr>
<td>Messemer Garden Beds</td>
<td>47JE092</td>
<td>Garden Beds</td>
</tr>
<tr>
<td>Crab Apple Point</td>
<td>47JE093</td>
<td>Village/Burial/GardenBed/Cache</td>
</tr>
<tr>
<td>Bingham Corn Hills</td>
<td>47JE1158</td>
<td>Historic Garden Beds</td>
</tr>
<tr>
<td>Saunders Corn Hill</td>
<td>47DA1201</td>
<td>Historic Garden Beds</td>
</tr>
<tr>
<td>Marsden North</td>
<td>47JE854</td>
<td>Unknown</td>
</tr>
<tr>
<td>Weisensell</td>
<td>47JE855</td>
<td>Unknown</td>
</tr>
<tr>
<td>Blue Herron</td>
<td>47JE1001</td>
<td>Village</td>
</tr>
<tr>
<td>47JE1002</td>
<td>47JE1002</td>
<td>Village</td>
</tr>
</tbody>
</table>

Site Placement within an Optimization Context Despite the environmental variation within the study area, it appears that economic factors played an important role in determining site location. The results of this research suggest that additionally there were three main economic factors that influenced site location: 1) distance to nearby aquatic environments, 2) access to a complex ecotonal environment, 3) proximity to a large amount of arable soils.
All of the sites were located overlooking some form of aquatic environment. Given that the known Oneota diet consisted heavily of wetland, riverine and lacustrine resources, the close proximity to such resources makes sense from an economic perspective. As discussed in chapter two, many species of upland game are superficially thought to be encountered by random chance can be effectively aggregated either seasonally or by baiting favorable locations. Many aquatic resources, which are primarily aggregated, found only within the boundaries of the aquatic resource zones can be interpreted as patches. Because the Oneota occupants of the region knew exactly where to go to exploit these aggregated resources, pursuit time was greatly reduced by placing settlements in locations adjacent to the these highly productive wetlands. From these locations near the water, hunters could travel into the nearby savannas to find the upland game (e.g., deer), or they could wait near the water’s edge for their prey to arrive since, like humans, they need water for survival.

While there may have been significant differences in composition of ecotones among the sites, the extreme proximity of each of the sites to ecotones makes their importance to the Oneota site occupants evident. The benefits of ecotones have been discussed in-depth above, however it is important to reiterate that within an optimal foraging context, ecotones represent areas that would have provided access to a wider variety of resources. Since there were a greater variety of resources, it would have been possible to exploit the more resource types with less time spent traveling to different patches or regions. In optimal foraging terms, settlements placed near ecotones would allow for shorter pursuit times. Additionally the richness of the ecotonal environment,
especially in aquatic ecotones, would have provided a large amount of food, at least
during the warm months, maximizing the time before the resources would be
overexploited. Therefore, by placing settlements near these highly productive resources
the sites’ residents were able to maximize their efficiency.

While there was some degree of variation of arable land among the sites, each site
was placed near a large amount of arable land. With substantial amounts of arable land
near the villages, it would have been possible to concentrate the majority of the cultivated
agricultural fields near the villages. There are multiple benefits of placing agricultural
fields near a site. For example, daily travel time during planting and harvesting to and
from the fields would be reduced. In autumn, harvested crops would not need to be
hauled far for processing, storage, or consumption, thereby saving time and energy for
other efforts. Cornfields also draw competitors/prey animals such as deer, raccoon, and
squirrel. As such they themselves provide excellent hunting grounds (Odum 1959).

As Sasso (2003) points out, keeping the agricultural fields close also provides a
measure of security for plants themselves as well as the people who would have been
tending the fields. It is not clear if security was an important factor in determining
Oneota settlement locations, however it is important to note that at current there is no
evidence of warfare at eastern Wisconsin Oneota sites (Foley Winkler 2010). With such
a small sample size, it is not possible to determine the minimum number of hectares that
were required before placing a settlement; however, based on Carcajou Point, the
minimum required was not any higher than 115 hectares.

Despite the fact that all of the sites are superficially in similar environments (i.e.,
savannas near a large lake), they are in several distinctly different microenvironmental
zones with differential access to a wide variety of resources. Nonetheless, each of the sites was placed at the intersection of a variety of aquatic and upland ecotones, near large islands of arable land. This central location allowed the Oneota site occupants to maximize multiple resource zones effectively. Carcajou Point (Figure 41) is located just north and west of a long lacusterine ecotone, with the most complex ecotones south of the site. In the opposite direction, north and west of the site is a large mass of arable land. A similar pattern can be seen for the other sites (Figures 42 to 44) as well, with ecotonal regions concentrated to one direction from the site, and arable land to the other.

Summary of Oneota Settlement Patterns in the Koshkonong Locality While the residents Oneota sites in the Koshkonong Locality may not have been choosing similar environments in which to place each site, it appears that there were several important factors that determined Oneota site placement. As is true with most settlements (c.f. Hart and Jeske 1987; Jochim 1976), the Oneota residents placed their village sites in areas that were at a high enough elevation that they were not likely to flood. Rather than looking at distance above absolute sea levels, it seems more appropriate to examine each site’s elevation in reference to the topography surrounding it. The data suggest that the centers of the sites were placed at least 10 meters above the adjacent aquatic environments with the lowest portion of the sites roughly six meters above the wet environments. It is important to note that with such a small sample that this argument is, at best, tentative. Sites were also placed upon well-drained soils, at least in part to reduce flooding or oversaturation of the ground. In order to maximize efficiency, the sites were placed adjacent to aquatic environments on land that was on the border of ecotonal boundaries and the edge of masses of arable land.
Figure 41. Map Results of Carcajou Point Catchment Analysis.
Figure 42. Map Results of Crescent Bay Hunt Club Catchment Analysis.
Figure 43. Map Results of Schmeling Catchment Analysis.
Figure 44. Map Results of Twin Knolls Catchment Analysis.
**Question 5: How does this settlement pattern compare to previous explanations of Upper Mississippian settlement patterns?**

Past attempts at explaining the settlement patterns of Oneota typically used coarse-grained data and described settlement placement in very broad terms. Over the last two decades however, a great number of progress has been made, both archaeologically and technologically that allow for a closer examination of the sites environmental settings. Due to these advances, it is now possible to revisit, revaluate, and build off of these previous studies; however, the differences in scale make comparisons difficult.

Overstreet and Rodell offered conflicting descriptions of Oneota site locations in eastern Wisconsin. Overstreet argued that Oneota sites were placed in a large-scale ecotone that fostered a great deal of diversity which supported the wide spectrum resource exploitation practiced by the occupants of Oneota sites, as evidenced by the faunal and floral data recovered from the sites within his study (1976:235). Rodell argued that the Eastern Ridges and Lowlands offered a very diverse environment, but the Oneota sites were placed within relatively similar environments where they could exploit wetland-eutrophic regions that supported savannas and forests (1983:107-108). Using the settlement patterns within the Koshkonong Locality presented above as a test case, it may be possible to assess the validity of each of their arguments.

Overstreet’s (1976:235) statement “that though they are marked by demonstrable diversity, the environments of prehistoric [Oneota] components do not vary greatly” is not well supported by the patterns present near Lake Koshkonong. Notably, there is more variation of environmental composition within the study area than noted by Overstreet for
the region as a whole. The sites at Lake Koshkonong were placed in significantly
different environmental settings, with a high degree of variation in types of water
available, ecotone coverage and amounts of arable land.

Rodell’s assertion that the “region has a diverse environment that limited Oneota
adaptation to specific habitats” (1983:107) is partially supported by the data within the
Koshkonong Locality. As Rodell argues, the data for the Koshkonong Locality indicate
it was located within an extremely diverse environment. However, Rodell’s description
of how sites are placed within the diversity, i.e., areas along the Fox/Wolf and Rock
Rivers with wetland and oak resources does not accurately portray the diversity indicated
by the more fine-grained analysis. Twin Knolls for example is not located on the Rock
River, or where it widens to form Lake Koshkonong. It is found on a smaller tributary,
which is significantly smaller than both the other water bodies.

Sasso (1989) concluded that Oneota village sites in western Wisconsin were
placed adjacent to aggregated resources, i.e., wetlands and arable land and were occupied
at least late from late spring into early fall. As previously noted, a similar pattern can
also be seen in the Koshkonong locality. Sasso also discusses the seasonality of the
villages and the relationship among Oneota sites. He argues that during the warm months
villages were occupied by the majority of the region’s residents, though small farmsteads
were occupied regularly and extractive camps would have been occupied as needed.
Shortly after the fall harvest was complete, the village residents would begin to disperse
into smaller settlements over a larger area. While it is possible that there was a similar
pattern of site exploitation within the Koshkonong Locality, there is currently not enough
data pertaining to small Oneota sites in the region to determine the site utilization
patterns. As indicated above, the study sites may have been occupied year around. If this is true, then it would indicate that the residents of the Koshkonong Locality sites adapted to winters differently than their western neighbors. With additional data pertaining to smaller sites, it may be possible to shed further light on the topic. If the Koshkonong Locality residents did disperse into smaller groups in the winters, then the smaller sites should provide an indication of this.

The Langford settlement patterns described by Jeske (1989, 1990b, 2000b, 2003b) is quite different than the settlement patterns exhibited by the residents of the Oneota sites in the Koshkonong Locality. While both Langford and Oneota sites were placed near wetlands and arable land, the Langford sites were clearly placed in much drier environments. Since the catchments for the Langford sites were measured in miles and the Oneota sites in kilometers, it is difficult to make exact comparisons; however, the averaging the values of the double catchment should allow for a relatively accurate comparison. Approximately five percent of the one-mile (1.6 km) catchment of the Keeshin Farm site was a wet environment. Wet environments accounted for six percent of the one-kilometer catchment and 14 percent of the two-kilometer catchment of Twin Knolls, the driest of the four study sites, which average to 10 percent, or twice that of Keeshin Farms. The range of wet environments near all the sites is 10 to 53 percent (ca. 2-11 times higher than Keeshin Farm) and averages 27 percent (more than 5 times Keeshin Farm) of total catchment (Jeske 2003b:172).

Jeske (1989) also argued that Langford sites were placed near soils that were drier and better drained than Oneota sites. After examining the soils distribution with a one-mile catchment of 15 Langford sites in the Chicago and Rock River regions, Jeske found
that, on average, Langford sites had 30 percent wet soils and 70 percent dry soils. The Koshkonong Locality villages do not exhibit a similar pattern; in fact, they seem to have an inverse relationship. Again, to allow for a comparison of metric and imperial catchments, the values from the one and two-kilometer catchments for the study sites were averaged. For the study sites, 62 percent were wet soils while 38 percent were dry (Table 23). While the sample size is small, the study sites were clearly not similarly placed in reference to well-drained soils.

<table>
<thead>
<tr>
<th>Site</th>
<th>Proportion Dry</th>
<th>Proportion Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcajou Point</td>
<td>0.25</td>
<td>0.75</td>
</tr>
<tr>
<td>Crescent Bay Hunt Club</td>
<td>0.41</td>
<td>0.59</td>
</tr>
<tr>
<td>Schmeling</td>
<td>0.40</td>
<td>0.60</td>
</tr>
<tr>
<td>Twin Knolls</td>
<td>0.47</td>
<td>0.53</td>
</tr>
<tr>
<td>Average</td>
<td>0.38</td>
<td>0.62</td>
</tr>
</tbody>
</table>

In summary, the results of this thesis conform to the general patterns described by Overstreet, Rodell, Sasso, and Jeske; i.e., sites placed near wetlands, waterways, and arable land. However, with the fine-grained data used for this analysis, the results indicate that the Koshkonong locality, due to the high degree of variation among sites, and heterogeneity of environment, does not fully conform to the patterns suggested by Overstreet and Rodell for eastern Wisconsin. There may be differences between the LaCrosse Region and the Koshkonong Locality in the seasonality of village occupation as well as relationship of village sites to other site types, however, there is currently not enough data available from small sites in the Koshkonong Locality to draw any conclusions. Additionally, Langford village sites in Northern Illinois were placed in considerably more dry environments than Oneota village sites in the Koshkonong Locality.
CHAPTER FIVE

CONCLUSION

Summary

The research conducted for this thesis was centered on four Oneota sites, Carcajou Point, Crescent Bay Hunt Club, Schmeling, and Twin Knolls, occupied from circa A.D.1200-1400. This research was heavily influenced by the work of Overstreet (1976, 1978), Rodell (1983), Sasso (1989), and Jeske (1989, 1990b, 2000b, 2003b). It was the goal of this research to build upon the results of these previous research projects, and to expand and produce more-refined results for one locality. The data generated were used to evaluate the environmental contexts of the site to determine what, if any, ecological factors were used to place sites. This goal was accomplished with the use of catchment analysis and interpretations based on optimal foraging theories. Original vegetation was modeled with the use of the General Land Office survey notes, sketch maps, and modern soil data. Variables used included environmental zones, ecotones, amount of arable land, and distance to important resources. The results indicated that Oneota village sites were placed in a diverse set of environments; however, the sites were located to optimize three things: distance to an aquatic environment; distance to ecotones; distance to large amounts of arable land. In order to optimize these three factors, the occupants of the region built their sites on high ground at the edge of an aquatic environment, between an area of ecotones and arable land.
Future Research

There is still a great deal of work that needs to be done on this topic in order to refine and test the validity of the results of this study. Higher resolution data of the subsistence practices of the sites’ occupants needs to be conducted. Much of this is currently underway for the Schmeling and Crescent Bay sites, but was not available at this time. Before such a study can be conducted of the Twin Knolls site, further archaeological work must be conducted at the site, including subsurface excavations. With such data, comparisons of the fauna and flora from each site could be conducted, thereby allowing a means to determine the variation of resources exploited from each site. Given the environmental differences of the sites, it would not be unreasonable to assume that there would be some differences in resource exploitation. The occupants of Twin Knolls, the driest of the sites, may have exploited more non-prairie upland game, while the residents of Schmeling and Crescent Bay may have obtained a greater amount of prairie resources such as bison than Carcajou Point. Research of this type could also benefit from more data pertaining to the smaller Oneota sites in the region, especially data that would allow for site type determinations. Until such data are obtained, it is not possible to make interpretations as to the relationships among the various sites, or the ways in which the creators of the sites utilized the landscape. Additionally, conducting similar settlement pattern analyses in other Oneota localities could prove to be another potentially fruitful avenue of research. This would allow for regional comparisons to be made, and a better understanding of the nature of interactions among the residents of the various regions of southeast Wisconsin. Additional raster-based GIS work on this topic can utilize the vector-based data that was generated for this research. A raster-based
analysis may be able to more accurately model the sites’ residents’ access to resources with the use of digital elevation models, least cost path analyses, and other cell by cell, map algebra based computations.
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Yarnell, Richard A.


Yesner, David R.
## APPENDIX

### Agricultural Rating of Soils by Type

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<td>YaA</td>
<td>Yahara Fine Sandy Loam</td>
<td>0 to 3</td>
<td>Not Eroded</td>
<td>Fair</td>
</tr>
</tbody>
</table>